



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Determinants of U.S. Children's and Teenagers' Body Mass Index

by

James Eales, James Brinkley, and Mark Jekanowski

American Agricultural Economics Association
2002 Annual Meeting, July 28-31, 2002, Long Beach, California
Selected Paper

Determinants of U.S. Children's and Teenagers' Body Mass Index

by

James Eales

James Binkley

and

Mark Jekanowski

Running Head: Determinants of Childhood Obesity

Contact author:

James Eales

1145 Krannert Bldg. No 636

West Lafayette, IN 47907-1145

USA

ph: 765/494-4212

email: eales@purdue.edu

Authors are an associate professor and a professor in the Department of Agricultural Economics, Purdue University and an agricultural economist at Sparks Consulting Group, respectively. Support from Purdue University's Agricultural Research Program is gratefully acknowledged.

Copyright 2002 by James Eales, James Binkley, and Mark Jekanowski. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

Determinants of U.S. Children's and Teenagers' Body Mass Index

OBJECTIVE: To determine if the increase in consumption of food away from home has contributed to the increased weight of the US population of children and teenagers, while controlling for demographic, lifestyle, and regional factors.

METHODS: Multiple regression and Logit analysis are used to estimate the effect of food source on body mass index (BMI), probability of being at risk (RISK) of overweight, and probability of overweight while accounting for other factors which have been shown to affect weight in a nationally representative sample of the U.S. population.

SAMPLE: This study used secondary data from a sub-sample of the 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII). The CSFII is a nationally representative sample of 16,103 individuals of all ages, obtaining for each respondent 24 hour recalls of all food intake on two nonconsecutive days as well as demographics and information on lifestyle choices. (Note: Because this study focuses on children and teenagers whose female parents are also respondents samples will be smaller.)

RESULTS: While food away from home and especially fast food tend to increase BMI and the probabilities of RISK and OVERWEIGHT, the more statistically significant effects were in the variables that measured activity.

CONCLUSIONS: This suggests that it is more important to get children and teenagers to engage in more exercise than it is to get them eating at home more.

Introduction

The increase in overweight and obesity in the U.S. adult population is well documented.^{1,2,3} The Surgeon General's recent call for action on U.S. obesity and overweight contains some shocking statistics. Over 60% of Americans are overweight or obese. The direct and indirect costs of obesity are now over \$100 billion per year.⁴ The number of U.S. children and adolescents who are at risk of overweight or overweight has increased, as well.^{5,6,7,8} Troiano and Flegal found that the age- and sex-adjusted prevalence of overweight U.S. children and adolescents went from about 4% in the early 1960s to 10.5% in the mid-1990s with most of the increase coming later in that period and mostly affecting the heaviest children.⁷ Strauss and Pollack found even more pronounced increases in overweight among subpopulations in the U.S.⁸ They found that by 1998 prevalence of overweight to be 21.8% for Hispanics, 21.5% for African Americans, and 12.3% for non-Hispanic whites. Several issues related to the increase in the number of overweight American youth have been addressed in the literature. First, it is difficult to define when children/adolescents are overweight or obese. The typically used definition for adults is that they are overweight if their Body Mass Index ($BMI = \text{weight in kilograms} / (\text{height in meters})^2$) is over 25. They are obese if their BMI is greater than 30. These cutoffs have been chosen to reflect the increase risks of morbidity and mortality associated with BMIs > 25 and particularly BMIs > 30.^{9,10} When it comes to children, defining the cutoffs becomes more controversial.^{11,12,13,14} Currently, the Center for Disease Control (CDC) defines children who are above the 85th percentile of their BMI-for-age/sex distribution to be at risk of overweight and those above the 95th percentile of their BMI-for-age/sex to be overweight.¹⁵ Evidence continues to mount that overweight in childhood leads to increased risk of overweight/obesity in adulthood

