

B-vitamins over-consumption may be the cause of the increased prevalence of obesity and diabetes

Obesity and type 2 diabetes have been a major health issue in the United States. It is during the past few decades that obesity and type 2 diabetes have rapidly reached epidemic levels not only in adults but also in children and teenagers. The fact that human genome has not changed markedly in such a short period has led to the hypothesis that obesity and type 2 diabetes are the outcomes of the gene-environment interaction. Increasing evidence has indicated that, among those environmental factors, diet may play a crucial role in the prevalence of obesity and type 2 diabetes.

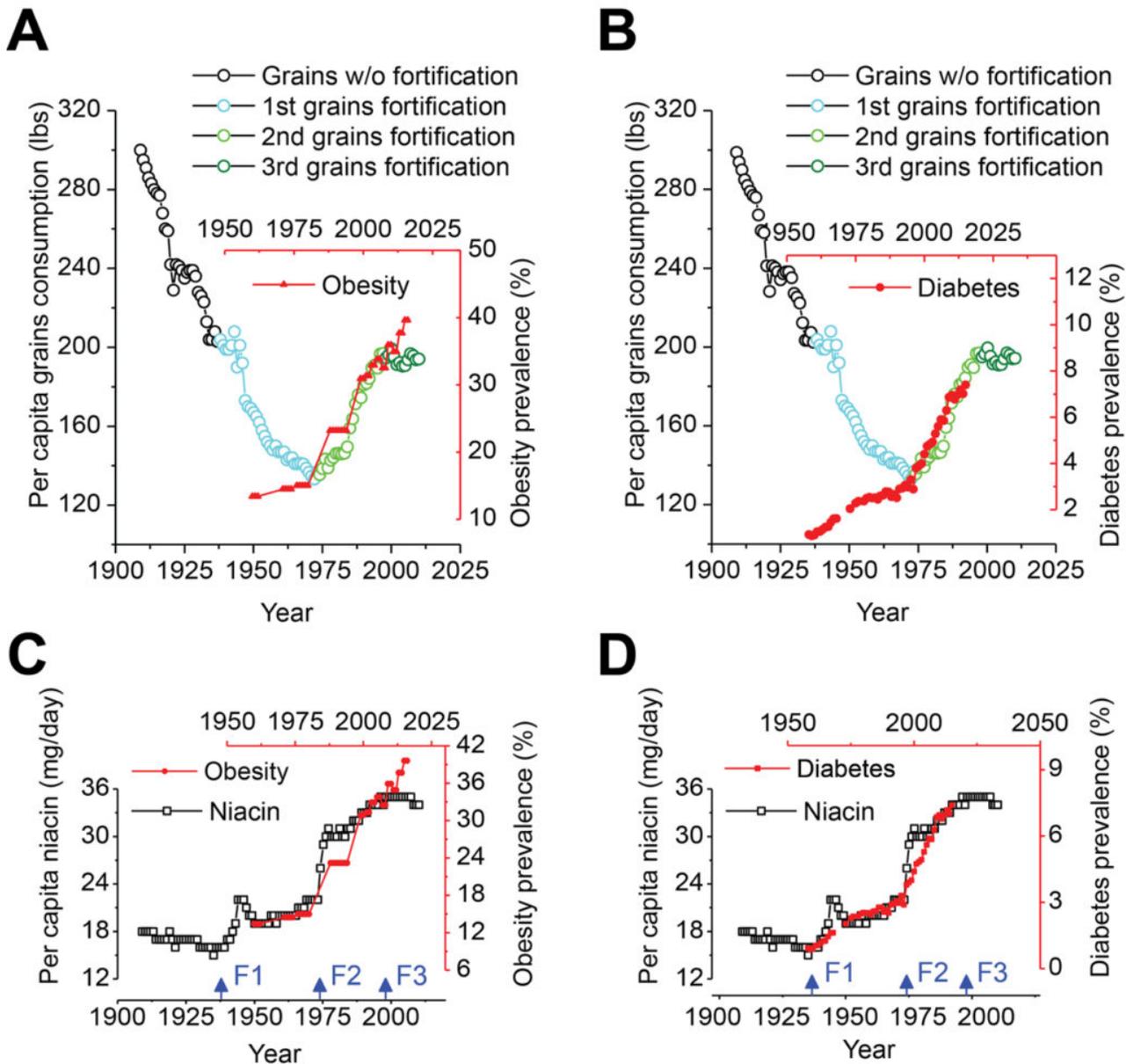


Fig. 1. Correlation of obesity and diabetes prevalence to the grain fortification with niacin. (A and B) The increased prevalence of obesity (A) and diabetes (B) is correlated with grain fortification in a 1- and 2-decade time-lag fashion. (C and D) the increased prevalence of obesity (C) and diabetes (B) is correlated to the niacin per capita consumption in a 1- and 2- decade time-lag fashion. Arrows indicate the starting times for the 1st, 2nd and 3rd fortification. Data sources: USDA and CDC.

Recently, considerable attention has been focused on dietary carbohydrates, for the epidemiological studies from the United States have shown that the rising prevalence of obesity and type 2 diabetes has been accompanied by a significant increase in carbohydrates per capita consumption during the past three decades. However, the current per capita consumption of carbohydrates in the US has not even reached to the same level as that in 1900s (Fig. 1A and B). These results indicate that there might be other risk factors in the carbohydrate-rich diets that contributed to the prevalence of obesity and type 2 diabetes in the US.

Since 1938, one of the major changes in diets has been the grain fortification, which led to add B-vitamins (niacin, thiamin, and riboflavin) into grain productions, including white flour, corn, rice, ready-to-eat cereals, sweetened beverages and so on. The initial purpose of grain fortification was to prevent the pellagra, a severe clinical symptom caused by the deficiency of the B vitamins, especially niacin, since the late 1930s. The implementation of mandatory grain fortification began in the early 1940s, and the fortification standards were further increased in 1974. These two changes in grain diets were followed by 2 sharp increases in the mean BMI of the US populations, which occurred in 1944-1950s and in 1975 through 1980s, respectively (Fig. 1A and B). The grain fortification has dramatically increased the amount of niacin per capita consumption from 16 mg daily in the 1930s to 33 mg in the early 2000s (Fig. 1C and D), a level of more than 2 time higher than the recommended dietary allowance by the US Food and Nutrition Board (RDA: 14 and 16 mg for adult women and men, respectively). Intriguingly, the overall trend of the prevalence of obesity and type 2 diabetes occurred first in the earlier grain-fortification states, which now have the highest levels of obesity and type 2 diabetes in the US, such as Alabama, Arkansas, Louisiana, Mississippi, and West Virginia. Our studies have shown that the prevalence of obesity and type 2 diabetes was highly correlated with per capita consumption of B-vitamins with a 10-year and 26-year time lag, respectively (Fig. 1C and D). Given the fact that B-vitamins play important roles in glucose metabolism and insulin signaling in the body, over-consumption of B-vitamins may disrupt these physiology events which contributed to obesity and type 2 diabetes. Therefore, we consider it important to avoid taking fortified vitamins, for example, substitution of whole grains for fortified (refined) grains.

In conclusion, we think that B-vitamins over-consumption through grain fortification may be involved in the increased prevalence of obesity and diabetes in the US in the past 50 years. Therefore the standard for grain fortification with B-vitamins should be carefully discussed and modified, although the US FDA has recently published new nutrition-labeling regulations to

decrease the nutrition labeling for the B-vitamins, which will only lead to a 20-24% decrease in B-vitamin consumption in US adults and children.

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Publication

[Substitution of whole grains for refined grains: a means to avoid excess B-vitamin intake.](#)

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