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Position Paper

Prevention of Childhood Overweight – What Should Be Done?

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Childhood Overweight and the Need for Prevention

Overweight among children has increased dramatically in recent decades.[87, 135, 146, 172, 226] Based on national data, the prevalence of overweight among 6- to 17-year-old youth has more than tripled from approximately 4% in the 1960's to over 15% in the 1999-2000 National Health and Nutrition Examination Survey.[227*] Further, based on initial findings from the most recent national survey, this trend continues to increase.[33] The prevalence of childhood overweight is generally highest for Hispanic and Native American children of both genders and for African American girls, but also of concern are the high rates for Pacific Islanders and the increasing rates among Asian American children, particularly among the second and third generation.[40] While several notable variations in overweight prevalence exist, no gender, age or racial/ethnic group appears immune from the secular increases.[70, 227] *Primary prevention of overweight among children, prior to the onset and consolidation of risk-related behaviors, is considered critical to stemming the obesity epidemic for the entire population*.[160]

Pediatric overweight has been associated with numerous health risks for children: increased stress on weight-bearing joints, [26] high blood pressure and abnormal blood lipids,[65, 74, 148, 149] insulin resistance and type 2 diabetes mellitus,[74, 181] and respiratory problems.[128] Overweight during childhood can also have a damaging impact on psychosocial and emotional development, particularly in light of our societal preoccupation with thinness.[64, 155] Further, child-onset overweight increases adult morbidity and mortality risk.[10, 52, 53, 93, 155, 236]

Pediatric overweight is also a risk factor for overweight during adulthood, *with child-onset overweight potentially resulting in a higher degree of adiposity among adults than adult-onset overweight.*[247] It has been estimated that about one-third of overweight preschool children and one-half of overweight school age children remain overweight as adults.[208] Increased childhood adiposity and age of occurrence are correlated with overweight in adulthood.[94, 208, 245] Adult overweight, in turn, has been associated with increased risk of osteoarthritis, coronary heart disease, high blood cholesterol, high blood pressure, type 2 diabetes mellitus, and gallbladder disease.[154] Physical inactivity and poor nutrition practices are second only to smoking as the leading preventable cause of death among adults in the United States.[3, 143]

While some may question the need for intervening on essentially healthy children, *there are numerous reasons to attempt to prevent childhood overweight and promote healthy lifestyles among children*: children may receive immediate benefits (such as improved nutrient intake or fitness); modifying chronic disease risk in childhood may result in lower rates and risk of chronic disease in adulthood; and health promoting behaviors adopted during childhood may persist into adulthood, thereby conferring sustained protection against chronic disease.[12]

*For children 2-18 years of age overweight is defined as defined a body mass index (BMI) $\geq$ 95th percentile and "at-risk " of overweight is defined as BMI between the 85th and 95th percentile[227].

What Are Appropriate Childhood Overweight Intervention Goals?

The most obvious outcome measure of overweight interventions is reduction in body fatness and therefore the means of evaluating success include prevention of excessive weight or fat gain on an individual basis, and reduction in the prevalence of overweight on a population basis. Although weight loss is the conventional goal for interventions among adults, for the majority of children** weight maintenance rather than weight loss is recommended.[11] Severe caloric restriction in childhood may result in retardation of linear growth,[66] increased risk of subsequent osteoporosis,[235] and impaired intellectual development.[121] Further, weight loss efforts, particularly those that rely upon extreme dietary practices, such as fasting, and use of laxatives, diet pills, and vomiting, may be counterproductive and ultimately result in health problems, eating disorders, poor self-esteem, and even weight gain.[163, 216] Further, focus on weight status alone introduces the risk of weight-based stigmatization among children. Numerous studies have identified deleterious consequences in the quest for ideal weight among both children and adults.[130] It is important that overweight interventions do not result in children feeling bad about their selves and their bodies. Teaching that healthy bodies come in all shapes and sizes is a critical principle to be incorporated in overweight interventions targeting children.

