

Book Chapter

Substitution of Formal and Informal Healthcare among Retired Population: Implication for Social and Public Health Policy

Chia-Ching Chen¹, Tetsuji Yamada^{2*}, Taeko Nakashima³ and I-Ming Chiu²

¹Department of Epidemiology and Community Health, School of Health Sciences and Practice, New York Medical College, USA

²Department of Economics, Rutgers University, the State University of New Jersey, USA

³Department of Social Healthcare and Business Management, Nihon Fukushi University, Japan

***Corresponding Author:** Tetsuji Yamada, Department of Economics, Rutgers University, the State University of New Jersey, 311 North Fifth Street, Camden, NJ 08102, USA, Tel: 1-212-808-5375

Published **July 08, 2021**

This Book Chapter is a republication of an article published by Tetsuji Yamada, et al. at *Frontiers in Public Health* in November 2017. (Chen C-C, Yamada T, Nakashima T and Chiu I-M (2017) Substitution of Formal and Informal Home Care Service Use and Nursing Home Service Use: Health Outcomes, Decision-Making Preferences, and Implications for a Public Health Policy. *Front. Public Health* 5:297. doi: 10.3389/fpubh.2017.00297)

How to cite this book chapter: Chia-Ching Chen, Tetsuji Yamada, Taeko Nakashima, I-Ming Chiu. Substitution of Formal and Informal Healthcare among Retired Population: Implication for Social and Public Health Policy. In: *Prime Archives in Public Health*. Hyderabad, India: Vide Leaf. 2021.

© The Author(s) 2021. This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Acknowledgements: We are grateful to the JSTAR for providing the data. Japanese Study of Aging and Retirement (JSTAR) is an interdisciplinary data resource on health, economic position, and quality of life in Japan, which follows people as they age. The JSTAR is supported by a collaboration between the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University, and the University of Tokyo and distributed by RIETI in Tokyo, Japan. Any credits, analyses, interpretations, conclusions and the views expressed in this paper are those of the authors, and do not necessarily reflect those of the institutions. This research study was selected and awarded as honorable mention for the 2016 Nobuo Maeda International Research Award at the Conference of American Public Health Association of 2016 in Denver, the U.S.A. The research work was presented at the APHA Annual Meeting, 2016, in Denver, the U.S.A.

Ethics Statements: Japanese Study of Aging and Retirement (the JSTAR) conducted the survey with the collaboration of the Research Institute of Economy, Trade and Industry (RIETI), Hitotsubashi University, and the University of Tokyo and distributed by the RIETI in Tokyo, Japan. Institutional review board approval is not required for this study because the data are a secondary analysis of de-identified JSTAR data.

Conflict of Interest Statement: The research was conducted in the absence of any commercial or financial relationships that could be constructed as a potential conflict of interest.

Author Contribution Statement: CC, TY, TN, and IMC all contributed to the study design, research question definition, analysis and manuscript drafting and approved the final version. They all fulfill ICMEJ criteria for authorship since they all contributed to the important intellectual content.

Abstract

Objectives: The purposes of this study are: (1) to empirically identify decision-making preferences of long-term healthcare use, especially informal and formal healthcare use; (2) to evaluate outcomes vs. costs based on substitutability of informal and formal healthcare use; and (3) to investigate health outcome disparity based on substitutability.

Methodology and Data: The methods of ordinary least squares, a logit model and a bivariate probit model are used by controlling for socio-economic, demographic and physical/mental health factors to investigate outcomes and cost-based substitutability of informal and formal healthcare use. The data comes from the 2013 Japanese Study of Aging and Retirement (JSTAR), which is designed by Keizai-Sangyo Kenkyu-jo, Hitotsubashi University, and the University of Tokyo. The JSTAR is a globally comparable data survey of the elderly, which is like the Health and Retirement Study (USA).

Results: There exists a complement good between the informal homecare and community-based formal homecare services, and the elasticities ranges from 0.18~0.22. The study reveals that a monthly opportunity cost for an elderly care at home is about \$692. Regarding healthcare outcome efficiency issue, the informal homecare is the best one among three types of elderly care: informal homecare, community-based formal homecare, and nursing home services. Health improvement/outcome of elderly with the informal homecare is heavier concentrated on informal homecare services than the elderly care services by community-based formal homecare and nursing homecare services.

Conclusions: Policy makers need to address a diversity of health outcomes and efficiency of services based on providing services to elderly through resource allocation to the different types of long-term care.

A provision of partial or full compensation for an elderly care at home is recommendable and a viable option to improve their quality of lives.

Keywords

Informal and Formal Home Care; Healthcare and Health Outcomes; Health Disparity

Introduction

The rapid increase in an aging population through a prolonged life expectancy combined with an increase in dependent elderly in Japan [1,2] has caused a shortage of labor supply (a decrease in the labor force participation rate from 60% in 2010 to 54% in 2030), a deterioration of the pension system (from one elderly vs. 2.4 working ag persons in 2012 to 1.2 persons in 2060), an upsurge in healthcare costs (an increase in health spending in % of GDP from 9% in 2010 to 14% in 2020, and to 19% in 2030), and a change in elderly nursing care programs/policies [3-5]. An imminent aging society compels many governments to change their policy orientation from institutional formal healthcare settings to informal home healthcare because of the forthcoming rising of the elderly healthcare costs, and long-term care financing [6-9]. The Japanese government has recently emphasized and promoted a more community-based comprehensive care system with preventive care to mitigate the financing burden [10]. For example, in 2000, the public long-term care insurance system was implemented to restrain the rapid increase in healthcare expenditures, as well as to accommodate the rising demand for elderly care with an aging population (65+) from 23% in 2010 to 31% in 2025. The major feature of this approach by the Japanese government is to reduce institutional long-term care and the pensions and to reduce ever increasing long-term care financing (ever rising the social security benefits including health and pensions from 21.8% in 2010 in GDP and 24.4% in 2025) by developing a community-based comprehensive long-term care, i.e. formal home care for the elderly [11]. This is imperative because of the tightening healthcare economy in addition to a lack of human resources,

long-term care facilities, and financial resources. Is a change in policy/program from institutional formal care to a community-based formal/informal care efficient and sufficient?

There is extensive literature documenting long-term care issues [5,8,12-18]. However, there are few empirical works documenting elderly behavioral choices regarding the interaction among community-based formal/informal home care and nursing home care [13-15,17].

Van Houtven and Norton [13] demonstrated a simultaneous approach with instrumental variable estimation about elderly people and stated that informal home care reduces formal health care of older adults. However, their findings do not clearly reveal the substitution between informal home care and formal home and nursing home care. Yamada et al. [14] shows that the one-way substitution of informal home care for nursing home care and the existence of a weak two-way substitution between nursing home care and community-based day-service and short-stay facility centers in Japan using the General Survey on Actual Living Conditions of the Elderly data of 1990. Hanaoka and Norton [15] focus on the potential source, i.e. children, of informal care by using the data of the Nippon University Japanese Longitudinal Study of Aging in 2001. Their findings are that the benefits of having unmarried children compared to the opportunity costs of having children makes a difference in the use of nursing care. The approach by Sole-Auro and Crimmins [17] discloses the different influences of socio-demographic factors on formal and informal care for elderly persons in England, Spain, and the USA. The results show that the use of formal care is higher in England and the USA compared to Spain. However, functional limitation receiving care is higher in Spain.

Purpose of this Study

The aforementioned studies do not provide clear-cut evidence to generalize a two-way substitution among informal home care, community-based formal care, and nursing home care. To our knowledge, very few or no study has been conducted to

investigate "outcomes" vs. "costs" based on substitutability of informal and formal healthcare use. The primary contribution of this paper is to detect decision-making preferences of long-term healthcare use, especially informal and formal healthcare use empirically. A crucial challenge is quantifying and evaluating outcomes vs. costs based on substitutability of informal and formal healthcare use. Our critical second contribution is to investigate and clarify health outcome disparities based on substitutability among informal care, community-based formal care, and nursing home care.

