PREVENTION OF OBESITY

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Updated September 15, 2023

ABSTRACT

Obesity has become a major public problem which is associated with increased risk to health and enhanced mortality along with increased medical costs. Prevention is obviously the first line of attack and this chapter outlines preventive strategies starting with a model which translates the energy imbalance which produces obesity into the social framework in which this occurs and where intervention must occur. Increased food intake is the major driver with reduced physical activity as a second component, modified by many other factors. Prevention begins with pregnant woman where maintaining a healthy weight gain improves the outcome for both infant and mother with diet and exercise both showing positive results. The early years of life are another important time for prevention. Studies of children have shown that exercise and nutritional quality can be improved by lifestyle intervention, but that impacting body weight change is more difficult. Reducing sugar-sweetened beverage intake and increasing water intake are two potentially useful strategies. Finally, there are many studies examining strategies for prevention of weight gain in adults as a group and in special subsets of adults with variable effect. One can conclude that prevention is the cornerstone for reducing the prevalence of obesity in pregnant women and their offspring, in children and adolescents, and in adults, but that the current strategies may need to be supplemented with additional successful modalities of implementation.

INTRODUCTION

Obesity is a worldwide problem (1) and affect more than 100 million Americans (2). In the 1980s the prevalence of obesity began to rise more rapidly than before and has now reached epidemic proportions worldwide. Since 1980 it has more than doubled and In the United States. Data provided by the US National Health and Nutrition Examination Survey (NHANES) in 2009-2010 showed that 35.5 % (95% CI, 31.9%–39.2%) of men were obese (BMI>30 kg/m^2) and 35.8% (95% CI, 34.0%–37.7%) of adult women were obese (1, 2). The National Health and Nutrition Examination Surveys (NHANES) in 2014 noted a BMI of ≥25 was present in 71.3% of men 20 years or older and in 65.8% of women 20 years or older. The prevalence of obesity (BMI ≥30) was 33.5% for men and 36.1% for women. Females at any age are disproportionately at greater risk for obesity, and especially extreme obesity (BMI ≥40, 8.3% in females; 4.4% in males). The prevalence of obesity has risen dramatically since 1980, but may have slowed at current higher than desirable levels. The prevalence of obesity among children age 3-5 is alarmingly high at 12.4% in boys and 10% in girls with higher rates in Hispanic and Blacks (3). The increase has continued in extreme obesity in the United States and is rising worldwide. This increase in the prevalence of obesity carries with it increased risks for diabetes, metabolic syndrome, non-alcoholic fatty liver, heart disease and cancer among others (4). It also has significant costs to the individual and to society (5). Clearly the "brakes" that prevented a rapid increase in obesity before 1980 are not working well enough, and new

preventive strategies are needed. To select papers for this chapter the words prevent, prevention, obesity, and overweight were screened in PubMed and additional references identified from the selected papers.

FRAMEWORK FOR DEVELOPMENT OF OBESITY

Figure 1 is a model with the "energy balance" equation at the center and social and environmental factors surrounding it (4). When an individual becomes obese it is a clear sign that the balance has tipped slightly towards positive energy intake (or reduced expenditure) and that this imbalance has been present for months to years. Primary prevention of obesity would occur if strategies similar to what were in place before 1970-1980 were re-introduced and obesity rates were reversed, or alternatively if equally effective new ones were implemented. Secondary prevention is the use of techniques to prevent regain of weight in an individual who has gained too much weight as fat and then lost it. These are often also called "maintenance" strategies.

