Conducting a national burden of disease study in South Korea: *From past to present*

Seok-Jun Yoon *M.D., Ph.D.*

➢ Professor, Dept. of Preventive Medicine, College of Medicine, Korea University
➢ Dean, Graduate School of Public Health, Korea University

Principle Investigator, the Korean National Burden of Disease (KNBD) study, Ministry of Health and Welfare

Outline

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History of KNBD study

History of the KNBD study

A Study of Research Methodology and Long-Term Planning Regarding the Estimation of the Economic Burden of Major Disease in Korea 2007
(S-J Yoon et al., 2009)

A Study of the Development of a Health Status Measurement Platform for the Implementation of Precision Public Health in Korea
(S-J Yoon et al., 2019)

Estimating the burden of non-communicable diseases alone

Estimating the burden of all diseases and injuries and healthy life expectancy (HALE)

2007

2016~

HISTORY

2002

2012

The Burden of Disease in Korea 2002
(S-J Yoon et al., 2005)

A Study on Measuring and Forecasting the Burden of Disease in Korea 2012
(S-J Yoon et al., 2015)

Estimating the burden of approximately 130 diseases

Estimating the burden of diseases and the economic burden of all diseases and injuries (260)

Increase in the target diseases since 2002: 130('02) ⋯→ 260('12~)

Modification of the methodology for considering the Korean-specific context

- ✓ Data: aggregated data ⋯→ individual data *(reconstruction with cohort data using personal ID)*

- ✓ Disability Weight (DW): subdivide the disease category and quantitative expansion of the survey

Budget for KNBD study

KNBD 2012 **(launched in 2013/**measurement from 2012 to 2015)

The Korean National Burden of Disease (KNBD) study

- Initiated by the **Research and Development Project of the Ministry of Health and Welfare**
- Funded by a 5-year grant from 2013 to 2018
- Research grant: **$2.1 million over 5 years**

KNBD 2016 **(launched in 2018**/measurement from 2016 to 2018)

The Korean National Burden of Disease (KNBD) and Health-Adjusted Life Expectancy (HALE) study

- ❖ *Extension of research to measure the sub-national burden of disease and HALE*
- Initiated by the **Research and Development Project of the Ministry of Health and Welfare**
- Funded by a 3-year grant from 2018 to 2020
- Research grant: **$1.6 million over 3 years**

KNBD study *vs.* GBD study

Difference in DALY measurement perspective

- Data from GBD are from a prevalence-based perspective
- Data from KNBD are from an incidence-based perspective

GBD study *vs.* KNBD study

Differences in purpose of using results

- Data from the GBD are for international comparisons
- Data from the KNBD measure the gap between sub-national groups, income level, *etc.*

KNBD study best for Korean-specific analyses

- Uses detailed **Korean data** (*less modeling required*)
  - ✓ Based on high-level access to medical services and coverage rates for health care
  - ✓ Survey data are not used due to concerns about overestimation
- Based on assumptions relevant to Korea
- Epidemiology data reviewed by Korean experts
- Use of DW developed by Korean medical experts
- Includes sub-national and socio-demographic estimates
- High level of transparency of input data

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Methods

Data for measuring input parameters

Database

- Uses **national representative data sources** to estimate epidemiological parameters

  - **Population**
    - Residents registered with the Ministry of the Interior

  - **Mortality and life expectancy**
    - Cause of death statistics and life expectancy tables from Statistics Korea

  - **Non-fatal health loss**
    - National Health Insurance Service (NHIS) claims big data *(except Oriental medicine claims)* → Cohort data re-construction using individual level claims data
    - National Injury Hospital Discharge Survey from the Ministry of Health and Welfare

Length of duration and age of onset

- Estimate using DISMOD-II program by WHO

- particularly for infectious diseases
  ⋯→ directly calculated them using the claims data (cohort data)
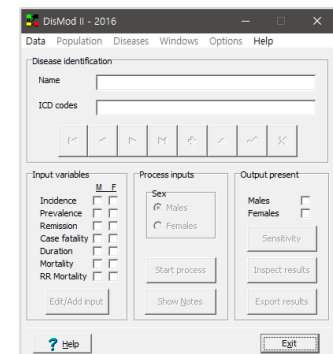
Disease and injury categories