and the consequent increase in risk of morbidity and mortality.^{16, 17, 18}

There are, of course, many potential determinants of overweight in children. Previous research has examined two broad categories in some depth: genetics and energy imbalance. Parents who are overweight are more likely to have children who are overweight for two reasons. The first is genetics. Previous studies of identical and fraternal twins and siblings have shown that genetics plays a strong role in the determination of children's risk of being overweight.^{19, 20, 21} However, parents also have an environmental influence on their children's risk of overweight. The relative importance of these is a matter of some controversy. For example, Cutting, et al. found that a mother's eating habits (especially tendency to eat when not hungry) had a positive influence on her daughter's weight-for-height, but when that covariate was included the mother's BMI was not a significant factor.²² Alternatively, Sorensen, et al. conclude:

... a genetic influence on body mass index as strong as that in adult life is already expressed by age 7 years. The rearing environment shared by the family has a weak influence during childhood.²³

and Stunkard, et al.

We conclude that genetic influences on body-mass index are substantial, whereas the childhood environment has little or no influence.²⁰

Yet, it seems unlikely that genetics can be the cause of the increase in overweight among U.S. children and adolescents. The energy balance must play a role. Many previous authors have attributed the increases in overweight to either an increase in energy intake²⁴ or a decrease in energy expenditure.^{25, 26, 27, 28, 29} Here we attempt to examine an aspect of the former. That is, we examine whether the food source plays a role in the increase in overweight among U.S. children and adolescents.

In what follows a large survey is used to examine the determinants of BMI in children and adolescents. The survey is titled the Continuing Survey of Food Intake by Individuals (CSFII). It is a nationally representative sample of noninstitutionalized individuals. Included in the survey is a 24 hour recall of all food consumed by the respondent, as well as demographic information on the respondent and their household. A key aspect of the survey, that is made use of in this study, is that for many of the children/adolescents surveyed, it is possible to match their responses with those of their parents. In particular, we focus on those children and adolescents who can be matched with their mothers. This is because requiring the mother's presence in the sample reduces the sample size from 2655 to 1565. If we were also to require the father's presence this would further reduce the sample to 1057. When we did so, the only significant factor was the mother's BMI of the parental factors considered. Therefore we opted for the larger sample. This makes it possible to relate children's BMI to household demographics, including the child's mother's BMIs, as well as lifestyles and diets of the children. Our contribution will be to also include as potential determinants the source of the food consumed, that is whether some food consumed in the last 24 hours came from a table-service restaurant, a fast food restaurant, or school lunch program. Our hypothesis is that the mix of foods obtained from such sources is different in nature from foods prepared at home and that, particularly in regards to the first two sources, this is contributing to the increase in overweight amongst U.S. children/adolescents. The motivation behind the inclusion of food source as a child's BMI determinant is that food consumed away from home continues to be a concern and evidence suggests that this is the case.^{30, 31} Thus, the goal of the current research is to gauge whether food source has any statistically or practically significant effect while accounting for children's

demographics, diet, and lifestyle.

Data and Methodology

Study Design

Data used in this study is from the Continuing Survey of Food Intake by Individuals 1994-1996 (CSFII).³² The CSFII is a survey conducted for USDA by Westat, Incorporated of Rockville, Maryland. Its design was implemented with the goal of obtaining a nationally representative sample of noninstitutionalized individuals. Sample selection is based on a stratified, multistage area probability sample.³³ Ultimately, this resulted in the in-person interview of 16,103 individuals, obtaining for most 24 hour recalls of all food intake on two nonconsecutive days. The sample is stratified by sex, ten age categories, and income, with the low income strata being over sampled. While the CSFII contains information on individuals of all ages, attention here is limited to those between the ages of 5 and 18 years old, which reduces the sample size. As genetics are viewed as an important determinants of a child's BMI, our attention is also limited to the subsample of children in the CSFII whose mother was included in the sample so that the mother BMIs could be included as determinants of her children's BMI. Also, included in the survey was a wide range demographics for the child and the household, a variety of lifestyle factors, and whether the child was on a diet.

