The Relation Between Dietary Change and Rising U.S. Obesity

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ABSTRACT

A serious U.S. health problem is an unexplained increase in obesity. Using state and large-market data, diet's role is examined by relating diet differences and obesity differences across areas. Results suggest that the obesity problem is not due to recent changes in food consumed at home or away.

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Nutrition and health have long been a policy concern, especially in programs to ensure a minimally adequate diet, such as food stamps (1, 2). Now the focus is being broadened. The 1990 U.S. National Nutrition Monitoring and Related Research Act calls for a 10-year plan to increase knowledge of the link between nutrition and specific health measures and problems, and to improve monitoring of nutrition in the general population. Partly in response, agricultural economists are studying the nutritional aspects of food demand, and there is a large and growing body of work in this area. (6, 7)

A health concern clearly related to nutrition is obesity. Despite growing awareness of its associated problems, and the wide availability of low calorie, and low or no-fat foods, Americans are gaining weight. Between 1960 and 1991 overweight adults (defined as 120% or more above ideal weight) increased from 25% to 33%. Among adolescents the percentage doubled, from 10 to 20%, between 1970 and 1991. (4, p.5) Wolf and Colditz report the 1990 direct and indirect costs of obesity in the U.S. to be $46 billion and $23 billion, respectively (17).

The causes of increased obesity are not clear. Most believe that weight depends on a balance between calorie intake and energy expenditure, implying calories have risen and/or activity has declined. There is no explicit evidence of declines in activity, although “surveys have indicated an excess of energy over consumption, probably because of low levels of physical activity" (4, p.7). Concerning calories, availability data suggests that U.S. per capita calorie disappearance rose from 3300 to 3700 per day between 1970-90 (12). Unless waste is increasing, a distinct possibility given more processing and rising FAFH, this implies an increase in consumption. Finke et al. estimated per capita daily calorie consumption to be in the range 2500-2650, compared to the recommended 2250 (5, p. 202). However, Rose, summarizing recent USDA nutrition surveys, states that overweight respondents "consumed about the same amount of calories as did those who were not overweight" (13, p. 33). Also, some nutritionists believe that "fat calories may promote obesity more than ...calories from carbohydrates." (3, p. 13). If so, then calories-constant changes in diet can affect obesity.

Whatever the causes of obesity, one would expect them to bear a relation to diet and dietary change. A favorite culprit in the popular press is the large increase in food away from home (FAFH), especially fast food (see 14). However, there is no statistical evidence to either support or refute this, since the possible role of dietary change in increased obesity prevalence is largely uninvestigated.

This study investigate this association, using state and regional data. An obvious question is whether relevant measures vary significantly across areas this large. Indeed they do. There are large differences in diet across areas in the U.S., even for basic foods (8). Also, U.S. Center for Disease Control (CDC) survey data show large differences in obesity across states, and even for genders within states. We investigate whether weight differences are associated with consumption differences, for both detailed food at home and specific types of FAFH.

Our purpose is not to determine whether the consumption of certain foods increases weight, an already well-researched question, and one far better suited to laboratory methods. Our goal is to determine whether regional differences in obesity are recognizably linked to diet differences. If so, this can contribute toward explaining rising obesity.

Data

Most of the data are from three sources: (1) the CDC Behavioral Risk Factor Surveys; (2) The 1992 Census of Retail Trade; and (3) 1990 Sales Area Marketing Inc. (SAMI) data on warehouse grocery movements.

The CDC data is from an annual telephone survey in cooperation with states, with sample sizes of 1000-4000 per state. State averages, including two measures of overweight, are published in a Summary Report (10). The measure we used is based on the ratio of weight to height. All states do not always participate, but nearly so recently (49 in 1994). We used 1990 and 1992 (depending upon whether the SAMI data or retail trade data was under analysis), filling out omissions with adjoining years. Including the District of Columbia, we had 50 observations (Wyoming never participates), for both males and females.[1]

[1]Some examples of percentages overweight are (male, female): Florida (28.66, 28.04); Massachusetts (29.83, 24.86); Mississippi (31.45, 37.60); Washington (26.63, 22.76). We note that results were not sensitive to which CDC measure we used. See (9) for discussion of the measures.

