

# The Causal Structure of the Role of Physicians and Dentists in the Healthy Longevity of Elderly Dwellers Residents

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## Abstract

**Background:** The significance of living a healthy and long life in an aging society is increasing. The causal structure of the role of physicians and dentists in healthy longevity is not clear.

**Objective:** The purpose of this research was to clarify the socioeconomic factors underlying three health factors and the relationship among these three health factors. In addition, a main purpose of this research is to clarify the causal structure between subjective health after 3 years and healthy longevity, which is a dependent variable that is defined as the survival days for the next 3 years, as an observation variable, based on the presence of a physician and/or dentist by gender.

**Method:** For the survey method, a self-administered questionnaire was mailed to 16,462 suburban elderly residents in Tama City, Tokyo, in September 2001. Responses were obtained from 13,066 residents (response rate of 79.4%). A similar survey was conducted in 2004. We analyzed a total of 7,905 subjects, including 3,754 males and 4,151 females aged 65 to 84, for whom we were able to clearly determine the need for long-term care after 3 years and their survival days for the next 3 years. Following these subjects for three years from 2004 to 2007, we confirmed the death dates of 278 men and 160 women.

**Results:** According to this study, elderly people with desirable socioeconomic factors tended to have a family dentist. A causal structure was shown, indicating that three health factors are advisable based on socioeconomic status, and as a result, healthy longevity, including both a high level of subjective health and a reduced bedridden status, was maintained. This related structure could explain 64% of healthy longevity. In addition, a similar tendency was shown by gender. Future research will require the use of oral care and health indicators such as blood pressure and blood glucose levels. It is also expected that the external validity would be enhanced by analyzing the causal structure through intervention studies including a randomized control group.

**Keywords:** Home dentist; Home physician; Healthy life; Socioeconomic status; Aged people

## Preface

In a country with a rapidly aging society, much more attention should be focused on healthy longevity [1]. Healthy longevity not only reduces the burden of long-term care but also is linked to the stabilization of medical and long-term care costs. Above all, it is important that the person himself or herself maintains the quality of life and lives affluently.

Under these circumstances, Japan announced Healthy Japan 21, aiming to both prevent premature death and promote healthy longevity, in 2000 [2]. This plan clarifies the plan for maintaining oral care, which is the basis of a rich diet, as well as measures to favor lifestyle-related habits, including smoking cessation and adherence to a desirable diet.

Family dentists may play a main role in promoting desirable oral care. On the other hand; family doctors play a large role in the prevention and treatment of various diseases, various health checkup activities and the improvement of lifestyle habits.

The Japan Dental Association defines a family dentist as follows [3]. A dentist not only provides safe and secure dental care but also has a wide range of knowledge and insights related to medical care; he or she can fulfill his or her responsibilities in regional medical care with the aim of maintaining and improving oral function throughout the lives of residents.

On the other hand, the Japanese Medical Association defines a family doctor as follows: home medical doctors who can discuss anything related to health and refer patients to a specialized medical institution when necessary [4]. Japan's medical system is not a registered medical system as in the United Kingdom but a free practitioner system in which patients freely visit clinics, hospitals, and dental clinics.

The Government of Japan announced "The Long-term Strategic Guideline Innovation 25(2007) [5]"; embodying the need to shift from medical care with therapeutic treatment to a health care system that emphasizes preventive health promotion. To promote new strategies

in such a situation, family doctors and family dentists were expected to support the prevention of diseases and maintenance of health of citizens. After the prior guidelines were published, the Government of Japan aimed to ensure safe lives for the elderly population in the region through “The New Growth Strategy 2010 [6]”.

Regarding the relationship between the presence of a family dentist and the subsequent maintenance of survival, the authors tracked the survival days of 16,462 elderly people living in the suburbs of the city for 6 years. We previously reported that the cumulative survival rate thereafter was significantly maintained for both men and women compared to the group without a family dentist [7].

However, the presence or absence of a family dentist was self-reported, and the detailed mechanism, including the diagnosis of oral hygiene linked to the role and function of the dentist and the significance of survival, has not been clarified. Therefore, since 2009, we have been conducting joint research with the Shiba Dental Association in Minato-ku, Tokyo and with Tokyo Metropolitan University to clarify the causal structure in which survival has been maintained [8]. We investigated the level of emphasis on prevention, and at the same time, we investigated the actual condition of oral self-care, the oral hygiene status diagnosed by dental doctors, and the quality of food and subjective health. The results showed that the more people who visited a dental clinic with an emphasis on prevention, the better their oral care with the support of dentists and dental hygienists; in addition, the results showed that the more frequent use of inter dental brushes was linked to the survival days [8].

