**The Causal Structure Between the Family Physicians and Dentists and the Bedridden Status after Three Years in Older People**

Words 6,281

Ⅰ**. Introduction**

Much more attention should be focused on healthy longevity in a rapidly aging country like Japan. Healthy longevity reduces the burden of bedridden status and is linked to stabilizing medical and bedridden status costs. Above all, it is significant that the person maintains a high quality of life and lives affluently [1]. Under these circumstances, Japan announced the Health Japan Plan 21 for healthy longevity in 2000 [2]. This plan clarifies the plan to maintain oral hygienic care, the basis of a rich diet, and measures to favor lifestyle-related habits, including smoking cessation. However, no previous studies have reported an association between oral hygiene and bedridden status. According to the Ministry of Health, Labour, and Welfare survey, 18.9% of people aged 65 and over need bedridden status in 2022[3]. In fiscal 2022, 12.191 trillion yen (800 million US dollars) was used for bedridden status insurance alone. Bedridden status insurance medical expenses exceed 10% of the general account budget [4]. Until then, it has been reported that cerebrovascular disease and dementia are the most significant factors contributing to diseases requiring long-term care. Recently, frail has been attracting attention as a factor that requires bedridden status[5].Previous studies have examined the roles and definitions of family dentists and family physicians [6-8]. The Japan Dental Association has published a report aiming to explain the scientific foundation for dentists' role in promoting health and medical care to help achieve a society with extended lifespans. The report is titled "Evidence for Dental and Oral Health's Contribution to a Healthy and Longevity Society in 2015" [9]. A follow-up study reported that women's survival rates were maintained when they had ten or more remaining teeth, which is a sign of good oral hygiene [10]. Additionally, the incidence of aspiration pneumonia was significantly lower in the interventional group compared to the control group, which didn’t receive oral hygiene care support from institutional residents [11]. A survey and oral hygiene examinations were conducted on 2,900 individuals visiting a dental clinic at the Tokyo Metropolitan Ward. The results revealed that proper oral hygiene and healthy gums positively impact the quality of life (QOL) linked to personal health and overall life satisfaction. While the direct effect of interdental cleaning tools on QOL is minor, consistent self-oral care and regular preventive consultations have a much more significant effect on improving the QOL [12]. **The authors studied the relationship between having a family dentist and more prolonged survival in 16,462 older adults living in the suburbs over six years. We found that men and women with a family dentist had significantly better cumulative survival rates than those without a dentist. Additionally, further analysis using the Cox proportional hazard model, which included other relevant factors, revealed that the survival days of women with a family dentist were significantly improved [13].**

**Thus, it is clear that the presence of a family dentist and excellent oral hygiene lead to the maintenance of survival in the future. However, studies on the relationship between a family dentist's presence and the required bedridden status have yet to be reported in the international literature. In addition, cerebrovascular diseases, dementia, and frailty have been reported as diseases that cause the need for long-term care[3-5]. However, there is no relational original paper that includes lifestyle and diet, physical, mental, social health, and socioeconomic status, which are the background of such diseases, and research on the relationship between the presence of only family dentists. Understanding these causal structural relationships, along with whether** having a family physician and/or dentist**, can provide valuable insights for developing new health strategies to prevent the need for bedridden status.**

This study aims to investigate the causal structural relationship between being bedridden status and having only family doctors or dentists, as well as the socioeconomic status, physical, mental, and social health, disease status, and lifestyle of older people in the suburban area of Tokyo by sexes.

**Ⅱ. Materials and Methods**

**1. Research Design**

A cohort survey for three years, including bedridden status, was followed among older people living in a suburban city in Tokyo.

**In** September 2001, we targeted a questionnaire survey to 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 via mail a second questionnaire, which was the same as previously used by the respondents, and 8,558 participants responded (505 cases had moved, 914 were deceased, and 3,218 did not respond). We analyzed 8,162 subjects, including 3,851 males and 4,311 females aged 65 to 84 at the second survey, from among those who could determine the need for long-term care.

2. Research Area

The city used as the study field had developed partly as a commuter town to accommodate increased workers and their families in the metropolitan Tokyo area between the 1970s and 1990s, which included a new era of high Japanese economic growth. The majority of dwellers were middle class. The city's total population was 145,862 as of 2000, with 11.1 percent of the population aged 65 years or older.

**3. The Questionnaire and Measures**

Standardized questions were validated in these questionnaire surveys to determine health status and lifestyle.

**1) Family Doctor and Family Dentist**

Questions about family physicians and dentists were investigated separately. Three years later, survival rates were significantly higher for patients who only saw a family dentist, followed by those who did not see either a physician or a dentist, then by those who saw both a physician and a dentist, and finally by those who only saw a family physician. Those in the physician-only group had a significantly lower survival rate than those in the dentist-only group. The study used a graded scale from 1 to 4 to measure the variables of physicians and/or dentists. The code for only family doctors was 1; 2 had both family physicians and dentists; 3 was the group with none of the family physicians and dentists, and had only family dentists was 4.

