ENVIRONMENTAL CONSIDERATIONS IN CHILDHOOD OBESITY PREVENTION
WHICH FACTORS FACILITATE SUCCESS?

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ABSTRACT

Background: The rapidly rising prevalence of childhood on a global scale is closely linked to changes in the environment. Childhood obesity is ranked as one of the most serious challenges to public health in the 21st century. Community-based interventions that pay explicit attention to environmental factors appear most likely to bring success.

Aim: The aim of the review is to identify environmental factors that impact success in community-based childhood obesity prevention interventions.

Method: Ten articles were selected for review through a systematic search with a pre-defined search strategy. A systematic literature review with a qualitative approach and a qualitative manifest content analysis was conducted.

Result: The analysis enabled the definition of three categories and eleven sub-categories related to environment. The three main categories are: built environment, food environment and social environment. The social environment is most frequently and most extensively considered; this is followed by the food environment and, lastly, the built environment.

Conclusion: This review contributes to the emerging literature on feasibility and applicability of intervention components that consider environmental changes. It also demonstrates that there is an urgent need for further documentation; policy makers need evidence-based data in order to mobilize support and justify funding for public health efforts to prevent childhood obesity.

Although a single determinant of success cannot be identified, the analysis shows that community participation and capacity building contribute to the sustainability of interventions and, hence also, to chances of success.

Key words: Childhood, environment, obesity, prevention
INTRODUCTION

According to WHO (2013c), the rapid increase in childhood obesity that has been documented during the past decades is closely linked to societal changes. Economic and social developments resulting from changes in agriculture, urban planning, transport policies as well as food processing, distribution and marketing have all contributed to the global childhood obesity epidemic (WHO, 2013c). Societal changes easily explain why many more meals are consumed outside the home and the associated growth of fast-food chains as well as the increased availability of convenience food-items on the market (Nestle, 2007).

WHO (2013a) estimates that globally there are at least 40 million children under the age of five who are overweight. During the last three decades, the global prevalence of overweight and obesity has increased drastically. The global nature of this problem recently prompted the WHO to coin the term “globesity” (WHO, 2013a). Globally, children living in urban settings are particularly at risk to develop overweight (WHO, 2013b). However, according to the Swedish National Public Health Report 2012 overweight among children in Sweden is more common in rural areas and among children from socioeconomically disadvantaged groups (Hjern, 2012). The contrast between the global trend and the pattern that prevails in the Swedish context highlights the importance of avoiding generalizations and paying attention to context-specific variations in discussions of overweight/obesity.

The rise in overweight and obesity rates represents a growing public health problem. In addition to having negative effects on personal life of individuals and societies, overweight and obesity are recognized causes of numerous non-communicable diseases (NCDs) (WHO, 2010). The severity of overweight/obesity as a public health challenge is widely recognized and has prompted a plethora of public health interventions. The public health efforts aimed at helping children and adolescents overcome weight issues have been particularly prominent. While the basic physical cause of obesity is identical across all age-groups (it is the most immediate result of a chronic imbalance between calorie intake and energy consumption (Nestle & Jacobson, 2000; Huang, Drewnowski, Kumanyika, & Glass, 2009)), patterns of food consumption and exercise vary between different groups.

In the interventions against overweight/obesity, one can observe an emerging interest in the complex interactions between different factors that contribute to the issue. There is an increasing awareness among public health officials that physical and social environments impact the risks of overweight and obesity. One encounters references to the built environment, social interactions, food marketing and prices, levels of physical activity, and food choices among others (Maziak, Ward & Stockton, 2007). These factors are interdependent and interact dynamically (Huang et al., 2009). The careful considerations of these dimensions are reflections of the recognition that behavior-change interventions cannot operate in isolation from the context and the interplay between the obesogenic environment and the child.

This paper reviews ten community-based interventions against obesity aimed specifically at children aged 6-12 years. The goal is to identify the key features of and potentially shared characteristics between the different interventions in order to develop a more accurate and evidence-based understanding of the ways in which considerations of environment impact the success of an intervention.
BACKGROUND

Overweight/Obesity

According to WHO, overweight is recognized as a risk-factor of numerous non-communicable diseases (NCDs), whereas obesity is classified as a chronic disease (WHO, 2000). A simple index of weight-for-height with a result in a BMI-value (BMI = Body Mass Index) is commonly used to define overweight and obesity. The cut-off point for overweight is a BMI of greater than or equal to 25 and for obesity greater than or equal to 30. This measure can provide useful information of prevalence among some groups or populations (WHO, 2013b). For children however, the body mass index varies substantially depending on age and gender and cut-off points related to these factors are not consistently defined. The most commonly used and internationally accepted are the gender- and age- specific percentile curves with cut-off points developed by Cole, Bellizzi, Flegal and Dietz (2000), but other measures are seen. The updated Extended International (IOTF, International Obesity Taskforce) Body Mass Index cut-offs for childhood overweight and obesity from 2 to 18 years are defined as follow (IASO, International Association for the Study of Obesity, 2012):

- 23 overweight (unofficial Asian cut-off)
- 25 overweight
- 27 obesity (unofficial Asian cut-off)
- 30 obesity
- 35 morbid obesity

However, there is no consistent application of one methodology and a variety of percentile methods are used. This makes it difficult or impossible to compare the effectiveness of different interventions with reference to simple changes in BMI (Waters et al, 2011).

Prevalence of Childhood Obesity

During the last three decades, the global prevalence of overweight and obesity has increased drastically (WHO, 2013a) and childhood obesity in particular is assessed as one of the most serious challenges to public health in the 21st century (WHO, no year). Globally, according to IASO/IOTF (2010), up to 200 million school-aged children are estimated to be either overweight or obese and 40-50 million children within this group are classified as obese. In the 27 European Union member states approximately 20 percent of the school-aged children are overweight or obese. Yet, there are significant differences between the individual countries. In Greece, which is topping the list, 44.4 percent of the 10 to 12 years old boys and 37.7 percent of the girls were overweight or obese in 2010; in Italy, 37.2 percent of boys and 34.7 percent of girls are classified as overweight or obese. In the European context, only Turkey, Estonia, France and Romania can demonstrate overweight/obesity rates below 15 percent among both boys and girls. The United States of America registered 35 percent and 35.9 percent for boys and girls respectively in 2003/4; the Australian figures were 22 and 24 percent in 2007 and in India 20.6 for boys and 18.3 for girls in 2007/8. Although the years of measurement and age group classifications differ slightly between the countries (IASO/IOTF, 2010), these figures provide an impression of the scale of “globesity” as a pressing challenge.
Interventions

The interventions that have been implemented in an attempt to prevent childhood obesity vary greatly and have also yielded varying degrees of success. Interventions can take place on different levels (e.g. global, national, and local/community levels); both single- and multi-component interventions can be identified (WHO, 2012). Single-component interventions may yield important insights and can serve as useful start-ups for multi-component or multi-setting programs. However, both the UN and the WHO identify nationwide population-based prevention of childhood obesity as central (WHO, 2012). From a public health perspective there are different possible approaches to address childhood obesity:

- **upstream policies** which target social, environmental and economic conditions that indirectly influence behaviors
- **midstream approaches** address settings such as schools, workplaces and households
- **downstream approaches** are directed towards individuals through health-care clinics or services (Sacks, Swinburn & Lawrence, 2009).

Huang, Grimm and Hammond (2011) emphasize the importance of considering not only effectiveness, but also sustainability, scalability, and the reach of interventions. Sustainability is identified as a key parameter for success. An intervention’s sustainability refers to the potential of long-term pursuit and maintenance. Cost-efficiency, as well as motivation and cohesiveness of key-actors can influence the sustainability of an intervention in a positive way, whereas dependency on subsidies is likely to have a negative influence. An intervention’s scalability refers to the ability to distribute the intervention structure in different contexts and the possibility to – gradually – expand successful local intervention to regional or national levels. The reach of an intervention refers to the capacity to impact several different target-groups or entire populations. An intervention with a limited reach may be very successful within a certain community, but is unlikely to have a strong impact across a larger target population or to be effective in a different context (Huang, Grimm & Hammond, 2011).

The success and effectiveness of an intervention is measured by it outcomes. According to Huang, Grimm and Hammond (2011) both success and effectiveness are highly dependent on three dimensions of intervention. These dimensions are:

- **Top-down vs. Bottom-up**
  - Refers to the initial **locus of intervention drivers**. Top-down interventions are primarily driven by government or large private industries, whereas bottom-up interventions originate in the community or grass-root organizations.

- **Policy vs. Individual behavior**
  - Relates to the **locus of change effected**. Policies are mainly aimed to modify economic, social, and/or physical- environments that enable/restrict individual behaviors. Most documented interventions have focused on changes in individual behavior through skills development, increased knowledge, training and education, but have had limited long-term effects.