Measures

Relevant to the current study, each survey respondent was asked their height and weight, from which their BMI was calculated. The dependent variable used in the multiple regression is the child's BMI with the mean for that child's age and sex deducted. Two other variables

employed in Logit analysis are RISK which is one if the child's BMI is above the 85th percentile of their BMI-for-age/sex distribution and zero otherwise and OVERWEIGHT which is one for children whose BMI is above the 95th percentile of their distribution. These thresholds are defined by the Center for Disease Control to be for those being at risk of becoming overweight and those deemed to be overweight, respectively.

Also of primary importance to this study, each food item's source was determined, that is: Was the food item obtained from a grocery store, a restaurant, a fast food outlet, school lunch program, or some place else? A number of variables to characterize diet, demographics, lifestyle, and region were obtained as well. All of the variables are defined in table 1. Descriptive statistics by gender and age are given in table 2.

The appropriate way to measure food obtained from the different sources is a matter of concern. Below, restaurant, fast food, and school lunch are measured as the proportion of total grams of food obtained from each source. This was done to differentiate those who, for example, stopped at a food outlet for a beverage from those who had a complete fast food meal, and similarly for restaurants and school lunches. It is the different mix of foods obtained from these sources which we wish to examine as a potential contributor to increased BMI. Other definitions for the food source variables that were considered were proportion of items consumed from each source and dummy variables which were one if any food was obtained from a source and zero otherwise. Results for each of these definitions were qualitatively similar to those presented, below.

Statistical Analysis

Linear regression is used in the analysis of BMI adjusted for age/sex means. The discrete

dependent variables, RISK and OVERWEIGHT, are analyzed using Logit. In either case confounding factors, such as mother's BMI, diet, demographics, and lifestyles, are be controlled for while the effect of food source on BMI is determined. Implicitly, in relating current BMI to current behavior, demographics, and lifestyle variables, it is assumed that these variables will be highly positively correlated with their past values, which are the determinants of current BMI. Expected effects are discussed in appendix A.

Virtually all previous studies of obesity in children have found differences in the effects of factors between males and females and between pre-pubescence and post-pubescence. We conducted Chow tests on the adjusted BMI regression and found no significant difference either by sex or by age. Thus, the analysis is based on the pooled sample of all children ages five eighteen.

Results

Potential determinants of the BMIs of children and adolescents are many and in many cases difficult to measure. We employ 15 variables to attempt to capture all the aspects of demographics, lifestyle, and diets. The variables and their definitions are given in table 1. Since both amount of television viewed and a variable which measures whether the child exercises regularly are available and both are proxies for the amount of energy expended, both are included as is mother's BMI.

Descriptive statistics are given in table 2. These statistics do not incorporate the sampling weights and so cannot be taken as representative of the U.S. population as a whole. The reported statistics for BMI do not incorporate the adjustment for age and sex. The percentage of children at risk of being overweight and those who are overweight are large, given their definitions and

are probably due, in part, to the over sampling of low income households. Of the food source variables, children ate 5% of their food at restaurants, 11% at fast food outlets, and 11% in school lunch programs. Mother's BMI averages in the overweight range. Household incomes average about \$33,000. Approximately 14% of young children were African American and 13% were Hispanic.

Children and adolescents average almost 3 hours of television watching. About 27% of children exercised regularly. Seventy seven percent of children rated themselves in excellent or very good health. Three percent of children admitted to smoking. Small percentages of children are vegetarians or on diets to lose weight. Twenty seven percent of the sample lived in cities, while 24% of households are rural.

Regression and Logit results for are given in table 3. The fit of all three model, while low, is comparable to what others have found with similar samples. For all three sets of results, food source effects are in the expected direction for Restaurant and for Fast Food, with fast food being significantly so for the BMI and Overweight results ($p=.03$ and $p=.04$, respectively). The School Lunch Program effect is always negative and nearly achieves significance in the BMI regression.

