Original Article

Veganism does not reduce the risk of the metabolic syndrome in a Taiwanese cohort

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The purpose of the present study was to assess the risk of the metabolic syndrome (MS) with vegan, pescovegetarian, lactovegetarian and nonvegetarian diets in Taiwan. The design was a retrospective cohort study using secondary data analysis from a Taiwan longitudinal health check-up database provided by MJ Health Screening Center during 1996–2006. A total of 93209 participants were classified as vegans (n=1116), pescovegetarians (n=2461), lactovegetarians (n=4313) and nonvegetarians (n=85319) by food frequency list of self-administered questionnaire at baseline. The association between MS or MS components and different dietary groups was evaluated using Cox proportional-hazards regression models with adjustment for confounders. During the mean 3.75 years of follow up, a total 8006 MS incident cases occurred and the incidence of MS was 229 (95% CI, 224, 234) per 10000 person year. Compared with vegans, hazard ratios of MS for nonvegetarians, pescovegetarians, lactovegetarians were 0.75 (95% CI, 0.64, 0.88), 0.68 (95% CI, 0.55, 0.83) and 0.81 (95% CI, 0.67, 0.97) after adjusting for sex, age, education status, smoking status, drinking status, physical activity at work and leisure, respectively. As for MS components, nonvegetarians and pescovegetarians had 0.72 (95% CI, 0.62, 0.84), 0.70 (95% CI, 0.57, 0.84) times risk of developing low high density lipoprotein cholesterol (HDL-C), while nonvegetarians had 1.16 (95% CI, 1.02, 1.32) times risk of developing high fasting plasma glucose. Our data suggest that the vegan diets did not decrease the risk of metabolic syndrome compared with pescovegetarian, lactovegetarian and nonvegetarian diets in a Taiwanese cohort.

Key Words: vegan, pescovegetarian, lactovegetarian, nonvegetarian, metabolic syndrome

INTRODUCTION

Metabolic syndrome (MS) is a disorder composed of central obesity, impaired glucose metabolism, hypertension and dyslipidemia.[1] With rapid economic development, prevalence of MS for Taiwanese has been increasing, the age-standardized prevalence of MS in Taiwan was 15.7% according to the National Cholesterol Education Program Adult Treatment Panel III criteria (ATP-III) modified for Asian populations.[2] The individuals with MS may increase incidence of diabetes mellitus and coronary heart disease, as well as the mortality of cardiovascular diseases (CVD),[3-5] thus MS is an important predictor for future occurrence of those chronic diseases. CVD and diabetes had been reported to be the third and fourth cause of death of causes in Taiwan.[6] Therefore, risk of development of MS for Taiwanese should be concerned because the study of MS can give valuable reference to development of the two chronic diseases.

Diet has been reported to be one of important impact factors for MS. The health effects of vegetarians in western countries have been evaluated by the European Prospective Investigation into Cancer and Nutrition-Oxford (EPIC-Oxford) study[7] and some other early large population studies.[8,9] Most studies showed that a vegetarian diet was not only nutritionally adequate but also associated with lower risks of MS and certain chronic diseases compared with a non-vegetarian diet.[8-12] However, the vegetarian diet can be divided into vegan (those that eat no meat, fish, dairy products or eggs) diet, lactoovovegetarian (those that eat dairy products or eggs or both but no meat or fish) diet and pescovegetaian (those that eat fish, dairy products or eggs or both but no meat) diet,[8] different types of vegetarian diet may not experience the same health effects.

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The vegan diet is growing in popularity today for its proposed health vegan diet effects.[9] Vegan diet includes substantially greater quantities of fruit and vegetables compared with other type of vegetarian diets. It appears to be useful for increasing the intake of protective nutrients and photochemical and for minimizing the intake of dietary factors implicated in several chronic diseases,[13] which indicated that a vegetarian diet is related to lower risk of MS. However, the assumed beneficial health effects of a vegetarian diet extending to the vegan diet is still open to question, and whether the vegan diet can offer any additional benefit compared with other types of diet is unclear too. Moreover, the traditional Chinese diet is a plant based diet with high intake of vegetables and fruit,[14,15] thus the health effects of diet in Taiwan may be different compared to western countries. Therefore, the present study was aimed to compare the vegan diet and other dietary patterns (e.g., lactoovovegetarian, pescovegetaian and nonvegetarian diets) with the risk of developing of MS among Taiwanese.