Based on our previous study [9], elderly people with desirable socioeconomic status tend to have a family dentist. In addition, a related structure was shown in which the degree of care required was maintained together with three health factors, and as a result, healthy longevity with a high level of subjective health was maintained. This related structure could explain 54% of healthy longevity. At the same time, a similar tendency was shown for both genders.

Extensive research reviews have shown that the health support from family physicians reduces health risks and results in sustained survival. The desired HBA1c is 7% or less, the desired systolic blood pressure is 120 to 139 mmHG and the GFR indicating renal function is 60 ml/mor more. In April 2021, 22,099 research papers on the relationship between risk factors for diabetes and hypertensive disease and subsequent mortality were reviewed. These meta-analyses showed that various diseases and mortality risk factors are controlled by the core medical activities of family doctors, and as a result, survival is maintained [10].

Since oral infections such as tooth decay and periodontal disease are risk factors for infectious pericarditis, Yamada H, et al. [11] reported that it is necessary to remove the source of infection in the oral cavity in dental care by coordinating medical examinations before surgery for congenital heart disease. Thus, it is important for doctors and dentists to work together.

Waza K, et al. [12] analyzed 16,824 individuals who were examined by family doctors in an urban clinic over a period of one year; they presented the referral rate and hospitalization rate as indicators of triage function in primary care, and they proposed the distribution of referral patients as an indicator as well. However, no referral cases were found from the family doctor to the family dentist.

The role of the family dentist is not limited to supporting oral hygiene self-care. There have been reports on the detection of cancer in the oral cavity and the early detection of cancer [13,14]. Therefore, the early detection of fatal diseases by referral from a family dentist to

specialized hospital medical care is one of the indispensable functions for improving health maintenance. Yoshioka Y, et al. [13] reported that the diagnostic technique for oral cancer has improved and that oral function can be restored after treatment. Sufficient oral hygiene was also reported to reduce the risk of esophageal cancer by Sepehr A, et al. [14].

Thus, the role and function of the family dentist, as well as the causal structure of subsequent survival and longevity, have been reported. However, based on PubMed searches and literature searches in Japan, there is no studies have been reported on the causal structure of retaliation, the presence of a family physician, socioeconomic factors, the subsequent need for nursing care, and the length of survival.

The purpose of the research is to clarify the extent to which elderly suburban resident have internal physicians and/or dentists. Furthermore, the socioeconomic factors behind this are investigated to clarify the relationship between three health factors, including subjective health, illness prevalence and daily living ability. The final purpose of this research is to clarify the causal structure between subjective health and bedridden status after 3 years and healthy longevity, which is a dependent latent variable that is defined as the survival days for the next 3 years based on the presence of an internal physician and/or dentist by gender.

## Methods

### Subjects

In September 2001, we conducted a questionnaire survey targeting all elderly individuals aged 65 years and over who lived at home in suburban Tokyo, Tama City, Japan. Of 16,462 eligible elderly individuals, 13,066 people (79.4% as a respondent percentage) gave informed consent to participate in the study and returned the self-administered questionnaire by mail. In September 2004, we sent a second questionnaire *via* mail that was the same as that previously sent to the respondents, and 8,558 participants responded (505 cases had moved, 914 were deceased and 3,218 did not respond). We followed all of the participants until August 31, 2007. We analyzed a total of 7,905 subjects, including 3,754 males and 4,151 females aged 65 to 84, for whom we were able to clearly determine the need for long-term care and their survival. Following these subjects for three years starting in 2004, we confirmed the death dates of 278 men and 160 women through the municipal resident registry.

The city used as the study setting developed partly as a commuter town to accommodate increased workers and their families in the metropolitan Tokyo area between the period of the 1970s and 1990s, which included a recent era of high Japanese economic growth. The majority of elderly individuals were in the middle class.

The city's total population was approximately 145,862 as of 2000, with 11.1 percent of the population aged 65 years or older. This number was 64.2% of the national average of 17.3% in 2000. The average life expectancy in 2000, the closest to the survey year, was investigated. Males were 79.0 years old, and females were 85.2 years old.

### Research content and research methods

Questions about family dentists and family physicians were used, with the option to distinguish between medical doctors and dentists; the questions asked who usually received treatment or consulted about their health.

Socioeconomic status in 2001 was assessed *via* educational attainment and annual income. Respondents were categorized into four groups according to their level of educational attainment: those

who graduated from senior high school, those who graduated from junior college, those achieving a higher educational level than college and those who did not want to respond. Annual income levels fell into five categories: less than one million Japanese yen (equivalent to less than US \$13,000), less than three million yen, less than five million yen, less than nine million yen and more than nine million yen in 2001.

As an observation variable for socioeconomic factors, we added not only educational background and annual income but also height as one of the factors. The reason is that a certain amount of growth in height is one of the indicators of a rich and healthy life experience in childhood. Height has been reported to be a highly valid indicator of survival prognosis after approximately half a century.