**2)Socioeconomic Status**

In 2001, socioeconomic status was determined using educational attainment and annual income. Educational attainment was grouped into three categories: high school graduation, junior college graduation, higher academic achievement than college, and non-responders. Annual income levels were divided into four categories: less than one million Japanese yen (equivalent to less than US $7,142), less than three million yen, less than seven million yen, and more than seven million yen. We included height, educational background, annual income, and age as an observational variable for socioeconomic factors. Height is considered an indicator of a prosperous and healthy childhood. Studies have shown that height is a reliable indicator of survival prognosis even after many years [13,14]. Jousilahti et al. found that shorter individuals had a higher overall mortality rate in a 15-year follow-up cohort study of 31,199 adults in East Finland [13]. In a similar study, 13,460 older adults in the suburbs of our country were followed for three years. The results showed that the mortality rate of a height less than 150 cm was significantly higher than that of the taller group [14].

**3) Three Health factors**

The study examined three dimensions of health: physical, mental, and social. The physical health parameters included the basic activities of daily living (BADL) [15] and the instrumental activities of daily living (IADL) [16] at the time of the 2001 survey. The BADL score was based on three questions: “Can you go to the toilet by yourself?”, “Can you take a bath by yourself?” and “Can you walk outside?”. Respondents received one point for each function they could perform, and the total scores ranged from 0 to 3, with higher scores indicating a higher level of basic activity competence. The IADL score was determined through five questions about 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?” [16]. Like the BADL score, the IADL score ranged from 0 to 5, with higher scores reflecting more excellent proficiency in instrumental activities.

**4)Mental health**

Mental health was measured through self-reported subjective health in the 2001 surveys. The question was, "Do you consider yourself to be healthy?" There were four response options: very healthy, moderately healthy, not so healthy, and not healthy [17]. The life satisfaction question was, "Are you satisfied with your daily life?". The response options were very satisfied, moderately satisfied, and unsatisfied [18].

**5)Social health**

Social health was assessed using various factors, such as frequency of going outside and communication with the neighborhood. The survey asked respondents how often they went outside, including around their neighborhood, with answer options ranging from less than once a month to more than 3 to 4 times a week [19]. Additionally, communication with the neighborhood was evaluated by asking respondents about the frequency of their communication with friends or neighbors, with response options including seldom, once a month, 3 to 4 times a week, and almost every day, using a scale ranging from 1 to 4 [20].

6)Lifestyle

Advisable habit items were considered healthy lifestyle habits when significantly associated with the number of survival days to six years later. As a result of our analyses, the habits associated considerably with several survival days were alcohol consumption, never smoking (even in the past), less than nine hours of sleep per night, exercising more than once a week, and having a BMI of more than 20. We scored these healthy lifestyle habits from 0 to 5, with a higher score representing a healthier lifestyle [21].

**7)Diet Scores**

The study identified several healthy dietary habits, including:

- Eating meat, eggs, and blue-backed fish 1 to 4 days a week

- Consuming soy foods, milk products, and fruits more than three days a week

- Eating vegetables more than five days a week

- Having breakfast almost every day

A score was calculated based on the consumption of these four healthy food categories to assess overall dietary health. Participants received three points for each type, resulting in a score ranging from 0 to 12. A higher score indicates healthier nutritional habits [22].

**8)Treated Diseases**

The treated diseases significantly linked to a decrease in survival rate after three years were summarized based on the number of treated diseases. The five diseases included in the study were hypertension, cerebrovascular disease, diabetes, heart disease, and liver disease. The score for the number of diseases being treated ranged from 0 to 5 points.

**9)Bedridden Status**

In September 2001 and 2004, a public assessment tool developed by the Japanese Ministry of Health, Labour, and Welfare was used to assess the bedridden status of elderly individuals. This tool includes six levels ranging from mild support to comprehensive care[3]. In our analysis, a respondent who required no care was scored as zero, while a score of one indicated the lightest degree of care, and a score of six indicated the most severe degree.

4**. Privacy**

The Tama City local government and the Tokyo Metropolitan University have signed an agreement to protect privacy and confidentiality. Both parties strictly enforce mutual confidentiality, and all analysis data is supported by ID only. The survey was conducted on September 16, 2000, with the consent of the Tokyo Metropolitan University Graduate School of Ethics Committee.

5**. Data Analysis**

The data was analyzed using IBM's Statistical Package for the Social Sciences (SPSS and AMOS) Version 27 software. The relationship between categories was determined using the chi-square test or the Kendahl τ test. Quantitative comparisons were made using a one-way analysis of variance. Covariance structure analysis was used to clarify the causal structure of the hypothetical model with latent variables[23,24]. The latent variables in the model were determined by exploratory factor analysis with varimax rotation using the maximum likelihood method. In the causal structure analysis, the model's goodness-of-fit was assessed using NFI (Normed Fit Index), IFI (Incremental Fit Index), and RMSEA (Root Mean Square Error of Approximation). All estimates were standardized constants. The statistically significant difference was considered as 1% or less.