The Retail Trade data is state sales by table service and fast food restaurants, by menu type (e.g. “Chicken,” “pizza”, etc.). Demographics were taken from the 1992 County City Data Book.

The SAMI data (taken from Larson (8)) are indices of consumption relative to national averages within 54 SAMI warehouse districts for 126 commodity categories. The districts are aggregations of counties, accounting for over 85% of U.S. sales. The basic data are monthly movements, for every variety and size of every branded product (no fresh meat or produce), except items directly distributed to stores (which includes most salty snacks and major carbonated beverages). The indices vary considerably across regions, making them highly suitable for present purposes. For example, for cereal it ranges from 68 in Boston to 151 in Salt Lake City. (The interpretation is that Boston households spend 68% of the national average.) For flour the range is 58 (Philadelpha) to 248 (San Antonio) and for iced tea, it is 12 (Wichita) to 323 (Scranton). See Larson for extended discussion.

Results

Separate analysis was conducted for FAFH and SAMI markets[2]. For each, CDC obesity measures were regressed on food consumption, first as a single variable, then with sociodemographic variables thought to potentially affect weight and/or to be associated with food consumption. This was to consider possible jointness with other factors (e.g. higher education may lead to healthier diets). This resulted in 40 FAFH models and over 500 category models, so only the most important aspects of results are presented. In particular, since the emphasis is identifying relations and not measuring them, only t statistics are presented.[3]

I. Food Away From Home

Ten measures of FAFH were considered, all in 1992 sales per capita: all FAFH, fast food (47% of the total), non-fast food, and five specific fast foods (percent of total fast food in parentheses): hamburger (43.6), pizza (15.0), chicken (8.9), Mexican (7.0), Submarine (6.6), the sum of these five, and other fast food. Demographics used are percent of population (a) 65 years or older, (b) Black, (c) Hispanic, (d) high school graduates, (e) college graduates, (f) leading a sedentary lifestyle (g) engaging in frequent vigorous activity, and (h) who smoke. The last three are gender-specific CDC survey

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[2]CDC state measures and other state variables were converted to SAMI markets (which generally span state borders) proportionately to population of component counties.

[3]Degrees of freedom for univariate models was 48; addition of demogaphics reduced this to 35-40. Hence “2" is a reasonable critical value for $\alpha = .05$.

measures. Also, 1992 state per capita (a) income, (b) sales by supermarkets, and (c) sales by sporting goods stores. We deliberately over-specified this equation to remove joint variation with food consumption.

Briefly, when obesity was regressed only on demographics, results were as follows, with t's in parenthesis (male, female). States with a higher proportion of hispanics (-2.37, -1.16) were found to have less obesity for both genders, especially for men; a higher portion of blacks (-.61, 2.91) is associated with greater female obesity. The latter has been consistently verified in prior studies, and Putler and Frazao found lower intakes of fat among hispanics. The percent over sixty-five (-1.03, -.49) has a small negative effect. Higher education, known to increase nutritional awareness, is associated with less obesity for college (-2.22, -1.49), not high school (-.13, 1.35), which for women has the wrong sign. Of the activity measures, sedentary lifestyle (-.22, .30) is not important and vigorous exercise (1.26, 1.03) carries the incorrect sign (with a weak effect). But sporting goods sales (-1.89, -2.31), an indirect measure, is strongly negative for both genders. The general effect suggests activity reduces weight (which it certainly does, ceteris paribus), but the specifics are problematic.[4] Female labor force participation (.13, -1.15) is of little effect.