Weight status is not a perfect proxy for health status (i.e., an overweight person who eats a healthy diet and participates regularly in physical activity may be more healthy than a non-overweight person who eats poorly and is sedentary).[20, 210] Therefore, *multiple indicators of a healthy lifestyle and improved health should be used to evaluate the success of overweight interventions and should be the primary goals.* Appropriate outcome measures include components of physical activity and diet, as well as psychosocial adjustment and physiologic measures.[11, 164] Specifically, physical activity goals include: increased physical education participation and physical activity self-efficacy, reduced sedentary activity (i.e., TV watching, computer usage), and improved fitness. Appropriate outcomes for a healthier diet include: decreased consumption of dietary fat, fast food, soda and other empty calorie foods; and increased consumption of fruits and vegetables. Other appropriate goals include: improved eating patterns, positive body image and self-esteem, and improved physiological measures (e.g., decreased lipids, blood glucose, blood pressure, or respiratory problems).

Which Strategies Are Most Promising?

Depending on the desired outcome, the optimum strategy may differ. For example, a very different approach might be used to promote physical activity (e.g., increase physical education participation), than would be useful to promote a healthy diet (e.g., increase fruit and vegetable intake). In order to limit the present discussion to a manageable number of strategies, reducing the prevalence or degree of overweight was selected as the focus. Two lines of evidence in studies of children were examined to determine strategies likely to prevent overweight: 1) factors known to be associated with overweight; and 2) factors altered in successful overweight prevention programs. While it may be intuitively obvious that overweight prevention should involve promotion of increased energy expenditure and decreased energy intake, experience has shown that this presumption is overly simplistic. Table 1 is a tabular summary of factors potentially modifiable to reduce pediatric overweight (based on a recent review conducted by the Center for Weight and Health[188]). It should be noted that, while the limited research conducted to date precludes definitive conclusions and more studies are clearly indicated, we have attempted to present, to the best of current knowledge, the strategies most likely to be efficacious in preventing overweight among children. It is not meant to be an exhaustive list of all possible strategies.

Physical Activity

Low levels of physical activity have repeatedly been related to increased overweight among children.[14, 47, 59, 78, 100, 119, 124, 138, 171, 183, 184, 195, 202, 221, 222, 241] Further, increased physical activity appears important for long-term maintenance of weight loss among children[62], and for overweight prevention.[72] However, not all studies have found an association between physical activity and weight status[58, 137, 151, 196] or a physical activity intervention effect on weight status.[55, 134, 144, 200] Methodological differences between studies aside, it is not clear which elements of physical activity are most crucial to body weight regulation or health (e.g., intensity, duration, metabolic efficiency, type of activity or overall energy cost).[83] Treatment studies suggest that lifestyle exercise (e.g., walking to school) had the greatest impact on weight loss, followed by aerobic exercise. [61] Lacking are analogous studies of prevention of overweight among children. Regardless of weight status and impact on adiposity, regular participation in physical activity is critical to child health. Benefits of regular moderate to

** Weight loss is recommended only for the following children: 1) 2-7 years old who are "overweight" (body mass index (BMI) $\geq$ 95th percentile) **and** have secondary complications (e.g., mild hypertension, dyslipidemia, insulin resistance, sleep apnea); 2) $\geq$ 7 years old who are "at risk for overweight" (BMI 85th-95th percentile) **and** have secondary complications; and 3) $\geq$ 7 years old who are "overweight" regardless of presence of complications.[11]

vigorous physical activity include improved fitness, blood pressure, coronary risk profile, attitude, discipline, and behavior.[95, 117, 184, 210]

Table 1: Relative Merit of Various Overweight Intervention Strategies Among Children.

Factor	Most Promising	Somewhat Promising	Not Promising
Physical Activity Patterns			
Increase PE participation	√		
Increase recreational physical activity	√		
Decrease television viewing	√		
Decrease video/computer game playing/use		√	
Dietary Factors			
Decrease total calories		√	
Decrease dietary fat; promote a heart-healthy diet		√	
Decrease energy density of foods		√	
Increase fruits and vegetables		√	
Decrease sweetened beverages	√		
Decrease fast food consumption		√	
Decrease fruit juice			√
Avoid skipping meals		√	
Decrease snacking on unhealthy foods		√	
Familial and Psychosocial Influences			
Overly restrict child's access to food; strict dieting			√
Improve limit-setting	√		
Avoid using food as reward	√		
Parental modeling of healthy behaviors	√		
Improve family communication		√	
Improve self-esteem		√	

