Special Article

Pathways to Obesity Prevention: Report of a National Institutes of Health Workshop[1]

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Abstract

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There is an extensive research base on obesity treatment and on the health benefits of weight loss, but relatively little research has focused on obesity prevention. This article summarizes results of a workshop conducted by investigators funded under a National Institutes of Health initiative designed to stimulate novel research for obesity prevention. The 20 pilot studies funded under this initiative involved study populations that were diverse with respect to life stage and ethnicity, were conducted in a variety of natural and research settings, and involved a mix of interventions, including face-to-face group and individual counseling, as well as mail, telephone, and internet-based approaches. The workshop, which occurred approximately halfway through the 3-year funding period, emphasized concepts and experiences related to initiating and conducting obesity prevention studies. Investigators discussed theoretical perspectives as well as various challenges encountered, for example, in study implementation in different clinical and community settings, in working with children and families, and in studying pregnant and postpartum women. Other topics discussed included the difficulty of motivating individuals for prevention of weight gain, relevant cultural and racial/ethnic considerations, and the particular need for valid and practical measures of energy balance, body composition, and physical fitness in obesity prevention research. A key conclusion was that using obesity treatment as the primary paradigm may be a limiting perspective for considering obesity prevention issues. Further insights derived from the workshop deliberations are reflected in a detailed list of recommendations for future obesity prevention research.

Key words: health promotion, children, families, interventions, weight control

Introduction

Apart from the continuing study of how to improve success in treating those who are already obese (1–3), the prevention of obesity has risen to the top of the list of public health priorities (4). The proportion of children and adults who are obese has already reached alarming levels (5–8), particularly in some ethnic and socioeconomic status groups (4,6–9). Reliance on treatment approaches, even if fully effective, is neither practical nor desirable (4,10,11). The burden of obesity in the population, particularly when certain high-risk and currently underserved populations are considered, is likely to exceed the capacity of the health care delivery system to deliver such treatment either for obesity itself or for the associated conditions (12). Furthermore, obesity treatment cannot necessarily remove or reverse the adverse effects of obesity on health status and quality of life, particularly for obesity of long duration (1,13).

Although effective interventions for obesity prevention may share some similarities with those used for weight loss, the science of obesity prevention—which includes identification of those aspects that are unique to prevention compared with treatment—is only now emerging. This article summarizes the results of an inaugural workshop on scientific directions in obesity prevention convened by NIH in August 2001. The core participants and workshop planners were investigators funded under a special NIH initiative for obesity prevention studies (14) and scientific program staff from the participating NIH institutes. Several principal investigators of other relevant studies were also invited. Workshop objectives were 1) to exchange information on study designs used to addresses obesity prevention issues and on the lessons learned in the early stages of protocol implementation; 2) to identify the ways in which these studies advance the science of obesity prevention and treat-

[1] The online version of this article (available at http://www.obesityresearch.org) contains an appendix that includes principal investigators and project descriptions.

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ment; and 3) to derive insights about long-term goals and future directions for obesity prevention research. This report presents the main workshop findings in order to reinforce the need for research in this area, provoke thinking about new directions, and attract investigators with diverse perspectives and expertise to participate in this line of research as it evolves.

Background

Funding to Stimulate Obesity Prevention Research

The limited amount of research with obesity prevention as the stated outcome of interest is far from adequate to address this major public health problem, even when this area of research is defined broadly to include the cardiovascular disease prevention studies in which obesity was one of several outcomes addressed (15,16). In 1998, when the NIH obesity prevention research initiative was being developed, the research base included only a few published studies of obesity prevention in adults (17–19), small pilot studies in children (20,21), a small number of school-based studies (22–24), and some research in progress (25). The funding initiative described here (14) was developed to stimulate novel research into methods to prevent obesity, beginning with pilot studies limited to 3 years in duration and $125,000 in direct costs per year. The request for applications (RFA)[2] specified a comprehensive set of obesity prevention outcomes: prevention of weight gain in children and adults who are not yet overweight; treatment of overweight children to prevent obesity in adulthood; prevention of weight regain after weight loss in obese children and adults; prevention of further weight gain in overweight adults; and weight control for pregnancy and the postpartum period. Attention to segments of the U.S. population that are particularly vulnerable to obesity, e.g., ethnic minority populations, was also encouraged. To ensure high-quality research and rigor in research design, the RFA specified that interventions be based on behavior change theory and that a comparison group be followed, with random assignment to the intervention and comparison conditions preferred.