- Causes are structured with use of a 4-level classification hierarchy to produce levels that are mutually exclusive and collectively exhaustive

  ✓ Every cause was defined by ICD-10 code

- Hierarchical structure

  total: 313

  ➢ Level 1 (3) > Level 2 (21) > Level 3 (165) and Level 4 (123)

    ex] Level 1: a) communicable, maternal, neonatal, and nutritional conditions (CMNN)

    b) non-communicable diseases (NCD)

    c) injuries (INJ)

1분류	2분류	3분류	4분류	ICD-10 CODE

Communicable, maternal, neonatal, and nutritional disorders
HIV/AIDS and tuberculosis
Tuberculosis
HIV/AI...

1분류	2분류	3분류	4분류	ICD-10 CODE

Non-communicable diseases
Diarrhea, lowe... Neoplasms
Diarrh... Esophageal cancer
Stomach c...
Liver canc...
Larynx ca...

1분류	2분류	3분류	4분류	ICD-10 CODE

Injuries
Trachea, b...
Breast car... Transport injuries
Cervical ca... Road injury
Uterine ca... Pedestrian injury by road vehicle — V01, V02, V03, V04, V06, V09
Prostate c... Pedal cycle vehicle — V10, V11, V12, V13, V14, V15, V16, V17, V18, V19
Colon and Motorized vehicle with two wheels — V20, V21, V22, V23, V24, V25, V26, V27, V28, V29
Mouth ca... Motorized vehicle with three or more wheels — V30, V31, V32, V33, V34, V35, V36, V37, V38, V39, V40, V41, V42, V43, V44, V45, V46, V47, V48, V49, V50, V51, V52, V53, V54, V55, V56,
Nasophar... Road injury other — V80, V82
Cancer of Other transport injury — V05, V81, V83, V84, V85, V86, V882 V883 V91, V93, V94, V95, V96, V97, V98
Typho Gallbladd Unintentional injuries other than transport injuries
Lower Pancreatic Falls — W00, W01, W02, W03, W04, W05, W06, W07, W08, W09, W10, W11, W12, W13, W14, W15, W16, W17, W18, W19
Malignant Drowning — V90, V92, W65, W66, W67, W68, W69, W70, W73, W74
Non-mela Fire, heat and hot substances — X00, X01, X02, X03, X04, X05, X06, X08, X09, X10, X11, X12, X13, X14, X15, X16, X17, X18, X19
Ovarian c Poisonings — X46, X47, X48, X40, X43, X44
Upper Testicular Exposure to mechanical forces
Otitis Kidney an Mechanical forces (firearm) — W32, W33, W34
Menin Mechanical forces (other) — W24, W25, W26, W27, W28, W29, W30, W31, W45, W46, W20, W22, W23, W36, W37, W40, W41, W35, W38
O... W24, W25, W26, W27, W28, W29, W30, W31, W45, W46
Adverse effects of medical treatment — Y40, Y41, Y42, Y43, Y44, Y45, Y46, Y47, Y48, Y49, Y50, Y51, Y52, Y53, Y54, Y55, Y56, Y57, Y58, Y59, Y60, Y61, Y62, Y63, Y64, Y65, Y66,
Bladder c Animal contact
Brain and Animal contact (venomous) — X20, X21, X22, X23, X24, X25, X26, X27, X28, X29
Thyroid c Animal contact (non-venomous) — W53, W54, W55, W56, W57, W58, W59, W60, W64
Encepl Hodgkin's Unintentional injuries not classified elsewhere — W21, W39, W44, W49, W50, W51, W52, W75, W76, W77, W78, W79, W80, W81, W83, W84, W85, W86, W87, W88, W89, W90, W91,
Diphth Non-Hod... Self-harm and interpersonal violence
Whoo Multiple r Self-harm — X70, X76, X77, X72, X73, X74, X68, X71, X75, X78, X79, X80, X81, X82, X83, X60, X61, X62, X63, X64, X65, X66, X67, X69
Tetan Leukemia Interpersonal violence
Meas Bone and Assault by firearm — X93, X94, X95
Varicel Benign ne Assault by sharp object — X99
Neglected tro... Other nec Assault by other means — X85, X86, X87, X88, X89, X90, X91, X92, X96, X97, X98, Y00, Y01, Y02, Y03, Y04, Y05, Y06, Y07, Y08
Malari Cardiovascular an Forces of nature, war, and legal intervention
Chaga Rheumati Exposure to forces of nature — X30, X31, X32, X33, X34, X35, X36, X37, X38, X39
Leishm Ischemic... Collective violence and legal intervention — Y36, Y891 Y35, Y890
Cerebrovascular disease
Ischemic stroke — I63, I65, I66, I670, I671, I672, I673, I675, I676, I677, I678, I679, I693
Hemorrhagic and other non-ischemic stroke — I60, I61, I62, I690, I691, I692, I674

