

Relationship between Obesity and Korean and Mediterranean Dietary Patterns: A Review of the Literature

Eunhee Choi¹, Seong-Ah Kim², Hyojee Joung^{1,2,*}


¹Department of Public Health, Graduate School of Public Health and ²Institute of Health and Environment, Seoul National University, Seoul, Korea

Obesity is a well-known risk factor for various chronic diseases. Among the various risk factors for obesity, diet is one of the most modifiable. This study aimed to review current research on the association between obesity and the Korean diet compared with the Mediterranean diet. An electronic literature search was conducted using Medline and Embase. Totals of 10 and 17 studies were included in this review for the Korean dietary pattern (KDP) and the Mediterranean dietary pattern (MDP), respectively. These studies mainly applied factor analysis for the KDP and index analysis for the MDP. Only one of 10 KDP articles reported a significant inverse association with obesity, while most MDP studies showed a preventive association with obesity. There are a limited number of KDP studies compared with MDP studies, and the methods of deriving the dietary patterns are different between the KDP and MDP. To produce more conclusive evidence on the association between the KDP and obesity, well-designed and controlled trials or large prospective cohort studies are needed.

Key words: Diet, Obesity, Mediterranean diet, Review

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*Corresponding author
Hyojee Joung

 <https://orcid.org/0000-0003-1182-7786>

Department of Public Health, Graduate School of Public Health, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Korea
Tel: +82-2-880-2716
Fax: +82-2-883-2832
E-mail: hjjoung@snu.ac.kr

INTRODUCTION

Obesity is a well-known risk factor for various chronic diseases including cardiovascular diseases, type 2 diabetes mellitus (T2DM), hypertension, dyslipidemia, and some types of cancer.¹⁻³ In Korea, the mortality rate due to cancer and cardiovascular disease and the prevalence of dyslipidemia have been steadily increasing concurrent with an increase in obesity.^{4,5}

Globally, approximately 39% adults aged 18 years and over were overweight in 2016, and 13% were obese.⁶ Likewise, the prevalence of obesity in Korea has increased steadily. Obesity in Korean adults increased from 26.0% in 1998 to 34.8% in 2016⁴, based on the Korea National Health and Nutrition Examination Survey.

Obesity has been described as multi-factorial, affected by both

genetic and environmental factors including diet, physical activity, alcohol consumption, and psychosocial aspects.^{7,8} Among the various risk factors of obesity, diet is one of the most modifiable.⁹ The Dietary Guidelines for Americans 2015–2020 recommend increasing consumption of fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products and limiting saturated fats, trans fats, cholesterol, salt (sodium), and added sugars to prevent weight gain and maintain healthy weight.¹⁰ When these individual nutrients are combined as a certain dietary pattern, its effect on health will be more than that of the individual nutrients.¹⁰ A dietary pattern is a broader picture of the overall diet rather than a single nutrient or food. It is more predictive when examining disease risk because it allows for complicated interactional and synergistic effects of nutrients and foods.¹⁰

With these advantages, numerous researchers have recently applied dietary pattern approaches in nutritional epidemiological studies. There has been extensive research on the associations between various dietary patterns—including the Mediterranean diet¹¹⁻¹³, the Dietary Approaches to Stop Hypertension trial^{14,15}, and the adherence to the Healthy Eating Index¹⁶—and the risks of related chronic diseases including cancer, T2DM, and cardiovascular diseases.^{12,17} However, few studies have examined the effects of the Korean dietary pattern (KDP) on obesity, and their results have been inconsistent and inconclusive.^{9,18-22} Conversely, one of the best-known healthy dietary patterns, the Mediterranean dietary pattern (MDP), has been extensively researched and is highly recommended.²³⁻³⁹ Emerging research suggests that the health benefits of this diet go beyond obesity and include reduced risk of various chronic diseases.¹¹⁻¹³ Before advocating specific dietary patterns to promote health and prevent diseases, it is necessary to evaluate the existing scientific evidence and draw a comprehensive conclusion. Therefore, this study aimed to review the current research on the association between obesity and the KDP compared with the MDP.

METHODS

An electronic literature search was conducted using Medline and Embase from November 23 to December 27, 2018. The range of publication years in the searched references was 2006 to 2018. The search terms were “obesity,” “overweight,” “weight gain,” and “dietary pattern.” The terms “Korea,” “Korean,” and “Mediterranean” were added depending on the target population. The reference lists of selected articles were also assessed.