Methods

Analysis

Increasing evidence has shown that decision-making preferences of substitutability between informal and formal healthcare use [12,16]. Balia and Brau [16] not only underline statistically significant results but also emphasizes the size of substitution between nursing home care and community-based formal/informal care. In this study, the effects are divided into two dimensions.

The conceptual and theoretical framework underlying our research model is based on the PRECEDE-PROCEED model (hereafter referred to as the PP model) and postulates that health outcomes are attributed to the use of formal and informal care services based on behavioral, socio-demographic and psychoeconomics characteristics [19-21]. They offer some concepts and analytical tools to help examine preferences of formal and informal long-term care for elderly people and health outcomes by using the Japanese Study of Aging and Retirement. By applying the PP model, we assess behavioral substitutability, which affects preferences for community-based informal care, formal care, and nursing home care by the elderly between Phases 3 and 4 in Figure 1. In addition, the study evaluates health outcomes from the preferences of formal and informal care services in health changes and quality of life of Phase 8. This study does not implement an intervention of health promotion, policy and regulation in Phase 5.

There are four categories of behavioral influential factors: enable, predisposing, reinforcing, and economics and health risk factors by controlling government regulations, socio-demographic and psych-economic factor incorporating with the PP model framework. Enabling factors include access to long-term care resources, availability of health care resources, health insurance, economic resources, social networks, development of skills etc. This study also reflects financial burden, opportunity costs, and physical burden of informal care as a measure of enabling factors. Predisposing factors of the PP model include personal attitudes, values, beliefs, knowledge and perceptions. In this study, the PP model contains the following socio-demographic factors: gender, age 52 and older, education attainment, health knowledge, etc. Table 1 illustrates the characteristics of the aforementioned variables. Reinforcing factors encompass the different kinds of rewards and feedback pertaining to formal and informal preferences. These factors can be derived from family, self, marital status, friends and others who control the benefits and gains from community-based informal and formal care service use. These reinforcing behaviors comprise of different types of feedback and rewards after behavioral changes.

Table 1: Descriptive statistics of variables used in the present study.

Variables	Min.	Max.	Mean	Standard Deviation
Dependent variable				
<i>Community-based formal home care:</i> It includes day-care services, short-stay services, and rehabilitation services at a healthcare center with the following scale: minimum of 0 services ~ 24 services per month. Unit of value is number of times.	0	24	0.020	0.598
<i>Informal home care:</i> It includes physical care services, services of home chores, basing services, rehabilitation services, and nurse visits at home with the following scale: minimum of 0 services ~ 8 services per month. Unit of value is number of times.	0	8	0.008	0.205
<i>Nursing homecare use:</i> 1=yes and otherwise=0	0	1	0.012	0.110
<i>Formal and informal homecare:</i> 1=yes and otherwise=0	0	1	0.018	0.132
Independent variables				
<i>Enabling factors</i>				
<ul style="list-style-type: none"> • Availability of care resources: availability of care resources by children because a workplace provides care-leave days, 1=yes, otherwise=0. 	0	1	0.123	0.329
<ul style="list-style-type: none"> • Private health insurance policy in addition to the national health insurance program: a person who has a private insurance policy in addition to the national health insurance program, 1=yes and otherwise=0. 	0	1	0.621	0.485
<ul style="list-style-type: none"> • Accessibility of healthcare services and facilities: It also includes accessibility to pharmacists, 1=yes and otherwise=0. 	0	1	0.854	0.352
<ul style="list-style-type: none"> • Care-leave days by a worker for elderly parent(s). • Care-leave policy by a workplace. 1=yes and otherwise=0. 	0 0	60 1	0.214 0.006	2.214 0.078
<i>Reinforcing factors</i>				
<ul style="list-style-type: none"> • Marital status: married=1 and otherwise=0. 	0	1	0.776	0.416
<ul style="list-style-type: none"> • Degree of own healthcare required level by government regulation: A degree of professional care requirement by government regulation with the following scale: 1=independent, 2=needs preventive care, 3=least requirement of professional care ~ 9=highest requirement of professional care because of physical and mental severity. 	1	9	1.104	0.797
<ul style="list-style-type: none"> • Degree of spouse healthcare required level by government regulation: It is the same scale above. 	1	9	1.494	1.661
<i>Predisposing factors</i>				
<ul style="list-style-type: none"> • Age (years) 	52	80	67.45	6.841
<ul style="list-style-type: none"> • Educational level as knowledge: Education; 1=elementary and middle school, 2=high school, 3=junior college, 4= senior college, 5=university, 6=master, 7=doctoral degree. 	1	7	2.877	1.431
<ul style="list-style-type: none"> • Perception of family responsibility for elderly's healthcare and nursing care: 1=yes and otherwise=0. 	0	1	0.407	0.491
<i>Health risk and economic factors</i>				

<ul style="list-style-type: none"> Change in health status: a change in health status compared to 1 year ago: 1=excellent ~ 5=worse 	1	5	3.075	0.496
<ul style="list-style-type: none"> Preventive care: receiving preventive care services for the past year, 1=yes and otherwise=0. 	0	1	0.668	0.470
<ul style="list-style-type: none"> Days of hospitalization: number of hospitalization days for the past year, minimum=1 day and maximum=365 days. 	1	365	1.926	13.968
<ul style="list-style-type: none"> Mental aspects: I have been feeling depressed lately, I have been feeling lonely lately, etc., Each question has a 4-point scale (1=none, 2=1~2days, 3=3~4 days and 4=5 days and more). Thirteen questions are added (minimum = 13 days and maximum = 50 days in total). 	13	50	17.574	5.757
<ul style="list-style-type: none"> Income of a household head: annual income, a unit of value is 10,000 Japanese yen. Income (spouse): annual income, a unit of value is 10,000 Japanese yen 	0 10	1800 400	583.031 61.428	61.337 11.296
<ul style="list-style-type: none"> Savings: amount of saving in Japanese yen, a unit of value is Japanese 10,000 yen. Assets: amount of asset in Japanese yen, unit of value is Japanese 10,000 yen. 	0 0	3000 3000	33.290 61.37	205.552 264.094
<i>Instrumental variables</i>				
<ul style="list-style-type: none"> Preventive cost: annual expenses of preventive cares, a unit of value is 10,000 yen. 	0	18	0.36	1.219
<ul style="list-style-type: none"> Tooth: tooth treatment per year, a unit of value is number of visits 	0	52	4.03	6.649
<ul style="list-style-type: none"> Caremother2_indep: good health status of spouse's mother who is not a member of husband's family 	0	1	0.91	0.201

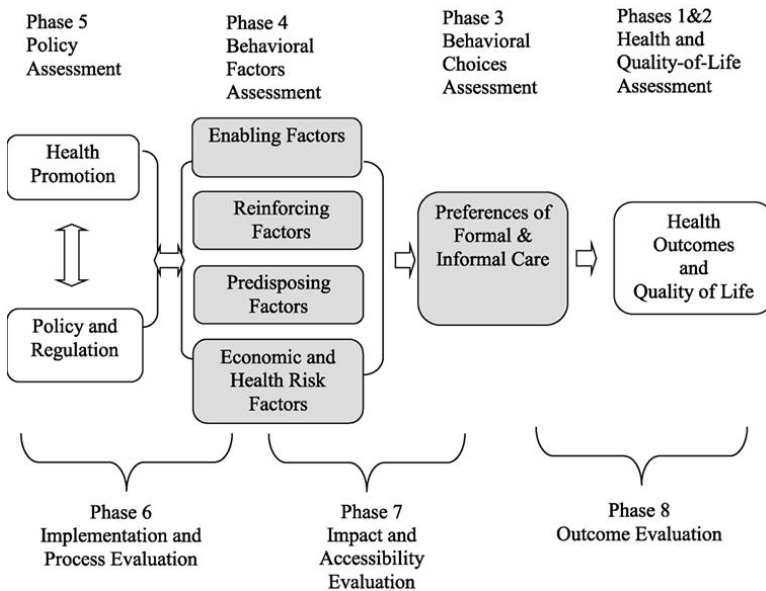


Figure 1: Application of PRECEDE-PROCEED model to examine preferences of formal and informal care and health outcome changes. Notes:

1. Green & Kreuter, *Health Promotional Planning*, 4th ed., McGraw-Hill, [25].
2. Glanz, Rimer, Lewis, *Health Behavior and Health Education*, 3rd ed., Jessey-Bass, [26]

The Precede-Proceed model is a planning model used to analyze and assess a health behaviors and behavioral changes in the target population within a given socio-economic and demographic environment. This model allows for a series of assessments and evaluations designed to help the health planning and policy and needs to the improvement of overall quality of life through the analysis of needs and problems.

