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Do We Fatten Our Children at the Television Set? Obesity and Television Viewing in Children and Adolescents

William H. Dietz, Jr, MD, PhD, and Steven L. Gortmaker, PhD

From the Division of Pediatric Gastroenterology and Nutrition, New England Medical Center, and Department of Behavioral Sciences, Harvard School of Public Health, Boston

ABSTRACT. The association of television viewing and obesity in data collected during cycles II and III of the National Health Examination Survey was examined. Cycle II examined 6,965 children aged 6 to 11 years and cycle III examined 6,671 children aged 12 to 17 years. Included in the cycle III sample were 2,153 subjects previously studied during cycle II. These surveys, therefore, provided two cross-sectional samples and one prospective sample. In all three samples, significant associations of the time spent watching television and the prevalence of obesity were observed. In 12- to 17-year-old adolescents, the prevalence of obesity increased by 2% for each additional hour of television viewed. The associations persisted when controlled for prior obesity, region, season, population density, race, socioeconomic class, and a variety of other family variables. The consistency, temporal sequence, strength, and specificity of the associations suggest that television viewing may cause obesity in at least some children and adolescents. The potential effects of obesity on activity and the consumption of calorically dense foods are consistent with this hypothesis. *Pediatrics* 1985;75:807–812; *television, obesity, nutrition, adolescents.*

Children in the United States spend, on average, as much time watching television in the course of a year as they do attending school. In 1982, children aged 6 to 11 years watched an average of 24 hours of television per week.[1] The association of television viewing with a variety of behaviors in children and adolescents, therefore, occasions no surprise. Watching violent programs on television is associated with aggressive behavior in children and adolescents,[2] although recent longitudinal data fail to confirm this relationship.[3] The duration of weekly television viewing is inversely correlated with school performance,[4,5] even when controlled for IQ, amount of nonschool reading, hours spent doing homework, or parental reading habits.[5] Television viewing by children also correlates with between-meal-snacking,[6,7] consumption of foods advertised on television,[6] and the children's attempts to influence their mother's food purchases.[8]

Several consequences of television viewing could contribute to childhood obesity. Watching television requires no energy in excess of resting metabolic rates, and it may reduce the time spent in more energy-expensive activities. The foods most heavily advertised on children's television, and more likely to be consumed by children watching increased amounts of television, are calorically dense foods such as sugared breakfast cereals, candy bars, cakes, cookies, and carbonated beverages.[9–11] Nonnutritious food references occur even more frequently in prime-time programs than in advertisements[12]; these may contribute to the eating that frequently occurs among adolescents watching television.[13] The low frequency of obesity among the stars of prime-time television[12] may

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Reprint requests to (W.H.D.) Division of Gastroenterology and Nutrition, Box 213, New England Medical Center, 171 Harrison Ave, Boston, MA 02111.

indirectly suggest to children that eating and drinking high caloric foods is of little consequence with regard to weight.

The association of television viewing with obesity in subjects of any age has not previously been examined. We, therefore, examined data from cycle II and cycle III of the National Health Examination Survey to determine whether excessive fatness was associated with increased television viewing in two cross-sectional samples and one longitudinal sample of children and adolescents in the United States, and whether this association would persist when other variables known to influence childhood obesity were controlled.

MATERIALS AND METHODS

The subjects of this investigation were 6,965 children, aged 6 to 11 years, studied in 1963 to 1965 during cycle II, and 6,671 children aged 12 to 17 years studied in 1966 to 1970 during cycle III of the National Health Examination Survey (NHES). The sample of adolescents studied during cycle III included 2,153 subjects who had been previously studied during cycle II. Slightly larger numbers of subjects had been selected for study in each survey. The subjects included in our analysis were all those of both races who agreed to participate and for whom complete data were available. The sampling technique, described in detail elsewhere,[14] provided a sample in each age group that was representative of the noninstitutionalized population of the same age in the United States.

Measurements of triceps skinfolds were made by pediatricians, specially trained nurses, or technicians. The triceps skinfold appears to be a more reliable measure of fatness than weight for height.[15] Therefore, for the purposes of this report, we defined obesity as a triceps skinfold equal to or greater than the 85th percentile, and superobesity was defined as a triceps skinfold equal to or greater than the 95th percentile for children or adolescents of the same age and sex.

