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Masters Program in Public Health, Universitas Sebelas Maret

Meta-Analysis

The Relationship of the Health Belief Model to the Prevention Behavior of Metabolic Syndrome: A Meta-Analysis Study

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ABSTRACT

Background: Risk factors for Metabolic Syndrome include hypertension, glucose intolerance, central obesity and dyslipidemia. These conditions if they occur together are referred to as Metabolic Syndrome which can increase the risk of non-communicable diseases, namely heart, stroke, and type 2 diabetes. This study aimed to estimated the relationship between the constructs of the Health Belief Model (HBM) on the prevention of metabolic syndrome (SM) risk factors.
Subjects and Method: This article was compiled with a systematic review and meta-analysis study. This study uses the PICO Model. The meta-analysis study was conducted by searching for articles from databases in electronic form including Google Scholar, Pub-Med, and Science Direct. The keywords used are "Health Belief Model" or "Metabolic Syndrome Prevention" or "MetS" or "Risk Factors Metabolic Syndrome" or "Hypertension" or "High Blood Glucose" or "Insulin Resistance" or "Central Obesity" or "Dyslipidemia". The inclusion criteria for this study were full articles using a cross-sectional study, with the publication year 2012-2021. Analysis of articles in this study using RevMan 5.3 . software.
Results: A total of 12 cross-sectional studies from Asia, and Africa were selected for systematic review and meta-analysis. The data collected showed that high perceived severity increases 1.38 times to metabolic syndrome risk factor prevention behavior compared with low perceived severity, but its statistically not significant (aOR= 1.38; 95% CI= 0.82 to 2.30; p= 0.220), high susceptibility perception increases metabolic syndrome risk factor prevention behavior 1.15 times compared with low susceptibility perception (aOR= 1.15; 95% CI= 0.83 to 1.58; p= 0.410) but it was statistically not significant.
Conclusion: Perceived severity, and susceptibility perception was not statistically significant in predicting preventive behavior for metabolic syndrome risk factors.

Keywords: health belief model, risk factors, syndrome metabolic, meta-analysis

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BACKGROUND

Metabolic syndrome (SM) is still one of the main health problems in the world. Metabolic syndrome refers to cardiovascular risk factors, stroke and type 2 diabetes mellitus (DM2) that can occur together, risk factors for this metabolic disorder include hypertension, central obesity, glucose intolerance, and dyslipidemia (Huang, 2009). Currently, Metabolic Syndrome (SM) has be-

come a public health problem and clinical challenge worldwide related to the urbanization of excessive energy intake, the increasing incidence of obesity and a sedentary lifestyle and related impacts. The average prevalence of the metabolic syndrome is 31%, and is associated with a twofold increase in the risk of coronary heart disease, cerebrovascular disease, and a 1.5-fold increase in the risk of all-cause mortality (Engin, 2017).

In epidemiological studies, the incidence of Metabolic Syndrome (SM) varies between 20% and 45% of the population. Abdominal obesity is the most frequently observed component of Metabolic Syndrome (SM). The incidence of Metabolic Syndrome (SM) is expected to increase to about 53% by 2035 (Gierach et al. 2014). According to research conducted by the Framingham Offspring Study, the prevalence of respondents aged 26–82 years was 29.4% in men and 23.1% in women (Ford, 2005). The prevalence of SM in the adult population in Europe is currently reported to be around 15%3, in South Korea 14.2%,4 and in America 24% (Hadaegh et al, 2017).

Research in Iran found the incidence rate of 550.9/10,000 person years (95% CI: 519.5-584.2). For women, the incidence rate is 433.5/10,000 person years (95% CI: 398.8-471.2) and for men 749.2/10,000 person years (95% CI= 689.9 to 813.5). Globally the incidence of SM is likely to increase rapidly. Meanwhile, in Indonesia, 23.34% of the total population experienced SM, 26.2% for men and 21.4% for women. (Hadaegh et al, 2017). To date, three definitions of Metabolic Syndrome (SM) have been proposed, namely the WHO definetion, NCEP-ATP III and the International Diabetes Federation (IDF). The three definitions have the same main components with different criteria determination (Magdalena et al, 2016).

