Review Article

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Research on obesity using the National Health Information Database: recent trends

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The prevalence of obesity has increased markedly in Korea during the past few decades. Korea is one of the most well-organized countries in terms of its National Health Insurance System (NHIS), which conducts screening examinations. Since the NHIS is unified and managed by the government, its data—contained in the National Health Insurance Database (NHID)—are centralized. The Korean government has recently encouraged researchers to access the NHID, conduct research, and write papers to convey their findings. Expanded research using the NHID could shed light on the future of big data research. In this review, I would like to present an overview of current trends in obesity research using the NHID.

Keywords: National Health Insurance System; Obesity; Epidemiology

INTRODUCTION

The prevalence of obesity has increased markedly worldwide during the last decades [1,2]. The main reason for this increase is due to westernized lifestyles, including foods rich in fat and carbohydrates, sedentary habits, and decreased physical activity. Obesity causes multiple metabolic diseases, including diabetes, cardiovascular disease (CVD), cancer, osteoporosis, and sleep apnea [3].

In Korea, the National Health Insurance Service (NHIS) is a compulsory health insurance scheme covering the entire Korean population [4]. The National Health Information Database (NHID) provided by the NHIS can produce various health statistics. In this review, I would like to present an overview of recent research on obesity using the NHID.

OBESITY AND ABDOMINAL OBESITY: DEFINITIONS

Studies have generally employed the body mass index (BMI; body weight in kilograms divided by height in meters squared) to define obesity and the waist circumference (WC; measured in centimeters) to define abdominal obesity, in accordance with obesity guidelines [5]. The NHIS has available data on BMI starting in 2006; however, WC measurements were initiated in 2009, meaning that abdominal obesity data are available thereafter [4]. According to the obesity guidelines issued by the Korean Society for the Study of Obesity (KSSO) and the Asia-Pacific criteria of the World Health Organization guidelines, a BMI ≥25 kg/m^2 is used as the threshold to define obesity [6]. Following the KSSO's definition, a criterion of WC ≥90 cm in men and ≥85 cm in women is used to define abdominal obesity [5].

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OBESITY FACT SHEET IN KOREA

The KSSO publishes an Obesity Fact Sheet annually or biennially. The most recent update, issued in 2021, contains data from analyses of people ≥20 years of age who participated in health checkups provided by the Korean NHIS between 2009 and 2019 [2]. In the last 11 years, from 2009 to 2019, both general and abdominal obesity have shown a rising prevalence in the overall population, rising from 29.7% to 36.3% [2]. Obesity rates have grown more quickly among individuals aged 20–29 and ≥80 years compared to other age groups. Abdominal obesity showed an increasing prevalence from 2009 to 2019, especially in men (from 16.2% to 19.0% in women, from 20.7% to 29.3% in men, and from 19.0% to 23.9% in the total population). Obesity and abdominal obesity are associated with 2 to 5 times higher relative risks of developing ischemic stroke (IS), myocardial infarction (MI), and type 2 diabetes compared to those without these conditions, although the magnitude of risk elevation varies among age groups. Another pressing issue is the near tripling of the prevalence of class III obesity in both sexes during the last 11 years, signaling an urgent need for nationwide interventions to address this escalating trend in higher-degree obesity.

OBESITY AND ITS RELATIONSHIP WITH CVD AND MORTALITY

The majority of studies exploring the link between obesity and CVD or mortality using the NHID have been led by the KSSO's Taskforce Team of the Obesity Fact Sheet of the KSSO. Among 11,524,763 Koreans over 20 years of age who underwent NHIS health checkups between 2005 and 2015, weight loss presented a stronger correlation than weight gain with an elevated risk of mortality. A 2.6-fold higher risk of mortality was observed in subjects who experienced a ≥15% weight loss, and this finding was consistent regardless of the BMI group [7]. Moreover, the strongest relationship with mortality was observed in subjects who had a BMI ≥30 kg/m^2, with a 3.5 times elevated mortality risk. Regarding abdominal obesity, a study analyzing 23,263,878 NHIS health checkup participants revealed a linear correlation between WC and all-cause mortality in all BMI groups, and the significance of this relationship persisted even after adjusting for BMI, implying that abdominal obesity might have a harmful impact on the risk of mortality [8].

This team additionally utilized the NHID to study the relationship of obesity with CVD, in research involving 11,084,683 participants in the Korean national health screening program from 2009 to 2012. Over the course of follow-up, which lasted until 2015, experiencing weight loss or gain was associated with a higher hazard ratio (HR) of IS compared to weight maintenance. A U-shaped curve was identified for this relationship, with the lowest risk in individuals whose weight remained stable; this finding implies that maintaining body weight plays an important role in IS risk [9]. With regard to abdominal obesity, the association of WC with the risk of IS and MI was investigated in 21,749,261 national health screening program participants between 2009 and 2012, with follow-up extending until 2015 [10]. WC was grouped into 11 categories for analysis, and the lowest risk was found in men with a WC of 70–74.9 cm and women with a WC of 65–69.9 cm. Meanwhile, the lowest risk of IS was observed in men with a WC of 65–69.9 cm and women with a WC of 60–64.9 cm. This study also demonstrated that CVD was predicted more effectively by WC than by BMI.

