Korea Institute for Health and Social Affairs

Working Paper 2014-10

Healthy Life Expectancy in Korea by using the Disability Weights of Diseases

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http://www.kihasa.re.kr
ISBN: 978-89-6827-142-7 93510

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Chapter 1

Introduction

1 Introduction

Since the 1980s, many nations in the world have set and implemented goals and strategies for health promotion at a national level: the US-〉 'Healthy People 2000,' 'Healthy People 2010,' and 'Healthy People 2020;' the UK-〉 'The Health of the Nation'(2000) and 'Our Healthier Nation'(2010); Japan-〉 'The National Health Promotion Movement,' 'The Health Plan for a Vibrant Life to 80s' and 'Healthy Japan 21;' Australia-〉 'The Better Health Commission.' Such initiatives aimed at reducing inequality in health and extend healthy life expectancy.

Such policy trends also apply to Korea. Korea announced its plan to increase healthy life expectancy to 75 by 2020 on June 2, 2011, publicizing "the 3rd Health Plan 2020, '11~20." The goal of extending healthy life span to 75 was based on Koreans' healthy life expectancy (men: 68; women: 74) of 71 presented by the World Health Statistics (2009).

However, the index from WHO, just an estimate, can be applied to actual policies only in a limited manner. Applying the Sullivan method, WHO identified 135 disability factors for 17 regions and used weighted disability prevalence rates. For Korea, the average of the region to which it belongs was used but concerns were raised over the possibility of the figure be-

ing underestimated. In reality, Koreans' life expectancy presented in 2003 is deemed to have been underrated. Moreover, healthy life expectancy data has not been properly updated, raising the need for more indices. Therefore, against the backdrop of the quality, rather than quantity, of life being prioritized and healthy life expectancy being put at the top of the agenda for health promotion, systematically producing indices for monitoring and evaluating health performances is required more.

This study is designed to calculate 'healthy life expectancy' as a health performance index for the development and assessment of Korea's health policies and to present it as the basic data for such purposes. Healthy life expectancy can be estimated in diverse ways. WHO and the OECD have also used various analysis techniques. This study applied WHO's analysis method based on the disability weights of diseases. The analysis system can effectively resolve difficulties in reflecting the quality of life in accordance with the severity of disabilities.

To this end, this paper studied a variety of research and methodologies related to the calculation of healthy life expectancy to identify healthy life expectancy for Koreans. Then, presenting a research methodology, it calculated healthy life span in Korea. The last chapter discussed limitations in research and proposed ways to produce better indices in the future.

Chapter 2

Preliminary Research

2 Preliminary Research

Healthy life expectancy data has been produced at a national level in Europe, North America, and Australia starting more than 10 years ago. Via the Jakarta declaration on health promotion in the 21st century, WHO (1997) announced that its ultimate goal is to extend healthy life span and narrow the gap among nations or social classes in healthy life expectancy. Likewise, healthy life expectancy has been recognized as a core index for health policies and has been used as significant information for devising national goals and strategies in health policy.

Not only WHO but also many nations in the world have calculated healthy life expectancy (HLE) in diverse ways. HLE can be identified based on subjective health levels while Health-adjusted Life Expectancy (HALE) is often calculated by using the weight of health-related quality of life (EQ-5D). Health level assessment-related weights such as health utility index and disability weights can also be used to figure out healthy life expectancy.

〈Table 1〉 Types of healthy life expectancy and classification by nation

Types of healthy life expectancy	Nations
Disease-free life expectancy	Belgium, the UK, France, the Netherlands
Impairment-free life expectancy	Canada, the UK
Disability-free life expectancy	Austria, Belgium, Denmark, the UK, France, Italy, the Netherlands, Spain, Sweden
Handicap-free life expectancy	the UK, Denmark, Finland, Germany, France, the Netherlands
Healthy life expectancy	Belgium, Denmark, the UK, Finland, Germany, Italy, the Netherlands, Spain, Sweden
Health-adjusted life expectancy	WHO and others

The Sullivan method is generally used to calculate healthy life expectancy. It is designed to figure out healthy life expectancy by using a standard life table or health status data represented by disabilities or severity-weighted disabilities. HLE is calculated by using weighted disability prevalence and the formula below (Lee Seung-wook et al., 2007).

- Dx: Severity-weighted prevalence for the healthy or the sick whose age is between x and x+5
- YDx=Lx × Dx: Years of healthy life lost between age x and x+5
- YWDx=Lx × (1-Dx): Years of healthy life between age x and x+5
- Lx: Cumulative number of years lived between age x and x+5 based on a life table
- DALE at age x: The value created by dividing the sum of YWD between age x and w (the last extendable age on a life table) by lx (the number of survivors at age x)

- DALEx=$\{\sum_{i=x}^{w} YWDi\}/lx$

- DLEx= $\{\sum_{i=x}^{w} YDi\}/lx$ =LEx-DALEx

Before WHO identified healthy life expectancy, Canada and Australia had used disability survey data to calculate healthy life expectancy. WHO developed standardized survey and research tools for its members to figure out healthy life expectancy for 2002. The expectancy was calculated by using both estimates from the global burden of disease project and health survey data for representative population groups, when weighted disability prevalence rates were applied based on the Sullivan method. WHO identified 135 disability factors for 17 regions in connection with the weighted disability prevalence. For Korea, the average of the region to which it belongs was used but concerns were raised over the possibility of the figure being underestimated. In reality, Koreans' life expectancy presented in 2003 is deemed to have been underrated.

〈Table 2〉 Healthy Life Expectancy in Korea from WHO

Year	All	Men	Women
2000	66.0	63.2	68.8
2002	67.8	64.8	70.8
2007	71	68	74

Source: World Health Report (by Year)

Since WHO's publication of healthy life expectancy, many nations in the world have made strenuous efforts to measure healthy life expectancy. Mathers et al. (2003) analyzed HALE to compare Australia and other OECD member countries in terms of health level. For the HALE analysis, the study used mortalities in OECD members presented by GBD 2000, prevalence estimates by country in connection with 135 health categories, and health survey data for 34 OECD member nations. According to the results, as of 2001, Japan ranked 1st with a healthy life expectancy of 73.6, while HLE in Australia was estimated at 71.6 (95% CI: 70.9~72.8). HLE in Korea was assessed at 67.4 [men: 64.5 (63.8~65.6); women: 70.3 (69.6~71.8)], generally lower than the average of the OECD (68.4; men->66.6; women->70.2). However, HLE for Korean women was evaluated to be higher than the OECD average.

