

# Evidence-based estimation of health care cost savings from the use of omega-3 supplementation among the elderly in Korea

Ji-Yun Hwang<sup>1</sup>, Wu Seon Kim<sup>2</sup>, Sewon Jeong<sup>3</sup> and Oran Kwon<sup>4,5\*</sup>

<sup>1</sup>Nutrition Education Major, Graduate School of Education, Sangmyung University, Seoul 110-743, Korea

<sup>2</sup>Department of Senior-Friendly Industry, Korea Health Industry Development Institute, Chungbuk 363-700, Korea

<sup>3</sup>BiofoodCRO Co., Ltd. Seoul 120-160, Korea

<sup>4</sup>Department of Nutritional Science and Food Management, Ewha Womans University, 52, Ewhayeodae-gil, Seodeamun-gu, Seoul 120-750, Korea

<sup>5</sup>Biofood Network, Seoul 120-750, Korea

**BACKGROUND/OBJECTIVES:** By the year 2050, thirty-eight percent of the Korean population will be over the age of 65. Health care costs for Koreans over age 65 reached 15.4 trillion Korean won in 2011, accounting for a third of the total health care costs for the population. Chronic degenerative diseases, including coronary heart disease (CHD), drive long-term health care costs at an alarming annual rate. In the elderly population, loss of independence is one of the main reasons for this increase in health care costs. Korean health policies place a high priority on the prevention of CHD because it is a major cause of morbidity and mortality.

**SUBJECTS/METHODS:** This evidence-based study aims to estimate potential health care cost savings resulting from the daily intake of omega-3 fatty acid supplementation. Potential cost savings associated with a reduced risk of CHD and the medical costs potentially avoided through risk reduction, including hospitalizations and physician services, were estimated using a Congressional Budget Office cost accounting methodology.

**RESULTS:** The estimate of the seven-year (2005-2011) net savings in medical costs resulting from a reduction in the incidence of CHD among the elderly population through the daily use of omega-3 fatty acids was approximately 210 billion Korean won. Approximately 92,997 hospitalizations due to CHD could be avoided over the seven years.

**CONCLUSIONS:** Our findings suggest that omega-3 supplementation in older individuals may yield substantial cost-savings by reducing the risk of CHD. It should be noted that additional health and cost benefits need to be revisited and re-evaluated as more is known about possible data sources or as new data become available.

Nutrition Research and Practice 2015;9(4):400-403; doi:10.4162/nrp.2015.9.4.400; pISSN 1976-1457 eISSN 2005-6168

**Keywords:** Cost-effectiveness, omega-3 fatty acid, functional food, health cost, elderly

## INTRODUCTION

By 2050, thirty-eight percent of the Korean population will be over the age of 65 [1]. Health care costs for Koreans over age 65, measured by expenditures of the national health insurance service, reached 15.4 trillion Korean won in 2011, accounting for a third of the total health care costs for the population [2]. Chronic degenerative diseases, including coronary heart disease (CHD), drive long-term health care costs at an alarming annual rate [3]. In the elderly population, loss of independence is one of the main reasons for this rate increase. Korean health policies place a high priority on the prevention of CHD because it is a major cause of morbidity and mortality.

The potential health benefits gained from the consumption of omega-3 fatty acids, such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), have been widely reported, with

the predominant literature indicating that omega-3 fatty acids can prevent or reduce the risk for CHD in humans [4]. The anti-inflammatory, anti-thrombotic, and anti-atherosclerotic effects of omega-3 fatty acids are believed to play a key role in the reduction of CHD and its clinical manifestations. The use of omega-3 supplementation improves health and reduces total costs under various scenarios [5,6], although each study has theoretical limitations. It has been reported that giving each member of the Medicare program in the United States (US) approximately 1,800 mg of omega-3 fatty acids per day would prevent 374,000 hospitalizations from heart disease and would thus reduce hospital and physician costs by \$3.2 billion over five years, as measured using the Congressional Budget Office (CBO)'s accounting methods [5]. Supplementation with omega-3 fatty acids is implicated in fewer fatal myocardial infarctions and less cardiovascular mortality, as well as cost-savings compared

This work was carried out with the support of "Cooperative Research Program for Agriculture Science & Technology Development (Project title: Research on New Functional Food Materials with Domestic Agricultural Products, Project No. PJ00845002)" Rural Development Administration, Republic of Korea.

\*Corresponding Author: Professor Oran Kwon, Tel. 82-2-3277-6860, Email. orank@ewha.ac.kr

Received: November 14, 2014, Revised: May 20, 2015, Accepted: May 22, 2015

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

to no supplementation, in the US context [6]. In Korea, edible oils containing omega-3 fatty acids are registered as functional ingredients, and the consumption of omega-3 supplementation has been steadily increasing. However, no comparable study has been conducted in a Korean context so far.