TV Viewing

One of the most promising areas of intervention centers on television viewing. TV viewing has become an increasingly popular pastime among US children.[86] The average child watches an estimated 3 hours of TV per day, not including time spent watching videotapes or playing video games.[168] When all media are considered, the average increases to 5 ½ hours daily.[189] Time spent watching TV is one of the modifiable factors that has most consistently been associated with overweight status.[6, 14, 39, 41, 46, 51, 56, 88, 90, 92, 96, 102, 137, 147, 152, 183, 195, 199] More video and computer play has also been noted among overweight compared to non-overweight children in some,[42, 46, 183] but not all[102, 222] studies. TV viewing is believed to result in both reduced energy expenditure and increased energy intake (as a result of the influence of food advertising on food purchasing and/or by increased consumption while watching TV).[191] Unfortunately few interventions have been designed specifically to influence children's TV viewing habits.[85, 89, 191] One program that was successful at reducing TV viewing, overweight, and meals eaten in front of the TV has been tested to date only among a comparatively high socioeconomic status and ethnically homogeneous population of school children.[191] Without additional study, generalization of the results of this intervention to US children in general is premature.

Caloric Intake

Most research regarding *dietary factors* in the etiology of overweight has focused on caloric intake, yet with few exceptions,[14] there is not clear evidence of a relationship between total energy intake and overweight among children.[34, 58, 105, 114, 124, 137, 171, 192, 209, 222, 232, 238] Further, dietary surveys have generally reported similar mean energy intakes for children in each of the last three decades.[1, 120, 167, 215, 225] One explanation for an inability to elucidate the expected relationship between calories and weight gain or overweight is that dietary methods lack sensitivity to detect small caloric differences. Increasing caloric intake by as little as 150 kilocalories per day above the requirement for weight maintenance can result in

substantial weight gain over a year.[194] Some have also proposed that lack of an observable relationship is a result of children's underreporting of foods and serving sizes.[114] Recent US ecologic data (determination of food availability, independent of self-reported intakes) suggest that per capita energy intake has increased by 15% between 1970 and 1994.[97] Regardless of whether absolute increases in energy intake have contributed to the increased prevalence of pediatric overweight, it is clear that energy intake has increased relative to energy expenditure and therefore merits attention in overweight prevention programs. *However, focusing on calorie counting does not appear to be an effective strategy for preventing overweight among children.*

Fat Intake

Modifying the source of dietary energy may be effective in overweight prevention. Dietary fat, because it is energy dense, highly palatable, and efficiently converted to body fat, is theoretically more obesigenic than other energy sources.[139, 175] However, while numerous studies have found a relationship between dietary fat intake and body adiposity among children,[5, 39, 78, 79, 124, 171, 190, 229] many others have not.[7, 14, 58, 114, 136, 137, 151, 234] The national prevalence of overweight has risen while the percentage of dietary energy derived from fat has decreased.[32, 120, 167, 215] Further, for the most part, interventions promoting a low fat, heart healthy diet, have not been successful in preventing overweight among children.[45, 55, 89, 99, 158] Therefore, *while a diet low in fat, particularly saturated fat, is recommended for optimal health, the impact of moderate reductions in the intake of dietary fat, in the absence of other lifestyle changes, appears to hold limited promise for overweight prevention.*

Energy Density

Although not yet well documented, other factors related to diet composition might also be involved in the etiology of overweight, manipulation of which may potentially help to prevent overweight among children. For example, there is evidence to support the contention that the energy density of food influences food regulation more so than macronutrient content, at least for adults.[38, 193] Energy dense foods of concern are typically those that provide calories, but have little other nutritional value. Consistent with the energy density concept, associations of food groups with childhood overweight include: low intake of fruit and vegetables,[152, 165] high intake of sweetened beverages, such as soft drinks,[133] and high intake of fast foods.[152]

Fruit and Vegetable Intake

Of all the food groups, fruits and vegetables are most likely to consumed in inadequate amounts by children.[120] School-based interventions have been successful in increasing fruit and vegetable consumption, frequently with a concomitant decrease in fat intake. However, the resultant effect on weight status has not been systematically evaluated.[73, 166, 179, 186]