Jousilahti P, et al. [15] followed 31,199 adult residents in East Finland for 15 years and reported that their short stature increased the subsequent overall mortality rate. Similarly, 13,460 elderly people in the suburbs of our country were followed for 3 years. As a result, it was reported that the mortality rate of males with a height of less than 150 cm and females with a height of less than 140 cm was significantly higher than that of the taller group [16].

The three health-related dimensions examined in our study consisted of physical, mental, and social health components. Physical health parameters included the basic activities of daily living (BADL) and instrumental activities of daily living (IADL) as well as the number of diagnosed diseases from which the respondents had suffered at the time of the 2001 survey [17]. The BADL score was assessed by three questions: "Can you go to the toilet by yourself?", "Can you take a bath by yourself?" and "Can you take a walk outside by yourself?"

Individuals obtained one point for being able to perform each of these functions, and the overall scores ranged from 0 to 3, with higher scores indicating a greater level of basic activity competence [18]. The IADL score was measured *via* five questions related to instrumental activity: "Can you buy daily necessities by yourself?", "Can you cook daily meals by yourself?", "Can you deposit and withdraw money in a bank account?", "Can you complete documents related to insurance and pensions?" and "Can you read books and newspapers?"

IADL were scored in a similar fashion to BADL, with total scores ranging from 0 to 5, with higher scores indicating greater IADL ability. The total of the ADL and IADL scores was used as an indicator of daily activity ability, and the scale was set from 0 to 8.

The prevalence of comorbidity was determined by instructing the individuals to "Choose the diagnosed diseases for which you now are treated". We discovered five diseases (cerebrovascular disease, cardiovascular disease, hepatic disease, liver disease, and diabetes mellitus) that were significantly and negatively associated with the number of survival days of the respondents between September 2004 and August 2007; thus, the extent of comorbidity was defined as the number of diseases with which the respondent was diagnosed among these five. For participants with no illness, we calculated the number of spaces from 0 to 5 points.

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## Method

An agreement has been signed between the Tama City local

government and the Tokyo Metropolitan University regarding the protection of privacy and confidentiality. Here, it is clarified that mutual confidentiality is strictly enforced. All analytical data are still supported by ID only. The survey was conducted with the consent of the Tokyo Metropolitan University Graduate School of Ethics Committee on September 16, 2000.

All data obtained were evaluated by score or degree to examine differences between males and females using Kendall's tau rank correlation coefficient. Exploratory factor analysis was used to fit the observed variables to corresponding latent variables. This analysis was performed by the maximum likelihood procedure and a Promax oblique rotation using SPSS Statistics 27 for Windows (IBM).

We used structural equation modeling (SEM) to examine the presumed underlying relational structure between the latent variables by AMOS ver.27 for Windows (IBM). The analyses were performed using a cross-lagged effects variation model with longitudinal data followed over six years. Four latent variables were fitted with socioeconomic status and the three health-related dimensions as causes using data obtained in the 2001 survey, bed-ridden status as an intermediate cause using data from the 2004 survey, and survival days from 2004 to 2007. All observed variables corresponding to the three health-related dimensions were collected *via* the questionnaire survey in September 2001. Estimation of the best-fitting model was carried out by the maximum likelihood method in SEM.

## Results

### Subjects by gender and age groups

In this study, we analyzed 4,151 males and 7,905 females. Women tended to have a significantly higher proportion of older people than men.

### Distribution of the family physician and/or family dentist

We analyzed the relationship between the presence of a family physician and/or family dentist and the number of days of survival thereafter. The participants were classified into the following 4 groups in descending order of survival days. The longest-lived group had only a family dentist, and the second longest-lived group had no family physician or dentist. The third group was those with both a family physician and family dentist. The shortest survival group was those with only a family physician.

The proportion of participants with both a family physician and a family dentist was the highest, at 60.6%. The next highest percentage was 17.2% for those with only a family physician, followed by 12.7% for those with only a family dentist. The percentage of participants with a family physician increased significantly with age. On the other hand, the proportion of participants with only a family dentist decreased significantly with age. There were 679 people who were uncertain whether they had a family physician or a family dentist.

The longest three-year survival was found for those with only a family dentist, at 1,042.9 days for men and 1,054.7 days for women. On the other hand, in the group with only a family physician, the survival was 1,031.0 days for men and 1,036.7 days for women (Table 1).

A significant difference was found only in women when comparing the number of survival days between the group with only a family dentist and the group with only a family physician ( $P < 0.001$ ).

