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Intergenerational Energy Balance Interventions: A Systematic Literature Review

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Abstract

Many nations have witnessed a dramatic increase in the prevalence of obesity and overweight across their population. Recognizing the influence of the household environment on energy balance has led many researchers to suggest that intergenerational interventions hold promise for addressing this epidemic. Yet few comprehensive reviews of intergenerational energy balance interventions have been undertaken. Our review of the literature over the past decade revealed that intergenerational intervention approaches to enhance energy balance use a broad array of designs, target populations, and theoretical models, making results difficult to compare and "best practices" challenging to identify. Additional themes include variation in how interventions incorporate the intergenerational component; an increasing acknowledgment of the importance of ecological models; variations in the location of interventions delivery; diversity in the intervention flexibility/structure, intensity, and duration; and variation in outcomes and measures used across studies. We discuss implications and future directions of intergenerational energy balance approaches.

Keywords

health behavior; health promotion; intergenerational relations; intervention studies; family

Introduction

This article reviews the literature from 1998–2008 addressing interventions that take place within an intergenerational context and are designed to improve energy balance (i.e., the balance between caloric intake and energy expenditure). Intergenerational programs typically include children and co-resident adults (e.g., parents, grandparents, guardians), although the nature of the intergenerational component varies widely in the studies reviewed.

The Growing Epidemic of Obesity and Overweight

From 1980–2002, the prevalence of obesity in the U.S. doubled among those aged 20 years and older and tripled among children and adolescents (Ogden, Carroll, & Curtin, 2006). Recent National Health and Nutrition Examination Survey (NHANES) data indicate that

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66.3% of adults and 33.6% of youth in the US are overweight* or obese (Ogden, et al., 2006). Even over a short period of time (1999 to 2003), disturbing trends have been noted in obesity and overweight among youth; the prevalence of overweight and obesity increased among girls from 27.4% to 32.4% and among boys from 28.9% to 34.8% (Ogden, et al., 2006). Using more than 3 decades of NHANES data, Wang and colleagues projected that unless current trends are curbed, 80% of American adults will be overweight or obese within the next 15 years (Y. Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008).

The health, economic, and psychological effects of overweight and obesity are of growing concern. The increasing prevalence of obesity has been associated with escalating rates of type 2 diabetes, cardiovascular disease, certain cancers (including endometrial, postmenopausal breast, kidney, and colon cancers), musculoskeletal disorders, sleep apnea, and gallbladder disease (Roberts, Dive, & Renehan, 2009; Villareal, Apovian, Kushner, & Klein, 2005; Y. C. Wang, Colditz, & Kuntz, 2007). Obesity is second only to tobacco as the most prevalent risk factor for premature death (E. A. Finkelstein, Ruhm, & Kosa, 2005; Flegal, Graubard, Williamson, & Gail, 2005; Mokdad, Marks, Stroup, & Gerberding, 2004). In addition to physical health problems, economic consequences of the obesity epidemic challenge both the nation's health care resources and personal finances. For example, the number of obesity-related physician visits in the U.S. increased by 88% from 1988 to 1994(Wolf & Colditz, 1998). Hospital costs for treating obese youth have more than tripled over the past two decades, from $35 million in 1979–1981 to $127 million in 1997–1999 (G. Wang & Dietz, 2002). Obese individuals are themselves burdened by greater medical expenditures; Finkelstein and colleagues found that the average per capita increase in annual medical expenditures related to obesity is 37.4% ($732) (E. Finkelstein, Fiebelkorn, & Wang, 2003). Additionally, negative psychological sequelae can stem from obesity and overweight, including peer relationship challenges, lowered self-esteem, and problematic perceptions of body image (Janicke, Sallinen, Perri, Lutes, Silverstein, et al., 2008). While few would disagree that this epidemic constitutes a threat to the nation's health and well-being, there is little consensus on how to best address the rising rates of obesity and overweight.

Although obesity ultimately is caused by an imbalance between energy intake and expenditure (NHLBI and NIDDKD, 1998), an individual's behavior cannot be understood in isolation from his or her environment. Accordingly, many researchers have adopted a multi-level approach incorporating individual, interpersonal, and structural factors to understand the causes of obesity and to identify leverage points for obesity prevention and treatment (Cohen, Scribner, & Farley, 2000; Hill & Peters, 1998; IOM, 2005; S. K. Kumanyika, et al., 2008; Swinburn, Egger, & Raza, 1999). Research have identified a range of important environmental influences on diet, physical activity, and obesity, including factors related to the household or family, the community, and society (i.e., policy influences) (M. Story, Neumark-Sztainer, & French, 2002). Given the importance of family in dietary and physical activity behavior, interventions targeting entire families hold particular promise.

Intergenerational Influences on Energy Balance

Researchers have established the importance of family and household in shaping dietary intake, weight, and physical activity. Foods prepared at home contribute to more than 65% of daily energy intake (Guthrie, Lin, & Frazao, 2002). Epidemiological evidence suggests that diet and physical activity patterns are shared between parents and children (Hood, et al., 2000; McGuire, Hannan, Neumark-Sztainer, Cossrow, & Story, 2002; Moore, et al., 1991;

*While some authors use the term "overweight" to describe children with BMI>= 95th percentile, this review adheres to the Centers for Disease Control and Prevention's use of the term "obese" for both adults and children in the highest BMI category, and "overweight" to describe those individuals between normal weight and obesity (Centers for Disease Control and Prevention, 2009).

Oliveria, et al., 1992; Wardle, Guthrie, Sanderson, Birch, & Plomin, 2001), at least in part because parents and other family members tend to serve as the primary role models for dietary intake and physical activity (C.A. Hopper, et al., 1996). Furthermore, childhood obesity is positively correlated with parental obesity (Garn, Sullivan, & Hawthorne, 1989; Guillaume, Lapidus, Beckers, Lambert, & Bjorntorp, 1995; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997; Wrotniak, Epstein, Paluch, & Roemmich, 2004). For example, Fiore and colleagues found that adolescents whose parents were obese were 30% more likely to be overweight than adolescents whose parents were at a healthy weight (Fiore, Travis, Whalen, Auinger, & Ryan, 2006).

Stemming from this compelling connection between individual and household health and health behavior, researchers have begun to develop and implement intergenerational energy balance programs (L. H. Epstein, Paluch, Roemmich, & Beecher, 2007; Golan, Kaufman, & Shahar, 2006). Several recent review articles underscore this interest in the potential of such interventions to reduce obesity through improved dietary intake and/or physical activity levels; existing reviews, however, have focused solely on randomized controlled trials (RCTs) (Berry, et al., 2004; McLean, Griffin, Toney, & Hardeman, 2003; Nowicka & Flodmark, 2008; Young, Northern, Lister, Drummond, & O'Brien, 2007) or have restricted the target populations of reviewed studies to narrow groups, e.g., including only certain age groups (Nowicka & Flodmark, 2008; Young, et al., 2007) or already overweight participants (Kitzmann & Beech, 2006).

Aims of the Current Systematic Review

This systematic review of intergenerational energy balance intervention studies extends prior reviews by taking a more comprehensive approach, enumerating and describing the full range of intergenerational energy balance intervention studies – from pilot and feasibility studies to RCTs – over the last decade. The aims of this review are to (a) provide a comprehensive overview of intergenerational interventions developed to improve energy balance; (b) identify common themes found in these studies; and (c) explore strengths and shortcomings of this emerging field of research, providing background and guidance for ongoing projects in this field, and helping researchers and practitioners to identify various models and issues in intergenerational approaches to energy balance.

Methods

Article Identification and Selection

The PubMed, AGELINE, CINAHL, PsycInfo, and Web of Science databases were searched for English language articles about intergenerational health interventions. The search terms "intergenerational health promotion," "intergenerational health intervention," "parents and children/grandparents and grandchildren health intervention," "parents and children/grandparents and grandchildren health promotion," "family-based health interventions," and "family-based health promotion" were used to identify potentially relevant studies. A total of 874 article titles were identified through this method.

The abstracts of all identified articles were reviewed to determine if they met the criteria for inclusion. For several of these studies, abstracts were either unavailable or too brief to ascertain appropriateness, so the full articles were obtained to make this assessment. To be included, studies needed to address multiple related generations and involve a description of an intervention protocol or a completed intervention. Studies discussing caregiver experiences or interpersonal relationships were excluded. After applying these criteria, 112 articles remained. The articles were then limited to the years 1998–2008, resulting in 91 articles.