Specification

The basic structural framework is shown in Figure 1. It is crucial to understand that decision-making preferences of long-term healthcare use, especially informal and formal healthcare use are attributed to the quality and quantity of physical family resources and community-based formal and informal programs, which can influence health outcomes and disparity as well as quality of life. The arrows of Figure 1 show that enabling, predisposing, reinforcing, economic, and health risk factors are predictors of preferences of informal home care, community-based formal care, and nursing home care. As an exclusion criteria, this study

focuses on elderly persons between the ages of 50 and 80. The following equations describe the basic structural model of analysis:

$$IHC_i = \alpha_0 + E_i\alpha_1 + R_i\alpha_2 + P_i\alpha_3 + X_i\alpha_4 + \alpha_5LTC_i + \varepsilon_{iIHC} \dots\dots\dots[1],$$

$$FHC_i = \beta_0 + E_i\beta_1 + R_i\beta_2 + P_i\beta_3 + X_i\beta_4 + \alpha_5LTC_i + \varepsilon_{iFHC} \dots\dots\dots[2]$$

and

$$NH_i = \phi_0 + E_i\phi_1 + R_i\phi_2 + P_i\phi_3 + X_i\phi_4 + \alpha_5LTC_i + \varepsilon_{iNH} \dots\dots\dots[3].$$

Equations 1, 2 and 3 represent the relationship between the health behavioral choice of individual “i” and a person revealing the preference of healthcare services, e.g. services of informal homecare (IHC), services of formal homecare (FHC), and services of nursing home (NH). Factors will influence an individual’s preference of services, and ε_{iIHC} is an unobserved error, generally assumed to satisfy $f(\varepsilon_{iIHC} | E, R, P, X)=0$. ε_{iFHC} is an unobserved error, generally assumed to satisfy $f(\varepsilon_{iFHC} | E, R, P, X)=0$. ε_{iNH} is an unobserved error, generally assumed to satisfy $f(\varepsilon_{iNH} | E, R, P, X)=0$. E_i , R_i , and P_i are vectors of the presumably exogenous variables of the predisposing, reinforcing, and enabling factors of individual i, respectively, that potentially influence healthcare services. Equations 1, 2 and 3 show the influential composition. Three different types of care, IHC, FHC and NH, consisting of enabling (E), reinforcing (R), and predisposing (P) will influence preference of needed healthcare and are also incorporated in the extended PP model in Figure 1 to observe influential determinants. X_i is the vectors of additional determinants of service needs and economic and health risk factors. LTC represents FHC in equation [1], IHC in equation [2], and IHC or FHC in equation [3].

The association between informal home care services and community-based formal homecare services is an ambiguous association, and could be positive or negative. To address this research question, i.e. the objectives, we hypothesize that homecare and nursing homecare is negative and both indicators are negatively and simultaneously determined within this study. An elderly person wants to have a certain preference under prevailing constraints, such as economic, psychological, social, and demographic factors which are influenced by government

policy and regulations, e.g. social security retirement benefits, i.e. income, welfare policy for elderly care, working regulation/condition for children who work and live with the elderly person, etc. Within the given constraints, a specific preference is determined by maximizing their own utility, i.e., satisfaction from services of homecare or nursing homecare.

The process and selection of receiving healthcare services from home care or nursing home care will generate an economic, psychological, and physical burden on family members and spouses. This burden generally involves cost. For example, an increase in costs will distort the selection of needed healthcare, and will be transformed into the pecuniary term of their own children and a spouse's quality of daily life. This transformation or change depends on an elderly person's psycho-economic and social factors. Constraints of prevailing human and financial resources will lead to an individual's optimal decision.

Statistical Analysis

Multiple-regression analyses are used to conduct and examine the effects of enabling, reinforcing, predisposing, and economic and health risk factors on homecare and nursing home care. For this estimation, we used the methods of ordinary least squares (OLS) for homecare regressions, a logit model for nursing homecare and the bivariate probit model to identify substitutability. The key dependent variables which are shown in Table 2 measure the signs and the effects of the informal homecare: equation 1, the community-based formal care: equation 2, and the nursing home care by assuming some simultaneous effects in equation 3. We therefore implement to identify the exogeneity/endogeneity tests. This study uses the Hausman specification test to examine the endogeneity of this empirical model, and to examine preference of home care and nursing home care services.

Table 2: Empirical Results of Long-Term Care Preference: Informal Homecare and Community-based Formal Homecare in Japan, (OLS, n= 1750).

Dependent variable	Informal homecare		Community-based formal homecare		
Variables	Coefficient	Standard error	Coefficient	Standard error	
Independent variable:					
• Community-based formal homecare	0.071a	0.008	---	---	
• Informal homecare			0.511a	0.063	
Independent variable					
<i>Enabling factors</i>					
• Availability of care resources	0.002	0.016	-0.008	0.043	
• Private health insurance policy in addition to the national health insurance program	0.004	0.010	0.017	0.028	
• Accessibility of healthcare services and facilities	-0.171	0.014	-0.036	0.038	
<i>Reinforcing factors</i>					
• Marital status	0.006	0.012	0.008	0.034	
• Degree of own healthcare required level by government regulation	-0.001	0.006	0.001	0.017	
• Degree of spouse healthcare required level by government regulation	0.001	0.003	-0.006	0.008	
<i>Predisposing factors</i>					
• Age	0.002a	0.000	-0.001	0.002	
• Educational level as knowledge	0.006c	0.003	-0.000	0.010	
• Perception of family responsibility for elderly's healthcare and nursing care	-0.018c	0.010	-0.039	0.028	
<i>Health risk and economic factors</i>					
• Change in health status	0.022b	0.010	0.023	0.027	
• Preventive care	-0.020c	0.011	-0.014	0.029	
• Days of hospitalization	0.001c	0.000	0.021a	0.001	
• Mental aspects	-0.001	0.001	-0.001	0.002	
• Income of a household head	0.000	0.000	-0.000	0.000	
• Savings	0.000	0.000	0.000	0.000	
• Assets	0.000	0.000	0.000	0.000	
Number of observations	1750		1750		
F-statistics	5.93		21.62		
Probability of F-statistics	0.000		0.000		
R-squared	0.056		0.208		
Root MSE	0.211		0.567		

Note: a, b and c represent statistically significant level of regression coefficients as follows: 99% level (a), 95% level (b), and 90% level (c) for a two-tailed test.

In order to address the outcomes and costs, the second objective, we used the OLS to examine opportunity costs of caring for an elderly person in terms of home care and nursing home care. As per the third objective of the study is to evaluate health outcome disparity, this study employed the concentration index (CI). The CI is used to quantify the degree of health outcome inequality in health outcomes. This analysis of informal home care, formal home care and nursing home care is focused on horizontal equity, and is not concerned with vertical issues [21-23]. The aforementioned analyses involved phase 3, phase 4, phase 7, and phase 8 in Figure 1.

