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A Review of Family and Environmental Correlates of Health Behaviors in High-Risk Youth

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Abstract

Disparities in the prevalence of obesity in youth place minority and low socioeconomic status youth at increased risk for the development of chronic disease, such as metabolic syndrome and type 2 diabetes. Contributing factors to the increases in obesity include a decline in positive health behaviors, such as making healthy dietary choices, engaging in physical activity, and limiting sedentary behaviors. Family and physical environmental contextual factors related to health behaviors are increasingly the focus of health behavior interventions in line with the bioecological model that encourages a system-focused perspective on understanding health behavior influences. Physical environmental characteristics, such as home and neighborhood characteristics and resources, provide the tangible means to support health behaviors and are important contextual variables to consider that may increase intervention effectiveness. Therefore, the current review seeks to highlight the importance of investigating influences of behavior beyond individual characteristics in understanding factors related to the risk of developing metabolic syndrome and type 2 diabetes in youth at high risk for developing chronic disease. The current study reviews the non-intervention literature on family and physical environmental factors related to health behaviors (i.e., diet, physical activity, and sedentary behavior) in youth who are considered to be at-risk for developing metabolic syndrome and type 2 diabetes. Results on 38 published articles of diet, physical activity, and sedentary behaviors showed support for the role of parenting and physical environmental factors, particularly parental monitoring and neighborhood context, such as social cohesion, as they relate to health behaviors in high-risk youth. Implications and recommendations for future research are discussed.

INTRODUCTION AND SIGNIFICANCE OF THE PROBLEM

The rising prevalence rates of obesity in youth have caused major public health concern (1). Obesity has been linked with increased risk for the development of chronic diseases such as cardiovascular disease, type 2 diabetes, stroke, and cancer (2), as well as early onset effects in youth including psychosocial problems (e.g., depression), orthopedic problems, dyslipidemia, and increased blood pressure (3). From an economic standpoint, obesity has been associated with estimated medical costs of over $78 billion and estimated indirect costs of over $65 billion per year in the United States (4). Of further concern is the rate of obesity in minority adolescents who are between 1.13 and 1.73 times more likely to be overweight compared to white youth, and this disparity only increases into adulthood (1). The rising rates of obesity are due, in part, to the imbalance in energy expenditure related behaviors (i.e., poor diet, low physical activity (PA), high levels of sedentary behavior). Research has

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shown that less than 10% of adolescents are meeting PA recommendations, less than 20% are meeting fruit intake recommendations and less than 11% are meeting vegetable intake recommendations (5,6).

The rates of metabolic syndrome and type 2 diabetes in children and adolescents have risen dramatically and are likely, in part, due to rising rates of obesity (7). While definitions of metabolic syndrome in adolescents vary, some common characteristics include over-weight, insulin resistance, dyslipidemia, and high systolic blood pressure (7). Type 2 diabetes in adolescents is characterized by increased plasma glucose concentrations related to insulin resistance or insulin deficiency (8). National studies have shown a prevalence rate of metabolic syndrome at ~23% in over-weight or obese youth (9), and up to 50% in severely obese youth (10). Overweight youth have been shown to increase their risk for developing metabolic syndrome by 1.55 times for every one-half unit increase in BMI (10), and ~85% of obese youth displayed at least one risk factor for metabolic syndrome compared to only 20% of normal weight youth (7). Similarly, prevalence of type 2 diabetes is significantly related to obesity status and is more common among ethnic minority than white youth (11).

Previous research has shown that racial/ethnic disparities in insulin resistance persist even when controlling for BMI (12). The increased risk of metabolic syndrome in low socioeconomic status (SES) populations appears to be largely related to behavioral and biological factors and, thus, emphasizes the need for effective health behavior change interventions in high-risk youth (13). For example, high levels of sedentary behavior have been associated with the development of pediatric metabolic syndrome (14). Furthermore, changing health behaviors seems to be an effective prevention strategy. Indeed, PA has been associated with decreases in insulin levels in a 6 year longitudinal study (15) as well as decreased risk factors for metabolic syndrome including insulin resistance, systolic blood pressure, and lipids, with moderate PA exceeding 60 min per day (16). These studies show that the development of obesity, metabolic syndrome, and type 2 diabetes in minority adolescents is specifically associated with health behaviors; however, risk factors are not yet well understood. These data are particularly concerning given that metabolic syndrome in childhood has been shown to predict adult metabolic syndrome, type 2 diabetes, and cardiovascular disease 30 years later (17).

Interventions aimed at treating obesity, commonly through modifications to PA, sedentary behaviors, and dietary habits, have demonstrated only modest effects over time (see ref. 18 for a review), particularly in high-risk groups (19). For example, several large scale trials aiming to reduce risk of chronic disease have shown statistically signifi-cant but relatively modest changes in behavior, such as a 10% decrease in the proportion of previously inactive youth (20), an 8-min increase in vigorous PA (21), a 1% decrease in fat intake (21), or a half serving increase per day in fruit and vegetable intake (22). While interventions to reduce sedentary behaviors, particularly television (TV) viewing, have been more successful (23), research on these interventions is in its earlier stages compared to interventions related to improving PA and nutrition. Furthermore, health behavior interventions have been even less effective in minorities (19). Overall, these studies indicate the need for gaining a better understanding of important correlates and predictors of PA, healthy diet, and sedentary behaviors in at-risk adolescents before effective interventions can be developed to increase positive health behaviors. For the purpose of this review, health behaviors are defined as including dietary intake (e.g., fruits and vegetables, fat, nutrients, fast food), sedentary behaviors (e.g., screen time) and PA (e.g., leisure PA, moderate-to-vigorous PA).

A BIOECOLOGICAL APPROACH

Interventions for youth obesity have been modestly effective and often do not produce long-term change (24,25). A strong relationship between adolescent and adult obesity has been consistently demonstrated with correlations ranging from 0.46 to 0.91 (26), which reinforces the importance of developing effective prevention programs for reducing the rate of adolescent obesity. The bioecological model has been an important theoretical framework for understanding health behavior change and obesity prevention in youth and constitutes the framework for the current review (19,27,28). A bioecological approach to understanding health behaviors incorporates genetic/biological, intrapersonal, social, environmental, and cultural variables and assumes simultaneous interactions across levels of influence (27,28). The bioecological model describes the interaction of variables at different levels or systems: the intrapersonal level (individual characteristics, such as genetics and motivation), the micro-system (influences external to but directly experienced by the individual, such as family and peer factors), the meso-system (interaction of micro-systems, such as families and institutions), the exo-system (influences external to the individual that do not involve the individual directly, such as a parent's workplace in the case of a child), and the macro-system (consistencies across the lower order systems that exist at a cultural or sub-cultural level) (27). The bioecological model, while being widely referenced, has not been effectively utilized in conceptualizing and testing the influences on health behavior (29,30). For example, studies often do not measure multiple levels of influence on behavior and may not examine reciprocal relationships.