These 91 studies were then reviewed in full for appropriateness. Articles were excluded if they were review articles or if they did not describe an intergenerational intervention. Additionally, if several articles reported on the same intervention, only the most comprehensive article was included. Similarly, when large bodies of work were produced by the same group of researchers, the most representative, comprehensive, and empirical article was selected. In both situations, these decisions were made by consensus of the authors. Because the significant diversity among the full range of intergenerational programs would make useful conclusions difficult to reach, this review was limited to studies addressing energy balance, the single largest topic of focus in all intergenerational articles.

References of all 91 articles, as well as of excluded review articles, were searched for additional articles of potential relevance. This method identified an additional 46 articles for review, which were subjected to the same evaluation process for appropriateness for inclusion. In total, 137 articles were reviewed in full for appropriateness for the present study. After applying the aforementioned exclusionary criteria to these 137 articles, 37 remained.

Data Extraction

The 37 articles were systematically abstracted for details including: study objective; theoretical orientation; description of the intervention, including treatment length and follow-up; target population; intergenerational component; response rate; outcome variables; key conclusions; type of programming; setting; and target of the intervention delivery. Bibliographic references for all included articles are provided in Table 1.

Results

Key features of each of the reviewed articles are presented in Tables 2–4. Table 2 provides a description of the 37 articles reviewed, including the study objectives, theoretical framework specified, target of the intervention, and nature of the intergenerational component. Table 3 provides detail on the sample sizes, outcomes reported, and key conclusions reached, while grouping the studies into those reporting on pilot or feasibility studies, quasi-experimental studies, and RCTs. Finally, Table 4 provides additional detail on the types of programming utilized, the research setting, and the intergenerational nature of program delivery, along with a summary of how many studies included each type of intervention component.

The process of constructing Tables 2–4, along with discussions of patterns identified by the research team, led to the identification of several core themes. Specifically, summary tables were developed of the major points, foci, and notable issues for every article. Upon review of these key issues by the research team, certain themes emerged repeatedly, and the team returned to previously examined articles to discern the presence of each identified theme. Initially, approximately twelve themes were identified, but through a process of discussion, debate, and synthesis, the team focused on seven major themes threaded throughout the articles.. To enhance the validity of results, we used methods standard to quantitative and qualitative systematic reviews (Harden, et al., 2004), including team input (to check bias and interpretation); triangulation (to include and synthesize data from varying approaches); and providing supporting evidence and audit trails (to document inclusion/exclusion decisions and enhance consistency) (Finfgeld, 2003).

Themes include: (a) variation in how interventions incorporate the intergenerational component; (b) lack of explicit theoretical basis for many of the interventions; (c) differences in the target populations under study; (d) variations in the locations of intervention delivery; (e) diversity in the intervention structure, intensity, and duration; (f) variations in the research designs utilized; and (g) heterogeneity in the outcomes and

measures used for assessment of intervention effects. Results pertinent to each theme are presented below, with additional detail provided in Tables 1–3.

Variation in Intergenerational Elements

The projects reviewed were diverse in their use of intergenerational approaches. Some of the intervention components were delivered only to the younger *or* older generation, though more commonly intervention delivery involved both younger *and* older generations (see Table 3). For instance, Cullen and Thompson (2008) intervened solely with the older generation, involving parents in web-based activities with the goal of improving nutrition for their daughters. However, 33 of the 37 studies involved both generations. Most of these (25/33) delivered some component of the intervention to both generations together, though a substantial number (18/33) presented at least one component of the intervention to both generations separately. As suggested by this overlap, most of the studies reviewed incorporated multi-component interventions and used different delivery methods for various aspects of the intervention.

In addition, when interventions involved both generations, the method of delivery varied in terms of whether generations were combined or separated to receive the intervention. Of the 33 studies involving both generations, 10 included interventions that were delivered to the generations combined as well as to the generations separated. There were many studies, however, that included one component directed to one generation and a second component directed to both generations, either separated or together. For instance, Robinson et al. (2008) delivered one aspect of their intervention to the younger generation only (dance classes for children) and another aspect to the generations together (in-home parent-child activities to reduce screen time).

In addition to variation in how intervention components were delivered to each generation, there was significant variability in the extent of intergenerational involvement. Some interventions had a minimal intergenerational component, such as optional parental participation in completing meal planning packets (Eisenmann et al. 2008), whereas others employed a substantial intergenerational component, including requiring involvement in weekly group meetings (Beech et al., 2003; Epstein et al. 2008; Janicke et al. 2008; Wilfley et al. 2007).

Variation in Theoretical Orientation

Despite the importance of theory in the development of health interventions (Crosby, Kegler, & DiClemente, 2002; Glanz, Rimer, & Viswanath, 2008), only slightly more than half of the articles reviewed (20/37) explicitly referenced a theoretical framework guiding the intervention, although others used concepts central to specific health behavior theories. Among those theories cited, Social Cognitive Theory (SCT, sometimes referred to as Social Learning Theory) was by far the most common, accounting for 16 of the 20 articles specifying a theoretical orientation. The choice of SCT—with its emphasis on social interaction, observational learning, and reinforcement—is a logical one for intergenerational interventions. Several of the interventions based on SCT were explicitly designed to promote modeling, observational learning, and reinforcement among family members (Cullen & Thompson, 2008; Fitzgibbon, Stolley, Dyer, VanHorn, & KauferChristoffel, 2002; Harrington, Franklin, Davies, Shewchuk, & Binns, 2005; C.A. Hopper, et al., 1996). Additionally, most of the studies reviewed placed a high importance on cognition, specifically centering on education about diet and/or physical activity. The role of cognitive factors in health behavior change, stressed by such theories as SCT and the Theory of Planned Behavior, led a number of studies to incorporate behavioral counseling and goal

setting as key intervention components (Anand, et al., 2007; De Bourdeaudhuij & Brug, 2000; De Bourdeaudhuij, Brug, Vandelanotte, & Van Oost, 2002; Williams, et al., 2004).

Several studies, both those with and without an explicit theoretical framework, explored the influence of factors beyond the levels of the individual and family. These ecologically-oriented interventions included changing the school food environment, increasing availability of healthier foods and beverages, and offering group exercise/dance sessions in the community. While ecological approaches have great promise, many researchers report difficulties in adequate penetration of targeted groups and inability to maintain experimental designs for evaluation purposes.

Variation in Targeted Populations

The targeted populations of the studies varied by several factors, particularly age, race and ethnicity, socioeconomic status, and weight-related criteria. The composition of study samples impacts both the internal and external validity of the studies reviewed; the latter is a vital consideration in determining the utility of the study for particular groups and populations. Most studies (25/37) targeted elementary school-aged children, while adolescents and preschool-aged children were the focus of the intervention in only a small minority of studies. One study (Ransdell, Robertson, Ornes, & Moyer-Mileur, 2004) explicitly included three generations in the intervention, focusing on triads of pre-adolescent daughters, mothers, and grandmothers. In contrast with the preponderance of studies targeting children and adolescents, 2 studies focused primarily on intergenerational adult participants: Grassi et al. (1999) included adults only for a walking club program, but welcomed all generations of family members to participate in the clubs, while Williams et al. (2004) developed an intervention specifically for adult children of diabetic patients.

Despite significant racial and ethnic disparities in the prevalence of overweight and obesity (Flegal, Carroll, Ogden, & Johnson, 2002), most studies did not target race or ethnicity in the inclusion criteria. When studies did not specify race or ethnicity in the inclusion criteria, most participants were Caucasian. Several studies did target populations of color, specifically African American children and parents (e.g., Beech et al., 2003; Robinson et al., 2008), Latino children and parents (e.g., Fitzgibbon et al., 2002), and Native American children and parents (Caballero et al., 2003; Harvey-Berino & Rourke, 2003). Only four reviewed studies included participants outside the U.S. (Aboriginal Canadian in Anand et al., 2007; Finnish in Saakslahti et al., 2004; and Israeli in Golan et al., 1998, and Golan et al., 2006, respectively). While not defined by race or ethnicity, a traditionally underserved rural population was targeted by Janicke et al. (2008) in their investigation of a family-based intervention delivered by Cooperative Extension offices. Similarly, low socioeconomic status, another important predictor of obesity and overweight, was only specifically noted as an inclusion criterion in one study (Robinson et al., 2008). Several studies, however, included populations typically of low socioeconomic status without specifying this particular criterion (e.g., Cabellero et al., 2003; Fitzgibbon et al., 2002).