〈Table 3〉 Healthy Life Expectancy in OECD members (2001)

Ranking	Scope	Nations	Healthy Life Expectancy			Life Expectancy	
			Total	Men	Women	Men	Women
1	1-2	Japan	73.6	71.4	75.8	77.9	84.7
2	1-4	Switzerland	72.8	71.1	74.4	77.3	82.8
3	2-7	Sweden	71.8	70.5	73.2	77.7	82.3
:							
22	22-25	The US	67.6	66.4	68.8	74.4	79.6
23	22-25	Korea	67.4	64.5	70.3	71.2	78.7
24	22-25	Portugal	66.8	64.3	69.4	72.7	80.1
25	23-25	The Czech Republic	66.6	63.8	69.5	71.9	78.8
	OECD	Average	68.4	66.6	70.2	74.0	80.2

Sources: Mathers, Murray, Salomon et al. Healthy life expectancy: comparison of OECD countries in 2001, Aust N ZJ Public Health, 2003; 27(1):5-11

Salomon et al. (2012) presented HLE for 1990 and 2010 in 187 nations in the world, which was a little different from WHO's HLE. According to WHO's data, HLE for Korean women in 2007 was 74 while Salomon et al. (2012) estimated it at 72.6, number 3 in the world.

〈Table 4〉 Healthy Life Expectancy in Korea from Salomon et al. (2012)

Year	Men	Women
1990	60.6	67.1
2010*	67.9	72.6

Sources: Salomon et al, Healthy life expectancy for 187 countries, 1990-2010: a systematic analysis for the global burden disease study 2010. 2012

〈Table 5〉 Rankings of Countries in Healthy Life Expectancy

Ranking	Men	Women
1	Japan	Japan
2	Singapore	Spain
3	Switzerland	Korea
4	Spain	Singapore
5	Australia	Switzerland
6	Italy	Andorra
7	Andorra	Taiwan
8	Canada	France
9	Israel	Italy
10	Sweden	Australia

Sources: Salomon et al, Healthy life expectancy for 187 countries, 1990-2010: a systematic analysis for the global burden disease study 2010. 2012

On the other hand, the OECD has also calculated and presented healthy life expectancy, specifically focusing on disability-free life expectancy. Based on the status of disability, ADL, IADL, a bedridden state, the subjective health evaluation and the status of diseases, healthy life expectancy is calculated. This method has advantages of easier measurement and comprehension but is exposed to limitations in reflecting the quality of life in accordance with the severity of disabilities. Differences in disability assessment data, calculation methods, and announcement cycle make it harder to compare disability-free life expectancy by country.

The calculation of healthy life expectancy in Korea dates back to Yoon Byung-joon (1995)[1], who introduced the concept of healthy life span for the first time in Korea. His study pro-

1) Yoon Byung-joon, A study on the health level of Koreans based on the concept of healthy life expectancy, a SNU doctoral thesis, 1995

duced health indices by combining mortalities and morbidities in Korea. The study used an abridged life table to figure out mortalities and relied on morbidity/medical service use/inpatients/chronic morbidity data from the Korea National Health & Nutrition Examination Survey (KNHANES) to calculate the period of morbidity, morbidity rates, the period of activity-related disabilities and the percentage of activity-related disabilities. Then, it applied the Sullivan life table technique to calculate healthy life expectancy and disability-free healthy life expectancy.

Lee Seung-wook, et al. (2007)[2] also calculated and presented healthy life expectancy in Korea. It figured out disease and disability prevalence by using various data from the Korean National Health & Nutrition Examination Survey, the Social Statistics Survey, the Korea Labor and Income Panel Study and the National Health Insurance Service, as well as disability estimates from WHO's Global Burden of Diseases Project, before applying the Sullivan life table technique to calculate healthy life expectancy.

They identified healthy life expectancy by data source and presented the following characteristics and issues. According to the study, the WHO method uses the average of the region to which Korea belongs, thereby raising concerns over the possi-

2) Lee Seung-wook, et al., A study on the estimation of healthy life expectancy in Korea, SNU·Health Promotion Support Club, 2007

bility of generating underestimated results. It also proposed that data needed should be regularly produced via expert meetings and information gathering on a long-term basis at a national level, assessing not only healthy life expectancy but also inequalities in health.

〈Table 6〉 Healthy Life Expectancy from Lee Seung-wook, et al. (2007)

Sources	Gender	Healthy Life Expectancy	Average Life Expectancy	YLL Rate
WHO (HALE) 2002, Age 0	M	64.8	71.8	9.7
	F	70.8	79.4	10.8
KNHANES (Subjective health evaluation), 2001, Age 0	M	62.2	72.8	14.6
	F	63.4	80.0	20.8
KNHANES (Number of days of illness), 2001, Age 0	M	51.5	72.8	29.3
	F	49.6	80.0	38.0
KNHANES (Limitations in activity), 2001, Age 0	M	70.3	72.8	3.4
	F	76.0	80.0	5.0
KNHANES (Bedridden state), 2001, Age 0	M	71.9	72.8	1.2
	F	78.7	80.0	1.6
KNHANES (Number of inpatient days), 2001, Age 0	M	73.6	72.8	0.4
	F	80.5	80.0	0.4
Social Statistics Survey (Subjective health evaluation), 2003, Age 15	M	48.4	59.5	18.7
	F	46.2	66.4	30.4
Social Statistics Survey (ADL), 2003, Age 15	M	58.0	59.5	2.5
	F	64.1	66.4	3.5

Note: YLL rate (%) = (average life expectancy - healthy life expectancy)/average life expectancy ×100
Source: Lee Seung-wook, et al., 2007

Another research study calculated healthy life expectancy by applying EQ-5D. Kang Eun-jeong, et al. (2007)[3] used EQ-5D in the 2005 KNHANES and the Sullivan life table technique to calculate healthy life expectancy. According to the results, life expectancy and healthy life expectancy in 2005 were estimated to be 78.63 and 68.40, respectively.

