Working Paper 2015-07

The Lifestyle-Related Disease Reduction Strategy

- Pathway Analysis of Health Perception, Health Behavior, and Health Status

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ISBN: 978-89-6827-305-6 93510

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1 Introduction

1 Background

Section 1. Background

Chronic diseases, and particularly lifestyle diseases such as cardiovascular and cerebrovascular diseases, cancers, diabetes, and COPDs(chronic obstructive pulmonary diseases),have become a leading cause of death and disability in South Korea and around the globe (WHO, 2011).[1)]The burden such diseases impose is high and growing. In 2008, non-communicable diseases accounted for 63% of global deaths.

At 30 deaths per 100,000 population, Korea's mortality rate from diabetes is 2-3 times greater than the OECD average. In 2010, the mortality rate of cardiovascular and cerebrovascular diseases was 53.2 deaths per 100,000 population, ranking as the second leading cause of deaths in Korea. Strokes lead to a high rate of disability and complications and thus are increasing the economic burden of healthcare. The total healthcare cost associated with hypertension in 2008 was KRW 2.0998 trillion, which is a 2.5 fold increase from 2002. The total healthcare cost associated with diabetes in 2008 was KRW 1.1276 tril-

1) WHO, Global status report on noncommunicable diseases 2010, 2011.

lion, which is a2.2 fold increase from 2002.

Chronic diseases are the most significant threat to Korea's national health, and they are a leading cause of premature deaths and declining health. In 2009,Korea's life expectancy and healthy life expectancy were 80.67 years and 72.63 years, respectively(Jung et al., 2011). The 8-year gap between the two figures indicates that Koreans suffer health problems during the last 8 years of life.

Lifestyle diseases, which are a clear burden on our society, can be traced back to risky health behaviors. Canada's 1974 Lalonde report (Lalonde, 1974)[2] suggests that the determinants of health and lifestyle diseases are based on the following factors (with the contribution of each factor in parentheses): genetic (10%), environmental (10%), medical (10%), and lifestyle (60%).In the case of Korea, smoking, excessive drinking, inactivity, poor nutrition, excess weight, and obesity accounted for 28.45% of all health risk factors in 2003 (Jung, 2011).[3]

In other words, lifestyle choices, such as smoking, excessive drinking, physical activity, and diet, are major factors influencing individual health. Modifiable health risk factors contributing to chronic diseases include smoking, excessive drinking, inactivity, and poor nutrition, as well as biological compo-

2) Lalonde M., *A new perspective on the health of Canadians: A working document,* Government of Canada, 1974.

3) Young-Ho Jung et al.et al., A study to establish a health-oriented financial policy, Korea Institute for Health and Social Affairs, 2011

nents such as obesity, hypertension, and high cholesterol(AIHW, 2008). Such health risk factors suggest that chronic diseases may be preventable, or their symptoms may be improved through changes in lifestyle.

〈Table 1-1〉 Types of health risk factors contributing to lifestyle diseases

Modifiable health risk factors		other factors	
health behavior	biological	semi-modifiable	non-modifiable
smoking	excess weight and obesity	socio-environmental	age
excessive drinking	hypertension	socio-psychological	gender
inactivity	high cholesterol	adolescent period	ethnicity
poor nutrition	others	political	family history
others			genetics

Source: AIHW 2008

The effective primary prevention of chronic diseases can decrease incident rates and ensure healthy lives, as well as reduce the economic burden such diseases impose on society. A study by the WHO(World Health Organization) reports that eliminating everyday health risk factors can reduce cardiovascular disease, strokes, and diabetes by 80%, and cancers by 40%(WHO, 2005).

As seen thus far, there is a clear need for more effective management of lifestyle diseases, as the increasing rate of such chronic diseases is increasing healthcare costs world-wide. The aging of the population also suggests that there will be a sig-

nificant increase in the rates of chronic diseases in Korea. As such, in order to increase the quality of life in Korea, such diseases require improved management via increased rates of therapeutic compliance. Unlike acute diseases, which are typically treated and monitored by clinicians, the effective treatment and management of chronic diseases requires patients to comply with a clinician's treatment guidelines and recommendations (medication regimen, exercise, diet, etc.).

Currently, Koreans' health-risk behaviors appear to be unflinching. The rate of smoking among male adults is the highest of all OECD nations (Korea Health Promotion Foundation, 2013),[4]and the rate of high-risk drinking is at a concerning level(Korea Centres for Disease Control, 2012; Jung et al., 2012).[5],[6]These particular rates have maintained the same high levels during the last few years.

In 2005, the smoking rate in Korea was 28.8%. The figure exhibited a decreasing trend until 2007, when it was measured at 25.3%. By 2008, however, the rate increased to 27.7%, and it has remained steady at around 27.5% since 2010. The smoking rate among adult males, which started increasing in 2005,reached a record high of 28.4% in 2008. The rate ex-

4) Korea Health Promotion Foundation, Tobacco Control Issue Report, 2013
5) Korea Centers for Disease Control, National Health Statistics, 2012
6) Jung et al., Social/economic cost of excessive drinking and cost effectiveness analysis for prevention projects against its harmful effects., Korea Institute for Health and Social Affairs· Korea Health Promotion Foundation. 2012

hibited a decreasing trend again until 2011, when it showed a slight increase from 2010.

Clearly, Korea is at a point where new ways to reduce the societal costs of lifestyle diseases and improve policy acceptance by targeting perceptions and health behaviors need to be explored. Changes that directly impact behaviors are needed. More specifically, considering the tendency to make irrational decisions at times, policies that incentivize rational decisions need to be adopted.

In this study, we analyze the concept of lifestyle diseases and how such diseases pertain to the current situation in Korea. Additionally, in order to identify the causes behind the discrepancy between people's desire for a healthy life and the behaviors they actually engage in, risk preferences are analyzed. By comparing the risk preferences of diabetic subjects and hypertensive subjects, this study aims to identify the differences in disease management styles between the two groups. Based on the preceding discussion, policy direction is suggested which will hopefully curtail the growth of lifestyle diseases.

- ☐ Discuss a theoretical model for changing health behaviors
- ☐ Analyze current realities of lifestyle diseases in Korea
- ☐ Review the possibility of adopting behavioral economics as a mechanism by which to change people's behaviors
- ☐ Analyze factors contributing to the cognition-practice gap

□ Suggest a new policy paradigm to improve national health

○ Based on the study's findings, suggest a new policy paradigm to improve national health

○ The present study considers these phenomena from a behavioral economics standpoint to offer a novel outlook in policy design

Section 2.Content and method

The details of the current study, including the methodology, are as follows. Following the introduction in Chapter 1, Chapter 2 offers an overview of the existing literature pertaining to behavioral change theories and behavioral change models. Rather than focusing on behavioral changes occurring at an individual level, we focus on the behavioral changes produced as a result of interaction between individuals and society. Additionally, we explore a case incorporating a behavioral change model and an empirical model with a focus on individual preferences and behavioral change (which are typically discussed in behavioral economics).

Chapter 3 discusses the current status of lifestyle diseases, which includes the definition and scope, the associated current healthcare expenditures, and a future projection of lifestyle diseases.

Chapter 4 examines the relationship between risk preferences and health risk behaviors (smoking, excessive drinking, obesity, etc.),followed by a correlation analysis of chronic disease patients' therapeutic compliance and risk preferences.

Finally, we examine policies pertaining to lifestyle diseases from the perspective of complex disease management and medication compliance and suggest a new approach with which to address the growing rate of lifestyle diseases.

2 Previous Studies

Section 1. Empirical application of a behavioral change model

2 Previous Studies

Section 1. Empirical application of a behavioral change model

In the 1950s, Simon introduced the concept of bounded rationality, combining psychology and economics. Afterwards, perceptual psychologists began researching whether the assumptions of economics are compatible with the human perception system, which provided a starting point for behavioral economics.

In behavioral economics, individuals' preferences change depending on social circumstances. In other words, preferences are created by circumstances and contexts. Typically, if there are an odd number of options available, the option in the middle gets selected. In addition, we tend to choose the few options that are within our realm of perception, rather than to go for numerous other options(Tomono Norio, 2009).

1. Time preferences and health behavior

In general, we tend to value 'here and now' more than the future. This tendency is rooted in our aversion for uncertainty

and loss, as well as in our human nature, which dislikes prolonged waiting.

Individuals often encounter occasions where they have to make a decision in the face of uncertainties. On these occasions, individuals analyze potential costs and benefits, while taking into account future uncertainties, in order to choose the best option. Such a choice, which is made upon a cost-benefit analysis, is called an inter-temporal choice.

Bickel et al.(1999)perform an experiment to examine the preferences for immediate gratification vs. delayed gratification of current smokers, ex-smokers, and non-smokers. Their study finds that current smokers showed a greater tendency to discount the value of future rewards than did the comparison groups. The study also examines the discounting of a delayed hypothetical cigarette by current smokers. The results show that, for current smokers, delayed cigarettes lost subjective value more rapidly than delayed money.

The experiment conducted by Sloan and Wang(2008) examines smokers' time preferences (discount rate) and the value they put on health outcomes. The results show that smokers tend to assign less value to future well-being than current well-being, and their short-term time preference measured higher than their long-term time preference,

In an experiment involving teenagers, Reynolds et al.(2007) finds that teenage smokers display a higher rate of time prefer-

ence than their non-smoking counterparts, indicating that they place a greater value on current rewards than on future rewards.

2. Risk preferences and health behaviors

In the field of health economics, attitudes towards risk are typically reflected in an individual's health insurance enrolment status, preventative health services utilization status, and the rate of risky health-related behaviors, such as smoking.

Barsky et al. (1997) apply the framework of asking questions concerning gambling over lifetime income in order to measure health-related risky behaviors. The results suggest that individuals who are not sensitive to risk are more likely to smoke and drink. However, Picone et al.(2004) report that an individual's risk sensitivity does not have a statistically significant influence on an individual's decision to purchase preventative health services, a finding which somewhat challenged the finding of Barsky et al. (1997). Dave & Saffer(2008) suggest that risk-averse individuals tend to have a lower rate of alcohol consumption than risk-loving or risk-neutral individuals.

3. Eliciting time preferences and risk preferences

The risk aversion experiments conducted by Holt and

Laury(2002)have been used to elicit individuals' risk preferences with a multiple price list(MPL) design. In this experiment, participants are asked to choose between lottery A and lottery B.

〈Table 2-1〉 Sample pay off matrix used in risk aversion experiment

Lottery A				Lottery B				EVa	EVb	Diff	CRRA
p	DKK	p	DKK	p	DKK	p	DKK	DKK	DKK	DKK	DKK
0.1	2000	0.9	1600	0.1	3850	0.9	100	1640	475	1165	-∞, -1.71
0.2	2000	0.8	1600	0.2	3850	0.8	100	1680	850	830	-1.71, -0.95
0.3	2000	0.7	1600	0.3	3850	0.7	100	1720	1225	495	-0.95, -0.49
0.4	2000	0.6	1600	0.4	3850	0.6	100	1760	1600	160	-0.49, -0.15
0.5	2000	0.5	1600	0.5	3850	0.5	100	1800	1975	-175	-0.15, 0.14
0.6	2000	0.4	1600	0.6	3850	0.4	100	1840	2350	-510	0.14, 0.41
0.7	2000	0.3	1600	0.7	3850	0.3	100	1880	2725	-845	0.41, 0.68
0.8	2000	0.2	1600	0.8	3850	0.2	100	1920	3100	-1180	0.68, 0.97
0.9	2000	0.1	1600	0.9	3850	0.1	100	1960	3475	-1515	0.97, 1.37
1	2000	0	1600	1	3850	0	100	2000	3850	-1850	1.37, ∞

Source: Holt and Laury (2002).

The first row of option A indicates that participants face a 10% chance of winning 2,000DKK and a 90% chance of winning 1,600 DKK. This particular choice's expected value(EV) is 1,640 DKK, included in the first row of the third column. On the other hand, for option B, there is a 10% chance of winning 3,850DKK and a 90% chance of winning 100 DKK. The EV of this decision is 475.

The EVs of both option A and B increase for each subsequent row, but option B's EV increases at a higher rate than option A's. A risk-neutral individual would choose option A for the first four rows and switch to option B thereafter.

Based on this, Anderson et al.(2008)created four risk aversion

tasks. The four sets are composed of lottery A; in the case of lottery B (A1: 2000 DKK, 1600 DKK; B1: 3850 DKK, 100 DKK), (A2: 2250 DKK, 1500 DKK; B2: 4000 DKK, 500 DKK), (A3: 2000 DKK, 1750 DKK; B3: 4000 DKK,150 DKK), and (A4: 2500 DKK, 1000 DKK; B4: 4500 DKK, 50 DKK), which is equivalent to US $7.65 ~ $687.

Harrison et al.(2008)created four risk aversion tasks and six discount rate tasks in order to deduce risk preference and time preference. Each task is composed of about 10 binary choices. As a result,100 binary choices are to be made to elicit risk preference and time preference.

4. Health risk signals and changes in disease prevention and management behaviors

Recently, efforts to link risk preference analysis methods with health risk behaviors have been increasing. For instance, Brandt & Dickinson (2013)[7]examines asthma patients' disease management status and risk preferences to investigate the role of patients' perceptions and attitudes in asthma management. The results indicate that patients who are less risk-averse tend to have lower rates of therapeutic compliance. In addition to these studies, there are analyses that examine the influence of

7) Brandt and Dickinson Time and risk preferences and the use of asthma controller medication. Pediatrics 2013;131

a health shock, such as receiving a negative result for a health examination or a being diagnosed with a disease, on individual risk preferences.

Tison et al.(2010)[8]find that a disease diagnosis can have a psychological effect on individual behaviors and risk preferences as they pertain to finance. Based on this, they conduct an empirical analysis through the use of HRS(Health and Retirement Study) data to determine how a sudden change in health status influences individual risk aversion. Disease variables consist of new diseases discovered between 2002 and 2006 and 8 major disease categories ("cancer, diabetes, heart problems, stroke, arthritis or rheumatism, chronic bronchitis or emphysema, hypertension, and emotional/nervous/ psychiatric problems" (Tyson et al. (2010), p.1).Their study analyzes the effects of an aging society and the effect of a health shock on a manual laborer's risk aversion in particular.