Per capita grocery sales (-2.23, -1.13) has a negative effect, quite significant for men. If all markets paid similar prices for the same goods, this implies more food reduces

[4]Univariate regressions of obesity on these variables always produced expected signs and significant coefficients.

weight. We return to this below. Smoking (.47, -1.36) has no effect for males and for women has what is considered as the wrong sign in laboratory data (11). We believe it reflects lifestyles, an issue also pursued below. Income (1.20, 1.02) has a weak positive effect.

In Table 1 are presented the key results, those for FAFH consumption. The most striking feature is the prevalence of negative effects: 33 of 40 coefficients. For both genders the "alone" effect of all FAFH is significantly negative. For men, this is all associated with economic and demographic variables, inclusion of which eliminates the effect; for women, it is only reduced. For non-fast food, it occurs for both genders.

Given the popular view of fast food's role in obesity, its results are of particular interest. The view is not supported; most t's are negative; the only positive and significant effect is chicken "alone" for females, but this disappears when demographics are included.[5] And with demographics, the effect for females for the "top five" group and hamburger individually is strongly negative.

We thus find that states with more obesity are *not* states where demand for FAFH is strong, especially for fast food. Although we can say nothing about causality, this is certainly not evidence in support of a positive relation.[6]

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[5]Specifically the percent of the population that is black, which is highly positively correlated with both fast food chicken consumption and female obesity.

[6]We did some limited analysis using annual changes. Again, we either found no effect or a negative relation.

II. Results For SAMI

For the 126 SAMI categories, interpretation is more difficult. Not only is diet correlated with demographics, no one commodity should have a perceptible impact on weight. Furthermore, with two genders, 126 categories, and with and without demographics, we have 504 food coefficients, so we should find some “significance” by pure chance. These reasons and space constraints lead us to focus on patterns in the results, not individual estimates. Nor can we discuss demographics, which involved somewhat different variables than FAFH but broadly similar results.

Thus, we present in table 2 products whose “alone” coefficient t-value exceeded –2–. There are 53 entries for females, 32 for males; 32 products are unique to women, 11 to men. An asterisk indicates items for which, when demographics were added, the t did not fall below 1.5.[7] There are about the same number of these for each gender; only two, pudding and canned pasta, are common to both.

A negative relation between weight and consumption cannot be a *ceteris paribus* effect (since increasing consumption of anything, making no other changes, will not reduce obesity) but substitution for other foods and/or a lifestyle effect associated with demographics. Of the negative t’s, about 40% involve frozen items; several are “trendy” foods, perhaps with a degree of snob appeal (jarred peppers, black olives, honey, rice cakes); and convenience foods. There are few canned goods. On the other hand, for

[7] There were only two cases (not presented) in which an insignificant effect became significant when demographics were added.

those with positive t's, approximately half are canned goods; the three frozen items are bread, pastry, and appetizers; and the remaining items are frankfurters, pudding, two sugars, and shortening.

Although the items in the first group are generally less fattening than those in the second, there is a suggestion of lifestyle effects. There are calorie equivalent forms of similar goods in each: honey-sugar; black olives-stuffed olives; frozen green beans-canned green beans. Which is consumed will not *per se* affect obesity. Also, the first group is associated with a modern, convenience-oriented lifestyle; the second with a traditional diet. Finally, adding demographics eliminates much statistical significance, especially for the negative group, and for women.

This does not mean that dietary differences play a minor role in differences in obesity. Indeed, aside from exercise, "lifestyle" affects obesity because different lifestyles have different diets. Also, items associated with greater obesity are less affected by demographics and are in general energy intense, suggesting a direct diet factor cutting across lifestyles. Nevertheless, adequately dealing with rising obesity appears to involve more than admonitions to "eat X and not Y."

As a final observation, the "low obesity" items tend to be typically more expensive items, which may explain the negative effect of grocery sales on obesity found above. This implies that an assault on obesity might increase the food bill, with more going to the non-farm sector, and that low income groups face an inherent disadvantage in achieving a healthier diet.