- **Public vs. Private sector**
  - Public sector refers to local, regional or national governments, public schools and academic research institutions. The private sector includes companies, industries and private non-profit organizations.
Geographical Foci of Intervention

Among the documented interventions, one finds a clear dominance of United States-focused efforts. This reflects the fact that Public Health (as a distinct field) as well as associated prevention and life-style interventions are well established in the American society (Nestle & Jacobson, 2000). In the United States, obesity is recognized as a public health problem since 1952 and numerous policy guidelines have been published in an attempt to prevent obesity through diet and exercise. However, these guidelines rarely address the environmental and societal influences (Nestle & Jacobson, 2000). Today, the country has one of the highest prevalence of childhood obesity in the world, and spends nearly $150 billion per year on treatments of obesity-related medical conditions (Barnes, 2010). The American culture stresses personal responsibility for choice of life-style; this is clearly reflected in the emphasis on education and development of personal skills in childhood obesity prevention programs (Huang, Drewnowski, Kumanyika & Glass, 2009). During the past decade, the United States has – gradually – built a set of institutions in both academia and the health-care sector that registers and monitors the development of the problem. The economic incentives for interventions are great and, consequently, considerable resources are allocated to preventative measures. The combination of expertise, infrastructure, and resources enable public health researchers in the United States to implement, document and publish design(s), process(es) and result(s) of completed interventions (Executive Office of the President of the United States, 2010).

Community-Based Interventions

Community-based interventions are interventions that pay careful attention to and build upon local contexts and local social structures such as school systems or other existing social structures (WHO, 2012). There are different meanings of the notion “community”. In the available literature, a community is defined as a target population defined by: (i) geographic locality (Wolfenden & Wiggers, no year); (ii) membership of a particular social or religious community (WHO, 2012); or (iii) membership of a social unit that create dimensions of identity, such as a family, social network or neighborhood (Israel et al., 2005).

There are varying approaches to engage with communities. The community-based approaches range from pre-designed interventions that are applied within a local setting to interventions that are developed on the basis of a deep involvement of several sectors and key stakeholders within the targeted community. The engagement of communities and building of partnerships, both within and between communities, serves the purpose of building capacity within communities, create a sense of ownership of interventions and, hence, to increase the sustainability of interventions even after a stipulated implementation period (WHO, 2012). Partnerships, capacity building and ownership are according to WHO (2009) crucial factors in the development of supportive environments and empowerment on both an individual and a community level.

As a result the complexity of factors that influence the development of overweight and obesity as well as the vast differences between the circumstances under which people live their daily lives, the reach and impact of an intervention can differ immensely. Consequently, knowledge about local contexts, including specific possibilities, needs and wishes are crucial
for the development of effective interventions and implementations. The direct involvement of community members throughout the planning/research process facilitates communication and trust between stakeholders and the research team, and also between the community and different stakeholders (National Institutes of Health, NIH, 2012).

The approach known as “Community Based Participatory Research” (CBPR) was developed with a view to enhancing involvement and participation of community members in the research process. This approach brings many advantages such as joining partners, increasing trust and bridging cultural gaps between partners and increasing quality and validity of the research (National Institutes of Health, NIH, 2012).

Evidence suggests that the immediate context(s) is most effectively incorporated into community-level interventions with direct engagement and participation of the constituents. Similarly, interventions that are environmentally suitable seem more likely to be successfully implemented (WHO, 2012), thereby also increasing their chances of positive outcomes. In contrast, short-term interventions and interventions that lack community involvement tend to have limited success and sustainability (WHO, 2012).

Environment

As indicated above, obesity/overweight is increasingly conceptualized a result of the complex interaction between diet, physical activity and the environment (Papas et al., 2007). According to WHO (no year), supportive environments are fundamental to the prevention of obesity. The Sundsvall Statement on Supportive Environments for Health (WHO, 2009), defines four dimensions of the environment: physical, social, economic, and political environment(s). However, in a health context, the term supportive environment is often used and refers to the physical and social aspects of our environment. When considered as a dimension of the supportive environment, the physical environment includes, for example, access to healthy food and the built environment within the local community (WHO, 2009). Environmental changes often depend on policy support, policy changes and long-term funding and/or subsidies in order to be executed (Cheadle et al. 2010). Further on, once implemented, environmental changes require long-term maintenance to bring about the desired effects. This implies that interventions with a strong emphasis on environmental change are highly dependent on factors that influence sustainability (Cheadle et al., 2010)

The Public Health Perspective

The overview presented above reveals that efforts to prevent overweight and/or obesity among children are well established in the public health and health promotion context. Public Health, as defined by the WHO (2013), can be conceptualized as:

“…all organized measures (whether public or private) to prevent disease, promote health, and prolong life among the population as a whole” (WHO, 2013).

The public health approach to childhood obesity is appropriate to address the adverse effect of obesity on health in the population of children and adolescents. The harmful effects of obesity on morbidity and mortality, as well as the high medical and social costs for both
individuals and societies resulting from the persistence of obesity from childhood into adulthood constitute powerful arguments for increased efforts on prevention (Nestle & Jacobson, 2000). Two of the main goals associated with public health efforts are: (i) to identify and monitor populations at risk; and (ii) to assure that all populations have access to appropriate healthcare, health promotion and disease prevention services (WHO, 2013). These explicitly stated goals can be directly related to obesity, i.e. obesity affects different groups in diverse ways with minorities, children and lower-income groups (in developed countries) as high risk groups.

The global scale of the current obesity epidemic often transcends individual control of dietary and exercise patterns (Kumanyika, et al., 2002). This situation calls for action in the form of health promotion strategies. In the Ottawa Charter from 1986, health promotion is defined as the process of enabling people to increase control over and to improve their health (WHO, 2009). Preventive measures of childhood obesity align with cornerstones of the health promotion concept with regard to the development of public health in creating supportive environments and strengthening community actions (WHO, 2009).

AIM

The aim of the literature review that is presented in this paper is:

- To identify environmental factors that impact the success of community-based public health interventions with a view to preventing obesity among children aged 6-12 years

METHOD

The paper took the form of a systematic literature review with a qualitative approach as defined by Green and Thorogood (2009). The review was based on a systematic literature search with an explicit and pre-determined search strategy (Bryman, 2008). In keeping with the aim of the paper, the review focused on ten carefully documented interventions against overweight and obesity among children that had been selected with a view to identifying different environmental factors that can facilitate success. The articles had been selected from two databases relevant to the subject: Cinahl and PubMed. The analysis was performed through a qualitative content analysis as described by Graneheim and Lundman (2004). The review considered the manifest content in the text (what the text says) and was divided into categories (Graneheim & Lundman, 2004).

Systematic Literature Review

As described by Green and Thorogood (2009), the systematic review is a useful tool to examine specific empirical questions. A systematic review of the literature follows an explicit and pre-determined strategy that makes it possible to replicate and update the findings. The review contains specified criteria for inclusion and exclusion of the reviewed articles (Green & Thorogood, 2009). However, as a result of the time restrictions under which this paper was...
developed, and because the existing literature in the field is vast, this study makes no claim to be comprehensive.

Search Strategy

In the research, data identified through systematic searches in two databases were conducted: Cinahl and PubMed. Cinahl and PubMed offer access to a wide range of full-text articles in the fields of health, health care and health innovation. Having consulted with the librarians at the Blekinge Institute of Technology (BTH) and having conducted test searches in other databases, it was determined that Cinahl and PubMed yielded the most and the most relevant results. Academic Search Elite and Science Direct databases were tested and considered less useful for this review.

The search strategy was – of course – developed with reference to the aim of the review and key words were derived from the main focus of the study. Headings-terms were used in Cinahl and MeSH-terms in PubMed. Keywords used were: obesity, community-based, policy-based, and combinations of these. Boolean term AND was used. The decision to include “community-based” and “policy-based” as keywords was based on reference to WHO (2012) that environmental factors and local context (as included in the aim of the study) are most effectively incorporated into these categories of interventions. Results of the searches are presented in Appendix 1.

In the database Cinahl, the subtitle Cinahl Headings was used and the browser-function for the keyword obesity. The subheading “Prevention and Control” was selected with the Scope note:

“Used with disease headings for increasing disease resistance, control of transmission agents, prevention and control of environmental hazards, and prevention and control of social factors leading to disease. Includes immunization and screening.”