PURPOSE OF THE PAPER

An understanding of the social contextual and environmental influences on health behaviors is key to understanding individual intrapersonal factors and subsequent behavior (31). Furthermore, physical environmental characteristics, such as home and neighborhood characteristics and resources, provide the tangible means to support health behaviors and are important contextual variables to consider. Therefore, the current review seeks to highlight the importance of investigating influences of behavior beyond individual characteristics in understanding factors related to the risk of developing metabolic syndrome and type 2 diabetes in youth at high risk for negative health trajectories so as to better inform intervention development.

Given the increasing prevalence of obesity and its relation to later chronic disease problems, such as metabolic syndrome, type 2 diabetes, and cardiovascular disease, it is imperative that researchers gain an understanding of the multiple influences involved, particularly in high-risk youth (e.g., youth who are of minority, low-SES, or overweight status) that are often not the focus of other reviews (32–35). Additionally, existing research has focused little on social and environmental variables. Therefore, the goal of the present review is to further our understanding of the role that family, home, and neighborhood environmental factors have on PA, dietary, and sedentary behaviors in youth who are at high risk for chronic disease. Specifically, family variables, including parental support, monitoring, and parenting style, and environmental variables, including home and neighborhood resources and characteristics, will be reviewed as they influence PA, diet, and sedentary behaviors in youth at risk for metabolic syndrome and type 2 diabetes. This review will focus on summarizing the general relationships and methodological limitations and making recommendations for how these variables can be incorporated into future research studies and interventions targeting at-risk youth.

EXPLICATION OF FAMILY AND ENVIRONMENTAL FACTORS

Parental support for health behaviors

In an ecological model, parental support is included to capitalize on the social context provided by the parents and has been defined in many different ways including social, emotional, tangible or instrumental support, and through modeling (36,37). However, parental support may be broadly conceptualized as any parent behavior that assists the youth in achieving a desired goal or outcome, such as eating a healthy diet, engaging in PA, and limiting sedentary activities (36). Examples of types of parental support for diet, PA, and sedentary behavior include, (i) parental encouragement and praise (i.e., social or emotional support) for the child to eat healthy foods, engage in PA, and avoid sedentary behaviors, (ii) purchasing and serving healthy foods, and providing transportation to activities, (i.e., tangible or instrumental support), and (iii) fixing a healthy meal together or engaging in an activity with the child (i.e., modeling; 36). Parental food intake, PA, and sedentary behaviors when measured were included as parental support and conceptualized as modeling behaviors. Recent reviews have summarized the parental support literature in the PA and diet domains in the general youth population (35,38).

Parenting style and monitoring surrounding health behaviors

Parenting style concerns the parent– child interaction independent of content and reflects the degree to which parents provide acceptance and behavioral control (39). In this review, aspects of behavioral control and acceptance are specific to health behaviors (40–42). For example, do parents set rules and limits regarding health behaviors with a warm, accepting interaction style? Parental monitoring captures the behavioral control parents provide independent of their interaction style (e.g., permissive, strict, or warm) for youth PA, diet, and sedentary behavior and is a determinant in the assessment of parenting style (39). Previous literature (40–45) has applied the concept of parental monitoring to health behaviors such as keeping track of and limiting what youth eat and what physical and sedentary activities youth are engaging in.

Physical environmental factors related to health behaviors

Physical environmental factors can include a variety of home, neighborhood and school variables (32). However, the current review will focus on home and immediate neighborhood factors related to health behaviors. Examples include the availability of healthy foods in the home, the availability of equipment, resources, and space to be physically activity at home, neighborhood access to PA facilities, neighborhood safety, and neighborhood social characteristics, such as community connectedness. These factors, from a bioecological perspective, are intended to capture the resources through which individuals are able to achieve their health behavior goals.

SELECTION CRITERIA FOR INCLUSION OF STUDIES

A search for studies examining parenting and physical environmental variables was conducted using indexed article databases, article references, and recommendations. PsycInfo, Academic Search Premier, and PubMed (Medline) were searched using family related search terms (e.g., parenting, family meals, family support, parental support, monitoring, parenting style, etc.), physical environmental related search terms (e.g., built environment, home resources, neighborhood factors, etc.), and health behavior related search terms (e.g., PA, exercise, sedentary behavior, screen time, diet, fruit and vegetable intake). The current review aimed to summarize recent literature (1995–2010) since the publication of some key reviews on correlates of diet and PA in broad youth populations

(33–35). Study abstracts and full-text articles were then reviewed to assess for inclusion and exclusion criteria.

Definition of at-risk

Studies were included in our review if they sampled adolescents and preadolescents ranging in age from 10 to 18 that were determined to be "at-risk" for developing metabolic syndrome or type 2 diabetes. Our definition of at risk was based on previous studies which indicate that obesity and central adiposity are highly correlated with risk for metabolic syndrome (7); and that ethnic minorities and those of low SES are at increased risk for obesity, metabolic syndrome, and type 2 diabetes (1,11). Thus our definition of at-risk for the current review was: (i) overweight, defined by mean sample BMI in the overweight or obese range (i.e., BMI at or above 85th percentile for sex and age or unadjusted BMI over 25.0) or at least 50% of the sample was categorized as overweight, (ii) comprised predominantly of ethnic minorities, defined by at least 40% of the sample identified as nonwhite, or (iii) comprised predominantly of youth of low SES, defined by at least 40% of the sample being low SES. A requirement of 50% ethnic minorities or youth of low SES would have excluded several studies with sufficiently diverse samples to generalize to high-risk youth. Important metabolic parameters, such as elevated blood pressure, glucose, insulin, or HbA1c were also included to determine high-risk samples; however, no studies examined these markers in adolescents who were not already diagnosed with diabetes.