For this empirical study, there are three issues of reliability of estimation: exogeneity and endogeneity issue, multicollinearity issue, and heteroskedasticity in OLS and logit estimation. Health status of the elderly is included in a base specification and educational level, i.e., health knowledge. This is a factor that improves the efficiency with which the elderly can produce better health. The income level of the elderly affects the living standard, which contributes to their health. In addition, the correlation of educational attainment and income is generally positive. An elderly person with a higher education level is more likely to have higher health stock because of his/her health knowledge. Both variables are theoretically important to evaluate the elderly with preferences of healthcare services with given resources, e.g. family human resources for elderly care. Therefore, we included multiple endogenous variables in our empirical analysis.

Data

This study uses the Japanese Study of Aging and Retirement (JSTAR), which was designed and carried out jointly by the Research Institute of Economy, Trade, and Industry and Hitotsubashi University in Japan, and the University of Tokyo. The JSTAR is a globally comparable data survey of the elderly, which is similar to the Health and Retirement Study (HRS) of USA. The design of JSTAR is like the U.S. HRS, the Survey of Health, Ageing and Retirement in Europe (SHARE), and the English Longitudinal Study of Ageing (ELSA). The 2011 wave

was conducted in September and October and collected data on individual living circumstances of 4,500 persons aged between 50 and 80 years in three municipalities: Hiroshima city in Hiroshima prefecture, Chofu city in Tokyo, and Tondabayashi in Osaka.

The original sample size was 2,184 persons (983 men and 1,201 women; response rate of 48.5%). The survey has two units of observation: individual and household. A household is a single individual or individual with his/her spouse, whatever applicable. Unlike the HRS, the JSTAR only interviews one respondent per household but the survey includes several questions to the respondent about the spouse. The JSTAR covers a wide range of information including: income, wealth, working status, family structure, relationship with family members and neighborhood, capacity of memory and cognitive, health conditions, medical care, and nursing care.

Results

Table 2 represents the results from the OLS regression of the factors that are associated with preferences of the elderly for informal homecare and community-based formal homecare. All the results reported in Table 2 used heteroskedasticity-robust standard errors, so heteroskedasticity does not threaten the internal validity of the multiple-regression analysis with the definition of variables in Table 1. Table 3 offers the logit model results for examining a negative influence of informal and formal homecare services on nursing home cares. The results of Table 4 provide opportunity costs for elderly care through working hours by a family member.

Table 5 presents the results of a bivariate probit model to examine a substitutability of informal and formal healthcare use and Institutional care.

Table 3: Empirical Results of Long-Term Care Preference: Nursing Home, Informal Homecare and Community-based Formal Homecare in Japan, (Logit, n= 1750).

Dependent variable	Nursing home		Nursing home	
Variables	Coefficient	Standard error	Coefficient	Standard error
Independent variable:				
• Community-based formal homecare	---	---	-1.247	224.39
• Informal homecare	-5.477	868.08	---	---
Independent variable				
<i>Enabling factors</i>				
• Availability of care resources	0.122c	0.745	1.726b	0.732
• Private health insurance policy in addition to the national health insurance program	-0.678	0.473	0.328	0.738
• Accessibility of healthcare services and facilities	-0.435	0.568	-0.455	0.757
<i>Reinforcing factors</i>				
• Marital status	1.136	0.701	2.189c	1.128
• Degree of own healthcare required level by government regulation	0.788a	0.095	1.048a	0.133
• Degree of spouse healthcare required level by government regulation	-0.276	0.179	0.039	0.132
<i>Predisposing factors</i>				
• Age	-0.124a	0.042	-0.020	0.055
• Educational level as knowledge	-0.118	0.163	0.115	0.207
• Perception of family responsibility for elderly's healthcare and nursing care	0.165	0.453	-0.744	0.663
<i>Health risk and economic factors</i>				
• Change in health status	-0.814c	0.465	-0.209	0.657
• Preventive care	-0.507	0.472	1.241	0.832
• Days of hospitalization	-0.185	0.367	-0.011	0.091
• Mental aspects	0.004	0.038	-0.174c	0.007
• Income of a household head	-0.002	0.006	-0.003	0.007
• Savings	-0.001	0.002	-0.002	0.007
• Assets	-0.001	0.001	-0.000	0.001
Number of observations	1750		1750	
Log likelihood	-101.342		-58.846	
Log likelihood Chi square	108.83		127.27	
Prob>Chi square	0.000		0.000	
R-squared	0.349		0.519	

Notes: A standard error of coefficient leads to z value (Wald statistic) by STATA. a, b and c represent a confidence level of regression coefficients as follows: 99% level (a), 95% level (b), and 90% level (c) for a two-tailed test.

Table 4: Empirical Results of Working Hours and Elderly Care (OLS, n= 47).

Dependent variable		Working hours			
Variables	Coefficient	Standard error	t-statistics	[95% confidence intervals	
Independent variable: • Care time	22.907b	10.198	2.25	2.23	43.56
Independent variable <i>Enabling factor</i>					
• Private health insurance policy in addition to the national health insurance program	2.325	6.732	0.35	-11.31	15.96
<i>Reinforcing factor</i>					
• Marital status	11.983c	6.607	1.81	-1.40	25.37
<i>Predisposing factors</i>					
• Age	0.559	0.566	0.39	-0.58	1.70
• Educational level as knowledge	-4.085c	2.242	-1.82	-8.62	0.45
<i>Health risk and economic factors</i>					
• Change in health status	-1.211	2.984	-0.41	-7.25	4.83
• Income of a household head	-0.287b	0.116	-2.46	-0.52	-0.05
• Income (spouse)	-0.036	0.051	-0.71	-0.13	0.06
<i>Constant</i>	147.95	93.341	1.59	-41.17	337.07
Number of observations	47				
F-statistics	2.41				
Probability of F-statistics	0.029				
R-squared	0.3691				
Root MSE	19.064				

Note: a, b and c represent statistically significant level of regression coefficients as follows: 99% level (a), 95% level (b), and 90% level (c) for a two-tailed test.

Table 5: Empirical Results of Long-Term Care Preference: Formal & Informal Homecare and Institutional Care (Bivariate probit, n= 1694).

Dependent variable: the 2 nd stage of bivariate probit model					
Institutional care [nursing homecare]					
Variables	Coefficient	Standard error	z	P > z	
Independent variable					
<i>Enabling factors</i>					
• Availability of care resources	-52.324	53448.2	-0.000	0.999	
• Private health insurance policy in addition to the national health insurance program	0.137	0.328	0.420	0.676	
• Accessibility of healthcare services and facilities	-0.296	0.343	-0.860	0.387	
• Care-leave days by a worker for elderly parent(s)	-4.214	12151.0	-0.000	1.000	
• Care-leave policy by a workplace	0.674	1.105	0.610	0.542	
<i>Reinforcing factors</i>					
• Marital status	0.768	0.681	1.130	0.259	
• Degree of own healthcare required level by government regulation	0.484	0.073	6.620	0.000	
• Degree of spouse healthcare required level by government regulation	0.013	0.067	0.200	0.843	
<i>Predisposing factors</i>					
• Age	-0.029	0.023	-1.230	0.217	
• Educational level as knowledge	0.103	0.095	1.080	0.280	
• Perception of family responsibility for elderly's healthcare and nursing care	0.372	0.284	1.310	0.191	
<i>Health risk and economic factors</i>					
• Change in health status	-0.116	0.335	-0.350	0.729	
• Preventive care	0.607	0.409	1.480	0.138	
• Days of hospitalization	-0.004	0.040	-0.110	0.913	
• Mental aspects	-0.095	0.046	-2.060	0.039	
• Income of a household head	-0.001	0.003	-0.340	0.732	
• Income (spouse)	-0.005	0.002	-1.980	0.047	
• Assets	0.001	0.001	0.180	0.853	
<i>constant</i>	2.638	3.309	0.800	0.425	
Dependent variable: the 1 st stage of bivariate probit model					
Formal & Informal Homecare					
Variables	Coefficient	Standard error	z	P > z	
Independent variable					
<i>Enabling factors</i>					
• Availability of care resources	0.094	0.053	1.760	0.078	
• Private health insurance policy in addition to the national health insurance program	-0.329	0.204	-1.620	0.106	