Twenty research projects were funded as a result of this initiative, through grants from five different NIH institutes, with supplementary funding from other federal agencies or offices. The projects were diverse in terms of study populations, research questions, outcomes targeted, intervention goals and approaches, and settings. Eight studies focused on children or adolescents, ranging in age from 1 to 16 years, and their caregivers, and they were reached through WIC programs (Supplemental Nutrition Program for Women, Infants, and Children), day care or school settings, medical centers, churches, and homes, with group and individual education and counseling and internet approaches. The other 12 studies were in adults, reached in medical, worksite, community, or home settings and through the internet. Some studies focused specifically on women and some on high-risk periods for weight gain, such as the postpartum or perimenopausal period or after smoking cessation. The degree of selectivity for weight status, e.g., broad weight range, normal weight only, or obese only, varied. The studies were conducted in several U.S. regions, with some in rural populations, and approximately one-half focused on or included substantial numbers of African-American or Latino/Hispanic participants.

[2] Nonstandard abbreviation: RFA, request for application.

Workshop Planning and Format

This first investigators' workshop took place approximately midway during the 3-year funding period and, therefore, focused on study design and implementation. Each principal investigator was asked to provide, in a standardized format, basic information about his or her project, including study design, sample size, population target in terms of age, sex, and ethnicity, and intervention description, to be compiled for distribution to workshop attendees. Principal investigators were also assigned to one or more working groups (termed panels), charged with developing workshop content around six themes (see the listing of panels in Table 1). The panels were asked to comment on certain general issues, as well as on specific challenges relevant to the assigned perspective, e.g., the nature of the research setting (panel 1), study population (panels 2 and 4), intervention focus (panels 3 and 5), and intervention approach (panel 6). Panels met by conference call during the months before the workshop and were given 30 minutes to present their findings at the 1-day workshop. The workshop chair (the first author of this article) synthesized overall findings and impressions in a closing summary.

Findings

As shown in Table 1, the types of issues and challenges identified differed across the different thematic foci. The panel that considered issues specific to working with organizations brought together investigators working with churches, primary care clinics, schools, day care centers, federal feeding program sites, and a not-for-profit women's health organization. In each case, the setting was viewed by the investigators as a venue for reaching the population of interest with the intention of incorporating the obesity prevention services into the ongoing program or service delivery framework. These studies were not designed to be "participatory action research" (26). In participatory action research, a key aspect of the study design is giving community or organizational partners a major role in shaping the research agenda and process and interpreting study findings. Rather, partnering organizations were asked to add obesity prevention to their primary agendas. However, even

Table 1. Focus and key issues and challenges identified by the six panels of investigators at the Obesity Prevention Workshop