Excluded studies

Studies were excluded if they were (i) not peer-reviewed, (ii) qualitative, (iii) the sample was predominantly adolescents who had already received a diagnosis of metabolic syndrome or diabetes (either type 1 or type 2), (iv) examined the effects of an intervention, or (v) did not provide sufficient information to determine if the sample was at-risk. Studies focusing on adolescents who had already received a diagnosis were excluded because the focus of the current review is on preventing the onset of chronic disease. It is possible that the relationships between social contextual and physical environmental variables and health behaviors are different in adolescents who have already received a diagnosis and require treatment. For example, monitoring may be more directed at medication compliance as compared to health behaviors. The focus of the current review was to summarize cross sectional and longitudinal studies that examine the influences of several social and environmental variables in order to determine the strength of associations independent of interventions, which may enhance these effects or relationships. Therefore, interventions were not included in the current review.

Classification of study results

Studies were classified as (i) showing either a positive or negative statistically significant relation (indicated with a + or - sign), (ii) showing no statistically significant relations (indicated with a 0), or (iii) showing mixed findings with some variables and outcomes being statistically significant and some variables or outcomes not showing statistically significant results (e.g., in studies with multiple variables assessing parenting, family, or environmental relations, studies with stratified analyses, or studies with multiple indicators of the health behavior outcomes of interest such as F&V intake, whole grain intake, fat intake, etc.; indicated with a ?).

Effect size calculation

To aid in summarizing the studies in the current review measures of effect size were calculated for studies reporting statistically significant results (46,47). Effect sizes were reported for bivariate relations of social environmental variables of interest and health

behavior outcomes. Reported Cohen's *d*, correlations, and *t*-statistics were extracted from published studies and converted to proportion of variance accounted for (46,47). If information to calculate bivariate effect sizes was not available, estimates of overall R^2 were reported when available. Variance accounted for was described as small ($R^2 < 0.10$), medium ($R^2 < 0.25$), or large ($R^2 < 0.40$) according to guidelines suggested by Cohen (47). Many studies examining diet as an outcome included multiple dietary outcome measures (e.g., fruit and vegetable intake, fat intake, dairy intake, etc.). In studies where multiple models or correlations were used comparisons were made between outcome-specific independent variables and the specific diet outcome (e.g., availability of F&V with F&V consumption but not with dairy consumption). When multiple informants were used (e.g., parents and youth), the youth's self-report was used for analysis. When results were stratified the eligible subsample (i.e., within the age range) or subsample at higher risk (i.e., minority, obese, inactive) were used. When results were stratified by sex effect sizes were calculated for both boys and girls separately.

REVIEW OF THE EMPIRICAL LITERATURE

Study descriptive information

Table 1 presents articles reviewed as they relate to family variables such as parent support and monitoring. **Table 2** presents articles reviewed as they relate to environmental variables, such as access to resources and safety for health behaviors. From 38 published papers (consisting of 12 diet, 24 PA, and 8 sedentary behavior articles including repeat articles assessing more than one health behavior), 24 original studies of youth published between 1997 and 2010 were reviewed with 66% published during or after 2005. From the published papers, sample sizes ranged from 54 to 7,907. Approximately 5% ($n = 2$) of the published papers had a sample size less than 100, 26% ($n = 10$) had a sample size between 100 and 500, and 71% ($n = 26$) had a sample size greater than 500. Cross-sectional designs were used by 87% ($n = 33$) of studies, a cohort design was used by 3% ($n = 1$), and longitudinal designs were used by 13% ($n = 5$ from two original studies). About 24% ($n = 9$) incorporated only family variables, 37% ($n = 14$) incorporated only environmental variables, and 39% ($n = 15$) incorporated both family and environmental variables. These statistics were similar across the three health behaviors, with the notable exception of the majority of longitudinal studies ($n = 4$ from one original study) occurring with dietary behaviors. Over 84% ($n = 32$) of studies were conducted in the United States. About 16% ($n = 6$) of studies included female subjects only, and the rest included both sexes. Of concern, only 41% of studies assessed both parenting and environmental factors.

Measures of health behaviors were overwhelmingly assessed using self-report. Overall, 84% ($n = 32$) used self-reported health behaviors, and 16% ($n = 6$) reported objective estimates of health behaviors. For diet, 100% used self-report with a questionnaire or interview and none used 3-day random dietary recall. For PA, 79% ($n = 19$) used self-report measures and 21% ($n = 5$) used accelerometer estimates. Sedentary behaviors were measured by self-report 88% ($n = 8$) of the time. Effect sizes given as a proportion of variance accounted for were calculated for significant results and showed effects were generally small (0.01–0.14; see **Tables 1** and **2**; 47).

Parental support for health behaviors

Twenty-five studies examined the effects of parental support on health behaviors in at-risk youth (3 examined more than one health behavior, 9 examined dietary variables, 11 examined PA, and 2 examined sedentary behavior). Including all forms of support (i.e., tangible, emotional, and modeling), nine studies (36%) found a positive relationship (43,44,48–54), five (20%) found no relationship (55–59), and 11 (44%) found mixed

support (37,45,60–68) for the role of parental support in adolescent health behaviors. In studies that examined parental modeling (n = 10), two (20%) found support (44,54), three (30%) found no relation (56,58,65), and five (50%) found mixed support (45,48,66–68) for the role of parental modeling in youth health behaviors. Not including results on modeling, 18 studies looked at other forms of support (i.e., encouragement, concern, tangible support), nine (50%) found support (43,48–53,54,65), five (28%) found no relation (37,56,57,59,63), and four (22%) found mixed support (60,62,64,66) for the role of parental support in youth health behaviors. Results were similar across health behaviors. Proportion of variance accounted for ranged from small to medium (ranged from 0.01 to 0.11). Taken together, these studies provide modest support that parental support is positively associated with health behaviors in at-risk youth, and indicate that parental modeling may exhibit a more complex relationship with adolescent health behaviors.

Parenting style and parental monitoring surrounding health behaviors

Only one study examined the effect of parenting style on dietary outcomes. This study showed authoritative parenting style was associated with increased family meals (69). While several studies have supported the effectiveness of authoritative parenting style in increasing health behaviors in general (40–42), there is a paucity of research on at-risk youth.