Cause of death

- Redistribution of deaths assigned to ICD codes that cannot be the underlying cause of death

  ✓ The algorithm for garbage code redistribution was developed based on the GBD 2010 and 2013 Study methodologies, the New Zealand Burden of Disease Study report, and the Korean Standard Classification of Diseases-6

- The proportion of garbage code deaths was 24.6% in 2010, 25.2% in 2012, South Korea
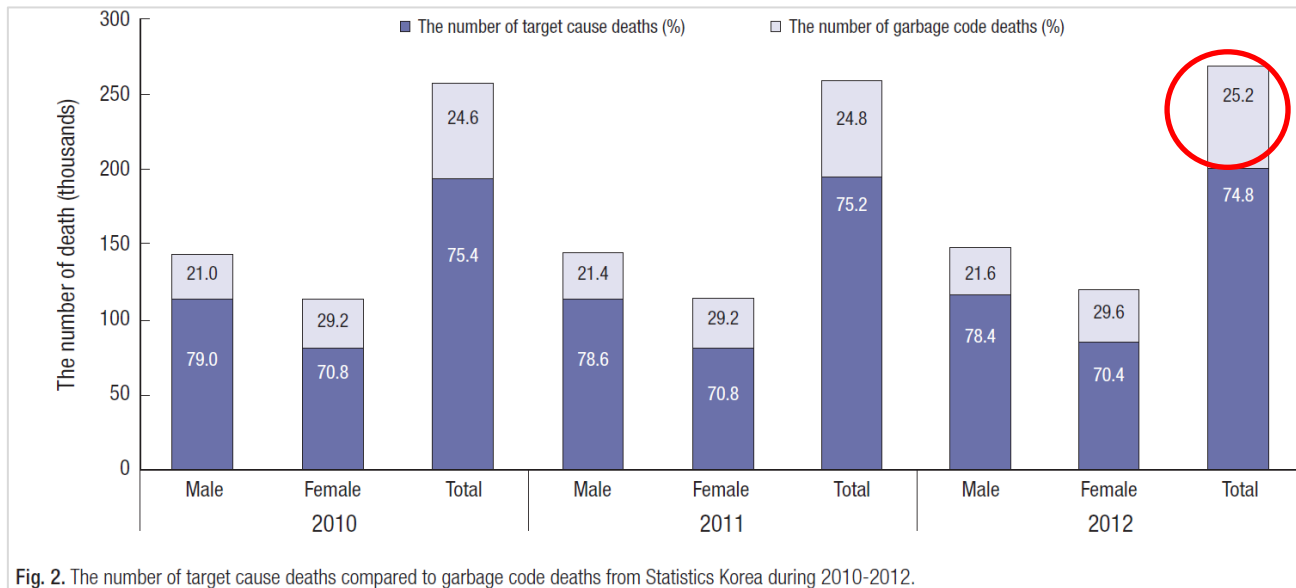

Fig. 2. The number of target cause deaths compared to garbage code deaths from Statistics Korea during 2010-2012.