Anderson et al.(2008)[9] applies the field method of Harrison et al.(2006) for eliciting risk and time preferences. They incorporate the risk aversion experiments of Holt and Laury(2002) into Coller and Williams(1999) and apply the discount rate experiments of Harrison et al.(2006)'s. Harrison et al.(2006) composes 4 risk aversion tasks and 6 discount rate tasks in order to elicit risk and time preferences. Each task is

8) Tison A, Davin B, Ventelou B, Paraponaris A Influence of diseases on risk aversion through time, Aix Mareille University

9) Anderson et al. (2008) Eliciting risk and time preferences, Econometrica 76(3)

designed with 10 binary choices. As a result, subjects were asked to make 100 binary choices in order to elicit risk and time preferences.

Coller and Williams(1999) and Harrison et al. (2010) implement discount rate experiments. As the table below shows, option A provides the subject with 3,000DKK in a month, and option B provides the subject with 3,000 DKK + α DKK in 7 months. Here, α DKK is defined by an annual interest rate, with increments of 5 percentage points and ranging from 5% to 50% for different payoff alternatives. If a risk neutral person prefers the option of 3,000DKK within a month, it can be deduced that their discount rate is greater than the corresponding interest rate.

〈Table 2-2〉 Sample payoff matrix of a time preference experiment

Payoff Alternative	**Payment Option A** (pays amount below in 1 month)	**Payment Option B** (pays amount below in 7 months)	**Annual Interest Rate** (AR, in percent)	**Annual Effective Interest Rate** (AER, in percent)	**Preferred Payment Option** (Circle A or B)	
1	3,000 DKK	3,075 DKK	5	5.09	A	B
2	3,000 DKK	3,152 DKK	10	10.38	A	B
3	3,000 DKK	3,229 DKK	15	15.87	A	B
4	3,000 DKK	3,308 DKK	20	21.55	A	B
5	3,000 DKK	3,387 DKK	25	27.44	A	B
6	3,000 DKK	3,467 DKK	30	33.55	A	B
7	3,000 DKK	3,548 DKK	35	39.87	A	B
8	3,000 DKK	3,630 DKK	40	46.41	A	B
9	3,000 DKK	3,713 DKK	45	53.18	A	B
10	3,000 DKK	3,797 DKK	50	60.18	A	B

Anderson et al. (2008) compose six time preference tasks consisting of delays in payments of 1 month, 4 months, 6 months, 12 months, 18 months, and 24 months. Subjects were asked to choose between the short time-frame income option (3,000 DKK in a month) and future income option(3,000 DKK plus a varying number of DKK in a varying number of months) at six month intervals to elicit their time preference.

Anderson et al. (2008) samples the Denmark population, stratified by area, gender, and age. They conducted a field experiment involving 253 participants in 2003.

The right column of the payoff matrix in 〈Table 2-3〉 shows the CRRA (constant relative risk aversion) range for corresponding choices. For example, if a subject switches to a riskier alternative after 5 safe choices, the CRRA interval is between 0.14 and 0.41. Also, if a subject switches to a riskier alternative after 7 safe choices, the CRRA is between the interval of 0.68 and 0.97. Therefore, a subject's binary choices can be explained by CRRA intervals, which can be estimated by applying a maximum likelihood process.

According to the experiment conducted by Harrison et al. (2006), the average CRRA interval for Danish subjects was 0.67, which is similar to that of the U.S. These study findings suggest that the utility of money function is concave.

The estimation results of Harrison et al. (2006) show that option A is a product of risk aversion, while option B is a product

of risk neutrality. Table 2-5 illustrates that option A's CRRA value is 0.646 and option B's estimated risk neutrality is 24.9%. However, the estimated discount rate of option A, which assumes risk aversion, is 8.2%. This figure is far less than the 24.9% estimated discount rate of option B, which assumes risk neutrality. This shows that the discount rates vary greatly depending on whether or not risk aversion is assumed. When r decreases from 0.646 to 0, it becomes similar to option B's estimates, which means that the individual discount rate (δ) will increase significantly.

〈Table 2-3〉 Estimated risk preference and time preference

Parameter	Estimate	Standard Error	*p*-value	Lower 95% Confidence Interval	Upper 95% Confidence Interval
		A. Allowing a Concave Utility Function (Risk Aversion)			
r	0.646	0.040	0.000	0.567	0.725
δ	0.082	0.011	0.000	0.060	0.103
μ (for RA)	0.129	0.014	0.000	0.101	0.158
ν (for DR)	0.047	0.006	0.000	0.035	0.058
		B. Assuming a Linear Utility Function (Risk Neutrality)			
δ	0.249	0.014	0.000	0.222	0.276
ν (for DR)	0.132	0.009	0.000	0.115	0.149

5. Applying time preferences to health behaviors

Understanding time preferences is vital in developing public health policies(Lawless et al., 2013).[10]Existing studies on time

10) Lawless L, Drichoutis A, Nayga RM. Time preferences and health behavior: a review Agricultural and Food Economics 2013 1:17.

preferences and health outcomes have conventionally had applications in shaping public policy, explaining psychological phenomenon, and unveiling motives behind seemingly irrational health behaviors.

Many time preference studies focus on theoretical models. (See Section 4:Literature review of theoretical models). Recently, however, studies are conducted more frequently, and empirical analyses are more commonly implemented.

1) The effect of time preferences on health behaviors
2) The difference between the social discount rate and the individual discount rate when it comes to health
3) The effect of the discount rate on health risk behaviors (obesity, smoking, drinking)
4) Time preferences regarding disease prevention and health promotion

Individuals make choices about what and how much to consume at various points in time, which indicates preferences regarding several domains, including health, income, environment, etc. For instance, Hardisty and Weber(2009) suggest that the domains of money and environment are comparable. However, various explanations for the correlation between money and health exist. The correlation between money and health is generally weak, and some researchers refer to this phenomen-

on as domain independence (Chapman, 2003).Domain independence may be problematic because, theoretically, discount rates should not change with decision domains (Chapman, 2003).However, individuals may not consider money and health to be fungible, or tradable. Yet in the field of public health policy, the two are assumed fungible because policy makers make monetary investments to garner future health benefits (Chapman, 2003). The issue of domain independence is an important issue discussed in literature. If it is assumed that money and health are fungible, then the same discount rate may apply to both domains. However, if it is assumed that individuals do not assign values to health and money in the same way, the argument that different discount rates should apply to different domains is more reasonable.

Lazaro(2002) reviews arguments for both concepts and suggests that neither can be accepted unconditionally. However, his study also suggests that, in empirical analyses, when choosing a framework worth adopting, it can be a determinant. For instance, Lazaro et al. (2002) suggests that health outcomes are discounted at a higher rate than money. Another example shows that beer drinkers have a high discount rate for beer but a low discount rate for potato chips(Tsukayama and Duckworth, 2010).

Time preferences play an important role in shaping public health policy. When public policy and time preferences are dis-

cussed, personal time preference and social time preference must be differentiated. Personal time preferences pertain to an individual's decision making, and social time preferences pertain to society's preference, which may take into account others' well-being. When public health policy decisions are made, it is generally understood that applying social discount rates is efficient (Drummond et al., 1987; Olsen, 1993).

There are many studies showing that discount rates for health are typically higher than those for money in both private and social contexts(Lazaro et al., 2001, 2002). There are some who argue that the social discount rates for health are lower than those for money(Meerding et al., 2010). This may be due to idiosyncrasies in the populations or samples being surveyed, or to differences in how time preferences are framed. For instance, higher discount rates for health may be due to the fact that health outcomes are delayed, or that a delayed outcome associated with money have a greater level of uncertainty. However, there is no evidence suggesting that individual discount rates and social discount rates are similar in level in the domain of health(Cairns and van der Pol, 2000; van der Pol and Cairns, 2002).

When time preferences are incorporated into public health policy design, the concept of intergenerational time preference (how the current generation's utility should be weighed against the utility of future generations) needs to be considered.

Sacrificing resources from the current generation for the sake of future generations is a key argument not only in Korea, but all around the world(Frederick, 2006). The essential element of this is the fact that individual discount rates and intergenerational discount rates are not easily comparable.

One of the most important reasons for time preference analysis is that it can play a vital role in designing government policies. For instance, a high discount rate means that the government must place more focus on acute disease treatment than on preventative health. Certainly, public policy incorporates a variety of angles in addition to time preferences. However, time preference must be considered when making public policy decisions. Subsidizing fee-based systems and treatments can contribute to inefficiency via the overconsumption of treatments in general(Watts and Segal, 2009).

Time preferences can help explain decisions pertaining to the resource distribution for certain programs. Robberstad (2005) deduced the discount rates for fatal and non-fatal illnesses and applied different discount rates to individual illnesses in his analysis.

〈Time preferences and health-risk behaviors〉

Health-risk behaviors, such as smoking, excessive drinking, and obesity, increase healthcare expenditures and represent an

economic burden on society. In the case of obesity, inter-temporal food choices affect behaviors that can lead to obesity. As such, understanding the relationship between food habits and time preferences is important. Analyzing the specific factors influencing time preferences can aid in developing strategies associated with food-related health promotion policy.

In order to determine whether changes in time preferences can affect obesity, different measurement tools are considered. Blaylock et al. (1999) uses time preference proxies, including saving rates (which decreased) and credit card debt(which increased). In order to review the relationship between an individual's savings patterns and obesity, Kosmo et al. (2004) compares obesity prevalence and lagged personal savings in the U.S.(30 year trend) and finds that obesity prevalence increased 30% while personal savings decreased by 83%. Obesity prevalence and the lagged debt-to-income ratio show a similar trend. Opposite situations also suggest that countries with high rates of personal savings have low rates of obesity prevalence.

〈Table 2-4〉 Time preference proxies and elicitation methods in obesity studies

Study	Topic	Proxies and elicitation method
Ayyagari et al. 2011	diabetes management (obesity)	- Do you agree to "I take life one day at a time and don't think too much about the future"?
Sloan et al. 2009	diabetes management (obesity)	- Do you agree to "I take life one day at a time and don't think too much about the future"?
Zhang and Rashad 2008	obesity	- time preference proxies: degree of willpower and "desire but no effort"
Komlos et al. 2004	obesity	- time preference proxies: savings, debt-to-income ratio
Huston and Finke 2003	obesity	- time preference proxies: education level, smoking, exercising, using nutrition labels on a regular basis, level of nutrition knowledge, etc.

Source: Lawless et al., 2013.

Cawley (2008) and Sloan and Wang (2008) explain an individual's choice to engage in addictive behavior according to perfectly rational addiction(adopting Becker and Murphy's opinion from 1988), imperfectly rational addiction, and irrational addiction.

Cawley (2008) distinguished addictive behaviors into tolerance, withdrawal, and reinforcement. Tolerance refers to dissatisfaction regarding the current level of consumption. Withdrawal contributes to an aversion for quitting because of the negative feelings associated with cessation. Reinforcement encourages increasingly higher consumption levels because individuals continually derive positive marginal benefits from consuming a good.

Adams(2009) analyzes the relationship between time preferences and smoking cessation and finds that smoking rates decrease as a respondent's financial planning period increases.

〈Table 2-5〉 Time preference proxies and elicitation methods in smoking studies

Study	Topic	Proxies and elicitation method
Scharff and Viscusi 2011	smoking	- Worker wage-fatality risk trade-offs (implied time discount rate for non-smokers was 8.1% compared to 13.8% for smokers)
Ida and Goto 2009	smoking	- Discrete choice experiment to measure time and risk preferences
Adams 2009	smoking	- Response to "In planning your/your family's saving and spending, which of the following time periods is more important to you and your husband/wife/partner?"
Goto et al. 2009	smoking	- Discrete choice experiment to measure time and risk preferences
Khwaja et al. 2007	smoking	- Financial intertemporal choices: health intertemporal choices - (e.g., 20 extra days in perfect health this year vs. extray days in perfect health x years from now)
Fersterer and Winter-Ebmer 2003	smoking and education	- Smoking status at 16 years of age

Source: Lawless et al., 2013.

〈Table 2-6〉 Time preference proxies and elicitation methods in combined smoking and obesity studies

Study	Topic	Proxies and elicitation methods
Cutler and Lleras-Muney 2010	health-risk behaviors including smoking and obesity	- Health intertemporal choices: "20 extra days in perfect health this year vs. y extra days in perfect health x years from now (x=1, 5, 10, 20)
Adams 2009	smoking, obesity	- Response to "In planning your family's spending, which one of the following time periods is more important to you and your partner?"
Adams and White 2009	smoking, obesity	- Consideration of future outcomes
Robb et al. 2008,	smoking, obesity	- Time preference proxies: "diet choice, vitamin use, education, smoking status, exercise, nutritional knowledge, use of nutrition labels and importance of nutrition"

Source: Lawless et al., 2013.

Understanding time preferences in relation to human behavior alone is insufficient. If psychological phenomena can be associated with intertemporal choices, time preferences can be better incorporated into public health management policy and predicting and preventing diseases. Behavioral economics provides tools with which to influence the direction of time-consistent choices. For instance, tools that nudge individuals to make future-oriented choices can be utilized.