One aspect of parenting style, behavioral control, has been studied more frequently. Three studies examined the effects of behavioral control through parental monitoring on health behaviors in at-risk youth (one examined all three health behaviors and two examined sedentary behaviors). All three studies found moderate to strong relationships with parental monitoring and health behaviors, and a notably strong negative relationship to sedentary behaviors (43–45). It is important to note monitoring was measured generally (i.e., not with regards to a specific health behavior) and was predictive of all three health behaviors (43). Some studies examined the effect of having parents present at meals and showed mixed effects (37,59,61). It seems to simply have a parent present at meals may not be sufficient to increase healthy eating, and the establishment of formal, explicit rules and limits is needed. Proportion of variance accounted for ranged from small to medium (0.04–0.08). Overall, the literature supports the use of parental monitoring to increase health behaviors in at-risk youth and demonstrates the need for more studies on the role of specific parenting styles in influencing at-risk youths' health behaviors.

Environmental factors for health behaviors

Home availability/access—Thirteen studies examined home availability or access to environmental supports for health behaviors, including availability of healthy foods, serving, PA equipment, and TV location. Five (38%) studies (37,44,45,63,64) showed a positive relationship, two (15%) showed no relation (56,70), and 6 (46%) showed mixed results (55,58,59,67,71,72) for home availability and access to environmental supports for positive health behaviors. Preparing food had a positive effect on diet, but when adolescents purchased their own food, they were more likely to make unhealthy choices (43,71). In five studies assessing family meal frequency, family meal frequency showed mixed relations with healthy diet in two studies (61,63), showed no relation in one study (55), was associated with home availability but not healthy diet in one study (37), and was not associated with fast food restaurant use in one study (59). Proportions of variance accounted for by home availability variables were generally small (0.02–0.05). Overall, no consistent conclusions could be reached about the influence of home environmental factors on adolescent health behaviors in at-risk youth. These studies suggest home availability and access to resources may be related to health behaviors in at-risk youth, but further research is needed to clarify the relationship, particularly in regards to PA and sedentary behaviors.

Neighborhood availability/access and the built environment—Fifteen studies examined neighborhood access and built environment factors as they relate to PA and sedentary behaviors. Five (33%) studies showed relationships in the expected directions (i.e., a positive relationship between access and PA, a negative relationship between neighborhood SES and sedentary behavior, or a negative relationship between negative environmental characteristics and PA) (37,49,52,73,74), five studies (33%) (53,56,57,75,76) showed no relationship, four studies (27%) showed mixed results (58,77–79), and one study (7%) showed an effect in the unexpected direction (i.e., a positive relationship between neighborhood hazards and PA) (80). Some studies reported no relationship to overall PA but also examined self-reported park use, which showed a positive relationship with access (58,73,76). Some studies also showed positive relationships with environmental characteristics (e.g., availability of space, access to equipment, adult supervision, crowdedness) (73), but none reported associations with aesthetics (77,78). No studies examined the effects of neighborhood accessibility on individual dietary outcomes. Proportions of variance accounted for by neighborhood factors were small to medium (0.02–0.11). Overall, these studies suggest that availability of neighborhood resources for PA may not be related to general PA but are associated with increased use of the neighborhood resources and/or that key moderators should be considered.

Neighborhood safety—Twelve studies examined neighborhood safety as it relates to PA and sedentary behaviors. Five (42%) showed a positive relationship (49,70,77,78,81) while six (50%) showed no relationship (52,57,73,76,79,80) to PA or sedentary behaviors though one (8%) reported a relationship with park use (58). Proportions of variance accounted for ranged from small to medium (0.02– 0.11). These results indicate neighborhood safety may be related to PA and sedentary behaviors; however, the mixed results indicate the need to consider other environmental factors as well. When considering sex as a moderator, results were more interpretable. Studies that examined sex as a moderator consistently showed girls' but not boys' PA and sedentary behaviors were related to neighborhood safety but did not show a relation in the combined sample.

Neighborhood social factors—All four studies examining social neighborhood factors reported associations with PA (49,75,78,81). Positive social factors included characteristics such as social cohesion, social environment, and social influences, and negative social factors included social disorder. These variables capture the social aspects of the broader neighborhood context and include characteristics such as seeing people being physically active in one's neighborhood, the absence of neighborhood social conflict, and the presence of neighborhood social bonds (75). Proportion of variance accounted for was small (0.01), and most studies did not provide adequate information to calculate effect sizes. These studies provide support for the influence of neighborhood social factors in at-risk youths' health behavior though the effects are relatively small.

Behavior specific results

Results were fairly consistent across behaviors, and studies that examined more than one health behavior (43,54,65,72) generally showed stable associations for parent and environmental factors. However, some notable differences were observed. Home accessibility largely focused on availability of healthy and unhealthy foods and access to devices that facilitate sedentary behavior (i.e., computers, TVs, video games, etc.). Few studies examined home accessibility for PA (53), and instead focused on neighborhood accessibility (56–58,73,75–77,79,80). However, results from other reviews have failed to show consistent associations between home PA resource accessibility and PA in white youth (32,82). Additionally, no dietary studies focused on neighborhood accessibility or neighborhood social factors in at-risk youth though several studies have established a

relationship between neighborhood accessibility and increased BMI cross-sectionally (83,84) and longitudinally (85). These studies also show that low SES neighborhoods and increasing food prices most negatively aftect families of low SES and are predictive of higher BMI.

Self-report vs. objective measures

Health behavior assessment methods greatly limit the interpretability of the results due to bias in self-reporting. In the current review, objective measures tended to show fewer and weaker relationships with PA and sedentary behaviors, particularly for measures of environmental access for PA (e.g., Geographic Information Systems and coded videos). Studies using accelerometer estimates of PA or sedentary behavior also showed weaker relations compared to self-report (58,66). Effect sizes for self-reported health behaviors ranged from small to medium (0.01–0.14) and were generally small with objective measures (0.003–0.01). Dietary studies did not report the use of any objective measures. Some studies used interview techniques, but no studies of at-risk youth used the gold standard of 3-day random dietary recalls. Furthermore, some dietary and sedentary behaviors were measured using a single variable (e.g., How many of the last 7 days did you eat at fast food restaurants?). Discrepancies across health behaviors in the use of objective measures of the environment as well as accelerometer estimates of PA may be contributing to the lack of finding significant relationships between PA and environmental access variables.

DISCUSSION

Given the increasing prevalence of obesity and its relationship to later chronic disease problems, such as metabolic syndrome, type 2 diabetes, and cardiovascular disease, it is imperative that researchers gain an understanding of the multi-level risk factors involved, particularly in high-risk groups such as youth who are overweight, minority, or of low SES. Furthermore, little research has focused on both intrapersonal characteristics as well as social and physical environmental variables. The purpose of the present review was to further our understanding of the role that parenting, home, and neighborhood environmental factors have on PA, dietary, and sedentary behaviors in youth who are at risk for metabolic syndrome and type 2 diabetes. To that end, the current review found support for some parenting and physical environmental factors for health behaviors, particularly parental monitoring and neighborhood social factors.