<ul style="list-style-type: none"> • Accessibility of healthcare services and facilities • Care-leave days by a worker for elderly parent(s) • Care-leave policy by a workplace 	-0.269	0.247	-1.090	0.277	
	0.061	0.035	1.720	0.085	
	-5.475	19402.6	-0.000	1.000	
<i>Reinforcing factors</i>					
<ul style="list-style-type: none"> • Marital status 	0.798	0.406	1.970	0.049	
<ul style="list-style-type: none"> • Degree of own healthcare required level by government regulation 	0.423	0.054	7.780	0.000	
<ul style="list-style-type: none"> • Degree of spouse healthcare required level by government regulation 	-0.135	0.088	-1.540	0.124	
<i>Predisposing factors</i>					
<ul style="list-style-type: none"> • Age 	-0.052	0.017	-2.990	0.003	
<ul style="list-style-type: none"> • Educational level as knowledge 	-0.049	0.075	-0.660	0.509	
<ul style="list-style-type: none"> • Perception of family responsibility for elderly's healthcare and nursing care 	-0.160	0.201	-0.800	0.425	
<i>Health risk and economic factors</i>					
<ul style="list-style-type: none"> • Change in health status 	-0.350	0.217	-1.600	0.109	
<ul style="list-style-type: none"> • Preventive care 	-0.087	0.208	-0.420	0.676	
<ul style="list-style-type: none"> • Days of hospitalization 	-0.075	0.144	-0.520	0.601	
<ul style="list-style-type: none"> • Mental aspects 	0.002	0.017	0.120	0.905	
<ul style="list-style-type: none"> • Income of a household head 	-0.001	0.003	-0.240	0.814	
<ul style="list-style-type: none"> • Income of a spouse 	-0.001	0.001	-0.140	0.890	
<ul style="list-style-type: none"> • Assets 	0.001	0.001	-0.650	0.515	
<i>Constant</i>	2.226	2.437	0.910	0.361	
Number of observations	1694				
Wald chi ² (36)	151.99				
Log likelihood	-139.64				
Prob > chi ²	0.000				
Rho (ρ)	-0.734	0.218			
LR test of rho=0: chi2(1)	6.927				
Prob > chi ²	0.008				

Notes: Rho (ρ) of informal homecare on nursing homecare presents the estimate: -0.725 and standard error: 0.220. The LR test is conducted to test the null hypothesis of rho = 0. The chi-squared test statistic with one degree of freedom is 6.613 and the corresponding p-value is 0.010, which rejects the null and indicates the significance of parameter rho.

Results of Reliability/Specification of Estimation

Regarding the issue of exogeneity/endogeneity, the study uses the Hausman specification/simultaneity test to examine the endogeneity of this empirical model: informal homecare, community-based formal homecare, and nursing home care are implemented. Under the null hypothesis, there is no simultaneity and correlation between, informal homecare variable and ε_{iNH} which an error term of NH equation (3), and community-based formal homecare variable and ε_{iFHC} which is an error term of NH equation (3) should be zero, asymptotically. The predicted variable of IHC or FHC with instrumental variables is included in the structural form. The study used three instrumental variables: expenses of preventive care, tooth treatments and health status of spouse side of parent in Table 1. For Hausman specification/simultaneity test, two of the predicted variables in the structural equations were not found to be statistically significant at the 5% level, the predicted variable of informal homecare (coefficient=-0.0449; standard error=0.1790; $t = 0.25$ and $p > |t| = 0.802$) in the nursing home regression, and the variable of community-based formal homecare (coefficient=-0.0384; standard error=0.4804; $t = 0.08$ and $p > |t| = 0.936$) in the nursing home regression. The results imply both informal homecare and community-based formal homecare variables are exogenous [the outcome available upon request].

The hypothesis that the coefficient on the health status, the coefficient on education, and the coefficient on the income are zero is an example of a joint hypothesis on the coefficients in the multiple regressions (1, 2 and 3). The regressors are possibly multicollinear and linear relationship among some or all-explanatory variables of a regression model makes precise estimation difficult. The variance inflation factors (vif) for the obese and overweight groups' regressions range from 7.04 to 8.25 in Table 2. All vifs are less than 10. As a rule of thumb, when analyzing standardized data, a $vif < 10$ indicates a non-harmful multicollinearity [24].

Results of Informal and Formal Homecare Use, and Nursing Home

Interestingly, the influence of both coefficients of community-based formal homecare on informal homecare (2nd column) and the effect of informal care (4th column) on community-based homecare are statistically significant and positive in Table 2. One unit (10 units) increase in community-based formal homecare services received by an elderly person will raise 0.071 (0.71 units) units of informal homecare services. On the other hand, one unit (10 units) increase in informal homecare services received by an elderly person will raise 0.511 (5.11 units) of community-based formal homecare services.

In Table 2, an elderly person who has health related knowledge will have preventive care. The coefficient of preventive-care service use (-0.020 in the 2nd column) in *Health risk and economic factors* has less use of informal homecare series. It is understandable that the elderly people are healthier by using preventive care than those who do not have preventive care. Other interesting results are that the effects of “Days of hospitalization” on both informal homecare (0.001) and community-based formal homecare (0.021) are positive and statistically significant. One-day hospitalization (10 days) will raise 0.001 (0.01) unit increase in informal homecare services. The services of community-based healthcare center include day-care services, short-stay services, and rehabilitation services at a healthcare center. The effect of hospitalization on the community-based homecare center is that an increase in one-day hospitalization by an elderly person will raise 0.021 units increase in services at the community-based formal homecare center.

For the results of nursing home with a logit method, both effects of community-based formal homecare and informal homecare are negative but not statistically significant in Table 3. Analytical model of 3 in *Specification* correspondingly proposes “additional examinations” in the nursing home about a matrix of Pearson correlation, using observation with no missing values and showing probabilities from “t-tests” of $H_0: p=0$ on each

correlation. The results of Pearson correlations: IHC vs. NH (-0.0047, $t=0.8356$) and HC vs. NH (-0.0038, $t=0.8669$). Both are weakly and negatively correlated and both results are not statistically significant. For the variable “Degree of own healthcare required level by government regulation” holding the other influential factors constant, the log of the odds in favor of nursing care increases by 0.788% as a rise in one degree of professional care requirement by government regulation criteria for an elderly with informal home care and by 1.048% for an elderly with community-based formal home care in Table 3.

Focusing on the relationship and substitution between informal home care and community-based formal home care, and nursing home, we implement “bivariate probit model” in Table 5. The new information provided by the bivariate probit model is the estimate of “ ρ [rho]”, the correlation coefficient for the two error terms. Table 5 shows that the dependent variable of the 1st stage use IHC and FHC [informal and formal home care] and the 2nd stage use NH nursing home care] with the same independent variables for both regressions. The estimate of FHC and NH is “ ρ ”=-0.734 and Likelihood ratio test of “ ρ ” with chi-squared test of 6.927 with $\text{prob}>\text{chi-squared test}=0.000$; and the estimate of IHC and NH is “ ρ ”=-0.735 and Likelihood ratio test of “ ρ ” with chi-squared test of 6.613 with $\text{prob}>\text{chi-squared test}=0.010$. Both estimations are significantly different from 0. These are plausible results that indicate that unobservable factors are positively related to informal home care and community-based formal home care, but negatively related to NH. These empirical results do not provide a quantitative clear-cut evidence about the substitution between informal home care and community-based formal home care, and nursing home.