Metabolic syndrome is not a disease but a collection, but early detection in a person will give a very big meaning to be overcome immediately. The criteria that are often used to assess patients with SM are the NCEP-ATP III criteria, if a person meets three of the five agreed criteria, including: abdominal circumference of men >102 cm or women >88 cm, hypertriglyceridemia (serum triglyceride levels >150 mg/dL), HDL-C levels <40 mg/dL for men and <50 mg/dL for women; blood pressure >130/85 mmHg; and fasting blood glucose >110 mg/dL. A certainty that the clinical phenomenon that occurs is that central obesity is the main indicator of the occurrence of Metabolic Syndrome (Grundy et al, 2004).

The risk factor for metabolic syndrome is psychosocial stress through the mechanism of hormone balance disturbances in the hypothalamic-pituitary-adrenal axis (HPAaxis) (Tsigos, 2002). Increased fat in the visceral area in patients with central obesity will increase the risk of insulin resistance (Shen 2006). Inadequate physical activity and excessive caloric intake are also risk factors for metabolic syndrome. Individuals with low physical activity are at risk of suffering from metabolic syndrome 2 times greater than those who have good physical activity (Katzmaryk, 2003).

Health Belief Model (HBM) is a model that is used to describe individual beliefs about healthy living behavior, so that individuals will perform healthy behavior, healthy behavior can be in the form of preventive behavior or the use of health facilities. The HBM is often used to predict preventive health behaviors as well as behavioral responses to treatment of patients with acute and chronic diseases. However, recently the HBM theory has been used as a predictor of various health-related behaviors (Yamamoto, 2012).

Behavioral theory Health Belief Model (HBM), explains why individuals engage in health behaviors using factors such as perceived vulnerability, perceived severity, perceived benefits, and perceived barriers (Yamamoto, 2012). Another major component of HBM is perceived threat. It derives from two subcomponents: perceived severity and perceived vulnerability. Perceived severity is an individual's belief about the severity or seriousness of an illness. Perceived susceptibility is the perception of susceptibility to a disease. Threat perception is calculated as the product of perceived severity and perceived vulnerability, and has a direct effect on behavior (Yamamoto, 2012).

So, the Health Belief Model (HBM) is a very effective model in health education techniques. This model shows the relationship between health beliefs and health behaviors. It is based on the premise that preventive behavior is the result of personal beliefs. Metabolic syndrome is a chronic disease, and the Behavioral Health Belief Model (HBM) is the right model for chronic disease prevention, especially when a researcher is going to educate the public about health promotion as a preventive measure to those who have not been diagnosed with Metabolic Syndrome or those who already have a risk factor. risk for developing the metabolic syndrome. On this basis, we want to know the relationship between the constructs of the Health Belief Model (HBM) on the prevention behavior of Metabolic Syndrome (SM) risk factors.

SUBJECTS AND METHOD

1. Study Design

The research design used in this study was a systematic review and meta-analysis. Google Scholar, Pub-Med, and Science Direct with selected articles published in 2012-2022 using PRISMA flowchart guidelines. The keywords used are "Health Belief Model" or "Metabolic Syndrome Prevention" or "MetS" or "Risk Factors Metabolic Syndrome" or "Hypertension" or "High Blood Glucose" or "Insulin Resistance" or "Cen-tral Obesity" or "Dyslipidemia".

2. Inclusion Criteria

The inclusion criteria used in this study is a full paper article with a cross-sectional research method that analyzes the Relationship between the Health Belief Model Construct and the Prevention Behavior of Metabolic Syndrome Risk Factors. Risk factors for the metabolic syndrome include hypertension, glucose intolerance, central obesity and dyslipidemia. The measure of the relationship used is the Adjusted Odd Ratio (aOR) with a 95% confidence interval.

3. Exclusion Criteria

Exclusion criteria in this study included articles published other than English and Indonesian, non-cross-sectional study design, non-full text articles, articles published before 2012.

4. Operational Definition of Variables

The search for articles was carried out by considering the eligibility criteria determined using the PICO model. Population: general public. Intervention: high perceived severity and high susceptibility perception. Comparison: low perceived severity and low susceptibility perception. Outcome: metabolic syndrome risk factor prevention behavior.

General publics are community is a person who occupies an area, either directly or indirectly, who are interconnected.

Perceived severity is individual's motivation to perform a behavior if they believe that they have a vulnerability to being negatively affected by a particular disease or problem.

Metabolic syndrome risk factor prevention behavior is individual's ability to prevent a set of symptoms of attacking dise-

ases, such as hypertension, high blood sugar levels, dyslipidemia, and obesity.