The strongest influences in all three models are by mother's BMI and household income, the first being positive and the second negative. Given previous results it is somewhat surprising that African American and Hispanic are insignificant, for the most part.

On the other side of the energy balance equation, both television viewing and exercise have the expected effects and are significant (except exercise in the BMI regression). Another controllable factor, smoking, has a significant negative impact in all three models.

Finally, Diet variables effects are consistent across all three models. Being a vegetarian has a negative impact on being overweight, while those on a diet are overweight. The Urbanization variables are insignificant.

While marginal effects for the BMI regression results can be read directly from table 3, those for the Logit results must be calculated and are given along with those for the BMI regression in table 4. While it is not clear how to interpret the marginal effects for the BMI regression, those for Risk and Overweight results are straight forward. They measure the impact of either a one unit change in the continuous variables or a switch from zero to one for the dummy variables. While the significance of the Lifestyle variables is clearly stronger, the marginal effects of Restaurant and Fast Food is comparable in magnitude to Exercise and larger than that of TV. The biggest impacts are for those on a diet and for smokers.

Discussion

Our main interest was initially in whether eating more food away from home was contributing to the increase in overweight in the U.S. population of children and adolescents. Previous research has shown that source of food does have a significant positive effect on older Americans' BMI.³⁴ While we did find positive effects of eating in Restaurants and Fast Food outlets, it was only significant for Fast Food's effect on BMI and Overweight. If food consumed at restaurants and fast food places is contributing to the obesity epidemic in U.S. children and adolescents, then the effect is a weak one.

The other food source, school lunches, had a negative impact in all models. While this effect was technically significant for none of the groups, the evidence here suggests that they

have been better for children than what would have been consumed as an alternative.

The mother's BMI has a significant positive impact in all models. Even with its strong statistical significance though, the marginal impact of a mother with a one unit higher BMI on the probabilities of being at risk or overweight are fairly small. A much stronger demographic effect comes from income, suggesting that low income children run higher risk of obesity.

The bottom line then appears to be that while there is evidence that increased consumption of food away from home has contributed to the obesity epidemic in the U.S., evidence suggests that the increasing sedentariness of our children is a more significant factor.

Appendix

Expected effects of the independent variables in the regressions are as follows: The hypothesis that growth in food consumed away from home has contributed to increased overweight translates to an expectation of positive effects for the fast food and restaurant variables, especially for the former.^{35, 35} School lunch programs provide diets which are chosen by nutritionists, which would suggest that they would decrease BMI. However, several studies have found school lunches to contain too much fat and sodium.^{36, 37} Therefore, the expected effect of eating a school lunch could be either positive or negative.

Demographic effects which may influence a child's BMI are: mother's BMI, the household's income, and the race of the child. The BMI of the mother will have two effects. The first one is the genetic effect. Previous studies of have shown that the effect of over-feeding on identical twins is more similar than between siblings. A study of identical and fraternal twins some reared together and others separately found that separation had almost no effect on the identical twins' BMI. Thus, BMI of a child's mother should have a positive effect on the child's BMI due to genetics. The other influence of the mother's BMI is behavioral. If mothers who are overweight provide environments which are more likely to produce overweight in their children, then this would reinforce the positive effect of the genetic influence. Household income has been found to have a negative influence on BMI in adults, especially in women.^{31, 38, 38, 39} Findings for children and adolescents are less clear. Troiano and Flegal found little or no influence of income, while Strauss and Pollack found higher increases in overweight only for those below 150% of the poverty level.^{7, 8} The ethnicity of the respondent is expected to be related to overweight for cultural reasons. Both African American and Hispanic children have a higher

prevalence of overweight and obesity.⁴⁰

Several lifestyle variables are included in the model: television viewing, exercise, smoking, and whether respondents claim their health is excellent or very good. Television watching and exercise are measures of sedentary versus active lifestyles. As such we would expect the effects to be positive for TV and negative for exercise. Decreased smoking is associated with increased eating, so its effect should be negative.^{2, 41} Children who rate their overall health as very good or excellent will typically be lighter, which suggests a negative influence.