The National Health Examination Survey included a parental report in cycle II, and self-reports by the adolescent in cycle III of the hours per day spent watching television, reading books or magazines, listening to the radio, reading comic books, alone, with friends, or playing sports. Mean hours of television viewed daily was calculated from the midpoint of each time interval except for the last interval when an additional half hour was added to account for potential outliers. In addition, time spent in leisure activities excluding sports and television viewing was calculated, and the prevalence of obesity and superobesity was estimated for different levels of these activities.

Three general types of analyses were performed. In cross-sectional analyses of the cycle II and cycle III surveys, the prevalence of obesity and superobesity at different levels of reported television watching were compared. χ^2 tests, simple regression coefficients, and associated F tests were used to indicate the strength and statistical significance of associations.

Second, multiple environmental, economic, and family variables were incorporated as controls into these analyses, using weighted multiple regressions. This weighting allowed us to incorporate our knowledge of the sample design into the estimates.[16] The significance of the adjusted coefficient estimates was examined using F tests. In the analysis of the effects of television viewing on obesity and superobesity in cycle III, we controlled for obesity and superobesity in cycle II. This procedure controlled for the potential confounding influence of a variety of measured and unmeasured variables, including the possibility that prior obesity was a determinant of both current obesity and time spent watching television.

All the analyses described above assume a short time lag whereby television viewing (reported at the time of the examination) influenced obesity (measured at the examination). Seasonal changes in the prevalence of obesity[17] suggest that a short lag period between television watching and obesity is plausible. However, the prospective sample of children studied during cycle II who were restudied in cycle III provided the opportunity to test the effects of a 3- to 4-year time lag between television viewing and subsequent obesity. For these analyses we also used weighted stepwise regressions. Our sampling plan and our procedures for incorporating the sampling characteristics into our analyses are described elsewhere.[17]

RESULTS

The association of obesity, superobesity, and television viewing for children aged 6 to 11 years is shown in Fig 1. Children who watched more television experienced a greater prevalence of obesity ($P < .01$) or superobesity ($P < .02$) than children watching less television. No significant differences existed between obese, superobese, and nonobese children with respect to the number of friends, their ability to get along with friends, or time spent with friends, alone, listening to the radio, reading, or in leisure activities.

The association of obesity, superobesity, and television viewing for adolescents aged 12 to 17 years in 1966 to 1970 is shown in Fig 2. Adolescents who watched more television daily were significantly more obese ($P < .0001$) or superobese ($P <$

.0001) than their counterparts who watched less television.

In both cycle II and cycle III samples, there was evidence for a dose-response relationship between obesity, superobesity, and time spent television-viewing (Table, first row). These positive relationships can be expressed as slopes in regression equations. The estimated regression coefficients indicate that the prevalence of obesity increased 1.2 to 2.9% for each additional hour of television watched per day. Similarly, the slope of the regression linking superobesity to television viewing indicates an increase in prevalence of 1.6% to 1.4% (Table, first row) for each additional hour of television viewing.

In regression analysis with a dichotomous dependent variable, results can be interpreted as changes in probabilities. Although coefficient estimates are less efficient because of heteroscedastic errors, the estimates are unbiased.[18] For the present analysis, we assumed that a model linear and additive in the probabilities was appropriate.

A wide variety of control variables were then introduced into these analyses to control for their potential bias on the obesity, superobesity, and television associations (Table, rows 2 to 4). These variables included a past history of obesity (cycle II) and socioeconomic characteristics of the family. In the cross-sectional analyses, addition of all avail-