The search is documented in Appendix 1:1

In the database PubMed two searches were performed. In the first search the MeSH-term obesity/Prevention and Control and keyword community-based were used. The search is documented in Appendix 1:2

Selection

In order to ensure that only articles that are relevant to the aim were included, the following inclusion/exclusion criteria were developed. A given article was only included in the literature review if it met all of the following criteria:

- It included a description of a community-based public health intervention with a target group of children that covered/included the age-bracket of 6-12 years
- No exclusion of population groups based on gender, race/ethnicity or socio-economic status
- It included explicit considerations of some aspect of environmental context
- It included assessment of outcomes and a conclusion
The minimum duration of intervention was at least five months. It was published between 2007 and 2013 in a peer-reviewed journal. Published in English.

Articles in the field of “public health nursing” were not included because of the focus on health-care sector and treatment of overweight and obesity related diseases. Articles which describe interventions to treat obesity or eating disorders such as anorexia and bulimia nervosa were excluded. The search/selection also excluded articles with an explicit focus on high-risk individuals such as children of obese families and articles that did not include data documenting the outcome(s).

The second search was performed with the same MeSH-term and limitations but the keyword policy-based was applied. The search is documented in Appendix 1:3.

In the selection of articles for inclusion, the title was used as a first criterion; if this did not reveal conclusive information, the abstracts were read. The articles that were deemed relevant were read (and re-read) in their entirety before the final selection was made. The final selection is documented in Appendix 1:4.

**Trustworthiness**

Graneheim and Lundman (2004) emphasize the importance of trustworthiness in qualitative research. The trustworthiness is dependent on credibility, dependability and transferability. Credibility refers to: (i) the ways in which relevant data is collected; (ii) the selection process that leads to the definition of suitable meaning units; and (iii) how accurately the conclusions correspond to the results. The identification of appropriate meaning units and categories that adequately capture the data is important to achieve credibility. Dependability is related to the possible alterations by the researcher over time in the decisions of choice of meaning units and the interpretation of the selected units. Transferability considers the possibility of transferring findings from one study to other settings or groups Graneheim & Lundman, 2004). In keeping with this, careful attention was paid to the selection of meaning units and the accurate understanding and representation of the research that was documented in the reviewed articles. During the process, the meaning units were revised several times in order to reflect an increasingly accurate understanding of the documented research and, hence, to minimize the risk of misinterpretation(s).

**Ethical considerations**

The material included in this review was peer-reviewed and published documentations of implemented interventions with the aim to prevent childhood obesity. When the interventions were developed and implemented, they have been subject to several review processes. At both research institutions and in policy implementations, the development and implementation of interventions are preceded by careful considerations of ethical responsibilities. It is, for example, common practice to protect the identity of the participating individuals; the appropriateness and usefulness of the activities and the measures that are
employed are also carefully reviewed. Because the interventions are aimed at a particularly sensitive target group, i.e. children, it is reasonable to expect that this has received particular attention at each step of the development and implementation of every single intervention.

ANALYSIS

With a view to identifying different environmental factors that can impact success in childhood obesity prevention interventions a qualitative content analysis, as described by Graneheim and Lundman (2004), was applied. Ten articles were selected and included in the analysis. The selected articles are presented in Appendix 2. The ten articles selected were analyzed through a manifest content analysis with the central concepts of: meaning unit, condensed meaning unit, code, sub-category, and category (Graneheim & Lundman, 2004). The articles were read and re-read several times before the meaning units were identified and extracted. The meaning units consist of both whole sentences and parts of a sentence. In the process of condensation the sentences were shortened to be more manageable but the content retained. The content was elevated to a higher logical level and compared to the meaning unit and condensed meaning. Thereafter, a code was created that succinctly described the content attached to the condensed meaning. The codes sharing a commonality were sorted into categories. The categories refer to the content on a descriptive level and a number of sub-categories were allocated to each category to give the analysis increased precision and a clearer structure.
RESULTS

The analysis resulted in identification of three categories: built environment; food environment and; social environment and 11 sub-categories. The categories and sub-categories are presented below in figure 1. An example of the content analysis is shown in Appendix 3. The categories and sub-categories are presented in Figure 1 below.

**Figure 1: Categories and sub-categories**

**Built Environment**

*School garden*

*Active transport*

*Parks and neighborhoods*

**Food Environment**

*School food-environment*

*Retail*

*Restaurants*

**Social Environment**

*Use of CBPR principles*

*Use of EBPH principles*

*Parent outreach*

*Staff outreach*

*Social marketing*

**Built Environment**

*School garden*

School gardens for growing fruits and vegetables were cultivated to increase knowledge about fruits and vegetables and understanding for the production. The school gardens were also used as a tool/additional resource in cooking classes for parents and children. An educational program associated with the school garden was developed and, after a successful pilot intervention, this program was expanded to six schools. The program was developed to increase student awareness and appreciation of locally produced fresh products. The school garden was assessed as an element that contributes to the post-intervention sustainability of the intervention. The CBPR approach (Community-Based Participatory Research) facilitated
both momentum and the community participation that were needed to run a school garden on a long-term basis (Chomitz et al., 2010).

The school garden was also used as a curriculum component. The curriculum component consisted of a school-based holistic nutrition and healthy life-style management program directed at parents, children and school staff. Activity packets were distributed on a monthly basis which among other educational materials included school gardening instructions (Hollar et al., 2010).

“Fruit and vegetable gardens at intervention schools provided a fun and creative addition to the nutrition curriculum that taught children how the nutritious fruits and vegetables served in their school cafeterias, their homes, and in restaurants are raised.”

(Hollar et al., 2010, p. 97)

Active transport

Only one intervention included an element to facilitate and encourage children to walk to and from school or to walk to and from the school-bus stop. The use of CBPR principles made it possible to bring stakeholders together in a campaign that included the development of safe routes school maps, traffic calming tactics, walking contests and participation in the International Walk to School Day (Economos et al., 2007). The policy support for creating complete streets was achieved with the aim to improve walkability and bikability in the neighborhood (Samuels et al., 2010).

Parks and neighborhoods

Improvements in local parks and neighborhood streets were implemented to facilitate and encourage an increase of unregulated physical activity. An agreement that made it possible for children to have access to the schoolyards in the neighborhood outside the regular school days was developed. Influence was exercised on the general plans of land use and plans for redevelopment with a view to improving local parks (Samuels et al., 2010). Parental concerns about safety in the nearby local park were addressed through an agreement with the park-management and the formation of an adult-led after-school program in the park (Correa et al., 2010).

Food Environment

School food-environment

Several different approaches were identified to achieve beneficial changes in the school food-environment. The most common approach were changes in the offerings in vending machines: unhealthy food and snack items and sweetened beverages were replaced with more healthy options (Foster et al., 2008, Benjamins & Whitman, 2010, Chomitz et al., 2010 and Coleman et al., 2012). Modifications in the school menu were undertaken with a view to increasing the intake of foods with high-fiber content, whole grains, fresh fruits and
vegetables. Items with high-glycemic effects such as cereals with high sugar content, and
dishes prepared with processed flour were exchanged (Hollar et al., 2010). A dietitian was
consulted for advice on healthy changes to the “hot lunch program” that was served two
times weekly (Benjamin & Whitman, 2010). The cafeteria stopped selling unhealthy food
items either entirely (Foster et al., 2008) or during the meal times (Coleman et al., 2012). In
the classroom, only non-food rewards were used and unhealthy food and beverages from
home were not allowed (Coleman et al., 2012). For fundraising purposes only non-food
activities were performed (Coleman et al., 2012). Combinations of different components like
modifications in the local involvement, staff training, and the introduction of new healthier
recipes were brought together in one element:

“School nutritionist and consultant chef introduced 15 new recipes emphasizing fresh, local
ingredients; 110 “taste-tests” in 12 schools, including staff coaching to prepare recipe; 4
group technique trainings”

(Chomitz et al., 2010, p. 47).

Observations were done in order to document the interconnections between dietary patterns
and the role(s) of parents:

“Observations documented that when children were allowed to select an item from the
“walk” they always selected the nonfood prizes. When parents selected items they always
selected cakes”.

(Coleman et al., 2012, p. 7)

Retail

There were modifications in the offerings by local shops in the school area (Samuels et al.,
2010). Collaborations with local farmers were established and a local purchase-system was
founded. The CBPR principles facilitated the involvement of local producers of agricultural
products and contributed to the development of different kinds of collaborations between
members of the community. Various “farm-to-school” activities were developed in order to
increase awareness of and knowledge about local production and farming (Chomitz et al.,
2010) and a Farmer’s Market was established (Economos, 2007).