A recent study investigated the relationships of BMI and WC with CVD in individuals who were 40 and 66 years old (i.e., in transitional ages) [11]. This research involved 1,866,591 Korean adults who were 40 years old and 563,919 who were 66 years old, all of whom took part in the national health screening program from 2009 to 2012. For the adults who were 40 years of age, the study identified a J-shaped association between BMI and the occurrence of IS, MI, and CVD, with the lowest risk observed in a BMI range of 18.6 to 22.9 kg/m^2. Meanwhile, the participants who were 66 years of age demonstrated significant U-shaped associations between BMI and MI and CVD, with the lowest risk observed in a BMI range of 23.0 to 24.9 kg/m^2. Unlike the findings for BMI, WC exhibited linear associations with all study outcomes for both the 40-year-old and 66-year-old participants. These findings imply that general and abdominal obesity had a more prominent impact on CVD in the younger age group (i.e., 40 years) than in their older counterparts (i.e., 66 years).

Heart failure (HF) is often overlooked or neglected as a diabetes complication, although guidelines have recently emphasized preventing HF as a crucial objective in diabetes treatment [12]. Our team examined the association between HF risk and baseline glycemic status in 9,720,220 Koreans

who were followed for a median period of 6.3 years [13]. Impaired fasting glucose (IFG) and diabetes were associated with 1.08- and 1.86-fold higher risks of HF, respectively, than were observed in participants with normoglycemia. Additionally, compared to normal weight, a 1.1 times higher risk of HF was found for class II obesity and a 1.7 higher risk for underweight, implying that BMI has a J-shaped relationship to HF risk. This study was the first to reveal an association between IFG and elevated HF risk in Koreans and to demonstrate a connection with obesity.

Another research team examined the relationship between obesity and atrial fibrillation (AF). In a study population of 9,797,418 individuals who underwent national health checkups, the researchers analyzed the association between the degree of obesity and the risk of new-onset AF [14]. Significantly elevated risks of new-onset AF were observed in all groups other than the reference group (i.e., in underweight, upper normal, overweight, and obese participants). Furthermore, more advanced stages of diabetes were associated with a progressive increase in the risk of new-onset AF. Diabetes and body weight exerted a synergistic impact on the risk of new-onset AF.

To summarize, these studies that used NHID data to investigate the relationships of obesity with CVD and mortality demonstrated that general and abdominal obesity exerted substantial negative impacts on CVD and mortality across various disease categories.

OBESITY AND CANCER

Numerous studies have used the NHID to investigate the relationship between obesity and cancer. For instance a study analyzed 139,519 men ≥40 years of age who underwent national health examinations from 2002 to 2008 and did not have prostate cancer at baseline, with follow-up extending until 2012 [15]. The association of prostate cancer risk with BMI was assessed according to the presence of diabetes. Patients who did not have diabetes showed a pattern wherein the HR for prostate cancer was significantly higher for BMI values higher than the reference range, even when the excess BMI was slight. However, patients with diabetes presented a significantly increasing HR for prostate cancer as BMI increased from underweight (<18.5 kg/m^2) to within the reference range (18.5–22.9 kg/m^2). The observation of a considerably lower HR for prostate cancer in participants with diabetes who had a BMI <18.5 kg/m^2 than in the other BMI categories implies that prostate cancer risk varies according to BMI and the presence of diabetes [15,16]. Another study highlighted the impact of obesity on cancer risk by using the NHID to analyze the relationship between BMI and bladder cancer risk [17]. That study included 23,378,895 participants in national health examinations between 2009 and 2012 who did not have bladder cancer at baseline and were followed up until 2015, and found the lowest risk for bladder cancer in participants with a BMI <18.5 kg/m^2 and the highest risk in those with a BMI ≥30 kg/m^2, suggesting that BMI is significantly related to individuals' risk of bladder cancer [17]. Smoking was also positively associated with bladder cancer risk, indicating that both obesity and smoking are crucial factors linked to the development of bladder cancer. Another study revealed that abdominal obesity had an additional impact on bladder cancer risk [18].

A link between obesity and hepatocellular carcinoma (HCC) was established by a study that utilized the NHID and analyzed 10,505,818 participants in national screening examinations in 2009 for a follow-up of 7.3 years [19]. General obesity was associated with an elevated risk of HCC compared to normal-BMI participants (BMI 25–30 kg/m^2: HR, 1.14; BMI ≥30 kg/m^2: HR, 1.52). Central obesity, which was measured in terms of the WC, also demonstrated a significant correlation with HCC risk. The researchers concluded that the combination of both general and central obesity particularly intensified the risk of HCC.