Panel (Theme)	Relevant studies*	Key issues and challenges
(1) Clinical or community settings	• "Effect of Active-Play on Obese At-risk Toddlers" (Sanborn; #1) • "Brocodile the Crocodile: Obesity Prevention in Day Care (Dennison; #2) • "Girls Rule!: Obesity Prevention for African American Girls" (Ammerman; #4) • "Community Steps for Minority Youth Fitness" (Yancey; #5) • "Weight Control for Black Women's Cardiovascular Health" (Kumanyika; #9) • "Primary Care Office Management of Obesity" (Martin; #14)	• Investigators had limited control over program environment or process compared to experimental settings. • Obesity prevention was usually not the primary agenda for either staff or clients • Programmatic approach and timetable needed to accommodate changes in organizational staff, policy, or budget, or unanticipated shifts in the size or needs of the client population • Differences in policies or organizational capabilities across sites within the same project posed implementation problems.
(2) Families	• "Family-based Interventions: Preschool Children & Parents" (St. Jeor; #3) • "Community Steps for Minority Youth Fitness" (Yancey; #5) • "Internet-based Obesity Prevention for Black Adolescent" (Williamson; #6) • "Peer-based Skills Training to Enhance Teen Weight Loss" (Jelalian; #7)	• Nutrition and physical messages should be positive, promoting healthy growth • Approach should avoid labeling the child as obese and should consider how parents define and perceive overweight and obesity in their children • Optimum level of parental involvement, appropriate for the child's age and developmental stage, should be clearly defined from both theoretical and practical perspectives • Participation in time-consuming intervention activities may not be feasible for busy parents • Both complexity and amount of information to be delivered should be considered carefully • Design considerations for family-based weight management interventions include interactions among family members (e.g., parenting styles or skills, sibling or spousal interactions, and family members as role models) • Motivations of parents and family members may be mixed, particularly depending on whether they have to meet weight eligibility criteria and whether their own weight is also a focus of the intervention
(3) Preventing weight gain	• "Family-based Interventions: Preschool Children & Parents" (St. Jeor; #3) • "Weight Control for Black Women's Cardiovascular Health" (Kumanyika; #9) • Obesity Prevention After Smoking Cessation in Menopause" (Geiselman; #18) • Weight Control in Peri- and Early Postmenopausal Women" (Racette; #20)	• If the anticipated change in the intervention group is no weight gain, then the ability to observe significant treatment effects depends on adverse weight changes that may occur in the comparison group, which are difficult to predict ahead of time to inform study design • In circumstances where major adverse weight gain would be expected in the comparison group, an intervention must be offered to that group on ethical grounds, although this tends to diminish the intervention minus control difference

Table 1. (Continued)

Panel (Theme)	Relevant studies*	Key issues and challenges
		• Effect sizes in studies where no weight gain is the targeted outcome are smaller than when the targeted outcome is a major weight loss; hence, prevention studies have relatively large sample size requirements • More incentives for both recruitment and attendance may be needed for obesity prevention programs compared to programs in which the outcome (weight loss) is itself more motivating. • Because not all participants in preventive interventions may need to lose weight and because preventive behaviors must be maintained indefinitely, the messages in obesity prevention programs should focus on food intake and physical activity behaviors that can be recommended for permanent adoption. • The ability to counsel for balancing day-to-day energy intake and output is much more challenging than counseling to create an energy deficit, particularly given the difficulty of accurate self-assessment of whether one is on track for making the small reductions.
(4) Pregnancy and postpartum period	• "Weight Gain in Pregnancy: Staying in the Range" (Olson; #15) • "Internet-Aided Prevention of Pregnancy Induced Obesity" (Lovejoy; #16) • "Mothers' Overweight Management Study" (Krummel; #17)	• Weight gain prevention programs directed to pregnant women must be guided by obstetrical standards for appropriate weight gain during pregnancy as well as by the potential consequences of excess pregnancy-related weight gain and post-partum weight retention to longer term maternal health. • The prenatal care period is more feasible than the immediate postpartum period for obesity prevention interventions but may be unable to effectively address postpartum weight management. • Interest in nutrition and weight counseling may be high among pregnant women; however, organizing programs to provide the desired content in a timely manner once a woman enrolls in prenatal care can be challenging. • The main challenges in intervening with postpartum women are synchronization of the intervention program with other postpartum services and working around the time constraints of new mothers.
(5) Weight maintenance	• "A Mentor-based Approach to Long-Term Weight Loss" (Jakicic; #10) • "A Nutritional Approach to Weight Loss Maintenance" (Lowe; #11)	• The weight loss component of the program should be of sufficient quantity and quality to promote maximum weight loss. • The weight loss and weight maintenance phases should be clearly differentiated.

Table 1. (Continued)