**Ⅲ. Results**

**1. Analysis Targets Number**

Table 1 presents the gender and age group of the subjects. A total of 8,162 individuals aged 65 to 84 were analyzed, comprising 3,851 men and 4,311 women. The distributions of all variables used in this study by sexes were previously detailed in other studies [12,14,25].

**Table1. Total Subjects by Gender and Age Groups**



**2. Factors Related to the Bedridden Status after 3 years**

**After three years, this study found that having only family dentists had a lower rate of bedridden status than those who only visited family physicians, regardless of gender.**

**Additionally, a significant relationship was found between the level of bedridden status and all 12 observed variables, except for men's educational background, as shown in Table 2. We analyzed the structural causal relationship three years later, including all relevant variables influencing the bedridden status.**



**3. Bedridden Status Changes After Three Years**

**The results revealed that 96% of individuals who did not need assistance in 2001 remained independent in three years later. For those who required support, their level of bedridden status decreased to level 2 or 3 after three years. Additionally, 7% of individuals who initially needed level 5 care showed improvement in not being bedridden after three years (refer to Table 3). This pattern was observed consistently in both men and women.**

**Table 3 Relationship with Changes in the Status of Bedridden status**

**after 3 Years**

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**4. Causal Structure of Factors Related to the「Bedridden Status」 after Three Years**

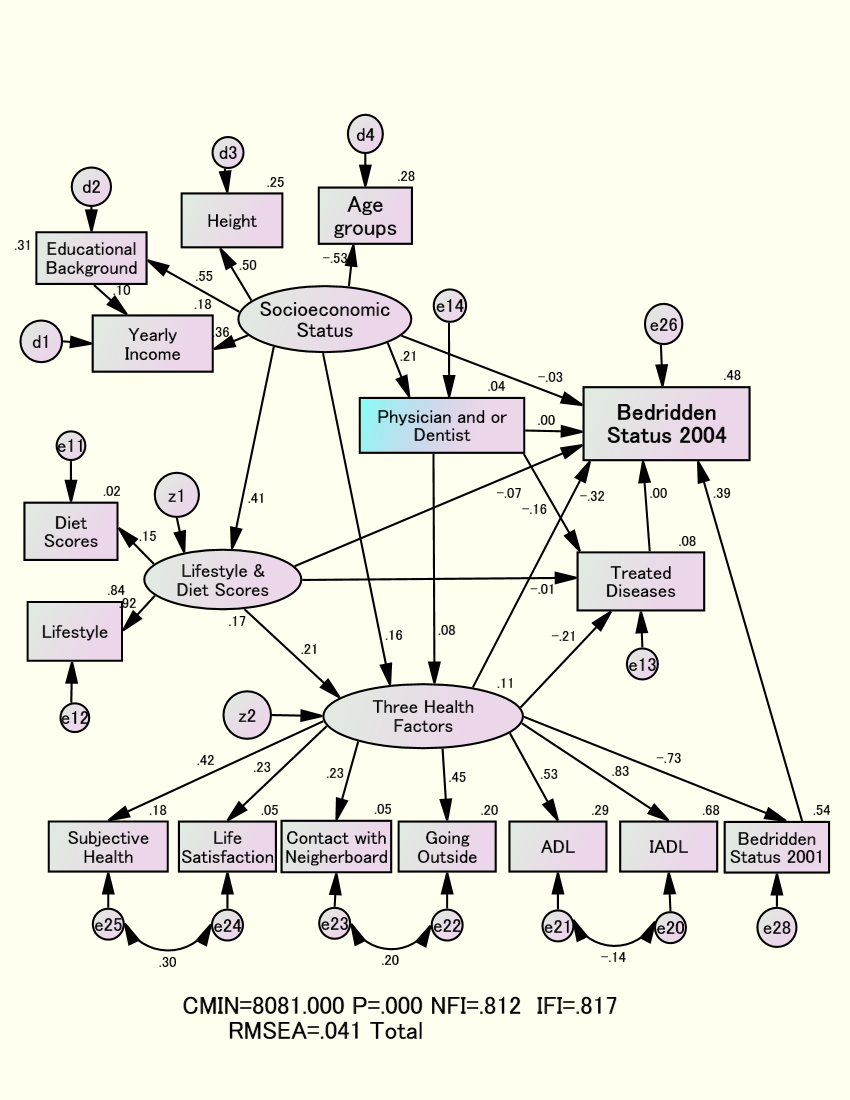
1) Results of Exploratory Factor Analysis

Factor analysis using the maximum likelihood method and Promax oblique rotation was performed to determine the latent variables. As a result, the first factor was the 「Bedridden Status」in the initial survey in 2001, the 「Bedridden Status」in 2004, and「ADL」and「IADL」. Both 「ADL」and「IADL」were positioned as an observation variable, hoping to be analyzed as an explanation variable. The second factors were 「Treated Diseases」 and 「Physician and/or Dentist」. Still, they were positioned as observational variables because we wanted to clarify their contribution to the degree of care required. The third factor is 「educational background,」 「annual income,」 「height,」 and「age.」 We named it "socioeconomic status" (“” indicates a latent variable). The fourth factor is 「subjective health,」「life satisfaction,」「connection with the neighborhood,」「going out,」「lifestyle,」 and 「Diet Score.」 Among them, "lifestyle habits" and "diet scores" were designated as "lifestyle habits and diet scores," and the remaining factors were named "three health factors." (Table 4).