Diet variables included in the model are Diet (whether the respondent was on a weight-loss diet.) and Vegetarian (whether they claimed to be a vegetarian). The effect of Diet on BMI should be positive, that is, children are on a diet because they need to lose weight. Vegetarians tend to be lighter, so its effect should be negative.

Urban lifestyles tend to be more hectic, rural lifestyles less so. Therefore, Urban is expected to have a negative and Rural a positive effect on BMI.

Table 1. Variables used in the BMI regressions:

Variables	Definitions
BMI	Body Mass Index; BMI is the ratio of the weight in kilograms to the square of the height in meters, both of which are self-reported. Means by age and sex are deducted.
Risk	=1 if respondent at or above the 85 th percentile of age/sex BMI distribution; =0 otherwise.
Overweight	=1 if respondent at or above the 95 th percentile of age/sex BMI distribution; =0 otherwise.
Food Source	
Restaurant ^a	Proportion of total grams of food purchased at restaurants.
Fast Food ^a	Proportion of total grams of food purchased at fast food outlets.
School ^a	Proportion of total grams of food obtained from a school lunch program.
Demographics	
BMI_FP	Body Mass Index of the female parent; the ratio of the weight in kilograms to the square of the height in meters, both of which are self-reported.
Log(Income)	Logarithm of household income in thousands of dollars. (Truncated at \$100,000 and only observations where income is reported are used.)
African American	=1 if African American; =0 otherwise.
Hispanic	=1 if Hispanic; =0 otherwise.
Lifestyle	
TV	Hours of television watched yesterday or the average if two days are reported.
Exercise	=1 if exercise vigorously enough to work up a sweat at least twice a week; =0 otherwise.
Smoke	=1 if respondent is currently a smoker; =0 otherwise. Applicable for teenagers, only.
Healthy	=1 if self-assessed rating of health is excellent or very good; =0 otherwise.
Diet	
Vegetarian	=1 if respondent considers themselves to be a vegetarian; =0 otherwise.
Diet	=1 if respondent is on any type of diet to lose weight; =0 otherwise.
Urbanization	
Rural	Household is not in a Metropolitan Statistical Area.
Urban	Household is in a Metropolitan Statistical Area, central city.

Table 2. Descriptive Statistics of Variables used in BMI Regressions

	Mean	Std.Dev.	Min	Max
Overweight Measures				
BMI	20.09	4.83	9.64	49.39
Risk	32	47	0	100
Overweight	17	37	0	100
Food Source				
Restaurant ^a	5	12	0	72
Fast Food ^a	11	16	0	90
School ^a	11	16	0	82
Demographics				
BMI_FP	25.91	5.92	15.55	58.46
Log(Income)	3.50	0.86	0.18	4.61
African American	14	35	0	100
Hispanic	13	33	0	100
Lifestyles				
TV	2.83	2.12	0.00	16.50
Exercise	27	44	0	100
Smoke	3	17	0	100
Healthy	77	42	0	100
Diet				
Vegetarian	2	16	0	100
Diet	1	12	0	100
Urbanization				
Rural	24	43	0	100
Urban	27	45	0	100

Note: While sampling weights are available they have not been used in the calculation of these statistics, so they cannot be considered representative of US population, as a whole.

^a Figures reported are percentages, while proportions are used in the BMI regressions.