Panel (Theme)	Relevant studies*	Key issues and challenges
	• "Weight Connection: Weight Loss Maintenance Using the Web" (Kaplan; #12) • "Profile-based, Internet-linked Obesity Prevention Trial" (Going; #13) • "Hormone Replacement for Prevention of Visceral Obesity" (Poelhman; #19) • "Weight Control in Peri- and Early Postmenopausal Women" (Racette; #20)	• Several complementary strategies may be useful in making an effective transition to maintenance, including a gradual increase in caloric intake goals to the level appropriate for maintenance, continuing the use of meal replacements, maintaining a tapering frequency of contact through various media (e.g., group meetings, individual counseling, telephone, mail, and internet), and training some participants for leadership roles as peer group leaders or mentors.
(6) Internet	• "Internet-based Obesity Prevention for Black Adolescent" (Williamson; #6) • "Weight Connection: Weight Loss Maintenance Using the Web" (Kaplan; #12) • "Profile-based, Internet-linked Obesity Prevention Trial" (Going; #13) • "Internet-Aided Prevention of Pregnancy Induced Obesity" (Lovejoy; #16)	• Advantages of internet-based programs include the ease of updating them and their versatility as cost-effective ways to provide ongoing support either as a stand-alone or to enhance counseling by interventionists • Several challenges related to internet programs are: — Translating program content into internet applications — Designing websites that will be appealing to the intended audience — Motivating participants to maintain long-term participation over the internet — Availability of computer access for participants and participants' need for training — Readiness of the study population to use the internet — Staff time and resources required to tailor programs and to provide a short response time (e.g., via email) — Procedures to assure the validity and security of data collected through the internet. • Potential problems with internet approaches to obesity prevention are that they may inadvertently encourage sedentariness and discourage relevant social interactions.
All panels (see text for findings)	• Underlying behavioral/theoretical framework • Cultural and racial/ethnic factors • Relevance and feasibility of various physiological measurements for clarifying mechanisms of obesity prevention • Recommendations for future research	

* These themes were not mutually exclusive but rather posed different perspectives from which to examine research content. Some projects were assigned to more than one theme panel. The name of the principal investigator and number of the project description, as listed in the online appendix, are given in parentheses after the project title.

when partnering organizations and investigators were highly committed to the study and agreed that it was desirable for the research project to hold constant certain program-related variables, often this was not possible.

In some cases, considerable ingenuity and flexibility were required for investigators to meet their aims. However, there was a sense that these scenarios reflected the "real world" and that the more rigorous, but also somewhat contrived, research setting in which the investigator had more control could not truly reflect the context for prevention. The issue of unbudgeted but necessary costs was considered critical. For example, some in-kind contributions originally offered by the partnering organizations (e.g., contributed staff time or equipment) ultimately proved unfeasible and had to be covered from the research budget. Also, compensation to clients for the extra burdens associated with data collection that was strictly for research purposes was sometimes required even if not included in the original research budget. The lack of client motivation for weight control relative to that usually assumed in obesity treatment settings was felt to have significant potential implications for how obesity prevention interventions in natural settings are formulated. Strategies for linking the obesity prevention program to the usual services and for fostering motivation for obesity prevention are needed.

Investigators attempting obesity prevention in family settings were all focused on children or adolescents. The ability to reach children in family settings was viewed as attractive for numerous reasons. Children and adolescents are a prime audience for obesity prevention, and one can conceive of numerous ways that families influence child and adolescent eating and physical activity behaviors. The possibility that other family members will benefit from the intervention content and process is another positive feature of family-based programs. However, the potential to benefit other family members or work through them to achieve weight gain prevention goals essentially means that all of these individuals are intervention participants at some level. Their motivations and practical concerns must be addressed.

Of the interventions involving prevention of weight gain, one investigator focused on women at high risk for weight gain because of life stage (perimenopausal or early postmenopausal), whereas others targeted weight gain prevention in high-risk situations or population groups, and one focused on children. As shown in Table 1, the issues and challenges identified by this panel included the type of messages used in recruitment and intervention, e.g., whether these were different from those that one would use in a program targeting weight loss, and design problems arising from the fact that the outcome for prevention is essentially that there be no change (or—in the case of children—no deviation from norms) in the active intervention group. The behavioral counseling objective of prevention programs was considered particularly difficult. Whereas obesity treatment programs may advise certain behavior modifications that are not sustainable but nevertheless could be adopted for a limited period to achieve a desired amount of weight loss, obesity prevention programs must promote life-long sustainable behaviors. With respect to counseling for day-to-day energy balance, it was suggested that it might be more effective to advise periodic cycles of modest weight reduction to balance out expected periods of transient weight gain. However, with such an approach, one would need to guard carefully against the potential for rebound weight regain.