Jung Young-ho, et al. (2011)[4] applied the weights of health-related quality of life to calculate healthy life expectancy. It also analyzed and presented changes in healthy life expectancy from the removal of specific diseases (causes of death). For example, in case diabetes is eliminated, life expectancy is estimated to rise by 0.35 and 0.32 for men and women, respectively, while healthy life expectancy is evaluated to jump by 0.45 and 0.66 for men and women, respectively. Changes in healthy life expectancy from fluctuations in disease incidence, differences between health risk groups (obesity and non-obesity) in healthy life expectancy and the life expectancy of cancer patients by life cycle were also analyzed in the study. If men aged 60 stay alive until the age of 95, they are expected to live with cancer for 5.70 years. On the other hand, in case women aged 60 stay alive until the age of 95, they are forecast to live with cancer for 3.36, about 2.33 years shorter than men.

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3) Kang Eun-jeong, et al., In-depth Analysis of the Korea National Health & Nutrition Examination Survey (Health-related Quality of Life and Health-adjusted Life Expectancy in Korea), 2007

4) Jung Young-ho, et al., A Report on the Korea Health Panel Survey in 2009, KIHASA·National Health Insurance Service, 2011

Likewise, healthy life expectancy has been calculated at home and abroad in various ways. This paper will present specific ways that WHO applies to figure out healthy life expectancy, as well as providing measurement methodologies reviewed by local and foreign researchers. It will also study healthy life expectancy assessment methodologies recently announced by WHO, etc., and review ways to set methodologies standardized to consistently calculate healthy life expectancy in a time series manner.

Chapter 3
Analysis Methods

1. GBD Classification of Diseases for Application of Disability Weights
2. Accompanying Disease-based Adjustment
3. Disability Weight-adjusted Number of Patients by Disease
4. Disability Weight-adjusted Number of Patients by Gender and Age

3 Analysis Methods

Measuring disability weights requires standardizing and quantifying social values and subjective preferences differentially accepted by people. To this end, PTO, TTO, VAS, SG, and other methods are utilized. WHO and the GBD group developed PTO-based (Person-Trade-Off) protocols to measure the disability weights of diseases. Based thereon, Korea also developed PTO-based disability weights (Lee Joong-gyu, et al. 2003 and Do Young-gyung, et al., 2004). To produce disability weights, PTO-based protocols were developed for 16 indicator diseases, choosing disability weights by disease in consultation with panel experts and ultimately measuring disability weights for 123 diseases based thereon. This research study applied disability weights for 123 diseases in Korea to calculate healthy life expectancy.

1. GBD Classification of Diseases for Application of Disability Weights

There are no clear and consistent ways to define disabilities. However, a phase exists where years of life are lost due to diseases and injuries, as well as a period of time during which

people should live with disabilities. For example, a weight of 0.5 disability weight x 0.5 year is applied to a patient who has to live with a migraine for 6 months while a weight of 0.6 disability weight x 1 year is applied to a patient who should live with arthritis for one year. As a result, the number of years of a healthy life lost due to disabilities or injuries is calculated and reflected.

To this end, it is necessary to select diseases to which disability weights are applied. The GBD project classified them into the following three illnesses: 1) infectious diseases; 2) non-infectious diseases; 3) injuries. Studies in Korea on disability weights have also applied the same criteria. However, taking into account Korea's unique circumstances, locally designated communicable diseases and several types of cancer have been added.

To calculate healthy life expectancy, this paper applied the same disease classification criteria as disability weight studies in Korea to identify the number of patients and disability weight-adjusted prevalence.

〈Table 7〉 GBD Classification of Diseases

Communicable, maternal, perinatal and nutritional conditions	ICD-10
Tuberculosis	A15-A19, B90
Syphilis	A50-A53
Chlamydia	A55-A56
Gonorrhoea	A54
Herpes genitalia	A60
HIV/AIDS	B20-B24
Diarrhoeal diseases	A00,A01,A03,A04,A06-A09
Typhoid and Paratyphoid	A01 A02
shigellosis	A03
Pertussis	A37
Poliomyelitis (c)	A80,B91
Diphtheria	A36
Measles	B05
Tetanus	A33-A35
Mumps	B26
Rubella	B06
Chicken pox	B01
Meningitis	A39, G00, G03
Hepatitis B (d)	B16-B19
Malaria	B50-B54
Trypanosomiasis	B56
Chagas disease	B57
Schistosomiasis	B65
Leishmaniasis	B55
lymphatic filariasis	B74.0-B74.2
Onchocerciasis	B73
Leprosy	A30
Dengue	A90-A91
Japanese encephalitis	A83.0
Trachoma	A71

〈Table 7〉 GBD Classification of Diseases: Continued

Communicable, maternal, perinatal and nutritional conditions	ICD-10
Ascariasis	B77
Trichuriasis	B79
Hookworm disease (Ancylostomiasis and necatoriasis)	B76
Influenza,	J10 J11
pneumonia	J12-J18
Upper respiratory infections	J00-J06
Otitis media	H65-H66
Maternal haemorrhage	O44-O46, O67 O72
Maternal sepsis	O85-O86
Hypertensive disorders	O10-O16
Obstructed labour	O64-O66
Abortion	O00-O08
Prematurity and low birth weight	P05-P07
Birth asphyxia and birth trauma	P03 P10-P15 P20-P29
Protein-energy malnutrition	E40-E46
Iodine deficiency	E00-E02
Vitamin A deficiency	E50
Iron-deficiency anaemia	D50, D64.9
Noncommunicable diseases	ICD-10
Mouth and oropharynx cancers	C00-C14
Oesophagus cancer	C15
Stomach cancer	C16
Colon and rectum cancers	C18-C21
Liver cancer	C22
Pancreas cancer	C25
Gallbladder	C23-C24
Trachea, bronchus, lung cancers	C33-C34
Melanoma and other skin cancers	C43-C44
Breast cancer	C50
Thyroid	C73
Cervix uteri cancer	C53
Corpus uteri cancer	C54-C55
Ovary cancer	C56
Prostate cancer	C61
Bladder cancer	C67
Kidney	C64
Lymphomas, multiple myeloma	C81-C90, C96
Leukaemia	C91-C95
Brain tumor	C70-C72