Table 3. Determinants of BMI in Children and Teenagers^a

	BMI		Risk		Overweight	
	Coef	T Stat	Coef	T Stat	Coef	T Stat
Intercept	-1.09	-1.32	-0.88	-2.02	-1.55	-3.01
Food Source						
Restaurant	0.84	0.94	0.41	0.83	0.77	1.27
Fast Food	1.24	1.87	0.43	1.18	0.80	1.80
School	-1.31	-1.91	-0.44	-1.18	-0.14	-0.30
Demographics						
BMI_FP	0.13	7.15	0.05	5.35	0.05	4.89
Log(Income)	-0.61	-4.22	-0.37	-4.72	-0.45	-4.86
African American	0.48	1.36	0.32	1.71	-0.01	-0.04
Hispanic	0.43	1.30	0.07	0.37	0.03	0.15
Lifestyle						
TV	0.14	2.71	0.10	3.52	0.08	2.41
Exercise	-0.39	-1.64	-0.44	-3.20	-0.76	-4.02
Smoke	-1.16	-1.84	-1.55	-3.33	-1.89	-2.56
Healthy	-0.83	-3.32	-0.32	-2.38	-0.27	-1.64
Diet						
Vegetarian	-1.09	-1.62	-0.57	-1.22	-0.92	-1.24
Diet	3.11	3.61	0.89	2.02	0.84	1.65
Urbanization						
Rural	0.35	1.31	0.19	1.33	0.07	0.37
Urban	-0.25	-0.97	-0.10	-0.68	0.00	0.02
Adjusted R ^{2b}	0.09		0.10		0.08	
n	1565					

^a Values given are t statistics with degrees of freedom equal to 1550, so the cutoff for a two-tailed, 0.05 significance level is 1.96.

^b For the Logit results the R² reported is due to Estrella.⁴²

Table 4. Marginal Effects of Determinants of BMI in Children and Teenagers^a

Intercept	BMI	Risk	Overweight
Food Source			
Restaurant	0.84	0.09	0.09
Fast Food	1.24*	0.09	0.10*
School	-1.31	-0.09	-0.02
Demographics			
BMI_FP	0.13*	0.01*	0.01*
Log(Income)	-0.61*	-0.08*	-0.05*
African American	0.48	0.07*	0.00
Hispanic	0.43	0.01	0.01
Lifestyle			
TV	0.14*	0.02*	0.01*
Exercise	-0.39	-0.08*	-0.08*
Smoke	-1.16*	-0.22*	-0.14*
Healthy	-0.83*	-0.07*	-0.04
Diet			
Vegetarian	-1.09	-0.11	-0.09
Diet	3.11*	0.21*	0.15*
Urbanization			
Rural	0.35	0.04	0.01
Urban	-0.25	-0.02	0.00

* Associated coefficient is significant at the .05 level.

1. Federation of American Societies for Experimental Biology Life Sciences Research Office. (FASEBLS) *Third Report on Nutrition Monitoring in the United States; Volume I*. Prepared for the Interagency Board for Nutrition Monitoring and Related Research. US Government Printing Office, Washington, DC . 1995.
2. Galuska, D., M. Serdula, E. Pamuk, P. Siegel, and T. Byers. "Trends in Overweight among US Adults from 1987 to 1993: A Multistate Telephone Survey." *American Journal of Public Health* 86 (December 1996): 1729-1735.
3. Kuczmarski, R., K. Flegal, S. Campbell, and C. Johnson. "Increasing Prevalence of Overweight Among US Adults." *Journal of the American Medical Association* 272 (July 20, 1994): 205-211.
4. U.S. Department of Health and Human Services. The Surgeon General's call to action to prevent and decrease overweight and obesity. [Rockville, MD]: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General; [2001]. Available from: US GPO, Washington.
5. Flegal, Katherine M.. "The obesity epidemic in children and adults: current evidence and research issues." *Medicine & Science in Sports & Exercise* 31 (Nov 1999): S509-S514.
6. Flegal KM. Carroll MD. Kuczmarski RJ. Johnson CL "Overweight and obesity in the United States: prevalence and trends, 1960-1994." *International Journal of Obesity* 22(1):39-47, 1998 Jan.
7. Troiano, RP and Flegal, KM. "Overweight children and adolescents: Description, epidemiology, and demographics." *Pediatrics* 101 (MAR 1998): 497-504.
8. Strauss, RS and HA Pollack. "Epidemic Increase in Childhood Overweight, 1986-1998." *Journal of the American Medical Association* 286 (Dec 12, 2001): 2845-8.
9. VanItallie TB. "Health implications of overweight and obesity in the United States." *Ann Intern Med* 103 (1985): 983-988.
10. Troiano RP, Frongillo EA Jr, Sobal J, and Levitsky DA. "The relationship between body weight and mortality: a quantitative analysis of combined information from existing studies." *Int J Obes Relat Metab Disord* 20 (1996): 63-75.
11. Cole, TJ, Bellizzi, MC, Flegal, KM, and Dietz, WH. "Establishing a standard definition for child overweight and obesity worldwide: international survey." *Br. Med. J.* 320 (MAY 6 2000): 1240-1243.
12. Mulligan, J. "Standard definition of child overweight and obesity worldwide - Body mass index is harder to interpret in children than adults." *Br. Med. J.* 321 (NOV 4 2000): 1159-1159.