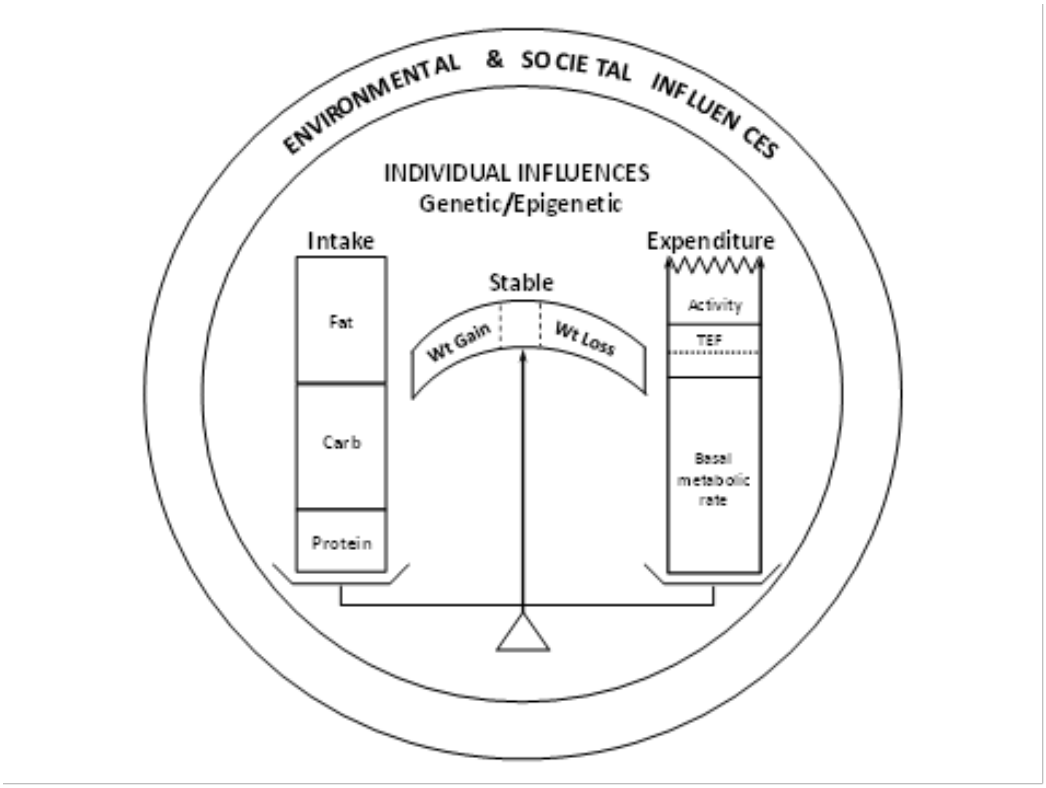

Figure 1. Model of Energy Intake and Energy Expenditure on a Balance Influenced by Genetic and Epigenetic Factors and Environmental and Social Influences.

The development of obesity, that is moving the central pendulum in Fig 1 to the right in favor of a positive energy balance could occur because there is a small increase in energy expenditure, a small decrease in energy expenditure or a combination of both.

Food available for consumption and food intake, corrected for plate waste, began to increase in the US after 1970 and has continued to the present (6, 7). The extra amount of food is now estimated to be about 400

kcal/d which is enough to account for the calories needed to produce the documented weight gain (8). An alternative explanation would be a decrease in activity in the ordinary duties of the day (9). I tend to favor the rise in food intake as the major factor.

The rise in consumable food items from farms in the United States began after a change in food policy for reimbursing farmers in 1970 (10). There are several outlets for this growing surplus of food. First, it could be stored in warehouses against a future need. It could be destroyed. Or it could be transferred to storage depots on people – obesity (11). Since the growth of the population is less than 1-2% per year, the growth in food supplies was larger than needed to meet this growing population. Since we don't see stores of food in warehouses, we have probably transferred it to the population producing obesity. As Tillotson has said "…certain of our agricultural and industrial policies have had the unintended and unforeseen consequences of increasing overweight and obesity". Our current "preventive strategies" thus operate in a setting of agricultural and industrial policies that favor production of more food that is needed to feed the population. Surpluses of food operate in a socio-economic environment. In many groups of women this is reflected in an inverse relationship between the prevalence of obesity and the educational and income levels (10).

Several economic hypotheses related to "food security" have been proposed. These economic factors may need to be part of the preventive strategy if we are to develop a cohesive approach to dealing with obesity around the world.

The positive energy balance that we see leading to obesity can be influenced by a variety of factors which are controlled by the individual, by the family, and by society. We know that people can "consciously" control their weight by restrained eating. It is clear from the model that the individual is at the center of this system but their responses in terms of energy intake and energy expenditure are influenced by a myriad of factors over which they have little or no control. Genetics underpins obesity (11, 12, 13). There are some genes that have such potent effects on body weight that when defective obesity is almost certain. Leptin is one of the most potent (11). There are more than 90 other genes that contribute small amounts to differences in body weight accounting for less than 5% of the risk for obesity (11, 13).