3 Analysis of the Current State of Lifestyle Diseases

3 Analysis of the Current State of Lifestyle Diseases

Section 1. Concept and classification of lifestyle diseases

1. Concept of lifestyle diseases

The terms used to describe lifestyle diseases vary by country. The U.S. adopted "chronic diseases," whereas the U.K. uses "lifestyle related diseases" (Jinkyung Kang, 2004). "Adult diseases," which was commonly used in Korea, is an administrative term coined by the Ministry of Health, Labor, and Welfare in 1955. The adult diseases mainly include strokes, cancers, and cardiovascular diseases for which the mortality rates increase sharply around the age of 40 years. They were also presented as diseases which typically develop during a person's prime working years (40-60 years of age) that also have the highest mortality rate in Korea (Jeongsu Lee et al., 2008).[11]

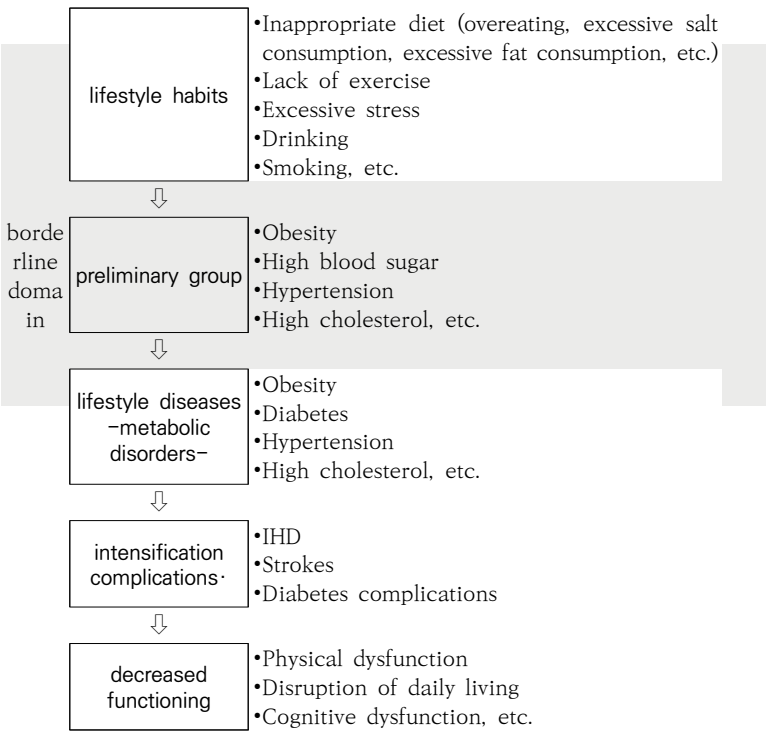
The Japanese Ministry of Health, Labor, and Welfare adopted the disease concept of "lifestyle diseases" in December of 1996

11) Jeongsu Lee, Wonchurl Lee, Kyoungsu Lee et al., Japan's health promotion policy direction: with a focus on lifestyle diseases. Health education· Health promotion journal No. 25 Vol 3 pp167-181 2008.

and began pushing for preventative public health policy. The definition of lifestyle diseases discussed here is "a group of diseases associated with a person's lifestyle choices such as dietary habit, exercise habit, rest, smoking, drinking"(Ministry of Health, Labor, and Welfare, 1996).[12]It was revealed that, although harmful substances and genetics contribute to the development and acceleration of diseases, lifestyle habits, such as dietary habits, exercise, and rest, also contribute significantly to the development and acceleration of diseases such as diabetes, hypertension, cancers, strokes, and cardiovascular diseases. The concept of lifestyle diseases has replaced that of adult diseases in Korea. In other words, it is a new concept adopted in order to implement public policies pertaining primarily to the prevention of diseases through lifestyle improvement. Included in lifestyle habits are diet, drinking habits, smoking habits, and exercise.

12) Ministry of Health, Labor, and Welfare, Public health review board, 1996.

[Figure 3-1] Components of lifestyle diseases



Source: Japanese Ministry of Health, Labor, and Welfare.

2. Classification of lifestyle diseases and analysis of current condition

A. Classification of lifestyle diseases for analysis of current condition

The classification of lifestyle diseases used by the Japanese Ministry of Health, Labor, and Welfare are described in Table

〈3-1〉below. Lifestyle disease types include diabetes, hypertension, high cholesterol, high levels of uric acid, liver dysfunction, kidney dysfunction caused by hypertension, cerebrovascular diseases, and ischemic heart disease(IHD). These diseases are represented by four major disease categories: endocrine, nutritional, and metabolic diseases (4 in Table 3-1), vascular diseases (9), digestive diseases (11), and genitourinary diseases (14). Endocrine, nutritional, and metabolic disorders include diabetes, hypertension, and high levels of uric acid. Vascular diseases include hypertension, kidney dysfunction due to hypertension, cerebrovascular diseases, and IHD. Digestive diseases include liver dysfunction, genitourinary diseases, and kidney dysfunction due to hypertension.

〈Table 3-1〉 8 lifestyle diseases based on ICD-10

classification code		disease	association with lifestyle diseases
1	A00-B99	certain infectious and parasitic diseases	
2	C00-D48	neoplasms	
3	D50-D89	diseases of the blood and blood forming organs and certain disorders involving the immune mechanism	
4	E00-E90	endocrine, nutritional, and metabolic diseases	○
5	F00-F99	mental and behavioral disorders	
6	G00-G99	diseases of the nervous system	
7	H00-H59	diseases of the eye and adnexa	
8	H60-H95	diseases of the ear and mastoid process	
9	I00-I99	diseases of the circulatory system	○
10	J00-J99	diseases of the respiratory system	

classification code		disease	association with lifestyle diseases
11	K00-K93	diseases of the digestive system	○
12	L00-L99	diseases of the skin and subcutaneous tissue	
13	M00-M99	diseases of the musculoskeletal system and connective tissue	
14	N00-N99	diseases of the genitourinary system	○
15	O00-O99	pregnancy, childbirth, and puerperium	
16	P00-P96	certain conditions originating in the perinatal period	
17	Q00-Q99	congenital malformations, deformations, and chromosomal abnormalities	
18	R00-R99	symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	
19	S00-T98	injury, poisoning, and certain other consequences of external causes	
21	Z00-Z99	factors influencing health status and contact with health services	
99	U00-U99	codes for special purposes	

⇩

19 disease classification	ICD-108 disease classification	ICD-10 code
4. endocrine, nutritional/metabolic diseases	①diabetes	E11~E14
	③high cholesterol	E780, E781, E785
	④high uric acid	E790
9. diseases of the circulatory system	②hypertension	I10
	⑥kidney dysfunction due to hypertension	I129, N26
	⑦cerebrovascular diseases	I61, I64 I639
	⑧IHD	I209, I219, I259
11. diseases of the digestive system	⑤liver dysfunction	K760, K701
14. diseases of the genitourinary system	⑥kidney dysfunction due to hypertension	I129, N26

footnote: 8 lifestyle diseases suggested by Health Insurance Federation, IT data analysis group(2012)

B. Current status of lifestyle diseases in Korea

In order to examine the scale and scope of lifestyle diseases in Korea, lifestyle diseases are classified into 8 categories and 2011 HIRA-NPS data are investigated. For this analysis, data on inpatient and outpatient care at health clinics is extracted from a sample of patient data. Healthcare service utilization records pertaining to dental, maternity, psychiatry, and the use of oriental medicine are excluded from the analysis. From a total of5,649,268 utilization cases, 5,300,516cases pertain to healthcare service utilization due to lifestyle diseases.

If a single patient has complex chronic diseases, each separate disease is counted in the calculation. For instance, if patient A has both hypertension and diabetes, the patient is counted one time for diabetes and a second time for hypertension. In addition, patients are classified based on the main diagnosis.

The first of the three most commonly reported disease in the sample is neoplasms, followed by diseases of the musculoskeletal system, and, finally, diseases of the circulatory system. Lifestyle diseases account for 7.13% of the total hospitalization and outpatient treatment cost (excluding non-payments) in 2011. In the case of Japan, this statistic is 10.9% (excluding those aged over 75 years) during the same year (National Health Insurance Federation, 2012).

〈Table 3-2〉 Proportion of 8 lifestyle diseases in the overall healthcare expenditures as of 2011

(Unit: %)

disease classification code		total	lifestyle disease	lifestyle disease (Japan)*
1	certain infectious and parasitic diseases	2.72	0	
2	neoplasms	13.56	0	
3	diseases of the blood and blood forming organs and certain disorders involving the immune mechanism	0.63	0	
4	endocrine, nutritional, and metabolic diseases	3.10	1.92	4.6%
5	mental and behavioral disorders	5.79	0	
6	diseases of the nervous system	3.67	0	
7	diseases of the eye and adnexa	3.72	0	
8	diseases of the ear and mastoid process	1.22	0	
9	diseases of the circulatory system	11.87	5.11	6.2%
10	diseases of the respiratory system	10.18	0	
11	diseases of the digestive system	6.24	0.09	0.1%
12	diseases of the skin and subcutaneous tissues	2.07	0	
13	diseases of the musculoskeletal system and connective tissue	13.08	0	
14	diseases of the genitourinary system	7.62	0.01	0.0%
15	pregnancy, childbirth and the puerperium	1.67	0	
16	certain conditions originating in the perinatal period	0.01	0	
17	congenital malformations, deformations and chromosomal abnormalities	0.36	0	
18	symptoms, signs, and abnormal clinical and laboratory findings not elsewhere classified	1.58	0	
19	injury, poisoning and certain other consequences of external causes	9.21	0	
21	factors influencing health status and contact with health services	1.26	0	
99	codes for special purposes and others (see note)	0.45	0	
proportion of 8 lifestyle diseases		100.0	7.13	10.9%

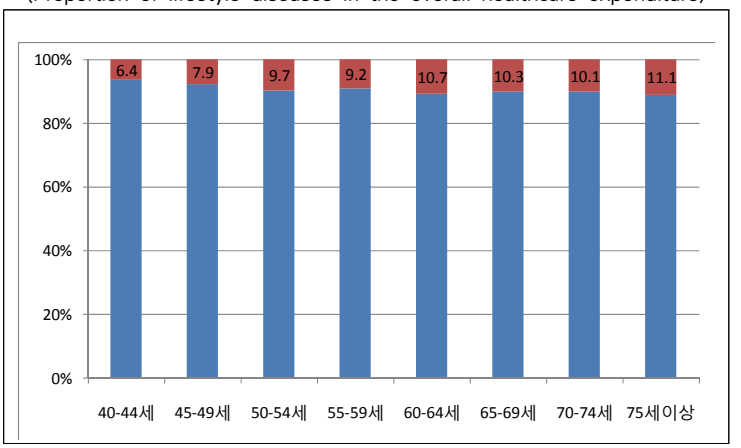
Note: other classification criteria= 0.44%, special purpose code=0.01%
* excluding individuals over 75 years of age.

Data: Korean National Health Insurance Review Board patient sample data(HIRA-NPS) 2011data
*Japanese National Health Insurance Federation, 2012

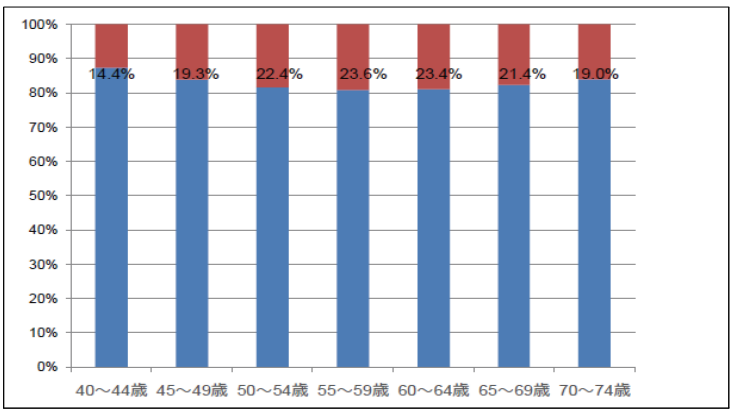
[Figure 3-2] Lifestyle diseases in Korea and Japan for Males

〈Proportion of lifestyle diseases in the overall healthcare expenditure〉

Korea



Japan



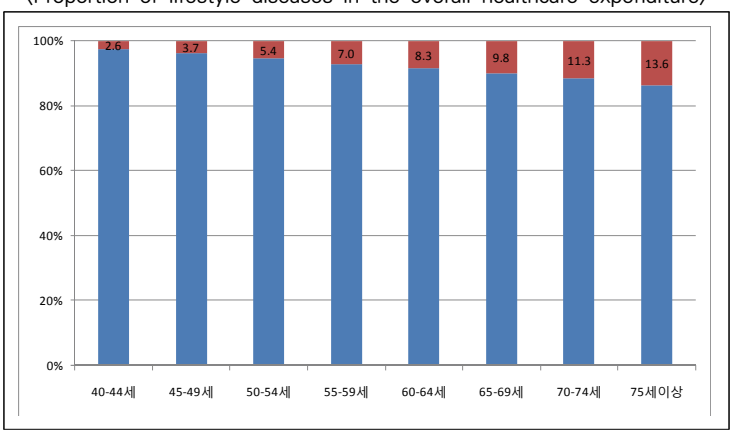
Note: Korea - hospitalization and outpatient care, 2011
Japan -hospitalization and outpatient care, 2010

Source: Korean data -National Health Insurance Review Board patient sample data (HIRA-NPS) 2011data.
*Japanese data -National Health Insurance Federation, 2012

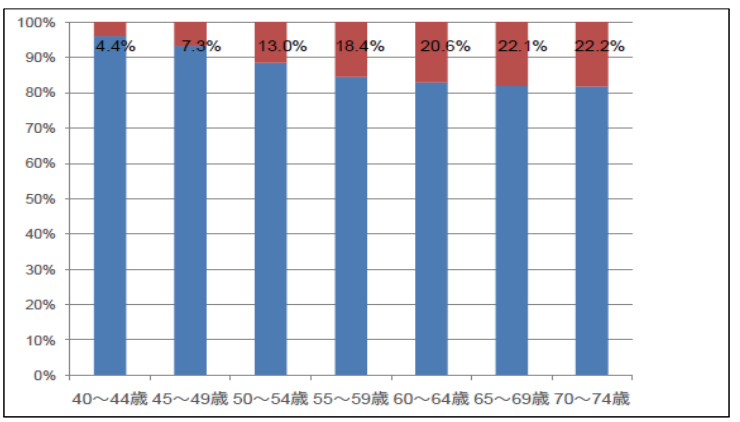
[Figure 3-3] Lifestyle diseases in Korea and Japan for females

〈Proportion of lifestyle diseases in the overall healthcare expenditure〉

Korea



Japan



Note: Korea -hospitalization and outpatient care, 2011
Japan -hospitalization and outpatient care, 2010

Source: Korean data -National Health Insurance review Board patient sample data(HIRA-NPS) 2011data.
*Japanese data -National Health Insurance Federation, 2012

3. Disease classification according to lifestyle medicine

Lifestyle medicine is a branch of medicine dealing with lifestyle habit intervention in order to reduce the risk of developing lifestyle diseases and to provide management plans to those who already have lifestyle diseases.