Investigators involved in interventions for pregnant and postpartum women provided an overview of the guidelines for evaluating appropriate weight gain and weight retention, respectively, in pregnancy and postpartum, noting the variability in the extent to which individual women or subgroups of women achieve the recommended pattern of pregnancy-related weight gain and subsequent weight loss in the postpartum period. In the two studies that were linked to prenatal counseling settings, interest in the intervention was relatively high, particularly for those who were over age 31 years and who had more than a high school education. Different types of challenges were encountered in mounting prenatal and postpartum interventions, and the prenatal programs were apparently more feasible. Postpartum interventions must also consider the possibility of a subsequent pregnancy that would contraindicate further weight loss.

In keeping with the scope of the RFA, some investigators focused on the prevention of weight gain after weight loss. Techniques studied for maintenance effects (i.e., hormone replacement therapy, enhanced self monitoring, low-caloric density foods, and web-based strategies) were sometimes incorporated into the weight loss phase and then continued in maintenance. Other studies introduced the maintenance interventions (web-based strategies or assignment to mentor other individuals engaged in the initial phase of weight loss) after the initial weight loss phase.

Four of the pilot studies involved internet-based components as a novel way of implementing proven approaches to achieving weight loss or maintenance. All included face-to-face counseling as part of the initial program. Internet approaches may be able to support self-directed and individualized behavior change, can be used for frequent monitoring and long-distance intervention, and can provide links to related information. Possible formats include self-guided tutorials involving text, audio, or video; tools designed for self-monitoring of diet, physical activity, or weight; tools for individualized goal setting or planning (e.g., recipes or menus); and interactive tools for ongoing counselor-client or peer-to-peer support, such as bulletin boards, chat rooms, or e-mail. Investigators involved in these interventions weighed the several advantages against disadvantages such as the burden on staff, technical issues associated with web

program design and internet providers, and inherent contradictions such as having people sit at a computer to be motivated for physical activity.

Cross-Cutting Issues

As shown at the end of Table 1, investigators in each panel were also asked to consider theoretical frameworks, cultural and racial/ethnic factors, and physiological measurements—factors that potentially influence all types of obesity research—from the specific perspective of obesity prevention studies and to derive research recommendations based on their experiences to date. Key findings related to these cross-cutting issues, as well as recommendations, are summarized in this section.

Theoretical Frameworks. Although most interventions were guided by adaptations of social cognitive theory (27,28) and the Transtheoretical Model (29), several other theoretical and conceptual frameworks were used as reference points for problem identification and interpretation of process and outcomes. Particularly relevant to community and organizational settings were Green's PRECEDE-PROCEED (respectively, for Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation and Policy, Regulatory, and Organization Constructs in Educational and Environmental Development) Model, which guides systematic, theory-based planning of community-based health interventions (30); the Spectrum of Prevention framework that highlights the importance of "upstream" strategies such as changing community or organizational environments, practices, and policies in addition to direct "downstream" interventions to improve individual knowledge and skills (31); socioecologic theory, which emphasizes the multilevel and interactive forces influencing effective health promotion strategies (32,33); and guidelines for selecting organizations for academic-community partnerships (34).

Frameworks to guide culturally focused interventions included Airhihenbuwa's PEN-3 model (35), a tool for thinking through cultural influences on health behaviors and planning culturally appropriate health education programs; conceptual models of cultural influences in weight reduction program delivery and outcomes (36); Learning Theory, specifically the context-dependency of conditioned behaviors and the ability to re-condition or extinguish them (37); and principles of tailoring to subgroups (38). One project involving intervention during smoking cessation, a physiologically high-risk period for weight gain, was guided by theories of neuroendocrine influences on appetite regulation and food cravings (39,40). Another included the concept of foods classified in terms of their energy density as a tool to facilitate control over caloric intake (41,42). Family-based interventions were guided by selected theories of child development and models of family organization and process that included conflict resolution, communication patterns, and parenting style (43). Reference also was made to the comprehensive model of determinants of physical activity and eating behavior developed by the Partnership to Promote Healthy Eating and Active Living (44).

The absence of reference to formal theories of organizational behavior and change was noteworthy considering the apparent strong influence of organizational processes and characteristics on the ability to implement the interventions based in community organizations, agencies, schools, or clinical practices. More deliberate attention to organizational systems may benefit interventions in natural settings, e.g., to better anticipate and respond appropriately to changes in staff, policy, procedures, and budget that have implications for maintaining the integrity of the study design or implementation.

