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빅데이터 분석을 활용한 콩 식품 중재가 대사증후군 위험요인에 미치는 영향 메타분석

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A Meta-Analysis of Influencing Soybean Food Interventions on the Metabolic Syndrome Risk Factors Utilizing Big Data

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요 약

빅데이터 분석은 기존 데이터베이스 관리 도구로부터 데이터를 수집, 저장, 관리, 분석할 수 있는 역량을 말한다. 따라서 메타분석은 여러 실증연구의 정량적인 결과를 통합과 분석을 통해 전체 결과를 조망할 수 있는 기회를 제공하는 통계적 통합 방법이다. 일반적으로 대사증후군 위험요인을 허리둘레, 수축기혈압, 이완기혈압, 공복혈당, 중성지방 그리고 고밀도지단백콜레스테롤 요인으로 정의한다. 메타분석 결과 공복혈당 사전 사후 경로에서 가장 큰 효과크기(r = -.324)인 것으로 나타났다. 따라서 콩 식품의 중재효과는 10%의 설명력을 확인할 수 있었다. 두 번째 큰 효과크기는 허리둘레 사전 사후 경로(r = .256)인 것으로 나타났다. 그런데 콩 식품의 습취는 허리둘레 (복부비만) 개선 효과가 없는 것을 확인할 수 있었다. 이러한 결과를 바탕으로 학문적 실무적 의의를 논의하였다.

ABSTRACT

Big data analysis refers the ability to store, manage and analyze collected data from an existing database management tool. Thus, meta-analysis is a statistical integration method that delivers an opportunity to overview the entire result of integrating and analyzing many quantitative research results. Commonly, factors of metabolic syndrome can be defined as abdominal obesity, systolic blood pressure, diastolic blood pressure, triglycerides, and high density lipoprotein cholesterol. In this meta-analysis, we concluded that the path between pre and post of the fasting blood glucose had the largest effect size of (r = -.324). Therefore, the effect of soybean food intervention showed an explanatory power of 10%. The second biggest effect size (r = .256) was found the path between pre and post in the waist circumference. Unfortunately, soybean food intake showed no improvement on abdominal obesity. Thus, we present the theoretical and practical implications of these results.

키워드 : 메타분석, 대사증후군, 콩, 비만, 빅데이터

Key word : Meta-analysis, Metabolic syndrome, Soybean, Obesity, Big data

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Ⅰ. INTRODUCTION

Metabolic syndrome can be defined with clinical characteristics such as waist circumference (abdominal obesity), blood pressure disorder, fasting blood glucose, high triglycerides, and fasting high density lipoprotein cholesterol, etc. The metabolic syndrome risk factors are reported major variables such as age, gender, stress, insufficient exercise, improper eating, not healthy lifestyle habits, and smoking. The world prevalence rate of the metabolic syndrome within adults shows an increase from 20% to 30%, with Koreans also reporting 28.8%, which is a rate of one in four adult people [1-4]. In addition, cardiovascular disease risk in the target person of the metabolic syndrome is higher than twice as compared to the healthy person, with risk of diabetes mellitus occurrence reported to be higher at least 3.5 to 5 times. Thus, professional and systematic management is required for the prevention of complications of metabolic syndrome [1,5]. The Korean prevalence rate of metabolic syndrome continues to be an increasing trend in 1998 (23.6%), 2007-2009 (25.1%), 2010 (25.9%). Currently, the worldwide obese population has been increasing rapidly, with the possibility that the prevalence rate of metabolic syndrome increasing believed to be very large [6].