Restaurants

The use of CBPR principles led to the involvement of local restaurants within the
intervention area. Participating restaurants were offered a “SUS Certification” (SUS = Shape
Up Somerville) if they implemented menu modifications that included the incorporation of
low-fat dairy products, option(s) for smaller portion sizes, fruit and vegetables as side-dish,
and if they highlighted the healthier options on the menu (Economos et al., 2007).
Social Environment

Use of CBPR principles

The CBPR approach was applied (Economos et al., 2007, Chomitz et al. 2010, and Coleman et al., 2012) and was described as a facilitator for collaboration, increased participation of communities and local organizations. This in turn facilitated the development of policies that were expected to sustain post-intervention. The community-wide momentum that emerged through the CBPR approach was recognized as an enabler to leverage of resources, enhancing community capacity and building constituencies for support (Chomitz et al., 2010).

“... the surge of innovation and multilevel health interventions served to raise community expectations around children’s health and quality of life”.
(Chomitz et al., 2010, p. 51)

“CBPR is a promising collaborative approach that combines systematic inquiry, participation, and action to address urban health problems”
(Economos et al., 2007, p. 1326)

There was recognition of advantages associated with the use of CBPR principles in the development, implementation and evaluation processes even though it was not explicitly stated that this approach was applied. The CBPR was assessed as a key component for facilitation, capacity building and community ownership of the intervention (Coleman et al, 2012).

However, the CBPR approach was also identified as a barrier to scalability and further dissemination of an intervention due to the requirements of established and lasting relationship(s) with the community of interest.

“There will be a need for communities to establish a method of collaboration to be able to replicate the intervention”. (Economos et al., 2007, p. 1334)

Use of EBPH (Evidence-Based Public Health) principles

”An evidence-based public health approach (EBPH) may be more effective in achieving positive outcomes when trying to change school environments and policies”
(Coleman et al., 2012, p. 2)

When an EBPH (Evidence-Base Public Health) approach was employed (in place of the EBM (Evidence Based Medicine) approach that until recently was more common), the authors/public health officials explained this choice with reference to the former’s emphasis on utilizing, participation and empowerment of stakeholders in the implementation and evaluation of the intervention. This was deemed necessary in order to achieve the desired sustainable changes in the school environment.
Social marketing

In the analysis, social marketing was identified as the most commonly used component. Posters and billboards were used with a view to raising awareness about the intervention among the public (Chomitz et al., 2010) or specifically to the target population (Foster et al., 2008). Raffle tickets were used as a reward for healthy meal participation or for bringing healthy snacks to school. The prices in the raffle were “healthy” prices in the form of bikes, jump-ropes or basketball-hoops instead of until recently used unhealthy food-items or snacks. A commonly used marketing strategy is the use of slogans and easily recognizable characters to increase recognition and build loyalty to a product (branding). This strategy was employed to reinforce health messages through frequent exposure to a specifically developed character and slogans (Foster et al., 2008 and Gentile et al., 2009). In order to increase its chances of success, the interventions employed a number of “catch phrases” that can alert the readers to the factors that the public health officials considered important to the outcome.

“The message “Want Strength? ... Eat Healthy Foods,” paired with an easily recognizable character, reinforced healthy messages through incentives and frequent exposure. Both the slogan and the character were developed through focus groups with students who were not in the study schools, but were of similar age, ethnicity, and socioeconomic status”.

(Foster et al., 2008, p.796)

Regular media placements in TV, radio or in internet (Economos et al., 2007, Gentile et al., 2009, Hollar et al., 2010 and Samuels et al., 2010) were used to increase the exposure of the interventions. Dissemination of other information materials also raised attention to activities (Foster et al., 2008, Gentile et al., 2009 and Correa et al., 2010). Newsletters sent home with the children or as hang-outs on school boards informed of activities of the intervention. Regular placements in the local paper contributed to the dissemination of information (Gentile et al., 2009, Benjamin & Whitman, 2010, Chomitz et al., 2010, and Hollar et al., 2010).

Parent outreach

The CBPR and EBPH approaches facilitated increased outreach to parents. Parental participation in taskforces, advisory-boards, parent-teacher associations and committees were different means to involve parents (Economos et al., 2007, Benjamin & Whitman, 2010, Chomitz et al., 2010 Correa et al., 2010 and Samuels et al., 2010). Parents provided input through forums, meetings and/or focus-groups (Economos et al., 2007, Foster et al., 2008, Benjamin & Whitman, 2010, Chomitz et al., 2010, Correa et al., 2010, and Samuels et al., 2010). Parents were sent individual fitness report cards with information about the individual child’s health status; however, it was emphasized that these reports were not diagnostic (Economos et al., 2007, Foster et al., 2008, and Chomitz et al., 2010). Parents were also utilized as informants and were asked to complete surveys, questionnaires and/or reports (Economos et al., 2007, Gentile et al., 2009, Benjamin & Whitman, 2010 and Samuels et al., 2010). One intervention used the family as the primary leverage point with strong emphasis on parental participation and support n the home environment. In extension of the hypothesis that the positive effect of the program would be greatest in families who were most involved, separate surveys with questions about perceptions of participation, screen-time, and fruit and vegetable consumption were conducted among both parents and children (Gentile et al., 2009).
There was a clear recognition of the important role played by parents in shaping and altering the social environment of their children. Different efforts were made to reach parents with information/education about cooking, nutrition or healthy life-style (Economos et al., 2007, Foster et al., 2008, Gentile et al., 2009, Benjamin & Whitman, 2010, Chomitz et al., 2010, Correa et al., 2010, and Coleman et al., 2012). Parents also received education and training in order to be able to act as advocates or role models for a healthier life-style (Gentile et al., 2009 and Samuels et al., 2010).

“...we offered after-school cooking classes for pairs of students and parents.”
(Correa et al., 2010, p. 10).

However, while strong emphasis was put on parental involvement, the reach and participation of parents was identified as one of the greatest barrier to effectiveness. This was even the case when activities were offered as direct responses to parents’ requests. Work schedules and language barriers were suggested as possible reasons. More advertising and different timings of activities were suggested as possible solutions (Coleman et al., 2012).

Staff outreach

A range of different approaches to involve local staff were performed in the form of education and training. However, the assessments of the usefulness of these efforts were contradictory. In one intervention, it was evaluated as an essential key factor that increased reach:

“Staff development was a key component of the intervention with extensive training not only in the curriculum that was used, but in general concepts of nutrition and PA. This approach resulted in a marked reduction in obesity rates, especially for African American children, when compared to children in control schools”.
(Coleman et al., 2012, p. 14)

However, in another intervention, it was stated that it represents a limitation to sustainability:

“Most previous school-based interventions have utilized tight controls to ensure uniform implementation, but these require frequent staff training and ongoing support. That approach is costly and limits sustainability”.
(Gentile et al., 2009, p. 9)

This intervention used standardized recommendations which allowed parents and teachers to adapt the program and to use the disseminated materials according to their specific needs (Gentile et al., 2009).

Additional staff

Additional staff in form of qualified activity coordinators was employed to achieve changes in the extra-curriculum environment. The activity coordinators were associated with individual intervention school (one part-time equivalent for each school) and were
responsible for developing increased non-curricular activities in recess, at lunch time and after school. The focus was on life-style based activities such as outdoor games, household chores, beach hikes and gardening (Taylor et al., 2007).

DISCUSSION

Method Discussion

The aim of this review is to examine if different aspects of the environment were considered in documented preventive interventions of childhood obesity and, if so, if these considerations contributed to the success of the interventions. To perform a systematic literature review with a view to achieving the stated aim, the principles/parameters defined by Green and Thorogood (2009) were followed and, with reference to Bryman (2011), an explicit and pre-determined search strategy was defined. The selected articles were subjected to a qualitative content analysis with considerations of the manifest content, as described by Graneheim and Lundman (2004).

Selection process

The systematic searches were conducted in two discipline-specific databases: Cinahl and PubMed. Both offer access to a wide range of full-text articles in the relevant field. The first challenge regarded the choice of keywords. The keywords used were selected with a view to framing the subject area. In order to limit the scale of the study and to make the vast amount of material published within the field manageable, the subtitle Cinahl Heading (Cinahl) and MeSH-term (PubMed) were used in combination with limitations and keywords. The keywords “community based” and “policy based” are likely to have defined the principal limitation. However, in order to ensure that the stated aim of the study (i.e. to consider different environmental aspects) was explicitly considered, these keywords were deemed necessary. According to WHO (2012), environmental aspects are primarily included in community-based interventions; and according to Huang, Grimm and Hammond (2011), policy development is the main tool to achieve changes in different aspects of the environment.