Epigenetic factors, environmental influences on the fetus and early life also have important effects. For example, offspring of mothers who smoke during pregnancy or whose mother is a diabetic are at higher risk of obesity later in life and those who gain large amounts of weight (4). Duration of sleep time also affects body weight. Availability of food and its palatability are environmental factors that have significant effects that can override the controls systems for body weight. It is clear that although many of these environmental factors can be controlled by the individual, the genetic and epigenetic influences make it difficult for many people to maintain a stable body weight. Thus, preventive and therapeutic strategies are needed.

STRATEGIES FOR PREVENTING OBESITY

At least 4 preventive strategies are available to deal with the epidemic: Education, regulation, modification of the food supply, and changes in the cost of food energy. Education about good nutrition and healthy weight in the school curriculum would be beneficial in helping all children learn how to select appropriate foods and should be included in school curricula. Foods used in school breakfast and lunch programs should match these educational messages.

> However, it is unwise to rely on educational strategies alone, since they have not, so far, prevented the

epidemic of obesity. The program of knowing your BMI initially instituted on a state wide basis in Arkansas may have helped that State to reduce the upward trend in obesity. Regulation is a second strategy. Regulations to provide an improved food label would be one good idea. Better regulations on appropriate serving sizes and caloric value that would be easy for the public to use might be part of the information provided by restaurants on their menus. This is now required in New York City and if effective may spread around the country.

Modification in some components of the food system is a third and very important strategy. Since the energy we eat comes from the food we eat, we need to modify this system to provide smaller portions and less energy density. One approach is to use differentiated food taxes to promote healthy diets. This is the approach New York State is trying with its tax on soft drinks introduced in 2007, and has been urged by a group of prominent nutritional scientists (15). This strategy has been argued both at the academic level (16, 17, 18), and at the policy level. It may be that economic tools that will shift food choices using cost is the "fluoride" for treating the epidemic of overweight that is described below.

Some years ago, I proposed that the best strategy for prevention of obesity may be modeled after the use of fluoride for prevention of dental caries (19). The addition of fluoride to the water supply had a more profound effect on the incidence of dental caries than brushing and flossing teeth. Brushing and flossing are like diet and exercise. They both require commitment on the part of the individual. Adding something like fluoride to the water supply doesn't require any commitment. Increasing the price of oil may be one such strategy. Between 1940 and 2005, Pollan pointed out that the number of calories from petroleum (oil) used to produce food energy has risen dramatically. In 1940 it was 0.4 cal of oil for each calorie of food energy. In 2005 it had risen over 20-fold with 10 calories of oil needed for each calorie of food. These calories come from the petroleum products used to make fertilizers, to transport food, to process and package food, for pesticides, and so on. If oil prices rise significantly, this will shift the use of oil for food and shift our consumption patterns (20).

Strategies for Preventing Obesity in Pregnant Women

Women who gain more weight during pregnancy have increased risk of diabetes, hypertension, pre-eclampsia, and still birth. The offspring is at increased risk for macrosomia and later obesity (21). A lifestyle intervention program during pregnancy in Denmark (Lifestyle in Pregnancy = LiP), however, failed to alter the metabolic risk factors in the offspring. A systematic review of evidence relating weight gain during pregnancy and outcomes of pregnancy found that dietary interventions were the most effective type of intervention in pregnancy. They reduced gestational weight gain and the risks of pre-eclampsia, hypertension, and shoulder dystocia in the infant. There was no difference in the incidence of small-for-gestational-age infants as a result of treatments (22, 23). Another systematic review reached similar conclusions and showed that dietary interventions significantly reduced gestational weight gain by 1.92 kg (95% CI -3,65, -0,19), and the incidence of Caesarean section (24). The Cochrane review of this subject in 2015 found that diet, exercise or both reduced the gestational weight gain by an average of 20%. These interventions included low glycemic index diets, supervised or unsupervised exercise program, and diet combined with exercise which were all comparable in their effects. Hypertension was reduced but pre-eclampsia was not. They also found no differences between intervention and control groups in the risk of preterm births, or macrosomia overall. However, the subgroup of women who were overweight or obese did have a 15% reduction in

macrosomia. Fetal distress syndrome of was also reduced in women with obesity in the intervention groups (25).

Strategies Aimed at Children

There is a great deal of concern for the plight of obese children. The pioneering work of the psychoanalyst, Dr. Hilde Bruch, a refugee from Nazi Germany working in the 1940's did much to alert the public to this important issue (26).