Weight-related inclusion criteria defined the target population in a minority of studies. Approximately one-third of studies reviewed required that child participants be overweight or obese, while very few included parent overweight or obese status as an inclusion criterion. Nemet et al. (2008) conducted the only reviewed study in which obesity was an inclusion criterion for both the child and parent. In contrast to the studies specifying weight-related inclusion criteria, the remaining studies embraced a primary prevention perspective, addressing energy balance among participants who were not necessarily overweight or obese at enrollment.

Variation in Locations of Intervention Delivery

Intergenerational energy balance interventions were situated in a variety of locations, including home, school, research-based (e.g., labs and clinics), and community settings. Location appeared to be integrally related to both the types and the foci of delivered interventions. Approximately half of the interventions were located either in the home setting (10 studies) or in the home setting in addition to other settings (9 studies). For example, Cullen & Thompson (2008) reported on Internet-based nutrition lessons; Cookson et al. (2000) described an intervention using Family Fun Packs; and Mueller and colleagues (2001) reported on a home support program offered in tandem with nutrition information and sports programs offered in the schools and the community. In contrast, 5 studies were located solely in research-based settings, with another 3 studies combining research-based and other settings. One study explicitly tested the effect of home versus university-based intervention delivery: Ransdell et al. (2003) investigated potential differences in the effects of home versus university location on a physical activity program directed at mother-daughter dyads, finding no significant difference in intervention effects based on setting.

Of the remaining studies, seven reported locating interventions in the school setting or some combination of school and other settings, while eight were located in community settings. Interventions located in school or community settings were generally more ecological in nature than the interventions situated in home or research-based settings. These studies tended to emphasize changes to school- or community-wide norms, communication, and other aspects of the environment. For example, Caballero et al. (2003) assessed the effects of school-based curriculum changes, school food service practices, physical activity offerings in school, and family involvement in a 3-year intervention targeting improvements in BMI among Native American children. Similarly, Eisenmann et al. (2008) aimed to improve children's energy balance via an extensive array of school and community intervention components over 9 months, including a community-wide public awareness campaign, school curriculum additions, and provision of meal planners, recipes, and other resources to families.

Variation in the intervention structure, intensity, and duration

The reviewed studies exhibited extensive variation in intervention design elements, specifically the structure, intensity, and duration of the intervention. Most of the interventions were structured through workshops, counseling sessions, or educational programming. Less structured intervention approaches included programs that encouraged physical activity through walking clubs (Grassi et al., 1999) (though even this intervention had several educational sessions), encouraged families to employ modest improvements in diet and physical activities (Rodearmel et al., 2006), and provided individual counseling sessions promoting the use of pedometers (Williams et al., 2004). Less structured still were more community-level interventions focused on spreading public service announcements, conveying menu information in restaurants, or providing worksites with dietary information (e.g., Gombosi et al., 2007).

Most of the interventions reviewed for this article were moderately to very intensive, with weekly/biweekly face-to-face group or individual sessions as the norm. When the intervention was structured as a series of classes or counseling sessions, they tended to last for one hour and occur once per week for 12 to 16 weeks (e.g., Golan et al., 2006, Epstein et al., 2007). However, when the interventions included a wider array of activities (e.g., curricular changes, family fun nights, take home activities), they were described as less regular and consistent in their intensity and duration. For example, Lytle et al. (2006) administered a multi-component school-based dietary intervention involving curricular changes, newsletters sent home, and alterations in the school food environment. Some of

these components were time consuming and intense (curricular changes), while others involve far fewer resources and less time (newsletter).

The duration of the intergenerational activities ranged dramatically among the interventions. Many of the interventions lasted 3 to 6 months, particularly if they were a structured classroom or counseling protocol. Those involving a broader, ecological orientation tended to last for years, perhaps due to the complexity and variety of activities within the intervention. For the GEMS program (Robinson et al., 2008), after-school dance classes combined with home visits encouraging limited screen time were planned to take place over the course of 2 years. For even more broadly-based public health approaches, such as the "Fit for Life" protocol (Gombosi et al., 2007), activities continued for up to 5 years.

Variation in Research Design

This review identified 6 reports of pilot/feasibility study results; 9 studies with quasi-experimental designs; and 22 RCTs (see Table 2). While the primary objectives of each of the 37 studies were examined (see Table 1), results regarding the objectives of the 22 RCT studies are highlighted here to illustrate differences in what effects were actually being tested. Although the overwhelming majority of interventions were multi-component, only a small proportion specifically tested the effects of the intergenerational component (i.e., the relative efficacy of an intervention targeting parents and children together versus parents alone). More typically, studies investigated specific behavioral approaches (e.g., stimulus control versus reinforcement) or compared the entire intervention strategy against a no-intervention control group. Thus, although all studies had an intergenerational component, few were designed to tease apart what role the intergenerational component played (for exceptions, see Janicke et al., 2008; Golan et al., 1998; and Golan et al., 2006).

Variation in Outcomes and Measures Used

Although outcomes can be grouped into five broad categories—diet, physical activity, physical fitness, anthropometrics, and psychosocial constructs (see Table 2)—there was substantial heterogeneity in specific dimensions assessed and measures utilized within each broad category. Seventeen of the 37 studies reported diet as a primary outcome. Among those studies, both changes in dietary patterns and nutrition knowledge were reported; the former were most commonly assessed by 24-hour recalls or FFQs. The majority of the 16 studies reporting physical activity outcomes used self-report questionnaires to assess physical activity; a minority used objective measures (i.e., pedometers and accelerometers). Nineteen studies reported on anthropometric outcomes that included BMI, skin-fold and circumference measurements, and percent body fat. Differences in outcomes assessed and measures used precluded making cross-study comparisons.

Further illustrating the variation in outcomes measured, the unit of analyses (i.e., child versus parent versus both) differed across reviewed studies. Table 2 presents outcome measures for the studies; 6 studies did not present outcome data due to their preliminary design. Outcomes were reported for children in only 14 of the 31 studies with outcome data. Eleven studies reported on at least one outcome measured in both parents and children, while 2 studies reported on separate outcomes for parents and children. Only 1 study reported on outcomes for parents only. Two studies did not specify the unit of analysis for reported outcomes, and 2 studies reported changes to the household environment.

Discussion

Although there is extensive enthusiasm and ample rationale for intergenerational energy balance interventions, numerous limitations and challenges exist within this newly emerging

field. Many intergenerational energy balance interventions have been administered in highly-controlled locations (i.e., clinics or academic research laboratories) rather than real life settings (Janicke, Sallinen, Perri, Lutes, Huerta, et al., 2008), highlighting the need for translational research in this field. Enrollment has been an obstacle, with parents of overweight or obese children frequently unwilling to enroll or not completing the sessions (Harrington, et al., 2005). Extensive variation in the incorporation of the intergenerational component, in the intervention strategies used, and in the objectives and outcomes assessed render cross-study comparisons difficult. Of particular concern for both practitioners and researchers, intervention descriptions in the reviewed studies range from very detailed (providing information on frequency, duration, topics, methods, targeted population, who provides the intervention, location, etc.) to very vague presentations that preclude replication.

The themes identified in this review lead to several key, interrelated conclusions regarding the state of the literature about and the need for further research on intergenerational interventions for energy balance, including: (a) a need for an improved understanding of the role of the intergenerational component in such interventions; (b) a need for extended bodies of work modeled in scope upon those produced by researchers such as Epstein and colleagues and Golan and colleagues; (c) a need for increased attention to the types of intervention development and research required to address known disparities in obesity among several at-risk and under-studied populations; (d) concerns regarding the external validity of much of the research on the subject, particularly regarding inclusion and exclusion criteria in existing studies; (e) concerns regarding the lack of theoretical underpinnings in most of the articles reviewed; and (f) a need for additional focus on environmental-level variables and strategies to change energy balance.