### The relational factor by family physician and/or family dentist

We analyzed the relationship between socioeconomic factors and

**Table 1:** Percentage of participants with a family physician and/or dentist by age group and gender.

		Dentist only	None of dentist and Physician	Having both dentist and Physician	Physician only	Total
Men	65-69	311	232	881	297	1721
		18.1%	13.5%	51.2%	17.3%	100.0%
	70-74	116	77	634	166	993
		11.7%	7.8%	63.8%	16.7%	100.0%
	75-79	57	39	349	98	543
		10.5%	7.2%	64.3%	18.0%	100.0%
	80-84	14	23	162	55	254
		5.5%	9.1%	63.8%	21.7%	100.0%
Survival days		1,042.9(114.2)	1,041.1(114.7)	1,027.0(151.7)	1,028.1(145.0)	
Women	65-69	270	124	1022	230	1646
		16.4%	7.5%	62.1%	14.0%	100.0%
	70-74	98	54	700	157	1009
		9.7%	5.4%	69.4%	15.6%	100.0%
	75-79	44	45	485	147	721
		6.1%	6.2%	67.3%	20.4%	100.0%
	80-84	11	18	217	93	339
		3.2%	5.3%	64.0%	27.4%	100.0%
Survival days		1,054.79(83.9)	1,042.8(117.9)	1,048.2(104.3)	1,036.7(129.2)	

P<0.036

living characteristics according to the presence or absence of only a family dentist or only a family doctor. As a result, it was shown that both men and women had significantly higher educational backgrounds in the group with only a family dentist than in the group with only a family physician, but there was no significant difference in the annual income (Table 2).

At the same time, subjective health was predominantly maintained for both men and women who had only a family dentist compared with those who had only a family doctor; at the same time, the number of diseases was significantly reduced in the group with only a family dentist, and their daily living activity and height were significantly higher. Furthermore, in the dentist only group, the degree of need for long-term care was significantly maintained after 3 years, and the number of survival days was shown to be longer for women (Table 2).

### Results of the exploratory factor analysis

This analysis was performed by the maximum likelihood procedure and a Promax oblique rotation to analyze the relational structure of healthy longevity using latent variables. As a result, the first factor is 「Subjective Health」 (「」 indicate an observed variable) in 2001, 「Subjective Health」 after 3 years, and 「Total Number of Disease」, which is named “Three Health Factors” (“” indicate latent variable).

Factor 2 was termed “Physical Health” and indicated 「Bedridden Stats」 and 「Daily Living Ability」, including BADL and IADL, among the target population, which are the observation variables. Factor 3 was termed “Socioeconomic Status” and indicated 「Educational Background」, 「Yearly Income」 and 「Height」. Finally, factor 4 was termed “Healthy longevity” and indicated 「Survival days」, 「Subjective Health」 after 3 years and 「Bedridden Status」 after 3 years later.

The cumulative contribution proportion of the above five factors was 40.7 percent. The Cronbach's alpha confidence factor was 0.65; however, socioeconomic factors and health longevity confidence factors were small (Table 3).

### Causal structure of healthy longevity

From the hypothetical models that can be assumed using the latent variables obtained by the exploratory factor analysis, the model with the highest goodness of fit was searched for based on the modified index. As a result, we positioned “Healthy Longevity” including 「Bedridden Status after 3 years」 as a dependent latent variable and adopted the figure 1 model using “Socioeconomic Status” and “Three Health Factors” as explanatory latent variables.

The goodness-of-fit index NFI was 0.817, the IFI was 0.822 and the RMSEA was 0.042. In addition, all pass cases between latent variables and observed variables were significantly different in the Wald test. On the other hand, there was no significant difference in the estimates from 「Physician and/or Dentist」 to “Healthy Longevity”.

The pass index that showed the direct effects on 「Physician and/or Dentist」 by “Socioeconomic Status” ranged from 0.12 to 0.25. The direct effects of “Three Health Factors” on 「Physician and/or Dentist」 were also similar, at 0.22 to 0.25. This model was able to explain 13 to 16% of 「Physician and/or Dentist」. Therefore, it was shown that the group with only a family dentist prefers “Socioeconomic Status” and “Three Health Factors” compared with the group with only an internal physician. 「Physician and/or Dentist」 and “Three Health Factors” are likely to be interrelated because they were investigated at the same time. Therefore, the estimated value from the 「Physician and/or Dentist」 to “Three Health Factors” was 0.45 and was larger than the estimated value of 0.25 from the Three Health Factors to 「Physician and/or Dentist」.

In other words, the group with only a family dentist was shown to have a higher 「Daily Living Ability」, higher 「Subjective Health」, and a greater possibility of reducing 「Total Number of Diseases」 compared to the group with only a physician.

At the same time, it was shown that if there were many diseases and the health level was low, there was a tendency to have a physician rather than a family dentist. However, the estimated value from the three health factors to 「Physician and/or Dentist」 was 0.09 to 0.17,

**Table 2:** The relations between the socioeconomic factors and living characteristics according to the presence or absence of sentences that only family dentist and those that only physician by sexes.