※ Reference:

Lee Y-R, et al. "**Application of a Modified Garbage Code Algorithm to Estimate Cause-Specific Mortality and Years of Life Lost in Korea,**"

Journal of Korean Medical Science, 2016;31 Suppl 2

Disability Weights (DWs)

- Used to estimate DWs, which reflect the unique social and cultural context of Korea

  - Survey to derive cause-specific DWs

    - Methods: A self-administered web-based survey employing a **ranking method**

    - Participants: Total of 901 participants (Doctors, nurses and medical students 3rd year or higher)

    - A total of 313 causes of disease were used in this survey

  - Survey step using ranking method

    - The participants ranked the five listed causes of disease in order of good health, considering the seriousness of the physical and mental problems caused by the diseases

      - ✓ The descriptions of the causes of disease were not presented to the participants, and they judged the severity by looking at the names of the presented causes of disease

    - Participants conducted a total of 20 ranking methods to evaluate five alternatives.

    - Among the 311 causes of disease (excluding "full health" and "being dead"), five randomly selected causes of disease were given to participants for each ranking method question

      - ❖ However, "full health" was fixed as the first cause of disease in question 1 and fifth cause of disease in question 11. Similarly, "being dead" was fixed as the first cause of disease in question 5, the fifth cause of disease in question 10, the first cause of disease in question 15, and the fifth cause of disease in question 20
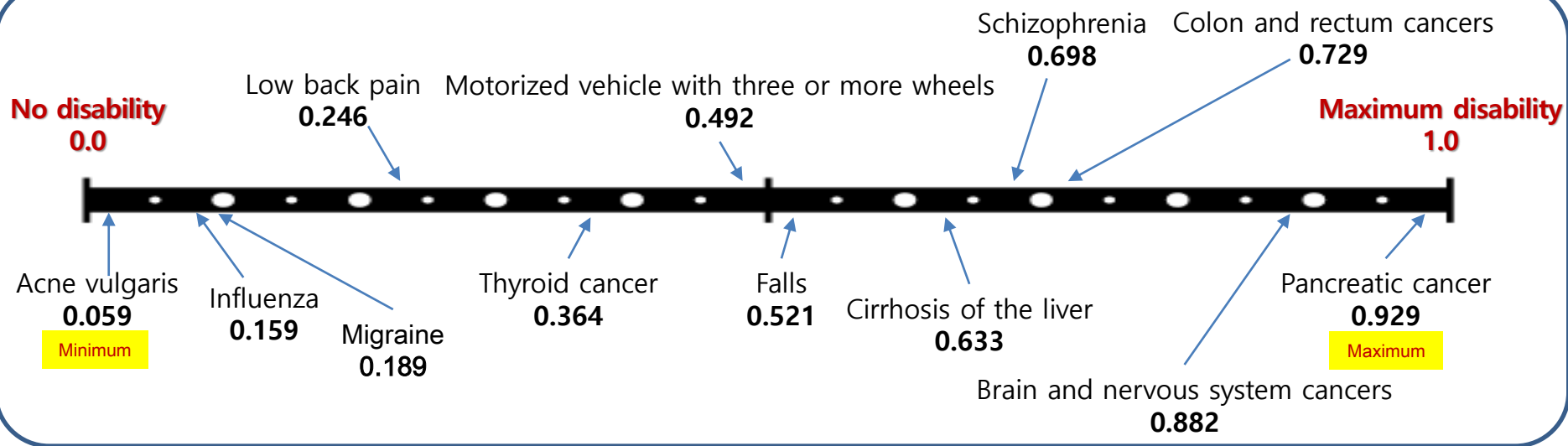
Disability Weights (DWs)

Questionnaire — *Please order in a better health condition.*

Ranking 1: D
Ranking 2: E
Ranking 3: A
Ranking 4: C
Ranking 5: B

A. Malaria
B. Almost death
C. Leukemia
D. Diabetes mellitus
E. Alzheimer's disease and other dementias

No disability 0.0

Maximum disability 1.0

Acne vulgaris 0.059 — Minimum

Influenza 0.159

Migraine 0.189

Low back pain 0.246

Thyroid cancer 0.364

Motorized vehicle with three or more wheels 0.492

Falls 0.521

Cirrhosis of the liver 0.633

Schizophrenia 0.698

Colon and rectum cancers 0.729

Brain and nervous system cancers 0.882

Pancreatic cancer 0.929 — Maximum

※ Reference:

