DOI Number: 10.37506/v20/i1/2020/mlu/194639

Risk Analysis of Metabolic Syndrome Affecting Osteoarthritis: Focused on the 6th Korean National Health and Nutrition Survey

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Abstract

Background/Objectives: With the rapid economic development and changes in living conditions in south Korea, the frequency of chronic diseases has been gradually increasing due to westernized eating habits and decreased physical activities. This study is a descriptive secondary analysis designed to provide basic data necessary to maintain healthy life for patients of osteoarthritis patients by analysing the risk of metabolic syndrome affecting osteoarthritis in Koreans.

Method/Statistical Analysis: Secondary analysis was conducted on the 6th KNHANESraw data provided by the Korean Ministry of Health and Welfare. A total of 4,571 adults aged 19 or older who received both health and medical examinations were selected for analysis.

Findings: 10.8% of total subjects were identified to have osteoarthritis. Logistic regression analyses after adjusting age, sex, education levels, smoking and drinking revealed that the odds ratio of osteoarthritis increased depending on waist circumference of the persons reviewed in the study (OR 1.474, 95% CI=1.121-1.938) in the metabolic syndrome components.

Improvements/Applications: In conclusion, this study showed the waist circumference only of other components of metabolic syndrome was significantly related to osteoarthritis in Korean adults. Therefore, this study suggested that intensive management of obesity including abdominal obesity be useful to prevent risks of osteoarthritis.

Keywords: *Metabolic syndrome, Osteoarthritis, Korean National Health and Nutrition Examination Survey, KNHANES.*

Introduction

Recently, the frequency of chronic diseases in south Korea has been gradually increasing due to rapid economic development and changes in living conditions, as well as westernized eating habits and decreased physical activities. Accordingly, various chronic diseases are leading the main causes of death, in the order of malignant neoplasms (cancer), heart disease, cerebrovascular disease, diabetes, chronic lower respiratory disease and hypertension[1]. The concept of metabolic syndrome emerged when it was announced that several risk factors for cardiovascular disease among these chronic diseases could increase the incidence of cardiovascular disease if they existed together in one person. It is known that the major risk factors of cardiovascular disease, such as abdominal obesity, hypertension, hyperglycemia and hyperlipidemia, occur simultaneously in clusters, especially insulin resistance,

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which is a common denominator, is known as the major etiology. The mechanism of outbreak of metabolic syndrome has not yet come to light, but it is caused by the interaction of environmental factors, including genetic factors and inappropriate eating habits. Genetic factors are difficult to control, but metabolic syndrome can be prevented by improving environmental factors[2]. In advanced countries, about a quarter of the population has metabolic syndrome, the overall prevalence rate of metabolic syndrome in south Korea ranged from 20.1% in 1998 to 23.2% in 2012. In addition, the prevalence rate of metabolic syndrome, that is adjusted for age in the population of total adults, has been steadily increasing to 31.3% [3-4]. It is also known that if the condition is not improved with metabolic syndrome, the risk of developing to cardiovascular disease is 2 times higher and the risk of developing to diabetes is 4 to 6 times higher [5].

Meanwhile, osteoarthritis is the most general joint disease in adults, accompanied by extreme pain and severely impairing physical and functional disorders and degrading quality of life. In addition, osteoarthritis is a very heavy economic loss and health-related economic burden in that it is the second highest in medical expenses after hypertension [6]. The prevalence rate of osteoarthritis in Koreans aged 50 and over was 12.5% between 2010 and 2013. By age, the 50s accounted for 4.7% and the 60s accounted for 14% [4]. The proportion of the elderly population in Korea has been increased from 7.2% in 2000 to 13.1% in 2015 and 14.3% in 2018 due to the development of medical technology and improved living standards and is expected to go into a super-aged society at 2026 with 20% in [7]. With this aging phenomenon, the prevalence rate of osteoarthritis is expected to continue to increase.

Both osteoarthritis and metabolic syndrome are chronic diseases and due to the characteristics of a rapidly aging society, the prevalence rate has continued to increase, affecting individuals or countries gradually with social and economic ways. In addition, cardiovascular disease and osteoarthritis, which are related to metabolic syndrome, are common risk factors for age and obesity and several epidemiological and biological studies show that similar inflammatory patterns in metabolic syndrome-related cytokine environments as osteoarthritis is no longer only degenerative. Recently, studies on the association of metabolic syndrome and osteoarthritis has been conducted in United Kingdom and the United States, a study conducted in Japan has been reported that the increase in the number of components of metabolic syndrome and the prevalence rate of knee arthritis have been associated [8]. In other words, studies on metabolic syndrome and osteoarthritis have been conducted internationally, but there are few studies regarding this subject in Korea.

Therefore, the purpose of this study is to provide basic data for maintaining healthy life of osteoarthritis patients by analysing the risk of metabolic syndrome affecting osteoarthritis in Koreans and identifying the association between metabolic syndrome and osteoarthritis.

Method

Study Design: This study is a secondary analysis study using raw data in 2014, the second year of the 6th KNHANESof the Ministry of Health and Welfare in Korea and is a descriptive research to determine the risk of metabolic syndrome affecting osteoarthritis in Koreans.

