



## Developing an index of dose of exposure to early childhood obesity community interventions



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### ABSTRACT

The recognition of the role of the environment in contributing to the obesity epidemic has led to increasing efforts to address obesity through environmental or place-based approaches in the past decade. This has challenged the use of the quasi-experimental design for evaluating community interventions. The objective of this study is to describe the development of an index of dose of exposure to community interventions that impact early childhood obesity. The goal is to provide an alternative means for evaluating the impact of multiple intervention strategies that target the same community at the same time. Two workgroups developed domains, constructs and protocols for estimating a “community intervention dose index” (CIDI). Information used to develop the protocol came from multiple sources including databases and reports of major funding organizations on obesity-related interventions implemented in Los Angeles County from 2005 to 2015, key informant interviews, and published literature. The workgroups identified five domains relevant to the consideration of dose of exposure to interventions: physical resources, social resources, context, capacity development, and programs and policies; developed a system for classifying programs and policies into macro- and micro-level intervention strategies; and sought ratings of strategy effectiveness from a panel of 13 experts using the Delphi technique, to develop an algorithm for calculating CIDI that considers intervention strength, reach and fidelity. This CIDI can be estimated for each community and used to evaluate the impact of multiple programs that use a myriad of intervention strategies for addressing a defined health outcome.

### 1. Introduction

Obesity has been declared a global epidemic by the World Health Organization (World Health Organization, 2000) and the United States has one of the highest obesity prevalence rates in the world (Wang and Beydoun, 2007). Its prevalence among American adults increased from 13% to 23% between the 1960s and 1980s, and then quickly climbed to 30% in the 1990s at which it has since hovered. Obesity-related medical

care is costly, ranging from \$147 billion to nearly \$210 billion a year (Cawley and Meyerhoefer, 2012). In addition, obesity-related costs associated with job absenteeism and lower productivity at work have been estimated at \$43 billion a year and \$506 per obese worker per year respectively (Cawley and Meyerhoefer, 2012; Gates et al., 2008). A cost effective approach to reducing obesity risk is to prevent its development early in childhood since obesity tracks from childhood to adulthood (Singh et al., 2008). Nation-wide, 9.4% of 2–5 year olds were

Abbreviations: CIDI, community intervention dose index

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obese and 1.7% were extremely obese in 2013–2014 (Ogden et al., 2016).

In Los Angeles County, home to about 400,000 children aged 2–5 years, the obesity rate among 3 and 4 year olds from low-income families is considerably higher than in the nation, reaching a peak of about 23% in 2009, and then decreasing to 18% in 2015 (Centers for Disease Control and Prevention, 2013; Los Angeles County WIC Data Website, 2017). Starting in about 2005, considerable amounts of funding from the federal government and private organizations and health systems have been used for local initiatives to address both adult and child obesity (Samuels et al., 2010; Kuo et al., 2016; Bunnell et al., 2012; Cheadle et al., 2010; First 5 Los Angeles Website, 2017). Initiatives such as The California Endowment's "Healthy Eating and Active Communities" (Samuels et al., 2010), Kaiser Permanente's "Community Health Initiatives" (Cheadle et al., 2010) and First 5 LA's "Best Start Initiative" (First 5 Los Angeles Website, 2017) have sought to increase the capacity of communities to improve access to healthy food, provide opportunities for exercise and play and/or provide environments that support optimal growth and development of children. Many initiatives used macro-level strategies to change institutional policies, business practices or the built environment in ways that would increase the accessibility of healthy foods, decrease the accessibility of unhealthy foods, or provide opportunities for physical activity. These macro-level intervention strategies may have had "trickle-down" or synergistic effects on childhood obesity. An example of such a macro-level effort is the new WIC food package implemented in October 2009 (Special Supplemental Nutrition Program for Women, Infants and Children (WIC), 2014), which provided vouchers specifically for the purchase of fruits and vegetables. Such an effort may have led to the stocking of fresh fruits and vegetables by some grocery stores, hence increasing access to fruits and vegetables by local families, and consequently, increasing consumption of fruits and vegetables and potentially decreasing obesity risk among children. Another example is the establishment of local school wellness policies by schools participating in the National School Meals Program (Child Nutrition and WIC Reauthorization Act of 2004, 2004). This may have affected the food choices of not only school-aged children but also younger siblings of the families who may already have received nutrition education from the WIC program.