Children of overweight parents are a high-risk group for development of overweight (27). In a long-term follow-up study, Berkowitz et al studied 32 high risk children whose maternal pre-pregnancy BMI was 30.4 kg/m^2 and compared them to 29 low risk children whose maternal BMI was low at 19.6 kg/m^2. At this age they consumed a test meal in which their eating behavior was assessed, including rate of caloric consumption, mouthfuls/min, and requests for food. Parental prompts for the child to eat also were measured. Parental feeding prompts were not different between high risk and low risk children, but the rate of eating measured by mouthfuls of food/min, and total caloric intake/min during the test meal predicted an increased risk of being overweight or obese at age 6. Thus, pre-school years are important in setting risks for future obesity

Schools have also changed. They were once a place where children could be very active. With security issues and concerns about safety when children walking home from school there is less opportunity for physical exercise. Providing safe pedestrian walk-ways to school could increase physical activity for children more easily than changing the built environment for adults. In a review of school-based programs, 18 studies involving 18,141 children were evaluated. They were primarily elementary school children and had programs that lasted from 6 months to 3 years. A meta-analysis showed that physical activity interventions did not improve BMI (28).

To examine the studies that have looked at prevention of childhood obesity, I have taken data from a Cochrane Collaboration review of preventive strategies for children divided studies into long and short term. Short-term studies were those with data for 12 weeks or more but less than 52 weeks. Long-term studies were those with data beyond 52 weeks. I will discuss only the long-term studies.

LONG-TERM STUDIES

One controlled trial that was deemed of good quality was conducted in the US randomized 26 children and their families to 2 conditions: 1) increasing fruit and vegetable and 2) decreasing fat and sugar (29). The children were 6-11 years old and at least one parent accompanied them. They received a comprehensive behavioral program. At the end of 12 months the decrease in percentage of overweight was decreased 1.10% in the fruit and vegetable group and 2.40% in the lower fat and sugar group. These differences were not statistically significant, but are nonetheless tantalizing and suggest the need for applying this to high-risk groups like the children of overweight parents.

A second study of good quality was conducted by James et al (30) where 644 children were randomized by school class into 15 intervention and 14 control classes in 6 schools. The baseline prevalence of overweight was comparable. The intervention focused on decreasing consumption of carbonated beverages. The intervention was delivered in 3 one-hour sessions by trained personnel with the assistance of teachers. At 12 months the change in BMI "Z" score was not significantly different between intervention and control classes (mean Z score 0.7 (SD 0.2). However, there was a reduction in the self-reported consumption of soft drinks.

Sugar-sweetened beverages have been incriminated in the development of obesity and cardio-metabolic risks in a number of studies (31). One outcome of this data were 2 randomized clinical trials to reduce the intake of sugar-sweetened beverages among adolescents (32, 33, 34). At the end of one year the weight gain in one study was significantly smaller in those provided with sugar-free beverages, but most of this benefit, except in the Hispanic children, was lost at 2 years after the treatment program had been discontinued. In the other trial lasting 18 months, the children receiving the artificially sweetened beverages gained less weight than those drinking the sugar-sweetened soft-drinks (33). In a follow-up of this study (34) it was shown that compensation for changing sugar content in beverages was sub-optimal in children in the upper half of the BMI spectrum. Thus, replacing the sugar-sweetened beverages associated with weight gain with lower calorie versions might be beneficial to most children and adolescents.

Another trial was conducted in Thailand randomized kindergarten children by class into an exercise group and a control group with 5 classes in each arm (35). The reduction in the prevalence of obesity tended toward significance (p=0.07).

A US trial including 549 children from 6 schools was stratified by percentage ethnicity (36). This intervention, called SPARK (Sports, Play and Active Recreation for Kids) was a physical education program with a self-management component. The results for boys showed that the control group had significantly lower BMIs at 6 and 12 months, but not at 18 months. In contrast, the girls in the control group had lower BMIs at each time point that reached statistical significance at 18 months.

The Pathways Study (37) is one of the largest studies for prevention of obesity in children. The participants included 1704 children from 41 American Indian schools. Children were age 8-11. Pathways was a school-based multi-component, multi-center intervention for reducing percentage body fat. There were 4 components: 1) changing dietary intake; 2) increasing physical activity; 3) A classroom curriculum focused on healthy eating and lifestyle; and 4) a family-involvement program. At the end of the 3-year study, knowledge improved and fat intake at lunch decreased, but there were no changes in either body composition or activity level measured by motion sensor.