The Role of the Intergenerational Component

There is a need for improved understanding of the role of intergenerational programming with regard to intervention outcomes. Only a few studies reviewed specifically investigated the efficacy of the intergenerational approach; instead, most incorporated intergenerational components into their interventions but did not specifically examine their independent effects. Researchers must continue to develop foundational insights, examining issues such as intervention delivery (should the intervention be delivered to one or both generations?); intervention target (is behavior change desired in one or multiple generations?); and extent of intergenerational involvement (is involvement mandatory or optional, minimal or substantial?). Finding the best balance among these multiple variables is an important area for future work. To advance understanding of whether (and what) intergenerational interventions are efficacious or effective, future research should follow the lead of Golan et al. (1998; 2006) and Janicke et al. (2008) by comparing interventions varying in the degree of intergenerational involvement to each other. The need for research indentifying best practices in intergenerational interventions is emphasized by the wide diversity in the reviewed articles.

Extended Bodies of Work

Understanding of the feasibility, efficacy, and effectiveness of intergenerational interventions can best be addressed by strengthening the foundation and longevity of such approaches. The bodies of research conducted by Epstein, Golan, and others provide a long term perspective on the challenges and potential of intergenerational health interventions that enhance our theoretical, methodological, and substantive understanding. For over 25 years, Epstein and colleagues have administered and evaluated family-based treatments for pediatric obesity. A recent comparative analysis (Epstein et al., 2007) of programs implemented two decades ago and more current interventions demonstrates consistency in

the efficacy of a family-based behavioral approach to treating childhood obesity. Golan and colleagues (1999; 2006) also have provided theoretical and practical insights that enrich intergenerational programming, finding fairly consistently that focusing exclusively on parents to decrease pediatric obesity tends to result in greater decreases in overweight and reductions in obesogenic environments than involving parents and children together in sessions. The longevity of such scholarship builds a foundation for the development of future interventions. As more researchers build such comprehensive bodies of work, practitioners in this area will have a wider array of approaches to adapt to their specific goals and communities.

Disparities in Obesity by Race, Ethnicity, and Socioeconomic Status

Racial, ethnic, and socioeconomic disparities in obesity present complex issues relevant to both researchers and practitioners working in this field. On the individual and family levels, the development and evaluation of intergenerational interventions for obesity targeted toward members of at-risk racial, ethnic, and socioeconomic groups require culturally targeted and/or tailored approaches. Such approaches intentionally select intervention components designed to resonate with cultural values, and thus may increase acceptability and efficacy (Wilson, 2009). Of the studies reviewed herein, cultural targeting and tailoring in some form were apparent in each of the projects aimed at African American, Latino, or American Indian participants (e.g., use of hip hop dance classes with African American girls, use of Spanish language and familial concepts for Latino families engaged in diabetes education, and others). However, while efforts to ensure the cultural acceptability and relevance of interventions targeted at individuals and families are necessary, they may not be sufficient to address known health disparities in obesity.

The very notion of disparities leads directly to questions of etiology, or the origin of the health disparities. Without considering why minority and low income communities tend to suffer higher rates of obesity and overweight, researchers will develop interventions likely to fail in the long term. Attribution of higher rates of obesity within particular racial, ethnic, or socioeconomic groups to individual- or family-level cognitions and behaviors—the “dominant paradigm” in current medical treatment and research (S. Kumanyika, 2005) ignores the glaring structural inequities underlying these cognitions and behaviors. Environmental and policy-related factors cannot be overlooked in the design and development of interventions intended to reduce disparities in obesity. These issues include unequal health care access and quality of health services (Flores, Olson, & Tomany-Korman, 2005); lack of healthful food choices in markets and fast-food restaurants in low-income and racially or ethnically segregated neighborhoods (Block, Scribner, & DeSalvo, 2004; Morland, Wing, Diez Roux, & Poole, 2002); limited economic opportunities afforded individuals residing in disadvantaged areas (Robert Wood Johnson Foundation Commission to Build a Healthier America, 2009); and lack of local access to health-promoting recreational choices and venues (Gordon-Larsen, Nelson, Page, & Popkin, 2006). Thus, the social and material disadvantage experienced by many racial and ethnic minority populations requires a broader, ecological perspective on the causes of, consequences of, and remedies for, energy balance problems (Braveman, 2009). Interventions and research designs stemming from such a perspective are complicated, time-consuming, and potentially sensitive; yet such an orientation is vital if disparities in obesity and overweight are to be successfully addressed.

External Validity

Several findings in this review are surprising in light of what is currently known about patterns and predictors of obesity. First, as discussed above, disparities in prevalence and rates of overweight and obesity (Flegal, et al., 2002; Ogden, et al., 2006) highlight the need

for the development of culturally relevant and effective interventions targeted toward several at-risk groups. Yet, in the current review, only six studies investigated interventions directed specifically at African American and/or Latino participants. Similarly, low socioeconomic status is a well-known risk factor for obesity in children and adults, yet the vast majority of studies in this review did not target this at-risk population. This lack of attention to the widely-recognized disparity in energy balance outcomes and to the highest risk groups is a serious shortcoming of the existing body of work in this area and demands extensive attention by researchers, funders, and publishers.

Elementary school-aged children were targeted for the majority of these studies. Only 4 of the 37 reviewed studies focused on children under the age of 5; from a prevention perspective, shifting to an early intervention model targeting families of toddlers and preschool-aged children may be one way to intervene earlier and more effectively. Future research should expand inclusion of participants to very young children.

In addition, nearly two-thirds of the studies reviewed incorporated a primary prevention perspective, focusing on participants who were not classified as overweight or obese. Of those with a secondary or tertiary prevention approach, only one specifically targeted families in which both the child and the parent were obese. Given the importance of the family environment in energy balance, it may be prudent for future studies to focus on families with obesity problems across generations.

A Dearth of Theory

Future intervention development must include explicit incorporation of theory in the conceptualization, design, implementation, and analysis of intergenerational energy balance interventions. Development of interventions explicitly based on theory offers the potential of more comprehensive and systematic approaches to energy balance, as this approach makes it more likely to incorporate lessons learned about health promotion in a wide range of areas.

Of those articles explicitly citing theory in the development of their interventions, the dominant theory used was SCT, a well-accepted choice for targeting individual- and family-level health behavior change. While SCT can incorporate environmental variables, very few of the interventions reviewed had a primary focus on environmental variables. Several studies incorporated environmental-level changes into their interventions, yet the vast majority intervened at the individual level, focusing solely on cognitive and behavioral strategies. Inclusion of environmental approaches, such as changes to food availability or improved access to physical activity opportunities, was rare. Only four of the thirty-seven studies reviewed specifically incorporated environmental changes to address obesity. This omission, in part, may reflect the challenges associated with designing, implementing, and evaluating environmentally-oriented interventions. However, recognition of the potential effects of environmental factors on energy balance health behaviors suggests that a focus restricted to individual-level factors and behaviors may miss important and powerful opportunities to promote change. As the Institute of Medicine and others have noted (IOM, 2005, 2009;S. K. Kumanyika, et al., 2008), despite the considerable challenges presented by multi-level approaches, incorporating environmental and policy variables is critical to the success of efforts against obesity. As researchers increasingly utilize socio-ecological approaches in addressing obesity (Mary Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008), more interventions are likely to incorporate changes in the physical and social environment, a change that promises to advance this field of research.

Study Limitations

Although this comprehensive review of intergenerational intervention approaches to enhance energy balance utilized broad inclusion criteria, it is likely that some important articles were overlooked. Given the fluidity and expansion of this field, future reviews may identify such overlooked and new interventions. Additionally, this review was not intended to be a meta-analysis, nor an evaluation of the quality of study design and conduct; some readers might prefer a best practices or effectiveness evaluation report. Instead, the articles reviewed here include projects at differing stages, providing various degrees of insights regarding their conceptual basis and/or their specific programming or outcomes. Such a descriptive orientation is not, however, problematic since there is a great deal to be learned from ongoing projects aside from solely outcomes. In the future, a marriage between the rich, conceptual descriptions provided by many "works in progress" and the reporting of scientifically rigorous intervention outcomes would be optimal. Such a blend necessarily would require some new orientations in the world of publishing—for example, additional page length and potentially publishing non-significant (but meaningful) results.