This evidence-based study therefore aims to determine the potential cost savings associated with encouraging the Korean older adults to consume omega-3 fatty acids. The potential health care cost savings resulting from the daily intake of approximately 1800 mg of omega-3 fatty acid supplementation will be estimated utilizing the best available evidence.

## SUBJECTS AND METHODS

### Model selection

A number of methods are available to estimate potential health cost savings, including cost-effectiveness and cost-benefit analyses. The selection of a model needs to be based not only on the aim of study but also on available data sources. Both cost-benefit and cost-effectiveness analyses are used to ascertain if any particular alternative is relatively cost-effective or has benefits exceeding its costs. The present study aimed to estimate cost savings associated with a decreased risk of CHD via the consumption of omega-3 fatty acids. As reflected in health claims, however, omega-3 fatty acid supplementation in Korea is currently used to improve blood flow [7] and blood lipid profiles, which are related to the intermediate health outcomes of CHD. Thus, a cost-effectiveness analysis was not suitable for our research because it could not compare alternatives with different goals. In addition, the estimation of the current cost premium of omega-3 fatty acids in Korea was difficult to obtain for a cost-benefit analysis. The CBO's cost accounting methodology, therefore, simply compares net costs and CHD outcomes of omega-3 supplementation versus no supplementation among the elderly. The CBO cost accounting convention, which has previously been used to estimate the cost savings of omega-3 fatty acids in CHD [5], was appropriately employed to estimate gross and net costs to elderly medical security beneficiaries during a seven-year period. Potential savings could be measured through the numbers of hospitalizations avoided and the number of physician visits obviated for individuals who had consumed omega-3 fatty acids and who had thus achieved a reduction in their risk of CHD. The potential cost savings associated with a reduced risk of CHD and the potentially avoided hospitalizations and physician services were estimated.

### Model structure and data sources

The target population was adults 65 years of age or older. Based on the International Classification of Diseases (7th Revision), CHD includes hypertension [essential (primary) hypertension (I10) and other hypertensive diseases (I11-I15)], stroke [intracranial hemorrhage (I60-I62), cerebral infarction (I63), and stroke, not specified as hemorrhage or infarction (I64)], CHD [acute myocardial infarction (I21-I22), other ischemic heart diseases (I20, I23-I25), heart failure (I50), atherosclerosis (I70), other heart diseases (I27-I43, I51-I52), and other cerebrovascular diseases (I65-I69)], and cardiovascular diseases [arterial embolism and thrombosis (I74), other diseases of arteries, arterioles and capillaries (I71-I72, I77-I79), and phlebitis, thrombophlebitis, and venous embolism and thrombosis (I80-I82)].

The study model compared gross cost estimates of the daily intake of omega-3 fatty acids for new elderly medical security beneficiaries and potential cost offset associated with avoided CHD in members of the same group who could benefit from the daily use of omega-3 fatty acids. Table 1 shows the sources of the study's data. To estimate the gross costs of omega-3 consumption for new users, data on the elderly medical security beneficiaries were obtained from the National Health Insurance Statistical Yearbook for each year [8]. Percentages of elderly medical security beneficiaries who were currently taking omega-3 fatty acids were estimated based on the results of the Korean National Health and Nutrition Examination Surveys [9,10]. The percentage of potential new users of daily omega-3 fatty acid supplements among the elderly medical security beneficiaries was estimated from the number of elderly medical security beneficiaries who currently were not using omega-3 supplementation divided by the number of elderly medical security beneficiaries  $\times 100$  (%). Because it is difficult to estimate the average annual cost associated with daily intake of omega-3 fatty acid per person in the Korean context, previously published data from the US [5] were used instead under the assumption that the cost of omega-3 fatty acid supplementation would be similar between the two countries. Amounts in US dollars were converted into Korean won using average annual exchange rates [11]. To estimate the potential cost offset associated with CHD avoided in elderly medical security beneficiaries who could benefit from the daily use of omega-3 fatty acids, the number of discharged elderly beneficiaries with CHD was obtained from the National Health Insurance Statistical Yearbook for each year [12]. The average annual medical cost per elderly medical security beneficiary with CHD included both