Research subject and data collection: The data of this study was analysed by receiving raw data on the KNHANES. Of the 7,550 persons surveyed in the study, 5,979 adults aged 19 or older received both health surveys and medical check-ups. Of these, 4,571 persons (1,927 males and 2,644females) were subject to analysis, excluding those who had metabolic syndrome components and missing values of osteoarthritis.

Research Variable: The health survey questions in the KNHANES datawere used such as monthly average income, education and economic activities, smoking, drinking and physical activities and the examination result was used for the analysis of physical measurements, blood pressure and blood. The demographic characteristics of the subjects were categorized by gender, age, marital status, education level and income level. The classification according to health behaviour was used by smoking, drinking, moderate physical activity days, weekly walking days, body mass index and stress perception rate, etc. The variables of osteoarthritis classified according to the subject's answers in health questionnaire. It is that those who answered with no osteoarthritis in the questionnaire were divided into 'group without osteoarthritis' and those who answered with osteoarthritis in the questionnaire were divided into 'group with osteoarthritis'. The diagnosis of metabolic syndrome was based on the diagnostic criteria of NCEP ATP III. The waist circumference was provided by the

Korean Society for Obesity [9], which is suitable for Koreans. A case of having three or more risk factors of blood pressure, waist circumference, blood sugar, HDL-cholesterol, or triglycerides as a component of metabolic syndrome is defined as metabolic syndrome.

Data analysis method: Statistical analysis was conducted using the IBM SPSS 23 program and statistical significance test level was p<0.05. The risk of osteoarthritis according to metabolic syndrome components and metabolic syndrome was analysed by logistic regression.

Result

General, physical and psychological factors: In this study, the prevalence rate of osteoarthritis was 10.8% of the total subjects. The prevalence rate of osteoarthritis by gender was 4.5% for male and 15.4% for female, which was higher for female than for male (p<.001). The prevalence rate of osteoarthritis by age was 0.4% under 40s, 1.7% in 40s, 9.8% in 50s, 22.1% in 60s and 29.6% in 70s and older (p<.001). The prevalence rate of osteoarthritis according to the marital status was 12.7% in married group, which was higher than 0.4% in unmarried group (p <.001). The prevalence rate of osteoarthritis according to education level was elementary school undergraduates, 28.9%, elementary school graduates, 13.7%, high school graduates, 5.3%, university graduates, 2.7% that is the higher the educational background was low of the prevalence rate of osteoarthritis (p<.001).

The prevalence rate of osteoarthritis according to the classification of the fourth-tier income level was 23.0% for the low class, 10.9% for the middle-low class, 8.2% for the middle-upper class and 5.8% for the upper class, with a lower rate of osteoarthritis as income increases (p<.001).

As a result of analysing the difference in osteoarthritis prevalence rate according to health behaviour, the rate of osteoarthritis prevalence was 13.8% in non-smoking groups, 7.4% in the past smoking groups and 3.1% in the current smoking group and lower in current smoking group (p<.001). 15.1% in non-drinking groups, 7.7% in moderate drinking groups and 6.2% in severe drinking groups. The higher the frequency of drinking, the lower the prevalence of osteoarthritis (p<.001). The prevalence rate of osteoarthritis due to moderate physical activity was higher in the group who did not exercise 6.0%, less than 3 days a week, 5.6% and 11.6% more than 3 days a week (p<.001). The prevalence rate of osteoarthritis according to the number of days of walking per week was in the group who did not walk per week, 12.9%, 8.2% for less than 3 days a week and 10.6% for more than 3 days a week (p=.013). The prevalence rate of osteoarthritis according to BMI was 8.8% under 25.0(normal) and 15.1% over 25.0(obesity). The prevalence rate of osteoarthritis according to the stress perception rate was 10.6% with low stress and 10.2% with high stress, so there was no difference between the two groups.

Effects of metabolic syndrome affecting osteoarthritis: The risk of metabolic syndrome affecting osteoarthritis is as shown in [Table 1]. In metabolic syndrome, the risk of osteoarthritis was 2.318times higher, in fasting glucose was 1.497 times higher, in HDL cholesterol was 1.721 times higher and in triglycerides 1.746 was higher in the abnormal group than in the normal group [Table 2].

Table 1. Odds ratio of osteoarthritis according to metabolic syndrome (N=4571)

Metabolic syndrome	Osteoarthritis	
	Odds ratio	95% CI
Abnormal(Ref. Normal)	2.318	1.913-2.808

Table 2. Odds ratio of osteoarthritis according to components of metabolic syndrome (N=4571)

Variables	Osteoarthritis	
	Odds ratio	95% CI
BP	2.376	1.966-2.871
WC	2.215	1.822-2.692
FPG	1.497	1.237-1.811
HDL-Cholesterol	1.721	1.417-2.089
TG	1.746	1.447-2.108

BP: Blood pressure, WC: Waist circumference, FPG: Fasting plasma glucose, TG: Triglycerides

Risk of osteoarthritis by metabolic syndrome: The risk factors of osteoarthritis tested by multivariate analysis with statistically significant variables extracted from multivariate analysis are shown in [Table 3]. The risk of osteoarthritis in gender was 5.772 times higher for female (95% CI=3.548-9.392) compared to male. The risk of osteoarthritis in age was 2.792 times in 40s (95% CI=1.019-7.651), 50's 14.869 times (95% CI=6.026-36.687), 60's 37.514 times (95% CI=15.097-93.214), over 70's 45.620 times (95% CI=17.895-116.297), the older the age, the greater the risk of osteoarthritis. At the education level compared to the elementary graduates,

the risk of osteoarthritis was 0.632 times (95% CI=0.442-0.904) for high school graduates and 0.537 times (95% CI=0.334-0.849) for university graduates and 0.747 times (95% CI=0.515-1.086) for middle school graduates but not statistically significant.