The Planet Health study is a high quality randomized controlled trial (38) conducted among 1295 ethnically diverse children in 10 US schools in New England who were randomized by school. The children were 11-12 years old and in the 6-8th grade. The program was a behavioral choice intervention and concentrated on the promotion of physical activity, modification of dietary intake, and reduction of sedentary behavior with an emphasis on reducing time watching television. At follow-up the percentage of obese girls in the intervention schools was reduced 53% compared with controls, [Odds Ratio 0.47 (95% CI 0.24 to 0.93)]. Each hour of reduction in television time predicted a 15% reduction in obesity [OR 0.85 (95% CI 0.75 to 0.97]. Among the boys there was a decline in BMI in both groups, but no significant difference between them. Time spent viewing television was reduced among both boys and girls and fruit and vegetable consumption increased significantly. Gortmaker et al (38) concluded that the decline in television watching was a major factor in preventing obesity.

In another clinical trial from Germany, Muller et al (39) randomized a group of 414 children from 6 schools into control or intervention groups in the Kiel Obesity Prevention Study or KOPS. The key messages in the intervention group were to eat more fruits and vegetables each day, to reduce high fat foods, to keep active for at least 1 hour a day, and to decrease

television viewing to less than 1 hour a day. At the end of one year there was no significant difference in change of BMI between the intervention and control groups.

In a program called Active Program Promoting Lifestyle in School, or APPLES, 634 children in 10 schools were randomized to intervention or control groups (39). The intervention included teacher training and resources, modification of school meals, support for physical education, and playgroups activities. At one year there was no difference in change in BMI between the children in the two groups, nor was there any difference in dieting behavior. However, children reported a higher consumption of vegetables. Although APPLES was successful in changing the ethos in the schools and the attitudes of the children, the trial was ineffective in changing weight status.

The program "VERB™--It's What you Do!" was developed by the US Centers for Disease Control and Prevention is another example of a social marketing strategy. It is designed to increase physical activity among ethnically diverse 9- to 13-year-olds (40). The question of whether it is really possible to get long term behavioral change in a society with a vibrant advertising industry remains to be seen.

Mind, Exercise, Nutrition – Do it (MEND) is a British program held at a sports center, twice-weekly, for 3 months which consists of behavior modification, physical activity, and nutrition education. In their pilot study, 11 obese children age 7-11 years and their families were recruited and attended a mean of 78% (range 63-88%) of the sessions. Waist circumference, cardiovascular fitness, and self-esteem were all significantly improved at 3 months and continued to improve at 6 months. BMI was significantly improved at 3 months but lost significance by 6 months. This program has now been expanded to many sites through the United Kingdom (41) and Australia (42). The Stockholm Obesity Prevention Program (STOPP) is another randomized trial parents who are overweight or obesity designed to prevent obesity in their children. (43)

A meta-analysis examining the impact of lifestyle interventions on body weight and cardio-metabolic outcomes in overweight children found 33 studies with complete data on weight change. Lifestyle interventions compared to either no treatment control or usual care resulted in significant weight loss of 1.25 to 1.30 kg/m2 (BMI units). In the 15 studies reporting cardio-metabolic outcomes, there were significant reductions in fasting insulin, triglycerides, blood pressure, and LDL-cholesterol, but no effect on HDL-cholesterol (44). The importance of prevention in childhood and adolescence has prompted 3 Cochrane Reviews of the effect of Lifestyle Interventions. One focused on improvements in school performance (45), another focused on improvements in physical activity and fitness from lifestyle interventions (46), and a third one on the effects on body weight (47). This latter report showed that lifestyle was effective in in age groups 0 to 5 years, age 6 to 12 and age 13 to 18 with the largest effects seen in the children under 12. Community wide interventions for Increasing population levels of physical activity are not very effective based on another Cochrane Database Review (48).

Systematic analyses have also been done for special groups of individuals with obesity in the United States. Two of these reviews have examined Latino children and find that lifestyle and physical activity interventions are promising (49, 50). In a review of studies on Latino and African-American children Robinson et al (51) found that 2 of 17 studies showed benefits for preschool and elementary schools on reducing obesity in African-American children. Parent-child participation has also been found to be valuable (52).

Strategies Aimed at Adults

A large number of trials have been conducted in adults and reviewed in detail by Kumanyika and Daniels (53). The Pound of Prevention study (54, 55) is probably the largest and most general study for prevention of overweight reported to date. It demonstrated the feasibility of reaching a large number of people and producing some positive behavioral changes. However, as with many of the studies in children, the interventions were not successful in preventing weight gain relative to the control condition. The decrease of fat intake and increased physical activity were the strongest predictors of weight maintenance (55). Again, behavioral changes were positive and perhaps a higher intensity might have produced different results, but at the present time there is a reasonable argument to be made that money spent on behavioral efforts at changing behavior is wasted.