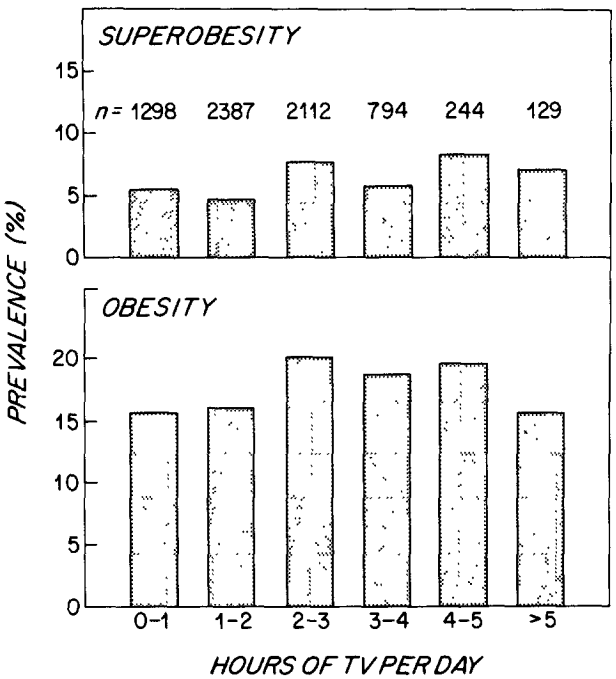

Fig 1. Prevalence of obesity and superobesity in 6- to 11-year-old children by hours of television viewed daily.

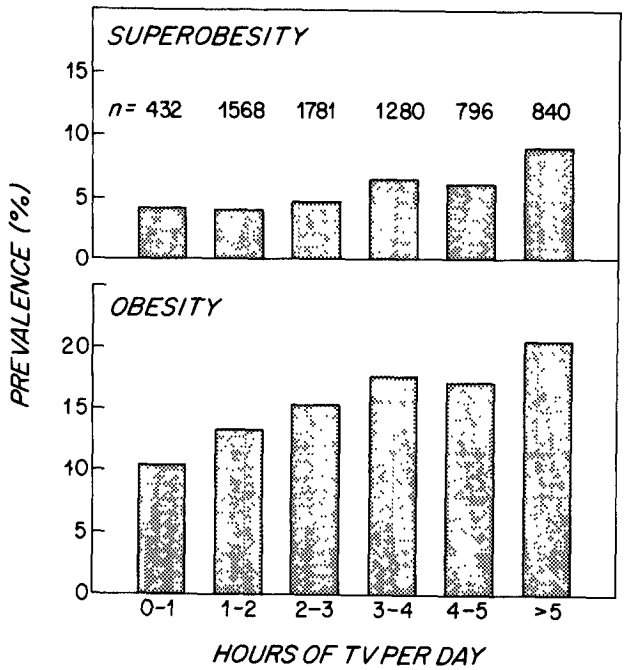

Fig 2. Prevalence of obesity and superobesity in 12- to 17-year-old adolescents by hours of television viewed daily.

TABLE. Coefficient Estimates Relating Hours of Television Watched to Obesity and Superobesity, from Weighted Regressions, Cycle II and Cycle III National Health Examination Survey Data with Various Controls

Control Variables Added	Cross-Sectional Cycle II (1963–1965)		Cross-Sectional Cycle III (1967–1970)		Longitudinal* Cycle II-Cycle III	
	Obesity	Superobesity	Obesity	Superobesity	Obesity	Superobesity
Television viewing (measured at same cycle as obesity)	.011‡	.006†	.019‖	.012‖	.029‖	.014§
Past obesity or superobesity					.023‖	.011‡
Season, region, population density	.010†	.005†	.020‖	.012‖	.023‖	.012‡
Mothers/fathers education, age, income, No. of children, birth order, race, condition restricting activity	.012†	.006†	.022‖	.012‖	.020‖	.009†

* Column shows longitudinal sample. Obesity, superobesity, and television viewing are shown for cycle III.
† $P < .05$.
‡ $P < .01$.
§ $P < .001$.
‖ $P < .0001$.

able control variables did little to alter the magnitude or statistical significance of the television-obesity relationship. In the longitudinal analysis, controlling for past obesity and socioeconomic characteristics attenuated the relationships, although the coefficient estimates remained statistically significant ($P < .001$ and $P < .05$). The small differences we observed in these relationships as successive controls were introduced supports the hypothesis that the association is causal.