Research on family context and parenting has been shown to be important for influencing PA, diet, and clinical outcomes in youth. Consistent with the bioecological model, results from the current review suggest that parent factors, including parental support, parenting style, and monitoring are related to health behaviors in at-risk youth. Specifically, the majority of studies examining parental support (independent of parental modeling), including tangible and emotional support, found same evidence for a positive relation to health behaviors. One study showed that parenting factors were predictive of home availability of healthy foods but not directly related to adolescent dietary intake (37) highlighting that factors at multiple levels are important to consider. The studies examining parental role modeling showed less consistency. This could be due to sex differences in child related factors (e.g., importance of parental support) or in parent factors (e.g., type of support given, sex of parent providing support; 36,38). It may also be that modeling is more important for younger youth. The current review included studies that spanned a wide age range. A limited number of studies examined the effects of age; therefore, conclusions about differences in social-environmental factors and health behaviors based on age could not be made. Two studies seemed to show stronger effects in older compared to younger adolescents (56,69), two studies showed no differences by age (43,62), and the remaining studies did not examine age effects or controlled for age of participants. As most research

studies include primarily mothers in studies of support and may be limited in the age range of participants, a comprehensive picture of sex and developmental differences in parental support and health behaviors is not yet available.

Some of the mixed associations of parenting factors to health behaviors shown in the current review may be related to cultural factors and perceptions. For example, research has shown that only 44% of African American caregivers perceived their children's overweight or obesity to be a problem, despite the fact that 57% of the sample was obese and 12% were extremely obese (86). Other qualitative research among low-income families has also shown that many felt their diet and PA levels were already good (87). If parents and families, and thus, likely their youth, are not perceiving overweight or obesity as a problem, attention to and support for health behaviors may be limited and varied. Furthermore, no studies in the current review examined broader family contextual relationships, (e.g., family conflict) despite research showing adolescents' adherence to diabetes management is improved through family systems approaches (88). Future research should examine additional family contextual characteristics in a preventative manner, which may help provide a more comprehensive picture of family environment and parenting factors in at-risk populations.

Studies examining the effects of parenting style or parental monitoring are very promising. While little parenting style literature exists on high-risk youth, the relationships between authoritative parenting style and health behaviors in the general population suggests it may be an effective intervention strategy (40,41). Some research in overweight and minority youth has shown parenting style to be related to weight outcomes (89–91). However, parenting style has not been examined as it relates to specific health behaviors, such as diet and PA, in at-risk youth, who may show differences in the relation of parenting style and health behaviors (92). For example, some research has shown interactions of parenting style, monitoring, conflict, and support in overweight versus healthy weight children (89,90). Results showed parents of overweight children were more restrictive, displayed twice as many maladaptive behavior control strategies (e.g., permissive and authoritarian strategies), and provided less support for their children during mealtimes when compared to parents of healthy weight children, but levels of overall positive involvement were similar. It is also important to note that while the children in some of these studies were considered high risk, only one (90) included an ethnically diverse sample. However, potential differences in parenting style with at-risk youth emphasize the need for research on this diverse population, particularly measurement development (see ref. 91 for an example). The studies on monitoring in the current review also support the utility of this line of research across health behaviors, particularly surrounding screen time (43–45).

Environmental factors including home and neighborhood accessibility and built environment, neighborhood safety, and neighborhood social factors were also significantly related to health behaviors, in general. Though there is a lack of studies examining neighborhood characteristics as they relate to dietary habits in at-risk youth, studies on PA, and to a lesser degree sedentary behaviors, were promising. Additionally, several studies have established a relationship between neighborhood accessibility and increased BMI in adults as well as children cross-sectionally (83,84) and longitudinally (85). These studies also show low SES neighborhoods and increasing food prices, which most negatively affect low SES families, are predictive of higher BMI. Future research should continue to investigate neighborhood factors in individuals' healthy dietary choices and weight outcomes as well as potential mechanisms for and moderators of the relationship, such as risk and protective factors in the home, social, and physical environment.

Though several studies failed to show relationships in neighborhood and health behavior outcomes, it is important to keep in mind that environmental studies more frequently used

accelerometer measures of PA and Geographic Information Systems measures of neighborhood characteristics, which have been shown to have weaker correlations than self-report measures with outcomes (66). Furthermore, while studies of environmental factors have established relationships to health behaviors in youth not at high risk (82), it may be that these relationships differ when considering at-risk youth. Indeed, it is likely minority adolescents display different risk factors for obesity and metabolic disorders than white youth due to additional biological, social, and environmental stressors (e.g., genetic susceptibility, maternal gestational diabetes, cultural norms regarding acceptable weight, increased access to fast food) (19). It has been shown that although SES is inversely related to childhood obesity, higher SES does not seem to protect minorities against obesity, indicating biological factors such as genetic risk may be particularly important (93). While the current review did not consistently show neighborhood environmental factors were related to health behaviors, future research should continue to explore these relationships as other reviews have demonstrated these relationships, with the exception of home resources, are important in youth who are not at high risk (32,82). It may be that potential moderators of the relationship are not being accounted for. For example, some neighborhood factors may be associated with PA only if safety is not a concern or are related to increased light and moderate PA but not vigorous PA. Additionally, neighborhood environmental factors are multifaceted and may be difficult to summarize accurately in composite variables (i.e., a single variable which captures more than one neighborhood characteristic).

It has been suggested that the effectiveness of obesity interventions may be improved through an ecological approach to conceptualization of the problem and approach to behavior change on multiple levels (i.e., individual level, social and environmental factors) (19). However, the current review showed that only about 41% of studies assessed both parenting and environmental factors. While the attention to at-risk youth is increasing, research successfully incorporating multiple levels of influence on health behaviors in at-risk youth continues to be scarce. The current review provides one example of how multiple ecological levels may be incorporated into research designs (i.e., parenting and social-environmental factors); however, a wide array of multilevel approaches should be considered by researchers. Examples of several interesting and comprehensive studies are available in youth not at increased risk, including those that focus on multiple levels of behavioral influences (20,21). Still, results from these interventions remain modest indicating our lack of understanding of correlates, moderators, and mechanisms at work in changing health behaviors. One comprehensive study focusing on at-risk youth has been recently reported (94). Despite the comprehensive design including social marketing, healthy eating, increasing PA, and decreasing sedentary behaviors using intrapersonal, family, and school level intervention components, the HEALTHY study did not successfully modify diabetes risk among at-risk youth (94). While, modest or ineffective intervention results seems to be the state of the health behavior change field, this is particularly concerning for at-risk youth. The limited success of interventions, in both general and at-risk populations, may indicate more biological factors such as genetic risk and other approaches to conceptualizing multiple ecological levels also need to be included in future research. It is important to note that the field is increasingly exploring genetic and epigenetic factors related to the development of obesity, which are key biological influences (30).