MATERIALS AND METHODS

Study population

The study is a secondary data analysis using the Taiwan longitudinal health check-up database provided by MJ Health Screening Center. Details of this database have been described elsewhere.[16,17] Briefly, MJ Health Screening Center is a private membership chain clinic with four centers located in Taipei, Taoyuan, Taichung and Kaohsiung. Each center provides periodic health examinations to its members and all data have been recorded electrically since 1994.[18] This database includes participant information from a series of medical tests for blood, urine, anthropological measurements, physical examination and medical history (questionnaire). The database can be used for academic research upon the request.

In brief, a total of 168138 individuals aged 20-93 years from 1996-2005 in the MJ database were selected as the object of our study. To obtain a healthy cohort at baseline, we first excluded participants with MS according to modified Adult Treatment Panel III (ATP III) (n=24875), then 50054 subjects were excluded for missing key information on demographic and dietary variables. Finally, an eligible cohort population consisted of 93209 (45890 men and 47319 women) participants with average age of 37.1±12.1 years. Their MS outcome information was collected from the MJ database between 1997 and 2006.

Each participant signed a consent form authorizing MJ Health Screening Centre to process the data generated from medical screening. Data related to individual identification were removed and remained anonymous during the entire study process.[16]

Classification of diet group

The dietary intakes of participants were reported using a self-report questionnaire. The food frequency questionnaire included 23 food items with specified serving sizes. Participants indicated their average frequency of consumption over the past year by checking 1 of 5 frequency categories, such as "almost never", "1-3 servings/wk", "4-6 servings/wk", "1serving/d" and "≥ 2 servings/d".

According to the classification of vegetarian diets used in the Adventist Health Study-2,[8] participants were categorized into 1 of 4 dietary groups judged by their replies to 4 questions: How much meat (including red meat and poultry) do you eat? How much fish do you eat? How much dairy product do you eat? How many eggs do you eat? From these 4 questions, 4 dietary groups were defined as nonvegetarians (those that eat meat, fish, dairy products or eggs or both), pescovegetarians (those that eat fish, dairy products or eggs or both but no meat), lactoovovegetarians (those that eat dairy products or eggs or both but no meat or fish), and vegans (those that eat no meat, fish, dairy products or eggs).

Criteria of MS

MS was defined using the modified ATP III criteria for Asians,[19,20] which required meeting at least three of the following components: (1) waist circumference (WC) >90 cm for men and >80 cm for women; (2) triacylglycerol (TG) ≥150 mg/dL; (3) high density lipoprotein cholesterol (HDL-C) <40 mg/dL for men and <50 mg/dL for women; (4) systolic blood pressure (SBP) ≥130 mmHg or diastolic blood pressure (DBP) ≥85 mmHg or current use of antihypertensive drugs; (5) fasting plasma glucose (FPG) ≥100 mg/dL or current use of antihyperglycemic drugs.

Statistical analysis

Baseline characteristics of participants were described as mean±SD for continuous variables and percentages for categorical variables. MS incidence rates and 95% confidence intervals (CI) were calculated among people with different dietary groups. Cox proportional-hazards model adjusted for possible confounders (sex, age, education status, smoking status, drinking status, physical activity at work and leisure) was used to estimate the hazard ratios (HRs) for MS and its components. The statistical analyses were performed using SAS software (9.1.3 version, SAS Inc. Cary NC). A *p*-value less 0.05 was considered as statistically significant.

RESULTS

Baseline characteristics

There were statistically significant difference in sex, age , education status, smoking status, drinking status, physical activity at work and leisure among the four groups (all $p<0.05$). More females and older age were found in vegans than in nonvegetarians and lactoovovegetarians. Education status of vegans was the lowest among the 4 dietary groups. The proportion of vegans who smoked and drank was lower than nonvegetarians. The comparison for any 2 dietary groups in physical activity at work and leisure had statistical difference (Table 1).

Incidence of MS

The mean follow-up years (SD) was 3.73 (2.50), 3.69 (2.51), 4.20 (2.82), 3.65 (2.53) for nonvegetarians, pescovegetarians, lactoovovegetarians and vegans. During the mean 3.75 years (2.52) period of follow up, there were 8,006 MS incident cases and the incidence of MS was 229 (95% CI, 224, 234) per 10000 person year. Incidence estimates and 95% CI of MS in four groups are listed in Table 2.