5. Data Analysis

Articles were analyzed using the Review Manager (RevMan) 5.3 application to calculate effect size and heterogeneity, and form the final results of the meta-analysis. The results of data processing are presented in the form of forest plots and funnel plots.

RESULTS

Process of searching article wascarried out by searching several journal databases including Google Scholar, Pubmed, and Science Direct. it can be seen using the PRISMA FLOW flowchart shown in Figure 1.

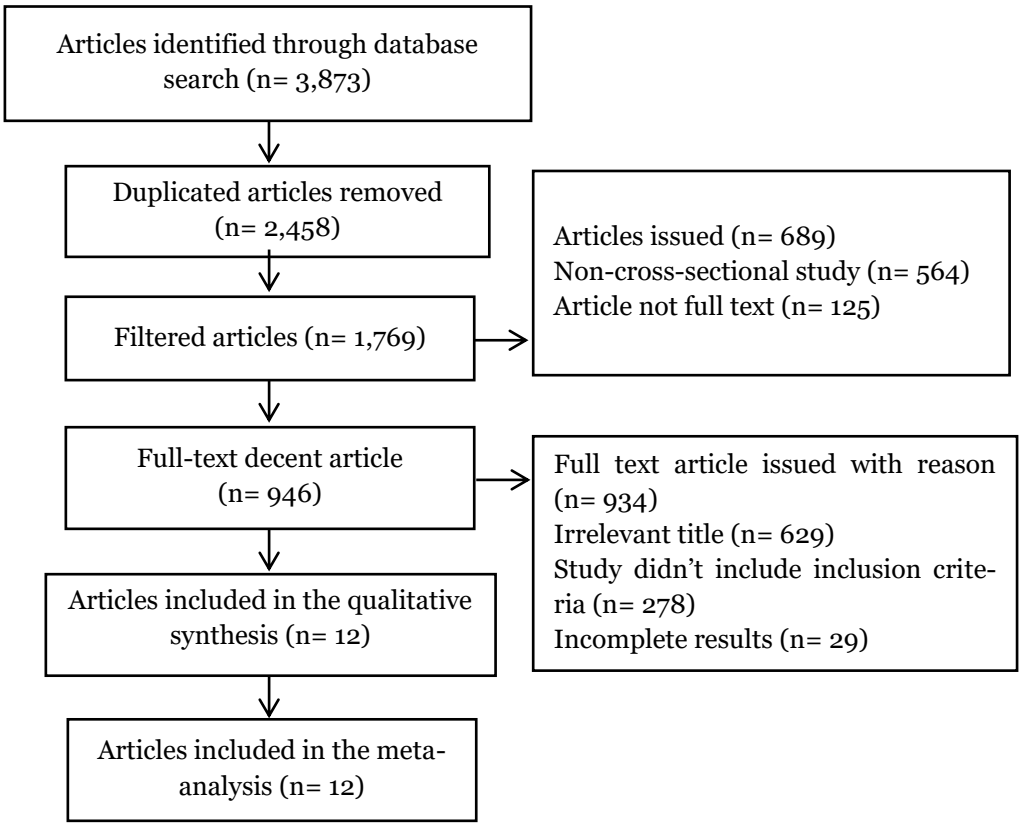

Figure 1. Results of Prisma Flow Diagrams

Figure 2. Research Distribution Map

Figure 1. Research related to exclusive breastfeeding in mothers who visited ante-natal care consisted of 12 articles from the initial search process yielding 917 articles, after the deletion process, articles were published with 2,458 requirements for full-text review more carry on. A total of 12 articles that met the quality assessment were included in the quantitative synthesis using a meta-analysis.

It can be seen in Figure 2 that the research articles come from two continents, namely Africa (Ghana, Nigeria, Ethiopia) and Asia (Japan, Taiwan, Bangladesh, Saudi Arabia, Indonesia, Iran).

Assessment of the quality of research articles using the Critical Appraisal Checklist for cross-sectional study which can be seen in table 1. The criteria for evaluating arti¬cles with cross-sectional study design are as follows:

1. Does the study formulate the research question (research problem) clearly?
2. Is the cross sectional research method appropriate to answer the research ques-tion?
3. Is the method for selecting research subjects clearly described?
4. Does the sampling technique not introduce bias (selection)?
5. Is the sample representative of the research target population?
6. Is the sample size based on consideration of the results of previous studies regarding statistical power?
7. Is the minimum response rate achieved?
8. Is the instrument in determining screen time and fast food valid and reliable?
9. Has statistical significance been tested?
10. Did the researcher report confidence intervals?
11. What confounding factors have been taken into account?
12. Are the results applicable in practice or in the community?