Finally, study limitations reflect the overall limitations of the field. For example, despite the disproportionate prevalence of obesity among traditionally underserved and minority populations in the US, (S. Kumanyika, 2005) there are very few descriptions of the cultural appropriateness of particular intergenerational energy balance interventions, or techniques undertaken to enhance the development of such designs. Additionally, despite compelling evidence of the importance of environmental and policy-level influences on energy balance, we identified few intervention studies that focused on the built environment or that examined the impact of policy changes on intergenerational energy balance (Yancey, et al., 2007). Since insights on how environment shapes energy balance are newly emerging, researchers are only now designing interventions to optimize such environmental impacts on energy balance. The potentially strong impact of policy on health outcomes, on the other hand, has been examined extensively for many other topics (for example, teen smoking rates have been reduced where policy efforts include excise taxes, limitations in advertising and sales, and restricting smoking in public places), but such policy interventions for energy balance are at an early stage (McGinnis, Williams-Russo, & Knickman, 2002). The Institute of Medicine identified over 700 legislative bills introduced between 2003 and 2005 that were designed to prevent and address childhood obesity. Such bills included efforts to encourage farmers' markets and establish more walking and biking trails, efforts that would address adult energy balance as well (Koplan, Liverman, Kraak, & Wisham, 2006). It is too soon to tell whether energy balance will improve in these communities, but assessment of whether, to what extent, and how policy influences energy balance is a critical area for researchers to explore in the immediate future.

Future Research Needs

One of the most salient themes identified in this review is the need for greater theoretical grounding of intergenerational programs. In particular, theoretical perspectives emphasizing the role of environmental change in promoting energy balance are critical. Secondly, interventions focusing on groups at highest risk for obesity, including ethnic minorities and lower-income populations, are particularly important. Finally, researchers are urged to design studies that explicitly test the effectiveness of intergenerational approaches in order to elucidate the importance of this element in energy balance interventions.

Implications for Practitioners

Practitioners wishing to incorporate research on intergenerational energy balance interventions into their clinical work are faced with several challenges. First, there is no clear set of "best practices" established by this body of research that can instruct

practitioners in designing interventions. Success (and failure) has been attained by interventions with different target populations, different intervention components, and different delivery mechanisms. Additionally, the lack of programmatic detail provided by most authors makes it difficult to replicate successful interventions in the field. While page limitations may make it impossible to provide the needed level of detail in published articles, authors should be encouraged to provide links to documents more fully describing the structure and details of interventions. Second, the lack of multi-level, ecologically-oriented strategies evaluated deprives practitioners of examples of what many experts believe may be among the most promising types of interventions. However, the diversity of this body of literature offers practitioners a wide range of options in designing programs that meet the specific needs of their communities. These articles can be a valuable resource for practitioners seeking ideas for components of multi-level programs. Finally, as more descriptions of pilot and feasibility studies in this field are published, the continuing emergence of the kinds of details needed to translate this research into evidence-based practice will be invaluable.

Conclusions

The variety of studies reviewed in this article –pilot/feasibility studies, quasi-experimental studies, and RCTs – make this body of literature rich and useful to a wide range of researchers and practitioners. Sole reliance on results reported from RCTs would omit important information regarding: project development and challenges; consideration of research on a community scale where randomization is difficult or impossible; and other details explicating the content and delivery of specific intervention protocols, often cut from articles due to journal space limitations and a general focus on results rather than process. Researchers are urged to submit and editors to solicit and accept such articles as a means towards building a richer body of knowledge about intergenerational approaches to energy balance. The contributions of those authors who have developed a body of work in intergenerational interventions over time serve as excellent examples of this dissemination strategy. Such a corpus of work would provide a broader understanding of the rationale, theoretical underpinnings, development, implementation, and effects of intergenerational intervention approaches, and move the science forward.

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Table 1

Author	Year	Citation	Article Title
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Beech, B. M.; Klesges, R. C.; Kumanyika, S. K.; Murray, D. M.; Klesges, L.; McClanahan, B.; Slawson, D.; Nunnally, C.; Rochon, J.; McLain-Allen, B.; Pree-Cary, J.	2003	Ethnicity and Disease 13(1 Suppl 1):S40–53.	Child- and parent-targeted interventions: the Memphis GEMS pilot study.
Caballero, Benjamin; Clay, Theresa; Davis, Sally M; Ethelbah, Becky; Rock, Bonnie Holy; Lohman, Timothy; Norman, James; Story, Mary; Stone, Elaine J; Stephenson, Larry; Stevens, June	2003	American Journal of Clinical Nutrition 78(5):1030–1038.	Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren.
Cookson, S.; Heath, A.; Bertrand, L.	2000	Canadian Journal of Public Health 91(4):256–9.	The HeartSmart Family Fun Pack: an evaluation of family-based intervention for cardiovascular risk reduction in children.
Cullen, K. W.; Thompson, D.	2008	American Journal of Health Behavior 32(1):40–51.	Feasibility of an 8-week African American Web-based Pilot Program Promoting Healthy Eating Behaviors: Family Eats.
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De Bourdeaudhuij, I.; Brug, J.; Vandelanotte, C.; Van Oost, P.	2002	Health Education Research 17(4):435–49.	Differences in impact between a family-versus an individual-based tailored intervention to reduce fat intake.
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Author	Year	Citation	Article Title
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Stern, M.; Mazzeo, S. E.; Porter, J.; Gerke, C.; Bryan, D.; Laver, J.	2006	Journal of Clinical Psychology in Medical Settings 13(3):217–228.	Self-esteem, teasing and quality of life: African American adolescent girls participating in a family-based pediatric overweight intervention.
Teufel-Shone, N. I.; Drummond, R.; Rawiel, U.	2005	Preventing Chronic Disease 2(1):A20.	Developing and adapting a family-based diabetes program at the U.S.-Mexico border.

Author	Year	Citation	Article Title
Warren, J. M.; Henry, C. J. K.; Lightowler, H. J.; Bradshaw, S. M.; Perwaiz, S.	2003	Health Promotion International 18(4):287–296.	Evaluation of a pilot school programme aimed at the prevention of obesity in children.
Wilfley, D. E.; Stein, R. I.; Saelens, B. E.; Mockus, D. S.; Matt, G. E.; Hayden-Wade, H. A.; Welch, R. R.; Schechtman, K. B.; Thompson, P. A.; Epstein, L. H.	2007	Journal of the American Medical Association 298(14): 1661–73.	Efficacy of maintenance treatment approaches for childhood overweight: a randomized controlled trial.
Williams, K.; Prevost, A. T.; Griffin, S.; Hardeman, W.; Hollingworth, W.; Spiegelhalter, D.; Sutton, S.; Ekelund, U.; Wareham, N.; Kinmonth, A. L.	2004	BMC Public Health, 4, 48.	The ProActive trial protocol - a randomised controlled trial of the efficacy of a family-based, domiciliary intervention programme to increase physical activity among individuals at high risk of diabetes

Table 2

Design of Interventions

Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
Anand et al. (2007)	To determine if a household-based lifestyle intervention is effective at reducing energy intake and increasing physical activity among Aboriginal families after 6 months, compared to control group families receiving basic energy balance educational materials	Protection Motivation Theory, Social Learning Theory, Normative Influences, Theories of Persuasion	Home counseling and goal setting, filtered water provided, physical activity program for children, and educational events provided over six months	Canadian Aboriginal children, ages 5+, and a parent	Families involved in counseling & goal setting
Beech et al. (2003)	To assess the feasibility, acceptability, and outcomes of 2 versions of a culturally relevant, family-based intervention to prevent excess weight gain in pre-adolescent African-American girls	Social Cognitive Theory	Twelve separate weekly group sessions with girls and with parents involving physical activity and nutrition education	African American daughters, ages 8–10	Parents and children have separate weekly educational sessions
Caballero et al. (2003)	To evaluate effectiveness of a school-based body fat reduction program Among American Indian children (intervention schools were compared to control schools).	Social Learning Theory	Classroom curriculum, food service, physical activity, and family involvement offered in school settings over 3 years	Predominantly American Indian children, grades 3–5	Families have materials based on classroom curriculum to be used at home, and families participate in workshops and events
Cookson et al. (2000)	To evaluate effectiveness of HeartSmart Family Fun Pack in promoting family-based lifestyle changes	Transtheoretical Model	3 month program using “Family Fun Pack” with games, posters, brochures, growth chart	Children, ages 6–10, and a parent	Families participate in Fun Pack activities
Cullen & Thompson (2008)	To assess log-on rates and change in mediating variables achieved from a web-based nutrition intervention for African American families.	Social Cognitive Theory	8 weekly web-based lessons on nutrition	African American daughters, ages 8–10, and a parent	Parents are expected to be involved in activities via the web
De Bourdeaudhuij & Brug (2000)	To assess the impact of tailored nutrition education letters addressed to each family member compared with control condition of standardized, non-personalized nutrition education letters	Operant and Social Learning Theories, Theory of Planned Behavior	Provision of individually tailored or standardized nutrition education letters to family members	2+ children, ages 12–18, and both parents	Family members receive intervention separately but simultaneously