〈Table 7〉 GBD Classification of Diseases: Continued

Noncommunicable diseases	ICD-10
Bone Cartilage	C40-C41
Benign brain neoplasm	D33
Diabetes mellitus	E10-E14
Endocrine disorders	D55-D64 (minus D64.9),D65-D89, E03-E07, E15-E16, E20-E34, E65-E88
Unipolar depressive disorders	F32-F33
Bipolar disorder	F30-F31
Schizophrenia	F20-F29
Epilepsy	G40-G41
Alcohol use disorders	F10
dementias	F00-F03
Parkinson disease	G20-G21
Multiple sclerosis	G35
Drug use disorders	F11-F16, F18-F19
Post-traumatic stress disorder	F43.1
Obsessive-compulsive disorder	F42
Panic disorder	F40.0, F41.0
Borderline personality disorder	F60.3
Eating disorder	F50
Attention-deficit hyperactive disorder	F90
Autism and Asperger's syndrome	F84
Mental retardation	F80-F83 F88-F89
Glaucoma	H40
Cataracts	H25-H26
Rheumatic heart disease	I01-I09
Ischaemic heart disease	I20-I25
Cerebrovascular disease	I60-I69
Inflammatory heart diseases (h)	I30-I33, I38, I40, I42
Chronic obstructive pulmonary disease	J40-J44
Asthma	J45-J46
Peptic ulcer disease	K25-K27
Cirrhosis of the liver	K70, K74
Appendicitis	K35-K37
Nephritis and nephrosis	N00-N19
Benign prostatic hypertrophy	N40
Skin diseases	L00-L98
Rheumatoid arthritis	M05-M06
Osteoarthritis	M15-M19
Chronic back pain	M40-M49 M53-M54
Herniated intervertebral disc	M50-M51

〈Table 7〉 GBD Classification of Diseases: Continued

Injuries	ICD-10
Abdominal wall defect	Q79.2-Q79.4
Anencephaly	Q00
Anorectal atresia	Q42
Cleft lip	Q36
Cleft palate	Q35, Q37
Oesophageal atresia	Q39.0-Q39.1
Renal agenesis	Q60
Down syndrome	Q90
Congenital heart anomalies	Q20-Q28
Spina bifida	Q05
Dental caries	K02
Periodontal disease	K05
Edentulism	K00-K01
Road traffic accidents	(e)
Poisonings	X40-X49
Falls	W00-W19
Fires	X00-X09
Drownings	W65-W74
Other unintentional injuries	RestofV,W20-W64,W75-W99,X10-X39,X50-X59,Y40-Y86,Y88,Y89
Self-inflicted injuries	X60-X84, Y870
Violence	X85-Y09, Y871
War and civil conflict	Y36

2. Accompanying Disease-based Adjustment

A patient may suffer from one or more diseases. Therefore, considering accompanying diseases, disability weights should be adjusted.

The table below shows data based on the following assumptions: 1) 10 patients; 2) the prevalence rates of diseases i and j are 0.2 and 0.3, respectively; 3) disability weights are 0.5 and 0.4, respectively. Patient 8 has both diseases i and j. Therefore,

the disability weights of diseases i and j are calculated by using the following formula before figuring out the final disability weight for patient 8.

Cumulative DWij=1-(1-DWi)×(1-DWj)

=1-(1-0.5)(1-0.4)=1-(0.5×0.6)=0.7

Accompanying disease-adjusted DWi=0.5/0.9×0.7=0.39

Accompanying disease-adjusted DWij=0.4/0.9×0.7=0.31

〈Table 8〉 Accompanying Disease-based Adjustment Process

Patient	Disease i	Disease j	DW	Attributable DWi	Attributable DWj
1	0	0	0	0	0
2	0	1	0.4	0	0.4
3	1	0	0.5	0.5	0
4	0	0	0	0	0
5	0	1	0.4	0	0.4
6	0	0	0	0	0
7	0	0	0	0	0
8	1	1	0.7	0.39	0.31
9	0	0	0	0	0
10	0	0	0	0	0

Source: GBD Research 2010

3. Disability Weight-adjusted Number of Patients by Disease

This study used 2010 and 2011 sample patient survey data from the Health Insurance Review and Assessment Service. Health insurance claim data is gathered to review medical ex-

penses so that diagnosis terms may be inaccurate. In order to resolve the issue about inaccurate terms, existing studies using health insurance claim data either consider only the primary or first secondary diagnosis in accordance with empirical judgments or include cases where people are hospitalized for one day or longer or go to hospital as outpatients for two days or more (Lee Joong-gyu, et al., 2005).

Such a method may not completely resolve inaccurate diagnosis terms-related issues. However, this study tried to overcome the inaccuracy of diagnosis terms by taking into account only the case where people go to hospital as outpatients twice or more by disease.

According to the 2011 data for this research study, outpatient visits totalled 5,551,543 and patients numbered 1,112,411. And people who went to hospital as outpatients twice or more totalled 363,640 (GBD Classification of Diseases).