Table 1. Research Quality Assesment

Primary Study	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Yamamoto et al. (2012)	1	1	1	0	1	1	1	1	1	1	1	1	11
Kamran et al. (2014)	1	1	1	1	1	1	1	1	1	1	1	1	12
Najar et al. (2015)	1	1	1	0	1	1	1	1	1	1	0	1	11
Larki et al. (2018)	1	1	1	1	1	1	1	1	1	1	0	1	10

Obiri et al. (2018)	1	1	1	1	1	1	1	1	1	1	1	1	12
Chen et al. (2019)	1	1	1	1	1	1	1	0	1	1	1	1	10
Coker et al. (2019)	1	1	1	1	1	1	1	1	1	1	1	1	11
Tsadik et al. (2020)	1	1	1	1	1	1	1	1	1	1	0	1	11
Yanti et al. (2020)	1	1	1	1	1	1	1	1	1	1	0	1	11
Kim et al. (2020)	1	1	1	1	1	0	1	1	1	1	1	1	11
Tamimi et al. (20201)	1	1	1	1	1	1	1	1	1	1	1	1	11
Melkamu et al. (2021	1	1	1	1	1	1	1	1	1	1	1	1	11

Table 2. showed the description of primary studies. A total of 12 articles were designed as a cross-sectional study that analyzed the relationship of perceived severity or seriousness to metabolic syndrome prevention behaviors.

Based on table 2, there are 12 articles with a total sample of 9524 participants. Most studies state that there is an influence of perceived severity/seriousness on prevention behavior of metabolic syndrome risk factors.

Figure 3 showed the results of forest plot perceived severity to prevention behavior of metabolic syndrome risk factors that there is a very high heterogeneity (I^2= 100%; p <0.000), so the data analysis on the forest plot uses a random effects model. People who have a high perception of severity or seriousness related to metabolic syndrome risk factors, have a metabolic syndrome risk factor prevention behavior of 1.38 times better than people who have a low perception of severity or seriousness related to metabolic syndrome risk factors, but it was statistically not significant (aOR = 1.38; 95% CI= 0.82 to 2.03; p= 0.220).

Based on Figure 4, results of funnel plot perceived severity to prevention behavior of metabolic syndrome risk factors, it can be seen that the publications marked by asymmetry of the left plot are 7 plots, the middle is 1 plot, and the right is 4 plots. The plot on the left is between standard errors of 0.1 and 0, there is a 1 plot of standard error of 0, and on the right is between errors of 0 and 8. Bias can also be inferred from the imbalance of distances between studies on both the right and left sides.

Table 1. Description of Primary Research included in the Meta-Analysis

No	Author (Year)	Country	Study Design	Sample	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	aOR (CI 95%)
1	Yamamoto et al. (2012)	Japan	Cross-sectional	3457	Japanese health insurance member August to September 2010	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	1.83 (1.83 to 2.10)
2	Karman et al. (2014)	Iran	Cross-sectional	671	Hypertensive referral patient	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	3.10 (2.00 to 4.80)
3	Najarkolaei et al. (2015)	Iran	Cross-sectional	368	Tehran University students are between 18 and 55 years old	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	0.89 (0.77 to 1.03)
4	Larki et al. (2018)	Iran	Cross-sectional	152	Referral patients in Bushehr . City	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	1.56 (1.03 to 2.36)
5	Obirikorang et al. (2018)	Ghana	Cross-sectional	678	Hypertensive patient at Kintampo Hospital	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	1.15 (0.75 to 2.72)
6	Tamimi et al. (2020)	Saudi Arabia	Cross-sectional	385	Female male educators in Riyadh City	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	0.99 (0.96 to 1.01)