**Table 1.** List of variables and their sources

Variables	Source references
Number of elderly medical security beneficiaries	National Health Insurance Corporation/Health Insurance Review & Assessment Service 2013 [12]
Percent of elderly medical security beneficiaries estimated to take omega-3 fatty acids	Ministry of Health and Welfare/Korea Institute of Health and Social Affairs 2006 [9]; Ministry of Health and Welfare/Korea Centers for Disease Control & Prevention 2010 [10]
Average annual cost for the daily intake of omega-3 fatty acids per person	DaVanzo <i>et al.</i> 2006 [5]
Number of discharged elderly beneficiaries with coronary heart disease (CHD)	National Health Insurance Corporation/Health Insurance Review & Assessment Service 2013 [12]
Average annual medical costs per elderly medical security beneficiary with CHD	National Health Insurance Corporation/Health Insurance Review & Assessment Service 2013 [12]; National Health Insurance Corporation/Health Insurance Policy Research Institute 2013 [8]
Reduction in CHD associated with the daily intake of omega-3 fatty acids	GLSSI-Prevenzione Investigators 1999 [13]

hospitalization and physician service costs [8]. The reduction in CHD associated with the daily intake of omega-3 fatty acids was assumed to be 15% based on a clinical trial studying the daily intake of 1 g of omega-3 fatty acids for patients who had suffered myocardial infarctions [13].

## RESULTS

Table 2 illustrates that the estimate of the seven-year (2005-2011) net cost savings in hospital expenditures and physician charges resulting from a reduction in the incidence of CHD among the elderly population through daily use of omega-3 fatty acids is approximately 210 billion Korean won, suggesting a relatively high cost-savings. Approximately 92,997 hospitalizations due to CHD would be avoided during the seven-year period. From 2005 to 2011 gross cost estimates have increased and potential cost offsets have also increased except for those in 2011.

## DISCUSSION

Our findings suggest that omega-3 supplementation in older individuals may yield substantial cost-savings by reducing the risk of CHD, consistent with previously reported results [5,6]. In a US study using the same methodology, approximately 1,800 mg of omega-3 fatty acids per day were estimated to prevent 374,000 hospitalizations from heart disease and thus reduce hospital and physician costs by \$3.2 billion across a five-year period [5]. Omega-3 supplements were likely to prevent secondary

cardiovascular events in US males using decision-analytic models [6]. Various studies suggest that omega-3 intake may be positively related to other disease conditions, such as disorders of cognitive functioning [14]. Among older adults, postponing the loss of independence is important because disability puts extensive financial burden on themselves, their families, and the healthcare system. In this regard, omega-3 supplementation may have greater cost-savings than what was reported in the aforementioned study.

The lowest net cost savings in 2011 can be explained by several reasons. During 7 years gross cost estimates have increased due to increased number of elderly medical security beneficiaries and increased potential new daily users of omega-3 fatty acids among elderly medical security beneficiaries. Potential cost offsets have increased as well up to 2011 but reduction existed in 2011 due to decreased number of discharged elderly beneficiaries with CHD and thus decreased case reduction in CHD associated with the daily intake of omega-3 fatty acids. Therefore the lowest net cost savings were observed in 2011 due to the highest gross cost estimates as well as reduced potential cost offsets.

Our study had a number of limitations that should be addressed in future studies. Direct non-medical costs, such as transportation and caregiver costs, or unpaid care costs, such as lost wages for the caregiver, were not included in our model due to limited data sources. Indirect costs, such as lost earnings due to premature death and lost workdays due to illness, were not captured in the present study. However, our study population consisted of older adults, and the possibility of

**Table 2.** Estimates of health care cost savings for the daily use of omega-3 fatty acid supplementation for elderly beneficiaries of national health insurance (Thousand Korean Won)

Variables	2005	2006	2007	2008	2009	2010	2011	Total
Number of elderly medical security beneficiaries, n	4,371,884	4,542,509	4,873,120	5,086,195	5,286,383	5,448,984	5,644,757	
Percent of elderly medical security beneficiaries estimated to take omega-3 fatty acids at present, %	0.08	1.13	2.19	1.34	2.95	4.15	5.85	
Number of elderly medical security beneficiaries who currently were not using omega-3 supplementation, n	4,368,368	4,491,053	4,766,638	5,017,989	5,130,361	5,222,661	5,314,810	
The percentage of potential new users of daily omega-3 fatty acid supplements among the elderly medical security beneficiaries, % <sup>1)</sup>	99.9	98.9	97.8	98.7	97.0	95.8	94.2	
Percent of potential new daily users of omega-3 fatty acids among elderly medical security beneficiaries, %	4.9	5.9	7.7	11.8	22.4	25.0	33.0	
Average annual cost for the daily intake of omega-3 fatty acids per person	48	46	46	55	66	61	59	
Gross cost estimate of the daily intake of omega-3 fatty acids for new users among elderly medical security beneficiaries	10,276,955	12,216,108	16,639,554	32,849,870	75,483,364	79,789,173	103,680,804	330,935,829
Number of discharged elderly beneficiaries with coronary heart disease (CHD), n	67,102	72,781	82,179	88,674	93,197	109,633	106,411	
Average annual medical costs per elderly medical security beneficiary with CHD	3,283	3,981	4,142	6,384	6,752	7,427	7,031	
Case reduction in CHD associated with the daily intake of omega-3 fatty acids, n	10,065	10,917	12,327	13,301	13,980	16,445	15,962	
Potential cost offset associated with avoided CHD in elderly medical security beneficiaries who could benefit from the daily use of omega-3 fatty acids	33,048,785	43,466,262	51,062,079	84,912,362	94,390,559	122,135,278	112,230,026	541,245,351
Net cost savings of the medical security coverage of the daily use of omega-3 fatty acids for elderly medical security beneficiaries	22,771,829	31,250,155	34,422,525	52,062,491	18,907,195	42,346,105	8,549,222	210,309,521