Results of Opportunity Costs for Caring an Elderly as Informal Homecare

We notice that there might be significant missing value because the age ranges from 50 years old (minimum) and 80 years old (maximum) in Table 1. When an elderly father or mother needs help, his or her children become caretakers. Thus, we imposed an exclusion criterion. Table 4 shows the sample size is $n=47$. This

number still generalize the outcomes of this empirical results [24]. This study provides new insight of informal homecare concerning opportunity cost for elderly care. The results of Table 4 evaluate costs of elderly care which represent working hours by a family member. The coefficient of “care time” is a reciprocal specification to understand the effect and an optimal care-day off from work by a family member for an elderly care at home. The effect of care time by a family member in the 2nd column in Table 4 is that a one-day increase in elderly care days on average per year will reduce 22.907 hours of work hours on average.

Interesting results are other influential variables such as marital status, educational level and income. A married person has work 11.983 hours per month than an unmarried person. It is palpable that a spouse can take care for an elderly person and will raise husband economic activities. Both variables: education and income are theoretically important to evaluate cost of activities by the elderly children who takes care of an elderly father or mother at home. One level increase in education level will reduce working hours of the elderly child, who lives with an elderly parent, by 4.085 hours (the 2nd column in the predisposing factor).

Discussion

Elderly Care by Informal and Formal Homecare Use and Nursing Home and with Opportunity Costs

The primary parameter of interest in this study is the influence of behavioral preferences or choices of homecare or nursing care. Van Houtven and Norton [13] validate that informal homecare reduces formal health care of old adults. However, their findings do not clearly reveal the substitution between informal home care and formal home and nursing home care. However, Yamada et al. [14] express one-way substitution of informal home care for nursing home care, but a weak two-way substitution between nursing home care and community-based day-service. Hanaoka and Norton [15] emphasize children, especially unmarried children, affect children’s opportunity costs for choosing and using of nursing care. Sole-Auro and Crimmins [17] do not

clearly focus on use of formal informal care. We try to fill the gap of aforementioned findings.

The informal homecare service users tend to use more community-based formal home care services. Although the size of effects is different, both services are complements. Similarly, the impacts of the both services are that a 1% increase in community-based formal homecare will affect informal homecare services to rise by 0.18%. A 1% increase in informal homecare service will affect community-based formal homecare services to rise by 0.22%. The elderly person after hospitalization commonly receives healthcare services at the community-based formal homecare center.

Yamada et al. [14] illustrate that the one-way substitution of informal home care for nursing home care and the existence of a weak two-way substitution between nursing home care and community-based day-service and short-stay facility centers in Japan. Our study shows the effects of community-based formal homecare and informal homecare are negative but not statistically significant and this study is not able to reconfirm the empirical study by Yamada et al. [21]. Using “bivariate probit model”, we examined the relationship and substitution between informal homecare and community-based formal homecare, and nursing home,

our results indicate that unobservable factors are positively related to informal homecare and community-based formal homecare, but negatively related to nursing homecare. However, these empirical results do not provide a quantitative clear-cut evidence about the substitution between informal homecare and community-based formal homecare.

The coefficient represents the maximum limitation of working hours is 147.95 hours under the current family environment with controlling other socio-demographic and economic factors. By using the mean of annual income divided by working hours assuming 40 hours per week, our estimation shows that wage per hour is 3,020.72 in Japanese yen. Using the coefficient of 22.907 hours, we calculate a monthly opportunity cost is about 69,197 in

Japanese yen which is about \$692 (\$1=100 Japanese yen as the current exchange rate for simplicity). The effect of income on the elderly care by a family member is that an increase in 10,000 in Japanese yen will lower 287 hours of working hours by the elderly child with an elderly parent.

Health knowledge and behaviors are important elements of health and health behaviors. Health knowledge profoundly influence the daily lives of elderly. The earlier study of health knowledge disclosed how and whether an elderly person acquired health information and influenced the health behavior, healthcare access, health outcomes, and quality of life [21]. The effectiveness of health education depends on elderly's beliefs regarding the importance of new information and on their confidence in their ability to change their own health behaviors. Moreover, improving the health knowledge and behaviors of the elderly is helpful in strengthening their ability for reasonable treatment, promoting the rational use of existing medical and health resources, enhancing their consciousness in disease prevention and self-health care, enabling the elderly to make correct judgments on their own health and dealing with public health emergencies scientifically.

Disparity of Health Outcomes among IHC, FHC and NH

Figures 2-1~3 show the concentration curves which emphasize and measure health inequalities and identify inequalities in health by using the concentration index. The index is negative when the curve is above the equality line and positive when the curve is under the equality curve. The concentration index is defined regarding the concentration curve, which graphs on the x-axis the cumulative percentage of the population ranked by income beginning with the lowest, and on the y-axis the cumulative percentage of "IHC, FHC and HN care" [21-23].

Income:

In Figure 2-1, concentration index (CI) is defined as the concentration curve (CC), which is graphed on the horizontal

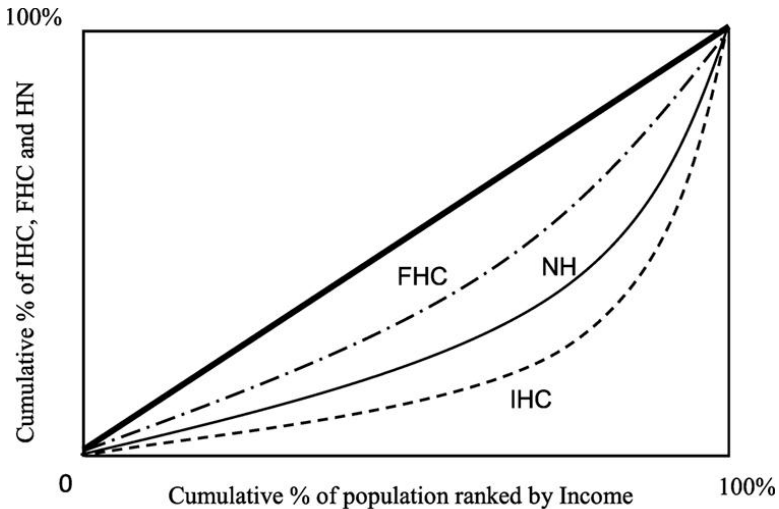
axis as the cumulative percentage of the population ranked by income beginning with the lowest, and on the vertical axis as the cumulative percentage of informal homecare (IHC), community-based formal homecare (FHC), and nursing home (NH) by corresponding to each cumulative percentage of the population of the income. The CI is positive when the CC lies below the diagonal and negative when it lies above. The lowest value of the CI, -1, implies that all the elderly care is concentrated in the lowest level of household income. The maximum value of the CI, +1, implies that elderly care is concentrated in the highest level of household income. Figure 2-1 presents that the CC of the IHC, and the informal home care burden is concentrated more heavily and unevenly amongst IHC family/person relative to nursing home family/person as the NH as the second and community-based formal homecare family/person of the FHC. All CIs are statistically significant, and, interestingly, an elderly care with IHC is more concentrated in high income households, while an elderly care with FHC is more evenly concentrated in different income levels. The indices of Figure 2-1 show the value of the CIs measure for the disparity of elderly care by the IHC, the NH and the FHC.