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Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
De Bourdeaudjuij et al. (2002)	To assess the impact of a tailored nutrition intervention on fat intake and psychosocial determinates of fat intake, including differential impact of family-based and individual-based interventions.	Operant and Social Learning Theories, Theory of Planned Behavior	Tailored nutrition education letters focused on fat intake sent either to parents only or to adolescents only	Children, ages 15–18, and one parent	Adolescents and parents receive the intervention
Eisenmann et al. (2008)	To modify children's physical activity, nutrition, and screen time through a randomized community, school, and family-based intervention.	Bronfenbrenner's Social Ecological Model	Community component included public education via community leaders and other strategies to increase public awareness; school components included teacher's packet and other curriculum items; family component included monthly materials packets, including meal planners, recipes, etc. All components offered over 9 months.	Children, grades 3–5	Children are exposed to intervention at school and family received packet at home (meal planners, informational materials)
Epstein et al. (2000)	To test the relative efficacy of three treatment arms on weight loss among obese children: standard family based treatment (FBT); FBT plus problem solving taught to parents and child; FBT plus problem solving taught to child	None explicit	6-month family-based behavioral weight-control program with either parent and child problem-solving, child problem-solving, or no additional problem-solving component.	Overweight children, ages 8–12, and a parent	Parents and children participated in individual sessions together and in group sessions separately.
Epstein et al. (2004)	To compare the effects of two methods of reducing target sedentary behaviors (reinforcement or stimulus control) on patterns of activity and weight loss in overweight children.	Behavioral economic theory	6 month intensive intervention that included 16 weekly meetings followed by two bi-weekly meetings and two monthly meetings. Group meetings focusing on Traffic Light Diet; weight control and self-monitoring; and behavior change techniques. One group was also taught stimulus control.	Obese children, 8–12 years old and a parent	Parents and children participate in separate group meetings.
Epstein et al. (2008)	To compare the effect of a family-based intervention targeting increased eating of fruits and vegetables and low-fat dairy foods to one targeting reduced intake of high energy-dense foods on children's weight.	None explicit	Weekly sessions for 2 months; biweekly sessions for 2 months; one session at 6 months, 1 year and 2 years. Traffic light diet with a focus on increasing fruits and vegetables and low-fat dairy foods or with a focus on decreasing high energy dense foods. Information about physical activity. Goal setting and self-monitoring. Stimulus control.	Overweight or obese children, 8–12 years old and a parent	Parents and children participated in individual sessions together and in group sessions separately.
Fitzgibbon et al. (2002)	To describe a family-oriented obesity prevention program targeted at	Social Learning Theory, Self-Determination Theory, Transtheoretical Model	3 child classes per week for 14 weeks, focusing on the Traffic Light Diet healthy eating activities and physical activity; for parents, weekly	African American and Latino Head Start children and their parents	Parents and children receive intervention

Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
	minority preschool-aged children.		newsletters, homework assignments, and twice-weekly low impact aerobics classes		
Golan et al. (1998)	To compare the effectiveness of a family-based childhood obesity treatment intervention in which parents served as the exclusive agents of change, with that of the conventional approach, in which the children served as the agents of change.	None explicit	Hour-long support and educational sessions were conducted by a clinical dietitian-14 sessions for the parents in the experimental intervention and 30 for the children in the conventional intervention. Individual sessions were held for members of both groups, when necessary.	Obese children, ages 6–11	Parents and children received group sessions separately
Golan et al. (2006)	To evaluate the efficacy of a family-based intervention that involves parents alone versus parents plus obese children together.	None explicit	32 families were randomized into parent only group or parent plus children group; both groups received sixteen one hour educational programs that emphasized healthy eating, encouraged regular physical activity, and, for the parents, emphasized parental control techniques. Parents and children attended the mixed group together. Families in both groups also received approximately six individual family sessions.	Overweight Israeli children, ages 6–11	Parent and children receive intervention separately
Gombosi et al. (2007)	To evaluate the impact of a school, family, community, and industry-based intervention on the rates of overweight and obesity among rural children over 5 years.	None explicit	“Fit for Life” involved 5 components implemented over 5 years: school based education, a wellness club, point source (nutritional info for each item on restaurant menus in community restaurants), occupational health, and community activities (e.g., family fun days)	Children, kindergarten - grade 8	Children involve parents in the home activities of the intervention. Family participates in family fun days
Grassi et al. (1999)	To determine whether a walking club program increased physical activity levels and changed perceived barriers to physical activity among a convenience sample of adults	None explicit	4 educational meetings offered over a 3 month period, as well as no-cost walking clubs	Adults, age 18–55	All generations allowed to participate in activities
Harrington et al. (2005)	To evaluate the predictors of completing a dietary intervention program involving school curriculum, family fun nights, and family meal and game sharing.	Social Cognitive Theory	7 sessions with menu suggestions, educational workshops, family fun nights, peer leaders, etc. Schools randomized to assessment only, curriculum only, or curriculum plus family do-at-home activities	Children, elementary school, and a parent	Family is involved in kick off night, and in at-home intervention activities

Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
Harvey-Berino & Rourke (2003)	To evaluate the relative effectiveness of maternal participation in an obesity prevention parenting support program compared to a control of parenting support only on reducing obesity prevalence rates among Native-American children.	None explicit	16-week obesity prevention classes plus parenting support intervention, or parenting support alone.	Native-American children, 9 months to 3 years, and overweight mothers	Mothers participate in instructional intervention
Hopper et al. (2005)	To examine the efficacy of a school-based physical activity and nutrition program involving a parental component, with 6 school randomly assignment to program versus control groups.	Social Learning Theory	Enhanced 20 week school curriculum and a home program in which parents and children completed activities for points and rewards	Children, grade 3, and a parent	Children and parents work together on home activities.
Janicke et al. (2008)	To compare the effects of a behavioral family based intervention to a behavioral parent-only intervention on children's weight delivered through Cooperative Extension Services offices.	None explicit	8 weekly and then 8 biweekly sessions focusing on Stoplight diet, combined with diet and physical activity goal setting and self-monitoring.	Overweight or obese rural children, ages 8–14, and a parent	Parents and children received intervention separately
Kalavainan et al. (2007)	To compare the efficacy of a group treatment program emphasizing healthy lifestyle versus a routine counseling group for obesity among 70 obese children.	None explicit	Nutrition education, physical activity, and behavioral therapy delivered either via routine child counseling (2 sessions plus informational booklets) or family-based group sessions (15 sessions).	Obese children, ages 7–9	Parents and children receive intervention
Klohe-Lehman et al. (2007)	To evaluate the effects of a weight loss intervention delivered to mothers on diet and physical activity of the mothers and their 1–3 year old children	Social Cognitive Theory	Weekly 2-hour sessions for mothers, involving exercise, nutrition education, and cognitive-behavioral strategies, over 8 weeks	Children, ages 1–3 years, of overweight and obese mothers	Mother only receives intervention
Levine et al. (2001)	To evaluate the feasibility, acceptability, and effects of a family based intervention for children with severe obesity.	None explicit	10–12 session behavioral group intervention adopted from Epstein's Stoplight Diet. Group sessions and self-monitoring.	Obese children, ages 8–12, and a parent	Parents and children receive intervention
Lytle et al. (2006)	To evaluate the effectiveness of a school-based dietary intervention by comparing intervention and control schools.	None explicit	Multi-component school-based intervention included classroom based curricula, family newsletters, and changes in the school food	Students, middle school	Family is involved in intervention, including newsletters/informati on, coupons, etc.

Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
			environment, various components conducted over two years		
Müller et al. (2001)	To discuss the background, approach and initial findings of the 8 year Kiel Obesity Prevention Study.	None explicit	8 hours of nutrition education delivered annually for 3 years to students, parents given same information at school meeting. In addition, family counseling and support program using 3–5 home visits, plus a structured sports program, offered to families with overweight or obese children and to families with normal-weight children but obese parents.	Children, ages 5–7	Parents receive educational intervention. Families offered counseling and support program. Children receive separate intervention.
Nemet et al. (2008)	To evaluate the effectiveness of a family-based diet and physical activity intervention for obese children from obese families, comparing children in the intervention with controls.	None explicit	3 months of family-oriented behavioral groups focused on diet (weekly sessions), physical activity (twice-weekly sessions), and movement therapy (weekly for children only)	Obese children, ages 8–11, and an obese parent	Parents and children receive group sessions separately
Northrup et al. (2008)	To discuss the development of a school based program to improve lifestyle (specifically diet and physical activity)	Maslow's Hierarchy of Needs, Social Cognitive Theory	School-based activities including physical activity and nutrition interventions and health screenings offered over 5 years	Children, grade 5, and a parent	Family members participate in intervention
Ransdell et al. (2003)	To compare the effects of a home-based versus university-based physical activity program delivered to mother-daughter dyads.	Social Cognitive Theory	2 introductory sessions addressing physical activity topics, followed by either university-based (group physical activity sessions 3 times per week) or home-based (provided with information, exercise logs, and recommended physical activity calendar to complete at home on their own) programs for 12 weeks	Healthy but sedentary – daughters, ages 14–17, and mothers, ages 31–60	Mothers and daughters participate in intervention together; For the home-based intervention, they participate either together or separately
Ransdell et al. (2004)	To compare the effects of a home-based physical activity program for mother-daughter-grandmother triads versus a control group condition.	None explicit	6-month home-based physical activity program; following 2 introductory sessions addressing physical activity topics, participants asked to complete 3 bouts of physical activity sessions each week. Materials were provided to recommend activities increasing in duration and intensity over the course of the intervention	Healthy but sedentary – daughters, ages 8–13, mothers, ages 30–50, and grandmothers, ages 50–70	Three generations of female family members participate in intervention together
Robinson et al. (2008)	To describe the study design and baseline results of an trial comparing a family-based physical activity and screen time	Social Cognitive Theory	GEMS Jewels after-school dance classes incorporating cultural themes important in the local African-American community; START (Sisters Taking Action to Reduce Television)	Low socioeconomic status, African American daughters, ages 8–10	Family members involved in in-home activities, although dance classes were for children only

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Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
	reduction intervention with a control group receiving community-based health education.		intervention in which a young adult African-American female role model conducted home visits aimed at family screen-time reduction. Interventions occur over 2 years.		
Rodearmel et al. (2006)	To evaluate the effects of an intervention focusing on small lifestyle changes (increasing walking and consuming two servings of ready-to-eat cereal) on the weight of overweight children and their family	None explicit	Family members asked to increase walking by at least 2000 steps per day above baseline and to consume 2 servings of cereal per day (breakfast and snack)	Overweight or at risk for overweight children, ages 8–12, and a parent	All families participate in intervention together
Sääkslahti et al. (2004)	To evaluate the effects on children's physical activity over 3 years of a parent-education intervention versus a no-intervention comparison group.	Social Learning Theory	2 annual hour-long educational meetings with parents focused on children's physical activity; participants provided with ideas and resources for increasing children's physical activity levels	Preschool-aged Finnish children	Only parents involved in intervention, though outcomes are measured in children
Stern et al. (2006)	To present formative research leading to the development of a weight management intervention among African American girls and to present baseline results from the intervention.	None explicit	Individualized program focusing on nutrition, exercise, and behavior modification, using self monitoring.	2 part study 1: Overweight daughters, mean age 14, and their mothers 2: Obese daughters, ages 11–17, and a primary caretaker	Daughters and mothers participate together
Teufel-Shone et al. (2005)	To present a case study describing the development, delivery and outcomes of a family based diabetes education intervention, *La Diabetes y La Unión Familiar*.	Social Learning Theory	"La Diabetes y La Union Familiar" provided 10 contacts over 12 weeks, focused on teaching team-building and communication skills; provision of information on food choices and physical activity; and celebratory events. Used games, educational flip charts, stories, food sampling and preparation, and low level-physical activities.	Diabetic patient and supporting family members (some of whom were children)	Family participates in intervention
Warren et al. (2003)	To compare the effectiveness of a control, dietary, physical activity, and combined dietary-physical activity school and family-based interventions for prevention of obesity in children 5–7 years old.	Social Learning Theory	Interactive nutrition and/or physical activity curriculum was delivered over 20 weeks through lunchtime clubs.	Children, ages 5–7	Worked with parents to overcome barriers to the desired health behavior.
Wilfley et al. (2007)	To examine the relative efficacy of two weight management interventions	None explicit	16 weekly sessions. 20 minute family treatment and 40 minute separate child and parent groups. Dietary	Overweight children (20%–100%), 7–12 years old and at least one parent	Parents and children participated in individual sessions together and in group sessions separately.

Authors (Year)	Study Objectives	Explicit theoretical framework cited	Description of Intervention	Target of Intervention	Intergenerational component
	(behavioral skills maintenance and social faciliation maintenance) compared to a conrol condition following a standard family-based childhood obesity treatment program.		modification (traffic light diet), physical activity, and behavior change skills (self monitoring and goal setting). 3 conditions: behavioral skills maintenance, social facilitation maintenance and usual care.		
Williams et al. (2004)	To present a description of a randomized controlled trial testing the efficacy of a family based intervention to increase physical activity among individual at high risk for diabetes	Theory of Planned Behavior	Face-to-face, telephone, and/or mail contacts focusing on education, goal setting, strategies to increase physical activity, and self-monitoring with pedometers	Inactive, non-diabetic adult-children of diabetics, ages 30–50	Family participation is encouraged in intervention

Table 3

Research Design and Findings

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
PILOT/FEASIBILITY STUDIES								
Beech et al. (2003)	60 (100%)	Child *						Recruitment and retention goals can be met
Cullen & Thompson (2008)	67 families (82%)					Child x Adult x		Failure to meet log-on rate goals and declining participation may be attributable to inadequate intervention dose. The positive change in mediating psychosocial variables suggests that Web-based programs can be successful if more attention is paid to recruitment.
Northrup et al. (2008)	Approximately 1,250 students and 825 parents	Child Ø	Child Ø					Addressing childhood obesity may be accomplished through the school setting and outreach to parents. Optimal programs should be flexible and include and desirable incentives.
Ransdell, Robertson, Ornes, & Moyer-Mileur (2004)	37 participants (43% control: 93% intervention)		Child and Adult: * x	Child and Adult: * xa	Child and Adult: Ø			Pilot results indicate that further research is needed on involving 3 generations of women in a home-based intervention to improve physical activity and fitness levels. Study limitations, especially small sample size and a high drop-out rate in the control group, should be addressed in future research to determine whether this intervention is efficacious or effective.
Rodearmel et al. (2006)	105 families (77%)	Child and parent: *	Child and parent: *		Child and parent: *			The intervention was successful in increasing steps/day and cereal consumption. The intervention had positive, significant effects on percentage BMI-for-age and

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
								percentage for body fat for children and weight, BMI and percent body fat for parents.
Warren et al. (2003)	213 children (83%)	Child: *x*			Child: Ø	Child: *x*		School is an appropriate setting for children's health interventions. Future interventions should have multiple components with a behavioral focus and include all children in the school, targeting the whole environment and striving to be sustainable.
Quasi-experimental studies (no controls)								
Cookson et al. (2000)	1387 children (27%)		Child: *x*					Low-cost Family Fun Pack is effective in promoting healthy lifestyle modifications, particularly among those with the intention to change behavior.
Grassi et al. (1999)	202 adults, aged 18+ (56%)		Ø			X		Strong family and communities ties facilitated involvement; word of mouth was the best recruitment tool. Low costs, flexibility of participation, involvement of family members were incentives to participate. The actual decrease in physical activity hours reported may stem from over estimation at baseline and inaccurate recall.
Harrington et al. (2005)	575 families (71%)							Successful interventions require optimal program completion. For this project, the main predictors of program completion were: participation in program kick off night; interactive family style; having several adults and several children in the household; having parents who are married; having a relatively high income; and being African American. To