	Men			Women		
	Physician only	Dentist only		Physician only	Dentist only	
<b>Educational Background</b>						
Graduated from senior high school	322(57.6%)	224(47.9%)		469(84.8%)	273(72.4%)	
Graduated from vocational school	32(5.7%)	19(4.1%)	<b>P&lt;0.01</b>	63(11.4%)	58(15.4%)	<b>P&lt;0.01</b>
Graduated from college	205(36.7%)	225(48.1%)		21(3.8%)	46(12.2%)	
<b>Yearly Income</b>						
<1 million yen	4(2.4%)	12(3.6%)		0(0.0%)	2(1.5%)	
1 million-3 million yen	35(20.8%)	60(18.2%)		15(23.8%)	25(18.9%)	
3 million-5 million yen	90(53.6%)	169(51.4%)		37(58.7%)	74(56.1%)	
5 million-9 million yen	31(18.5%)	74(22.5%)		11(17.5%)	29(22.0%)	
>9million yen	8(4.8%)	14(4.3%)		0(0.0%)	2(1.5%)	
<b>Subjective Health</b>						
very healthy	63(10.2%)	146(29.4%)		50(8.0%)	250(27.2%)	
almost healthy	409(66.5%)	317(63.8%)	<b>P&lt;0.01</b>	390(62.3%)	605(65.8%)	<b>P&lt;0.01</b>
not so healthy	97(15.8%)	27(5.4%)		129(20.6%)	47(5.1%)	
unhealthy	46(7.5%)	7(1.4%)		57(9.1%)	18(2.0%)	
<b>Total Number of Diseases</b>	0.92(0.82)	0.17(0.48)	<b>P&lt;0.01</b>	0.73(0.77)	0.07(0.28)	<b>P&lt;0.01</b>
<b>Daily living Ability</b>	7.45(1.45)	7.76(0.75)	<b>P&lt;0.01</b>	7.30(1.63)	7.84(0.69)	<b>P&lt;0.01</b>
<b>Survival days</b>	1,028.1(450.0)	1,042.9(114.2)	<b>P&lt;0.01</b>	1,036.7(129.2)	1,054.7( 83.9)	<b>P&lt;0.01</b>
<b>Height(cm)</b>	163.2(6.1)	164.5(7.0)	<b>P&lt;0.01</b>	150.2(7.2)	152.0(4.9)	<b>P&lt;0.01</b>
<b>Bed ridden degree</b>						
Bed ridden status	48(7.8%)	48(0.8%)	<b>P&lt;0.01</b>	81(10.4%)	9(2.1%)	<b>P&lt;0.01</b>
Non of bed ridden status	568(92.2%)	494(99.2%)		546(87.1%)	414(97.9%)	

( ) means Standard Deviation

**Table 3:** Results of the exploratory factor analysis.

	Three Health Factors	Physical Health	Socioeconomic Status	Healthy Longevity
Subjective Health in 2001	<b>.834</b>	.210	-.090	.022
Subjective Health in 2004	<b>.638</b>	.199	-.106	<b>-.302</b>
Total Number of Diseases	<b>.367</b>	.048	-.039	-.086
Bedridden status 2004	.121	<b>.826</b>	-.030	<b>-.109</b>
Daily Living Ability	-.206	<b>-.588</b>	.068	.030
Educational Background	-.046	.028	<b>.746</b>	.035
Height	-.010	-.033	<b>.467</b>	-.024
Yearly Income	-.080	-.051	<b>.299</b>	.040
Survival days	-.125	-.060	.023	<b>.463</b>
Cronback's $\alpha$ index	0.645	0.151	0.151	0.007

and the estimated value from 「Physician and/or Dentist」 to “Three Health Factors” was 0.45. There was no significant difference in this relationship for either gender (men  $Z=1.12$   $P<0.19$ , women  $Z=1.83$   $P<0.11$ ).

Thus, it was shown that 「Physician and/or Dentist」 and “Three Health Factors” were interrelated.

For “Three Health Factors”, the direct effect from the “Socioeconomic Status” was 0.13. The direct effect on “Three Health Factors” from

“Socioeconomic Status” was shown to be significantly ( $z=2.83$   $P<0.01$ ) greater for women than for men.

The direct effect of “Three Health Factors” on “Healthy Longevity” was the largest; at 0.81. The direct effect of “Socioeconomic Status” on “Healthy Longevity” was shown to have the lowest estimate of 0.01.