According to guidelines from the National Heart, Lung, and Blood Institute (NHLBI) and the American Heart Association (AHA), metabolic syndrome is diagnosed when a patient has at least 3 of the following 5 conditions: (1) fasting blood glucose $\geq$ 110 *mg*/*dL* (or receiving drug therapy for hyperglycemia), (2) systolic blood pressure/diastolic blood pressure $\geq$ 130/85 *mm Hg* (or receiving drug therapy for hypertension), (3) high triglycerides $\geq$ 150 *mg*/*dL* (or receiving drug therapy for hypertriglyceridemia), (4) high density lipoprotein cholesterol *HDL-C* < 40 *mg*/*dL* in men or < 50 *mg*/*dL* in women (or receiving drug therapy for reduced *HDL-C*), (5) Waist circumference $\geq$ 102 *cm* (40 in) in men or $\geq$ 88 *cm* (35 in) in women; if Asian American, $\geq$ 90 *cm* (35 in) in men or $\geq$ 80 *cm* (32 in) in women. To address variation between professional guidelines, the NHLBI, AHA, International Diabetes Foundation (IDF), and others have proposed a harmonized definition of metabolic syndrome [1]. Complaints of chest pain, dyspnea, or claudication (symptoms of possible complications) may warrant additional studies, including the following: Electrocardiography (rest/stress ECG), Ultrasonography (vascular, or rest/stress echocardiography), Stress single-photon emission computed tomography (SPECT) or cardiac positron emission tomography (PET). Investigation into other causes of or exacerbating factors in metabolic syndrome should be considered. For example, sleep-related breathing disorders, such as obstructive sleep apnea, are becoming increasingly relevant and novel risk factors for metabolic syndrome [1-4].

Ⅱ. PREVIOUS RESEARCH

The risk factors of metabolic syndrome in this study are only targeted factors such as waist circumference, systolic blood pressure, diastolic blood pressure, fasting blood glucose, triglyceride and high density lipoprotein cholesterol. Among studies that examined the effects of obesity improvement in Korea, athletic interventions are listed as aerobic exercise, cycling, complex exercise, aquatic exercise, bicycling, jumping rope, taekwondo, fencing training, walking, etc., health care. Also, among studies that examined the effects of obesity improvement, dietary interventions are checked as eating greens, vegetables, fruits, eating vitamins, nutrition educations, diet, grain, and etc., nuts [7]. In studies among target groups of obesity improvement could be confirm the most frequently in the adult group, older, breast patients, diabetes mellitus patients, lower metabolic syndrome, higher metabolic syndrome, no metabolic syndrome, etc., it is directed to various groups. In searching previous research related meta-analysis of influencing mediator athletics related to metabolic

syndrome and obesity, the study on “Effectiveness of Obesity Management Programs: Systematic Review and Meta-analysis” [8], listed mostly the effect size (r = .500) or more.

In addition, the study “A Meta-analysis of Influencing Mediator Athletics on the Metabolic Syndrome Risk Factors Utilized Big Data Analysis” [7], listed the effect size (r = -.420, -.375, -.234, -.368, -.303, .402) to athletic interventions on (*WC*, *SBG*, *DBP*, *FBG*, *TG*, *HDL-C*) of the metabolic syndrome. Also, the study “A meta analysis for the anti- hyperlipidemia effect of soybeans” [9], applying the fixed-effects model analysis of *FC*, *TC* and *TG* showed a statistically significant reduction in *HDL-C* increase was statistically significant at. Thus, A study on “A Meta-Analysis of Obesity Management Effects of Aromatherapy Use” [10], reported the effect size (r = -.320, -.200, .210) to aromatherapy interventions on (*WC*, *TG*, *HDL-C*) of the metabolic syndrome.

Ⅲ. RESEARCH METHODOLOGY

The risk factors for metabolic syndrome in this study, it is only targeted factors as waist circumference, blood pressure, fasting blood glucose, triglyceride and high density lipoprotein cholesterol. The conceptual model is shown in Figure 1. This study will find meaningful effect of soybean food intervention for criterion variables that effect before and after the metabolic syndrome studies, on the basis of the results of a meta-analysis. The papers included in this study meta-analysis were identified using the keywords “Metabolic Syndrome Soybean”, “Metabolic Syndrome Isoflavone”, specifying on RISS, DBpia, eArticle, and Kyobo Scholar in database articles of social science. We reviewed a total of 8 studies related to metabolic syndrome within journals and theses published in Korea between 2000 and 2016, where a cause and effect relationship is established between variables that are specified in the conceptual model of this study. Based on the methodology of meta-analysis, was utilized the CMA (comprehensive meta analysis) program developed by Biostat was utilized.

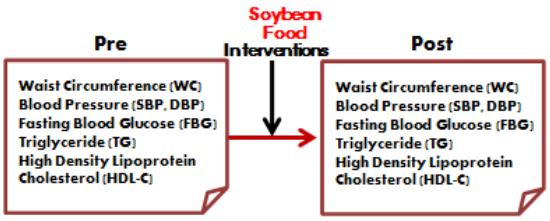

Fig. 1 The conceptual model

The following Table 1 lists authors, types, groups, terms and samples used as the raw data for the meta-analysis.