The methodological limitations in the current review represent an important area for researchers to improve upon. The review overwhelmingly found that cross-sectional designs are most often used to assess factors associated with health behaviors in at-risk youth. While five published articles, primarily on dietary behavior, reported longitudinal results, only two unique studies were represented. Differential attrition by race/ethnicity in longitudinal studies has also been shown (95) and highlights the need for longitudinal studies on at-risk youth. Additionally, health behaviors were measured via self-report in 86% of the studies in

the current review, emphasizing the need for more objective measures of health behaviors or multiple reporters, who may hold different perspectives, when objective measures are not feasible. Differences in effect sizes of self-report vs. objective measures may be contributing to the range of effect sizes and some inconsistent results shown in the present review (96). Estimates of R^2 as well as modest effect sizes also indicate that many studies are not accounting for a large percentage of variance in health behaviors, which emphasizes the complexity of the behavior but also a need for more psychometrically sound measures. Furthermore, with 71% of studies having sample sizes greater than 500, studies may often be powered to detect statistically significant changes that are relatively small effects. While several studies included statistics to convey a sense of clinical significance (e.g., minutes of PA) or relative strength (e.g., standardized coefficients) of the effects, there was a lack of utilization of standardized methods of reporting effect sizes (e.g., standardized mean differences or variance accounted for methods). Many studies did not report all the necessary statistical components needed for calculating standard effect sizes (e.g., standard errors, correlations, *t*-statistics, R^2). Future research should be conscious of reporting results in a way that facilitates systematic reviews of the literature.

Strengths and limitations

Strengths of the current review include the focus on high-risk adolescents, which have not been the focus of other reviews of parenting and environmental associations with health behaviors (33–35,82) and the investigation of multiple health behaviors within a bioecological framework. The current review also focuses on adolescence, an appropriate developmental time for prevention efforts. Research has shown discrepancies in low and high SES for PA and sedentary behaviors emerge affer adolescence, and adolescence has been associated with decreases in health behaviors (97), emphasizing the importance of early intervention.

Limitations of the current review should also be considered. Due to the large amount of time adolescents spend in school settings, school-based prevention and intervention programs have been a primary approach used to alter health behaviors and risk for negative clinical health outcomes. However, school level variables were not included in the current review (for a review see ref. 98). Access and availability of healthy dietary choices and safe facilities for PA in the school represent important contextual factors related to PA, diet, and clinical health outcomes that should be considered. Furthermore, it was outside the scope of the current review to examine additional levels of the bioeco-logical model such as interpersonal and other macro- or society and policy level factors. However, these factors should be considered when investigating the influences on health behaviors.

Conclusions and recommendations for future research

The limited effectiveness in reducing the risk of obesity, particularly in the long-term, or in increasing positive health behaviors despite using a variety of strategies (i.e., reduction in TV viewing, increasing PA, improving dietary choices, changing health behavior social climates, providing recreational after school programs) is concerning (21,22,94). This literature and some of the ambiguous findings from the current review highlight the need to increase our understanding of social and environmental predictors of adolescent PA and healthy diet, particularly in high-risk youth in order to minimize the likelihood they will develop chronic diseases such as metabolic syndrome, type 2 diabetes, or cardiovascular disease. The aim of the current review was to summarize parenting and environmental correlates of health behaviors in at-risk youth so as to facilitate more research into increasing effectiveness of health behavior and obesity prevention interventions. In line with a bioecological approach, the current review highlights several recommendations for future research.

- The current review has emphasized the role of the home and environment in affecting health behaviors in youth at high risk for developing chronic disease. Future research should explore these relations, particularly neighborhood social contextual factors such as social cohesion, and how factors at multiple bioecological levels may be influencing them (e.g., moderators).
- While little research is available on monitoring, the current review highlights this construct as an important feature of future research and interventions. General parental support was shown to have inconsistent effects on youths' health behaviors in the current review, which may be a function of the variety of types of social support (e.g., tangible vs. emotional) as well as omission of key moderators.
- Future research should seek to develop more valid measures of parenting, family, and home environment variables in high-risk youth and should be conscious of their inextricable link. Given that parents largely control home environments, pure environmental influences are difficult to separate from family and parent factors. This may help to disentangle the inconsistent effects of the home environment on health behaviors highlighted in the present review.
- More research is needed on parental beliefs about sedentary behaviors specifically. Parental support as it relates to sedentary behaviors was only measured as support for activity and fitness. Given PA and sedentary behaviors are rarely conceptualized as opposing ends of the same spectrum, behavior specific psychosocial correlates should be targeted in future research.
- Future research should investigate parenting style related to health behavior outcomes (e.g., diet, PA, and sedentary behaviors), particularly with high-risk populations who may show differences in parenting and family factors.