Race/Ethnicity and Culture. Numerous variables linked to race/ethnicity and culture were also identified as highly relevant to obesity prevention research. For example, the perceived need for weight control may be culture specific. Parenting styles and views of appropriate ways to feed and interact with children around food are culturally influenced. Cultural perceptions of menopause vary, and the experience of menopause, therefore, varies among women in different ethnic groups. Not all investigators had necessarily identified cultural considerations during the design or implementation phases of their studies, primarily because explicit attention to such issues is commonly viewed as applying only to racial/ethnic minority populations. However, in reflecting on the multiplicity of cultural aspects of obesity in all populations, cultural variables potentially influencing obesity prevention among even white study populations were identified—particularly for women. For, example, the culture of dieting and "quick fix" approaches to weight loss may have influenced responsiveness to a prevention message. Also, concerns about culturally driven body image problems or eating disorders are continuing issues for those designing obesity prevention programs for children and adolescents.

To the extent that cultural considerations require tailoring of interventions to study populations and individuals, the importance of also attending to considerations of age, gender, and income or education level was noted. The overlap among these variables was also discussed; for example, social disadvantage in terms of important variables such as food purchasing power or access to health care occurs disproportionately in minority populations. Moreover, disadvantaged populations are generally at higher risk for a range of health problems, rendering obesity prevention less likely to win out over a set of competing priorities.

Investigators conducting studies in minority or multiethnic populations contributed numerous insights about relevant program design and implementation issues. The importance of formative data collection in identifying important cultural variables was highlighted, as was the need

to build on existing traditions with respect to food, music, and types of activities, rather than attempt to "force-fit" participants into a preconceived model. The approach of embedding the program within an existing ethnic community institution or organization—as in two of the studies (one church-based and one based within a women's organization)—was viewed as the most far-reaching attempt to provide for cultural congruency and sustainability. Some additional challenges emanating from the "outsider" status of nonminority investigators with respect to the minority community were noted, as well as the complexities of helping "insiders," i.e., staff hired from minority communities, to balance their dual loyalties (e.g., to the research team and to their community of reference) and contribute unique insights from their combined "insider-outsider" status.

The importance of cultural adaptation of all aspects of the study or program was emphasized. For example, the manner of recruitment and the venue for both data collection and intervention should be appropriate for the population in question. Within the intervention, the content, e.g., with respect to terminology, language, symbolism, role models, and choice of incentives, should respect and match that of the client population. The critical importance of attending to within-group diversity, including the bicultural or multicultural perspectives of many in minority populations, was also stressed. One suggestion, particularly in relation to ethnically mixed study populations, was to supplement group counseling with periodic individual sessions during which culture-specific influences can be identified and addressed.

Physiological Assessments. The need to assess energy balance, body composition or body fat distribution, and physical fitness, as important processes or outcomes of obesity prevention studies, was viewed as particularly challenging because of feasibility issues associated with collecting measurements (e.g., DXA) in field settings. Community settings were considered favorable for accessing study populations reflective of the general public and for conducting of prevention research using less "medicalized" approaches, but with clear disadvantages in terms of transporting equipment, ensuring safety, and ensuring quality control of measurements. Another difficult-to-resolve issue was the choice of specific physiological measures for studies in children, because this depends on factors such as the time needed to perform the measurement, as well as the developmental stage of the child. The cost of physiological measurements was considered to be a major potential barrier considering that obesity prevention studies already tend to be labor intensive and costly. The need to collect blood was seen as a major potential barrier when trying to design prevention studies outside of medical settings and outside of a clinical paradigm, although some of the investigators felt strongly that data on obesity-related risk factors such as blood pressure, cholesterol, glucose, or insulin should also be obtained whenever possible to ascertain the clinical effects of changes in weight and body composition under conditions of obesity prevention.

Directions for Future Intervention Research

Specific recommendations about research directions are in Table 2. The overall sense of these recommendations was that more creative and diverse interventions should be studied, including attempts to find effective societal and policy-level interventions, that the science of obesity prevention should follow more systematically from observations about determinants of weight gain and weight maintenance, and that approaches tested should build more specifically on what we already know. Both theory and methodology to support obesity prevention research require elaboration. Theories should incorporate all of the relevant perspectives or levels, e.g., societal, organizational, and familial, as well as individual.