〈Table 9〉 Number of Patients by Disease

Communicable, maternal, perinatal and nutritional conditions	2010 Number of Patients (persons)	2011 Number of Patients (persons)
Tuberculosis	8,115	29,137
Syphilis	2,633	2,664
Chlamydia	5,294	4,097
Gonorrhoea	5,199	4,230
Herpes genitalia	15,893	15,390
HIV/AIDS	467	633
Diarrhoeal diseases	390,823	423,749
Typhoid and Paratyphoid	0	0
shigellosis	0	0
Pertussis	166	0
Poliomyelitis (c)	267	266
Diphtheria	0	0
Measles	0	99
Tetanus	0	0
Mumps	2,502	2,264
Rubella	0	100
Chicken pox	14,605	17,603
Meningitis	802	832
Hepatitis B (d)	4,099	3,268
Malaria	0	33
Trypanosomiasis	0	0
Chagas disease	0	33
Schistosomiasis	0	0
Leishmaniasis	0	0
lymphatic filariasis	0	0
Onchocerciasis	0	0
Leprosy	134	68
Dengue	0	0
Japanese encephalitis	0	0
Trachoma	34	0
Ascariasis	67	34
Trichuriasis	0	0
Hookworm disease	0	33
Influenza	27,810	14,025
pneumonia	228,011	260,862

〈Table 9〉 Number of Patients by Disease: Continued

Communicable, maternal, perinatal and nutritional conditions	2010 Number of Patients (persons)	2011 Number of Patients (persons)
Upper respiratory infections	6,531,194	5,817,972
Otitis media	725,484	725,943
Maternal haemorrhage	533	869
Maternal sepsis	2,930	3,191
Hypertensive disorders	967	865
Obstructed labour	66	66
Abortion	14,167	14,661
Prematurity and low birth weight	134	165
Birth asphyxia and birth trauma	331	695
Protein-energy malnutrition	1,374	1,775
Iodine deficiency	900	1,033
Vitamin A deficiency	10,282	9,052
Iron-deficiency anaemia	92,455	97,672
Noncommunicable diseases		
Mouth and oropharynx cancers	5,144	6,074
Oesophagus cancer	3,411	3,241
Stomach cancer	49,307	51,253
Colon and rectum cancers	45,250	48,783
Liver cancer	27,168	27,638
Pancreas cancer	3,643	4,811
Gallbladder	5,520	5,587
Trachea, bronchus, lung cancers	25,505	27,444
Melanoma and other skin cancers	3,312	2,709
Breast cancer	45,993	50,133
Thyroid	63,806	73,845
Cervix uteri cancer	10,141	11,208
Corpus uteri cancer	3,467	4,068
Ovary cancer	5,134	5,598
Prostate cancer	18,192	20,040
Bladder cancer	7,269	9,777
Kidney	4,773	6,111
Lymphomas, multiple myeloma	2,837	3,306
Leukaemia	6,702	7,732
Brain tumor	3,969	4,169
Bone Cartilage	1,233	1,334
Benign brain neoplasm	2,871	3,134

〈Table 9〉 Number of Patients by Disease: Continued

Noncommunicable diseases	2010 Number of Patients (persons)	2011 Number of Patients (persons)
Diabetes mellitus	1,599,605	1,692,500
Endocrine disorders	1,322,578	1,485,974
Unipolar depressive disorders	279,722	292,990
Bipolar disorder	38,951	38,025
Schizophrenia	78,337	84,126
Epilepsy	82,789	80,691
Alcohol use disorders	17,504	17,716
dementias	84,374	107,513
Parkinson disease	40,257	44,030
Multiple sclerosis	1,101	1,200
Drug use disorders	501	368
Post-traumatic stress disorder	2,064	2,101
Obsessive-compulsive disorder	13,864	14,065
Panic disorder	0	0
Borderline personality disorder	0	0
Eating disorder	2,328	2,529
Attention-deficit hyperactive disorder	0	0
Autism and Asperger's syndrome	6,062	6,396
Mental retardation	3,889	4,087
Glaucoma	186,903	204,621
Cataracts	329,300	329,406
Rheumatic heart disease	467	467
Ischaemic heart disease	360,967	361,214
Cerebrovascular disease	387,301	389,461
Inflammatory heart diseases (h)	11,401	11,859
Chronic obstructive pulmonary disease	548,256	545,925
Asthma	814,634	795,968
Peptic ulcer disease	639,464	607,542
Cirrhosis of the liver	77,484	81,160
Appendicitis	5,435	4,466
Nephritis and nephrosis	135,387	143,992
Benign prostatic hypertrophy	351,575	378,818
Skin diseases	2,697,509	2,766,976
Rheumatoid arthritis	113,920	116,666
Osteoarthritis	1,395,727	1,459,445
Chronic back pain	2,237,859	2,370,442
Herniated intervertebral disc	804,932	856,993

〈Table 9〉 Number of Patients by Disease: Continued

Injuries	2010 Number of Patients (persons)	2011 Number of Patients (persons)
Abdominal wall defect	0	0
Anencephaly	0	0
Anorectal atresia	166	66
Cleft lip	67	67
Cleft palate	132	132
Oesophageal atresia	0	0
Renal agenesis	66	67
Down syndrome	632	697
Congenital heart anomalies	6,400	7,058
Spina bifida	233	533
Dental caries	4,971	3,268
Periodontal disease	24,041	17,208
Edentulism	668	568
Road traffic accidents	67	0
Poisonings	0	0
Falls	133	67
Fires	0	0
Drownings	0	0
Other unintentional injuries	1,769	2,297
Self-inflicted injuries	0	0
Violence	33	0
War and civil conflict	0	0

In case a patient has two or more diseases, he or she was separately included in the patient group. Therefore, the number based on diseases may be bigger than the actual number of patients. This applies to 34.9% of the population, who has two or more diseases simultaneously, as shown in the table below. In 2011, the percentages of patients who have two diseases, three diseases, and four diseases at the same time were 23.1%, 7.9% and 2.7%, respectively.

〈Table 10〉 Number of Accompanying Diseases by Patient

Number of Diseases	2010	2011
1	66.2	65.1
2	22.5	23.1
3	7.5	7.9
4	2.5	2.7
5 or more	1.1	1.2

4. Disability Weight-adjusted Number of Patients by Gender and Age

The number of patients is calculated in accordance with the GBD classification of diseases. This study used 2010-2011 sample patient survey data from the Health Insurance Review and Assessment Service (HIRA). The figure was calculated, regarding people who went to hospital as outpatients twice or more due to a certain disease as patients who have the illness.

$$P_d = \frac{P_{ijd}}{N}$$

N= Mid-year Population on the Resident Registration[5)]

After the number of patients by disease is produced, the prevalence is calculated by applying disability weights for severity-based adjustments.

$$\mathrm{Prev}_x = DW_d \times P_d$$

DW_d= Disability Weight

5) Birth rates and mortalities are generally calculated as of July 1 (mid-year). The population calculated as of the date is referred to as the mid-year population.