13. Reilly JJ, Dorosty AR, Emmett P "Identification of the obese child: Adequacy of simple obesity definitions for clinical practice and epidemiology.." P Nutr Soc 59: 65A-65A Suppl. S SPR 2000
14. Reilly JJ, Dorosty AR, Emmett PM "Identification of the obese child: adequacy of the body mass index for clinical practice and epidemiology." Int J Obesity 24: (12) 1623-1627 DEC 2000
15. Center for Disease Control. Available at:
<http://www.cdc.gov/nccdphp/dnpa/bmi/bmi-for-age.htm>
16. Parsons TJ, Power C, Logan S, Summerbell CD. "Childhood predictors of adult obesity: a systematic review." International Journal of Obesity 23 Suppl 8:S1-107, 1999 Nov.
17. Stettler, N, Tershakovec, AM, Zemel, BS, Leonard, MB, Boston, RC, Katz, SH, Stallings, VA. "Early risk factors for increased adiposity: a cohort study of African American subjects followed from birth to young adulthood." Am. J. Clin. Nutr. 72 (AUG 2000): 378-383.
18. Whitaker, RC, Wright, JA, Pepe, MS, Seidel, KD, and Dietz, WH. "Predicting Obesity in Young Adulthood from Childhood and Parental Obesity." New England Journal of Medicine 337 (1997): 869-873.
19. Bouchard, C., Tremblay, A., Despres, J-P, Nadeau, A., Lupien, P. J., Theriault, G., Dussault, . "The response to long-term overfeeding in identical twins." The New England Journal of Medicine 322 (1990): 1477-1482.
20. Stunkard, AJ, Harris, JR, Pedersen, NL, and McClearn, GE. "The Body-Mass Index of Twins who have been Reared Apart." The New England Journal of Medicine 322 (1990): 1483-7.
21. Guillaume M, Lapidus L, Beckers F, Lambert A, Bjorntorp P. "Familial trends of obesity through three generations: the Belgian-Luxembourg child study." International Journal of Obesity & Related Metabolic Disorders. 19 Suppl 3:S5-9, 1995 Sep.
22. Cutting, TM, Fisher, JO, Grimm-Thomas, K, and Birch, LL. "Like mother, like daughter: familial patterns of overweight are mediated by mothers' dietary disinhibition." Am. J. Clin. Nutr. 69 (APR 1999): 608-613.
23. Sorensen TI, Holst C, Stunkard AJ. "Childhood body mass index--genetic and familial environmental influences assessed in a longitudinal adoption study." International Journal of Obesity & Related Metabolic Disorders. 16(9):705-14, 1992 Sep.
24. Harnack, Lisa J., Robert W. Jeffery, and Kerri N. Boutelle. "Temporal trends in energy intake in the United States: an ecologic perspective." American Journal of Clinical Nutrition 71 (2000): 1478-1484.