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Table 1

Studies on family and parenting factors for health behaviors

Study	Health behavior			N	Sex	Age	At-risk criteria	Design	Outcome measure	Family variables, relation[c] (outcome variable)	Effect size[d]
	PA	Diet	Sed B								
Adkins *et al.*, 2004 (57)	X			52	F	8–10 years	BMI	CS	Accelerometer	Parent support 0 (PA) Family environment 0 (PA)	n/a n/a
Anderson *et al.*, 2009 (51)	X			433	MF	8–10 years	BMI	CS	Self-report	Parent value of sports + (PA)	–
Arcan *et al.*, 2007 (68)[a,b]		X		509	MF	11–21 years	Minority	L	Self-report	V Modeling + (intake) F & Dairy Modeling 0 (intake)	.03–.07 n/a
Befort *et al.*, 2006 (55)		X		228	MF	12–15 years	Minority subsample	CS	Self-report	Family meals 0 (F&V intake)	n/a
Berge *et al.*, 2010 (69)[a,b]		X		806	MF	12–15 years	Minority	CS & L	Self-report	Authoritative parenting style + (Family meals)	.03–. 10
Bungum & Vincent, 1997 (56)	X			852	MF	11–12 graders	Minority	CS	Self-report	Parent modeling 0 (PA) Parent support 0 (PA)	n/a n/a
Burgess-Champoux, *et al.*, 2009 (61)[a,b]		X		667	MF	12–18 years	Minority	L	Self-report	Family meals – (fast food) Family meals + (V, calcium, fiber, and nutrients) Family meals 0 (energy intake, soft drink)	0.01–0.07 0.02–.07 n/a
French *et al.*, 2001 (59)[a]		X		4,746	MF	11–18 years	BMI	CS	Self-report	Family meals 0 (fast food) Parental concern 0 (fast food)	n/a n/a
Hanson *et al.*, 2005 (67)		X		902	MF	7–12 graders	Minority	CS	Self-report	Parent modeling ? (F&V, dairy intake)	0.00–0.07
Hohepa, *et al*, 2007 (62)	X			3,471	MF	9–13 years	Low SES	CS	Self-report	Parent encouragement ? (PA)	–
Kitzman-Ulrich *et al.*, 2010 (60)	X			669	MF	11–12 years	Minority	CS	Accelerometer	Boys: Parent support + (PA) Girls: Parent support 0 (PA)	0.004 n/a
Larson *et al.*, 2010 (63)[a,b]		X		792	MF	16–18 years	Minority	L	Self-report	Parental support 0 (intake) Family meals ? (intake)	n/a Overall R^2=0.28-0.31
Larson *et al.*, 2006 (64)[a]		X		4,079	MF	11–18 years	BMI	CS	Self-report	Parent support ? (calcium) Parent support 0 (dairy) Parent support 0 (milk intake)	0.00–0.002 n/a n/a
Lown & Braunschweig, 2008 (50)	X			72	F	3–8 graders	Minority	CS	Self-report	Parent support + (PA intentions)	0.00–0.18

Study	Health behavior			N	Sex	Age	At-risk criteria	Design	Outcome measure	Family variables, relation[c] (outcome variable)	Effect size[d]
	PA	Diet	Sed B								
McGuire *et al.*, 2002 (65)[a]	X		X	900	MF	7–12 graders	Minority	CS	Self-report	Girls: Parent fitness ? (PA), – (SedB) Parent modeling 0 (PA), 0 (SedB) Parent support + (PA), 0 (SedB) Boys: Parent fitness 0 (PA), – (SedB) Parent modeling 0 (PA), ? (SedB) Parent support + (PA) – (SedB) Parent modeling? (SedB)	0.00–0.02, 0.02 n/a 0.02, n/a n/a, 0.02 n/a, 0.00–0.05 0.07, 0.02
Moore & Harre, 2007 (43)	X	X	X	433	MF	13–16 years	Low SES	CS	Self-report	Parental monitoring + (healthy foods & PA) Parental monitoring – (unhealthy foods) Parental monitoring + (eating breakfast) Family cohesion + (healthy foods) Family cohesion – (unhealthy foods) Family cohesion + (eating breakfast)	0.04 0.08 0.08 0.06 0.03 0.03
Motl *et al.*, 2007 (52)	X			1,655	F	16–18 years	BMI	CS	Self-report	Social support + (PA)	0.11
Neumark-Sztainer *et al.*, 2003 (37)[a]		X		3,957	MF	11–18 years	Minority	CS	Self-report	Social support 0 (intake) Social support + (availability) Family meals 0 (intake)	Overall R^2 = 0.13
Neumark-Sztainer *et al.*, 2003 (53)	X			201	F	14–18 years	Minority	CD	Self-report	Social support + (PA)	.06
O'loughlin *et al.*, 1999 (54)	X		X	2,285	MF	9–13 years	Minority	CS	Self-report	Parent modeling + (PA) Parent support + (PA) Parent modeling – (SedB) Parent support – (SedB)	–
Prochaska *et al.*, 2002 (66)	X			138	MF	11–13 years	Minority	CS	Accelerometer Self-report	Parent support + (self-report PA) Parent support 0 (accel. PA)	0.02 0.01
Ries *et al.*, 2008 (49)	X			377	MF	13–18 years	Minority	CS	Self-report	Parent support + (PA importance)	–
Ries *et al.*, 2009 (58)	X			329	MF	9–12 graders	Minority	CS	Accelerometer Self-report	Parent modeling 0 (PA)	n/a
Sabiston & Crocker 2008 (48)	X			857	MF	15–18 years	Minority	CS	Self-report	Parent support + (PA) Parent modeling ? (PA) Parent beliefs + (PA)	0.07 0.01-0.03 0.05-0.06

Study	Health behavior			N	Sex	Age	At-risk criteria	Design	Outcome measure	Family variables, relation[c] (outcome variable)	Effect size[d]
	PA	Diet	Sed B								
Springer *et al.*, 2010 (44)			X	734	MF	9–10 years	Minority	CS	Self-report	Parent modeling + (SedB) Parent monitoring – (SedB)	–
Van Zutphen *et al.*, 2007 (45)			X	1,926	MF	4–12 years	Low SES	CS	Parent-report	Parent monitoring – (SedB)	0.04

CS, Cross-sectional; F&V, Fruit and Vegetable; F, Female; FFRU, fast food restaurant use; L, Longitudinal; M, Male; MVPA, moderate-to-vigorous physical activity; P, Prospective; SedB, Sedentary behavior.

[a] Indicates Project EAT-I sample.

[b] Indicates Project EAT-II sample. Only original results are summarized for studies examining the same sample.

[c] Relations were 0 = no significant relation, + = positive relation, – = negative relation, ? = mixed results.

[d] Effect sizes were calculated for significant results as percentage of variance accounted for. Overweight or obese = ≥85th percentile, obese = ≥95th percentile.