The cross-sectional analyses assume a short time lag between television viewing, measured retrospectively at the interview, and obesity present at the time of examination. A more stringent test of the television-obesity relationship was achieved by examining the association of television viewing in cycle II with obesity present in cycle III. As shown in Fig 3, the relationship between television viewing in cycle II and obesity in cycle III was positive. When the relationship was controlled for cycle II obesity and socioeconomic characteristics, the coefficient estimates for cycle II television viewing, obesity, and superobesity in cycle III were .008 ($P < .07$) and .006 ($P < .03$). Given the long interval between cycle II and cycle III, we believe these results also support a causal hypothesis, despite marginal levels of statistical significance.

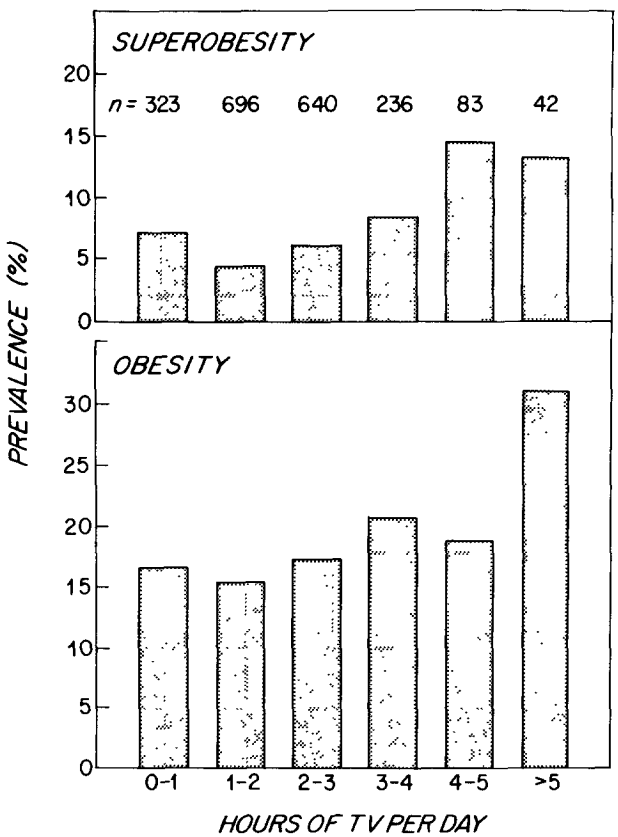

Fig 3. Prevalence of obesity and superobesity in 12- to 17-year-old adolescents by hours of television viewed at age 6 to 11 years.

DISCUSSION

The causes of obesity are clearly multiple and complex. The associations of childhood obesity with geographic region, population density, and season,[17] and with family characteristics such as parental obesity,[19] parental age,[20] marital status,[20] socioeconomic class,[19] race,[19] and family size[21] suggest that at least some of the causes are environmental. Host factors affecting susceptibility, such as reduced thermogenesis in response to carbohydrate,[22] should not cause obesity unless an associated defect in the regulation of energy balance is also present.

Our findings demonstrate highly significant and reproducible associations of television watching with obesity in children and adolescents, in both cross-sectional and prospective studies. In the multiple regression equation, only prior obesity had a larger independent effect than television on the prevalence of obesity. Three alternative explanations could account for our findings: (1) obesity could cause increased television viewing; (2) obesity and television viewing could each be associated with a third variable producing a spurious causal relationship between television watching and obesity; or (3) increased television viewing could cause obesity.

The social stigmatization that accompanies obesity is well documented. In preference tests, normal children consistently rank obese children less favorably than children with other handicaps.[23–24] In response to peer discrimination, obese adolescent girls are often passive, withdrawn, and isolated.[25] Obese children or adolescents might, therefore, spend more time alone or watching television.

Our data suggest that this possibility is unlikely. Obese and nonobese children did not differ with respect to time spent alone, with friends, or in other leisure activities. Furthermore, television watching in cycle III was positively associated with obesity in cycle III, even when controlled for obesity in cycle II.