25. Hernandez, B, Gortmaker, SL, Colditz, GA, Peterson, KE, Laird, NM, and Parra-Cabrera, S. "Association of obesity with physical activity, television programs and other forms of video viewing among children in Mexico City." *International Journal of Obesity* 23 (AUG 1999): 845-854.
26. Bar-on ME. "The effects of television on child health: implications and recommendations." *Arch Dis Child* 83(OCT 2000):289-292.
27. Crooks, DL. "Food consumption, activity, and overweight among elementary school children in an Appalachian Kentucky community." *Am. J. Phys. Anthropol.* 112 (JUN 2000): 159-170.
28. Dietz, W. H., & Gortmaker, S. L. "Do we fatten our children at the television set? Obesity and television viewing in children and adolescents." *Pediatrics* 75 (1985): 807-812.
29. Epstein, L. and G. Goldfield. "Physical activity in the treatment of childhood overweight and obesity: current evidence and research issues." *Medicine & Science in Sports & Exercise* 31 (Nov 1999): S553-S559.
30. Zoumas-Moorse, C., C.L. Rock, E.J. Sobo, and M.L. Neuhouser. "Children's Patterns of Macronutrient Intake and Associations with Restaurant and Home Eating." *Journal of the American Dietetic Association* 100 (AUG 2001): 923-25.
31. Lin, Biing-Hwan and Elizabeth Frazao, and Joanne Guthrie. January, 1999. "Away-From-Home Foods Increasingly Important to Quality of American Diet." US Dept. of Agriculture, Economic Research Service, Ag Information Bulletin No. 749.
32. US Department of Agriculture, Agricultural Research Service. 1998. 1994-96 Continuing Survey of Food Intakes by Individuals and 1994-96 Diet and Health Knowledge Survey. CD-ROM. Available from National Technical Information Service, Springfield, VA.
33. Tippet, K.S., and Y.S. Cypel (eds.). 1997. Design and operation: The Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey 1994-96. US Department of Agriculture, Agricultural Research Service, Continuing Survey of Food Intakes by Individuals 1994-96, Nationwide Food Surveys Rep. No. 96-1. Available at: <http://sun.ars-grin.gov/ars/Beltsville/barc/bhnrc/foodsurvey/pdf/Dor9496.pdf>.
34. Binkley, J.K., J.S. Eales, and M Jekanowski. "The Relation Between Dietary Change and Rising U.S. Obesity." *International Journal of Obesity* 24 (2000):1032-1039.
35. Jeffery, R.W. and S. A. French. "Epidemic Obesity in the United States: Are Fast Food and Television Viewing Contributing?" *American Journal of Public Health* 88 (February 1998): 277-80.
36. Devaney, BL, Gordon, AR, and Burghardt, JA. "Dietary Intakes of Students." *Am. J. Clin. Nutr.* 61 (JAN 1995): S205-S212.

37. Farris, RP, Nicklas, TA, Webber, LS, and Berenson, GS. "Nutrient Contribution of the School Lunch Program - Implications for Healthy People 2000." *J. Sch. Health* 62 (1992): 180-184.
38. Rimm, I. and A. Rimm. "Association Between Socioeconomic Status and Obesity in 59,556 Women." *Preventive Medicine* 3 (1974): 543-572.
39. Sobal, J. and A.J. Stuckard. "Socioeconomic Status and Obesity: a Review of the Literature." *Psychological Bulletin* 105 (1989): 260-275.
40. National Institutes of Health (NIH), National Heart, Lung, and Blood Institute (NHLBI). *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity: The Evidence Report* U.S. Government Press. Washington, D.C. 1998.
41. Shah, M., P.J. Hannan, and R.W. Jeffrey. "Secular Trend in Body mass Index in the Adult Population of Three Communities from the Upper Mid-western Part of the USA: the Minnesota Heart Health Program." *International Journal of Obesity* 15 (1991): 499-503.
42. Estrella, A. "Anew Measure of Fit for Equations with Dichotomous Dependent Variables." *Journal of Business and Economic Statistics* 16 (1998):198-205.