Although the direct effect of “Socioeconomic Status” was extremely small for “Healthy Longevity”, the overall effect, including the indirect effect on “Healthy Longevity” via “Three Health Factors”

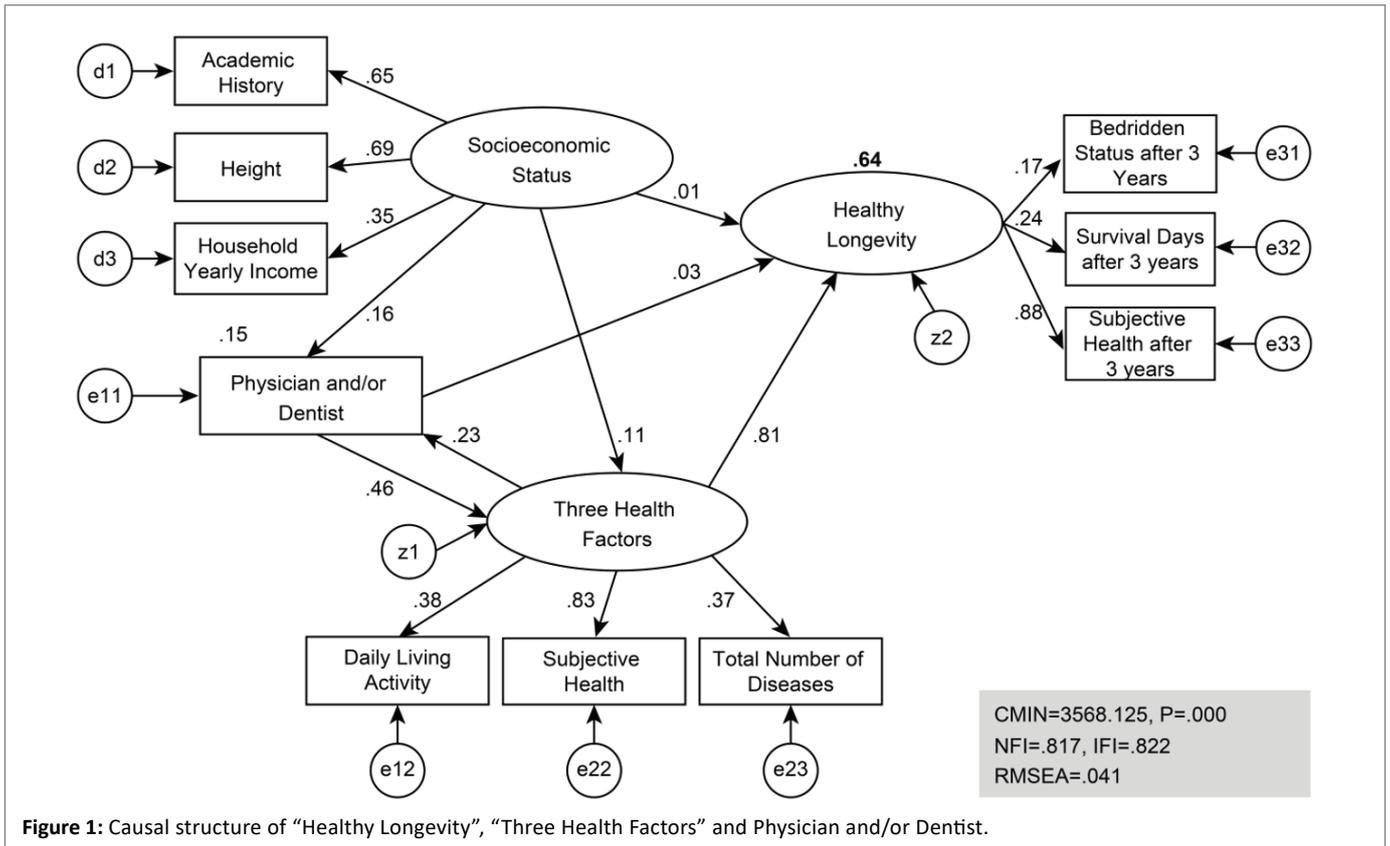


Figure 1: Causal structure of “Healthy Longevity”, “Three Health Factors” and Physician and/or Dentist.

and 「Physician and/or Dentist」 based on “Socioeconomic Status” was 0.12 to 0.17.

The largest overall effect on “Healthy Longevity” was from “Three Health Factors”, which ranged from 0.73 to 0.74. The next largest overall effect was 「Bedridden Status after 3 years」, at 0.22. The overall total effect on “Healthy Longevity” from 「Physician and/or Dentist」 was 0.31 (Table 4). This figure could explain 64% of “Healthy Longevity” (Figure 1).

## Discussion

### Causal structure of healthy longevity with a family doctor and/or a family dentist

It has become clear that the direct effects of both “Socioeconomic Status” and 「Physician and/or Dentist」 on “healthy longevity” including 「Bedridden Status after 3 years」 are small but can be positioned as the basis for maintaining “Three Health Factors”. “Three Health Factors” had the greatest total effect on “Healthy Longevity”, ranging from 0.73 to 0.74. The next largest total effect on “Healthy Longevity” was from 「Physician and/or Dentist」, and the total effect was 0.31 for both genders (Table 4).