Table. 1 Raw data of studies used in meta-analysis

N	Authors	Type	Group	Ter	*n*
1	Go et al. (2012)	SBN	MW	08W	29
2	Yang (2009)	DJG	AD	04W	26
3		DJG	AD	08W	26
4		DJG	AD	12W	26
5	Kang (2002)	ISF	WM	06M	11
6	Kim et al. (2006)	MLT	MW	02W	17
7		MLT	MW	04W	17
8	Kim et al. (2006)	CKE	MW	12W	8
9		SBN	AW	01M	102
10	Lee et al. (2010)	SBN	AW	01M	82
11	Kang (2004)	SOP	AD	13W	15
12		CKJ	AD	14W	18
13	Park (2006)	CKJ	AD	12W	21
14		CKJ	AD	MA, FE	42
Sum of samples					440

AD: Adult, AW: Adult Women, CKE: Chongkukjang and Exercise, CKJ: Chongkukjang, DJG: Doenjang, FE: Female, ISF: Iso Flavone, M: Month, MA: Male, MLT: Mulberry Leaf Tofu, MW: Middle Women, SBN: Soybean, SOP: Soy Pinitol, W: Weeks, WM: Women

By using collected raw data, the calculated number of standard deviations and samples were coded that verified studies influencing pre and post in metabolic syndrome risk factors. Therefore, the mean, standard deviation, and the number of samples calculated the

effect size using Equation 1.

$$ES(d) = \frac{\overline{X_e} - \overline{X_c}}{S_{pooled}} \quad (1)$$

$\overline{X_e}$: Mean of Post Group

$\overline{X_c}$: Mean of Pre Group

S_{pooled} : Combined Standard Deviation

$$S_{pooled} = \sqrt{\frac{(n_e-1)S_e^2 + (n_c-1)S_c^2}{n_e + n_c - 2}}$$

n_e : Sample size of Post Group

n_c : Sample size of Pre Group

s_e : Standard Deviation of Post Group

s_c : Standard Deviation of Pre Group

To understand whether the value extracted from the same population was calculated using the equation 2 proposed by Hedges and Stock [11].

$$Q = \sum(Wd^2) - \frac{\sum(Wd)^2}{\sum W} \quad (2)$$

Q : Coefficient of Homogeneity

W: Inverse Weighted Values

d : Size of Effect

$$N_{fs} = \frac{N(d-d_c)}{d_c} \quad (3)$$

N_{fs} : Number Fail-safe

N: Number of Papers

d : Size of Effect

d_c : Small Size of Effect

In the stability test, the publication bias occurs because the data sampled for use only paper published in order to a meta-analysis. Orwin [12] was devised to overcome this problem that resolved through the test of stability. The test of stability is shown in Equation 3. In Cohen [13], the author proposed a method to interpret the effect size, where $ESr \leq .10$ is defined as a small effect size; $ESr = .25$, a medium effect size; and $ESr \geq .40$, a large effect size.

Ⅳ. META-ANALYSIS

The homogeneity test in the meta-analysis was performed on these research subjects to find that the effect sizes of multiple independent studies are values extracted from the same population. The null hypothesis for the statistical homogeneity test is that there is no difference in the estimated effect sizes of the individual study results. Therefore, if the null hypothesis is proved, we can perform a meta-analysis to obtain estimates of the overall effect size by incorporating effect size estimates. The interpretation of the homogeneity test is based on a chi-square distribution of the test statistic, *Q* value, since the *Q* value is equal to the *chi-square* distribution [11,14]. The results of the homogeneity test conducted in this study are presented in Table 2.

