

# Dietary Patterns and Metabolic Syndrome Among Overweight and Obese Adults

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## Background

- Metabolic syndrome (MetS) is a condition that affects 20-25% of adults worldwide. MetS is highly related to central obesity, type 2 diabetes, and cardiovascular disease.<sup>1</sup>
- A Western diet high in fat and added sugar may contribute to the development of MetS, whereas a Mediterranean diet high in fruits, vegetables, and whole grains may reduce the likelihood of MetS development.<sup>2</sup>
- Understanding connections between dietary patterns and MetS among individuals with overweight and obesity is important as dietary interventions are a widespread method for MetS treatment and prevention.

## Objective

To assess the relationship of Western or Mediterranean diet patterns with MetS among overweight or obese adults.

## Methods

### Participants

- Adults (25-45 years, n=107, 69 women) with body mass index  $\geq 25.0 \text{ kg/m}^2$  were included in the present study.
- Participant eligibility criteria included an absence of medications known to influence outcomes of interest and no physician-diagnosed chronic conditions.

### Methods

- MetS was evaluated using international Diabetes Federation guidelines: Individuals with elevated abdominal adiposity, defined as a waist circumference  $\geq 94 \text{ cm}$ ,  $\geq 90 \text{ cm}$ , or  $\geq 80 \text{ cm}$  for Euroid males, Asian males, and females, respectively, and two or more additional risk factors (triglycerides  $> 150 \text{ mg/dL}$ , HDL cholesterol  $< 40 \text{ mg/dL}$  for males and  $< 50 \text{ mg/dL}$  for females, blood pressure  $> 130/85 \text{ mmHg}$ , fasting blood glucose  $> 100 \text{ mg/dL}$ ) were considered to have MetS.<sup>1</sup>
- Waist circumference was measured with inelastic tape; Lipid and glucose concentrations were assessed with a chemical analyzer following an overnight fast ( $\geq 10 \text{ hr}$ ); Blood pressure was evaluated in a seated position with an automatic blood pressure monitor.
- Habitual diet was evaluated using the National Cancer Institute Diet History Questionnaire II (DHQII, Past Year with Portion Size). DHQII data were processed using Diet\*Calc software and SAS 9.4. Diet variables were selected from the Food Patterns Equivalents Database.
- Mann Whitney U tests were used to assess differences between participants with or without MetS.
- Principal component analysis was conducted to identify unique dietary patterns with relation to MetS using RStudio Desktop version 1.1.442.

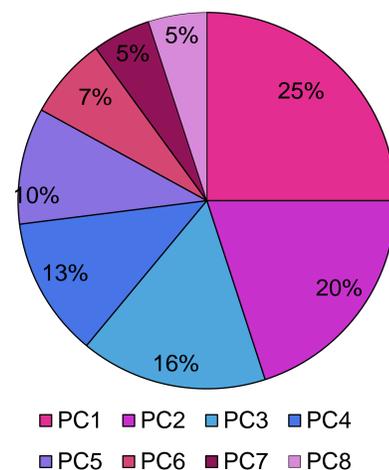
## Results

**Table 1.** Dietary intake among study participants with and without metabolic syndrome.

	Mean (SEM)			P-value
	All (n=99)	Without MetS (n=68)	With MetS (n=31)	
Total Fruit (cup equiv.)	1.07 (0.08)	1.07 (0.10)	1.06 (0.17)	0.435
Starchy Vegetables (cup equivalent)	0.37 (0.03)	0.34 (0.03)	0.43 (0.06)	0.088
Total Vegetables (cup. equiv.)	1.83 (0.11)	1.72 (0.12)	2.06 (0.11)	0.549
Whole Grains (ounce equivalent)	0.54 (0.04)	0.56 (0.05)	0.48 (0.06)	0.637
Refined Grains (ounce equivalent)	3.73 (0.20)	3.57 (0.22)	4.06 (0.42)	0.417
Legumes (oz. equiv.)	0.36 (0.05)	0.41 (0.07)	0.25 (0.05)	0.138
Milk (cup equivalent)	0.87 (0.11)	0.93 (0.15)	0.74 (0.10)	0.877
Yogurt (cup equivalent)	0.15 (0.02)	0.16 (0.02)	0.13 (0.03)	0.231
Cheese (cup equivalent)	0.78 (0.06)	0.70 (0.06)	0.96 (0.14)	0.077
Meat (ounce equivalent)	1.35 (0.10)	1.24 (0.11)	1.58 (0.18)	0.087
Poultry (ounce equivalent)	1.04 (0.11)	1.01 (0.12)	1.10 (0.23)	0.949
Eggs (ounce equivalent)	0.62 (0.05)	0.66 (0.06)	0.56 (0.09)	0.177
Nuts (ounce equivalent)	1.25 (0.16)	1.42 (0.22)	0.90 (0.17)	0.325
Seafood, low in omega-3 (ounce equivalent)	0.27 (0.03)	0.29(0.04)	0.21 (0.05)	0.016
Seafood, high in omega-3 (ounce equivalent)	0.20 (0.04)	0.21 (0.05)	0.18 (0.09)	0.016
Added Sugar (tsp. equivalent)	13.03 (1.46)	11.91 (1.85)	15.48 (2.27)	0.087
Oil (gram equivalent)	24.78 (1.38)	25.40 (1.80)	23.43 (1.98)	0.629
Solid fat (gram equivalent)	35.24 (1.85)	33.56 (2.06)	38.94 (3.78)	0.229
Alcoholic beverages (drink equivalent)	0.50 (0.09)	0.58 (0.11)	0.30 (0.14)	0.005