The cumulative load sum of squares up to factor 4 was 41.1%. The Cronbach alpha confidence coefficient for the first factor was 0.74, the second was 0.55, the third was -0.14, and the fourth was 0.38.

Table 4. Results of Exploratory Factor Analysis





**Figure 1. The relational structure of 「Bedridden Status 」 and “Three Health Factors,” “Socioeconomic Status,” “Lifestyle and Diet Scores” and 「Physician and/or Dentist」**

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**2)Structure Relationship for the Bedridden Status**

We created theoretical structural causal several hypotheses models based on latent variables obtained from exploratory factor analysis. We sought the best-fitting model using adjusted indices [23,24]. In addition to「Bedridden Status,」we also examined "Socioeconomic Status," "Lifestyle Diet Scores,"  "Three Health Factors," 「Treated Diseases,」 and 「Physicians and/or Dentists」 simultaneously. Each surveyed item could be both a cause and an effect. And then, we investigated the direction and strength of cause and effect in all combinations to establish causality. For instance, the three health factors are considered favorable if only dentists are chosen. On the contrary, due to the superiority of the "Three Health Factors," there might be fewer diseases, prompting individuals to opt for a dentist instead of a physician.

Consequently, we examined the causality of all combinations and selected the one with the larger standardized estimate. As a result, we designated 「Bedridden Status」 as a dependent observed variable. We used "Socioeconomic Status," "Three Health Factors," and "Lifestyle and Diet Scores" as explanatory latent variables, and 「Treated Diseases」 and 「Physicians or Dentists」 as an explanatory observed variable, as shown in Figure 2, which had the highest degree of fit and was adopted as the final structural causal model. **The NFI was 0.812, and the IFI for the final model was 0.817, with an RMSEA of 0.041 (Figure 1). These results indicate a high level of conformity and support the adoption of the final structure diagram based on the literature [23,24]. All effects on the dependent variable were measured using standardized coefficients. The analysis also considered direct and indirect effects and a total combined effect. Furthermore, all connections between latent and observed variables were found to be significant in the Wald test.**

**3)The Direct and Total Effects of Each Factor on the 「Bedridden Status」after Three Years**

The most considerable significant direct effect on the level of 「Bedridden Status」was the level of 「Bedridden Status」three years prior, with a standardized direct effect of 0.39. Similarly, the estimate of the "Three Health Factors" direct effect on 「Bedridden Status」 was -0.32, the second most significant effect. The direct effect of the "Lifestyle and Diet score" was relatively small at -0.07, while the direct effect from "Socioeconomic Status" was -0.03, and the direct effect from 「Physicians and/or Dentists」　 and 「Treated Diseases」 was less than 0.01(Table 4).

The combined direct and indirect effects as a total effect on 「Bedridden Status」 were analyzed, with the "Three Health Status" showing the most significant effect at -0.73. The next was followed by "Socioeconomic Status" at -0.19, "Lifestyle and Diet Scores" at -0.15, and 「Physician and/or Dentists」" at -0.06. In summary, both "Lifestyle and Diet Scores" and "Three Health Factors," based on the "Socioeconomic Status," collectively influenced the causal structure of 「Bedridden Status,」The coefficient of determination for the level of 「Bedridden Status」care required was 48%. This relationship is depicted in Figure 2.

**A pass analysis of the relationship between the two 「Bedridden Status」 over three years showed that the coefficient of determination of the level of care required after three years was 41%. Therefore, it was estimated that 85.4% (0.41/0.48) of the level of care required was determined only by the level of care needed three years ago.**

**4)Causal Structure of the 「Physician and or Dentist 」and 「Bedridden Status」**

The study revealed that "Socioeconomic Status" directly impacts 0.21 on access to a 「Physician and/or Dentist.」 However, the coefficient of determination for 「Physician and/or Dentist」 was only 4%, indicating that 96% of the determination still needs to be identified.

The study also found that individuals who exclusively visited a family dentist had a better health status based on their "Socioeconomic Status." Additionally, the direct impact of 「Physician and/or Dentist」 on "Three Health Factors" was calculated at 0.08. Lastly, the total impact of 「Physician and/or Dentist」 on 「Bedridden Status」 was estimated to be 31.6%(=0.06/0.19), comparing the total effect of “Socioeconomic Status” on the 「Bedridden Status」.