Table. 2 Results of homogeneity test

Paths	*df*	Critical region	*Q*	*P*
(*WC*) Pre → Post	1	3.84	16.1	.000
(*SBP*) Pre → Post	6	12.59	9.2	.000
(*DBP*) Pre → Post	6	12.59	51.3	.000
(*FBG*) Pre → Post	3	7.81	15.4	.000
(*TG*) Pre → Post	9	16.92	16.2	.000
(*HDL-C*) Pre → Post	9	16.92	29.6	.000

Q: *Q* statistics, *df*: degree of freedom

Q values from the paths between (*WC*) Pre → Post, (*SBP*) Pre → Post, (*DBP*) Pre → Post, (*FBG*) Pre → Post, (*TG*) Pre → Post, and (*HDL-C*) Pre → Post are 16.1, 9.2, 51.3, 15.4, 16.2, and 29.6, respectively. When the degrees of freedom (*df*) are 1, 6, 6, 3, 9, and 9 the limit values of the *chi-squared* distribution become 3.84, 12.59, 12.59, 7.81, 16.92, and 16.92, respectively where $p = .05$. Since the *Q* values are larger than the limit values, the null hypothesis of homogeneity is rejected. Thus, we can establish an estimation that these are extracted from a heterogeneous population, rather than from the same population. This explains that the distribution of effect sizes in all paths exceeds the standard error. In this heterogeneous case, we calculate

the average effect size by using calibrated inverse variance weighting values with the random-effects model, not the fixed-effects model [15].

The most problematic issue of integrating studies for the meta-analysis is the one related to study bias where unpublished papers were integrated with published papers into this study sample. Unpublished papers cover cases in which researchers may commit errors with insignificant research results, miss the right time of publication, and/or not meet the screening requirements of the reviewers. These problems are called publication bias, or the file drawer problem, and are explained to commit Type I mistakes [16]. This implies that papers published in journals have a high likelihood of positive results as compared to unpublished papers.

Table. 3 Results of calculator for fail-safe number

Paths	*N*	*r*	*Nfs*	*dc*
(*WC*) Pre → Post	2	.256	0.56	.2
(*SBP*) Pre → Post	7	.024	-6.16	
(*DBP*) Pre → Post	7	-.184	-.056	
(*FBG*) Pre → Post	4	-.324	2.48	
(*TG*) Pre → Post	10	-.186	-0.70	
(*HDL-C*) Pre → Post	10	.154	-2.30	

N: number of studies, *r*: effect size, *Nfs*: number fail-safe, *dc*: small effect size

In the meta-analysis, we review the validity of the research by checking the deflection possession through the stability factor, or the concept of fail-safe *N*. In particular, the stability factor or fail-safe *N* is the number of necessary studies to flip the significant findings into insignificant findings [12]. If the stability factor is 10, for example, the findings can be changed to a low effect size when 10 papers of effect size 0 are added. When fail-safe *N* is greater or the number of added papers is large, we can conclude that the consolidated treatment effect through a meta-analysis is true unless there is a sufficient number of unfounded or unpublished papers. Based on the theory above, the results calculated using the medium effect size suggested by Cohen [13] a represented in Table 3.

Ⅴ. RESULTS and CONCLUSIONS

This study reanalyzed the research papers with the purpose of classifying the results of the previous studies which analyzed causal relationships between pre and post of waist circumference, systolic blood pressure, diastolic blood pressure, fasting blood glucose, triglyceride and high density lipoprotein cholesterol in the designed metabolic syndrome risk factors included 8 studies for journals and theses published in Korea between 2000 and 2016. Based on information from these literature reviews, paths presented in the conceptual model in this study are converted to values of average effect size by using calibrated inverse variance weighting values and a random-effects model, as the effect size (*r*) shown Table 3.

Theoretical and practical implications of this study are as follows. After considering the meta-analysis results in detail, first, we concluded that the path between pre and post of the fasting blood glucose had the largest effect size of (r = -.324). Therefore, the effect of soybean intervention showed an explanatory power of 10%, lower than the research study of Yu et al. [7]. Next, the path between pre and post of the waist circumference had the higher the effect size of (r = .256). Unfortunately, soybean food intake showed no improvement on abdominal obesity. Next, the path between pre and post of the triglyceride, the diastolic blood pressure, and the high density lipoprotein cholesterol had the higher the effect size of (r = -.186, -.184, and .154), respectively. Thus, the effect of soybean intervention listed an explanatory power of about 3%, a little lower than the research study of Yu et al. [7]. Next, the path between pre and post of the systolic blood pressure had the effect size of (r = .024). Therefore, the effect of soybean intervention shows no an explanatory power. In conclusion, even though we failed to perform comparative analyses deeply with other variables presented in the conceptual model of this study, but not much studied in previous meta-analysis studies, the result of the study is significant in that we

can estimate effect sizes on the basis of paths. We expect that the results of by this study would be touchstones to researchers in similar studies.

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