MetS = metabolic syndrome, SEM = standard error of the mean. Variables were derived from the USDA Food Patterns Equivalents Database and evaluated using the Mann Whitney U test.

**Figure 1.** Among eight PCs, PC1, PC2, and PC3 comprise 61% of the variation in dietary pattern differences among study participants.

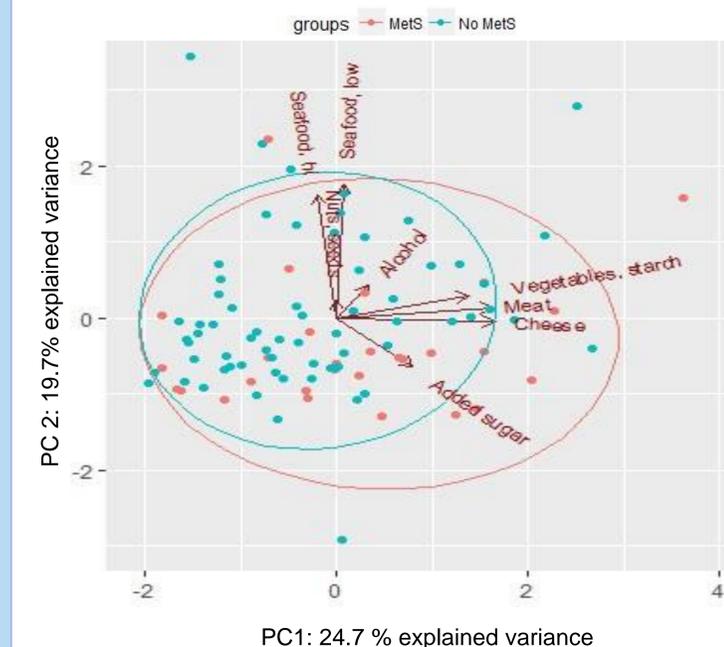


**Table 2.** Factor loadings of principal components (PC 1-8). The top three components include: 1) PC1, an energy-dense diet high in meat, cheese, added sugar, and starchy vegetables. 2) PC2, a dietary pattern low in added sugar and high in seafood, and 3) PC3, characterized by nuts and seeds with a lower intake of added sugar and starchy vegetables.

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Meat	0.57	0.06	0.09	0.20	-0.11	-0.47	-0.30	0.55
Cheese	0.58	-0.02	0.17	-0.17	-0.03	-0.28	0.35	-0.64
Seafood, low n-3	0.02	0.69	-0.03	-0.00	0.18	0.03	0.63	0.31
Seafood, high n-3	-0.07	0.64	-0.31	-0.08	0.11	-0.19	-0.56	-0.36
Nuts, seeds	-0.00	0.09	0.52	-0.79	0.10	0.10	-0.20	0.19
Starchy vegetables	0.49	0.12	-0.28	-0.09	-0.38	0.71	-0.11	0.04
Alcoholic beverages	0.12	0.17	0.62	0.53	0.33	0.36	-0.19	-0.16
Added sugar	0.28	-0.25	-0.37	-0.13	0.82	0.12	-0.04	0.08

## Results

**Figure 3.** Biplot derived from PC1 and PC2 data based on principal component analysis.



A dietary pattern difference can be observed between participants with or without MetS based on the plot. Higher consumption of meat, cheese, starchy vegetables, and added sugar (Western diet) are related to MetS. Intake of seafood, nuts, seeds, and moderate alcohol (Mediterranean diet) are inversely connected with MetS.

## Conclusions

- Dietary factors differed by presence or absence of MetS.
- A Western diet pattern, represented by meat, starchy vegetables, cheese, and added sugar, is positively associated with MetS, while a Mediterranean diet pattern, represented by seafood, nuts and seeds appeared to be protective against this condition.
- Our findings highlight the links between dietary habits and MetS among adults with overweight or obesity. Further research is needed to establish causal connections between dietary patterns and disease progression.

## References

- Alberti S, et al. International Diabetes Federation. 2006.
- Demosthnes B, et al. American Dietetic Association, 2007.

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