Concluding Remarks

This study investigated the relationship between diet and increased U.S. obesity, using measures of dietary differences across regions and state-level obesity data, with and without demographics. Although linkages were identified, we found little evidence that recent changes in diet are the source of rising obesity. The principal recent changes are an increase in the proportion of food consumed away from home, especially fast food, and more convenience-oriented and trendy foods. If anything, our results suggest these are negatively associated with obesity.

Much work remains before the causes of increased obesity are understood. Our result--that the most important recent dietary changes may not be detrimental--suggests further work examining the role of diet may not be fruitful until more is known about the role of activity. After all, it may be couch potatoes, not french fries, that are the heart of the problem.[8]

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[8]Results from a USDA Diet Nutrition Survey showed that 35% of women who watched at least three hours of TV per day were overweight, more than twice the percent of those watching one hour or less (Rose p. 33).

Table 1. T-values When Obesity is Regressed on Food Away From Home, by Type.

Type	Male		Female	
	Demo[a]	Alone	Demo	Alone
All FAFH	-.02	-2.61	-1.67	-2.66
Fast Food (FF)	-.72	-.60	-2.03	-.42
Other FAFH	.09	-.82	-1.17	-.96
FF Principal Five	-1.22	-.14	-2.20	.21
FF Hamburger	-1.15	.48	-2.73	.25
FF Pizza	-.32	-.26	-.71	-1.01
FF Chicken	-.92	-.27	-.82	2.07
FF Mexican	-.66	-1.03	-1.40	-1.72
FF Sub	-.08	-.26	-.46	-.00

[a]"Demo" is the coefficient when consumption allows for demographics; "Alone" is from the univariate models.

Table 2. T-Values Exceeding $-2-$ for Univariate Regressions of Obesity on Grocer Items. ("*" indicates did not fall below 1.5 when demographics added).

Item	Women	Men
Dried Soup	-4.85	-4.01
Frz. Fruit Juice	-4.80	-3.84
Frz. Apple Juice	-4.77	-4.84
Honey	-4.03	-5.46*
Black Olives	-3.91	-4.06
Cereal Bars	-3.81	-3.77
Bottled Juice	-3.78	--
Milk Modifiers	-3.52	--
Frz. Beans	-3.45	--
Rice Cakes	-3.35	-2.15
Frz. Grape Juice	-3.21	-3.15
Frz. Lemonade	-3.08	-2.66
Frz. Italian Dishes	-3.01	--
Frz. Orange Juice	-2.90	-
Prepared Rice	-2.81	--
Canned Tuna	-2.81	--

Tomato Sauce	-2.80*	--
Frz. Peas	-2.76	--
Jarred Peppers	-2.66	-4.09
Canned Tomatoes	-2.64	-
Dry Pasta	-2.61	--
Hot Cereal	-2.58	--
Frz. Fish	-2.56	--
Frz. Mexi Dinners	-2.52	-2.92
Vegetable Juice	-2.52	-3.33
Frz. Dinners	-2.43	--
Frz. Mexi Dishes	-2.28	-4.31*
Frz. Potpies	-2.27	--
Instant Breakfast	-2.16	-2.59
Frz. Poultry Dish	-2.12	--
Bot Grape Juice	-2.10	--
Pancake Mix	-2.07	-2.19
Frz. Strawberries	-2.03	--
Item	Women	Men

Maple Syrup	-2.03	--
Fruit Drinks	-2.02	-
Canned Chili	--	-2.78
Frz Orient Dishes	--	-2.71
Spices	--	-2.37*
Baking Nuts	--	-2.31
Mayonnaise	--	-2.10
Powdered Milk	--	-2.04
Bacon	2.00*	-
Tomato Juice	2.10	-
Powdered Sugar	2.22*	--
Pudding	2.25*	2.04*
Frankfurters	2.25	--
Frz. Pastry	2.27	--
Canned Poultry	2.29	--
Pork & Beans	2.41	-
Canned Pasta	2.51*	3.47*
Canned Stew	2.71	--
Shortening	2.84	--
Can Beans	3.01*	--