According to Egger(2008),[13]

- Doctors manage diseases with lifestyle intervention treatment to the extent applicable
- In clinical settings, health problems associated with lifestyle habits are approached with environmental, behavioral, medical, and motivational principles.

The American College of Lifestyle Medicine(ACLM) regards itself as "the professional medical association for physicians, medical professionals, allied health professional and those with professional careers devoted to advancing the mission of lifestyle medicine."[14] The Australian Lifestyle Medicine Association(ALMA) [15] also uses lifestyle intervention in the management of diseases that are typically associated with lifestyle habits.

Rippe(1999)[16] explains the concept of lifestyle medicine as an integration of lifestyle habits and traditional medicine in or-

13) Egger G., Binns A., Rossner S. (2008). Lifestyle Medicine. McGraw-Hill.
14) American College of Lifestyle Medicine, http://www.lifestylemedicine.org/about
15) Australian Lifestyle Medicine Association]http://www.lifestylemedicine.net.au/
16) Rippe J. Lifestyle Medicine. Blackwell Science, 1999

der to reduce the risk of developing or to alleviate existing chronic diseases.CPM, Johnson, Barry(2008)[17] describes it as an intricate and scientific approach to reduce the burden of diseases through lifestyle intervention that incorporates nutrition, physical activity, stress reduction, avoiding excessive drinking, smoking cessation, and rest.

Greenstone(2007)[18] argues that simple lifestyle adjustments incorporating appropriate diet, exercise, and stress reduction can be integrated into traditional Western medicine(including the prevention and promotion of health through treatment strategies).

Details of lifestyle intervention are as follows:

- Various non-medicinal treatments, including those for nutrition, physical activity, stress management, smoking cessation, personal hygiene, etc.
- Diet(nutrition), exercise, stress management, smoking cessation, various non-medical treatment (ACLM)
- Patient education to promote lifestyle improvement in the areas of weight, physical activity/exercise, nutrition, smoking cessation, stress management, depression management, etc. (Harvard ILM)[19]

17) ACPM, Johnson M, Barry M. ACPM Lifestyle Medicine Initiative description, Sept 2008.
18) Greenstone CL. A Commentary on Lifestyle Medicine Strategies for Risk Factor Reduction, Prevention, and Treatment of Coronary Artery Disease. Am J Lifestyle Med 2007; 1: 91-94

- Provide protocols and advice pertaining to physical activity, diet and nutrition, stress management, smoking cessation, and other lifestyle decisions and habits (Rippe, 1999)

The unique role of lifestyle medicine is to satisfy the following:

- Focus is on lifestyle habits
- Emphasize that success is dependent on a clinician's coaching and a patient's motivation
- Be applicable to all patients and all treatments
- Utilize a collaborative care model, because allied healthcare suppliers provide a great deal of direct counselling
- Limit the number of interventions approach
- Associated with a more descriptive lifestyle intervention regarding specific diseases or risk status
- Recommended as national guidelines in various countries for diseases prevention and treatment
- Incorporates cognitive behavioral treatment where patients are coached to take responsibility for his/her own success through help with lifestyle habit changes and motivational counselling

19) Harvard Institute of Lifestyle Medicine
http://www.institutelifestylemedicine.net/home.html

〈Table 3-3〉 Comparison of traditional Western medicine and lifestyle medicine

Traditional Western medicine	Lifestyle medicine
- treats individual risk factors	- treats lifecycle causes
- patient is often a passive recipient of care	- patient is an active partner in care
- patient is not required to make big changes	- patient is required to make big changes
- treatment is often short term	- treatment is almost always long term
- responsibility falls mostly on clinician	- responsibility mostly falls on patient
- medication is often the end treatment	- medication may be needed but as an adjunct to lifestyle change.
- emphasis is on diagnosis and prescription	- emphasis on motivation and compliance
- goal is diseases management	- goal is primary, secondary, tertiary disease prevention
- little consideration of environment	- consideration of environment
- side effects are balanced by the benefits	- side effects are seen as part of the outcome
- referral to other medical specialties	- referral to allied health professionals
- doctor generally operates independently on a one to one basis	- doctor is a coordinator of a team of health professionals

Source: Egger et al, 2008.Lifestyle Medicine: 21st century lifestyle disease management. Lifestyle Medicine Research Group (translated). Beom-Moon Education.

Major medical conditions associated with lifestyle habits include obesity, hypertension, high cholesterol, diabetes, metabolic disorders, cardiovascular diseases, arthritis, and osteoporosis, which are in the domain of primary medicine.

Lifestyle medicine intervention has been proven effective for the following diseases:

〈Table 3-4〉 Improvement in lifestyle diseases according to changes in health risk factors

Lifestyle diseases	Exercise	Diet/ nutrition	Stress reduction	Smoking cessation	Drinking cessation	Combined behaviors
A. Obesity	RCT	RCT				RCT
B. Hypertension	RCT	RCT	RCT			RCT
C. Dyslipidemia	O	RCT				RCT
D. Impaired Glucose Tolerance, Metabolic Syndrome	RCT	O				RCT
E. Type 2 Diabetes	RCT	RCT				RCT
F. Cardiovascular Disease	RCT	RCT	O	O	O	
G. Stroke	RCT					
H. Heart Failure	RCT					
I. Peripheral Artery Disease	RCT					O
J. Chronic Obstructive Pulmonary Disease	O					RCT
K. Osteoarthritis	RCT	O				O
L. Rheumatoid arthritis	O					RCT
M. Cancer - All	RCT					O
N. Breast Cancer,	O	O				
Prostate Cancer						O
O. Osteoporosis	RCT					
P. Depression	RCT					
Q. Fibromyalgia	RCT					
R. Chronic Fatigue Syndrome	O					
S. Type 1 Diabetes	RCT					
T. Non-alcoholic fatty	O					
U. Multiple Sclerosis	O					
V. Parkinson's	O					
W. Cognitive Impairment /Dementia	RCT					
X. Chronic Low Back Pain	RCT					O

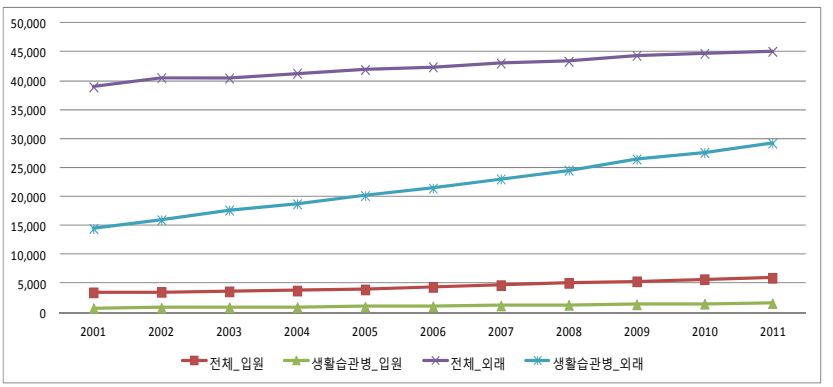
Note: RCT= based on Randomized Controlled Trials, O=based on Observational studies

〈Table 3-5〉 Diseases analyzed based on lifestyle medicine

Category	Disease	ICD-10
1	Hypertension	I10-I15
2	Chronic back pain	M40-M45,M47, M48.0-M48.2, M48,5-M48.9, M50-M54
3	Knee pain	M15-M19
4	Diabetes	E10-E14
5	Chronic ischemic cardiovascular diseases	I20, I21, I25
6	Obesity	E66
7	Metabolism disorder	E79, M10
8	Depression	F32-F33
9	Asthma/COPD	J40-J45, J47
10	Atherosclerosis/peripheral vascular diseases	I65-I66, I67.2, I70, I73.9
11	Osteoporosis	M80-M82
12	Chronic stroke	I60-I64,I69, G45
13	Heart failure	I50
14	Rheumatoid arthritis	M05-M06, M79.0
15	Dementia	F00-F03, F05.1, G30, G31, R54
16	Parkinson's diseases	G20-G22
17	Liver diseases	K70
18	Cancers	C00-C14, C15-C26, C30-C39, C40-C41, C43-C44, C45-C49, C50, C51-C58, C60-C63, C64-C68, C69-C72, C73-C75, C81-C96, C76-C80, C97, D00-D09, D37-D48

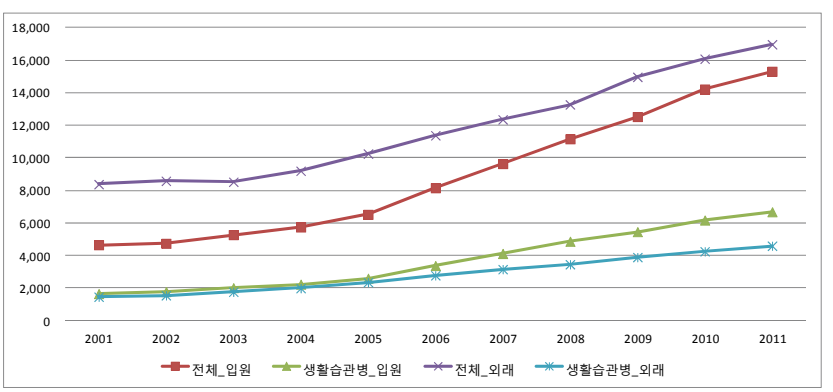
[Figure 3-4] Trend in the number of lifestyle disease patients, 2001-2011

(unit =1,000 persons)



[Figure 3-5] Trend in lifestyle disease treatment cost, 2001-2011

(unit =billion)

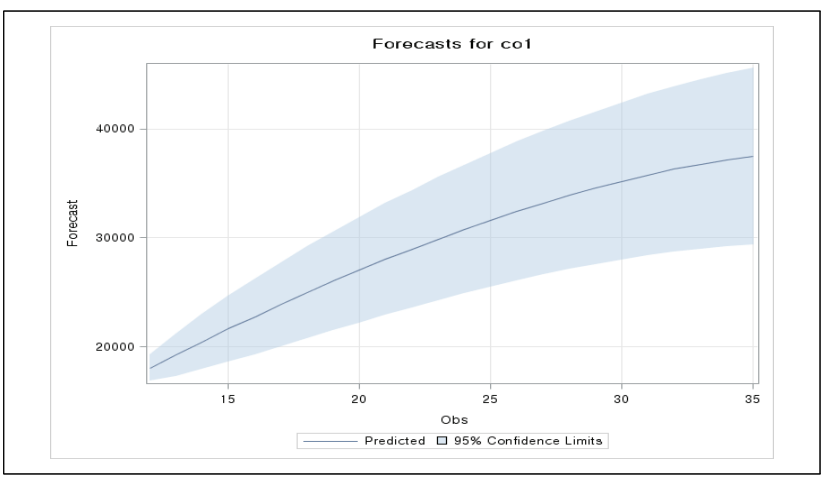


4. Forecasting the future of lifestyle diseases

[Figure 3-6] illustrates the long-term forecast of lifestyle diseases estimated by analyzing health insurance statistics from the period of 2001 to 2014. Results of the forecast up to 2023 are obtained by applying an ARIMA model. The results indicate that the number of patients suffering from a lifestyle disease will start decreasing after 2030. However, the associated healthcare cost exhibits a continuously increasing trend. Nevertheless, the curve is concave, and the results suggest that the increasing trend will slow down after 2035.

[Figure 3-6] Forecasting the future of lifestyle diseases: Present -2035

〈Projection of healthcare cost associated with lifestyle diseases 〉



Note: ARIMA model applied.

5. A behavioral science approach for improving lifestyle habits

In order to elicit changes in lifestyle habits, a behavioral science approach is sometimes used. For instance, patients whose doctors requested a dietary treatment are reported to change their fat and fiber intake more so than other nutrients.[20] Additionally, it has been reported that using a behavioral science approach to influence patient behaviors and educate patients improves patient care.[21]

A behavioral science approach in lifestyle intervention involves patient assessment, environment, goals, increased cognition, impeding factors, stress management, cognitive restructuring, providing support, contact, prescribing medication, etc. One component of the counselling framework is the5A protocol:[22]

①Assess: Ask about/assess behavioral health risk(s) and factors affecting choice of behavior change goals/methods.

②Advise: Give clear, specific, and personalized behavior change advice, including information about personal health harms/benefits.

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20) Nawaz H, Adams ML, Katz DL. Physician-Patient Interactions Regarding Diet, Exercise, and Smoking. Preventive Medicine 2000; 31, 652-657.

21) Holman H. Chronic Disease – The Need for a New Clinical Education. JAMA, 2004; 292, 1057-9.

22) Whitlock EP, Orleans CT, Pender N, Allan J. Evaluating primary care behavioral counseling interventions: an evidence-based approach. Am J Prev Med. 2002:22(4):267-284.

③Agree: Collaboratively select appropriate treatment goals and methods based on the patient's interest in and willingness to change the behavior.

④Assist: Using behavior change techniques (self-help and/or counseling), aid the patient in achieving agreed-upon goals by acquiring the skills, confidence, and social/environmental supports for behavior change, supplemented with adjunctive medical treatments when appropriate (e.g., pharmacotherapy for tobacco dependence, contraceptive drugs/devices).

⑤Arrange: Schedule follow-up contacts (in person or by telephone) to provide ongoing assistance/support and to adjust the treatment plan as needed, including referral to more intensive or specialized treatment.

Section 2. Current prevalence of lifestyle diseases and associated complications

In this section, the prevalence of major lifestyle diseases are examined, with a focus on diabetes, hypertension, and high cholesterol(dyslipidemia), as well as the current scope of associated complications which develop when these diseases are poorly managed.

