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Original Study

Effects of a Community-Based Program for Oral Health and Nutrition on Cost-Effectiveness by Preventing Disability in Japanese Frail Elderly: A Quasi-Experimental Study Using Propensity Score Matching

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A B S T R A C T

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Objective: In the Japanese Long-Term Care Insurance (LTCI) system, a community-based program for oral health and nutrition (OHN program) has been implemented with the aim of reducing incident disability and care costs. However, the effectiveness of this program has not been confirmed epidemiologically. The purpose of the present study was to test the hypothesis that the OHN program does reduce incident disability and care costs.

Design: A prospective study with a 28-month follow-up period was conducted using data from administrative databases at Tagajo City, Japan. Among frail elderly persons (aged 65 years or more) who were enrolled in the LTCI program in Tagajo, 64 participants in the OHN program and 128 controls (non-participants) were selected by propensity score matching.

Measurements: We used 2 types of outcome measure: composite outcome (incident disability and death) and care cost. Data on incident disability were retrieved from the public LTCI database. Care cost was defined as the total amount of LTCI service cost added to medical care cost.

Results: The hazard ratio of composite outcome was significantly lower for the intervention group than for the control group (hazard ratio = 0.32, 95% confidence interval 0.12–0.82). Even when we set incident disability as an outcome, the hazard ratio for the intervention group did not change (hazard ratio = 0.33, 95% confidence interval 0.11–0.97). The mean cumulative care cost during the 28 months tended to be lower for the intervention group (\$4893) than that for the control group (\$5770), but this was not statistically significant by the gamma regression model (cost ratio = 0.85, $P = .513$). The mean care cost per unit follow-up period (1 month) for the intervention group was significantly lower (cost ratio = 0.54, $P = .027$).

Conclusions: The results of this study suggest that the OHN program is effective for preventing incident disability and, consequently, for saving care costs per unit survival period.

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With the aging of the population, an increase in disabled elderly is becoming a large burden on social security systems worldwide.^{1,2} Japan, in particular, is experiencing the effects of population aging, having the highest proportion of elderly citizens of any country in the world.³ To cater for disabled elderly who need personal care, the Japanese government established the Long-Term Care Insurance (LTCI) program in 2000.³ For this system, everyone aged ≥ 40 years is required to pay premiums, and everyone aged ≥ 65 years is eligible to use benefits such as hiring a home help or being admitted to a nursing home if he/she is certified as “disabled.” The number of disabled

people certified for insurance benefits in Japan increased from 2.2 million in 2000 to 4.1 million in 2005.⁴ The annual total expense covered by LTCI in 2005 was \$59 billion (¥6.8 trillion), which was an increase of 89% from 2000,⁴ being roughly 20% higher than originally forecast.³ This rapid increase may threaten the sustainability of the LTCI system.

To contain the increase of LTCI-certified disabled elderly and the consequent expenditure, the Japanese government added the Disability Prevention Program in 2006.^{1,5} The LTCI Act mandates all municipalities to implement the Disability Prevention Program, which consists of 2 steps: (1) screening of frail elderly (individuals with a high risk of incident disability among the nondisabled population) in the community and (2) providing them with Secondary Preventive Services such as education programs in oral care and nutrition. These procedures were conducted in accordance with the Manual of Disability Prevention issued by the Japanese government.⁶

For elderly individuals, both oral function impairment and protein energy malnutrition are known to be among the risk factors for not only functional decline and sarcopenia^{7–10} but also onset and worsening of diseases (such as pneumonia, cardiovascular disease, diabetes mellitus, and dementia), and consequent medical expenditure.^{11–15} These problems are also inter-related, for example oral health status being a risk factor for malnutrition.^{7,16–18} Therefore, a complex education program for instruction in oral health and nutrition (OHN program) has been generally introduced^{19,20} and is recommended in the Manual of Disability Prevention.⁶

The Manual of Disability Prevention provides a set of standard procedures for a complex program that includes the content of the intervention, the duration of the intervention, the frequency of instruction, the number of participants, the assessment items, and the improvement targets.⁶ The targets of the OHN program include improvement of oral functions [(1) functions of the mouth (lips, cheeks, tongue, and soft palate), (2) saliva secretion, (3) chewing and swallowing, and (4) facial expression], and self-improvement of eating habits to prevent malnutrition.²¹

Education about oral health has been shown to be effective for maintenance of oral health status,^{22,23} and similar programs for nutritional care education have been effective for improvement of eating habits and avoiding malnutrition.^{24–26} If the OHN program can prevent functional decline, then care costs may be also contained. For example, a previous study suggested that an exercise program run by the Secondary Preventive Service reduced the risk of functional disability and contained care costs (LTCI service costs and medical care costs).²⁷ However, to our knowledge, no previous study has investigated the effect of the OHN program on functional decline and care costs.