Kim YE, et al. "**Updating Disability Weights for Measurement of Healthy Life Expectancy and Disability-Adjusted Life Year in Korea,**" *Journal of Korean Medical Science*, 2020 Jul;35(27)
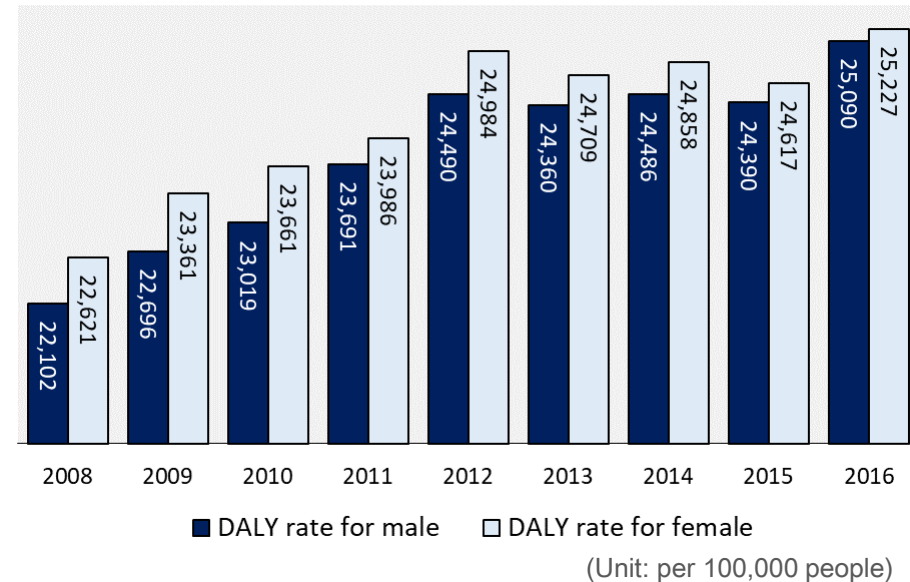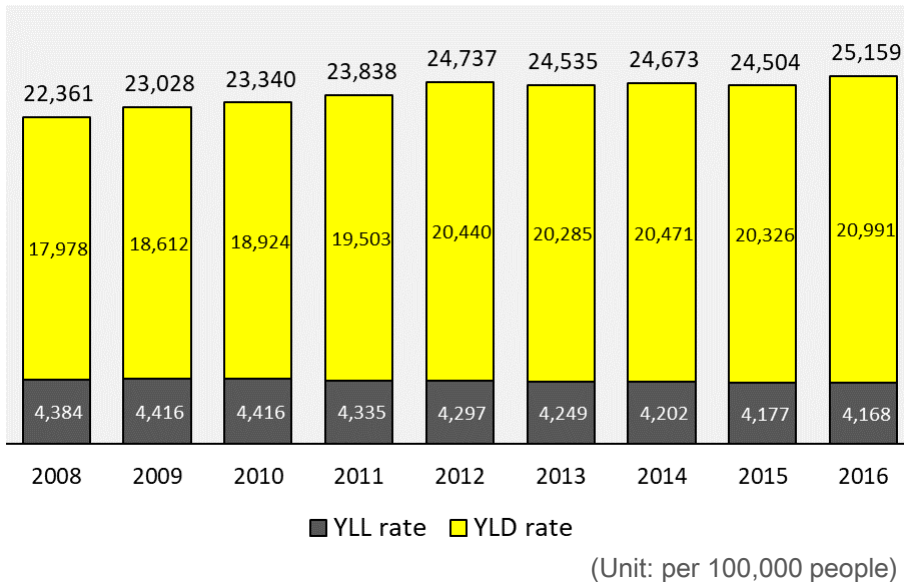
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Results & Challenges

Results

Trend of the DALY rate (per 100,000 person) **in Korea, 2008–2016**

- The DALY rate is steadily increasing
  - ➢ The YLL rate is slowly decreasing but the YLD rate is increasing
    - ➡ The growth in the YLD rate is faster than that of the YLL rate
- The DALY rate for females is higher than that for males
  - ➢ The gap between males and females is decreasing