The 21% decrease in the obesity prevalence for 3 and 4 year olds experienced in Los Angeles County from 23% in 2009 to 18% in 2015 (Los Angeles County WIC Data Website, 2017) suggests that at least some of these efforts are "working". However, it is less clear which specific intervention strategies or combinations of strategies have contributed to this decline in obesity prevalence. Given the number of obesity-related intervention efforts that have been implemented in various regions in Los Angeles County since 2005 (most of which were not implemented in a coordinated approach) as well as the lack of "comparison" communities, the use of traditional quasi-experimental designs for evaluating the impact of these interventions has not been practical nor feasible.

In 2013, the Early Childhood Obesity Systems Science Study (ECOSyS) – a partnership among UCLA, Public Health Foundation Enterprises (PHFE)-WIC, the Los Angeles County Department of Public Health (LADPH), the University of Washington, the University of California at Berkeley, the Samuels Center, First 5 LA, and Kaiser Permanente – supported by the National Institutes of Health, was implemented to pioneer the use of causal inference and systems science methods for evaluating community interventions. Using data from the WIC program, ECOSyS designed a natural experiment for evaluating the independent and combined effects of the many intervention strategies implemented in Los Angeles County over the past decade on early childhood obesity.

To evaluate the impact of exposure to multiple intervention strategies on early childhood obesity risk, ECOSyS developed a "community intervention dose index" (CIDI) for the purpose of measuring

simultaneous exposure to multiple interventions. Exposure to multiple interventions is conceptualized as having a *dose effect* that is influenced by community resources and capacity (Collie-Akers et al., 2013; Fawcett et al., 2015; Cheadle et al., 2012). Such an index would consider the combined effect of several intervention efforts by quantifying the efficacy and reach of each intervention strategy, and also implementation fidelity. For example, a community where a farmers' market has just been established, and where residents are exposed to a campaign to promote healthy eating and have the opportunity to participate in nutrition education classes would receive a higher index score than one where residents are exposed to a similar campaign and nutrition education classes but a plan to establish a farmers' market has *not* been implemented. ECOSyS hypothesized that: (i) the impact of multiple obesity-related policies and interventions in a community can be quantified using an index of intervention dose that considers the effectiveness of each intervention strategy and the reach and fidelity of the intervention; this impact is influenced by the community's characteristics (resources and capacity including neighborhood environment); (ii) the index of intervention dose will demonstrate good reliability, construct validity and predictive validity; and (iii) considering differences in community resources, a higher index of intervention dose will be associated with reduced obesity prevalence among preschool-aged children in a manner consistent with a causal effect. The objective of this paper is to describe the development of this community intervention dose index and its implications for using this method in community health research and evaluation.

## 2. Methods

Two work groups were established to develop the community intervention dose index (CIDI). Workgroup I was charged with identifying domains and constructs relevant to forming this index using a life course perspective (Elder Jr., 1995) and the socio-ecological model as frameworks (Bronfenbrenner, 1979). This workgroup was made up of an interdisciplinary team of 12 members from a range of organizations including academic research institutions, major funding and health organizations, WIC, non-profit organizations and the local health department, and with training and experiences in public health, economics, social sciences, nutrition and/or pediatrics. Workgroup II reviewed the domains and constructs identified by the first workgroup, and provided guidance on the development of methods for operationalizing variables and gathering relevant data for analysis. It consisted of 15 members and included researchers with expertise in the development of indices and the collection and/or analysis of evaluation data, as well as representatives of major funding organizations experienced in gathering data from grantees.

The workgroups were supported by research staff who reviewed: (a) the published literature on methods for assessing exposure to multiple interventions and childhood obesity related interventions; (b) recent requests for proposals by major funders to address early childhood obesity so as to understand current thinking about intervention approaches and knowledge gaps relevant to childhood obesity efforts; and (c) descriptions of relevant databases maintained by major funders to determine the types of available data. These activities identified two major barriers to gathering data for estimating exposure to community interventions: (1) inconsistent use of terminology referring to various intervention strategies, indicating a need for a system for classifying and defining intervention strategies to facilitate data gathering efforts; and (2) lack of adequate information for estimating intervention outcomes.

To address the first barrier, a classification system of intervention strategies was developed by determining how obesity intervention experts thought about intervention approaches. This information was obtained by interviewing a select group of six obesity intervention experts, and identifying references to obesity-related intervention strategies in the published literature and requests for proposals issued by

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