The purpose of this study was to test the hypothesis that an instruction project on oral health and nutrition would reduce incident disability and care costs among frail older individuals.

Methods

Design

We performed this quasi-experimental study using data from the administrative database of Tagajo City, Miyagi Prefecture, north-eastern Japan, between October 2009 and January 2013. As part of the Long-Term Care Insurance (LTCI) Project, in 2009 and 2010, Tagajo City conducted screening of frail elderly at annual health check-ups. The Tagajo local government invited screened frail elderly to participate in the OHN program, and a proportion of those invited did so. As a secondary use of these public data, we compared outcome measures between the participants and nonparticipants. To consider the possibility of bias that baseline characteristics (eg, health condition, and lifestyle) among the participants were more favorable than those of

nonparticipants, we applied propensity score matching to select a portion of nonparticipants who had similar baseline characteristics to the participants. For this analysis, we used a dataset merged with LTCI data, health check-up data (self-reported questionnaire about disease history and lifestyle), and medical insurance data.

Study Participants

Figure 1 shows the flow of study participants for the analysis. The pooled analysis consisted of 2 waves (follow-up from 2009, and follow-up from 2010). Tagajo City conducted screening of frail elderly using the Japanese frailty checklist (the Kihon checklist) in June of the each year.^{28,29} The number of persons who were screened as frail elderly (aged ≥ 65 years) was 386 in 2009 and 351 in 2010. These individuals formed the source population for this analysis.

We excluded persons who had already been certified as having a disability by the LTCI before the starting date of follow-up, persons who had died or moved away before the starting date of follow-up, and persons for whom various items of information used for calculation of the propensity score had been unavailable. Among persons eligible for propensity score matching, 25 were extracted as intervention participants in 2009 and 39 in 2010; twice as many people as the participants were extracted as a control group. Thus, the total numbers of people used for pooled analysis were 64 in the intervention group and 128 in the control group. This sample size provides a statistical power of 0.873 if the result is the same as that of the previous study (Figure 1).²⁷

We followed up each of the participants for 28 months (851 days) from the starting date.

Intervention

An outline of the OHN program is shown in Supplementary Table 1. The same intervention program was conducted twice for each wave.

During each intervention period, an ambulatory program was held 6 times (see intervention contents in Supplementary Table 1). This was a standard program forming part of Secondary Preventive Services in conformity with the manual issued by the Ministry of Health, Labor, and Welfare.⁶

None of the participants received interventions in both of the 2 waves.

Kihon Checklist

The Kihon checklist (devised by the Japanese Ministry of Health, Labor and Welfare) is a 25-item self-administered questionnaire designed to identify frail elderly individuals (Supplementary Table 2).^{28,29} The Kihon checklist is composed of 7 domains: (1) instrumental activities of daily living (ADL); (2) motor abilities; (3) nutrition; (4) oral function; (5) seclusion; (6) forgetfulness; and (7) emotions. Elderly persons are classified as “high risk” if their answers meet any of the following criteria: “motor abilities score ≥ 3 points,” “nutrition score 2 points,” “oral function score ≥ 2 points,” or “summed score for question numbers 1–20 (excluding items for emotions) ≥ 10 points.” The predictive ability of the Kihon checklist to identify individuals at “high risk” of 1-year incident disability has been verified in a previous study (sensitivity 78.1% and specificity 63.4%).³⁰ The area under the receiver operating characteristic curve for evaluation of frailty was 0.92, using the 25-item total score.²⁹

Propensity Score Matching

To reduce the possibility of bias, we performed propensity score matching with a ratio of 1:2 (intervention group vs control group) according to the following 29 variables: sex, age (as of April 1, 2014;

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