The growth of the main organs is considered to be complete at the same time as when height ceases to increase, which is strongly related to “Socioeconomic Status”. At the same time, a desirable parental educational background would be linked to the reduction of illnesses and the maintenance of daily living ability in elderly individuals, as well as the enhancement of subjective health, approximately half a century later.

As a result, having only a family dentist but not a family physician is likely to lead to the maintenance of survival. Furthermore, it was

suggested that there was a possibility that a causal structure that maintains healthy longevity can be seen *via* the maintenance of the three health factors based on socioeconomic status. These results regarding the causal structures were the main novelty of this study.

The relationship between 「Physician and/or Dentist」 and “Three Health Factors” was shown based on cross-sectional survey, and the causal relationship cannot be discussed. Therefore, the mutual relationship was analyzed by pass analyses. As a result, 「Physician and/or Dentist」 had an estimated value of 0.23 when affected by “Three Health Factors” and an estimated value of 0.46 when affected by 「Physician and/or Dentist」, and these effects were significant ( $Z=2.36$   $P<0.001$ ). Therefore, it is presumed that 「Physician and/or Dentist」 may have the effect of reducing 「Total Number of Diseases」, maintaining 「Daily Active Ability」, and enhancing 「Subjective Health」. Thus, it was suggested that 「Physician and/or Dentist」 and “Three Health Factors” were interrelated.

The characteristics of this study were that the latent variable of healthy life expectancy included subjective health, long-term care degree, and the number of survival days as observation variables. Additionally, it became clear that socioeconomic factors were the basis for choosing dentists rather than physicians. This made it clear that health status became more desirable, and as a result, healthy life expectancy was maintained and promoted. As a result, a high degree of conformity was obtained compared to our previous study [9]. This model was able to explain 64% of healthy life expectancy.

Therefore, it may not be desirable to interpret that the presence of a family dentist directly preserves the subsequent survival days and cumulative survival rate. Rather, in a group that has good “Socioeconomic Status” and that has only a family dentist, “Three Health

**Table 4:** Direct and total effects on the “Healthy Longevity” by “Three Health Factors”, “Socioeconomic Status” and “「Physician and/or Dentist」 by gender.

		Men	Women	
<b>Standardised Direct Effect</b>	“Socioeconomic Status”⇒“Healthy Longevity”	0.01	0.01	
	“Socioeconomic Status”⇒“Three Health Factors”	0.11	0.15	
	“Socioeconomic Status”⇒「Physician and/or Dentist」	<b>0.10</b>	<b>0.25</b>	<b>P&lt;0.10</b>
	「Physician and/or Dentist」⇒“Three Health Factors”	0.45	0.45	
	“Three Health Factors”⇒“Healthy Longevity”	0.81	0.81	
	“Three Health Factors”⇒「Physician and/or Dentist」	0.22	0.25	
<b>Standardised Total Effect</b>	“Socioeconomic Status”⇒⇒ “Healthy Longevity”	0.12	0.17	
	“Socioeconomic Status”⇒⇒ “Three Health Factors”	0.15	0.23	
	「Physician and/or Dentist」⇒⇒ “Healthy Longevity”	0.31	0.31	
	“Three Health Factors”⇒⇒ “Healthy Longevity”	0.74	0.73	

“”: means Latent variable; 「」: Observed variable; ⇒: Direct Effect; ⇒⇒: Total Effect

Factors” are desirable, and “Healthy Longevity” including 「Bedridden Status after 3 years」 is maintained as a causal structure.

In this survey, the causal structure only indicates “Socioeconomic Status” and the effect on “Healthy Longevity” after three years. On the other hand, a limitation was that only the relation could be discussed because the year when “Three Health Factors” and “Socioeconomic Status” were assessed was the same year that 「Physician and/or Dentist」 was assessed. The next task is to clarify the causal structure *via* follow-up surveys with different years of research for all variables [19,20].

### The relational factor by physician and/or dentist

According to this study, the percentage of elderly people living at home in suburbs who had only an internal physician was 17.2%, and the percentage increased with age. On the other hand, the percentage who had only a dentist was 12.7%, and the percentage decreased with age for both genders.

Based on the 2001 patient survey conducted by the Ministry of Health, Labor and Welfare, the consultation status was almost the same as in this survey. Therefore, it is presumed that the results of this survey may reflect the actual situation. However, there are no research reports other than that by Trung Do, et al. [21] on the actual situation of family dentists, so this is an issue for future research.

The Japan Dental Association presented a dental hygiene week, emphasized the significance of having a family dentist, and proposed various projects for that purpose. Similarly, the Japan Medical Association has presented the roles and directions to promote family doctors. However, clarifying the actual situation of family physicians, including dentists, is a subject for future research.