When the searches were conducted, ten interventions were identified. Of these ten, all but one were developed and implemented in the North American context. This can be regarded as a weakness of this review. On the other hand, the United States is a key nation-state in the context of childhood obesity. The country has both one of the highest prevalences of childhood obesity and extensive experience with interventions aimed at tackling this problem. Already in 1952, the American Heart Association identified obesity as a modifiable risk factor to other severe diseases (Nestle & Jacobson, 2000). However, eight out of the ten interventions (exceptions are the one implemented in New Zealand and the culturally specific intervention implemented in a particular Jewish community in the United States) have diverse target groups and stratify for gender, race/ethnicity and socio-economic status at the base-line. The diversity and complexity of the target groups within the United States represents a partial compensation for the geographic limitation of the review.
In the systematic search for relevant publications, only two data-bases were used, and this can represent a limitation to the findings of the review. If additional data-bases had been used, it is possible that the number of documented intervention would have increased. However, in order to ensure that the material could be effectively and thoroughly reviewed within the limitations (word-count and time horizon) that are defined for this paper, the findings in the two central data-bases were prioritized and no further searches were performed. It should also be added, that the many overlaps between the findings that are documented in the included publications indicate that the chance of finding further relevant publications and other insights was relatively limited even if additional interventions had been included.

The decision to limit the searches to interventions published after 2007 is based on the recent and documented shift of attention from a primary focus on individual behavior and development of personal skills to the role of different aspects of environment on childhood obesity (Huang, Drewnowski, Kumanyika & Glass, 2009 and Huang, Grimm & Hammond, 2011). The age-bracket 6-12 years is used because a majority of interventions aimed at children includes this group and because interventions aimed at this age group have been found to be particularly effective (Waters et al., 2011).

The systematic searches revealed that numerous interventions have been documented and published. The vast published material offers others the opportunity to benefit from the experience-based and documented results that have been harvested by experienced researchers. However, the vast amount of publications also constitutes the greatest challenge to the execution of this review. It was difficult to select keywords/perform searches that included relevant articles, while also excluding the immense amount of irrelevant material and publications with marginal overlaps. It is possible that the selection of keywords and the limited number of databases and articles that are included will limit the validity of the result. However, the restricted time-frame did not permit a further extension of searches, selection and review.

The inclusion and exclusion criteria were used to assess the quality of the different articles before a final selection was made for the review. The articles which correspond explicitly to all criteria were assessed as “good”. Articles which did correspond explicitly to most criteria, while not conforming completely to one, or at the most two criteria, were assessed as “medium”. Other articles were not included. The assessment of the quality of the articles is presented in appendix 2.

Process of analysis

In order to identify the different components included in the interventions that were selected for review, a qualitative content analysis with considerations of the manifest content was undertaken (Graneheim and Lundman, 2004). The review was performed with a qualitative approach, which means the interventions were studied in their entirety (Graneheim & Lundman, 2004). After the articles were read several times, the selection of the manifest content was done with a view to identifying the specific components that seek to influence the environment. Citations were used throughout the analysis in order to enable the reader to assess the validity of the review. The selection of manifest content facilitated a further step of the analysis, namely the identification of differences between the different researchers’/authors’ perception of approaches and components. For example, differences in
the assessment of the CBPR approach were identified; similarly different authors perceived the utility of the component, “staff training and education” very differently.

The selection of meaning units, condensation, and coding resulted in the analytical distinction between three categories and eleven sub-categories. The three categories are: built environment, food environment, and social environment. The identification of these three categories was derived from the aim of the review, i.e. to identify environmental factors that impact an intervention’s success. If fewer or further categories had been included, it would have increased the risk of data either falling between categories or data fitting in to more than one category. However, according to Graneheim and Lundman (2004), is it not always possible to define categories that are consistently mutually exclusive.

**Result Discussion**

The articles selected for this review all had explicit considerations with regard to some aspect of environmental context in relation to childhood-obesity prevention.

The review identified three different environmental categories that were considered to influence the environment of a child: built environment, food environment and social environment. The first category considers the built environment in the form of parks, neighborhoods, streets, and transportation. The second category: food environment, refers to accessibility, affordability and consumption of different food items. The third category: social environment, concerns norms, customs and social processes that impact health. Here the social environment of the child in forms of family, school and community are considered.

In addition, the review yielded evidence that underline the importance of a comprehensive approach concerning the environments of children. When intervention efforts addressed several areas and when collaborations between community members and stakeholders were developed, the interventions seemed to be more sustainable. In single interventions where a CBPR approach was explicitly used (Economos et al., 2007 and Chomitz et al., 2010) it was possible to develop collaborations independent of the intervention; these are significant because they are expected to continue after a predefined implementation period. These findings correspond to the advantages associated with a CBPR approach as identified by the National Institutes of Health (NIH, 2012). There is a growing recognition among public health researchers of the potential associated with the CBPR approach with regards to the modification of environmental factors (Israel et al., 2005 and Faridi et al., 2007). According to Faridi et al. (2007) some researchers refer to CBPR as “research plus”. This has its foundation in the possible identification of interventions that made use of CBPR-principles, which proved to be both sustainable and suitable for further dissemination. However, the documented results varies and the body of knowledge is considered weak (Faridi et al., 2007). Even so, and corresponding to the assessment presented by Faridi et al. (2007), this review demonstrates that uses of a CBPR approach have many advantages. The single most significant disadvantages of the CBPR approach regard the replication of interventions.
The built environment considers urban planning such as walkability and bikability and land use, transportation such as dependence on cars and access to public transport. Furthermore, it considers access to parks and other green areas such as school and/or community gardens. The influence of the built environment in relation to obesity pattern on a population level is much-debated. Hill and Peters (1998 in Feng et al., 2009) described the importance of the built environment in population patterns of obesity fifteen years ago. The influence of the built environment on obesity patterns in a population is still contested (Cheadle et al., 2010). In the discussion of the correlations between the built environment and weight challenges among children, Davidson & Lawson’s study (2006) found positive associations between children’s physical activity (PA) and the presence of sidewalks, controlled intersections and access to recreational facilities and schools. Dense traffic, crime and area deprivations were found to have a negative association. In contrast, Cheadle et al. (2010) argue that there is no empirical evidence for the claim that changes in the built environment increase physical activity.

The built environment was found to be the aspect of environment that was least frequently and least intensively considered. Active transport such as walkability and bikability aimed at children are often restricted due to the built environment in form missing pedestrian zones, difficulties to cross the roads, dense traffic or high crime rates (Kong et al., 2009). The “Walking School Bus Program” was one component implemented to increase the possibility for children to walk to and from school. The “Walking School Bus Program” is a group of children walking to and from school together with one or more adults (Kong et al., 2009). A pilot study found that the children who were participating in the “Walking School Bus” were walking more. It was found that the “Walking School Bus” was a low-cost intervention, which had potential to reach several different groups in the community. The main barrier to a “Walking School Bus” was found to be the involvement of adults/parents to walk with the children and associated logistical challenges (Kong et al., 2009). The use of CBPR approach in the development and implementation of this kind of efforts may be beneficial.

The cultivation of a school garden was one of the applied components that address the built environment. School gardens have been found to have positive effects on the dietary behavior of children (Parmer, Sailsbury-Glennon, Shannon & Streumpler, (2009). Although knowledge of fruits and vegetables can be improved through nutrition education, it has been found that adding the gardening component increases the likelihood of higher intake of vegetables. Parmer, Sailsbury-Glennon, Shannon & Streumpler, (2009) found a significant increase in preferences for carrots, broccoli, zucchini, and cabbage when a gardening component was included to the curricula. The school garden was found to have further beneficial effects additional to the positive influence of the children. Parents’ participation and contribution to sustainability post intervention were added to the account of the school garden. The educational program developed in connection with the school garden was successfully implemented in additional schools, which is an indicator for the scalability of this component. Lack of resources and access to garden-land, short-term intervention period of intervention and lacking long-term perspective may represent barriers to this kind of component. The CBPR approach was considered as a facilitator of the school garden. With engagement of community members additional resources became available, which in turn increased sustainability to the intervention.
Food environment

Food environment refers to availability and affordability of healthy food and beverage choices within the community venues and accessibility to supermarkets. Food environment also considers eating habits as to what we eat, where we eat and with whom we take our meals (Nestle, 2007). Sweetened beverages, which are frequently sold in vending machines in school environments, are estimated to deliver 13 percent of the daily calorie intake of children in the United States (Executive Office of the President of the United States, 2010). Policies and incentives for local retailers to provide healthier food/beverage choices and support for local producers, can contribute to a healthier food environment. Limitations on advertising for unhealthy products, combined with a menu of options with smaller portion sizes, have similar positive effects (Cheadle et al., 2010). Nestle (2007) describes the influence of the food industry on dietary patterns in quite negative terms. According to Nestle (2007:21), an overheated and highly competitive food market provides no incentives for producers to encourage consumers to eat less, on the contrary. The food environment in schools is decisive to many children’s energy and nutrition intake (Wechsler, McKenna, Lee & Dietz, 2004). Fox, Dodd, Wilson and Gleason (2009) suggest a limitation to children’s access to low-nutrient and energy-dense foods in the school food environment with a view to reducing the total calorie intake. However, according to Cheadle et al., (2010) there is a lack of empirical evidence for the correlation between the increased availability of healthy food items and a healthier dietary pattern.