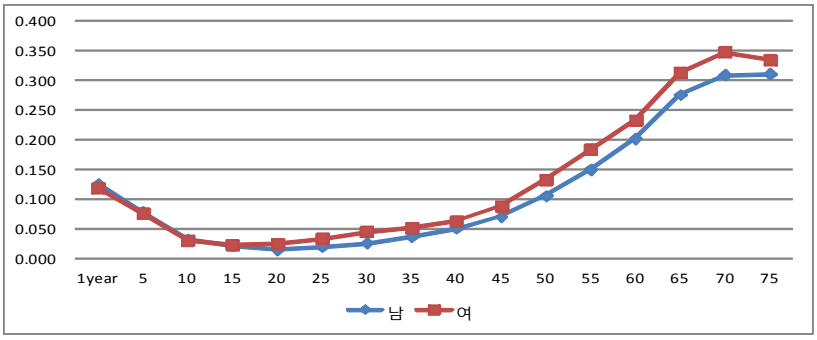
P_d= Prevalence by Disease

About 130 health states categorized as GBD illnesses were applied to the disability weights of diseases in Korea. For example, the disability weight of liver cancer in Korea is 0.87. In case a person has the disease, an adjustment was made by using the weight. Moreover, in case he or she has accompanying diseases, the weights of the accompanying diseases were adjusted in accordance with the aforementioned method.

〈Table 11〉 Disability Weight-adjusted Prevalence by Age: 2010

2010	Men		Women		Total	
Age	X	O	X	O	X	O
1-4	0.874	0.126	0.885	0.115	0.879	0.121
5-9	0.919	0.081	0.922	0.078	0.921	0.079
10-14	0.970	0.030	0.972	0.028	0.971	0.029
15-19	0.979	0.021	0.978	0.022	0.979	0.021
20-24	0.984	0.016	0.976	0.024	0.980	0.020
25-29	0.981	0.019	0.966	0.034	0.974	0.026
30-34	0.974	0.026	0.956	0.044	0.965	0.035
35-39	0.964	0.036	0.949	0.051	0.957	0.043
40-44	0.947	0.053	0.936	0.064	0.942	0.058
45-49	0.930	0.070	0.915	0.085	0.922	0.078
50-54	0.892	0.108	0.864	0.136	0.878	0.122
55-59	0.847	0.153	0.815	0.185	0.831	0.169
60-64	0.794	0.206	0.767	0.233	0.780	0.220
65-69	0.730	0.270	0.692	0.308	0.709	0.291
70-74	0.693	0.307	0.653	0.347	0.670	0.330
75-79	0.670	0.330	0.649	0.351	0.657	0.343
80-84	0.676	0.324	0.679	0.321	0.678	0.322

[Figure 1] Disability-adjusted Weights by Age: 2011

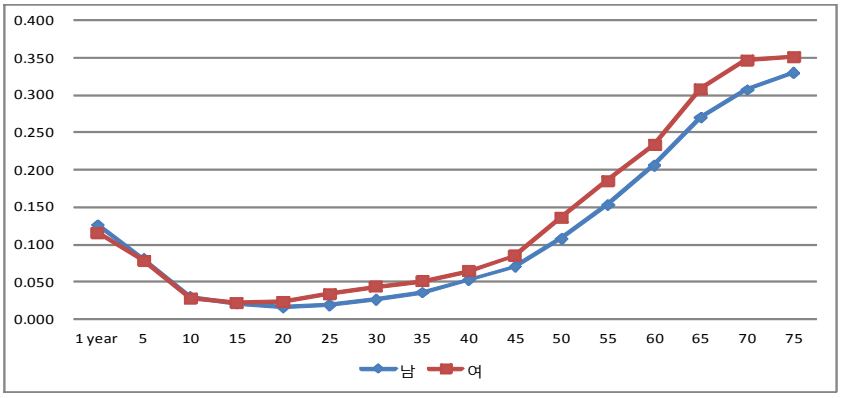


〈Table 12〉 Disability Weight-adjusted Prevalence by Age: 2011

2011	Men		Women		Total	
Age	X	O	X	O	X	O
1-4	0.874	0.126	0.882	0.118	0.878	0.122
5-9	0.922	0.078	0.925	0.075	0.923	0.077
10-14	0.968	0.032	0.970	0.030	0.969	0.031
15-19	0.978	0.022	0.977	0.023	0.978	0.022
20-24	0.985	0.015	0.975	0.025	0.980	0.020
25-29	0.981	0.019	0.966	0.034	0.974	0.026
30-34	0.974	0.026	0.956	0.044	0.965	0.035
35-39	0.963	0.037	0.948	0.052	0.956	0.044
40-44	0.949	0.051	0.937	0.063	0.943	0.057
45-49	0.929	0.071	0.912	0.088	0.921	0.079
50-54	0.895	0.105	0.868	0.132	0.881	0.119
55-59	0.850	0.150	0.817	0.183	0.833	0.167
60-64	0.798	0.202	0.768	0.232	0.782	0.218
65-69	0.724	0.276	0.687	0.313	0.704	0.296
70-74	0.691	0.309	0.653	0.347	0.670	0.330
75-79	0.690	0.310	0.666	0.334	0.675	0.325
80-84	0.685	0.315	0.691	0.309	0.689	0.311

Note: Includes only the cases where people went to hospital as outpatients twice or more due to the disease

[Figure 2] Disability-adjusted Weights by Age: 2011



Chapter 4

Analysis Results

1. 2011 Healthy Life Expectancy
2. 2010 Healthy Life Expectancy
3. Healthy Life Expectancy: 2010~2011

4 Analysis Results

1. 2011 Healthy Life Expectancy

The 2011 disability-adjusted healthy life expectancy was estimated to be 70.6. The difference between the 2011 life expectancy of 81 and the healthy life expectancy is 10.39, signifying that people live with diseases for 10.39 years throughout their life. This represents that the percentage of a disease-free life is about 87.2%.