Table 2

Studies on physical environmental factors for health behaviors

Study	Health behavior			N	Sex	Age	At-risk criteria	Design	Outcome measure	Environmental variables, relation[c], (outcome variable)	Effect size[d]
	PA	Diet	SedB								
Adkins *et al.*, 2004 (57)	X			52	F	8–10 years	BMI	CS	Accelerometer	Neighborhood Availability 0 (PA) Safety 0 (PA)	n/a n/a
Arcan *et al.*, 2007 (68)[a,b]		X		509	MF	11–21 years	Minority	L	Self-report	Availability 0 (F&V, dairy intake) V & Dairy Served + (intake)	n/a 0.05–0.07
Barr-Anderson *et al.*, 2008 (72)[b]	X	X	X	781	MF	11–12 graders	BMI	CS	Self-report	TV – (PA) TV + (SedB) Girls: TV ? (F&V) TV + (Sweet bev) TV 0 (Fast food) TV – (Family meals) Boys: TV ? (F&V) TV 0 (Sweet bev) TV 0 (Fast food) TV – (Family meals)	0.00–0.01 0.02–0.05 0.00–0.01 0.01 n/a 0.02 0.00–0.03 n/a n/a 0.02
Befort *et al.*, 2006 (55)		X		228	MF	12–15 years	Minority subsample	CS	Self-report	Meal setting + (fat intake) Availability 0 (F&V intake)	0.02–0.14 n/a
Brown *et al.*, 2008 (70)			X	7,907	MF	4th graders	Minority	CS	Self-Report	Community crime + (Sed B)	–
Bungum & Vincent, 1997 (56)	X			852	MF	11–12 graders	Minority	CS	Self-report	Availability 0 (PA)	n/a
Cradock, *et al.*, 2009 (75)	X			680	MF	12 & 15 years	Minority	CS	Self-report	Neighborhood social cohesion + (PA) Neighborhood availability 0 (PA)	0.01 n/a
Durant *et al.*, 2009 (73)	X			187	MF	12–18 years	Minority	CS	Self-report	Park environment + (PA) Park safety 0 (PA) Street Environment + (PA) Street safety 0 (PA)	0.05 n/a 0.02 n/a
Evenson *et al.*, 2007 (77)	X			1,554	F	6 graders	Minority	CS	Accelerometer	Safety + (PA) Neighborhood Aesthetic 0 (PA) Neighborhood access + (PA)	–

Study	Health behavior			N	Sex	Age	At-risk criteria	Design	Outcome measure	Environmental variables, relation[c], (outcome variable)	Effect size[d]
	PA	Diet	SedB								
Gomez *et al.*, 2004 (79)	X			177	MF	12–13 years	Minority	CS	Self-report	Access 0 (PA) Safety 0 (PA) Crime 0 (PA) Girls: Access 0 (PA) Safety + (PA) Crime – (PA) Boys: Access + (PA) Safety 0 (PA) Crime 0 (PA)	n/a n/a n/a n/a 0.05 0.11 0.10 n/a n/a
French *et al.* 2001 (59)[a]		X		4,746	MF	7–12 graders	BMI	CS	Self-report	Availability un/healthy foods ? (fast food)	0.00–0.02
Hanson *et al.* 2005 (67)[a]		X		902	MF	7–12 graders	Minority	CS	Self-report	Girls: Availability + (F & V intake) Availability sweet drinks – (milk intake) Availability milk at meals 0 (milk intake) Boys: Availability milk at meals + (dairy intake) Availability sweet drinks 0 (dairy intake) Availability F&V 0 (intake)	0.05 0.02 n/a 0.06 n/a n/a
Larson *et al.*, 2006 (71)[a]		X		4,746	MF	11–18 years	BMI	CS	Self-report	Food preparation + (F&V intake) Meal shopping 0 (nutrient intake) Girls: Food prep + (F&V intake) Food prep – (sweet drinks) Boys: Food prep + (F intake) Food prep – (fast food)	
Larson *et al.*, 2010 (63)[ab]		X		792	MF	16–18 years	Minority	L	Self-report	Availability + (intake)	–
Larson *et al.*, 2006 (64)[a]		X		4,079	MF	11–18 years	BMI	CS	Self-report	Availability + (calcium)	0.03–0.04
MacLeod *et al.*, 2008 (74)			X	787	F	9–10 years	Minority	CS	Self-report	Neighborhood socioeconomic status – (SedB)	–
Molnar *et al.*, 2004 (81)	X			1,378	MF	12–15 years	Minority	L & CS	Parent-report	Neighborhood safety + (PA) Neighborhood Social disorder – (PA) Neighborhood Physical disorder 0 (PA)	–
Mota, Ribeiro, & Santos, 2009 (78)	X			162	F	13–16 years	BMI	CS	Self-report	Neighborhood access + (PA) Neighborhood safety + (PA) Neighborhood infrastructure, aesthetics, connectiveity, and access 0 (PA) Neighborhood social environment + (PA)	–

Study	Health behavior			N	Sex	Age	At-risk criteria	Design	Outcome measure	Environmental variables, relation[c], (outcome variable)	Effect size[d]
	PA	Diet	SedB								
Motl *et al.*, 2007 (52)	X			1,655	F	16–18 years	BMI	CS	Self-report	Neighborhood Access + (PA) Neighborhood safety 0 (PA)	0.02 n/a
Neumark-Sztainer *et al.*, 2003 (37)[a]		X		3,957	MF	11–18 years	Minority	CS	Self-report	Availability + (intake)	–
Neumark-Sztainer *et al.*, 2003 (53)	X			201	F	14–18 years	Minority	CD	Self-report	Cost/lack access 0 (PA)	n/a
Ries *et al.*, 2008 (49)	X			377	MF	13–18 years	Minority	CS	Self-report	Negative neighborhood environment – (PA)	–
Ries *et al.*, 2009 (58)	X			329	MF	9–12 graders	Minority	CS	Accelerometer Self-report	Availability + (self-report PA) Availability 0 (accel. PA) Quality + (self-report PA) Quality 0 (accel. PA) Crime 0 (self-report or accel PA)	–
Romero *et al.*, 2001 (80)	X			796	MF	4 graders	Minority	CS	Self-report	Neighborhood hazards + (PA)	0.02
Rosenberg *et al.*, 2009 (76)	X			171	MF	12–18 years	Minority	CS	Self-report	Built Environment Characteristics 0 (PA)	n/a
Springer *et al.*, 2010 (44)			X	734	MF	9–10 years	Minority	CS	Self-report	Availability + (SedB)	–
Van Zutphen *et al.*, 2007 (45)			X	1,926	MF	4–12 years	Low SES	CS	Parent-report	Availability + (SedB) TV on during dinner + (SedB) TV in child's bedroom + (SedB)	0.05 0.02 0.02

CS, Cross-sectional; F&V, Fruit and Vegetable; F, Female; FFRU, fast food restaurant use; L, Longitudinal; M, Male; MVPA, moderate-to-vigorous physical activity; P, Prospective; SedB, Sedentary behavior.

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