Conclusions

The overarching question addressed by the workshop was how these studies, when taken together, will advance the science of obesity prevention research. Implicit in the workshop and, more fundamentally, in the RFA itself, was the use of the current base of obesity research—which is *treatment*-oriented—as the reference point both for formulating the research and also for judging the quality and success of the studies that were ultimately funded. Workshop deliberations revealed some fundamental differences between studying obesity treatment and studying obesity prevention. Prevention research is inherently more applied and more interdisciplinary than treatment-oriented research (26). Consistent with this, and different from what might be encountered within the obesity treatment field, this obesity prevention research initiative attracted principal investigators with very diverse disciplinary and content area perspectives: nutrition education and communications; public health practice; exercise physiology; physiology of aging; dietetics; nutritional epidemiology; minority health; maternal and child nutrition; and psychology and other social and behavioral sciences.

The differences in the potential study populations targeted in obesity prevention vs. treatment were also striking. Compared with the populations with strong motivations to lose weight that are identified, for example, when recruiting study participants for weight loss studies, there was no clear sense of a population clamoring for preventive interventions. Thus, an important insight from this workshop was that, to flourish both scientifically and practically, obesity prevention research cannot be viewed simply as an extension of obesity treatment research but also, and perhaps primarily, as a type of *prevention research.* This concept is shown schematically in Figure 1. Comparing view A to view B highlights this distinction. View B acknowledges

Table 2. Directions for future obesity prevention research identified by the NIH Pilot Studies Investigators

Expand the types of interventions to be tested to prevent obesity and promote weight control and long-term maintenance of weight loss	Explore approaches such as participatory action research that encourage community input and have an influence on intervention design and content.
	Develop and test interventions that target multiple societal levels, individual-based interventions, and their combination, to determine whether public health and individual approaches are interactive.
	Develop and test environmental strategies (in homes, organizations, work sites, neighborhoods), including policy changes.
	Develop and test family-based interventions and interventions in the primary health care setting, including physician incentives.
Conduct research to improve efficacy of interventions for obesity prevention and long term weight control programs.	Determine optimal intervention duration, frequency, and mode of delivery (group or individual face-to-face contact, telephone, mail, internet).
	Use highly controlled study designs to determine optimal physical activity and dietary prescriptions in adults and in children and adolescents.
	Determine the optimal use of meal replacements for weight loss and its long-term maintenance.
	Test interactive effects of genetic and/or psychosocial predictors of obesity by stratifying study participants on these factors.
	Explore and describe approaches to intervention by internet, alone and in combination with other intervention strategies. Gather information on the "dose" of intervention the internet provides and the ability of the internet to enhance motivation and adherence to interventions.
Conduct observational studies to guide interventions for obesity prevention, weight control, and long-term maintenance of weight loss.	Identify physiological and behavioral characteristics that put individuals at risk for weight gain.
	Identify physiological and psychosocial characteristics and other predictors of success in intervention programs.
	Identify barriers to enrolling and participating in weight control programs.
	Identify approaches and strategies to enhance motivation and adherence to intervention in children and adolescents, women during the prenatal and postpartum period, and other populations.
Use theoretical models to design obesity prevention interventions.	Incorporate theoretical perspectives from other areas of research in the conceptualization and design of obesity prevention studies; for example, family systems theory, and organizational behavior theory.
	Conduct studies in which obesity prevention objectives are integrated with other types of health promotion or behavior change objectives.
	Develop more systematic concepts of how interventions can be tailored to specific behaviors, populations, and contexts.
Conduct research to improve measurement methodology for obesity prevention research.	Develop valid and affordable energy balance measurements suitable for large-scale trials outside of clinical settings.
	Identify psychosocial measures most relevant for obesity research and explore whether these psychosocial measures can be standardized and used in weight control trials.
	Determine a health-related and functional definition of obesity in children.

the inherent relationship of obesity prevention to the larger obesity research field but also indicates the importance of bringing to bear on obesity prevention research the domain of "prevention science" as it has evolved in relation to many other behaviors (16,45). As summarized by Scrimshaw et al. in a discussion of the meaning and value of prevention research, what constitutes prevention is in the eye of the beholder (26). Those who are treatment-oriented see prevention as that part of the continuum related to preventing complications and death. Those who are public health-