Sweetened Beverages

Consumption of soft drinks and sweetened fruit drinks has increased dramatically among US children in recent decades.[22, 32, 80, 150, 230] According to a national survey, soft drinks were the sixth leading food source of energy among children,[219] representing over 50% of total beverage consumption.[120] *Several studies suggest that consumption of soft drinks or other sweetened beverages is related to increased caloric intake*[91, 98] *and increased risk of overweight*.[133, 225] While there is no clear evidence that consumption of sugar *per se* affects food intake and weight gain,[103] there is some evidence to suggest that "liquid sweets" or energy consumed as a liquid may be less well regulated than energy consumed in a solid form.[141] It should be noted, however, that consumption of high-calorie, low-nutrient-dense foods has been observed to be high among children and adolescents in general, regardless of weight status.[8, 24] And while promising based on the evidence at hand, intervention studies have not yet been performed to test the hypothesis that reducing "liquid sweets" consumption would prevent pediatric overweight.

Eating Out

Food consumption away from home has increased dramatically in the past several decades.[97, 207, 230] Outside food consumption increased from about 55% of food in 1977-1978 to about 66% in 1994.[230] Fast food accounted for only 2% of children's total caloric intake in 1977-78, but increased to 10% by 1994-96.[129] Meanwhile, the number of fast food restaurants has increased at an annual rate of 7%, compared to 3% for the restaurant industry as a whole.[177] Data on secular trends in restaurant portion sizes and implications for weight gain are scant and primarily anecdotal.[97] However, according to a study by the National Restaurant Association, which collected menus from the same 66 restaurants in 1988 and again in 1993, the number of menus offering more than one portion size, such as "super" sizes, increased by 12%.[161] Further, fast

food is aggressively marketed to children. In an analysis of the commercials aired during 17.5 hours of top-ranked prime-time network shows for the age 2- to 11-year-old category, 40% of the food advertisements were for fast food items.[29, 30] Not surprisingly, frequent consumption of foods at fast food and other restaurants has been associated with a diet high in fat and low in nutrient density.[43, 44, 249] Eating restaurant foods or fast foods has been associated with higher weight and energy intake among adults.[15, 110, 142] While not controlling for race or socioeconomic status, one survey found that at risk or overweight children may also be more likely to report eating fast food and more likely to attend a school with vending machines selling chips and candy.[183] Troubling is the fact that fast foods and vending machine foods sold separately from the National School Lunch Program are currently exempt from the Dietary Guidelines and that these food sales represent an increasingly larger percentage of total school food sales.[231] *Limiting fast food and less healthy vending machine foods at schools may be one way to impact dietary behaviors of school-age children, but effect on overweight remains to be determined.* Further, the pressing needs of schools for the funds generated by snack bars and vending machines may make it difficult to enact potentially health promoting school policies.

Fruit Juice

The data on a relationship between high intakes of 100% fruit juice and overweight among children are not compelling. While some studies have reported an association,[49, 222] others have not.[2, 187, 213, 214] The American Academy of Pediatrics recently recommended that fruit juice consumption be limited to 4-5 oz/day for children aged 1-6 years and 8-12 oz/day for children aged 7-18 years.[4] These recommendations, however, were based on consideration of nutrient and gastrointestinal problems; more research was viewed necessary before overweight could be considered a consequence of excess fruit juice consumption.[36] Other agencies, however, have stressed the important contribution to nutrient intake that 100% fruit juices can make and advise that fruit juice consumed in quantities consistent with the Dietary Guidelines for Americans is advantageous for children.[187]