Risk of MS and MS components

The proportional hazard assumption was reasonable examined by plotting the Kaplan–Meier survival curves among different dietary groups while comparing survival rates. Cox proportional hazards model was used to compare survival rates adjusted for sex, age, education status, smoking status, drinking status, physical activity at work and leisure. The HR and 95% CI of developing MS based on different dietary groups are shown in Table 3. After adjusting for age and sex together with another six covariates, nonvegetarians, pescovegetarians and lactoovovegetarians showed 0.75 (95% CI, 0.64,0.88), 0.68 (95% CI, 0.55,0.83) and 0.81 (95% CI, 0.67,0.97) times risk of developing MS than the vegans.

The HR of developing MS was also stratified by sex, age and education status among different dietary groups (Table 4). After adjusting for other covariates, different vegetarians and nonvegetarians showed lower risk of developing MS than vegans in some subgroups. Generally, the reducing risk from 0.79 (95% CI, 0.65, 0.97) for lactoovovegetarians in older than 35 years participants to 0.52 (95% CI, 0.32, 0.83) for pescovegetarians in college/higher participants.

After adjusting for age and sex together with another six covariates, compared to the vegans, nonvegetarians and pescovegetarians showed 0.72 (95% CI, 0.62, 0.84), 0.70 (95% CI, 0.57, 0.84) times risk of low HDL-C (low HDL-C: HDL-C < 40 mg/dL for men and < 50 mg/dL for

Table 1. Baseline characteristics of participants by different dietary groups[†]

Characteristic	Nonvegetarians (n=85319)	Pescovegetarians (n=2461)	Lactoovovegetarians (n=4313)	Vegans (n=1116)
Sex[*]				
Women (%)	49.6	65.0	62.2	67.3
Age (years)[*]	36.8±11.8	43.5±13.9	37.9±14.4	44.1±14.9
Education status[*]				
None/elementary school (%)	10.8	25.2	19.2	35.8
Secondary school (%)	29.1	34.0	38.1	37.6
College/higher (%)	60.1	40.8	42.6	26.6
Smoking status[*]				
Current (%)	21.4	14.5	14.3	14.7
Former (%)	5.9	6.2	5.1	4.8
Never (%)	72.7	79.3	80.6	80.5
Drinking status[*]				
Current (%)	18.0	14.3	13.5	13.0
Former (%)	2.0	3.2	2.8	2.3
Never (%)	80.0	82.5	83.7	84.7
Physical activity at work[‡*]				
Light (%)	61.6	57.1	59.3	53.5
Moderate (%)	27.4	30.9	28.5	30.7
Heavy (%)	8.8	9. 7	9.8	12.5
Intense (%)	2.2	2.3	2.4	3.4
Physical activity at leisure[§*]				
None/Mild (%)	48.4	46.3	50.4	56.4
Moderate (%)	39.0	36.3	34.2	28.9
Vigorous (%)	12.5	17.4	15.4	14.8
Other biomedical measurements[*]				
WC (cm)	75.3±9.4	74.5±9.1	74.8±9.5	75.7±9.6
TG (mg/dL)	98.4±61.6	97.1±68.8	94.3±52.2	99.4±60.5
HDL-C (mg/dL)	52.8±14.7	52.5±14.1	51.2±14.4	52.0±14.5
SBP (mmHg)	116± 16.2	116±16.4	116±16.5	114±15.3
DBP (mmHg)	70.3±10.5	71.4±11.3	70.2±10.5	71.4±11.4
FPG (mg/dL)	94.9±12.8	96.4±18.4	93.4±10.2	95.7±17.2

[†]Continuous and categorical variables were described as Mean± SD and percentages, tested by ANOVA and X^2-test, respectively;
[‡]Physical activity at work was divided into four levels: light, moderate, heavy and intense were defined as those who were sedentary occupation, standing and sedentary occupation, standing occupation and strenuous physical labor respectively;
[§]Physical activity at leisure was divided into three levels: none/mild, moderate, and vigorous physical activity were defined as those who exercised <1, 1–4, and >5 h per week, respectively;
[*]Significantly (p<0.05) different in 4 dietary groups (nonvegetarians, pescovegetarians, lactoovovegetarians and vegans).

Table 2. Incidence of metabolic syndrome among participants by different dietary groups[†]

Groups	n	Person-years	Metabolic syndrome	
			Incident cases	Incidence/10 000 person-years (95%CI)
Nonvegetarians	85319	318133	7226	227 (222, 232)
Pescovegetarians	2461	9075	217	239 (208, 271)
Lactoovovegetarians	4313	18127	403	222 (201, 244)
Vegans	1116	4075	160	393 (333, 452)

[†]The metabolic syndrome was defined by the National Cholesterol Education Program Adult Treatment Panel III criteria modified for Asian populations.