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
								best implement the program requires understanding issues specific to each family and initial program experience. Participation, but not outcome, data are reported
Klohe-Lehman et al. (2007)	91 parents (39% of those who attended the first class)	Child: ^{x} Parent: ^{x}	Child: ^{x} Parent: ^{x}		Child: ^{x} Parent: ^{x}			Weight loss classes for women of low socioeconomic status appeared to improve several facets of energy balance in overweight and obese mothers and their 1–3 year old children.
Levine et al. (2001)	24 families (67%)				Child: ^{x}	Child: ^{x}		Children who completed the family based intervention lost a significant amount of weight and reported significant improvements in depression, anxiety and eating attitudes
Lytle et al. (2006)	16 schools, 3600 students						Food environment: ^{*Ø} Healthier grocery choices: *	Intervention school parents reported healthier grocery choices, however no differences were observed in a home food inventory. Intervention schools had healthier a la carte offering and purchases, but no increases in regular meal fruit and vegetable sales.
Sääkslahti et al. (2004)	228 children (86% control, 84% intervention)		Child: ^{*x}					Children's physical activity levels can be increased through programs that focus primarily on parental education.
Stern et al. (2006)	39 daughters and mothers							A family-based approach shows promise for weight loss, as daughters and mothers differed in their perception of weight, and such differing perceptions will shape programming. Article provides baseline data only

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
Teufel-Shone et al. (2005)	72 families	Adult: *	Adult: *			Adult: *		A promotora-delivered intervention is feasible and results in an improvement in knowledge of risk factors for diabetes and self-efficacy to change food and activity behaviors.
Randomized control trials								
Anand et al. (2007)	57 households (89%)	Household: *	Household: Ø		Household: Ø	Household: Ø		While this household-based intervention had some positive results and trends, a more comprehensive intervention is needed to address both individual change and structural barriers in the community.
Caballero et al. (2003)	1704 children (83%)	Child: *	Child: Ø		Child: Ø	Child: *		Intervention resulted in reduction of energy from fat and improvements in health knowledge and behaviors, but no impact on activity levels or body fat. Intervention also resulted in a reduction of self-reported recall of energy intake, but did not show a similar reduction in direct observation of energy intake.
De Bourdeaudjuij and Brug (2000)	40 families (88%)	Child: x Adult: x						Both tailored and general nutrition education letters improved diet, but only mothers received additional benefit from tailoring the letter.
De Bourdeaudjuij et al. (2002)	180 participants (79%)	Child: x Adult: x				Child: x Adult: x		Tailored nutrition education letters were associated with decrease in fat intake for only those already eating above-recommended levels of fat. Psychosocial determinants of fat intake were affected similarly with the tailored individual and the tailored family letters.
Eisenmann et al. (2008)	1359 children (65%)							To develop a broad range series of intervention

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
								activities aimed at reducing screen time, increasing physical activity, and enhancing nutrition requires extensive, transdisciplinary partnerships and multiple players. Focus is on design and implementation of intervention; outcome dat not reported.
Epstein et al. (2000)	90 families (84.4%)				Child: * Parent: Ø	Child: x Parent: *		Problem solving did not add to treatment effectiveness beyond the standard family-based treatment.
Epstein et al. (2004)	63 families (95%)	Child: x	Child: x		Child: x			Obese children assigned to the treatment that included stimulus control and reinforcement to reduce sedentary behaviors had equivalent decreases in BMI z-scores, improvements in diet, decreases in sedentary activities, and increases in physical activities.
Epstein et al. (2008)	41 families (66%)	Child: *			Child: *	Parent: *		Focusing on increasing fruit and vegetable and low-fat dairy intake led to a greater reduction in BMI z-scores than focusing on reducing high energy-dense foods.
Fitzgibbon et al. (2002)	24 Head Start programs							Energy balance is best achieved through prevention and early intervention and prevention approaches. Authors provide the rationale and details on study design for an upcoming RCT.
Golan et al. (2006)	96 parents and children (95%)				Parents only group for children only: * Parents and children in the parent- child group: Ø	Parent only and parent-child group: Ø	Household food environment: Ø	Combined child and parent interventions are less likely to bring weight loss to obese children than sessions attended only by parents. Omitting the child from intervention activities is more likely to result in weight loss and sustained weight loss at

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Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
								one year follow up. Involving parents only shows a slight, though not statistically significant, improvement in obesogenic habits in the home.
Golan et al. (1998)	60 children (17% dropout)				Child: *			Treatment of childhood obesity with the parents as the exclusive agents of change, induces more behavioral changes as well as greater weight loss, than the conventional approach.
Gombosi et al. (2007)	4,241 K-8th graders	Child: Ø						Addressing childhood obesity and overweight from a broad, multiple environmental perspective is challenging because of the potential for inadequate penetration of educational and information dissemination, relatively long lag time, and a growing trend toward obesity.
Harvey-Berino & Rourke (2003)	43 child mother pairs (93%)	Child: Ø	Child: Ø Parent: v Ø		Child: Ø Parent: Ø	Parent: Ø	Child feeding practices: *	A home-visiting program focused on changing lifestyle behaviors and improving parenting skills shows promise for obesity prevention in high- risk Native-American children.
Hopper et al. (2005)	238 3rd graders	child Ø				Child: *		The school curriculum can be adjusted and obtain minor changes in knowledge of exercise and nutrition. Adding the family component may help round out the educational content.
Janicke et al. (2008)	93 families (76%)	Child x			Child: * Parent: Ø			At 10 months children in parent only intervention and family based intervention had a greater decrease in BMI z score compared with children in control condition.

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
Kalavainen et al. (2007)	70 7–9 year olds (87% control; 99% intervention)				Child: *			Family-based group therapy that emphasized a healthy lifestyle and was given separately for children and adults is an effective way to treat obese children.
Müller et al. (2001)	414 children, 92 families	Child: x	Child: x		Child: *	Child: x		Health behavior education, delivered through the school setting, and social support are valuable components for future interventions.
Nemet et al. (2008)	22 children		Child: *	Child: *	Child: *			The multi-component, intensive, weight management, family-oriented intervention was effective for obese children with obese parents. The intervention led to reductions in body weight, BMI, and sedentary activity as well as improvements in fitness.
Ransdell, Eastep, Taylor, Oakland, Schmidt, Moyer- Mileur, & Shultz (2003)	34 (70% control; 100% intervention)		Parent: x Child: x	Parent: x Child: x		Parent: x Child: x		Both home-based and university-based physical activity programs for mothers and adolescent daughters may be efficacious in improving short-term physical activity levels, physical fitness levels, and mother- daughter relationships of participants.
Robinson et al. (2008)	294 girls in 271 families							Recruitment efforts for the RCT were successful. Only baseline descriptive data are currently available.
Wifley et al (2007)	150 families (81%)				Child: *	Child: *		Weight control was significantly better in the active maintenance treatments (behavioral skills maintenance group and social facilitation group) compared to the control group (usual care) in the short term (4months) but the effects diminished after 2 years.

Author (Year)	Reported N (retention or participation rates, if available)	Outcomes reported						Key Conclusions Reported
		Diet	Physical activity	Physical fitness	Anthropometrics	Psychosocial constructs	Other	
Williams et al. (2004)	365							This intervention, The Pro Active trial, represents the first efficacy trial designed to increase physical activity in a high-risk group. No outcome data reported in this description of RCT.

[a]Direction of effect for one physical fitness outcome (mile walk time) favored the control group.

Key to "Outcomes Reported" columns in Table 2:

*-- denotes statistical significance compared to control group

x-- denotes statistical significance compared to baseline

Ø-- denotes no statistically significant findings

Table 4

Type of Programming						Setting					Intervention Delivery Target			
cation	Therapeutic group sessions	Physical activity sessions	Monitoring/goal setting	Environmental	Other	Home	Community	School	Research center	Unspecified	Generations combined	Generations separated	Older generation only	Younger generation only
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		•				•	•					•		
		•		•				•				•		
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Type of Programming						Setting					Intervention Delivery Target			
Education	Therapeutic group sessions	Physical activity sessions	Monitoring/goal setting	Environmental	Other	Home	Community	School	Research center	Unspecified	Generations combined	Generations separated	Older generation only	Younger generation only
						•							•	
		•	•			•		•			•			•
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Type of Programming						Setting					Intervention Delivery Target			
cation	Therapeutic group sessions	Physical activity sessions	Monitoring/goal setting	Environmental	Other	Home	Community	School	Research center	Unspecified	Generations combined	Generations separated	Older generation only	Younger generation only
			•			•								•
	10	17	17	4	3	18	11	10	9	3	24	18	6	5
	46	46	11	8	49	30	27	24	8	65	49	16	14	

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