The studies were eligible for inclusion in this review if they (1) explored association of dietary patterns and obesity rather than individual nutrients, (2) reported odds ratios (ORs) or hazard ratio as risk estimates, and (3) were in English. The articles were excluded if they (1) reported the risk estimates of regression coefficient and descriptive information, (2) had dependent variables of weight gain and loss (kg), fat-free mass, waist circumference, etc., or (3) were not in English. The complete search strategy is presented in Fig. 1.

CHARACTERISTICS OF THE KDP

Definition of the KDP differs depending on study and researchers. According to the Korea Food Research Institute, it is defined as “diets prepared by using Korean traditional cooking materials or similar food materials and made by own unique cooking method or similar method of Korea, and developed and handed down with the historical and cultural characteristics of Korean people.”⁴⁰ The Rural Development Administration defined the Korean diet as “a unique food or meal that Koreans have consumed for thousands of years.”⁴¹ Although nutritional transition to Western dietary patterns (WDP), characterized by high consumption of fat and meat, has accelerated, the traditional Korean diet has maintained its aspects in distinct ways.^{42,43}

Based on the literature, the traditional Korean diet is characterized by predominant consumption of plant-derived products and moderate intake of animal-derived food; it consists of grains (mainly rice), vegetables, seaweed, fish, and meat in moderation and thus has high carbohydrate and low fat contents.⁴⁴ Particularly, rice is a staple food and forms the basis of the Korean diet. Extensive use of fermented foods such as *kanjang*, *doenjang*, *cheonggukjang*, *gochujang*, and *kimchi*⁴⁵, which are known for their health benefits relating to antioxidant and anti-inflammatory activities^{46,47}, is another characteristic of the Korean diet.

CHARACTERISTICS OF THE MDP

The concept of the Mediterranean diet was introduced in the early 1960s as the typical dietary pattern of Crete, much of the rest of Greece, and southern Italy. It was first publicized in 1975 by Keys⁴⁸ in a seven-country study and became widely recognized in the 1990s.

The Mediterranean diet is traditionally a collection of eating habits followed by people from the various countries in contact with the Mediterranean Sea, rather than a specific diet.⁴⁹ According to a study by EL Rhazi et al.²³, general components of the traditional Mediterranean diet are: (1) high consumption of plant foods (fruits, vegetables, breads, cereals, beans, nut, and seeds), (2) olive oil as the main source of added fat, (3) nonexcessive consumption of wine, (4) low to adequate consumption of cheese, yogurt, fish,

poultry, and eggs, and (5) low intake of red and processed meat. However, it is difficult to define one particular MDP due to the diversity in Mediterranean countries. For example, a characteristic of the Italian MDP is high consumption of pasta, but in Spain, fish consumption is exceptionally high. In Greece, mainly whole grain bread and large amounts of vegetables and legumes are consumed.²⁴

To identify extent of adherence to the MDP, the Mediterranean diet score (MDS) was created. Various scoring systems for MDP have been developed and applied in different cohort studies. In the most widely used scoring system developed by Trichopoulou et al.⁵⁰ in 2003, using the sex-specific median as the cutoff, a value of 0 or 1 is allocated to each of nine components. For beneficial components, including vegetables, fruits and nuts, legumes, fish, and cereal, 0 is allocated to people whose consumption is below the median value and 1 to those whose consumption is at or above the median value. For components that are assumed to be harmful to health, including meat, dairy products, and poultry, those who consume less than the median value are allocated a value of 1, and those who consume more are allocated a value of 0. In the case of ethanol, a value of 1 is allocated to men whose consumption is between 10 and 50 g per day and to women whose consumption is 5 to 25 g per day. The aggregate MDS ranges from 0, indicating minimum adherence to the MDP, to 9 as maximum adherence.