Table 3. The hazard ratios (HRs) of metabolic syndrome among participants by different dietary groups[†]

	Crude HR (95%CI)	Adjusted HR (95%CI) [§]	Adjusted HR (95%CI) [¶]
Nonvegetarians[‡]	0.58 (0.50, 0.68)	0.73 (0.62, 0.85)	0.75 (0.64, 0.88)
Pescovegetarians[‡]	0.61 (0.50, 0.75)	0.60 (0.49, 0.74)	0.68 (0.55, 0.83)
Lactoovovegetarians[‡]	0.57 (0.47, 0.68)	0.73 (0.61, 0.88)	0.81 (0.67, 0.97)

[†]The metabolic syndrome was defined by the National Cholesterol Education Program Adult Treatment Panel III criteria modified for Asian populations;
[‡]Compared with vegans;
[§]Adjusted by age and sex;
[¶]Adjusted by age, sex, smoking status, drinking status, education status, physical activity at work and leisure.

Table 4. The adjusted hazard ratios (HRs) of metabolic syndrome[†] stratified by sex, age and education status among different dietary groups

Characteristic	HR (95%CI)		
	Lactoovovegetarians[‡]	Pescovegetaians[‡]	Nonvegetarians[‡]
Sex[§]			
Men (n=45890)	0.78 (0.59, 1.03)	0.62 (0.45, 0.85)	0.79 (0.62, 1.01)
Women (n=47319)	0.81 (0.64, 1.04)	0.68 (0.52, 0.89)	0.85 (0.69, 1.04)
Age[¶]			
≤35 years (n=49310)	0.75 (0.45, 1.28)	0.85 (0.47, 1.55)	0.78 (0.48, 1.27)
>35 years (n=43899)	0.79 (0.65, 0.97)	0.61 (0.49, 0.76)	0.78 (0.66, 0.93)
Education status[††]			
None/elementary school (n=11039)	0.84 (0.65, 1.09)	0.64 (0.48, 0.85)	0.77 (0.62, 0.95)
Secondary school (n=27741)	0.76 (0.53, 1.09)	0.80 (0.54, 1.18)	0.94 (0.69, 1.29)
College/higher (n=54429)	0.77 (0.51, 1.17)	0.52 (0.32, 0.83)	0.74 (0.51, 1.09)

[†]The metabolic syndrome was defined by the National Cholesterol Education Program Adult Treatment Panel III criteria modified for Asian populations;
[‡]Compared with vegans;
[§]Adjusted by age (numeric), smoking status, drinking status, education status, physical activity at work and leisure;
[¶]Adjusted by age (numeric), sex, smoking status, drinking status, education status, physical activity at work and leisure;
[††]Adjusted by age (numeric), sex, smoking status, drinking status, physical activity at work and leisure.

Table 5. The hazard ratios (HRs) of metabolic syndrome components among participants by different dietary groups[†]

Metabolic syndrome components [‡]	Groups[§]	Crude HR (95%CI)	Adjusted HR (95%CI)[¶]	Adjusted HR (95%CI)[††]
Abdominal obesity	Nonvegetarians	0.77 (0.63, 0.95)	0.91 (0.74, 1.11)	0.99 (0.81, 1.21)
	Pescovegetarians	0.75 (0.58, 0.97)	0.74 (0.58, 0.95)	0.91 (0.71, 1.16)
	Lactoovovegetarians	0.60 (0.47, 0.76)	0.72 (0.57, 0.91)	0.91 (0.73, 1.15)
High TG	Nonvegetarians	0.85 (0.74, 0.99)	0.86 (0.74, 1.00)	0.86 (0.74, 1.09)
	Pescovegetarians	0.84 (0.70, 1.01)	0.81 (0.68, 0.97)	0.85 (0.71, 1.02)
	Lactoovovegetarians	0.79 (0.67, 0.93)	0.88 (0.74, 1.03)	0.92 (0.78, 1.09)
Low HDL-C	Nonvegetarians	0.71 (0.61, 0.83)	0.71 (0.61, 0.83)	0.72 (0.62, 0.84)
	Pescovegetarians	0.67 (0.55, 0.81)	0.66 (0.54, 0.80)	0.70 (0.57, 0.84)
	Lactoovovegetarians	0.88 (0.74, 1.05)	0.92 (0.77, 1.09)	0.98 (0.83, 1.17)
High BP	Nonvegetarians	0.87 (0.75, 1.01)	0.93 (0.80, 1.08)	0.94 (0.81, 1.09)
	Pescovegetarians	0.94 (0.79, 1.14)	0.92 (0.76, 1.10)	0.94(0.79, 1.13)
	Lactoovovegetarians	0.77 (0.65, 0.91)	0.89 (0.76, 1.06)	0.92 (0.77, 1.08)
High FPG	Nonvegetarians	1.04 (0.92, 1.19)	1.17 (1.03, 1.33)	1.16 (1.02, 1.32)
	Pescovegetarians	1.05 (0.90, 1.23)	1.08 (0.92, 1.25)	1.09 (0.94, 1.27)
	Lactoovovegetarians	0.80 (0.69, 0.93)	0.93 (0.81, 1.07)	0.95 (0.82, 1.09)