〈Table 13〉 Disability-adjusted Healthy Life Expectancy: 2011

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
0	81	70.61	10.39	87.2
1	80	69.95	10.05	87.4
5	77	66.49	10.51	86.3
10	72	61.92	10.08	86.0
15	67	57.10	9.90	85.2
20	62	52.28	9.72	84.3
25	57	47.49	9.51	83.3
30	52	42.75	9.25	82.2
35	47	38.07	8.93	81.0
40	42	33.45	8.55	79.6
45	38	28.97	9.03	76.2
50	33	24.66	8.34	74.7
55	29	20.66	8.34	71.2
60	24	16.95	7.05	70.6
65	20	13.60	6.40	68.0

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
70	16	10.72	5.28	67.0
75	12	8.29	3.71	69.1
80	9	6.24	2.76	69.3
85	7	4.50	2.50	64.3

Note: * (Healthy Life Expectancy/Life Expectancy)*100

The disability-adjusted healthy life expectancy for men was estimated to be 68.68. The difference between the 2011 life expectancy of 78 and the healthy life expectancy is about 9.32, representing that men live with diseases for 9.32 years. This means that the percentage of men's disease-free life is about 88.0%.

〈Table 14〉 Healthy Life Expectancy for Men: 2011

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
0	78	68.68	9.32	88.0
1	77	68.04	8.96	88.4
5	73	64.60	8.40	88.5
10	68	60.04	7.96	88.3
15	63	55.23	7.77	87.7
20	58	50.43	7.57	86.9
25	53	45.64	7.36	86.1
30	49	40.89	8.11	83.4
35	44	36.19	7.81	82.2
40	39	31.58	7.42	81.0
45	34	27.13	6.87	79.8
50	30	22.89	7.11	76.3
55	26	18.96	7.04	72.9
60	21	15.34	5.66	73.0
65	17	12.09	4.91	71.1
70	14	9.32	4.68	66.5

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
75	10	7.02	2.98	70.2
80	8	5.17	2.83	64.6
85	5	3.70	1.30	74.1

Note: * (Healthy Life Expectancy/Life Expectancy)*100

The disability-adjusted healthy life expectancy for women was evaluated to be 72.34, 3.66 years longer than 68.68 for men. The 2011 life expectancy for women is 84, with the difference between life expectancy and healthy life expectancy being about 11.66 years during which women are deemed to live with diseases. This shows that the percentage of women's disease-free life is about 86.1%.

〈Table 15〉 Healthy Life Expectancy for Women: 2011

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
0	84	72.34	11.66	86.1
1	84	71.65	12.35	85.3
5	80	68.17	11.83	85.2
10	75	63.59	11.41	84.8
15	70	58.76	11.24	83.9
20	65	53.92	11.08	83.0
25	60	49.12	10.88	81.9
30	55	44.39	10.61	80.7
35	50	39.72	10.28	79.4
40	45	35.10	9.90	78.0
45	41	30.56	10.44	74.5
50	36	26.17	9.83	72.7
55	31	22.06	8.94	71.2

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
60	26	18.23	7.77	70.1
65	22	14.71	7.29	66.8
70	18	11.68	6.32	64.9
75	14	9.03	4.97	64.5
80	10	6.76	3.24	67.6
85	7	4.81	2.19	68.8

Note: * (Healthy Life Expectancy/Life Expectancy)*100

2. 2010 Healthy Life Expectancy

The 2010 disability-adjusted healthy life expectancy was evaluated to be 70.44. The difference between life expectancy and healthy life expectancy was estimated to be about 10.35 years, representing that people live with diseases during the period of time. This signifies that the percentage of a disease-free life is about 87.20%.

〈Table 16〉 Disability-adjusted Healthy Life Expectancy: 2010

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
0	81	70.44	10.35	87.20
1	80	69.79	10.27	87.18
5	76	66.34	9.78	87.15
10	71	61.76	9.40	86.79
15	66	56.95	9.25	86.03
20	61	52.14	9.16	85.06
25	56	47.36	9.07	83.92
30	52	42.62	8.98	82.60
35	47	37.95	8.83	81.12
40	42	33.34	8.66	79.39
45	37	28.87	8.44	77.38
50	33	24.58	8.15	75.11
55	28	20.58	7.69	72.78
60	24	16.88	7.04	70.57
65	20	13.53	6.21	68.55
70	16	10.72	5.06	67.95
75	12	8.34	3.86	68.39
80	9	6.29	2.83	68.92
85	7	4.57	2.07	68.90

Note: * (Healthy Life Expectancy/Life Expectancy)*100

The 2010 disability-adjusted healthy life expectancy for men was estimated to be 68.46. The difference between the 2010 life expectancy of 77 and the healthy life expectancy is about 8.74. The percentage of men's disease-free life is about 88.68%.

The 2010 disability-adjusted healthy life expectancy for women is 72.21, 3.75 years longer than the figure for men. The 2010 life expectancy for women is 84, with the difference between life expectancy and healthy life expectancy being about 11.86. This means that women live with diseases during the pe-

riod of time. In other words, the percentage of women's disease-free life is about 85.89%.