**5) Causal Structure of the 「Treated Diseases」on 「Bedridden Status」**

The direct effect of the "Three Health Factors" on the 「Treated Disease」 is -0.21. And then, the **explanatory power of 「**Treated Disease」 was only 8%. T**he direct effect on 「Bedridden Status」from the 「Treated Diseases」was as small as -0.05, and the explanatory power of 「Bedridden Status」 was infinitely zero.**

**6) “Socioeconomic Status” and Related Factors**

**The standardized "Lifestyle and Diet Score" estimation from the “Socioeconomic Status” had the most significant direct effect at 0.41. Despite having a direct effect from “Socioeconomic Status” on the “Three Health Factors” at 0.16, the total effect on the “Three Health Factors” was 0.27, making it the second largest among all items. The “Socioeconomic Status” was a fundamental factor for determining the「Bedridden Status」(Table 4).**

**The desirability of the latent variable "Socioeconomic Status" shown here indicates that educational attainment, income, and height are high, while age is not old. In terms of the relationship between "Socioeconomic Status" and observed variables, the estimate of educational attainment was the largest at 0.55, followed by age and height. Various variables were determined as desirable due to the essential basic background of the “Socioeconomic Status.”**

**7)Confounding Factors**

The standardized estimate of the association between 「Physicians and/or Dentists」 and 「Treated Diseases」 alone was -0.08, and the association between 「Physicians and/or Dentists」 and 「Bedridden status」 alone was -0.13. However, in the final model, the standardized estimates of 「Physicians and/or Dentists」 and 「Treated Diseases」 for 「Bedridden Status」 were almost zero, as shown in Figure 1. Based on these results, we can conclude that "Socioeconomic Status," "Lifestyle and Dietary Scores," and "Three Health Factors" are confounding factors for the relationship between「Physicians and/or Dentists」 and 「Treated Diseases 」 to 「Bedridden Status.」

Ⅳ**. Discussion**

**1. Possibility of Preventing the Need for Bedridden Status by Having Only a Family Dentist**

**This study's characteristic is that it clarified the causal structure of the background factor correlated with cerebrovascular accidents, frailty, and cognitive decline, which have been pointed out as bedridden needs. These background factors include lifestyle habits, diet, physical, mental, and social health, the disease to be treated, and the presence or absence of a family doctor or dentist. And also, this study revealed that socioeconomic factors are a basic factor in reducing the need for bedridden status after three years, tending to individuals having only a family dentist.** The need for bedridden status may be linked to a severe socioeconomic status that prevents individuals from having regular access to family dentists. Without a family dentist, their three health factors may not be ideal, leading to impaired cognitive function, frailty, and an increased risk of health problems such as cerebrovascular disease.

It is essential to pay much more attention to the role of family dentists in preventing bedridden status. Dental factors are seen as more controllable than socioeconomic factors, which are difficult to control. Reproducibility is required. **On the other hand, the group with only a family physician showed a negative effect on preventing bedridden status. It was suggested that the background to the adverse effects is that it should be noted that the related structure, which is the overall effect of increasing the number of diseases to be treated, was overlooked as a result of socioeconomic factors not being satisfied, lifestyle habits, including diet, being unfavorable, and the three health factors not being excellent.**

**2. Importance of Three Health Factors and Life Style for Prevention of Bedridden Status**

The "Three Health Factors" had the most significant total effect on the「Bedridden　Status 」, with a value of -0.73, followed by the "Socioeconomic Status" with a value of -0.19. Among the observed variables associated with the "Three Health Factors," the IADL estimate of intellectual activity was the largest, at 0.83. Therefore, a previous study [5], which showed the importance of not having dementia, was supported as a reproducible causal structure for preventing bedridden status.

In analyzing only three observed variables - 「Physician and Dentist,」「Treated Diseases,」 and 「Bedridden Status」 - the coefficient of determination for 「Bedridden Status」was nearly zero. However, when the three latent variables, "Lifestyle and Diet Scores," "Three Health Factors," and “Socioeconomic Status” were included in the analysis along with the three observed variables, the coefficient of determination for the 「Bedridden Status」 was 48%, which is the maximum value.

**3. Significance of Having a Family Dentist Only and Research Topics**

The total effect of 「Physician and/or Dentist」on 「Bedridden Status」 was small at -0.15. However, “Socioeconomic Factors” make it easier to choose family dentists only. Ultimately, it is linked to a decrease in the prevalence of diseases and helps maintain the 「Bedridden Status」required.

Health support related to oral hygiene for examinees by family dentists and dental hygienists was considered a systematic and comprehensive system of primary, secondary, and tertiary prevention, as shown by Ogden et al. [26]. Reichart [27] shows that if a family dentist may contribute to disease prevention, four A (Ask, Advice, Assist, and Arrange) should be utilized, which is the EU Europe's preventive strategy model.

The German researcher Gellrich et al.[28] reported that it should be used for early detection of illness and support activities to change behavior to a favorable lifestyle as a dentist's role.

Kaneko et al. [29] have shown that a critical significance of oral hygienic care is the function of eating.