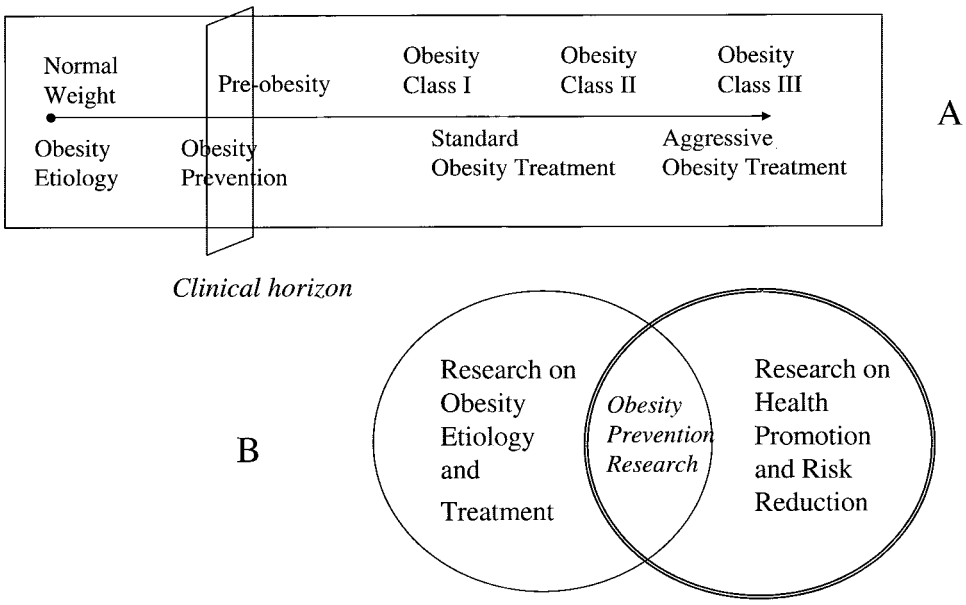

Figure 1: Views of obesity prevention and obesity prevention research. In view A, obesity prevention is essentially conceptualized as treatment of subclinical obesity. In view B, obesity prevention can be viewed as combining knowledge from the obesity research field with knowledge and strategies from the broader field of health promotion, i.e., in the same domain as prevention of risky behaviors such as smoking, alcohol, and drug abuse or unsafe sex in the general population.

oriented see prevention as protecting the population at large from the forces that cause disease. The public health focus is especially applicable to the prevention of widespread obesity.

Workshop participants identified a need to better specify the qualitative distinctions between obesity treatment and obesity prevention. If viewed as a subtype of obesity treatment, obesity prevention is inherently disadvantaged with respect to the motivation of the client population, the problems with conducting treatment outside of settings designed for this purpose, and the effect size that can be detected after a successful intervention. Figure 1 (view B) also illustrates the potential relevance of prevention-related research in other behavioral domains to the issue of obesity. Challenges faced in many of these obesity prevention studies have a striking similarity to research issues that are well known to those studying models for substance abuse prevention, HIV/AIDS prevention, or smoking cessation, particularly the difficulties of maintaining experimental designs in natural settings that can neither be standardized nor structured for the delivery of standardized treatments, the need to meet people in the community much more than "halfway" to keep the research going (45–47), the unique ethical dilemmas associated with preventive interventions (48), and the obligations associated with research intended to inform public health policy (49). This is not to overstate the extent to which the domain called "prevention research" has been established on solid footing but rather to point out that obesity prevention research has at least as much in common with other research that aims to promote health in the general population as it does with obesity intervention research focused on treatment. A key insight from this workshop was, therefore, that using obesity treatment as the primary paradigm may be limiting our ability to develop effective obesity prevention approaches. Movement toward a paradigm that will inform creative and powerful obesity prevention research is critically needed to address the challenging and now urgent research needs in this field.

NIH convened a second investigators' workshop in August 2002 to focus on the research results and develop further overarching conclusions about advancing the science of obesity prevention research (50). This second workshop, which was informed by work completed or in progress as well as by an invited speaker from the broader prevention research field, reaffirmed the early insights reported here.

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