The Health Insurance Cohort database is utilized to better understand how health risk factors contribute to the develop-

ment of lifestyle diseases (i.e., high BMI, high blood pressure, high cholesterol levels, glucose metabolism management issues and diabetes, hypertension, current prevalence of high cholesterol) and associated complications in Korea.

The health insurance cohort database is cohort data compiled between 2001 and 2010. It contains healthcare service utilization data, healthcare cost data, as well as health checkup data. As such, the database offers information pertaining to complications developed due to poor management of lifestyle diseases, which include measures of health behaviors and lifestyle disease healthcare service utilization.

1. Current status of major lifestyle diseases and complications

When testing for major lifestyle diseases, BMI, systolic pressure, diastolic pressure, total cholesterol, fasting blood glucose, and urine sugar are measured. Diagnosis criteria are as follows. Complications associated with diabetes are categorized as cerebrovascular dysfunction, ischemic heart diseases, diabetic coma, diabetic retinopathy, diabetic nephrosis, diabetic nerve disorder, peripheral circulatory complication, and other complications. Complications associated with hypertension are categorized as cerebrovascular dysfunction and ischemic heart disease. Complications associated with high cholesterol are categorized as cerebrovascular dysfunction and ischemic heart diseases.

〈Table 3-6〉 Major lifestyle disease testing and diagnostic criteria

Category	Testing criteria	Diagnostic criteria				
		1. Normal	2. Mildly abnormal	3. Closely monitor	4. Treatment required	5. Thorough examination
BMI	BMI	18.5-24.9		≧25.0 〈18.5		
blood pressure	systolic	90-139	〈90, 140-149	150-159	≧160	
	diastolic	〈90	90-94	95-99	≧100	
cholesterol	total cholesterol	140-199	200-219	220-239	≧240	〈140
	HDL	≧40		35-39	〈35	
	triglycerides	〈150	150-199	200-249	≧250	
sugar metabolization	fasting blood glucose	≦109		110-115	≧126	116-125
	sugar in urine	(-)	(±)	(+)		(++)이상

〈Table 3-7〉 Major lifestyle diseases and associated complications

Criteria	Major lifestyle diseases	Associated complications
1	diabetes	cerebrovascular dysfunction, IHD, diabetic coma, diabetic retinopathy, diabetic nephrosis, diabetic nerve disorder, peripheral circulatory complication, other complications
2	hypertension	cerebrovascular dysfunction, IHD
3	high cholesterol	cerebrovascular dysfunction, IHD

Source: SAKAMAKI H, KITAZAWA T, MUTO T, 2008.

The prevalence of major lifestyle diseases among individuals 30 years and older is as follows. A total of 637,928 subjects are included in the analysis. Of that total, 4.1% of these subjects have diabetes without complications, and 4.1% have diabetes with complications. Regarding hypertension, 15.6% have hypertension with no complications, and 3.9% have hypertension with complications. Lifestyle disease patients who have both diabetes and hypertension account for 4.6% of the total, and

those who have both diabetes and high cholesterol account for 2.4% of the total. Subjects that have both hypertension and high cholesterol account for 4.8%. Subjects that have diabetes, hypertension, and high cholesterol account for 1.2%.

In the case of Japan, 53% of diabetic patients over the age of 30 years old do not have complications. The proportion of patients with hypertension that do not have other complications is 72.6%. The proportion of high cholesterol patients that do not have complications is 83.3%(Sakamaki et al. 2008).

〈Table 3-8〉 Current prevalence of major lifestyle diseases (adults over 30 years of age), 2010

(unit: persons, %)

Major lifestyle diseases		(Number of persons)	Ratio 1(%)	Ratio 2(%)
diabetes	no complications	26,236	4.1	50.4
	complications*	25,853	4.1	49.6
hypertension	no complications	99,461	15.6	80.1
	complications	24,714	3.9	19.9
high cholesterol	no complications	52,671	8.3	89.5
	complications	6,196	1.0	10.5
diabetes+hypertension		29,541	4.6	
diabetes+high cholesterol		15,251	2.4	
hypertension+high cholesterol		30,742	4.8	
diabetes+hypertension+high cholesterol		7,613	1.2	
total		637,928	100.0	

Note: * subjects who used healthcare services due to diabetes or associated complications as the main disease or complications within the past year.
Ratio1: the ratio in relation to total analysis subjects (N=637,928persons) (%).
Ratio2: the ratio in relation to total analysis subjects with relevant conditions (%).

Current lifestyle diseases and complications status by age groups are displayed in [Table 3-9]. The prevalence rates of diabetes, hypertension, and high cholesterol increase as age increases. For example, 34.6% of diabetic patients in the 30-44 year old age group have complications, but the proportion increases to 56.0% in the 65-74 years age group, and to 58.6% in the 75 years and older age group.

〈Table 3-9〉 Current prevalence of lifestyle diseases by age group, 2010

(unit = %, persons)

Total		30-44 yrs	45-64 yrs	65-74 yrs	75 yrs and over	Total
diabetes	no complication	65.4	54.0	44.0	41.4	
	complication	34.6	46.0	56.0	58.6	
	subtotal(persons)	4,517	25,509	14,491	7,572	52,089
hypertension	no complication	88.5	83.0	76.8	73.5	
	complication	11.5	17.0	23.2	26.5	
	subtotal(persons)	9,215	59,896	33,581	21,483	124,175
high cholesterol	no complication	96.7	91.5	83.9	77.6	
	complication	3.3	8.5	16.1	22.4	
	subtotal(persons)	8,080	33,365	12,693	4,729	58,867
diabetes+hypertension		0.5	4.7	13.7	13.1	4.6
diabetes+highcholesterol		0.6	3.0	5.7	3.6	2.4
hypertension+highcholesterol		0.9	6.1	11.9	8.2	4.8
diabetes+hypertension+highcholesterol		0.2	1.3	3.6	2.6	1.2
Total(persons)		252,449	272,044	70,770	42,665	637,928

For income level, subjects were divided into free healthcare beneficiaries and health insurance enrollees. Health insurance enrollees were subsequently divided into income quintiles based on the insurance contribution. Free healthcare beneficiaries are found to have a higher rate of complications than insurance enrollees. For instance, 22% of the free healthcare beneficiaries have complications associated with hypertension, which was slightly higher than the rate found among the insurance enrollees (18.9%-20.9%).

〈Table 3-10〉 Prevalence of major lifestyle diseases by income level, 2010

(unit = %, persons)

Total		Free healthcare beneficiary	Lowest (low income)	Second quintile	Third quintile	Fourth quintile	Highest fifth (high income)
diabetes	no complication	47.0	49.5	51.5	51.5	50.6	49.6
	complication	53.0	50.5	48.5	48.5	49.4	50.4
	subtotal(persons)	251	8,067	7,189	8,619	11,064	16,899
hypertension	no complication	77.8	80.0	81.1	81.1	80.3	79.1
	complication	22.2	20.0	18.9	18.9	19.7	20.9
	subtotal(persons)	504	19,442	17,141	20,515	26,300	40,273
high cholesterol	no complication	87.4	89.3	90.2	89.8	90.0	88.8
	complication	12.6	10.7	9.8	10.2	10.0	11.2
	subtotal(persons)	127	8,254	7,656	9,361	12,906	20,563
diabetes+hypertension		0.5	5.3	4.3	4.2	4.3	5.5
diabetes+high cholesterol		0.1	2.4	2.1	2.1	2.3	3.1
hypertension+high cholesterol		0.3	5.1	4.3	4.2	4.7	6.1
diabetes+hypertension+high cholesterol		0.1	1.2	1.0	1.0	1.2	1.6
Total(persons)		24,098	87,844	93,367	113,584	142,848	176,187

Note: income quintiles are based on health insurance contribution.

Looking at the distribution of specific complications associated with diabetes, hypertension, and high cholesterol, peripheral circulatory disorders account for 20.28% of diabetes complications, followed by diabetic nerve disorder, and ischemic heart disease, and diabetic retinopathy.

Ischemic heart disease accounts for 16.27% of the complications associated with hypertension and 7.88% of the complications associated with high cholesterol.

〈Table 3-11〉 Current prevalence of complications associated with major lifestyle diseases, 2010

(unit =persons, %)

Category		30-44yrs	45-64yrs	65-74yrs	75yrs and over	ratio
diabetes	(no. of patients)	4,517	25,509	14,491	7,572	52,089
	cerebrovascular disorder	0.62	2.48	5.76	8.53	4.11
	Ischemic heart disease	2.63	6.02	9.74	10.42	7.40
	diabetic coma	0.89	1.35	2.53	3.45	1.94
	diabetic retinopathy	3.39	4.79	7.87	7.54	5.92
	diabetic nephrosis	5.82	5.67	5.86	5.40	5.70
	diabetic nerve disorder	10.29	14.11	16.49	16.79	14.83
	peripheral circulatory disturbance	13.57	19.49	23.31	23.20	20.58
	other complications	6.77	9.02	10.74	10.62	9.54
hypertension	(no. of patients)	9,215	59,896	33,581	21,483	124,175
	cerebrovascular disease	1.26	2.93	5.99	8.61	4.62
	ischemic heart diseases	10.43	14.61	18.52	19.89	16.27

Category		30-44yrs	45-64yrs	65-74yrs	75yrs and over	ratio
high cholesterol	(no of patients	8,080	33,365	12,693	4,729	58,867
	Cerebrovascular disease	0.38	2.10	5.13	9.54	3.11
	Ischemic heart disease	2.91	6.69	11.71	14.51	7.88

Note: A single patient with 2 or more complications were counted multiple times to represent each complication.
ratio(%)=the proportion of relevant complication present in diabetes/ hypertension/high cholesterol patients.

2. Current average treatment cost of accompanying complications of lifestyle diseases

Efforts are needed to reduce the risk of developing lifestyle diseases by encouraging a healthy lifestyle. In the presence of lifestyle diseases, the prevention of complications through effective disease management is equally important. Lifestyle diseases and their complications can place a large financial burden on a patient. The current scale of this burden is described in 〈Table 3-12〉 (below).

In the case of diabetic patients without associated complications, the average per-person annual treatment cost is approximately KRW 320,000. However, in the presence of associated complications, the cost increases to KRW670,000.

〈Table 3-12〉 Average per-person annual treatment cost of lifestyle diseases, 2010

(unit =KRW 1,000)

Category		No complication			Complication		
		Hospitalization	Outpatient care	Total	Hospitalization	Outpatient care	Total
diabetes	total treatment cost	175	144	319	354	313	666
	paid by patient	35	47	82	70	89	159
	paid by insurance	140	97	237	282	222	504
hypertension	total treatment cost	126	161	322	175	287	496
	paid by patient	26	43	59	54	69	113
	paid by insurance	99	117	261	119	217	381
high cholesterol	total treatment cost	25	108	133	174	110	284
	paid by patient	4	38	43	20	50	70
	paid by insurance	21	70	90	154	60	213

3. Analysis of healthcare cost by patient income level

A generalized linear model(GLM)is used to examine annual healthcare costs associated with lifestyle diseases by patient income levels.

GLM is commonly used in analyses of costs that have a right-leaning distribution, as is the case with healthcare cost. It offers the advantage of smoothing out potential errors that can occur during the non-linear or log conversion. For the present analysis, a logistic regression analysis is used, which incorporates the log link and gamma distribution typically used

in healthcare cost analyses.

The healthcare costs paid by patients and the healthcare costs paid by insurance are examined at each income level. Results indicate that the proportion of payments borne by the patient increased while that borne by the insurance decreased as income level increased, which suggests that guaranteed healthcare for all is at work.

A. Analysis of diabetes treatment cost by patient income level

Results of the examination of the annual per person healthcare cost for diabetes show that the proportion of payments borne by the patient increases as income level increases. On the other hand, free healthcare beneficiaries are found to have a higher proportion of payments borne by insurance compared to health insurance enrollees.

〈Table 3-13〉 GLM regression analysis results: diabetic patient healthcare spending by income level (free healthcare+health insurance)

	Diabetes treatment cost-paid by patient			Diabetes treatment cost-paid by insurance		
	Estimate	SE	Pr	Estimate	SE	Pr
constant	11.762	0.086	〈.0001	12.149	0.095	〈.0001
free healthcare	ref.			ref.		
income lowest quintile	-0.019	0.085	0.824	-0.138	0.094	0.140
second quintile	0.019	0.085	0.823	-0.302	0.094	0.001
third quintile	0.108	0.085	0.203	-0.191	0.093	0.041
fourth quintile	0.057	0.085	0.505	-0.297	0.093	0.001
highest fifth	0.129	0.084	0.127	-0.244	0.093	0.008
male	-0.036	0.012	0.002	0.052	0.013	〈.0001
female	ref.			ref.		
30-44 yrs	ref.			ref.		
45-64yrs	0.017	0.021	0.425	0.217	0.024	〈.0001
65-74yrs	0.140	0.023	〈.0001	0.562	0.025	〈.0001
75yrs and over	0.626	0.025	〈.0001	0.966	0.028	〈.0001
No complication	ref.			ref.		
complication	0.652	0.012	〈.0001	0.729	0.013	〈.0001
Scale	0.591	0.003		0.471	0.002	

A subsequent analysis conducted with health insurance enrollees alone (upon exclusion of free healthcare beneficiaries) finds that the higher the income level, the higher the proportion of payments borne by the patient and the lower the proportion of payments borne by insurance. However, there was no clear difference in the healthcare burden within the second quintile (which had the highest burden among quintiles).