This study only showed the causal structure between the existence of family dentists rather than physicians and those with bedridden status. However, the analysis did not provide information on the desirable oral hygiene status of having a family dentist. On the other hand, Takada et al. [30] conducted a dentist's examination and a dental hygienist's health education for 509 workers under 40 for two years. As a result, when the degree of periodontal disease was evaluated by CPITN(Community et al.), it was reported that the rate of suspected periodontal disease in men decreased from 43% to 21% in the following year. According to previous research [8,9,10,22,31], the significance of maintaining good health through desirable oral hygiene care in the future can be concluded as follows. Based on socio-economic status, it tends to have a family dentist to keep the number of teeth, and preventive activities such as oral hygienic care through the richness of food are preferable. It can be linked to disease prevention and decreasing the bedridden status as a final results. Previous research in Tokyo has also shown that maintaining good oral hygiene through regular visits to a family dentist can improve overall health and contribute to disease prevention and longevity [31].

**4. Collaboration between Family Dentists and Physician**

Extensive research reviews have shown that the health support of family physicians reduces health risks and results in sustained survival. By April 2021, 22,099 research papers on the relationship between risk factors for diabetes, hypertensive disease, and subsequent mortality were reviewed. The meta-analysis indicated that family doctors' core medical activities help control diseases and mortality risk factors, resulting in sustained survival [32]. It would be expected that reproducing scientific evidence demonstrates how survival rates were maintained in groups with no family physicians and only family dentists.

Yamada et al. [33] have reported that oral infections such as tooth decay and periodontal disease are risk factors for infectious endocarditis. They stated that dental care coordinated with medical examinations before surgery for congenital heart disease is necessary to remove the source of infection in the oral cavity. Thus, it is crucial to facilitate collaboration between medical and dental care.

**5. New Tactics for Preventing the Bedridden Status**

**According to this study and Yuan’s study (33), it was suggested that in the context of health maintenance, having family doctors focuses on treating diseases, while having family dentists plays a role in preventing diseases.　This study clarified the bedridden status of the elderly in urban areas and how it changes over time after three years. In particular, 96% of those without the bedridden status remained so even after three years. In addition, 85% of the factors that determine the bedridden status after three years were determined by the level of bedridden status three years ago. Therefore, it would be suggested that the key to avoiding bedridden status is to live without needing care at this time.**

**The remainder of the bedridden status determinants would be 15%. However, it was suggested that the contributing role of health support activities for bedridden status prevention, which can only be played by family dentists who are easier to control than socioeconomic factors that are difficult to control, may share about 32% of the total effect of the socioeconomic factors. It should also utilize the support of family dentists and socioeconomic factors that form the basis of preventive activities through lifestyle, physical and mental health, and social activities.**

**Ⅴ****. Future Research Issue**

**In this study, we used covariance structure analysis to examine the impact of fifteen observed variables on 「Bedridden Status」 three years later. The reason for choosing covariance structure analysis is because each of the 15 factors is significantly related to the level of care required. In other words, the explanatory variables used in multivariate analysis are methods that assume they are not correlated, taking into account multicollinearity. This survey's periods for "Three Health Factors," "Socioeconomic Factors," and 「Physician and Dentists」 are conducted simultaneously. The next step is to enhance the understanding of the cause-effect relationships through follow-up surveys conducted over different years for all observed variables. It is also essential to address the research issue of validating the findings with a representative sample and improving external validity.**

**Another challenge is to increase the percentage of target audience tracking and reduce selection bias.** Further research is needed to understand the relationship between having a family dentist, oral hygiene, and longevity. In particular, as a background to the selection of only family dentists, a survey study by intervention follow-up, including a randomized control group, that includes the viewpoint of socioeconomic factors linked to favorable lifestyle habits and, at the same time, leads to the prevention of the need for long-term care through disease prevention, is expected to be conducted. It is expected to clarify preventing the bedridden status through dental care.

**Ⅵ****. Conclusion**

**The presence of a family dentist, along with good socioeconomic factors and healthy lifestyle choices, such as a balanced diet and three advisable health factors, has been made clear to prevent bedridden status. It was found that having a family dentist accounted for approximately 31.6% of the effect of socioeconomic factors in preventing the need for bedridden status. Emphasizing the role of having a family dentist may be more significant in maintaining the level of care required than focusing solely on difficult-to-control socioeconomic factors.**

**Acknowledgments**

 The authors express special gratitude to all the participants in Tama City, Tokyo, Japan. The study was funded by a grant from the Japanese Ministry of Health, Labour and Welfare (Hone0-Health-042) and a Grant-in-Aid for Scientific Research (B) from the Japanese Ministry of Education, Culture, Sports, Science and Technology (No.15 31012 & 14350327). We are also grateful for financial support from the Mitsubishi Foundation (2009-21) in 2009.

**Supplementary Materials**

The follow-up data and survey questionnaire in Japan used in this study are available at the address of the first author, T. Hoshi([star@onyx.dti.ne.jp](mailto:star@onyx.dti.ne.jp)).

**Author Contributions**

Conceptualization, T.H., and M.M. T.S; methodology; validation; formal analysis; T.H. writing—review and editing, T.H. and M.M.T.S

Supervision, M.M.T.S. Funding acquisition, T.H. All authors have read and agreed to the published version of the manuscript.