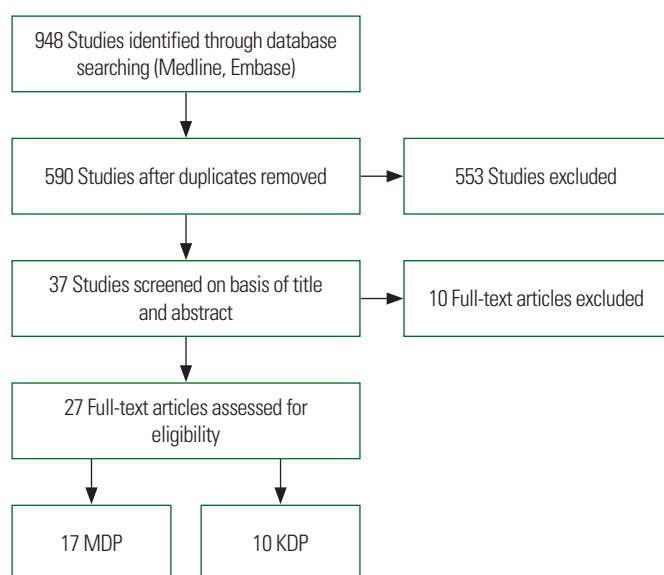


Figure 1. Study selection process. MDP, Mediterranean dietary pattern; KDP, Korean dietary pattern.

THE KDP AND OBESITY

We selected 10 cross-sectional studies aiming to identify an association between the KDP and obesity for this review (Table 1). There were some differences in the main components of the KDP through dietary pattern analysis; however, the food items with the highest factor loading of the KDP were white rice, kimchi, vegetables, and fish in most studies. In a study by Shin et al.¹⁸, the group with the highest traditional dietary pattern score showed a 24% decreased risk of abdominal obesity compared with the group with the lowest score (quintile 5 [Q5] vs. Q1: OR, 0.76; 95% CI, 0.59–0.98). Three articles showed no significant association between the KDP and obesity.^{19,20,51} Kim et al.²¹ and Choi et al.²² reported that the group with the highest KDP score had an increased likelihood of abdominal obesity (Q5 vs. Q1: OR, 1.07; 95% CI, 1.01–1.16; Q5 vs. Q1: OR, 1.27; 95% CI, 1.02–1.57). In a study by Kim et al.⁵², the highest tertile of the KDP score showed an increased risk of obesity compared to the lowest tertile (tertile 3 [T3] vs. T1: OR, 1.19; 95% CI, 1.06–1.33; *P* for trend = 0.004). Three studies using cluster analysis compared prevalence of obesity between the KDP group and the WDP group.^{20,53,54} The WDP group had 80% higher risk of abdominal obesity than the KDP group (WDP vs. KDP: OR, 1.81; 95% CI, 1.10–2.98)⁵³ and 40% higher risk of obesity diagnosed using BMI than the KDP group (KDP vs. WDP: OR, 1.40; 95% CI, 1.00–1.97).²⁰ In the study by Choi et al.⁵⁴, the OR for obesity was not considerably different between the KDP and WDP.

THE MDP AND OBESITY

Table 2 shows an overview of the selected studies (*n* = 17), which include 12 cross-sectional²³⁻³⁴ and five prospective cohort studies.³⁵⁻³⁹ Except for two studies^{31,32} using factor analysis, all studies used scoring methods to identify adherence to MDP. Of the 17 articles, 12 reported that the MDP has a preventive effect on obesity.^{24-33,35,37} Eight cross-sectional articles showed that high MDP adherence was associated with lower risk of obesity in both men and women.^{24-26,29-33} Of the 12 cross-sectional studies, two confirmed a significant inverse association of adherence to the MDP with obesity in women (OR, 0.79; 95% CI, 0.65–0.96; high vs. low score:

Table 1. Korean dietary pattern and obesity (cross-sectional study, n = 10)