[†]The metabolic syndrome was defined by the National Cholesterol Education Program Adult Treatment Panel III criteria modified for Asian populations;
[‡]Abdominal obesity: waist circumference > 90 cm for men and > 80 cm for women; high TG: TG ≥ 150 mg/dL; low HDL-C: HDL-C < 40 mg/dL for men and < 50 mg/dL for women; high BP: systolic BP ≥ 130mmHg or diastolic BP ≥ 85 mmHg or current use of antihypertensive drugs; high FPG: FPG ≥ 100 mg/dL or current use of antihyperglycemic drugs;
[§]Compared with vegans;
[¶]Adjusted by age and sex;
[††]Adjusted by age, sex, smoking status, drinking status, education status, physical activity at work and leisure.

women), while nonvegetarians showed 1.16 (95% CI, 1.02, 1.32) times risk of high FPG (high FPG: FPG ≥100 mg/dL or current use of antihyperglycemic drugs) (Table 5).

DISCUSSION

MS is a complex disorder and prone to increase the risk of diabetes and CVD, the diet plays an important role in developing MS.[21] After mean 3.75 years follow-up, we documented 8006 MS incident cases, the incidence of MS

was 229 (95% CI, 224, 234) per 10000 person year, there are different MS incidence among 4 dietary groups, as shown in Table1. Most previous studies on the relationship between diet and MS were based on the cross-sectional investigation, this is the first report about MS incidence of different dietary pattern based on a retrospective cohort study among Asian adults.

The present study showed that the people who took the different diet style had the different risk of MS, lactoovovegetarians, pescovegetarians and nonvegetarians had lower risk of developing MS than vegans with adjusted HR of 0.75 (95% CI, 0.64, 0.88), 0.68 (95% CI, 0.55, 0.83) and 0.81 (95% CI, 0.67, 0.97). Consideration of the vegans group had the different sex, age and education compositions, which may modify the association between dietary patterns and MS, we stratified the participants by sex, age and education status. The result demonstrated the identical tendency of lactoovovegetarians, pescovegetarians and nonvegetarians against on MS in some subgroups (see Table 4). The similar findings were observed in a recently large population study among Caucasians conducted by Gary Fraser,[22] who summarized the results of studies on Seventh-day Adventists and other vegetarians, and found that vegans did not appear to have any significant advantages on chronic disease patterns than other dietary patterns (lactoovovegetarians and pescovegetarians). This may be due to vegan diet further excludes fish, dairy products and egg, however, the latter had more protective effect against on MS.[8-10,23,24] Pescovegetarians diet containing fish is rich in n-3 fatty acids, which plays an important role in reducing abnormalities associated with the MS and mortality from coronary heart disease.[24] Lactoovovegetarian diet including dairy products could provide a substantial portion of essential nutrients for the human body, especially calcium, potassium and magnesium, which are beneficial for reducing risk of metabolic syndrome, stroke and some cancers,[23] although further reseach is required to elucidate the current inconsistencies in the literature.[25]

Compared with nonvegetarians, we also did not find that vegans had health benefits on reducing the risk of MS among Taiwan participants. The similar result found by Hung et al[6] with no significant different prevalence of MS between Chinese vegetarians and nonvetarians in Taiwan. The previous studies in western countries have shown that a vegetarian diet may be benefit in reducing risk of certain chronic disease.[9] However, these studies did not discriminate among the different vegetarian dietary groups and there is not enough evidence to declare health effects of the vegan diet. In addition, our results may be related to the difference of diet pattern and cooking methods between Taiwan and Western countries.[26] Traditional Taiwanese diet includes plenty of plant foods, absence of dairy products, fish in low to moderate amounts, poultry and eggs used in low amounts and red meat used sparingly.[14] The difference between nonvegetarians and vegetarians in Taiwan was not as significant as in western societies.