No	Author (Year)	Country	Study Design	Sample	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	aOR (CI 95%)
7	Yanti et al. (2020)	Indonesia	Cross-sectional	180	Community Health Center Kalirejo working area	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	0.28 (0.27 to 3.16)
8	Kim et al. (2020)	Bangladesh	Cross-sectional	368	Pregnant women > 20 weeks at KIA Clinic September to December 2019	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	0.54 (0.26 to 1.13)
9	Tsadik et al. (2020)	Ethiopia	Cross-sectional	989	Hypertensive patients in four hospitals	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	3.40 (2.20 to 5.20)
10	Melkamu et al. (2021)	Ethiopia	Cross-sectional	387	Diabetes patient at Special Hospital of Gondar University	High perceived severity and susceptibility perception	Low perceived severity and susceptibility perception	Preventive behavior metabolic syndrome risk factors	0.57 (0.33 to 0.97)
11	Chen et al. (2019)	Taiwan	Cross-sectional	1741	Health assessment program CGMH	High perceived severity	Low perceived severity	Preventive behavior metabolic syndrome risk factors	0.99 (0.96 to 1.01)
12	Coker et al. (2019)	Nigeria	Cross-sectional	148	Patient in NNPC	High perceived severity	Low perceived severity	Preventive behavior metabolic syndrome risk factors	0.28 (0.72 to 3.16)

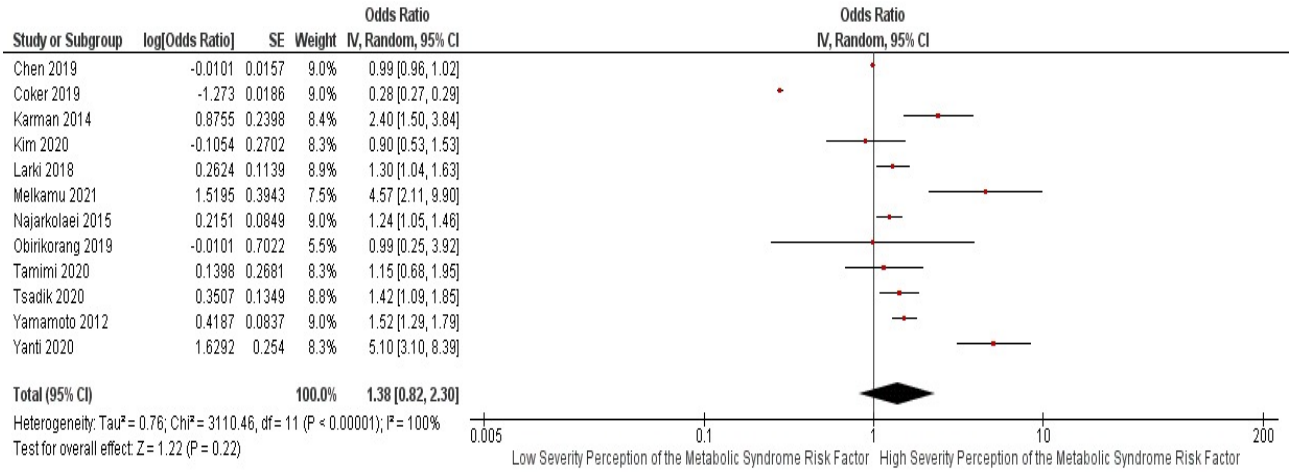

Figure 3. Forest plot Relationship of Perceived Severity on Preventive Behavior of Metabolic Syndrome Risk Factors