Author (year)	Study design	Subject	Dietary pattern	Outcome	Effect size (95% CI)
Kim et al. (2012) ⁵²	Cross-sectional	10,089 Adults aged ≥ 19 yr in Korea (KNHANES)	(1) White rice and kimchi (2) High-fat, sweets, and coffee (3) Meat and alcohol (4) Grains, vegetables, and fish	Obesity (BMI ≥ 25 kg/m ²)	(1) OR, 1.19 (1.06–1.33); P for trend = 0.004
Kim et al. (2012) ²¹	Cross-sectional	3,742 Women aged 40–69 yr in Korea (KoGES)	(1) Animal food pattern (2) Rice and vegetable pattern (3) Bread and dairy pattern (4) Noodle pattern	Obesity (BMI ≥ 25 kg/m ²) Abdominal obesity (waist circumference ≥ 80 cm)	(1) NS for obesity (2) OR, 1.07 (1.01–1.16); P for trend < 0.05 for abdominal obesity
Shin et al. (2014) ¹⁸	Cross-sectional	10,711 Adults aged 19–64 yr in Korea (KNHANES)	(1) Traditional dietary pattern (2) Meat and fast food pattern	Abdominal obesity (waist circumference ≥ 90 cm in men and ≥ 80 cm in women)	(1) OR, 0.76 (0.59–0.98); P for trend = 0.07
Kim et al. (2007) ⁵³	Cross-sectional	944 Adolescents aged 10–19 yr in Korea (KNHANES)	(1) Traditional Korean pattern (2) Western pattern (3) Modified pattern	Abdominal obesity (waist circumference ≥ 90th percentile)	(1) vs. (2) OR, 1.81 (1.10–2.98)
Choi et al. (2015) ²²	Cross-sectional	5,189 Women aged 31–70 yr in Korea	(1) Traditional pattern (2) Western pattern (3) Prudent pattern	Abdominal obesity (waist circumference ≥ 80 cm)	(1) OR, 1.27 (1.02–1.57); P for trend = 0.02
Song et al. (2010) ⁵¹	Cross-sectional	4,347 Adolescents aged 10–19 yr in Korea (KNHANES)	(1) Traditional pattern (2) Modified pattern (3) Western pattern	Obesity (BMI ≥ 95th percentile for age and sex)* Abdominal obesity (waist circumference ≥ 90th percentile for age and sex)*	(1) NS for obesity and abdominal obesity
Hong et al. (2012) ⁵⁵	Cross-sectional	406 Adults aged 22–78 yr in Korea	(1) Korean traditional pattern (2) Alcohol and meat pattern (3) Sweets and fast food pattern (4) Fruit and dairy pattern	Abdominal obesity (waist circumference ≥ 80 cm for women or ≥ 90 cm for men)	(1) NS for abdominal obesity
Choi et al. (2011) ⁵⁴	Cross-sectional	284 Children aged 7–8 yr in Korea	(1) Korean pattern (2) Modified Western pattern (3) Western pattern	Obesity (obesity index ≥ 20%) ^{1,†}	(1) vs. (3) NS for obesity
Cho et al. (2011) ²⁰	Cross-sectional	4,984 Women aged 30–79 yr in Korea	(1) Western pattern (2) Healthy pattern (3) Traditional pattern	Obesity (BMI ≥ 25 kg/m ²)	(3) NS for obesity
Lee et al. (2011) ¹⁹	Cross-sectional	4,762 Men aged 40–69 yr in Korea (KoGES)	(1) Animal food pattern (2) Rice and vegetable pattern (3) Noodle and bread pattern	Obesity (BMI ≥ 30 kg/m ²) Abdominal obesity (waist circumference ≥ 90 cm)	(2) NS for obesity and abdominal obesity

*The reference values for BMI and waist circumference percentile were adapted from the Korean Pediatric Growth Chart; ¹Obesity index (%) = [(present weight – standard weight) / standard weight] × 100; [†]Standard body weight was defined as the 50th percentile value for children of the same age, sex, and height according to the 2007 Standard for Korean Children and Adolescents Growth.

CI, confidence interval; KNHANES, Korea National Health and Nutrition Examination Survey; BMI, body mass index; OR, odds ratio; KoGES, Korean Genome and Epidemiology Study; NS, not significant.

OR, 0.13; 95% CI, 0.06–0.24).^{25,28} In the study by El Rhazi et al.²³, prevalence of obesity was significantly associated with decreased MDP adherence (obese vs. non-obese group: OR, 1.56; 95% CI, 1.16–2.11). One article³⁴ showed no significant association between MDP adherence and obesity. Among the five cohort studies^{35–37}, Mendez et al.³⁷ and Zappalà et al.³⁵ reported significant inverse association between MDP adherence and obesity (high vs. low score: OR for men, 0.68; 95% CI, 0.53–0.89 and OR for women, 0.69; 95% CI, 0.54–0.89 and high vs. low score: OR, 0.53; 95% CI, 0.32–0.89). However, no association was found between MDP

adherence and overweight or obesity in the other three prospective studies (Beunza et al.³⁶, Sánchez-Villegas et al.³⁸, and Woo et al.³⁹).