Throughout the analysis of the food environment, the school food-environment was found to be the aspect that was most frequently and most extensively considered. According to Wechsler, McKenna, Lee and Dietz (2008), the school can play a fundamental role in the prevention of childhood obesity. 95 percent of all young people are enrolled in schools and a large portion of the daily intake of food is consumed in the school environment. Moreover, the school is a setting for learning and there is evidence that school programs can promote healthy eating patterns (Wechsler et al., 2008). Different efforts were made to decrease access to unhealthy items and increase healthier options. Modifications of the offerings in vending machines were the most common effort in the school food-environment. In line with the recognition of the destructive role of sweetened beverages (Executive Office of the President of the United States, 2010), they were replaced by healthier juices, milk or water. In an effort to create a healthier lunch menu, some interventions replaced products whereas another changed to healthier options of some ingredients. In the classroom environment, only non-food rewards were given and only healthy snacks were allowed. The offerings in cafeterias, in vending machines, and in lunch menus were modified.

In one of the intervention areas the restaurants in the neighborhood were approached. Even though it is widely recognized and with strong evidence-base that highly energy-dense foods and snacks and sweetened beverages are not beneficial for children, the access to the aforementioned remains very high in schools and other environments where children are spending time. The findings by Currie, Della Vigna, Moretti and Pathania (2010) showed a significant increase of 5.2 percent in the obesity rate of children in a school with a fast-food restaurant within a distance of one-tenth of a mile. The increase was relative to children in a school with a fast-food restaurant within a quarter of a mile. Policy structures that limit the access of competitive food options such as fast-food restaurants within reach of the school environment could support a healthier food environment.

As emphasized by Huang, Dewnowski, Kumanyika, and Glass (2009), the determinants for the development of overweight and obesity are often beyond an individual’s control. This
applies to both adults (speak parents) and children. Nestle (2007:15ff) describes the interconnected political forces that determines what is produced and in turn what is consumed. The incentives for the food industry and producers to advertise and encourage healthier options and smaller portion sizes are non-existing according to Nestle (2007:15ff). This may be connected to the need of policy support and a top-down approach from the public sector to create sustainable political and economic incentives to change for retailers and producer (Huang, Grimm & Hammond, 2011). However, with only one exception, the interventions included in this review, were driven primarily by a bottom-up approach from the private or the public sector.

The food environment and social environment are closely connected as shown in the example of the “walk” were parents were choosing cakes and, if available, the children always opted for the non-food prices. It may be useful to consider the different components of the CBPR approach in order to adjust the particular design of an intervention with a view to increasing its reach and involve parents with a view to ensuring a more supportive home environment.

### Social environment

According to the WHO (2013), the social environment or the social conditions under which people are living and working have a major influence of people’s health. The social environment can influence the perception of what is assessed as overweight or obesity and also determine if this condition is regarded as detrimental to your health (O’Dea, 2008). Epstein and Wing (1987 in Eisenmann et al., 2008) emphasize the importance of parental and family involvement in obesity interventions for several reasons; (i) obesity often runs in the family and the effectiveness of an intervention may be inhibited of possible counteractive behaviors of other family members; (ii) some parental behaviors may facilitate the development of an unhealthy life-style; (iii) in order to achieve best effects of an intervention, parental support may be needed. According to Eisenmann et al. (2008), the involvement of the family in intervention efforts may lead to changes in the household environment.

The result of the analysis showed that efforts were made to achieve changes on a community level, before, during and after school and on the family and household level.

Changes in the social environment of a child were, in this analysis, found to be the most commonly used component in the interventions. Social marketing strategies and parent outreach were frequently applied. The participation and involvement of parents were assessed as factors of high importance although also afflicted with some difficulties. The education and training of staff was evaluated in different ways: one intervention saw this as a key component to reach a minority group, whereas another found it to create costs and limit sustainability of an intervention.

The principles of social marketing were also frequently applied with a view to achieving changes in the social environment. This may be the result of the multifaceted possibilities of social marketing and the prospect of high reach to different groups. Discussing the relationship between public health and social marketing, A. R. Andreasen (1994) defines the latter concept as:
“Social marketing is the adaptation of commercial marketing technologies to programs designed to influence the voluntary behavior of target audiences to improve their personal welfare and that of the society of which they are a part”

The concept of social marketing builds on the same marketing principles that are used to promote commercial products (Neiger, Thackeray, Barnes & McKenzie, 2003). However, the use of marketing in the field of public health differs from commercial marketing strategies with regards to the objectives of the marketer. Whereas commercial marketing is driven by the interests/benefits of the marketer, social marketing strategies seek to benefit the audience and/or the society at large by influencing specific behaviors. The two forms of marketing both draw extensively on direct communication with a target group, but the information that is sought and the messages that are communicated differ fundamentally. The corner stone of a social marketing strategy is the research and systematic evaluation which deliver information of perceptions, values and needs of the targeted population. This helps to elucidate and shape and re-shape the final product (Neiger, Thackeray, Barnes & McKenzie, 2003).

The social marketing was used on several levels: (i) on a community-level to raise public awareness, (ii) on a school-level to pass health messages to the target populations, and (iii) on a family-level with materials sent home through school or media (internet) to inform about specific efforts.

Parent outreach was found to be a component of high importance.

“Family components are critical for youth obesity prevention programs because parents directly and indirectly influence children's PA and nutrition behaviors at home and also dictate the physical and social environments that are available to their children”
(Gentile et al., 2009, p. 2)

Parents were seen both as facilitators for a healthier life-style, but also as one of the most difficult barriers to cross. As stated by Eisenmann et al., (2008) parental involvement enables changes in the home environment. Parents can serve as “gate-keepers” with regards to access to food or possibilities to physical activity (Eisenmann, 2008). As emphasized above, the social environment considers norms and cultural aspects. According to O’Dea (2008), the perception of overweight and obesity is influenced by the social context. It is therefore possible that some parents do not consider their child as overweight or obese and, consequently, do not recognize the importance of their participation in the activities associated with preventative efforts. Furthermore, it is possible that an obese child is perceived as something positive, as a sign of prosperity and not a health problem. Moreover, many barriers like the lack of a common language and parent’s obstructive time schedules frequently represent challenges to the intervention staff. Encouragement to participation and involvement of community members could be facilitated through CBPR approaches. Communication and trust are crucial factors to overcome different kinds of barriers and can increase the impact of an intervention.

The perceptions of the usefulness of local staff were surprisingly contradictive. One intervention assessed that the local staff who had received extensive training constituted a key factor to success. The present of local staff was associated with a marked reduction in obesity rates of children in a minority group. This must be viewed as a significant success due to the fact that children of minority groups often represent a high risk group with regards
Environmental changes requires sustainability

Environmental changes, such as availability and accessibility of healthy food items or changes in built environment often require policy support (Huang, Grimm & Hammond, 2011). Policies can create incentives for retailers or local producers to create partnerships for enhanced access to healthy and fresh products in under-served areas, or to new considerations of land-use, walkability or public transport (Huang, Grimm & Hammond, 2011). Policy interventions demand extensive time for implementation and, if not well established within the target population, changes implemented through policy can face high initial barriers (Huang, Grimm & Hammond, 2011). This, on the other hand, may depend on subsidies or large initial investments, which in turn may limit the sustainability or operability. As a result of these facts, environmental changes are central to the sustainability of an intervention. To increase the sustainability of an intervention the building of partnerships, capacity building, ownership and high levels of community participation are important factors.

Even though there is a growing support for environmental interventions, the research conducted on the effectiveness of this kind of intervention remains weak. According to Cheadle et al., (2010), there is a general lack of empirical evidence for the correlation between an increased availability of healthy food items and a healthier dietary pattern. Cheadle et al., (2010) also argue that there is no evidence for the claim that changes in the built environment increases physical activity. In contrast, Ewing and Cervero (2001) found that people walk more and drive less in more walkable communities. Corresponding to this, Tremblay and Willms (2003) found that the unstructured physical activity, such as biking and street playing, was more important than organized sports to prevent childhood obesity. Unstructured PA is in many ways connected to neighborhood safety, land-use and design of built environment, which in turn is connected to different policies both on local and national levels. The weak and/or contradictive evidence-base may discourage bodies for funding and decision makers.