A study used NHIS claims data to investigate the economic burden of cancer related to obesity between 2002 and 2015 [20]. In men, liver cancer resulted in the highest total costs of overweight or obesity, followed by colorectal cancer and kidney cancer. In women, postmenopausal breast, liver, and colorectal cancers ranked as the top three cancers in terms of the total costs attributable to above-normal BMI. This study underscored the importance of interventions targeting obesity in order to enhance health and reduce the financial burden of cancer in Korea.

OBESITY AND OTHER DISEASES

Our team examined the risk of incident hypertension depending on baseline WC in 16,312,476 individuals without hypertension who underwent national health checkups from 2009 to 2012 [21]. Using the middle-WC group as the

reference, participants in the highest WC category had the greatest risk of incident hypertension. Abdominal obesity was significantly associated with the development of hypertension, independently of physical activity.

The relationship between prepregnancy WC and maternal complications in reproductive-age women was assessed by research using NHID data [22]. The study collected NHIS health checkup data that had been gathered between 280 and 645 days prior to childbirth, from mothers of 783,406 deliveries from 2006 to 2015. BMI and WC were positively associated with the incidence of maternal complications. Women with low WC and low BMI showed a higher likelihood of threatened abortion. In summary, WC before pregnancy demonstrated a close relationship with some maternal complications. The link between abdominal obesity and fractures was explored in a study analyzing 1,556,751 participants who underwent NHIS health checkups between 2009 and 2011, with 6.5 years of follow-up. In both sexes, higher WC was associated with increased risks of femur and lumbar fractures [23], indicating that abdominal obesity is associated with fractures in Korean adults.

Finally, the NHID has been used to investigate whether BMI might be related to the risk of COVID-19. A nationwide case-control study included 3,788 cases (patients with confirmed COVID-19) and 15,152 age-/sex-matched controls (≥20 years of age) who underwent national health screening. The study linked data from the NHIS to data from the Korea Disease Control and Prevention Agency [24]. Multivariate logistic regression models showed a graded positive association between BMI and the risk of COVID-19 infection, with consistent findings in both sexes and all age groups.

VARIABILITY IN BODY WEIGHT AND BMI: RELATIONSHIPS WITH MORTALITY AND CVD

According to recent research, variability in metabolic risk may be linked to the development of chronic diseases such as dementia, diabetes, and CVD [25]. A study quantified variability in BMI and body weight in terms of the standard deviation and coefficient of variation of successive measurements in 125,391 individuals who participated in national health screening checkups [26]. After adjustment for confounders, a higher risk for all-cause mortality was found in the highest quartile of the variability indices than in the lowest quartile, implying that variability in body weight and BMI could be considered independent risk factors for both cause-specific and all-cause mortality. Another study of 4,244,460 participants in the national health screening program found progressively higher risks of IS and all-cause mortality in the higher quartiles of WC and body weight variability than in the lowest quartiles [27].

The relationship between body weight fluctuations and type 2 diabetes risk was investigated in a study utilizing the NHID. In that study, body weight variability in 3,855,884 participants in NHIS health checkups was quantified with the average successive variability index [28]. Fluctuations in body weight fluctuation were linked to an elevated risk of developing diabetes after adjusting for confounders, which implies that body weight variability might be an independent risk factor for diabetes.

Finally, the associations of changes in body weight and BMI with dementia risk were evaluated in patients who had new-onset type 2 diabetes. In 167,876 subjects ≥40 years of age who had been diagnosed with new-onset type 2 diabetes between 2007 and 2012, changes in weight were tracked for 2 years postdiagnosis, and the risks of vascular dementia, Alzheimer's disease, and all-cause dementia were calculated [29]. Proportional changes in weight (expressed as a percentage) over a 2-year period after type 2 diabetes was diagnosed presented significant U-shaped associations with the risk of incident all-cause dementia; furthermore, this risk was significantly higher for participants with >10% weight loss or gain. These study findings imply that weight gain or loss following the diagnosis of type 2 diabetes could be associated with an elevated risk of all-cause dementia.

CONCLUSIONS

Research using big data has received increasing attention in recent years. From this point of view, the current progress in obesity research using big data such as the NHID is invaluable for the prevention and treatment of obesity, which causes various metabolic diseases. The field of obesity research is expanding from year to year, and these research results enable clinicians caring for obese people to manage patients better in order to prevent comorbidities of obesity. More studies and support are needed to foster the development and growth of obesity research, which could eventually lead to a cure for obesity.

ARTICLE INFORMATION

Ethics statements
Not applicable.

Conflicts of interest
The author has no conflicts of interest to declare.

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