CONCLUSION

In this review, counter to our hypothesis that the Korean diet has a preventive association with obesity, most studies reported no significant association between the KDP and obesity. On the other hand, there was considerable epidemiological evidence for the preventive effect of the MDP on obesity. Only one of 10 articles iden-

Table 2. Mediterranean dietary pattern and obesity

Author (year)	Study design	Subject	Diet component	Outcome	Effect size (95% CI)
Cross-sectional study (n = 12)					
Tognon et al. (2014) ²⁹	Cross-sectional	16,220 Children aged 2–9 yr in 8 European countries (Sweden, Italy, Germany, Spain, Hungary, Belgium, Estonia, and Cyprus)	(+): Vegetables, legumes, fruit, nuts, cereals, fish (–): Dairy, meat products	Overweight including obesity (BMI: cutoffs calculated by IOTF database)	High MD adherence: obesity ↓ (OR, 0.85; 95% CI, 0.77–0.94)
Peng et al. (2017) ³⁴	Cross-sectional	5,268 Children aged 11–19 yr in Israel	(+): Fruit or fruit juice, vegetables, fish, pulses, cereals or grains, dairy products (yoghurt, milk, etc.), olive oil, nuts (–): Fast food, no breakfast, baked goods or pastries, sweets and candy	Age- and sex-specific cutoff values: overweight (85th to 95th percentile), obese (> 95th percentile)	Low MD adherence: NS for overweight (OR, 1.07; 95% CI, 0.75–1.52), obese (OR, 1.15; 95% CI, 0.72–1.84)
Bertoli et al. (2015) ³³	Cross-sectional	4,388 Adults aged 18–80 yr in Italy	(+): Olive oil, vegetables, fruits, wine, legumes, fish/seafood, nuts, sofrito sauce (–): Red or processed meat, butter, cream, or margarine, soda, sweets and confectionery	Obese (BMI ≥ 30 kg/m ²)	High MD adherence: obesity ↓ (OR, 0.72; 95% CI, 0.56–0.92)
Sánchez-Taínta et al. (2008) ²⁵	Cross-sectional	3,204 Adults who have diabetes or 3 or more other CVD risk factors aged 55–80 yr in Spain	(+): Olive oil, vegetables, fruit, wine, legumes, fish or shellfish, nuts, poultry, sofrito sauce (–): Red meat, hamburger, meat products, butter, margarine, cream, sweet or carbonated beverages, sweets or pastries	Obese (BMI ≥ 30 kg/m ²)	High MD adherence: obesity ↓ (OR, 0.81; 95% CI, 0.71–0.94)
Schröder et al. (2004) ³⁰	Cross-sectional	3,162 Adults aged 25–74 yr in Spain	(+): Cereals, fruits, vegetables, legumes, fish, nuts (–): Meat, high-fat dairy products (+m): Red wine	Obese (BMI ≥ 30 kg/m ²)	High MD adherence: obesity ↓ (men: OR, 0.61; 95% CI, 0.40–0.92; women: OR, 0.61; 95% CI, 0.40–0.93)
Grosso et al. (2014) ²⁸	Cross-sectional	3,090 Adults aged > 18 yr in Italy	(+): Non-refined cereals, potatoes, fruit, vegetables, legumes, fish, olive oil use in daily cooking (–): Meat and meat products, poultry and full-fat dairy products	Obese (BMI ≥ 30 kg/m ²)	High MD adherence: obesity ↓ (OR, 0.35; 95% CI, 0.24–0.51)
El Rhazi et al. (2012) ²³	Cross-sectional	2,183 Adults aged > 18 yr in Morocco	(+): Vegetables, legumes, fresh fruits, cereals, fish, olive oil (–): Red meat, dairy products (+m): Alcohol	Obesity (BMI ≥ 30 kg/m ²)	Obesity: low adherence of MD ↑ (OR, 1.56; 95% CI, 1.16–2.11)
Mistretta et al. (2017) ²⁶	Cross-sectional	1,643 Adolescents aged 11–16 yr in Italy	(+): Fruit, vegetables, fish, pulses, pasta or rice, cereals or grains, nuts, olive oil, dairy products, yoghurts or cheese (–): Fast food, no breakfast, sweets and candy	Obesity (age- and sex-specific cutoff calculated by IOTF database)	High MD adherence: obesity ↓ (OR, 0.70; 95% CI, 0.56–0.87) in both boys and girls
Panagiotakos et al. (2006) ²⁷	Cross-sectional	1,514 Men aged 18–87 yr and 1,528 women aged 18–89 yr in Greece	(+): Non-refined cereals and products, fruits, vegetables, olive oil, non-fat or low-fat dairy products, fish, poultry, potatoes, olives, pulses, nuts (–): Red meat, meat products, alcohol (+m): Wine, fat, eggs, sweets	Obesity (BMI > 29.9 kg/m ²)	High MD adherence: obesity ↓ (OR, 0.49; 95% CI, 0.42–0.56)