Both obesity and television watching could be associated with a third unmeasured variable, thereby producing a spurious inference with respect to the effect of television watching on the prevalence of obesity. Among the most important variables associated with obesity are family factors. We attempted to control for family effects by including a variety of family measures in our analyses, and by assuming that the influence of at least some of the unmeasured variables could be controlled by controlling the analysis for obesity in cycle II. We

observed that the effects of television viewing in cycle III on obesity in cycle III persisted when controlled for obesity in cycle II. Moreover, the effects of television on obesity in both cross-sectional and prospective surveys persisted after controlling for many of the recognized family variables that affect the prevalence of obesity.

Our study has demonstrated that the association of television viewing and obesity fulfills many of the criteria necessary for a causal relationship. These criteria include a consistency of association on replication, a temporal relationship of the associated variables, a strong association, a specific relationship, and a coherent relationship.[26]

We have shown that television viewing was associated with obesity in two cross-sectional studies. We have also shown a prospective association of television viewing with obesity even when controlled for prior obesity and a number of other variables previously recognized to affect the prevalence of childhood obesity. We also observed a dose-response effect of time spent watching television and the prevalence of obesity; each hourly increment of television viewing by adolescents was associated with a 2% increase in prevalence. The effects of other potentially confounding factors were excluded or controlled by the statistical tests used.

Finally, a coherent mechanism exists whereby increased television watching could be expected to cause obesity. Television viewing by children may affect both energy intake and expenditure. Energy expenditure may be reduced because less energy is required to watch television than is required for more energy-intensive activities such as bicycle-riding or playing tag. Television viewing tends to promote increased energy intake by several mechanisms. Food is the most heavily advertised product on children's television.[9-11] Time spent viewing television increases between-meal-snacking[6,7] and the consumption of foods advertised on television.[6] Eating while watching television may be promoted not only by the food advertising, but also by food references in the programs themselves.

Either reduced energy expenditure, or increased food intake alone would not be expected to cause obesity in the absence of impaired regulation of energy balance. For example, increased food consumption while watching television could be balanced by a reduction in food intake at other meals. However, television is such a pervasive influence and consumes so much time that children may not be able to restore the balance between energy intake and expenditure.

Television viewing only accounts for a small proportion of the variance of childhood obesity. Nonetheless, only obesity in cycle II was a more powerful predictor than television viewing for obesity in cycle III, even when all the variables in the Table were included. Our data suggest that alterations in the frequency of television viewing, food consumption while watching television, or reduced consumption of the foods advertised on television may be logical interventions to aid the treatment and prevention of obesity, at least in some cases.

SUMMARY

We have shown that the association of television viewing and obesity in children fulfills the criteria necessary to establish a causal association. These criteria include our observation that television viewing precedes obesity, even when controlled for confounding variables, that the relationship is unidirectional, that a dose-response effect occurs, and that a mechanism exists by which this association can be explained. Our findings also suggest that the prevalence of obesity could be reduced, and that the disease could, in some cases, be prevented by a reduction in television viewing and an increase in other activities.

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THE NUK NIPPLE OR IF GOD WANTED US TO...

Every so often the pediatrician finds that patients (or parents) are using a product that is related to child care that isn't subject to the testing required for most of the equipment and drugs that are in use. Some of these are enuresis devices, thermometers of various kinds, and toys.

Years ago, the Nuk pacifier was introduced and gained in popularity over the previously frowned upon pacifiers since this pacifier was "approved" by, of all people, the orthodontists. The implication was that should your child abuse the pacifier either by excessive daily sucking or failure to give it up at an appropriate time, his mouth would not suffer the deformities seen in those patients who abused the regular pacifiers of the past. The pediatrician benefited somewhat from this situation, since they didn't have to deal with nearly as many concerns from parents regarding pacifiers. The Nuk removed much of the guilt parents felt since the orthodontists said it was OK.

Somehow the Nuk pacifier expanded its role to the Nuk nipple for bottle feeding. For centuries man has had the prototype of nipples. Could we have been wrong all along? Have we been causing the orthodontic problems beginning in the delivery room? It is amazing that for obscure reasons we accepted the Nuk pacifier and now the concept is extended to another product. We know why parents wish to avoid the orthodontists, and they probably feel this is a small price to pay if successful. How can this weird nipple be an accepted substitute for the one we know works? If God wanted us to....

Submitted by Joseph A. C. Girone