〈Table 3-14〉 Results of GLM regression analysis: diabetic patients' healthcare spending by income level (health insurance enrollees)

	Diabetes treatment cost-paid by patient			Diabetes treatment cost-paid by insurance		
	Estimate	SE	Pr	Estimate	SE	Pr
constant	11.090	0.025	〈.0001	12.010	0.028	〈.0001
income lowest quintile	ref.			ref.		
second quintile	0.038	0.021	0.072	-0.164	0.024	〈.0001
third quintile	0.127	0.020	〈.0001	-0.053	0.023	0.018
fourth quintile	0.076	0.019	〈.0001	-0.159	0.021	〈.0001
highest fifth	0.147	0.018	〈.0001	-0.107	0.020	〈.0001
male	-0.040	0.012	0.001	0.049	0.013	0.000
female	ref.			ref.		
30-44 yrs	ref.			ref.		
45-64 yrs	0.020	0.021	0.335	0.221	0.024	〈.0001
65-74 yrs	0.146	0.023	〈.0001	0.566	0.025	〈.0001
75 yrs and over	0.634	0.025	〈.0001	0.975	0.028	〈.0001
no complication	ref.			ref.		
complication	0.649	0.012	〈.0001	0.727	0.013	〈.0001
Scale	0.592	0.003		0.472	0.002	

B. Hypertensive patient healthcare spending by income level

The analysis of healthcare spending associated with hypertension, which includes only the subjects with health insurance coverage, finds that, beyond the lowest income quintile, the proportion of payments borne by the patient increases and the proportion of payments borne by insurance decreases as income level increases. This trend is similar to that which is observed in the analysis of diabetic patients' healthcare spending.

〈Table 3-15〉 Results of GLM regression analysis: hypertensive patients' healthcare spending by income level (health insurance enrollees)

	hypertension treatment cost-paid by patient			hypertension treatment cost-paid by insurance		
	Estimate	SE	Pr	Estimate	SE	Pr
constant	10.932	0.016	〈.0001	12.021	0.018	〈.0001
lowest income quintile	ref.			ref.		
second quintile	-0.010	0.013	0.418	-0.038	0.015	0.011
third quintile	0.003	0.012	0.831	-0.087	0.014	〈.0001
fourth quintile	0.065	0.012	〈.0001	-0.003	0.014	0.840
highest fifth	0.073	0.011	〈.0001	-0.097	0.012	〈.0001
male	-0.070	0.007	〈.0001	-0.008	0.008	0.309
female	ref.			ref.		
30-44 yrs	ref.			ref.		
45-64yrs	-0.010	0.014	0.462	-0.007	0.016	0.679
65-74yrs	0.129	0.015	〈.0001	0.389	0.017	〈.0001
75yrs and over	0.809	0.016	〈.0001	0.924	0.018	〈.0001
no complication	ref.			ref.		
complication	0.448	0.009	〈.0001	0.518	0.010	〈.0001
Scale	0.669	0.002		0.496	0.002	

C. Healthcare spending of patients with dyslipidemia by income level

The present analysis finds that, beyond the lowest income quintile, the proportion of payments borne by the patient increases along with income. However, proportion of payments borne by insurance is higher across the second to fourth quintiles than in the lowest quintile. Only for the highest fifth is the proportion of payments borne by insurance comparatively low.

〈Table 3-16〉 Results of GLM regression analysis: healthcare spending of patients with dyslipidemia by income level(health insurance enrollees

	Dyslipidemia treatment cost-paid by patient			Dyslipidemia treatment cost-paid by insurance		
	Estimate	SE	Pr	Estimate	SE	Pr
Constant	10.575	0.018	〈.0001	11.314	0.021	〈.0001
lowest income quintile	ref.			ref.		
second quintile	0.063	0.018	0.001	0.071	0.021	0.001
third quintile	0.068	0.017	〈.0001	0.063	0.020	0.002
fourth quintile	0.108	0.016	〈.0001	0.035	0.019	0.059
highest fifth	0.176	0.015	〈.0001	-0.017	0.017	0.336
male	0.090	0.010	〈.0001	0.119	0.011	〈.0001
female	ref.			ref.		
30-44 yrs	ref.			ref.		
45-64yrs	-0.048	0.014	0.001	-0.028	0.017	0.088
65-74yrs	-0.093	0.017	〈.0001	0.070	0.019	0.000
75yrs and over	0.002	0.021	0.944	0.299	0.025	〈.0001
no complication	ref.			ref.		
complication	0.489	0.016	〈.0001	0.810	0.018	〈.0001
Scale	0.781	0.004		0.578	0.003	

4. Relationship between lifestyle diseases and disease risk assessed during a health examination

Using the data of subjects who had a health examination between 2002 and 2003 and who did not have any major lifestyle diseases, including diabetes, hypertension, and dyslipidemia, ischemic heart disease, and stroke, a logistic regression analysis is conducted to measure the risk of developing lifestyle diseases by 2010.

The risk of developing diabetes is twice as high in obese subjects with a BMI score of 25 and over. The risk of diabetes is 1.5 times greater in subjects with hypertension.

〈Table 3-17〉 Correlation between lifestyle diseases (2010) and risk assessed during a health examination(2002-2003)

Health examination results		Diabetes			Hypertension		
	Risk	OR	SE	pr	OR	SE	pr
BMI	yes	2.008	0.013	〈.0001	2.097	0.008	〈.0001
hypertension	yes	1.469	0.014	〈.0001	-		
dyslipidemia	yes	1.537	0.013	〈.0001	1.307	0.008	〈.0001
glucose metabolism	yes	-			1.398	0.012	〈.0001
gender	male	1.312	0.014	〈.0001	1.124	0.009	〈.0001
age	30-44 yrs	ref.			ref.		
	45-64yrs	3.496	0.021	0.953	4.631	0.013	〈.0001
	65-74yrs	6.749	0.027	〈.0001	11.698	0.017	〈.0001
	75yrs and over	6.362	0.039	〈.0001	16.956	0.024	〈.0001

Health examination results		Dyslipidemia			Ischemic heart disease		
	Risk	OR	SE	pr	OR	SE	pr
BMI	yes	1.609	0.010	〈.0001	1.403	0.021	〈.0001
hypertension	yes	1.431	0.011	〈.0001	1.417	0.022	〈.0001
dyslipidemia	yes	-			1.344	0.021	〈.0001
glucose metabolism	yes	1.356	0.014	〈.0001	1.118	0.029	0.052
gender	male	0.744	0.010	〈.0001	1.346	0.022	〈.0001
age	30-44 yrs	ref.			ref.		
	45-64 yrs	3.016	0.018	〈.0001	4.196	0.032	0.002
	65-74yrs	3.975	0.023	〈.0001	10.040	0.039	〈.0001
	75yrs and over	2.373	0.038	0.472	11.054	0.053	〈.0001

Health examination results		Stroke			Lifestyle disease		
	Risk	OR	SE	pr			
BMI	yes	1.145	0.019	0.001	1.727	0.008	〈.0001
hypertension	yes	1.610	0.019	〈.0001	2.727	0.008	〈.0001
dyslipidemia	yes	1.140	0.018	0.000	1.523	0.007	〈.0001
glucose metabolism	yes	1.128	0.026	0.019	1.792	0.011	〈.0001
gender	male	0.920	0.019	0.025	0.907	0.008	〈.0001
age	30-44 yrs	ref.			ref.		
	45-64yrs	6.016	0.030	〈.0001	3.731	0.012	〈.0001
	65-74yrs	19.301	0.034	〈.0001	7.857	0.017	〈.0001
	75yrs and over	32.827	0.040	〈.0001	9.201	0.024	〈.0001

Note: results of a logistic regression analysis. N=141,987persons.

4 Analysis of the Cause of the Cognition–Practice Gap

Section 1. Analysis method

Section 2. Analysis results

Section 3. Sintering

4 Analysis of the Cause of the Cognition-Practice Gap

Understanding attitudes regarding risk is vital in measuring risky behaviors associated with health, such as smoking and drinking. This is because, in various personal and social decisions, attitudes towards risk plays an important role. Diseases can have a psychological effect on an individual's behavior and influence risk preferences as they pertain to finance.

This study examines the relationship between individual risk preferences and health-risk behaviors, such as smoking, excessive drinking, and obesity, and analyzes the association between lifestyle disease patient therapeutic compliance and risk preferences with the goal of suggesting a policy direction that will improve therapeutic compliance rates among these patients.

Section 1. Analysis method

1. Designing a questionnaire to elicit risk preferences

A field experiment is conducted to analyze the relationship between individual risk preference and health related behaviors. The design of this study's questionnaire is based on

the widely known experiment method developed by Holt & Laury(2002). The design method is simple compared to other experiments pertaining to risk avoidance, and it offers the advantage of a simple interpretation in terms of risk-neutral, risk-seeking, and risk-avoiding attributes.

〈Table 4-1〉 Payoff matrix used in the present study's risk avoidance experiment

Decision making	Option A	Option B	E(A)-E(B)
1	Roll 1, win 20,000. Roll 2-10, win 16,000	Roll 1, win 38,500. Roll 2-10, win 1,000	11,650
2	Roll 1-2, win 20,000. Roll 3-10, win 16,000	Roll 1-2, win 38,500. Roll 3-10, win 1,000	8,300
3	Roll 1-3, win 20,000. Roll 4-10, win 16,000	Roll 1-3, win 38,500. Roll 4-10, win 1,000	4,950
4	Roll 1-4, win 20,000. Roll 5-10, win 16,000	Roll 1-4, win 38,500. Roll 5-10, win 1,000	1,600
5	Roll 1-5, win 20,000. Roll 6-10, win 16,000	Roll 1-5, win 38,500. Roll 6-10, win 1,000	-1,750
6	Roll 1-6, win 20,000. Roll 7-10, win 16,000	Roll 1-6, win 38,500. Roll 7-10, win 1,000	-5,100
7	Roll 1-7, win 20,000. Roll 8-10, win 16,000	Roll 1-7, win 38,500. Roll 8-10, win 1,000	-8,450
8	Roll 1-8, win 20,000. Roll 9-10, win 16,000	Roll 1-8, win 38,500. Roll 9-10, win 1,000	-11,800
9	Roll 1-9, win 20,000. Roll 10, win 16,000	Roll 1-9, win 38,500. Roll 10, win 1,000	-15,150
10	Roll 1-10, win 20,000.	Roll 1-10, win 38,500.	-18,500

In the above table, two options are available for each of 10 decisions. Rows list decisions while columns list options. For decisions 1-4, option A's expected value is higher than option B's, whereas, for decisions 5-10, option B's expected value is higher. As such, a risk-neutral individual will choose option A

for the first four rows, whereas a risk averse person will likely to choose option A more than the first four rows. On a side note, Holt & Laury(2002)'s experiment involving 212 college and graduate students finds that 26% are risk-neutral, 8% are risk-seeking, and 66% are risk-averse.

2. The CRRA utility function measurement method

Define a participant's expected utility as

Here, x represents the lottery prize, and r represents parameter.

According to expected utility theory (EUT), the probability of each outcome k is , which is obtained from each participant i. As such, the expected utility of each participant can be expressed as follows:

Assuming a constant relative risk aversion utility function in the lottery experiment above, the lower and upper limit of the parameter r can be calculated as follows:

Here, r represents the Coefficient of Relative Risk Aversion (CRRA) and M represents the payout.

The estimated value of $r$represents the attitude regarding risk, which can be classified into the following three categories:

- r=0→risk neutral
- r〉0→risk averse
- r〈0→risk seeking

For instance, consider that a subject who opted for the safer option A for decisions 1-6 switched to option B for decision 7. This falls into the interval for CRRA of between 0.41 and 0.68. This means that decision 6 is the lower limit where the risks associated with option A and options B are closest to being equal, and *r* is calculated as follows: Decision 6 is the lower limit where preference between A and option B becomes indifferent, and the r value is calculated as follows.

▸ r = 0.41

Further, decision 7 is the upper limit where the preference between the two options becomes indifferent, and it is calculated as follows.

▸ r = 0.68

When the subjects choose one of the two options, and when the monetary rewards differ each time, the value of *r*is estimated for each option via the calculation below.

Based on the estimated value of *r*, the difference in expected utilities for the two lottery options is

This represents an individual's potential preferences. When the expected utility of option A is greater than that of option B, is positive.

For this latent index, which represents potential preferences, the standard cumulative normal distribution function, is applied so that the observed decision was linked. Using the probit function, was converted into values from 0 to 1. The following equation represents the ratio of the potential variables.

Prob(choose option A)=

When 〉 1-,the subject chooses option A. Therefore, an observed decision's log-likelihood can be presented as follows:

Here, I(y=(0,1)) is an indicator function, where y=1(0)represents option A(B) of the two options. The variable X represents a person's demographic characteristics, such as gender, age, education level.

3. Survey method

Interviews were conducted with 1,000 adults over the age of 30 years residing across the nation. The survey was conducted between October 13 and November 4, 2014. Based on the registered population of October 2014, respondents were selected in equal proportion according to the relative population of the various areas.

Section 2. Analysis results

1. Estimated risk preferences

The sample of risk preference analysis subjects included 940 adults over the age of 30 years. Males accounted for 49.3% of the 940 adults sampled. In terms of age, the age group of 30-44 years old accounted for 36.7%, the age group of 45-64 accounted for 44.0%, and 65 years and older accounted for 19.3% of the total.

〈Table 4-2〉 General characteristics of subjects

		No. of respondents (persons)	%
gender	male	463	49.3
	female	477	50.7
age	30-44 yrs	345	36.7
	45-64yrs	414	44.0
	65 yrs and over	181	19.3
spouse	yes	758	80.6
	no	182	19.4
household income	monthly average(KRW10,000)	333.1	
Total		940	100.0

There were 10 decisions tasks and a total of 940 subjects, resulting in a total of 9,400 observations. Looking at the distribution of responses, 92.3% of the subjects opted for option A for the first decision and 91.3% for the second decision. The

proportion of subjects who chose option A decreased as the decisions became riskier until all subjects chose option B in decision 10.

〈Table 4-3〉 Lottery decisions and risk aversion

Risk aversion chose option A	Option A(no.)	Option B(no.)	Proportion choosing option A
1	868	72	0.923
2	858	82	0.913
3	831	109	0.884
4	710	230	0.755
5	511	429	0.544
6	360	580	0.383
7	249	691	0.265
8	154	786	0.164
9	96	844	0.102
10	0	940	0.000
	4,637	4,763	0.493

Notes: total no. of respondents*decision tasks =940*10=9,400observations.