Can Peaches	3.16	--
Catsup	3.43	2.93
Gran Sugar	3.52*	--
Meat Sauce	3.52*	--
Canned Peas	3.74	--
Canned Salmon	4.46*	2.04
Canned Kid Beans	6.11*	2.75
Frz Bread	--	2.38*
Span Olives	--	2.46*
Can Mushrooms	--	3.29*
Frz Appetizers	--	3.52*
Instant Potatoes	--	3.87*

References

1. Chavas Jean Paul; Yeung, M.S. “Effects of the Food Stamp Program on Food Consumption in the Southern United States.” *Southern Journal of Agricultural Economics*, 14(1), July 1982, pp. 131-39.

2 Devaney, Barbara; Moffitt, Robert. “Dietary Effects of the Food Stamp Program.” *American Journal of Agricultural Economics*; 73(1), February 1991, pp. 202-11.

3 Dattilo, Anne M. “Dietary Fat and Its Relationship to Body Weight.” *Nutrition Today*. Jan./Feb. 1992, pp. 13-19.

4 Federation of American Societies for Experimental Biology, Life Sciences Research Office. Prepared for the Interagency Board for Nutrition Monitoring and Related Research. *Third Report on Nutrition Monitoring in the United States; Volume I.* U.S. Government Printing Office, Washington, DC . 1995.

5 Finke, Michael, Luther Tweeten, and Wen Chern. “Economic Impact of Proper Diets on Farm and Marketing Resources.” *Agribusiness*, 12:3, 1996, pp. 201-207.

6 Huang, Kuo S. “Nutrient Elasticities in a Complete Food Demand System.” *American Journal of Agricultural Economics*, February, 1996.

7 Jayachandvan, V.N., Blaylock, J. And D. Smallwood. "A Probit Latent Variable Model of Nutrition Information and Dietary Fiber Intake." *American Journal of Agricultural Economics,* August, 1996.

8 Larson, Ronald. *Food Consumption Regionality, Seasonality, and Sales Promotion Evaluation*. Unpublished Ph.D. Thesis, Department of Agricultural Economics, Purdue University, 1993.

9. Marks, J.S. G.C. Hoglin, E.M. Gentry, J.T. Jones, K.L. Gaines, M.R. Forman, and F.L. Trowbridge, "The Behavioral Risk Factor Surveys: State Specific Prevalence Estimates of Behavioral Risk Factors." *American Journal of Preventive Medicine,* 1:6, 1985, pp. 1-14.

10. National Center for Health Statistics, Center for Disease Control, *BRFS Summary Report*, Atlanta, GA, Various years.

11."Obesity Controversy Heats Up" *Nutrition Action Newsletter,* No. 44, Summer 1996.

12. Putnam, J.J., and J.E. Allshouse. *Fppd Consumption, Prices, and Expenditures, 1970-1993*. Statistical Bulletin No. 915. Washington, DC: Commodity Economics Division, ERS, U.S. Department of Agriculture, December, 1994.

13. Rose, Donald. "Attitudes and Behaviors Related to Weight Status." *Food Review*, 17:1, Jan.-April 1994, pp. 30-35.

14. "Stuffing of USA: why Fast Food Is Geting Bigger." *USA Today*, February 20, 1996.

15. U.S. Bureau of the Census, Department of Labor Statistics, *1992 Census of Retail Trade: State Summaries and Special Subjects. Washington, 1995.*

16. ______________*1992 County-City Data Book*, Washington 1992.

17. Wolf, A.M. and G.A. Colditz. "The Cost of Obesity: The U.S. Perspective." *Pharmoeconomics*, 5:37, 1994.