



# Influence of Behavioral Theory on Fruit and Vegetable Intervention Effectiveness Among Children: A Meta-Analysis

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## ABSTRACT

**Objective:** To test the hypotheses that interventions clearly based on theory, multiple theories, or a formal intervention planning process will be more effective in changing fruit and vegetable consumption among children than interventions with no behavioral theoretical foundation.

**Design:** Systematic review and meta-analysis.

**Setting:** Identification of articles in PubMed, PsycInfo, Medline, Cochrane Collaborative database, and existing literature reviews and meta-analyses.

**Participants:** Children aged 2–18 years.

**Interventions:** Change in fruit and/or vegetable consumption in dietary change interventions.

**Methods:** Meta-analysis, meta-regression analysis, and summary reporting for articles.

**Conclusions and Implications:** Predicating an intervention on behavioral theory had a small to moderate enhancement ( $P < .001$ ) of outcome effectiveness. Differences in mean Hedges'  $g$  effect sizes between theory and non-theory interventions were 0.232 for fruit, 0.043 for vegetables, and 0.333 for fruit and vegetables combined. There was mixed support, however, for enhanced dietary change with multiple theories or a formal planning process. After controlling for study quality, theory use was related only to vegetable consumption ( $\beta = 0.373$ ;  $P < .001$ ). More research is needed on theory's influences on dietary behaviors to guide future interventions among children. More research is also needed to identify what may be effective practical- or experience-based procedures that complement theory, to incorporate into interventions.

**Key Words:** meta-analysis, theory, dietary change, children (*J Nutr Educ Behav.* 2014;46:506-546.)

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## INTRODUCTION

Higher levels of fruit and vegetable (FV) intake protect against hypertension, heart disease, stroke, and other chronic diseases<sup>1</sup> and may be a strategy for obesity prevention among children and adults.<sup>2–7</sup> Many child disease prevention interventions have targeted FV intake because of their low energy density, high fiber content, and abundance of phytochemicals.<sup>1</sup> Unfortunately, FV interventions have been minimally

effective and optimal design components remain elusive.<sup>8,9</sup>

One important component of intervention design may be theory. Using theory may increase the effectiveness of a behavioral change intervention by providing information on which variables influence a particular behavior.<sup>10–13</sup> Theory should embody what the behavioral sciences have learned about behavior and its change, identify key constructs demonstrated to predict behavior, and identify procedures to

change these constructs to lead to behavior change.<sup>14</sup> Given this, an early review of the dietary change intervention literature made the then bold statement that simply promoting knowledge is insufficient: Interventions based on behavioral theory are more likely to attain dietary behavior change.<sup>15</sup>

However, theories have not always been highly predictive of the targeted behavior.<sup>14,16</sup> A meta-analysis of adult dietary change studies<sup>17</sup> has revealed no association between theory use and intervention effectiveness. Reviews and meta-analyses of behavioral interventions for other health behaviors also reveal inconsistent results about the effectiveness of theory use in intervention design. Three reviews of behavioral interventions for human immunodeficiency virus risk behaviors<sup>18</sup> report evidence supporting increased effectiveness when interventions are predicated on theory,<sup>19–21</sup> 2 reported possible supporting evidence,<sup>22,23</sup> 1 reported no evidence,<sup>24</sup> and 1 reported

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contradictory evidence.<sup>25</sup> The latter 2 reviews include only studies among Hispanics/Latinos in the US and Latin Americans in the western hemisphere, and find extensive moderating effects on human immunodeficiency virus–related behavior change outcomes.<sup>24,25</sup> Similar inconsistencies are found in reviews of interventions for mammography<sup>26</sup> as well as for Internet methods<sup>27</sup> and tailored print messaging<sup>28</sup> targeting various health behaviors (eg, physical activity, dietary behavior, alcohol consumption, smoking cessation). Examining the effectiveness of theory in dietary change studies in children may provide different or additional insights.