If a subject's estimated risk avoidance coefficient is r〉0, he or she is considered risk-averse. If the subject chooses option A for more than the first 4 decisions before switching to option B, the person is risk-averse. If the subject chooses option A for the first 4 or fewer rows and then switched to option B for the remaining decisions, the person is risk-seeking.

Looking at the subjects' decision distribution, 1.06% chose option A for only the first row before switching to option B, and 2.87% chose option A for the first two rows before switching to option B. On the other end of the spectrum, 6.17% chose

option A for the first 8 rows before switching to option B, and 10.21% chose option A for the first 9 rows before switching to option B. Option A can be said to be a low-stake option, and 7.66% of the subjects chose option A for all 10 decisions.

〈Table 4-4〉 Lottery decisions and risk aversion

Unit (times, %)

Risk aversion Chose option A(times)	Proportion of choosing option A(%)	CRRA if switching to option B
1	1.06	$-\infty < r < -1.71$
2	2.87	$-1.71 < r < -0.95$
3	12.87	$-0.95 < r < -0.49$
4	21.17	$-0.49 < r < -0.15$
5	16.06	$-0.15 < r < 0.14$
6	11.81	$0.14 < r < 0.41$
7	10.11	$0.41 < r < 0.68$
8	6.17	$0.68 < r < 0.97$
9	10.21	$0.97 < r < 1.37$
10	7.66	$1.37 < r < \infty$
	100.0	

Note: total no. of respondents*decision tasks = 940*10 = 9,400 observations.
CRRA=constant relative risk aversion

A log likelihood function is used to estimate r (individual risk aversion) for the 940 respondents. Maximum likelihood estimation is applied, and the Newton-Raphson optimization method is implemented to maximize it.

The average value of CRRA is 0.258, indicating that the individuals are generally risk-averse in this decision task. The noise term was 0 on average, with a standard deviation of 1.442, indicating a regular distribution.

〈Table 4-5〉 Estimated risk preferences(1)

	Coef.	S.E	p-value	95% CI	
r					
- constant	0.258	0.022	0.000	0.215	0.301
noise					
- constant	1.442	0.064	0.000	1.316	1.568

Note: no. of observations=9,400, observations clustered around 940 individuals.
CI=confidence interval

A regression analysis that incorporates gender and age as control variables is conducted. No significant difference between genders in risk preferences is identified. However, in terms of age groups, subjects in the 30-44 year old age group were less risk-averse than those in the 65 years and older group. Similarly, subjects in the 45-60 years old age group were less risk-averse than those in the 65 years and older age group.

〈Table 4-6〉 Estimated risk preferences(2)

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.008	0.018	0.664	-0.027	0.042
	female	ref.				
age	30-44 yrs	-0.049	0.024	0.044	-0.097	-0.001
	45-64yrs	-0.050	0.023	0.030	-0.095	-0.005
	65yrs and older	ref.				
	constant	0.292	0.028	0.000	0.237	0.347
noise						
	- constant	1.445	0.065	0.000	1.318	1.572

Note: no. of observations=9,400, observations clustered around 940 individuals.
CI=confidence interval

Using the regression analysis results, the value of CRRA was estimated by gender and by age group, which are shown below. A subsequent analysis incorporating gender and age group as

control variables (i.e. omitting gender) estimates CRRA to be 0.256. This figure is close to the CRRA of 0.258, which is obtained in the regression without the control variables.

〈Table 4-7〉 Estimated CRRA by gender, age

	male	female	total	risk aversion level
30-44 yrs	0.253	0.244	0.249	2
45-64yrs	0.250	0.242	0.246	3
65yrs and older	0.300	0.292	0.295	1
total	0.259	0.254	0.256	

Note: A higher value of CRRA indicates a greater degree of risk aversion.

2. Correlation between risk preferences and health behaviors

A. Smoking status and risk preferences

Among the male subjects of the analysis, 24.26% indicated that they are daily smokers, 1.06% are occasional smokers, 13.94% are ex-smokers, and 60.74% are non-smokers who have never consumed a cigarette.

〈Table 4-8〉 Smoking status of the analysis subjects

(unit = %, KRW10,000)

		Daily smoker	Occasional smoker	Ex-smoker	Non-smoker	Total
gender	male	47.30	1.51	27.86	23.33	100.00
	female	1.89	0.63	0.42	97.06	100.00
age	30-44 yrs	31.01	0.58	11.01	57.39	100.00
	45-64yrs	22.22	1.45	14.73	61.59	100.00
	65yrs and older	16.02	1.1	17.68	65.19	100.00
spouse	no	30.77	0.55	14.29	54.4	100.00
	yes	22.69	1.19	13.85	62.27	100.00
household income	monthly average	24.26	1.06	13.94	60.74	-
total		24.26	1.06	13.94	60.74	100.00

The analysis of risk preferences based on smoking status finds that daily smokers are more risk-seeking than non-smokers. Non-smokers have an estimated CRRA of 0.260, and daily smokers have an estimated CRRA of 0.238.

〈Table 4-9〉 Estimated risk preferences

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.041	0.027	0.126	-0.012	0.093
	female	ref.				
age	30-44yrs	-0.043	0.027	0.109	-0.095	0.010
	45-64yrs	-0.046	0.025	0.065	-0.094	0.003
	65yrs and older	ref.				
spouse	yes	-0.013	0.024	0.598	-0.059	0.034
	no	ref.				
household income	monthly average	0.000	0.000	0.444	0.000	0.000
smoking status	daily smoker	-0.051	0.030	0.086	-0.109	0.007
	occasional smoker	-0.013	0.097	0.892	-0.203	0.177
	ex-smoker	-0.043	0.034	0.204	-0.109	0.023

	Coef.	S.E	p-value	95% CI	
non-smoker	ref.				
constant	0.311	0.036	0.000	0.241	0.381
noise					
- constant	1.448	0.065	0.000	1.320	1.575

Note: no. of observations =9,400, observations clustered around 940 individuals.
CI=confidence interval

〈Table 4-10〉 Estimated CRRAby smoking status

		daily smoker	occasional smoker	ex-smoker	non-smoker
gender	female	0.211	0.232	0.235	0.253
	male	0.240	0.284	0.255	0.292
age	30-44yrs	0.236	0.232	0.251	0.253
	45-64yrs	0.228	0.263	0.237	0.247
	65 yrs and older	0.281	0.319	0.292	0.302
total		0.238	0.268	0.255	0.260

Note: a higher value of CRRA indicates greater degree of risk-aversion

B. Obesity and risk preferences

In terms of the relationship between weight and risk preferences, 2.34% of the subjects in the sample are underweight, whereas 26.06% are obese (based on the classification criteria of BMI〈18.5 indicating an individual as underweight and BMI〉25 as obese).

〈Table 4-11〉 Obesity status of analysis subjects

(Unit: %, KRW10,000)

		underweight BMI 〈18.5	normal weight	obese BMI≥ 25
gender	male	1.08	66.52	32.40
	female	3.56	76.52	19.92
age	30-44yrs	2.90	72.46	24.64
	45-64yrs	2.17	73.67	24.15
	65yrs and older	1.66	65.19	33.15
spouse	no	2.75	63.19	34.07
	yes	2.24	73.61	24.14
household income	monthly average	295.4	341.5	313.4
total		2.34	71.60	26.06

The analysis does not find a significant difference in risk preferences between subjects with a normal BMI and obese subjects. Nevertheless, the estimates suggest that obese subjects may be slightly more risk-seeking than their counterparts with a normal BMI.

〈Table 4-12〉 Estimated risk preferences

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.009	0.018	0.630	-0.026	0.043
	female	ref.				
age	30-44yrs	-0.048	0.027	0.073	-0.100	0.004
	45-64yrs	-0.049	0.025	0.049	-0.098	0.000
	65yrs and older	ref.				
spouse	yes	-0.008	0.023	0.730	-0.054	0.038
	no	ref.				
household income	monthly average	0.000	0.000	0.510	0.000	0.000
BMI	underweight	0.058	0.067	0.387	-0.073	0.189
	Normalweigh	ref.				

	Coef.	S.E	p-value	95% CI	
t					
obese	-0.011	0.021	0.600	-0.053	0.031
constant	0.307	0.036	0.000	0.236	0.379
noise					
- constant	1.450	0.065	0.000	1.322	1.577

Note: no. of observations =9,400, observations clustered around 940 individuals.
CI=confidence interval

〈Table 4-13〉 Estimated CRRA by BMI level

		underweight BMI 〈18.5	normal weight	obese BMI ≥25
gender	female	0.305	0.249	0.252
	male	0.324	0.259	0.248
age	30-44yrs	0.300	0.247	0.241
	45-64세lyrs	0.303	0.242	0.235
	65yrs and older	0.359	0.299	0.287
total		0.309	0.254	0.250

Note: ahigher value of CRRA indicates a greater degree of risk aversion.

C. Alcohol consumption pattern and risk preferences

The subjects' drinking habits are examined. In the sample, 65.21% of the subjects engaged in drinking fewer than 4 times a month, 25.32% engaged in drinking 1-3 times a week, and 9.47% engaged in drinking more than four times a week.

〈Table 4-14〉 Alcohol consumption pattern of the analysis subjects

(Unit = %, KRW 10,000)

		Less than 4 times/month	1-3times/week	4 times or more/week
gender	male	45.57	38.23	16.20
	female	84.28	12.79	2.94
age	30-44yrs	58.55	34.20	7.25
	45-64yrs	65.94	22.95	11.11
	65yrs and older	76.24	13.81	9.94
spouse	no	62.64	23.63	13.74
	yes	65.83	25.73	8.44
household income	monthly average	321.6	376.3	295.4
total		65.21	25.32	9.47

A regression analysis is performed that includes alcohol consumption levels, with the reference group being drinking less than 4 times/month. The results show that those who engage in drinking 1-3 times a week are the most risk-seeking, followed by those who engage in drinking 4 times or more weekly.

The estimated value of CRRA based on the above results is 0.257 for those who engage in drinking behavior less than 4 times a month. Those who engage in drinking 1-3 times a week have an estimated CRRA of 0.245.

〈Table 4-15〉 Estimated risk preferences

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.011	0.019	0.569	-0.026	0.048
	female	ref.				
age	30-44yrs	-0.042	0.027	0.114	-0.094	0.010
	45-64yrs	-0.046	0.025	0.065	-0.094	0.003
	65 yrs and older	ref.				
spouse	yes	-0.006	0.023	0.807	-0.050	0.039
	no	ref.				
household income	monthly average	0.000	0.000	0.495	0.000	0.000
drinking	Less than 4 times/month	ref.				
	1-3 times/week	-0.010	0.023	0.671	-0.054	0.035
	4 times or more/week	-0.016	0.033	0.624	-0.080	0.048
	constant	0.303	0.034	0.000	0.235	0.370
noise						
	- constant	1.452	0.065	0.000	1.324	1.580

Note: no. of observations=9,400, observations clustered around 940 individuals.
CI=confidence interval

〈Table 4-16〉 Estimated CRRA by drinking pattern

		less than 4 times/month	1-3 times/week	4 or more times/week
gender	female	0.253	0.235	0.245
	male	0.265	0.248	0.248
age	30-44yrs	0.250	0.242	0.241
	45-64yrs	0.243	0.237	0.236
	65yrs and older	0.296	0.290	0.284
total		0.257	0.245	0.247
risk avoidance level		1	3	2

Note: ahigher value of CRRA indicates a greater degree of risk aversion.

2. Relationship between risk preferences and chronic disease management

Among the analysis subjects, 21.17% have hypertension and 7.66% have diabetes.

〈Table 4-17〉 Distribution of hypertension and diabetes among subjects 30years and older

(unit = %, persons)

		Hypertension	Diabetes
gender	male	19.65	9.50
	female	22.64	5.87
age	30-44yrs	6.38	2.61
	45-64yrs	19.81	7.25
	65yrs and older	52.49	18.23
	total	21.17	7.66
Patients(persons)		199	72

A. Disease management among hypertensive subjects

A risk preference analysis is performed based on the hypothesis that a subject's risk preferences vary depending on whether or not they are diagnosed with hypertension. However, no significant difference is identified in risk preferences between subjects with hypertension and those without.

〈Table 4-18〉 Estimated risk preference

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.007	0.018	0.702	-0.028	0.041
	female	ref.				
age	30-44yrs	-0.050	0.029	0.085	-0.106	0.007
	45-64yrs	-0.051	0.026	0.053	-0.103	0.001
	65yrs and older	ref.				
spouse	yes	-0.005	0.023	0.841	-0.049	0.040
	no	ref.				
household income	monthly average	0.000	0.000	0.458	0.000	0.000
hypertension	yes	-0.013	0.023	0.576	-0.059	0.033
	no	ref.				
	constant	0.309	0.037	0.000	0.236	0.381
noise						
- constant		1.451	0.065	0.000	1.323	1.578

Note: no. of observations=9,400, observations clustered around 940 individuals.
CI=confidence interval

〈Table 4-19〉 Estimated CRRA by hypertension status

		Negative hypertension diagnosis	Positive hypertension diagnosis
gender	female	0.248	0.260
	male	0.255	0.261
age	30-44yrs	0.247	0.246
	45-64yrs	0.243	0.232
	65 yrs and older	0.301	0.289
	total	0.252	0.261

Note: a higher value of CRRA indicates a greater degree of risk aversion.

Medication compliance of the subjects diagnosed with hypertension is hypothesized to be a reflection of their individual risk preferences. Based on this, a risk preference estimation model is implemented to analyze the risk preferences of the

subjects with hypertension. Results of the analysis are as follows.

Subjects who take their blood pressure medication daily (as directed)are found to be slightly more risk-averse than those who only occasionally or never adhere to their medication regimen. Based on these results, the estimated CRRA of subjects who took their daily medication as directed is 0.301, and the CRRA of those who only occasionally or never adhere to their medication regimen is 0.258.