<sup>1)</sup> The percentage of potential new users of daily omega-3 fatty acid supplements among the elderly medical security beneficiaries was estimated from the number of elderly medical security beneficiaries who currently were not using omega-3 supplementation divided by the number of the elderly medical security beneficiaries  $\times 100$  (%).

regular job activity for this group would be minimal. Furthermore, because some of the data used in the analyses were estimated from the best available proxies or were obtained from other nations, these data may not have been as accurate as those directly measured. Nevertheless, our study had several advantages. To date, this study was the first study to estimate the cost-savings of omega-3 supplementation among older adults in Korea. Furthermore, this study may provide valuable information for determining the type or target of interventions, prioritizing findings, and planning health policies for older persons in Korea.

## REFERENCES

1. Government of the Republic of Korea, Ministry of Health and Welfare. Plan for Ageing Society and Population 2011-2015. Seoul: Ministry of Health and Welfare; 2011.
2. Jeong HS, Song YM. Contributing factors to the increases in health insurance expenditures for the aged and their forecasts. *Korean J Health Econ Policy* 2013;19:21-38.
3. World Health Organization. International Statistical Classification of Diseases and Related Health Problems 10th Revision [Internet]. Geneva: World Health Organization; 2010 [cited 2013 March 7]. Available from: <http://apps.who.int/classifications/icd10/browse/2010/en>.
4. Din JN, Newby DE, Flapan AD. Omega 3 fatty acids and cardiovascular disease—fishing for a natural treatment. *BMJ* 2004;328:30-5.
5. DaVanzo JE, Dobson A, Tannamor M, Dollard J. An Evidence-Based Study of the Role of Dietary Supplements in Helping Seniors Maintain their Independence. Falls Church (VA): The Lewin Group Inc.; 2006.
6. Schmier JK, Rachman NJ, Halpern MT. The cost-effectiveness of omega-3 supplements for prevention of secondary coronary events. *Manag Care* 2006;15:43-50.
7. Jeong S, Kim JY, Paek JE, Kim J, Kwak JS, Kwon O. Systematic review of the effect of omega-3 fatty acids on improvement of blood flow while focused on evaluation of claims for health functional food. *J Nutr Health* 2013;46:226-38.
8. National Health Insurance Corporation, Health Insurance Policy Research Institute (KR). 2005-2011 Survey on medical expenditure of patients insured by National Health Insurance [Internet]. Seoul: Health Insurance Policy Research Institute; 2013 [cited 2013 March 5]. Available from: <http://www.nhis.or.kr/>.
9. Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. The Third Korea National Health and Nutrition Examination Survey (KNHANES III), 2005: Health Interview Survey. Cheongwon: Korea Centers for Disease Control and Prevention; 2006.
10. Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. Korea Health Statistics 2009: Korea National Health and Nutrition Examination Survey (KNHANES IV-3). Cheongwon: Korea Centers for Disease Control and Prevention; 2010.
11. Ministry of Strategy and Finance. Foreign exchange rate, each year [Internet]. Sejong: Ministry of Strategy and Finance; 2013 [cited 2013 March 7]. Available from: [http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx\\_cd=1068](http://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1068).
12. National Health Insurance Service, Health Insurance Review & Assessment Service. 2005-2011 National Health Insurance Statistical Yearbook [Internet]. Seoul: Health Insurance Review & Assessment Service; 2006-2012 [cited 2013 March 5]. Available from: <http://www.nhis.or.kr/>.
13. Dietary supplementation with n-3 polyunsaturated fatty acids and vitamin E after myocardial infarction: results of the GISSI-Prevenzione trial. Gruppo Italiano per lo Studio della Sopravvivenza nell'Infarto miocardico. *Lancet* 1999;354:447-55.
14. MacLean CH, Issa AM, MojicaWA, Newberry SJ, Morton SC, Shekelle PG, Hilton LG, Hasenfeld Garland R, McGowan J, Rhodes S, Rolon C, Traina S. Evidence Report/Technology Assessment: No. 114. Effects of Omega-3 Fatty Acids on Cognitive Function with Aging, Dementia, and Neurological Diseases. AHRQ Publication No. 05-E011-1. Rockville (MD): Agency for Healthcare Research and Quality; 2005.