### Significance of having a physician and a dentist

Large-scale reviews of medical treatment studies have shown that physicians reduce the risk of illness and, as a result, maintain the survival rate [10]. However, it was shown that the number of survival days was significantly shorter in the group with only an internal physician than in the group with only a dentist.

It was necessary to consider that the background to this was that the group with only a family physician had a low educational background, low living activity ability, a particularly large number of illnesses, and

a lower subjective health. On the other hand, the group with only a family dentist was an advantaged group with a selective bias of both men and women having excellent socioeconomic status. Therefore, it is presumed that excellent oral care may be linked to the maintenance of health as a result of fewer diseases.

Health support related to oral hygiene provided for examinees by family dentists and dental hygienists is considered a systematic and comprehensive system of primary prevention, secondary prevention, and tertiary prevention, as shown by Ogden GR, et al. [22].

The German researcher Gellrich NC, et al. [23] reported that such oral hygiene health support should be used for the early detection of illness as well as support activities to change behavior to a favorable lifestyle. Reichart PA [24] showed that if retaliation contributes to disease prevention, the four As (Ask, Advise, Assist, and Arrange) should be utilized, and this is the EU Europe's preventive strategy model.

Takada Y, et al. [25] conducted a dental examination and health education for 509 workers under the age of 40 for two years. As a result, when the degree of periodontal disease was evaluated by the CPITN (Community Periodontal Index Treatment Needs), it was reported that the rate of suspected periodontal disease in men decreased from 43% to 21% in the following year.

The Japan Dental Association created a report with the aim of clarifying the current scientific basis for the contribution of prevention and medical care by dentists toward the realization of societal longevity. The title of this report is “Evidence for Dental Health and Oral Health that Contributes to a Healthy and Longevity Society in 2015” [26].

In this report, a follow-up study was also reported in which the survival of women was maintained, especially when the number of remaining teeth, which is one of the desirable oral care effects, was 10 or more. Furthermore, the incidence of aspiration pneumonia was significantly reduced compared to the control group without intervention for institutional residents, and as a result, the mortality rate was also reduced [27,28].

Based on previous research, the significance of maintaining good health through desirable oral hygiene in the future can be suggested as follows. By having a family dentist, which is based on socioeconomic factors, the residual index tends to be maintained and preventive

activities such as oral care tend to be preferable; this can be linked to disease prevention through the richness of food.

In addition to screening activities to detect serious illnesses at an early stage with the support of a family physician, it is also an important measure to determine survival status through effective treatment, illness prevention activities, and reduction of health risk.

### Future research issue

A future research issue is to clarify the causal structure of healthy longevity by conducting continuous surveys at different times for each latent variable. Another issue for future research is to verify the reproduction of the research with representative samples and improve the external validity.

In addition, the next subject for research will be to analyze the truly causal structure of healthy longevity after clarifying the oral hygiene situation judged by the dentist, including the residual index, while using an objective medical examination.

Kobayashi K, et al. [29] reported that Hokkaido University Dental Hospital took the lead in establishing a community support medical department and receiving support requests from family doctors, family dentists, and home-visit nursing stations.

Watanabe T, et al. [30] set up a cardiovascular center as a regional core hospital and reported on the need to provide comprehensive and sustainable cooperation from health and welfare to long-term care by providing medical care that is closer to the community while specializing in heart disease. In future regional alliances, it is expected that efforts will be made to include family dentists [31].

### Conclusion

According to this study, elderly people with desirable socioeconomic factors tend to be advised by family dentists. In addition, a causal structure was shown that indicated that three health factors are advisable based on socioeconomic status, and as a result, healthy longevity, including both a high level of subjective health and a reduced bedridden status, was maintained. This related structure could explain 64% of healthy longevity. At the same time, a similar tendency was shown by gender. Future research will need to use oral care and health indicators such as blood pressure and blood glucose levels. It is also expected that the external validity will be enhanced by analyzing the causal structure through intervention studies including a randomized control group.

### Declarations

#### Consent of the institutional review

An agreement has been signed between the Tama City local government and the Tokyo Metropolitan University regarding the protection of privacy and confidentiality. Here, it is clarified that mutual confidentiality is strictly enforced. All analytical data are still supported by ID only. The survey was conducted with the consent of the Tokyo Metropolitan University Graduate School of Ethics Committee on September 16, 2000.

This study was conducted in accordance with the Declaration of Helsinki. All participants responded to the questionnaire based on informed consent.

#### Publication consent

I agree to publish this original paper.

### Possibility of data and materials

Analytical data and materials are available from the author by using the mail.

### Conflict of interest statement

The Author declares that there is no conflict of interest.

### Division of roles for writing a treatise

Hoshi summarized the entire sentence involved in data collection and analysis.

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