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total	22,361	23,028	23,340	23,838	24,737	24,535	24,673	24,504	25,159
YLD rate	17,978	18,612	18,924	19,503	20,440	20,285	20,471	20,326	20,991
YLL rate	4,384	4,416	4,416	4,335	4,297	4,249	4,202	4,177	4,168

■ YLL rate   ■ YLD rate

(Unit: per 100,000 people)

	2008	2009	2010	2011	2012	2013	2014	2015	2016
DALY rate for male	22,102	22,696	23,019	23,691	24,490	24,360	24,486	24,390	25,090
DALY rate for female	22,621	23,361	23,661	23,986	24,984	24,709	24,858	24,617	25,227

■ DALY rate for male   □ DALY rate for female

(Unit: per 100,000 people)

Results

Leading specific causes of burden: 2008 vs. 2016

- The top 20 diseases accounted for around 58% of the total DALY rate in 2008 and 2016

| Leading causes 2008	% DALY	Leading causes 2016	% DALY
1 Diabetes mellitus	7.4	1 Diabetes mellitus	7.6
2 Asthma	5.0	2 Low back pain	5.8
3 Chronic obstructive pulmonary disease	4.8	3 Chronic obstructive pulmonary disease	5.1
4 Low back pain	4.5	4 Ischemic heart disease	4.4
5 Ischemic heart disease	3.7	5 Osteoarthritis	4.0
6 Cirrhosis of the liver	3.7	6 Ischemic stroke	3.8
7 Ischemic stroke	3.6	7 Cirrhosis of the liver	3.5
8 Osteoarthritis	3.6	8 Falls	3.1
9 Motorized vehicle with three or more wheels	2.6	9 Periodontal disease	2.3
10 Self-harm	2.4	10 Major depressive disorders	2.2
11 Falls	2.3	11 Alzheimer's disease and other dementias	2.2
12 Major depressive disorders	1.7	12 Self-harm	1.9
13 Gastritis and duodenitis	1.7	13 Motorized vehicle with three or more wheels	1.9
14 Hypertensive heart disease	1.6	14 Asthma	1.8
15 Hemorrhagic and other non-ischemic stroke	1.6	15 Hemorrhagic and other non-ischemic stroke	1.4
16 Peptic ulcer disease	1.6	16 Trachea, bronchus and lung cancers	1.4
17 Schizophrenia	1.5	17 Tubulointerstitial nephritis, pyelonephritis, and urinary tract infections	1.4
18 Dental caries	1.5	18 Schizophrenia	1.3
19 Tubulointerstitial nephritis, pyelonephritis, and urinary tract infections	1.5	19 Gastroesophageal reflux disease	1.3
20 Stomach cancer	1.5	20 Benign prostatic hyperplasia	1.3

Communicable, maternal, neonatal, and nutritional disorders
Non-communicable diseases
Injuries

—— Ascending order in rank
------ Descending order in rank

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DALY rate by income level

- The DALY rate has increased for income levels
  - ➤ 8.6% increase for Q1, the lowest income level
  - ➤ 13.8% increase for Q5, the highest income level
- The higher the income, the lower the burden of disease