Environmental considerations in the description of an intervention are not uncommon, but only a limited number of interventions report changes in environmental components in the presentation of results. This may be due to the fact that it is difficult to measure the extent and impact of environmental changes. In addition, the environmental aspect of a prevention measure is relatively new; there is often a long time span between intervention and published documentation of effects. Finally interventions considering environmental changes in all forms (food, built or social environments) on a population level, need time to deliver effects.

CONCLUSION

The analysis presented in this review reveals that even if the examined interventions are modest in number, they nevertheless contain important evidence. That is, they demonstrate clearly that there is a wide range of elements and combinations of elements that can facilitate the desired effects. However, the analysis has not identified single elements or combinations
of elements that can certify success in childhood obesity prevention interventions. In the analysis, three categories of environmental aspects were identified: built environment, food environment and social environment. The categories were derived from the examined interventions in which the three environmental dimensions are considered to varying degrees. This, combined with recognition of the complexity of the causes that contribute to the increasing childhood obesity epidemic, confirms the need for multi-component and multi-level interventions.

The analysis revealed that the different approaches that enhance community participation, capacity building and ownership contributed to the sustainability of an intervention. Sustainability refers to long-term commitment and maintenance; these factors are recognized as fundamental for successful childhood obesity prevention. The CBPR approach was identified as one tool with which the participation of community members and stakeholders could be increased; this is fundamental to partnership, capacity building, and ownership and to further empowerment of target groups and communities. The interventions that made active use of CBPR principles proved to be more sustainable and were also characterized by higher degrees of participation. Both the increased sustainability and the higher levels of participation are likely to have a positive influence on the potential impact and effectiveness of an intervention.

Changes in the built environment and factors that influence the availability and access to healthy food items, while limiting access to competitive products, often require policy support. Wide reaching sustainable policies must be developed on a governmental level and this is dependent on political support. Policy development can also influence social norms, which in turn can initiate behavior change. In order to mobilize support and, hence, to ensure that public resources are allocated to childhood obesity prevention, policy developers and decision makers depend on a clear evidence-base. As a result, reliable information and documentation of the existing research with clear identification of both successes and continued challenges are crucial for the development of policy-based prevention.

This paper can contribute to the emerging literature on feasibility and applicability of various intervention components that consider environmental changes. Information about possible facilitators such as education and training of local staff or CBPR approaches, can contribute to more informed decisions when future interventions are developed. Barriers in form of parents’ time schedules, lack of a common language or lack of knowledge about the health implications associated with childhood obesity may be easier to cross if they are recognized in the early planning phases of future interventions.

In turn, the sustainability of an intervention is affected by the level of motivation and participation of key actors as well as by funding and/or subsidies. The absence of explicit economic evaluations in the examined interventions combined with the absence of common measures of success make it extremely difficult to assess and identify the relative contribution to success of individual or particular combinations of components. However, this (absence) of definitive conclusions can in itself be of critical importance for future efforts to prevent childhood obesity; i.e. there is a clear and continued need for further documentation.

Although this review did not yield an unequivocal answer to the question about which factors facilitate success, the results highlight the urgent need for applicable tools and comparable measures of outcomes to contribute to the evidence-base. It is likely to be beneficial if this evidence-base can include detailed information about the specific composition of the targeted
population and the context as well as a clear identifications of both what worked and what did not. In extension of this, the researchers’ experience enable them to assess how and why certain elements were successful, if it could work in another context, and if it is cost-effective. The latter point will be of increasing importance; as the global rates of obesity continue to rise, there is a corresponding need and an ethical responsibility to expand prevention efforts with a view to averting the enormous cost – both material and human – that otherwise will face large parts of the world in the not-too-distant future. In addition to highlighting the ethical responsibilities, public health officials will have to document that early intervention is more cost-effective than future cures; without the latter argument, it is unlikely that the necessary funding and political support can be achieved.
REFERENCES


http://www.iaso.org/resources/aboutobesity/child-obesity/newchildcutoffs/
http://www.iaso.org/iotf/obesity/obesitytheglobalepidemic/


APPENDICES


Appendix 1:4: Article selection total

Appendix 2: Overview of selected interventions

Appendix 3: Sample of Analysis
### Appendix 1:1

Article search and selection

Search 1: Cinahl (2013-04-25)

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Article search and selection