**Informed Consent Statement**

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest. The authors declare no conflict of interest. The funders had no role in the study's design, collection, analysis, or interpretation of data.

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**Reference**

1)Labor Statistics Association. Trends in national hygiene.2018/2019; 65:82-84.

<https://www.hws-kyokai.or.jp/publishing/type/magazine/103-magazine-list/2519-eis>

2)Sakurai N, Hoshi T. The aim of Health Japan 21. hokennokagaku 2003;

45:552-557. <https://search.jamas.or.jp/link/ui/2004038424>

3)The rate of bedridden status in Japan in 2022.

[2201a.pdf (mhlw.go.jp)](https://www.mhlw.go.jp/topics/kaigo/osirase/jigyo/m22/dl/2201a.pdf)

4)Total cost of long-term care in Japan.

[tp040531-1.xls (live.com)](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.mhlw.go.jp%2Ftopics%2Fkaigo%2Fosirase%2Fxls%2Ftp040531-1.xls&wdOrigin=BROWSELINK)

5)Satake S., Arai H. Importance of Frailty Concept in a Superaged Society and its Diagnosis and Management. Japan Society of Health Evaluation and Promotion.2017.44(2);370-377.

DOI <https://doi.org/10.7143/jhep.44.370>

6)Definition about family dentist in Japan.

<https://www.jda.or.jp/jda/other/kakaritsuke.html>

7)Definition about family physician in Japan.

<https://www.med.or.jp/people/kakari/>

8)Scientific evidence of dental health and oral health that contributes to a healthy and long-lived society in 2015.Japan Dental Association.2019.

[world\_concgress\_2015\_evidence\_jp.pdf (jda.or.jp)](https://www.jda.or.jp/dentist/program/pdf/world_concgress_2015_evidence_jp.pdf)

9)Fukai K, Takiguchi T, Ando Y, et al. Mortality rates of community-

residing adults with and without dentures.Geriatr Gerontol Int 2008;8(3)

:152-9. DOI: [10.1111/j.1447-0594.2008.00464.x](https://doi.org/10.1111/j.1447-0594.2008.00464.x" \t "_blank)

10)Yoneyama T, Yoshida M, Matsui T, et al. Oral hygienic care and

pneumonia. Oral Care Working Group.Lancet 1999.7;354(9177):515.

DOI: [10.1016/s0140-6736(05)75550-1](https://doi.org/10.1016/s0140-6736(05)75550-1" \t "_blank)

11)Rumi Tano、Tanji Hoshi、Toshihiko Takahashiet al. The Effects of

Family Dentists on Survival in the Urban Community-dwelling

Elderly.American Journal of Medicine and Medical Sciences 2013, 3(6):

156-165 　Doi:10.5923/j.ajmms.20130306.08

**12)Tano R.,**Yabuki Y.,Fukuzawa Y., et al. The Relationships between Oral Hygiene, Preventative Visits to Private Practices, and Psychological

Health in Urban Dwellers. J Dent Health60(2);163-169,2010

DOI <https://doi.org/10.5834/jdh.60.2_163>

13)Jousilahti P, Tuomilehto J, Vartiainen E, et al. Relation of adult height to cause-specific and total mortality: a prospective follow-up study of 31,199 middle-aged men and women in Finland. Am J Epidemiol 2000;151:1112-20．

DOI: [10.1093/oxfordjournals.aje.a010155](https://doi.org/10.1093/oxfordjournals.aje.a010155" \t "_blank)

14)Hoshi T, Nakayama N, Takagi T, et al. Relationship between height and BMI classification of elderly people living at home in urban suburbs. Journal of Japan Society of Health Education 2010; 18(4)268-77.

DOI::<https://doi.org/10.11260/kenkokyoiku.18.268>

15)Branch LG, Katz s, Kniepmann K.et al. A prospective study of

functional status among community elders Am. J. P H 1984;74:266-

268.DOI: [10.2105/ajph.74.3.266](https://doi.org/10.2105/ajph.74.3.266" \t "_blank)

16)Koyano W, Shibata H, Nakazato K,et al.Measurement of

competence.eliability and validity of the TMIG Index of Competence. Arch Gerontol Geriatr 1991;13:103-16.

　DOI: [10.1016/0167-4943(91)90053-s](https://doi.org/10.1016/0167-4943(91)90053-s" \t "_blank)

17)Kaplan GA, Camacho T. Perceived health and mortality: a nine-year follow-up of the human population laboratory cohort. Am J Epidemiol 1983; 117: 292-304.DOI: [10.1093/oxfordjournals.aje.a113541](https://doi.org/10.1093/oxfordjournals.aje.a113541" \t "_blank)

18) Laura C R, Longdi F, Emmalin B, Vivek G. Death and Chronic Disease Risk Associated With Poor Life Satisfaction: A Population-Based Cohort Study. Am J Epidemiol 2019;188(2):323-331.

　 DOI: [10.1093/aje/kwy245](https://doi.org/10.1093/aje/kwy245" \t "_blank)

19)Berkman LF，Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. Am J

Epidemiol 1979; 109: 186-204.