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Table 2. Continued

Author (year)	Study design	Subject	Diet component	Outcome	Effect size (95% CI)
Bahreini Esfahani et al. (2016) ³¹	Cross-sectional	840 Students aged 15–17 yr in Iran	(1) Western pattern (2) Low protein (3) Asian pattern (4) Salty pattern (5) Sweet pattern (6) Traditional pattern (7) Mediterranean pattern	Overweight: ≥ 85th percentile Obesity: ≥ 95th percentile	High MD adherence: overweight ↓ (OR, 0.50; 95% CI, 0.27–0.73), obesity ↓ (OR, 0.48; 95% CI, 0.15–0.80)
Panagiotakos et al. (2007) ²⁴	Cross-sectional	188 Elderly aged ≥ 65 yr in Cyprus	(+): Non-refined cereals, vegetables, fruits, olive oil, dairy products, fish, poultry, pulses, nuts, potatoes, eggs, sweets (–): Red meat, meat products	Obesity (BMI > 29.9 kg/m ²)	High MD adherence: obesity ↓ (OR, 0.88; <i>P</i> =0.001)
Moreira et al. (2014) ³²	Cross-sectional	126 Elderly aged ≥ 60 yr in Brazil	(1) Prudent (fruit, vegetables, and meat) (2) Sweets and fats (pastries, sugary foods, fatty foods, whole milk) (3) Typical Brazilian (fried eggs, cooked beans, beef, candy, string beans, fried cassava) (4) Mediterranean (fruit, vegetables, olive oil, and nuts) (5) Traditional meal (rice and beans)	Overweight (BMI ≥ 28 kg/m ²)	High MD adherence: overweight ↓ (OR, 0.33; 95% CI, 0.13–0.83)
Cohort study (n=5)					
Mendez et al. (2006) ³⁷	Cohort study	27,827 Adults aged 29–65 yr in Spain	(+): Fish, vegetables, fruits, legumes, cereals, ratio of MFA to SFA (–): Meat (+m): Ethanol, dairy products	Obesity (BMI ≥ 30 kg/m ²)	High MD adherence: obesity ↓ (men: OR, 0.68; 95% CI, 0.53–0.89; women: OR, 0.69; 95% CI, 0.54–0.89), NS for overweight (men: OR, 1.11; 95% CI, 0.81–1.52; women: OR, 0.99; 95% CI, 0.78–1.25)
Beunza et al. (2010) ³⁶	Cohort study	10,376 Adults with an average age of 38 yr in Spain	(+): Vegetables, fruit and nuts, legumes, cereals, bread and potatoes, ratio of monounsaturated fatty acids to saturated fatty acids, moderate alcohol (–): Meat and poultry, dairy products	Overweight or obesity (BMI ≥ 25 kg/m ²)	High MD adherence: NS for overweight or obesity (hazard ratio, 0.90; 95% CI, 0.75–1.06)
Zappalà et al. (2018) ³⁵	Cohort study	2,044 Adults aged ≥ 18 yr in Italy	(+): Fruit, vegetables, cereals, legumes, fish (–): Meat and meat products, dairy products (+m): Alcohol	Overweight (BMI 25–29.9 kg/m ²), obese (BMI > 30 kg/m ²)	High MD adherence: obesity ↓ (OR, 0.53; 95% CI, 0.32–0.89)
Sánchez-Villegas et al. (2006) ³⁸	Cohort study	6,319 Adults (university graduates) in Spain	(+): Cereals, vegetables, fruits, legumes, fish, nuts, olive oil (–): Meat/meat products, whole-fat dairy products (+m): Red wine	Overweight or obesity (BMI ≥ 25 kg/m ²)	High MD adherence: NS for overweight or obesity (OR, 0.90; 95% CI, 0.59–1.38)
Woo et al. (2008) ³⁹	Cohort study	1,010 Adults aged 25–74 yr in China	(+): Cereals, vegetables, fruit and nuts, legumes, fish (–): Meat, poultry, dairy products (m+): Ethanol	Overweight (BMI ≥ 23 kg/m ²), obese (BMI > 30 kg/m ²)	High MD adherence: NS for overweight (OR, 1.35; 95% CI, 0.94–1.93)