〈Table 4-20〉 Estimated risk preference by hypertension management status

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.001	0.039	0.972	-0.074	0.077
	female	ref.				
age	30-44yrs	-0.050	0.075	0.510	-0.197	0.098
	45-64yrs	-0.083	0.045	0.067	-0.171	0.006
	65yrs and older	ref.				
spouse	yes	0.048	0.046	0.293	-0.042	0.138
	no	ref.				
household income	monthly average	0.000	0.000	0.885	0.000	0.000
hypertension	take medication daily	0.023	0.057	0.687	-0.088	0.134
	tale medication occasionally or never	ref.				
	constant	0.272	0.081	0.001	0.114	0.430
noise						
	- constant	1.325	0.143	0.000	1.045	1.605

Note: no. of observations =9,400, observations clustered around 940 individuals.
CI=confidence interval
Because the number of subjects who only occasionally followed the daily medication regimen is not significant, they are included in the group of those that never adhere to their medication regimen.

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〈Table 4-21〉 Estimated CRRA by hypertension management status

		daily compliance	occasional compliance or no compliance
gender	female	0.297	0.272
	male	0.305	0.248
age	30-44yrs	0.303	0.252
	45-64yrs	0.262	0.239
	65yrs and older	0.330	0.323
	total	0.301	0.258
risk aversion level		1	2

Note: a higher value of CRRA indicates a greater level of risk aversion.
Because the number of subjects who only occasionally followed the daily medication regimen is not significant, they are included in the group of those that never adhere to their medication regimen.

B. Disease management among diabetic subjects

Subjects' risk preferences are examined based on whether or not they have been diagnosed with diabetes. The results indicate that those with diabetes are more risk-seeking than their non-diabetic counterparts. The estimated CRRA of those with diabetes is 0.266.

〈Table 4-22〉 Estimated risk preference

		Coef.	S.E	p-value	95% CI	
r						
gender	male	0.007	0.018	0.694	-0.028	0.041
	female	ref.				
age	30-44yrs	-0.044	0.027	0.097	-0.096	0.008
	45-64yrs	-0.047	0.025	0.060	-0.096	0.002
	65yrs and older	ref.				
spouse	yes	-0.005	0.023	0.823	-0.050	0.040
	no	ref.				
household income	monthly average	0.000	0.000	0.482	0.000	0.000
diabetes	yes	-0.004	0.035	0.906	-0.072	0.064
	no	ref.				
	constant	0.302	0.035	0.000	0.234	0.371
noise						
- constant		1.451	0.065	0.000	1.323	1.578

Note: no. of observations =9,400, observations clustered around 940 individuals.
CI=confidence interval

〈Table 4-23〉 Estimated CRRA by diabetes status

		Negative diabetes diagnosis	Positive diabetes diagnosis
gender	female	0.250	0.265
	male	0.255	0.267
age	30-44yrs	0.246	0.260
	45-64yrs	0.242	0.240
	65yrs and older	0.295	0.291
total		0.253	0.266
risk aversion level		2	1

Note: a higher value of CRRA indicates a greater level of risk aversion.

As is the case with the hypertensive subjects, the correlation between a diabetic subject's risk preference sand their disease management style is analyzed. The subjects are divided into those who routinely manage blood sugar with medication or injection and those who occasionally forget to adhere to the

regimen or do not adhere to the regimen at all.

The subjects who responded as being in regular compliance with the management regimen are found to be more risk-averse.

The estimated value of CRRA based on the above results is 0.341 for those who conscientiously managed their condition and 0.139 for those who did not.

〈Table 4-24〉 Estimated risk preferences by diabetes management status

		Coef.	S.E	p-value	95% CI	
r						
gender	male	-0.006	0.066	0.923	-0.135	0.123
	female	ref.				
age	30-44yrs	-0.115	0.131	0.383	-0.372	0.143
	45-64yrs	0.071	0.081	0.379	-0.087	0.229
	65yrs and older	ref.				
spouse	yes	-0.165	0.097	0.090	-0.355	0.026
	no	ref.				
household income	monthly average	0.000	0.000	0.785	-0.001	0.000
diabetes	daily management	0.180	0.060	0.003	0.062	0.299
	occasional management	ref.				
	constant	0.278	0.154	0.071	-0.024	0.580
noise						
- constant		1.485	0.268	0.000	0.959	2.011

Note: no. of observations=9,400, observations clustered around 940 individuals.
CI=confidence interval

〈Table 4-25〉 Estimated CRRA by diabetes management status

		daily management	occasional management
gender	female	0.327	0.157
	male	0.307	0.127
age	30-44yrs	0.269	-0.039
	45-64yrs	0.335	0.170
	65yrs and older	0.312	0.136
	total	0.314	0.139
risk aversion level		1	2

Note: ahigher value of CRRA indicates a greater level of risk-aversion.

Section 3. Sintering

People's risk preferences influence their health behaviors, including the utilization of preventative healthcare services, smoking, excessive drinking, private insurance purchase decisions, and frequency of health examinations. Despite the significant effect that risk preferences have on an individual's health, attempts to measure them have been insufficient.

In this chapter, Holt and Laury(2002)'s lottery choice decision task, which is one method to elicit an individual's risk preferences, is adopted in order to examine the correlation between an individual's health behaviors and chronic disease management.

This study finds that estimates of risk preferences can allow for the prediction of health risk behaviors. Risk preferences are one of the factors that can contribute to successful smoking cessation. As such, it is a variable that must be considered in

designing public health policy promoting smoking cessation, in addition to other traditional factors that have been incorporated in policy, including self-efficacy, past smoking history, and nicotine replacement therapy.

Additionally, hypertensive patients who follow their medication regimen daily are more risk-averse than those who occasionally or never followed their medication regimen. Similarly, diabetic patients who reported to be engaged in daily management of their condition were more risk-averse than their less-compliant counterparts.

If current public health policies or chronic disease management policies are based on differences in gender, age, and income, a new strategic approach may need to be considered. In other words, a constant analysis of individual preferences may be exploited to incentivize behavioral changes by implementing some form of libertarian intervention tailored to suit individual preferences even among the same gender, age, and income peers. The term "libertarian" here implies that individuals' choices are constrained to the least extent possible. In contrast to direct regulations, people's freedom of choice is respected and guaranteed to the fullest extent, and, rather than being coerced, people are naturally led to make better decisions.

In addition to direct regulations, such as prohibiting smoking in public places and increasing the price of cigarettes, reducing

public exposure to lighters and cigarettes, and promoting a non-smoking culture are needed in an effort to encourage people's autonomous and rational decision making.

〈Table 4-26〉 Libertarian intervention vs. regulations

Behavior	Libertarian intervention(nudging)	Regulations
smoking	‣ Increase exposure of non-smokers and non-smoking culture through mass media ‣ Reduce exposure of paraphernalia including lighters and cigarettes	‣ Prohibit smoking in public places ‣ Increase the price of cigarettes
drinking	‣ Reduce the size of drinking glasses. Campaign through the media that the majority do not engage in excessive drinking to promote reduction in excessive drinking	‣ Increase the legal age limit for drinking
diet	‣ Design shopping bags which can encourage purchasing fruits and vegetables Offercelery as a substitute for French fries on menus	‣ Limit food advertisement targeting children and teenagers ‣ Control production of food products containing trans fat
exercise	‣ Design buildings which promote the use of stairs ‣ Increase short-term bike rentals	‣ Enforce drop-off and pick-up areas in school zones

Furthermore, strategies need to account for behavioral differences between chronic disease patients who readily comply with their therapeutic regimen(risk-averse)and for those who do not.

5 Conclusion and Policy Implications

5 Conclusion and Policy Implications

According to the OECD, chronic diseases are a major cause of death and disability around the globe. Chronic diseases are responsible for 60% of deaths around the world. At 30 deaths per 100,000 population, Korea's diabetes mortality rate is 2–3 times greater than the OECD average. The mortality rate associated with cerebrovascular diseases is 53.2 deaths out of 100,000 population for 2010, ranking as the second leading cause of deaths in Korea following cancers. Strokes, in particular, have a high rate of complications and thus significantly increase healthcare costs.

In Chapter 2 of this study, a future projection of lifestyle diseases in Korea, based on the health insurance statistics data compiled since 2001, is developed. The ARIMA model predicts that healthcare costs associated with lifestyle diseases will continue to increase beyond 2030. Clearly, strategies are needed that reduce the number of individuals affected with lifestyle diseases via primary and secondary prevention and that halt the growth of mounting healthcare costs.

More efforts are needed to prevent lifestyle diseases by reducing risk factors by encouraging lifestyle changes. In the case that an individual already has a chronic condition, managing

the condition is vital to prevent complications. Complications tend to incur a great deal of financial burden. Consider the following statistics regarding complications. In 2010,4.1% of diabetic patients 30 years of age and older did not have complications associated with the condition, whereas 4.1% did. The percentage of hypertensive patients that did not have complications is 15.6%, whereas 3.9% did. The per-person annual treatment cost for diabetes without complications is KRW 320,000. On the other hand, the same figure is twice as great for diabetes with complications at about KRW 670,000 annually.

A logistic regression analysis is performed with data on subjects who had a health examination between 2002 and 2003and who also did not have diabetes, hypertension, dyslipidemia, ischemic heart disease, or stroke in order to determine whether they have developed a lifestyle disease by 2010. Results of the analysis indicate that individuals who have risk factors for lifestyle diseases in the past had a higher likelihood of developing a lifestyle disease by 2010. For instance, obese subjects with a BMI≥25 were twice as likely to develop diabetes, and the risk for subjects with hypertension was 1.5 times greater than the average.

Finally, the correlation between individual risk preferences and health risk behaviors, such as smoking, drinking, and obesity, as well as the correlation between lifestyle disease patients' risk preferences and therapeutic compliance, were ex-

amined with in order to estimate a parameter with which to improve therapeutic compliance. The average CRRA of the study sample is 0.258, which indicates risk-aversion.

An analysis of risk preferences based on smoking habits finds that daily smokers are more risk-seeking than non-smokers. Another analysis based on drinking habits finds that individuals who engage in drinking 1-3 times a week are the most risk-seeking, followed by those who engage in drinking 4 times or more a week.

Subjects who take blood pressure medication daily are found to be relatively risk-averse compared to those who only occasionally or never adhere to the medication regimen. The estimated CRRA of the subjects with daily compliance was 0.301, and the figure for the subjects with occasional or no compliance was 0.258. In addition, subjects who regularly adhere to their daily medication regimen are found to be more risk-averse than those who do not. The estimated value of CRRA for the diabetic subjects who adhered to their daily medication regimen is 0.314, and the CRRA for those who only occasionally followed the medication regimen is 0.139, a statistically significant difference.

The current smoking rate among Korean male adults is the highest of all OECD nations (Korea Health Promotion Foundation, 2013),[23] and high-risk drinking is also at a con-

23)Korea Health Promotion Foundation, Tobacco Control Issue Report, 2013.

cerning level (Korea Centers for Disease Control, 2012; Jung et al. 2012).[24),25)] Furthermore, the rates of smoking and high risk drinking have remained steady during recent years. The fact that various policies and strategies so far have been unable to improve the situation merits a consideration of a new approach. One explanation for the discrepancy between the desire for health and real-life decisions is that individuals may have an inability for self-control or might procrastinate important activities. In other words, some individuals tend to engage in behaviors that impede a healthy life. Despite the fact that smoking, excessive drinking, gambling, and drug use are known to be addictive, some individuals continue to make decisions that negatively affect our health. Therefore, new ways to increase policy acceptance and reduce social costs by changing people's perception and behaviors related to health need to be explored.

- The need for a policy direction that can directly promote changes in health behaviors
- The need to adopt a policy method that can effectively encourage people to make healthy choices, considering the tendency to make unhealthy decisions
- The need to adopt an approach that acknowledges and

24) Korea Centers for Disease Control, National Health Statistics, 2012.
25) Jung et al., Social/economic cost of excessive drinking and cost effectiveness analysis for prevention projects against its harmful effects., Korea Institute for Health and Social Affairs· Korea Health Promotion Foundation, 2012.

utilizes the psychological aspect involved, as evaluating acceptability of a policy inevitably involves cognitive and psychological factors

- The need to establish an effective foundation from which to facilitate behavioral changes in ways that are desired

If everybody made rational decisions all the time based on the available information, then beneficial health information, promotion, and campaigning would be more than useful. In reality, however, many people do not make rational decisions. Even worse, we tend to repeat the same irrational decisions.

In order to encourage positive changes in an individual's health behavior despite our irrational and repetitive decision-making tendency, a nudging policy may be needed in addition to incentive-based policies designed to influence the marginal cost and benefit associated with such decisions.

"Nudge" means a gentle elbow poke and has the connotation of bringing someone back to his/her senses or directing them towards a certain decision. In economics, it implies that people can be encouraged to make desirable modifications in their behavior through little adjustments in specific circumstances rather than through direct regulations or policies. In other words, it entails guaranteeing an individual's choices as much as possible but framing decision making situations in ways that individuals prefer to make healthier choices(Tharler et al, 2009).

Strategies that legislators can implement that influence people's choices are an example of nudging. For instance, there is a study in which food arrangement and counter height in an elementary school cafeteria were modified to identify whether these influence students' food choices. The field experiment found that simply by rearranging the placement of food items (French fries, vegetables, etc.) they could change the consumption of certain food items by 25%.

This case study shows that a little intervention, such as the rearrangement of food items offered, can change students' food consumption patterns.

Unlike strategies which eliminate unhealthy choices altogether or impose higher taxes on unhealthy food, strategies such as the one presented above guarantees diversity of choices and can achieve the goals far more effectively and efficiently.

Nudging is based on the premise that choices are not necessarily the products of our cognition, but of the environment(s) we live in. As such, the concept challenges the existing cognition-behavior model, which claims that we make the right decisions based on our cognition. Rather than prohibiting soda vending machines from elementary schools, "libertarian intervention" respects and guarantees individual choices and offers opportunities to make better choices.

Libertarian intervention, such as nudging, encourages people

to make better choices on their own volition rather than to force them to make particular choices, which minimizes resistance and cost associated with intervention. The applicability of nudging's in policy proposal and implementation may be seen by the fact it can change people'sreactionsvia steady exposure to the advantages a certain policy can offer.

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