The risk of osteoarthritis of metabolic syndrome was 1.167 times higher in the abnormal group than in the normal group, but it was not statistically significant.

Table 3. Risk of osteoarthritis according to metabolic syndrome (N=4571)

Variables	Osteoarthritis	
	Odds ratio	95% CI
Women(Ref. Men)	5.772	3.548-9.392
Age (Ref. ≤39)		
40~49	2.792	1.019-7.651
50~59	14.869	6.026-36.687
60~69	37.514	15.097-93.214
≥70	45.620	17.895-116.297
Married (Ref. Unmarried)	2.400	0.700-8.227
Education level (Ref.<Elementary)		
Middle school	0.747	0.515-1.086
High school	0.632	0.442-0.904
>University	0.537	0.340-0.849
Income level (Ref. Low)		
Middle low	1.062	0.752-1.500
Middle high	1.499	1.034-2.173
High	1.004	0.660-1.528
Smoking (Ref. No smoker)		
Past smoker	1.622	0.994-2.647
Current smoker	0.992	0.578-1.700
Drinking (Ref. No drinker)		
Moderate drinker	0.759	0.569-1.012
Heavy drinker	0.864	0.590-1.267
Metabolic syndrome (Ref. Normal)	1.167	0.901-1.513

Discussion

The prevalence rate of osteoarthritis in this study was 10.8%, that female was higher than that of males and increased with age. This is consistent with a study on osteoarthritis in Korea [9], which appears to be higher than that of men as women grow older due to a decrease in female hormones after menopause. The prevalence rate of osteoarthritis caused by health behavioural factors was higher in non-smoking and non-drinking groups and the results were consistent with preceding studies[6,10-11]. This appears to be due to the high number of osteoarthritis in women who have a high proportion of non-smokers and non-drinkers.

The body mass index showed a higher risk of osteoarthritis in cases higher than 25.0 than BMI below 25.0, which was consistent with preceding studies [2,12] that increased BMI raises the risk of osteoarthritis in the knee [13] and the U.S. NHANESreported that higher BMI increases the risk of knee osteoarthritis [13]. Only the waist circumference showed statistically significant results as an influence variable for osteoarthritis among metabolic syndrome components and these results were consistent with existing studies [13-14]. Previous studies have shown that obesity is associated with the development of osteoarthritis. However, In Korea, there are many cases of light and severe obesity and abdominal obesity compared to Westerners. It means despite low waist circumference and low BMI, risk factors for other chronic diseases as a high aspect seems to be increased[14].

In addition, according to the 5th Annual Report of the KNHANES[15], abdominal obesity was 18.3% in people aged 19 to 64 and 46.1% in people aged 65 or older, while BMI measures 24.1% in adults aged 19 to 64 and 37.8% in people aged 65 or older. In other words, in adults under 64 years of age, obesity by BMI is higher than abdominal obesity, while in people over 65 it is more likely to be abdominal obesity is higher than BMI [14]. The study also found that the prevalence rate of abdominal obesity is 21.2% for those under 65 years old and 34.2% for those over 65 years old, with the prevalence rate of osteoarthritis rising much higher. Therefore, it is necessary to control obesity including abdominal obesity and education should be strengthened to prevent and improve osteoarthritis in the future. In addition, as the number of risk factors of metabolic syndrome components increased, the risk of osteoarthritis increased and common risk variables among upper combinations were blood pressure and waist circumference, which would also be necessary to control the combination for each component.

Conclusion

This study is a descriptive secondary analysis designed to examine the association between metabolic syndrome and osteoarthritis in adults by analysing the raw data of 4,571 adultsfrom the 6th KNHANES in south Korea.

In metabolic syndrome, the risk of osteoarthritis was

2.318 times higher, in fasting glucose was 1.497 times higher, in HDL-cholesterol was 1.721 times higher and in triglycerides 1.746 was higher in the abnormal group than in the normal group.

In conclusion, the importance of abdominal obesity control should be emphasized considering the relation with osteoarthritis of metabolic syndrome. In addition, since metabolic syndrome and osteoarthritis are multi-factorial diseases and more risk factors for metabolic syndrome components cause to increase the risk of osteoarthritis, it is necessary to control each component as well.

This study is a secondary study that extracts and re-analyzes part of the master's thesis by Kim [16].

Ethical Clearance: Not required

Source of Funding: Self

Conflict of Interest: Nil

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