　 DOI: [10.1093/oxfordjournals.aje.a112674](https://doi.org/10.1093/oxfordjournals.aje.a112674" \t "_blank)

20)Seeman TE，Kaplan GA，Knudsen L, et al. Social network ties and mor tality among the elderly in the Alameda County Study. Am J Epidemiol 1987; 126: 714-723.

DOI:[10.1093/oxfordjournals.aje.a114711](https://doi.org/10.1093/oxfordjournals.aje.a114711" \t "_blank)

21)Berkman. Breslow L. Health and Ways of Living. OXFORD

UNIVERSITY PRESS. 1983.

[Health and ways of living : the Alameda County study : Berkman, Lisa F : Free Download, Borrow, and Streaming : Internet Archive](https://archive.org/details/healthwaysoflivi0000berk/page/n3/mode/2up)

22)Kodama S, Hoshi T, Kurimori S. Decline in independence after three

　 years and its association with dietary patterns and IADL-related factors

　 in community-dwelling older people: an analysis by age stage and sex. 　 BMC Geriatr 2021; 21: 385.　DOI: [10.1186/s12877-021-02332-5](https://doi.org/10.1186/s12877-021-02332-5" \t "_blank)

23)Finkel SE. Causal analysis with panel data. California: Sage

　 Publications. 1995; 41-56.

[Causal Analysis with Panel Data | SAGE Publications Inc](https://us.sagepub.com/en-us/nam/book/causal-analysis-panel-data)

24)Bentler P M 1, P Dudgeon P. Covariance structure analysis: statistical

practice, theory, and directions. Annu Rev Psychol.1996;47:563-92.

　DOI: [10.1146/annurev.psych.47.1.563](https://doi.org/10.1146/annurev.psych.47.1.563" \t "_blank)

25)Hoshi T. SES. Dietary and lifestyle habits, three health-

related dimensions, and healthy survival days. Hoshi

T,Kodama S, editors. The Structure of Healthy Life

Determinants: Lessons from the Japanese Aging Cohort

Studies. Singapore: Springer; 2018;134-189.

[The Structure of Healthy Life Determinants: Lessons from the Japanese 　　Aging Cohort Studies | SpringerLink](https://link.springer.com/book/10.1007/978-981-10-6629-0)

26)Ogden GR, Macluskey M.An overview of the prevention of oral cancer and diagnostic markers of malignant change: 1. Prevention.Dent

Update. 2000;27(2):95-9. DOI: [10.12968/denu.2000.27.2.95](https://doi.org/10.12968/denu.2000.27.2.95" \t "_blank)

27)Reichart PA.Primary prevention of mouth carcinoma and oral

precancerous conditions Article in German.Mund Kiefer Gesichtschir

2000;4(6):357-64. DOI: [10.1007/s100060000260](https://doi.org/10.1007/s100060000260" \t "_blank)

28)Gellrich NC, Suarez-Cunqueiro MM, Bremerich A, et al.

Characteristics of oral cancer in a central European population:

Defining the dentist's role. J Am Dent Assoc 2003;134(3):307-14.

DOI: [10.14219/jada.archive.2003.0159](https://doi.org/10.14219/jada.archive.2003.0159" \t "_blank)

29)Kaneko Y,Kato T,Yoneyama T.Oral hygienic care to restore the

function of eatingOral Hygienic Care.2003;162-163.Ishiyaku Shuppan.

Tokyo. [WorldCat.org](https://search.worldcat.org/ja/title/675101398)

30)Takada Y, Maeda Y, Isada T et al. Characteristics of workers for whom oral hygiene education is effective. Journal of Health and Wellness Statistics 2004:51;25-29. DOI: [10.14219/jada.archive.2003.0159](https://doi.org/10.14219/jada.archive.2003.0159" \t "_blank)

31) Hoshi T, Yabuki T, Nagai H,et al. Causal structure of the existence of

a family dentist and subsequent QOL and maintenance of survival.8020:

Hachi-Maru-Nii-Maru 15;130-133.2016.

https://search.jamas.or.jp/link/ui/2016223509 [(jamas.or.jp)](https://search.jamas.or.jp/link/ui/2016223509)

32)Yuan W,Eric Y Fai W ,Ivy L, et al.　The association between

trajectories of risk factors and risk of cardiovascular disease or

mortality among patients with diabetes or hypertension: A systematic review PloS one 2022.17(1) DOI: [10.1371/journal.pone.0262885](https://doi.org/10.1371/journal.pone.0262885" \t "_blank)

33)Yamaza H, [Takayama F](https://ci.nii.ac.jp/nrid/9000001250095), Ogasawara T, et al. A Case Report of Dental Treatment for Removing Sources of Oral Infection before Heart Surgery in a Patient with Noonan Syndrome through Medical Examination Cooperation.Journal of the Japanese Society for Disability and Oral Health 2020:41(4);318-324. DOI [10.14958/jjsdh.41.318](https://doi.org/10.14958/jjsdh.41.318" \t "_blank)