Change in Health Status:

For Figure 2-2, the magnitude of a relative disparity depends on the magnitude of the reference point from which the disparity was measured. The CC of IHC is farthest from the line of equality. The elderly care with health of elderly by NH is the nearest to the line of equality. These results demonstrate very interesting health issues about outcomes. The health variable is a change in health level/status of elderly from health level/status in period 1 to the health in period 2. A large change reveals better health improvement, i.e. more efficient elderly care. Regarding health outcome efficiency issue, the IHC is the best one among three types of elderly care: IHC, FHC and NC since the IHC concentrates on largely at the left side of the health of the x-axis.

The size of an absolute disparity among the elderly care: IHC, FHC and NH is expressed by the index in terms of each type of care of influence measured by the shape of the curve pm Figure

2-2. The CI of IHC is 0.919b (0.04); the CI of FHC is 0.874c (0.08); and the CI of NH is 0.670c (0.06). All CCs are positive and the value of the CI of IHC is larger than the FHC and the HN. Health improvement/outcome of elderly care by the IHC is heavier concentrated on informal homecare services than the elderly care services by community-based formal home care and nursing home care services.



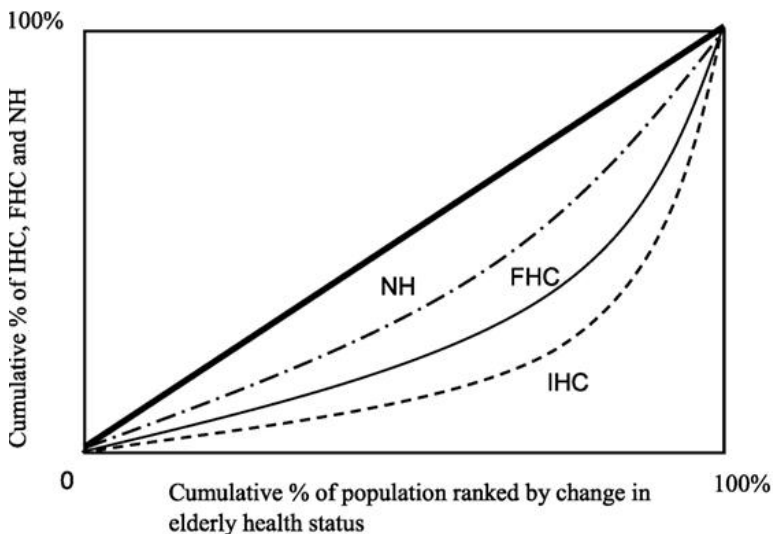
Concentration Index: Health care and Income: Age 50~80 (N=1750)

Health care	Concentration index	Standard errors
IHC	0.485c	0.10
FHC	0.318c	0.08
NH	0.356b	0.04

Figure 2-1: Concentration curves: informal home care (IHC), community-based formal home care (FHC), and Nursing home care (NH) by Income. Notes: concentration index (CI): CI using formula/covariance method. The CI of informal home care is 0.485c (0.10); the CI of FHC is 0.318c (0.08); and the CI of NH is 0.356b (0.04). SE: SEs of the CI using formula/covariance method. a, b, and c represent statistically significant levels of 99% level (a), 95% level (b), and 90% level (c) for a two-tailed test.

Care Time:

Figure 2-3 presents that the CC of care time for the elderly at the original health status (HS1) is lowest and heavily concentrated on the left of care time among three measures (HS1, HS2, and HS1-HS2). The HS2 denotes the 2nd period of health status. The difference is HS1-HS2 and the larger difference requires disproportionate concentration toward right. The HS1 is concentrated more heavily and unevenly amongst HS1 elderly relative to the elderly of HS2. It implies that after improving health status with care, the elderly of health status HS2 needs less care services and care time is more evenly distributed in different care time levels. All CIs are statistically significant, and, interestingly, the health gap between HS1-HS2 is more evenly concentrated than HS1 in different care time levels. The larger difference of HS1-HS2 is less efficient outcome level of health than the small difference. The indices below Figure 2-3 show the value of the CIs measure for the disparity of health with care time amongst the categories of HS1, HS2 and HS1-HS2.



Concentration Index: Health care and Change in health status: Age 50~80 (N=1750)

Health care	Concentration index	Standard errors
IHC	0.919b	0.04
FHC	0.874c	0.08
NH	0.670c	0.06

Figure 2-2: Concentration curves: informal home care (IHC), community-based formal home care (FHC), and Nursing home care (NH) by change in health status. Notes: concentration index (CI): CI using formula/covariance method. The CI of informal home care is 0.919b (0.04); the CI of FHC is 0.874c (0.08); and the CI of NH is 0.670c (0.06). SE: SEs of the CI using formula/covariance method. a, b, and c represent statistically significant levels of 99% level (a), 95% level (b), and 90% level (c) for a two-tailed test.

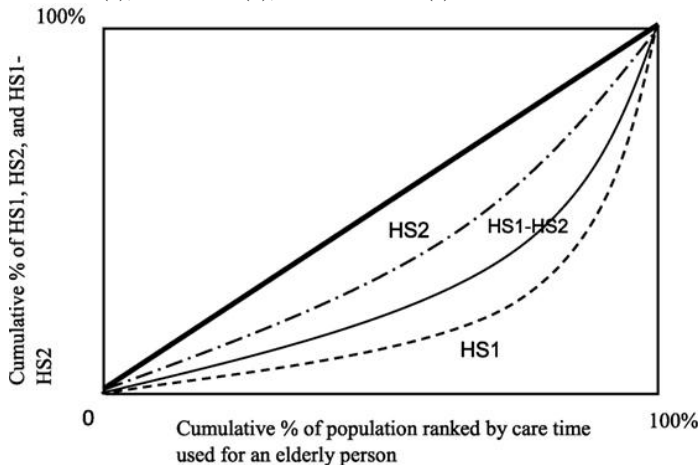


Figure 2-3: Concentration curves: Original health status (HS1), Current health status (HS2) and its Difference (HS1-HS2) by Care time used for an elderly person

Concentration Index: Health status and Care time used for an elderly person: Age 50~80 (N=1750)

Health status	Concentration index	Standard errors
HS1	0.066c	0.01
HS2	0.062c	0.01
HS1-HS2	0.064a	0.00

Notes:

Concentration index: Concentration index using formula/covariance method. The CI of informal home care is 0.919b (0.04); the CI of FHC is 0.874c (0.08); and the CI of NH is 0.670c (0.06). Standard error: Standard errors of the concentration index using formula/covariance method. a, b, and c represent

statistically significant levels of 99% level (a), 95% level (b), and 90% level (c) for a two-tailed test.

Summary, Policy Implications and Limitations

There is little doubt that the rapid increase in aging population through a prolonged life expectancy with an increase in dependent elderly causes to reduce institutional long-term care to reduce ever increasing long-term care financing [6-9]. Recent studies provide some opening evidence about empirical work documenting elderly behavioral choice regarding the interaction among community-based formal/informal home care and nursing home care by Van Houtven and Norton [13], Yamada et al. [14], Hanaoka and Norton [15] and Sole-Auro and Crimmins [17]. However, evidence of differential outcomes has been inconclusive. In this study, we apply the theory oriented empirical study in the health economics fields and attempt to explore the full range of factors and how preference of decision making for informal homecare, community-based formal homecare and nursing home contribute to the relationship between them, health outcomes, and health disparity which is caused by receiving services from informal homecare, community-based formal homecare and nursing home. This study tries to fill in a critical gap within the literature.

The statistics of this study illustrate that a 10-unit increase in community-based formal homecare services received by an elderly person will raise 0.71 units of informal homecare services while a 10-units increase in informal homecare services received by an elderly person will raise 5.11 units of community-based formal homecare services. We evaluate this relationship with an elasticity term, the effects of the both services are that a 1% increase in community-based formal homecare will affect informal homecare services to rise by 0.18% while a 1% increase in informal homecare service will affect community-based formal homecare services to rise by 0.22%.