Meal and Snack Patterns

Meal and snack pattern is another factor potentially related to overweight among children. Population-based surveys have revealed that many children, particularly adolescents, skip breakfast and other meals and eat more food later in the day, and that this pattern has increased in recent years.[211, 212] *Overweight children and adolescents have been shown to be more likely to skip breakfast and consume a few large meals per day than their leaner counterparts who are more likely to consume smaller, more frequent meals*.[39, 57, 174, 211, 248] Overweight children have also been reported to eat smaller breakfasts[174] and larger dinners[136] in comparison to non-overweight children. It has been suggested that eating breakfast reduces fat intake and limits snacking over the remainder of the day.[206] According to national surveys, while the average size of snacks and the energy per snack has remained relatively constant, the frequency of self-defined snacking has increased from 1977 to 1996 among children in all age groups between 2 to 18 years.[108, 120] Between one fourth and one third of the energy intake of adolescents has been reported to be derived from snacks.[44] Further, snacks tend to be higher in energy density and fat content than meals, [108] and frequent snacking has been associated with high intakes of fat, sugar, and calories.[43, 145] The top snacks selected by teens in national surveys included: potato chips, ice cream, candy, cookies, breakfast cereal, popcorn, crackers, soup, cake, and carbonated beverages.[44] Further, snack choices reflect the foods marketed to children. In a study of the advertising content of 50 hours of nationally broadcast Saturday morning children's television approximately 50% of the ads were for food, airing an average of one every 5 minutes.[126] Most (91%) of these ads were for foods high in fat, sugar, and/or salt; none of the ads promoted fruits and vegetables. *Frequent intake of high-fat snack foods has been associated with overweight among children*.[222] Thus, recommendations for eating more times a day must include the caveat that meals and snacks should include limited amounts of energy-rich foods. Confirmation of a relationship between meal and snack pattern and overweight by intervention studies is needed.

Parenting

To date much research in the area of familial and psychosocial factors and overweight has focused on factors associated with food choice and physical activity; effect on overweight has not been systematically investigated. It has been observed that while most children are inherently able to regulate their energy intake, about 10% appear unable to do so.[17, 139] One familial factor that has been related to inability of children to self-regulate food intake is related to inappropriate child feeding practices.[16] Restriction of food intake can lead children to have an increased desire for prohibited foods and to exhibit increased snacking.[67-69] Using food as a reward (e.g., giving a sweet treat to a child who has performed a desired behavior) tends to increase a child's preference for that food, whereas forcing a child to eat in order to obtain a reward (e.g., making a child finish her vegetables before she can be excused to play) tends to decrease a child's preference for that food.[18, 19] Likewise, living in a household with excessively strict rules on exercise and being forced to exercise have been related to relatively low levels of physical activity.[197, 223] On the other hand, excessively permissive child-feeding practices,

such as allowing children to snack at will, also appear to result in overeating.[17] *As child-feeding and physical activity promotion practices may have consequences opposite to those intended, teaching parents ways to improve parent-child interactions around eating, meal time and physical play is a likely area for successful overweight intervention*. It has been recommended that overweight prevention programs include more information to improve general parenting skills and focus less on an individual child's growth.[109] Positive feeding relationships involve parents actively using cues and information from children on the timing, amount, preference, and pacing of foods.[204] It is recommended that parents be responsible for selecting healthy foods and the manner in which these foods are presented, and children be allowed to select from the food choices and determine the quantity consumed.[203] Similarly, positive promotion of physical activity involves children being given latitude in their choice of type and extent of activity, and involves parental modeling of a physically active lifestyle.[125, 223]

Other Psychosocial Factors

Other parental and psychosocial factors, such as family communication, child self-esteem and child depression, have been examined with respect to child adiposity.[9, 25, 63, 77, 112, 116, 173, 233] While showing some association with overweight, these factors have not been conclusively evaluated with respect to overweight prevention. Potential sources of conflicting data include: an unclear direction of causality between weight and emotional status (e.g., overweight may contribute to poor self-esteem or poor self-esteem may contribute to overeating and weight gain); and psychosocial factors may relate to both overweight and underweight (e.g., poor self-esteem may be a risk factor for many types of disordered eating). A school-based approach used to successfully reduce the risk of disordered eating among adolescents focused on improving self-esteem and self-efficacy of students, as opposed to simply educating about eating disorders.[170] Improving self-efficacy for weight loss and eating behavior has also been effective in weight control among young adults.[21] Further, children who express a sense of self-efficacy and empowerment in attitudes towards physical activity have been shown to be more active.[228] Experts have voiced concern that programs addressing overweight and eating problems may inadvertently harm children psychologically or emotionally.[11, 169] In one overweight treatment study, for example, children aged 10-15 years had decreased self-esteem after enrollment in a 12-week weight management program.[31] O'Dea recommended that "Changing the focus from highlighting negative, problem-based issues to helping young people build self-esteem and enjoy healthy eating and regular enjoyable physical activity without developing a fear of food is the first step in establishing positive nutrition messages and school-based education programs which will do no harm."[169] *Providing health promoting environments and education, and empowering children to make healthy lifestyle choices are examples of strategies that need to be investigated for their effects on children's health outcomes*.