〈Table 17〉 Healthy Life Expectancy for Men: 2010

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
0	77	68.46	8.74	88.68
1	76	67.84	8.64	88.70
5	73	64.40	8.15	88.77
10	68	59.83	7.77	88.50
15	63	55.03	7.61	87.85
20	58	50.24	7.52	86.98
25	53	45.45	7.47	85.89
30	48	40.71	7.40	84.62
35	43	36.02	7.29	83.16
40	39	31.41	7.17	81.43
45	34	26.98	6.99	79.43
50	30	22.76	6.75	77.14
55	25	18.83	6.40	74.63
60	21	15.22	5.88	72.15
65	17	11.98	5.18	69.83
70	13	9.28	4.21	68.82
75	10	7.05	3.21	68.71
80	8	5.18	2.39	68.43
85	5	3.76	1.73	68.45

Note: * (Healthy Life Expectancy/Life Expectancy)*100

〈Table 18〉 Healthy Life Expectancy for Women: 2010

Age	Life Expectancy	Healthy Life Expectancy		
	(years)	(years)	Differences b/w Life Expectancy and Healthy Life Expectancy (years)	*Percentage of a Disease-free Life (%)
0	84	72.21	11.86	85.89
1	83	71.52	11.78	85.86
5	79	68.05	11.31	85.75
10	74	63.46	10.93	85.30
15	69	58.64	10.79	84.46
20	64	53.81	10.68	83.43
25	60	49.02	10.58	82.24
30	55	44.29	10.45	80.92
35	50	39.63	10.25	79.45
40	45	35.02	10.03	77.74
45	40	30.48	9.76	75.76
50	35	26.11	9.38	73.57
55	31	21.99	8.81	71.40
60	26	18.16	8.00	69.43
65	22	14.65	6.98	67.73
70	17	11.67	5.64	67.42
75	13	9.08	4.22	68.25
80	10	6.80	3.03	69.13
85	7	4.87	2.17	69.16

Note: *(Healthy Life Expectancy/Life Expectancy)*100

3. Healthy Life Expectancy: 2010 ~ 2011

The 2011 healthy life expectancy is 70.61, 0.17 year longer than the 2010 healthy life expectancy of 70.44. The healthy life expectancy for men rose by about 0.22 from a year earlier while the figure for women increased by about 0.13 from the previous year.

〈Table 19〉 Trends in Healthy Life Expectancy: 2010 ~ 2011

Age	Life Expectancy		Healthy Life Expectancy					
			Men		Women		Total	
	2010	2011	2010	2011	2010	2011	2010	2011
0	81	81	68.46	68.68	72.21	72.34	70.44	70.61
1	80	80	67.84	68.04	71.52	71.65	69.79	69.95
5	76	77	64.40	64.60	68.05	68.17	66.34	66.49
10	71	72	59.83	60.04	63.46	63.59	61.76	61.92
15	66	67	55.03	55.23	58.64	58.76	56.95	57.10
20	61	62	50.24	50.43	53.81	53.92	52.14	52.28
25	56	57	45.45	45.64	49.02	49.12	47.36	47.49
30	52	52	40.71	40.89	44.29	44.39	42.62	42.75
35	47	47	36.02	36.19	39.63	39.72	37.95	38.07
40	42	42	31.41	31.58	35.02	35.1	33.34	33.45
45	37	38	26.98	27.13	30.48	30.56	28.87	28.97
50	33	33	22.76	22.89	26.11	26.17	24.58	24.66
55	28	29	18.83	18.96	21.99	22.06	20.58	20.66
60	24	24	15.22	15.34	18.16	18.23	16.88	16.95
65	20	20	11.98	12.09	14.65	14.71	13.53	13.60
70	16	16	9.28	9.32	11.67	11.68	10.72	10.72
75	12	12	7.05	7.02	9.08	9.03	8.34	8.29
80	9	9	5.18	5.17	6.80	6.76	6.29	6.24
85	7	7	3.76	3.70	4.87	4.81	4.57	4.50

Chapter 5

Limitations in Research and Conclusion

5 Limitations in Research and Conclusion

This study calculated healthy life expectancy via diverse data in order to check the health level of people in Korea. The healthy life expectancy was determined by applying the disability weights of diseases. The disability weights of 123 illnesses in Korea were used to identify the 2010 healthy life expectancy, with the result that the 2010 disability-adjusted healthy life expectancy is 70.44. The difference between life expectancy and healthy life expectancy was shown to be about 10.35 years, which represents that Koreans live with diseases for about 10.35 years throughout their life and that the percentage of a disease-free life is about 87.20%. The 2011 healthy life expectancy was also calculated by applying the disability weights of diseases. As a result, the disability-adjusted healthy life expectancy was evaluated to be 70.61. The difference between the 2011 life expectancy of 81 and the healthy life expectancy is about 10.39, signifying that Koreans live with diseases during the period of time in their entire life.

However, the healthy life expectancy calculation system has some intrinsic limitations. First, data integrity/collection-related issues should be noted. "Cause of Death Statistics" from Statistics Korea are usually used as mortality data. The problem is that,

infant death data is not accurate enough to be used as a representative index that shows the health level of a nation. Moreover, data on reported deaths does not classify the causes of death accurately, so that it can be used only in a limited way (Shin Young-soo, et al., 2004).

As mentioned earlier, health insurance data is provided by hospitals for review and payment purposes, thereby reducing the accuracy of diagnosis terms. Furthermore, this issue should be considered not only for medical data but also for Korea's exemplary statistics surveys including the Korea National Health and Nutrition Examination Survey. A sufficient number of samples have to be gathered to ensure data reliability, accumulating survey data via systematic research in order to prevent sample selection bias.

Epidemiological indices with reliability and stability should be first produced in order to calculate healthy life expectancy more accurately and to generate indices of the gap in healthy life expectancy, etc. In case epidemiological indices of prevalence or incidence or the period of morbidity by disease are created, it is expected that diverse health performance indices can be produced, such as health levels, health-related quality of life and the effects of intervention into health policies.

In case DALY, QALY, and DFLE, burden of disease measurement indices, are generated, the following methodological issues can be raised. First, if the burden of disease is measured,

the issue over weights should be handled. For example, quality of life-adjusted weights should be identified for QALY while disability-adjusted weights have to be calculated for DALY. At this time, the extent to which weights should be given can be raised as an issue.

Moreover, various tools for assessing the status of health and the quality of life consist of the following items: physical functions, daily lives, social functions, pains, mental health, vitality, and perceptual abilities. Because they include mental and social realms, as well as physical areas, it is not easy to describe the status of diseases.

Nevertheless, research on health-related quality of life-adjusted weights and disability-adjusted weights has been continuously conducted. In case a basic framework can be established to offer metadata in connection with research results that are decentralized by research theme or project entity, and if deliverables can be provided via the connection between survey and administration data, limitations in methodologies for producing diverse health performance indices can be overcome to a certain degree.

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