The further study on MS components revealed that nonvegetarians and pescovegetarians had lower risk of developing low HDL than the vegan with adjusted HR of 0.72 (95% CI, 0.62, 0.84) and 0.70 (95% CI, 0.57, 0.84). According to the results of cohort studies of Seventh-day Adventists,[8,22,27] the level of HDL cholesterol was not different among different dietary groups,[11,12] while the levels of total and low density lipoprotein (LDL) cholesterol increased from vegans, other types of vegetarians to nonvegetarians. However, Ashen et al. found that plasma HDL cholesterol levels declined with reductions in the intake of dietary fat.[28] Meksawan K et al. also indicated that subjects consuming low-fat diet had lower HDL cholesterol than subjects with a high-fat diet.[29] This is due to the vegans had the lowest fat intake, which could induce to low HDL cholesterol level.

Our study showed that vegans displayed lower risk of developing high FPG than nonvegetarians, which is similar to the report of Hung et al, who found that Taiwanese vegetarians had lower glucose levels and higher insulin sensitivity than that of nonvegetarians.[30] Similar results in vegetarians were also reported by previous studies in Caucasians.[31-34] One recent pilot trial also demonstrated vegan diet could improve glycemic control in individuals with type 2 diabetes.[35] The benefits on glycemic control of vegan diet might relate to increase insulin sensitivity and reduce risk of developing high FPG.[30,36-38]

There are two limitations in this study. Firstly, the study is a secondary data analysis using the Taiwan health check-up database. Our study population was participate in the health screening program voluntarily and drop out voluntarily, it is possible that this study population has higher socioeconomic and nutritional status than general population. Secondly, participants were assigned to different dietary groups by self-administered questionnaire when initially entering study cohort and we assumed that dietary groups in this study were holding constant during follow-up. In order to examine the impact, the percentage of participants for each dietary group was counted between baseline and endpoint in this study. In fact, there was no significant change in the percent of each dietary group, for example, the percentage of omnivores changed from 91.5% to 91.1%, pescovegetarians from 2.64% to 3.06%, lactoovovegetarians from 4.63% to 4.43%, vegans from 1.20% to 1.45% at baseline and endpoint, respectively.

In summary, our findings did not support that a vegan diet decreases the risk of developing MS compared to nonvegetarians, pescovegetaian and lactoovovegetarian diet over a more than 3 years follow-up, after adjusted for baseline confounding factors in Taiwanese. The health effect of different types of vegetarian diet on different races and diverse lifestyles should be further explored in the future studies.

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AUTHOR DISCLOSURES

We declare that we have no conflict of interest.

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Original Article

Veganism does not reduce the risk of the metabolic syndrome in a Taiwanese cohort

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纯素食没有降低代谢综合症的发病风险-台湾队列研究

摘要：本研究的目的是为了比较台湾人群纯素食者相对鱼类素食、蛋奶素食和非素食者代谢综合症的发病风险。采用回顾性队列的研究方法，采集台湾美兆集团1996-2006年期间的健康体检数据进行二手数据分析。共有93,209名健康体检者纳入研究对象，根据自我调查问卷中的食物摄取频率表，将其分为纯素食、鱼类素食、蛋奶素食和非素食者四种类型。采用COX比例风险模型，分析不同膳食分组者发生代谢综合症和代谢综合症组分的风险。在平均3.75年的观察期内，总共有8006个代谢综合症新发病例，发生率为229 (95% CI, 224, 234)/10000人年。控制性别、年龄、教育程度、吸烟、饮酒、工作勞動、休閒运动等混杂因素的影响后，与纯素食者相比，非素食、鱼类素食和蛋奶素食者代谢综合症发生危险比(HR)分别为0.75 (95% CI, 0.64, 0.88), 0.68 (95% CI, 0.55, 0.83) 和 0.81 (95% CI, 0.67, 0.97)。代谢综合症组分发病风险的分析结果显示，与纯素食者相比，非素食和鱼类素食者低的高密度脂蛋白胆固醇发生的HR分别为0.72 (95% CI, 0.62, 0.84) 和 0.70 (95% CI, 0.57, 0.84)，非素食者高空腹血糖发生的HR为 1.16 (95% CI, 1.02, 1.32)。我们的研究结果提示：相对于鱼类素食、蛋奶素食和非素食者而言，纯素食没有降低代谢综合症的发病风险。

关键词：纯素食、鱼类素食、蛋奶素食、非素食、代谢综合症