When Should Interventions Be Initiated?

As childhood is not a single homogeneous stage of life and numerous developmental changes occur between birth and adulthood, it is relevant to ask "at what age is overweight intervention among children optimal?" The answer to this question is clouded by the fact that analogous interventions to test relative efficacy have not been undertaken among different age groups. However, several other lines of evidence can be examined: tracking of overweight from childhood to adulthood, and success of interventions at various age groups. Not all overweight children remain overweight as adults. However, there are three periods during childhood characterized by an increased risk of developing overweight that persists into adulthood: prenatal period, adiposity rebound (preschool to early school age), and adolescence.[54] Based on the literature available, two conclusions are supported: 1) *intervening earlier is better than intervening later*; and 2) *intervening at numerous ages is better than intervening at a single developmental stage*.

Early onset of overweight may occur during the adiposity rebound period between the ages of 4 and 8 years. This period is characterized as the age at which adiposity, after a decline from infancy, reaches a nadir and begins to increase. Studies have shown that children that reach this nadir earlier experience a higher risk of overweight as adults, compared to children who rebound at a later age.[208, 244] The disappointing results of the comprehensive NIH supported Pathways intervention, aimed at reducing overweight among 3rd through 5th grade American Indian school children, have been blamed on the fact that the lifestyle habits that contributed to a high prevalence of overweight are difficult to change by this age.[27] Further, preschool and early school-age children are generally very receptive to messages about healthy eating and physical activity and can significantly benefit from age-appropriate health messages.[246]

Although many studies of children have shown that risk of adult overweight is greatest for those who are most overweight during adolescence,[94, 208, 245] by this stage a significant percentage of children are already overweight. For example, in the largest longitudinal study to date of a biracial cohort of girls, the majority of overweight 16- to 17-year-olds were already at risk or overweight by age 9 or 10 when the study was initiated.[123] Treatment of overweight that is already established is more difficult, more costly, and less effective than overweight prevention.[107] By adolescence, much of the consolidation of

physical activity and dietary patterns that will persist into adulthood has already occurred, resulting in habits that are more ingrained and resistant to change than would be the case for younger children.[118, 178] Further, a decline in physical activity and rise in less healthy eating habits associated with dieting, particularly among girls, becomes especially evident during adolescence.[23, 84, 115, 119, 122, 131, 182, 201, 230] Finally, treatment interventions targeting younger children have been more successful than those aimed at adolescents.[218] Therefore, *interventions that begin in early childhood are recommended*.

Low birth weight (LBW) and high birth weight (HBW) have both been associated with increased risk of developing overweight during childhood or adulthood.[140] While the evidence that a relationship exists between subsequent overweight and HBW is stronger than for LBW, it is clear that the in utero environment can have a lasting impact on an individual's health.[132] In this regard, *intervening to promote appropriate maternal nutrition and weight gain during pregnancy, and adequate treatment of gestational diabetes are warranted*. Early nutrition in the form of breastfeeding, in addition to providing numerous other well-documented advantages to both mother and baby, may also provide some protection against pediatric overweight.[81, 239]

What Lessons Have Been Learned From Overweight Intervention Studies?

Family involvement is critical to successful overweight intervention among children.[28, 62, 71, 82, 156, 180, 217, 220, 240] Parents control access to food and physical activity programs, as well as model behaviors involving food purchasing, preparation and consumption, TV viewing, and physical activity participation. In one intervention, although physical activity and dietary improvements at school were achieved, compensation at home occurred such that there was no net change in energy expenditure or intake and consequently no effect on children's weight status.[55] One of the reasons cited for the disappointing results of many school-based studies has been the failure to adequately incorporate lifestyle changes at home.[179, 217, 224] Reliance on take-home materials has been the extent of many past extensions to family. *A systems approach more fully integrating the child with family, school, health professionals and community is recommended*.[224]

Lifestyle interventions must be long-term. Limited length of overweight prevention programs is a reason frequently cited for failure.[158] Most previous overweight interventions among children have been short-term, that is less that one year, and when follow-up was performed have shown a rapid drop-off in physical activity or dietary change once the intervention program was discontinued.[104, 158] It is therefore unlikely that interventions targeting a single age period, even one identified to be most critical with respect to overweight development, will result in sustained effects. Encouraging is the long-term effectiveness in reducing overweight among children participating in intensive, long-term individual/family-based programs.[60] Therefore, interventions that incorporate "booster" messages or that can be continuously modified to be relevant for older age groups are recommended.