The findings of this study confirm that the informal homecare and community-based formal homecare services are complements. To analyze the substitution effects between informal homecare and community-based formal homecare, and

nursing home, we implemented “bivariate probit model”. The probit analysis reveals the negative relationship, i.e., substitution between homecare services and nursing home care services as follows. The result of statistics test of “p” with chi-squared test of 6.927 with $\text{prob} > \text{chi-squared test} = 0.00$. Both estimations are significantly different from 0. These are plausible results that indicate that unobservable factors are negatively related to nursing home and homecare services. This study does not provide a quantitative clear-cut evidence about the substitution between informal homecare and community-based formal homecare, and nursing home.

This study incorporates family care hours and wages to evaluate the opportunity costs which is the loss of salary income. The effect of care time is that a one-day increase in elderly care day on average per year will reduce 22.907 hours of work hours on average with the maximum limitation of working hours is 147.95 hours under the current family environment. The result of the regression outcomes reveal that a monthly opportunity cost is about 69,197 in Japanese yen which is about \$692 (\$1=100 Japanese yen as the current exchange rate for simplicity).

An important contribution to the literature is that we integrate the analysis with the finding that the concentration curve exposes that the care burden is concentrated more heavily and unevenly amongst informal homecare family/person relative to nursing home and community-based formal homecare family/person. Regarding health outcome efficiency issue, the informal homecare is the best one among three types of elderly care: informal homecare, community-based formal homecare, and nursing home services. Health improvement/outcome of elderly care by the informal homecare is heavier concentrated on informal homecare services than the elderly care services by community-based formal home care and nursing homecare services.

Policy makers need to address a diversity of health outcomes based on providing services to elderly through resource allocation to the different types of long-term care: informal homecare, community-based formal homecare, and nursing homecare services. The recent policy recommendation about a transition for delivery of long-term care services form an

institutional care services to informal and formal community homecare services and developments of community-based homecare under the national healthcare insurance program is feasible. Using a behavioral model (the PRECEDE-PROCEED model), we comprehend efficiency of health outcomes through informal homecare services relative to community-based formal homecare which is complement to the informal homecare in this study. However, many families and caregivers give up their work efforts to take care for elderly parents. Loss of work efforts are their opportunity costs. A provision of partial or full compensation is recommendable and a viable option to improve their quality of lives since their loss of earning causes a deterioration of daily life to maintain quality.

Some of the limitations of this empirical study are as follows: First, a small sample size of elderly child who helps and supports elderly parents due to a large missing value; second, the long-term care selection/choice is a joint decision. However, the data do not clearly reveal/present this aspect; and the data do not include many samples of institutional elderly parents. Finally, an appropriate and more scientific sampling technique would have further improved the quality of data. Despite these limitations, this study contributes to the existing literature to fill the literature gap concerning long-term care services in terms of efficiency and health outcomes with health disparity, and loss of economic opportunity costs to take care for the elderly parents. The results of this empirical study shed light on aforementioned findings and related policy implications. Future research should develop and examine research on different societies and countries.

References

1. Japanese Nursing Association: Nursing for the older people in Japan. 2016. JNA, Tokyo, Japan, Available Online at: <https://www.nurse.or.jp/jna/english/>,
2. Chen BK, Jalal H, Hashimoto H, Suen SC, Eggleston K, et al. Forecasting trends in disability in a super-aging society: Adapting the future elderly model to Japan. NBER Working Paper No.21870. Cambridge: NBER. 2016.
3. Kozaki M, Kashiwase K, Saito I. Health spending in Japan: Macro-fiscal implications and reform options. IMF Working

- Paper:WP/14/142. Washington, D.C: International Monetary Fund. 2014.
4. Ganelli G, Miake N. Foreign help wanted: Easing Japan's labor shortages. IMF Working Paper:WP/15/181. Washington, D.C: International Monetary Fund. 2015.
 5. Rhee JC, Done N, Anderson GF. Considering long-term care insurance for middle-income countries: comparing South Korea with Japan and Germany. *Health Policy*. 2015; 119: 1319-1329.
 6. Muiser J, Carrin G. Financing long-term care programs in health systems. Discussion Paper HSS?HSF?DP.07.6. Geneva: World Health Organization. 2007.
 7. Brown JR, Finkelstein A. why is the market for long-term care insurance so small? *Journal of Public Economics*. 2007; 91: 1967-1991.
 8. Coe NB, Skira MM, Van Houtven CH. Long-ern care insurance: does experience matter? *Journal of Health Economics*. 2015; 40: 122-131.
 9. Zeng W, Chen CC, Yamada T, Harris JR III, Hamed O, et al. What can be emerging markets learn from a public long-term care insurance system from a mature country: Experimental study? In: Jakovljevic M, ed. *Health Economics and Policy Challenges in Global Emerging Markets*. New York: NOVA Science Publishers. 2016: 19-40.
 10. Welfare. Helping the elderly, the young, and the disabled, 2015, Japan Fact Sheet, Web Japan. Tokyo, Japan. Available at: <http://web-Japan.org/factsheet/en>,
 11. Fukawa T. Japanese social expenditure under rapid population aging. *Open Journal of Social Sciences*. 2015; 3: 138-144.
 12. Delgado M, Tennstedt S. Puerto Rican sons as primary caregivers of elderly parents. *Social work*. 1997; 42: 125-134.
 13. Van Houtven CH, Norton EC. Informal care and health care use of older adults. *Journal of Health Economics*. 2004; 23:1159-1180.
 14. Yamada T, Chen CC, Yamada T. Behavioral analysis of the choice of community-based formal home care, informal home care and nursing home care in Japan. *The Geneva Paper*. 2006; 31: 600-632.

15. Hanaoka C, Norton EC. Informal and formal care for elderly persons: how about children's characteristics affect the use of formal care in Japan. *Social science & Medicine*. 2008; 67: 1002-1008.
16. Balia S, Brau R. A country for old men? Long-term home care utilization in Europe. *Health Economics*. 2014; 23: 1185-1212.
17. Sole-Auro A, Crimmins EM. Who cares? A comparison of informal and formal care provision in Spain, England and the USA. *Aging and Society*. 2014; 495-517.
18. Garcia-Gomez P, Hernandez-Quevedo C, Jimenez-Rubio D, Oliva-Moreno J. Inequality in long-term care use and unmet need: Two sides of the same coin. *Journal of Health Economics*. 2015; 39: 147-156.
19. Gielen AC, McDonald EM. Using the precede-proceed planning model to apply health behavior theories. In: Glanz, K, Rimer BK, Lewis FM. editors. *Health Behavior and Health Education*. San Francisco: Jossey-Bass. 2002
20. Green, LW, Kreuter MW. *Health Program Planning: An Educational and Ecological Approach*. New York: McGraw-Hill. 2005.
21. Yamada T, Chen CC, Murata C, Hirai H, Ojima T, et al. Access disparity and health inequality of the elderly: Unmet needs and delayed healthcare. *International Journal of Environmental Research and Public Health*. 2015; 12: 1745-1772.
22. Kakwani NC, Wagstaff A, van Doorslaer E. Socioeconomic inequalities in health: Measurement, computation, and statistical inference. *Journal of Econometrics*. 1997; 77: 87-103.
23. Chen Z, Roy K. Calculating concentration index with repetitive values of indicators of economic welfare. *Journal of Health Economics*. 2009; 28: 169-175.
24. Kennedy P. *A guide to econometrics*. Malden: Wiley-Blackwell. 2013.
25. Green, W.H. *Econometric Analysis*. Upper Saddle River: Prentice Hall. 2012
26. Glanz K, Rimer BK, Lewis FM. *Health Behavior and Health Education*, San Francisco. San Francisco: Jossey-Bass. 2002.