(Unit: per 100,000 people)
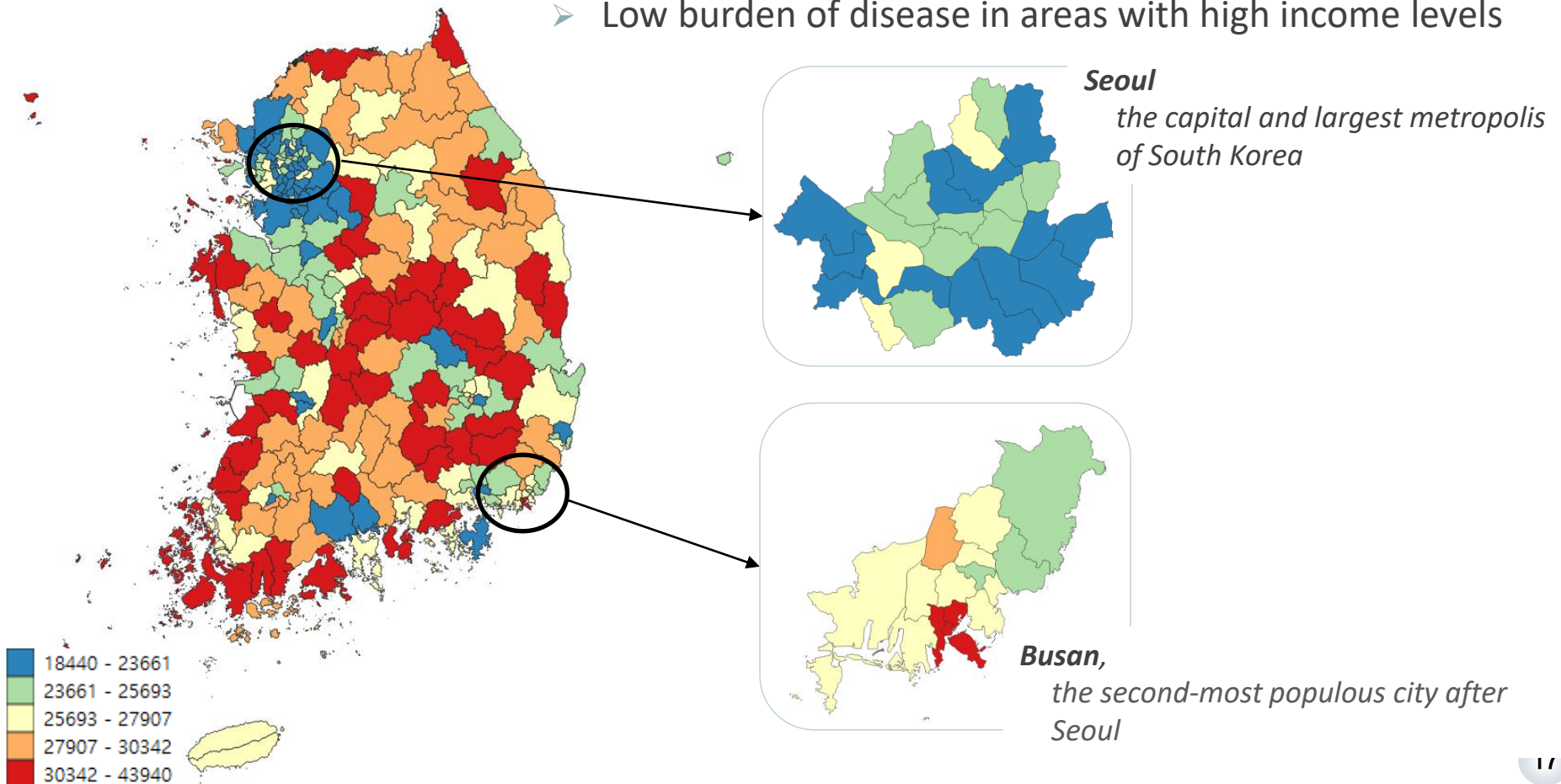
Q1 (Lowest)   Q2   Q3   Q4   Q5 (Highest)
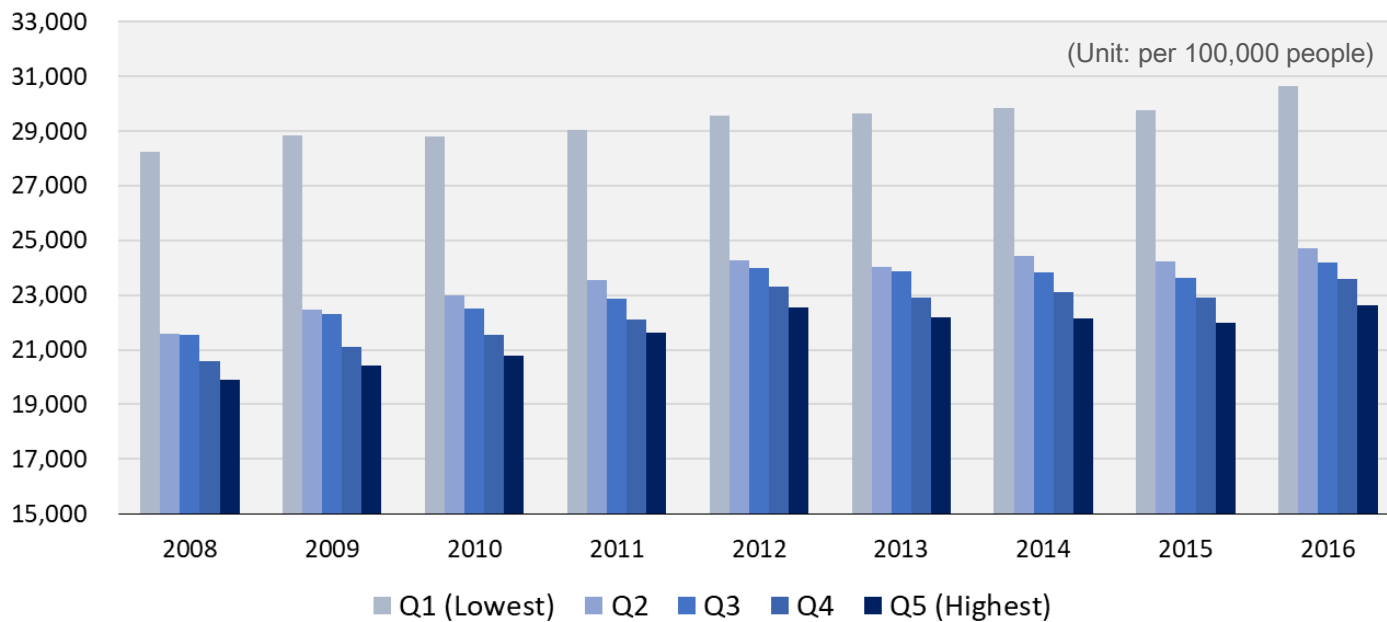
Results