It has been proposed that to maximize effectiveness overweight interventions should be comprehensive and multifaceted.[218] Yet, most broad-based intervention programs aimed at promoting healthy lifestyles (e.g., reducing cardiovascular disease risk) have not proven to be very effective at reducing pediatric overweight.[185] Further, several well conducted school-based trials aimed at reducing overweight among children and modeled on this multi-component approach, most notably the Child and Adolescent Trial for Cardiovascular Health,[134] have yielded disappointing results. *It is now suggested that single behaviors be targeted in a comprehensive and multifaceted manner.* Possibly, children and their families have difficulty incorporating numerous lifestyle changes all at once and more targeted and simple-to-adopt messages may be more effective at reducing overweight. Therefore simpler messages (e.g., targeting replacement of TV viewing with more physical activities or replacement of calories from soda and other sweetened beverages with water) have appeal. Targeting healthy food choices for school food service price reductions is another example of an innovative and appealing approach.[76] A single health promoting behavior might be influenced at a variety of levels: parents and families, preschool and day care, elementary and secondary school, the community.

In addition to education, early development of health promoting habits and a health promoting environment are necessary. Greater parental nutrition knowledge has been related to a lower risk of overweight among children.[237] There is an apparent need for increased health and overweight-related knowledge among both parents[13, 109] and children.[50, 113, 159] Education and public health messages with limited duration and outreach are diluted by for-profit advertisements of less healthy diet and physical activity options. In 1995 alone, $2.5 billion was spent in advertising by the top six fast food franchises in the US, an amount roughly equivalent to $10 for every citizen.[111] This expenditure, sizeable as it is, represents only the tip of the advertising barrel and yet dwarfs the public health monies spent to promote healthy eating and exercise behaviors. However, education alone is typically insufficient motivation for lifestyle change.[37, 104, 157, 158, 205, 242] Children must be equipped not only with the "know what" but the "know how"; they must not only be instructed to adopt more physically active lifestyles and healthy eating patterns, but also be provided with the tools to achieve these changes and a health promoting environment that makes these changes realistic and sustainable.[162] For example, one reason nutrition education

alone has not been very effective in inducing behavior change may be the large influence of food preference on food choice among children.[75, 153] Repeated exposure to new and healthy alternative foods may be necessary in order to change what children like to eat.[101] Child[106] and adult[176] consumers have also reported that they are tired of messages about unhealthy food or felt that eating low-fat foods took the pleasure out of eating. Focusing on the positive behaviors to adopt (e.g., increasing fruit and vegetable intake), rather than the negative behaviors to avoid (e.g., decreasing fat and sugar intake) may be a useful approach.[59a] Children have been shown to choose healthful alternatives when they are consistently available, tasty, appealing, and attractively or creatively served.[48, 243] Similarly, reasons cited for children not being more physically active include high cost, limited accessibility and lack of transportation, competitive nature of most programs designed for children, and lack of safe places for children to play without parent supervision.[35] Barriers to physical activity may be overcome and motivators employed by designing activities that are desirable, non-competitive, fun, and achievable by children with a wide range of skills and physical abilities.[198] Ignoring consumer demand for quick, easy, low-cost and attractive alternatives to current dietary and physical activity habits is a recipe for failure.

