

NHANES (N = 27911)

Exposure:

- Ratio of energy and macronutrients consumption at breakfast and dinner;
- Δ Ratio of energy and macronutrients

- Foods consumption at breakfast and dinner; Δ Foods
- Replacing 1 unit food consumption at dinner with the equivalent unit of food consumption at breakfast

Covariates:

Adjustments included age, sex, ethnicity, income, education, regular exercise, smoke, alcohol intake, supplement use, medication use for lower blood sugar, medication use for hypertension, medication use for cholesterol, and total intake of energy, fat, protein, SFA, high-quality carbohydrate, animal protein, dietary fiber, dietary cholesterol, AHEI and breakfast skipping; For the associations of Δ Food, and food substitution models were an additional adjustment for the total daily intake of the food consumption.

Outcome:

- Genemal obesity, Morbid obesity, Abdominal obesity
- Body Mass Index (Kg/m²)

- Genemal obesity, Morbid obesity, Abdominal obesity

Sensitivity analyses:

Thirteen sensitivity analyses were performed in Δ Ratio in terms of energy and macronutrients and obesity with multiple logistic regression models.

(1) Participants with breakfast skipping were excluded. (2) Participants with dinner skipping were excluded. (3) The snack consumption between breakfast and lunch as well as snack after dinner were considered (Δ = (dinner + snack after dinner) – (breakfast + snack between breakfast and lunch)). (4) Macronutrients in the energy-adjusted form were calculated. (5) Participants were stratified into tertiles with total energy consumption. (6) Participants who were night shift workers or rotating workers from 2005 to 2010 were excluded. (7) Further adjustment was made with sleep hours from 2005 to 2016. (8) Further adjustment was made with participants who did not consume both breakfast and snacks after breakfast. (9) The association of Δ nuts and Δ marine fats with obesity-related outcomes was investigated to examine whether the source of fat could affect the association. (10) Energy consumption and AHEI at dinner and breakfast in terms of quartiles of Δ poultry were compared. (11) General linear regression models were adopted to examine the difference in macronutrients consumption of snacks among participants. (12) We investigated the above associations among participants without excluding those with extremely energy intake. (13) Additionally adjusted with timing for breakfast and dinner.