Sub-national DALY rate (divided into 250 administrative districts)

- There is a 2.2-fold difference between the highest and lowest DALY rates

  ➢ Low burden of disease in areas with high income levels

Seoul
the capital and largest metropolis of South Korea

Busan,
the second-most populous city after Seoul

🟦	18440 – 23661
🟩	23661 – 25693
🟨	25693 – 27907
🟧	27907 – 30342
🟥	30342 – 43940

Results

Comparison of KNBD and GBD results (2016 DALY)

	GBD result (GBD 2017)	KNBD
	Model-driven	**Data-driven**
Ranking	1) Low back pain (1,618) 2) Diabetes type 2 (1,024) 3) Self-harm (1,003) 4) Ischemic heart disease (690) 5) Falls (677) (DALY rate per 100,000 people)	1) Diabetes mellitus (1,904) 2) Low back pain (1,456) 3) Chronic obstructive pulmonary disease (1,274) 4) Ischemic heart disease (1,116) 5) Osteoarthritis (1,010) (DALY rate per 100,000 people)
DALY rate	**22,270 DALY per 100,000 people**	**25,159 DALY per 100,000 people**
Perspective for the measurement of DALY	• YLL: Incidence-based • YLD: Prevalence-based	• YLL: Incidence-based • YLD: Incidence-based
HALE	**71.57 years**	**70.56 years**

Key challenges

- **(1) Perspective for DALY**: Incidence-based *vs*. prevalence-based
  - DALY estimation of prevalence-based approaches for international comparisons
  - Need research to estimate the distribution of health sequelae

- **(2) Database for measuring non-fatal health losses**
  - In Korea, the coverage rate is high in the National Health Insurance System
    - However, mild illnesses (e.g., migraines) with high OTC prescriptions may be overestimated
    - In particular, it is necessary to consider whether diseases such as migraines are regarded as those that reduce healthy life expectancy
      - ✓ Using the survey results to estimate the prevalence of these diseases overestimates the burden of diseases

- **(3) DALY for small area**
  - Consider using a Bayesian spatial model

We will strive for methodological improvements to more precisely measure the disease burden based on strong data sources

Thank you

yoonsj02@korea.ac.kr