The results of the 5-year trial from the Healthy Women's Study is also worth noting (56, 57). Behavioral counseling at 6 months was effective in preventing weight gain during the transition to menopause. The intervention program appears to have been well received, judging from retention rates, but it seems to be labor and cost intensive to deliver.

Rural counties in the United States have higher rates of obesity, sedentary lifestyle, and associated chronic diseases than non-rural areas. To tackle this problem, Perri et al worked with the USDA Cooperative Extension Service. They recruited obese women from rural communities who had completed an initial 6-month weight-loss program at Cooperative Extension Service offices in 6 medically underserved rural counties in Florida (n = 234). The women were randomized to extended care program or to an education control group. The extended-care programs entailed problem-solving counseling delivered in 26 biweekly sessions via telephone or face to face. Control group participants received 26 biweekly newsletters containing weight-control advice. The body weight at entry was 96.4 kg, and the women in the intervention group lost 10 kg during the 6-month intervention. One year after randomization, participants in the telephone and face-to-face extended-care programs regained less weight [1.2± 0.7 and 1.2 ±0.6 kg, (mean± SEM) respectively] than those in the education control group (3.7 ±0.7 kg; P = .03 and .02, respectively). The beneficial effects of extended-care counseling were mediated by greater adherence to behavioral weight-management strategies. Cost analyses indicated that telephone counseling was less expensive than face-to-face intervention, thus offering a strategy of working with the Cooperative Extension service using behavioral weight strategies to modulate body weight (58).

Strategies for Preventing Obesity Aimed at the Entire Population

Population-based messages aimed at the public concerning food and exercise are cognitive in nature requiring individual commitment (53). If the "individual" follows the advice in the message this strategy would be sufficient to "overcome" the epidemic of obesity. However, positive preventive messages are delivered in an environment in which there are many alternative messages urging consumption of this or that kind of food or eating at one or another of many different kinds of restaurants. The Low-Fat message of the 1990's is one example of a message that assumed obesity results from increased fat intake and that reducing fat intake would reverse it. Omitted from this was the realization that eating less fat did not necessarily mean eating fewer calories and thus redressing the energy imbalance. A test of the low-fat hypothesis as a public health message came from the Women's Health Initiative. Women were randomly assigned to normal or low-fat diets, but without calorie goals. The women assigned to the low-fat diet lost more weight that the other group, but after the low point, weight was regained (59). Of particular interest, is that the weight

change over 8 years had a strong relation to the level of fat that the women chose to eat. Those with the lower fat intake remained 2 kg or more lighter after 7 years than those in the highest fat intake group indicating that dietary fat is one component of the problem, but that it is not the "whole story". If one believed that the current epidemic of obesity was due to limited activity, then a campaign like "America on the Move", which enrolls individuals to use step counters as a way to increase their activity should be an effective strategy (60). The jury is still out on this strategy.

An alternative approach might be to re-engineer the built environment to make it both easier to walk and make it more likely that individuals would do so rather than getting into their car (61). The current housing model of the cluster of houses off a main street where the automobile is essential for mobility will make this strategy a long-term one. A systematic review by Papas et al (62) identified 20 studies, of which 18 were cross-sectional that examined the relation of obesity to the numbers of outlets for physical activity and food. Seventeen of these found significant relationship between built environment (food outlets or access physical activity) and risk of obesity. The number of recreational facilities and likelihood of overweight in adolescents were significantly related.

FOOD

Faith et al (63) reviewed research that used manipulations of the environment to produce weight change. They concluded that easy access to food may influence food purchases, consumption, and possibly weight change while restriction of food availability may accomplish the same goals although this requires further research.

The food industry, for obvious reasons, favors the hypothesis that obesity results from reduced levels of physical activity and strongly supports providing more places for people to exercise and providing them with more healthy alternatives in food stores as a strategy to help overcome the obesity problem (53, 64). However, since "healthy" food items are likely to be more expensive than the ones already on food shelves, and since newer technologies and marketing are needed, it is unclear whether a price-sensitive public can be moved in this direction.