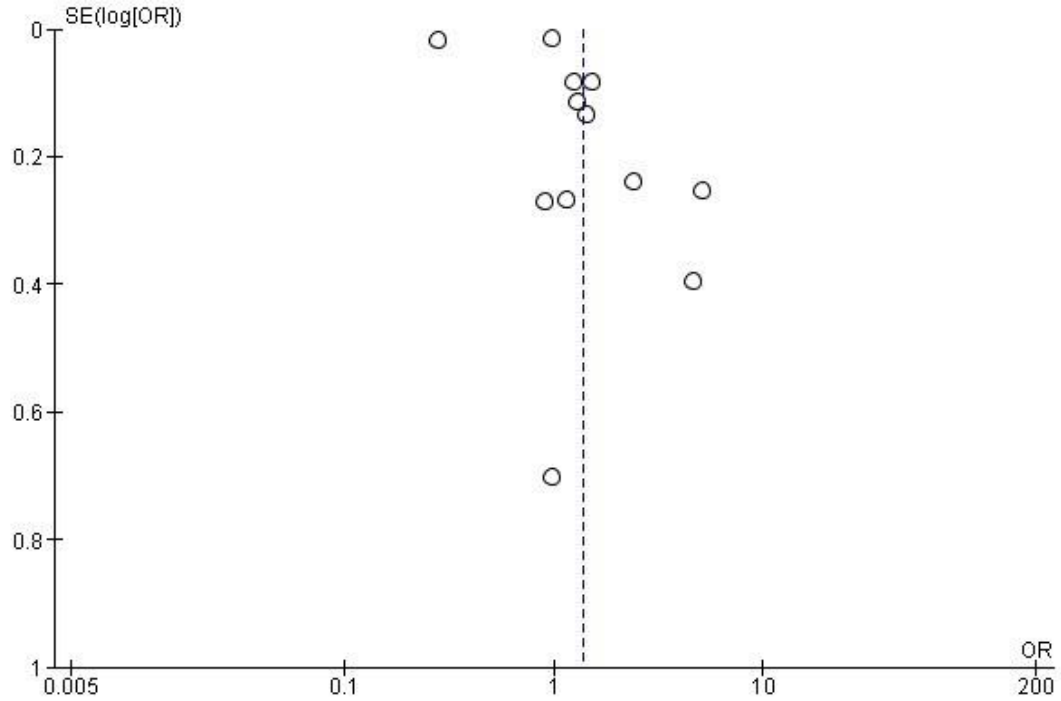

Figure 4. Funnel plot Relationship of Perceived Severity on Preventive Behavior of Metabolic Syndrome Risk Factors

Figure 5. showed that there is high heterogeneity (I^2= 90%; p< 0.001), so the data analysis on the forest plot uses a random effects model. People with high perception of metabolic syndrome risk factor susceptibility have 1.15 times compared with a low metabolic syndrome risk factor perception, but the results are statistically not significant (aOR = 1.15; 95% CI = 0.83, 1.58; p= 0.410). Based on Figure 6, the results of funnel plot, showed a publication bias, in the left plot have 6 plots, 1 plot in the middle, and 3 plots on the right. The plot on the left is between standard errors of 0.1 and 0, there is 1 Plot in the middle at standard error of 0, and on the right is between 0 and 5 errors.

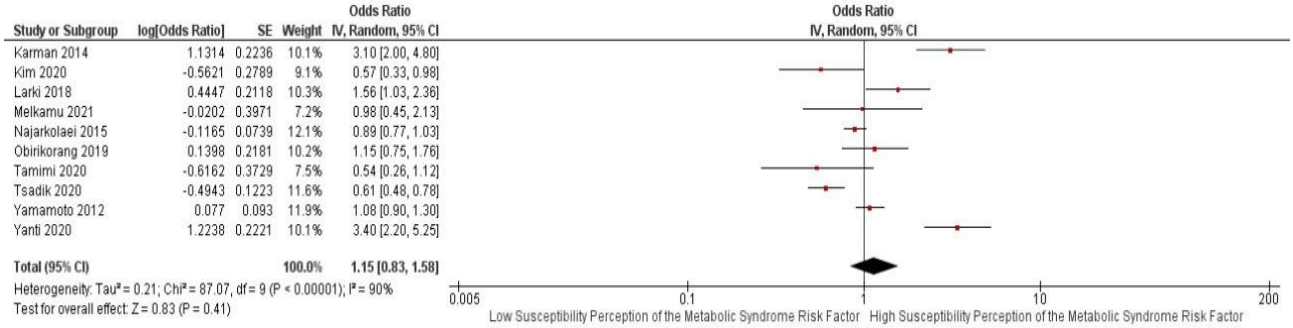

Figure 5. Forest plot Relationship of perceived susceptibility on Preventive Behavior of Metabolic Syndrome Risk Factors

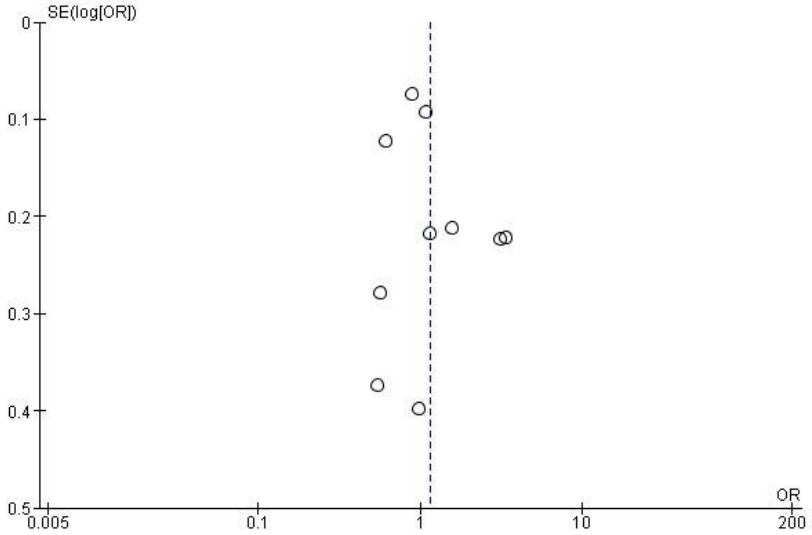

Figure 6. Funnel plot Relationship of perceived susceptibility on Preventive Behavior of Metabolic Syndrome Risk Factors