Cultural and gender-specific behaviors should also be addressed when designing interventions. Childhood overweight may be seen as a marker for high-risk dietary and physical inactivity practices. As recent increases in the prevalence of overweight among American children are not limited to one age, gender, or ethnic group, unique causal behaviors among members of various ethnic subgroups of the population are unlikely to be the major contributing factors.[40] Rather, environmental changes promoting increased energy intake and decreased energy output are occurring and have widespread impact on children from various backgrounds. Yet, specific barriers to program implementation may vary for different ethnic groups. For example, based on focus group interviews, concern about physical appearance was noted as a major barrier to physical activity among middle school African American and Hispanic girls; the primary reason for avoiding exercise was to avoid messing hair and make-up.[127] Additional barriers included self-consciousness when exercising in the presence of boys and feeling that boys, because of their size and athletic abilities, received preferential treatment from male PE teachers. The circumstances and needs of the individuals should be addressed and age, gender, educational level, socioeconomic status, and cultural sensitivity of the intervention should be considered.

Summary - What Should be Done?

The environment throughout childhood has a potent influence on the development and maintenance of a child's body weight. Modifiable risk factors deserve early attention, given the health implications and the high likelihood in the US of developing overweight during childhood. Rather than weight, healthy lifestyle should be used to evaluate the success of overweight prevention programs. *Interventions should target specific behaviors and begin early, be multi-level, and be multi-age in design.* Early interventions targeting toddler and early childhood diet and physical activity should be followed by booster interventions in elementary years and beyond. Interventions should seek to increase length of time spent in PE, increase availability and participation in desirable physical activities and programs, decrease sedentary behaviors such as TV viewing, decrease accessibility to high fat, high sugar, calorically dense foods and beverages, and improve accessibility to tasty and attractive healthy food alternatives. Because the habits of children are largely developed and maintained in the home, parents and families must be integrally involved if diet and physical activity improvements are to be effective and sustainable. Providing general parenting skills and promoting positive parental modeling of healthy lifestyle behaviors appear critical to success. Further, interventions should be tailored to respond to consumer demands including the culture and gender-specific needs of children and their families. Based on a review of the literature, opportunities for overweight prevention occur in each setting below.

Parents and Families –

- Provide classes and support groups where parents can explore ways to help their children improve their diets, increase physical activity, and decrease TV viewing.
- Form partnerships with parents to work toward changes in the schools and communities that support their efforts to prevent child overweight.
- Work with parents to overcome their own issues and struggles with weight and body image.
- In classes with parents emphasize "problem solving", rather than "information giving".
- Include the topics of: developmentally appropriate feeding and physical activity practices, limit setting, communication skills, and modeling of healthy behaviors.
- Engage parents prior to, or early in, parenthood.
- Provide education on maternal nutrition and weight gain during pregnancy.

Preschool and Day Care –

- Work with providers to create policies and an environment in their institutions (or home setting) that enable them to model and encourage healthy behaviors.

- Provider education and training should include topics such as: developmentally appropriate healthful meals and snacks and physically active play; the importance of the preschool ages as critical for the development of healthy habits; how to foster self-esteem and positive body image; how to work successfully with parents.
- Work with providers on their own issues and concerns related to weight and body image.

Elementary and Secondary School –

- Establish strong linkages between health promotion activities at school and home.
- Integrate health promotion into the curriculum so that booster interventions are provided throughout the grade levels.
- Require increased weekly PE hours.
- Provide increased opportunities for engaging in fun, non-competitive activities suitable for children of diverse interest levels and physical abilities in PE and after school leisure services programs.
- Reduce or eliminate vending machines and other sources of unhealthy snack foods and sweetened beverages and replace them with a selection of healthy alternatives.
- Improve the affordability of fruits and vegetables and increase the cost of less healthy alternatives, thus minimizing effects on food service revenues.
- Reduce access to and availability of fast foods and fast food establishments – both on and off campus.
- Involve food service directors, students, parents, teachers and other stakeholders in development and implementation of policy and environmental changes to maximize acceptance and minimize unintentional consequences on other services.

Community –

- Make health promoting foods readily available and affordable (e.g., increase availability of fruits and vegetables).
- Provide incentives to restaurants and fast food establishments that offer and promote healthy foods and reasonable portion sizes.
- Improve safety of and access to parks and other recreation areas.
- Promote zoning that requires neighborhood sidewalks.
- Support community efforts to increase availability of physical activity resources (e.g., walking trails, lights on tennis courts).
- Counteract unhealthy media messages, particularly those targeting children and their families.

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