Strategies for improving access to healthful foods often focus on fruits and vegetables. The value of a diet high in fruits, vegetables, and low-fat dairy products with a reduction in the level of fat and sugar containing products was found to lower blood pressure across the range of salt intake in individuals who were maintaining their body weight (65, 66). Regular farmers' markets, subsidizing the availability of fresh fruits and vegetables to school children, lowering the cost of fruits and vegetables while increasing the price of high-fat or high sugar foods in school or worksite cafeterias, or changing marketing strategies in other ways might increase fruit and vegetable consumption (67, 68, 69, 70, 71, 72). Since we are all price sensitive, these might move choices of food from the lower cost less healthy ones to more healthy choices. However, as Drewnowski has pointed out, the high-fat, high sugar alternatives provide much more food energy for the money than the so-called healthier options (73).

Another strategy toward this end is to "limit" availability of higher energy foods by making them more expensive. A review of the use of price of food items by Smed et al (16) has shown that in Europe increasing the tax or reducing the subsidies on "unhealthy" items and reducing the tax on "healthy" items through the value added tax system could shift consumption toward healthier foods (15). Federally funded programs such as food stamps, school lunches, and meals on wheels could also be used toward this end. Pending the willingness of the public and the politicians to tackle some of the political

implications of tax policy to combat the epidemic of obesity, this strategy is likely to remain on the back burner (13).

INCREASING PHYSICAL ACTIVITY AS A FOCUS FOR PREVENTION

An overall increase in physical activity would increase energy expenditure and is one strategy for prevention of obesity. One assumption of such a strategy is that activity may have decreased during the time that the epidemic of obesity developed. This is difficult to establish, but a recent publication used total daily energy expenditure in a small number of individuals (some 300) measured over years (74). This strategy would be appropriate, whether there has been a decrease in energy expenditure or not, and the data on this question is unclear. In contrast, Church et al (8) have presented data showing that leisure activity has declined as the obesity epidemic has moved ahead. Altering the "built environment" such as side-walks and shopping centers is one way to do encourage more physical activity (61). However, there is a 30–40-year lag between initiation of changes in architectural land use and real changes in configuration of sidewalks, making these approaches unlikely to impact this problem in the foreseeable future.

How much has our daily activity level changed? To examine this question Cutler et al (75) examined levels of activity in various tasks from 1965 to 1995, which covers the period before and to the peak of weight gain. They found that over the 30 years from 1965 to 1995 the major changes in activity have been a decrease in household work and an increase in recreation and communication. These are relatively small compared to the proportion of the daily routine which is spent in paid work and in personal needs and care. We thus think food intake is a more viable strategy for combating the obesity epidemic.

Work places are another place where prevention and intervention can occur. In a review of worksite nutrition and physical activity programs Anderson et al (76) noted modest improvements in employee weight status at the 6-12-month follow-up. Based on 9 randomized controlled trials, there was a loss of 2.8 pounds (-1.3 kg) (95% CI=-4.6, -1.0 weight loss) and a decrease of 0.5 (95% CI=-0.8, -0.2) BMI units based on six RCTs. The findings were applicable to both male and female employees, across a range of worksite settings. Most of the studies combined informational and behavioral strategies to influence diet and physical activity; fewer studies modified the work environment (e.g., cafeteria, exercise facilities) to promote healthy choices. This is an area of potential future advance.

The nutrition-transition in China provides an interesting example of how the modern way of life makes preservation of physical activity so difficult (77, 78). As recently as 20 years ago, the bicycle was a major mode of transport for Chinese. This is no longer the case. The automobile and public transport systems are relegating the bicycle to museums. Whether understanding the need for people to move can provide a rescue strategy for weight gain is doubtful.

USE OF SOCIAL MARKETING

One element in trying to combat the obesity epidemic is to focus on the needs of selected groups – so-called social marketing. The idea is to provide focused messages targeted at specific sub-groups. Another approach is to focus on specific food groups. The program by the National Cancer Institute to increase Fruits and Vegetable consumption through the "5 A Day for Better Health" program is an example of this idea. Although we would all agree that this is a desirable approach, its effectiveness in changing the consumption of fruits and vegetables has not been overwhelming (79).

SUMMARY AND CONCLUSION

Efforts to prevent obesity or to reverse components through changing lifestyle have focused on both adults and children and well as worksites. Although some changes can be documented in these studies, the net effects have been small and the epidemic has continued to move ahead. The role of economic incentives has received less exploration, but may be more promising as a way to halt this epidemic.

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