DISCUSSION

This systematic review and meta-analysis study took the theme of the Relationship of Health Belief Model to Preventive Behavior of Metabolic Syndrome Risk Factors. The independent variables of this study were perceived severity or seriousness and perceived vulnerability. The dependent variable of this study is the prevention behavior of metabolic syndrome risk factors.

This study uses the results of the aOR statistic from multivariate analysis, which aimed to control for confounding factors. Confounding factors can cause research results to be invalid because confounding factors also affect the relationship or affect the population being studied (Anulus et al., 2019).

1. **The relationship between Perceived Severity and prevention behavior of metabolic syndrome risk factors.**

This study showed that perceived high severity or seriousness was slightly more likely to engage in metabolic syndrome risk factor prevention behaviors than perceived low severity or seriousness, but it was not statistically significant. The results of this study are in line with the research conducted by Obirikorang et al. (2018), which states that perceived severity or seriousness can affect the prevention behavior of meta-

bolic syndrome risk factors, but it is not statistically significant. However, unlike the research of Chen et al. (2019) which states that perceived severity or seriousness is statistically significant in predicting preventive behavior for metabolic syndrome risk factors.

Sukohar et al. (2021) stated that the Health Belief Model construct is still relevant and feasible to use in predicting hypertension prevention behavior. To improve risk factor prevention behavior for metabolic syndrome, a person must have strong health beliefs, meaning they must be sensitive to health risks and understand the severity of the risk factors suffered. Perceived severity or seriousness is the extent to which a person feels or has beliefs about the severity of the illness suffered (Li et al., 2021).

The perceived severity or seriousness of the risk factors suffered can affect the behavior of preventing metabolic syndrome risk factors in the form of atherosclerosis, dyslipidemia, diabetes, hypertension, and obesity. Various preventive behaviors that can reduce the risk of metabolic syndrome include healthy dietary behavior through consumption of red yeast rice, because monacolin-K and other bioactive components contained in red yeast rice are able to reduce metabolic syndrome factors (Polibara, 2021).

2. The relationship between Perceived Susceptibility and prevention behavior of metabolic syndrome risk factors.

The results of this study indicate that there is no significant effect of the perception of susceptibility to the prevention behavior of metabolic syndrome risk factors. A person with a low perception of susceptibility has the same possibility to perform risk factor prevention behaviors for the metabolic syndrome with someone who has a high perception of vulnerability. The results of this study are in line with research conducted by Muscat et al. (2021) which stated that the perception of susceptibility did not significantly influence the prevention behavior of metabolic syndrome risk factors. Likewise with research conducted by Coker et al. (2019) which states that the perception of vulnerability has no significant effect on the prevention behavior of metabolic syndrome risk factors.

Perceived susceptibility is the perception of factors that are susceptible to the behavior of preventing metabolic syndrome risk factors to be carried out. Perceived vulnerability can be altered by advanced self-management skills, understanding of adverse health behaviors, medication adherence, diet-related knowledge of metabolic syndrome risk factors, and information skills (Truong, 2021). Modified lifestyle programs are effective in reducing vulnerability and risk behaviors that predispose a person to suffer from metabolic syndrome (Eze, 2021).

Coolen et al. (2021) also concludes that a higher level of perceived susceptibility to metabolic syndrome risk factors is associated with a specific quality of life than a lower level of perceived susceptibility. Chen et al. (2021) stated that metabolic syndrome that is not prevented and controlled can result in an increased risk of premature rupture of membranes in pregnant women, which is driven by proximal and distal colon cancer, thereby at least partially contributing to the increased incidence of premature rupture of membranes in pregnant women.

AUTHOR CONTRIBUTION

Cendekia Airedeta and Solehaini were the main researchers who selected topics, explored, and collected data of the study. Bhisma Murti who always provides input

and suggestions for this research. Herawati Prianggi played a role in analyzing data and reviewing documents of the study.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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