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Appendix 1:3

Article search and selection


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Article selection total

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## Appendix 2

Overview of selected interventions

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<td>1</td>
<td>Benjamins, M. R &amp; Whitman, S. (2010). A Culturally Appropriate School Wellness Initiative: Results of a 2-year Pilot Intervention in Jewish Schools. USA.</td>
<td>A 2 years pilot intervention to address high levels of childhood obesity uncovered by community health survey.</td>
<td>Two schools within the community were chosen on the base of perceived levels of need and eagerness to participate. All students in selected schools were included. Program based on 5 out of 8 original components of the Coordinated School Health Program model developed by the Centers for Disease Control and Prevention.</td>
<td>Results showed significant increases in knowledge and an increase in older students that met PA guidelines. Few changes in attitudes, other behaviors and environmental factors were reported.</td>
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<td>2</td>
<td>Chomitz, V. R., McGowan, R. J., Wendel,. J. M., Williams, S. S., Cabral, H. J., King, S. E., Olcott, D. B., Capello, M., Breen, S. &amp; Hacker, K. A. (2010). Healthy Living Cambridge Kids: A Community-based Participatory Effort to Promote Healthy Weight and Fitness. USA.</td>
<td>To assess the impact of a 3 years community-based healthy weight intervention on child weight and fitness.</td>
<td>Multi-component, non-control, intervention guided by social-ecological model and CBPR principles targeting community, schools, families and individuals. Included city policies and awareness campaigns; PE enhancements, food service reform, farm-to-school-to-home programs, family outreach and individual “BMI and fitness reports”. Cohort of 1858 K-5th grade children from diverse ethnic groups.</td>
<td>Modest improvements in obesity and fitness from base-line to follow-up. Decrease in BMI z-score and proportion obese children, increase in mean number of fitness-tests passed. Percentage of obesity declined among all ethnicity/race groups. Sustaining policies and program elements post-intervention.</td>
<td>Good</td>
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<td>Coleman, K. J., Shordon, M., Caparosa, S. L., Pomichowski, M. E. &amp; Dzewaltowski, D. A. (2012). The healthy options for nutrition environments in schools (Healthy ONES) group randomized trial: using implementation models to change nutrition policy and environments in low income schools. USA</td>
<td>Describes an application of the EBPH-approach to change public school nutrition policies and environments over two years of implementation and one base-line year.</td>
<td>Evidence-based Public Health approach with use of a rapid improvement process model for school nutrition policy and environmental change. Included changes in classroom-, before/after school-, recess-, and school cafeteria environments and behavioral observations. Hybrid design of a nested cohort group randomized trial with controls combined with formative evaluation methods for continuous adjustments during implementation. Students in elementary and middle schools in a low-income district with population of different ethnic groups. The average age of participants was 8.9 years.</td>
<td>Decrease in outside foods and beverages, primary in unhealthy items on campus and an increase of healthy items at lunchtime in intervention schools. No changes in obesity rates across time in either intervention or control schools.</td>
<td>Good</td>
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<td>4</td>
<td>Correa, N. P., Murray, N. G., Mei, C. A., Baun, W. B. Gor, B. J., Hare, N. B., Banerjee, D., Sindha, T. F. &amp; Jones, L. A. (2010). CAN DO Houston: A Community-based Approach to Preventing Childhood Obesity. USA</td>
<td>Community-based childhood obesity prevention initiative using existing resources. Activities based on input from community members</td>
<td>Use of 5 evidence-based target behaviors from the Expert Committee Recommendations Regarding the Prevention, Assessment and Treatment of Child and Adolescent Overweight and Obesity to create key messages to serve as focal points. Identification of partners and assessment of their capacity. Focus groups and key informant interview to assess needs and set priorities. Included after school PA-, and cooking program, PA equipment school staff training and wellness initiatives Stratified cluster sampling to identify neighborhood, elementary schools and parks as anchors for implementation. Students aged 6-12 years primary focus, parents, families and school staff secondary focus.</td>
<td>Partnerships established between schools, park management and stakeholders from community to facilitate activities and rising awareness. Emerge of consortium of organizations and people to address childhood obesity. Positive feedback which demonstrated changes in attitudes and behaviors.</td>
<td>Good</td>
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<tr>
<td>Nr.</td>
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<td>Economos, C. D., Hyatt, R. R., Goldberg, J. P., Must, A., Naumova, E. N., Collins, J. J. &amp; Nelson, M. E. (2007). <em>A Community Intervention Reduces BMI z-score in Children: Shape Up Somerville First Year Result</em>. USA</td>
<td>To test the hypothesis that a community-based environmental change intervention could prevent weight gain in young children</td>
<td>A comprehensive non-randomized controlled trial with CBPR approach in 3 culturally diverse urban cities targeting before-, during-, after- school, home and community environments in partnership with an entire city. 10 intervention (385 students), 15 control 1 (561 students), and 5 control 2 (232) public elementary schools grade 1-3 with mean age of ca.8 years. Targeting behaviors in screen time, PA and dietary intake Included policy development, social marketing, before school program, in-, and after- school curriculum, staff capacity building, school food service enhancements, parent-, and family- outreach and variety of community initiatives,- campaigns-, and trainings.</td>
<td>Modest decrease in BMI z-score for children above the 85th percentile among children in intervention schools.</td>
<td>Good</td>
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<td>6</td>
<td>Foster, G. D., Sherman, S., Borradaille, K. E., Grundy, K. M., Vander Veur, S. S., Nachmani, J., Karpyn, A., Kumanyika, S. &amp; Shults, J. (2008). <em>A Policy-Based School Intervention to Prevent Overweight and Obesity</em>. USA</td>
<td>To examine the effects of a multi-component school nutrition Policy initiative on the prevention of overweight and obesity among children in grades 4 through 6 over a 2-year period after base-line.</td>
<td>Multi-component, randomized control intervention in schools with 50 percent or more students with lower socioeconomic status. Schools matched on school size and type of food service. Intervention developed with guidance of CDC’s Guidelines to Promote Lifelong Healthy Eating and Physical Activity. Changes were made in the school food environment. Intervention included; school self-assessment, nutrition education, nutrition policy change, social marketing and parent outreach.</td>
<td>50 percent reduction in the incidence of overweight. Significantly fewer children became overweight in intervention schools (7.5 %) than in control schools (14.9%). No differences in incidence or prevalence of obesity or in remission of overweight or obesity after 2 years.</td>
<td>Good</td>
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<tr>
<td>Nr.</td>
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<td>Gentile, D. A., Welk, G., Eisenmann, J. C., Reimer, R. A., Walsh, D. A., Russell, D. W., Callhan, R., Walsh, M., Strickland, S. &amp; Fritz, K. (2009). <em>Evaluation of a multiple ecological level child obesity prevention program: Switch what you Do, View and Chew.</em> USA</td>
<td>Examine the immediate and short-term, sustained effects of the Switch program. 8 months intervention. Measures at base-line, immediately post-intervention and 6 month post-intervention.</td>
<td>Use of social-ecological framework to guide development of program. Randomized controlled intervention. Elementary schools matched within district by enrollment and percent students with free/reduced-cost lunch. Students in grade 3-5 and average age 9.6 years. Targeting 3 behaviors; decreasing screen-time, increasing fruit and vegetable consumption, and increasing PA at 3 ecological levels; family, school and community. Included social marketing, provide teachers with materials for use in classrooms and families were provided with behavioral tools in form of monthly packages. Data collected through pedometers, surveys completed by children, parents and teachers. Reports of screen-time and FV consumption over 7 days. Post-intervention survey on degree of change of the family and how much they have participated on a 5 point verbally anchored scale.</td>
<td>Small-to-modest effects in promoting FV consumption and minimizing screen-time. Small differences in body-mass index between intervention- and control schools (Cohen’s $d = 0.15$). Large differences in parents report of screen-time (Cohen’s $d = 1.38$).</td>
<td>Good</td>
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<td>8</td>
<td>Hollar, D., Lombardo, M., Lopez-Mitnik, G., Hollar, T. L., Almon, M., Agatston, A. S. Messiah, S. E. (2010). <em>Effective Multi-level, Multi-sector, School-based Obesity Prevention Programming Improves Weight, Blood Pressure, and Academic Performance, Especially among Low/Income, Minority Children.</em> USA</td>
<td>2-year elementary school-based obesity prevention intervention designed to keep children at normal healthy weight, and improve health status and academic achievement</td>
<td>Quasi-experimental design, schools non-randomly assigned to 1 of 4 intervention groups or to 1 of 2 control groups. Average age was 8 years in a sample of mixed ethnic groups. Designed to test feasibility and efficacy of combined effect of (1) including nutritious ingredients and whole foods in provided school-meals; (2) holistic nutrition and life-style curricula for children, parents, teachers, and staff; (3) school-based wellness activities such as cultivate school-gardens.</td>
<td>Statistically significant improvements in weight, blood pressure, and academic scores.</td>
<td>Medium</td>
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<td>Samuels, S. E., Craypo, L., Boyle, M., Crawford, P. B., Yancey, A. &amp; Flores, G. (2010). <em>The California Endowment's Healthy Eating, Active Communities Program HEAC: A Midpoint Review</em>. USA</td>
<td>Midpoint review of a 4-year community-based childhood obesity prevention program in 6 low-income communities with the aim to prevent childhood obesity through interventions in 5 key childhood environments.</td>
<td>Built on 2 components; 1. Community component: Through policy and environmental change increase opportunities for healthful eating and PA in 5 key environments for children; schools, after-school program neighborhoods, health care and marketing and advertising. 2. Technical assistance, advocacy and policy: To build and support policy and advocacy statewide. Formative planning process generated a logic model which guided each community to address each key sector. HEAC model of change as framework for program and comprehensive approach. Sustainability through adoption and implementation of policy. Communities with population 40,000-145,000, mixed ethnic groups and high level low-income households selected by The California Endowment.</td>
<td>Healthier life-style as a result of changes in 5 key environments for children. Children in HEAC communities engage more in healthy behaviors than before implementation.</td>
<td>Good</td>
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<td>10</td>
<td>Taylor, W. R., McAuley, K. A., Barbezat, W., Strong, A., Williams, S. M. &amp; Mann, J. I. (2007). <em>APPLE Project: 2-y findings of a community-based obesity prevention program in primary school-age children</em>. NZ</td>
<td>Determine the effectiveness of a community-based intervention to prevent excessive weight gain in 5-12-year old children by enhancing opportunities for healthy eating and non-curricular PA</td>
<td>Non-randomized controlled pilot-study of 7 primary schools in semirural geographically separated areas. Included nutrition education that targeted reduction in intake of sweetened drinks and increased intake of fruit and vegetables and PA non-curricular program based on life-style activities delivered through activity coordinators. Anthropometric data, PA measured through accelerometers and PA and SC assessed through 7-day recall questionnaire</td>
<td>Significantly lower mean BMI z-score and waist circumference among intervention compared to control children, significantly lower systolic blood pressure in year 1 among intervention children but no longer significant in year 2. Intervention children consumed significantly fewer carbonated drinks and 0.8 more servings of fruit. Water and flavored milk did not differ. Higher accelerometry counts in year 1 but not in year 2. No effects on SC.</td>
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### Appendix 3: Sample of Analysis

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<td>“Fit Together” family event nights, open to all families</td>
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<td>Family event</td>
<td>Parent outreach</td>
<td>Social environment</td>
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<td>The message “Want Strength? . . . Eat Healthy Foods,” paired /.../with an easily recognizable character, reinforced healthy messages through incentives and frequent exposure.</td>
<td>Use of slogans and easily recognizable character to pass intervention messages</td>
<td>Use of slogans and character (branding)</td>
<td>Social marketing</td>
<td>Social environment</td>
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<td>Coordinated monthly wellness seminar to educate parents on good nutrition and various wellness topics.</td>
<td>Educate parents in nutrition and wellness</td>
<td>Parent education</td>
<td>Parent outreach</td>
<td>Social environment</td>
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<td>/.../to remove all sodas, sweetened drinks, and snacks that did not meet the standards set by the committee/.../ from the vending machines and the cafeteria line.</td>
<td>Changes in offerings of foods and beverages in the school food-environment</td>
<td>Changes in school food-environment</td>
<td>School food-environment</td>
<td>Food environment</td>
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<td>During each session, students gathered fresh vegetables and herbs, such as radishes and basil, from the school garden.</td>
<td>Cultivation of a school garden</td>
<td>Access to recreational areas</td>
<td>School garden</td>
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<td>/.../and created joint use agreements that gave neighborhood residents access to schoolyards outside of the school day.</td>
<td>Access to schoolyards outside the school day</td>
<td>Access to recreational areas</td>
<td>Parks and neighborhoods</td>
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<td>This CBPR study included the facilitation of a collaborative partnership with the communities in all phases of the research</td>
<td>Facilitation of collaborative partnership in all phases</td>
<td>Guidance of CBPR principles</td>
<td>Use of CBPR principles</td>
<td>Social environment</td>
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