CI, confidence interval; +, positive components; –, negative components; +m, components positive in moderation; BMI, body mass index; IOTF, International Obesity Task Force; MD, Mediterranean diet; OR, odds ratio; NS, not significant; CVD, cardiovascular disease; MFA, monounsaturated fatty acid; SFA, saturated fatty acid.

tified a significant inverse association between the KDP and obesity, whereas 12 of 17 MDP studies reported a preventive association between the MDP and obesity.

Although the KDP and MDP are both considered healthy diets^{23,27,52}, the differences between them in our results might be attributable to differences in the detailed dietary components. Adherence to the MDP leads to adequate intake of various nutrients like vitamin C, tocopherols, carotene, linolenic acid, and minerals and that of beneficial non-nutrients like anthocyanins and polyphenols.²⁷ Compared to the MDP, the typical KDP generally lacks fruit and dairy products and is high in sodium. Thus, for the KDP to provide greater health benefits in lowering the risk of chronic diseases and to have similar effects as that of the Mediterranean diet, it may be necessary to complement it with consumption of fruit and low-fat dairy products and reduction in sodium.⁵⁶ Moreover, the results of research on the KDP and MDP are different because the methods to derive them are not the same. For MDP studies, we identified the association between obesity and dietary variation based on criteria for a predefined MDP regardless of population, whereas the KDP was defined based on distinct foods or food groups (such as white rice and kimchi) with significant variation in consumption between populations. Therefore, the KDP was slightly different in each study depending on the target population. By defining the characteristics of the KDP and developing criteria for it such as for the MDS, it may be possible to evaluate the health effects of the KDP more accurately and objectively.

Results of the KDP studies were inconsistent. Differences in general characteristics of subjects may have contributed to the inconsistency of these results. Four studies^{18,22,52,55} were conducted on adults, two studies^{20,21} focused on women, two studies^{51,53} on adolescents, one study⁵⁴ on children, and one study¹⁹ on men. Furthermore, differences in general characteristics such as income, education level, physical activity, and smoking status may also cause inconsistency in the results as confounding factors, although these factors were statistically adjusted in each study. For instance, in one KDP study¹⁸, the subjects within the highest quintile of the KDP were older, had more physical activity, had higher education and income levels, and were less likely to be current smokers. In the statistical analysis, the logistic regression model was adjusted for age, household income, education, smoking, physical activity, etc. In the

study by Kim et al.²¹, those in the highest quintile of the KDP were older and had higher education and income levels, and these factors were adjusted statistically. Ours is the first study to review the association between obesity and the KDP compared with the MDP.

However, this study has some limitations. First, selected studies on the association between the KDP and obesity were mainly based on cross-sectional design, making it difficult to identify the causal association between the two factors. Second, the statistical technique of dietary pattern analysis for the KDP is somewhat subjective because food categorization, labeling of components, and extracting the number of factors can be arbitrary. Due to the subjective aspect of the method for deriving dietary patterns, it should be carefully applied to the general population. Third, there was a difference in diet survey method between the MDP and KDP. Dietary data were collected via the validated food-frequency questionnaire (FFQ) for all the MDP studies, while five KDP studies collected dietary information through 24-hour recall and five through the FFQ. Also, the study populations for KDP and MDP research are different. The KDP studies targeted Koreans, and the MDP studies selected Westerners, except one study that focused on the Chinese population.³⁹ Finally, the methods to derive the KDP or MDP were different. Factor analysis explores what explains the variety in diets and how well those variations are related to risk, whereas index analysis asks whether variety from a predefined diet is related to risk.⁵⁷

In this study, we only examined the association of the KDP and the MDP with obesity; further studies need to identify the association between the KDP and other chronic diseases. Well-designed controlled trials and prospective cohort studies are also needed to conclude whether the KDP is related with obesity.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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