An important issue when evaluating theory in interventions is what constitutes a behavioral theory. Traditional behavioral theories that specify expected relationships among theoretically defined variables (eg, Social Cognitive Theory, Theory of Planned Behavior<sup>29</sup>) clearly qualify, but other theories may be more tenuous. For example, Social Ecological Theory<sup>30</sup> simply states that aspects of the environment should be related to behavior without specification of those aspects. In a related manner, it is not always clear which theory is most applicable in a specific population (eg, gender, age, ethnic, or socioeconomic status [SES] groups) for a specific behavior. Another issue related to theory is the inconsistency in theory implementation in interventions. At one time, it was thought interventions needed to be consistent with a single theory,<sup>31</sup> but more recently investigators have recognized the complexity of behavior change and may use multiple theories to guide an intervention.<sup>32</sup> Alternatively, some investigators simply name theories without explaining how they used them; others provide minimal reports, whereas others employ formal intervention planning procedures such as “intervention mapping”<sup>33</sup> or a logic model<sup>34</sup> to inform how to apply findings in the literature to the intervention. In the absence of empirically validated effective intervention procedures, common sense must be used to design and evaluate theory-based interventions.<sup>35</sup> Thus, reviews and meta-analyses of theory's impact on

intervention effectiveness in children are needed to clarify the issues related to number and type of theories, implementation strategy, and study quality.

This systematic review and meta-analysis tested the hypothesis: Interventions clearly based on theory were more effective in changing FV intake among children than interventions with no behavioral theoretical foundation. In addition, this study tested whether effectiveness varied by type and number of theories, having a formal intervention planning process (eg, intervention mapping<sup>33</sup> or qualitative formative research), or study quality.

## METHODS

### Search

The first author, who has expertise in the content area and has conducted other systematic reviews, performed all searches. The authors searched for theory-based, peer-reviewed studies in PubMed, PsycInfo (Ovid), Medline (Ebsco), and the Cochrane Collaborative database without a limit on year of publication. Search terms included combinations of the following: “dietary change,” “obesity prevention,” “children,” “adolescents,” and “theory.” The authors also searched published literature reviews and meta-analyses on FV interventions among children and adolescents,<sup>36–49</sup> and searched references of all studies for further relevant studies. To find articles without theory, searches occurred in the published literature reviews and meta-analyses. In the previous searches for theory-based studies, the earliest study found by the authors was published in 1989, so they only looked for non-theory articles published in or after 1989 for comparison. Figure 1 illustrates the literature search selection process.

The exported files from the literature search were uploaded and searched for duplicates in RefWorks-COS (ProQuest, LLC, Bethesda, MD, 2008) and then imported into Microsoft Excel for reviewing purposes. When an export was not possible, the authors manually entered the data into RefWorks and Excel. Files were copied and saved for the record

and searches were recorded using PRISMA guidelines.<sup>50</sup>

### Study Selection

Two stages identified relevant studies for inclusion. The first author screened reference titles and abstracts identified by the search strategies mentioned previously for inclusionary and exclusionary criteria. Studies had to have (1) at least 1 control group for comparison (eg, a no-intervention control group, a control group that received a similar intervention not based on theory, or both); (2) targeted dietary change (specifically, fruit [F], vegetable [V], or FV consumption); (3) reported means and standard deviations of F, V, and/or FV consumption in each group at baseline and after the intervention; (4) targeted children or adolescents (aged 2–18 years) for dietary change; and (5) employed behavior change procedures (eg, goal-setting, recipe preparation, or modified school meals). Exclusionary criteria were: (1) articles not in English; (2) non-research articles; and (3) obesity treatment studies (children were selected to already be obese). The authors obtained full texts of all references included in the first stage. The study was the unit of analysis. If more than 1 publication appeared in a study, they were combined to characterize the study. Some studies had more than 1 F or V target, in which case the authors attempted to identify any F, V, or FV combined targets and reviewed each.

### Data Extraction

The authors piloted a pre-coded data extraction form to ensure it captured all relevant information and then applied this form to all included studies. The information extracted from each study included program details (eg, name, focus, duration), theoretical basis, sample size and characteristics (eg, average age, race/ethnicity), conclusions, baseline and postintervention diet measures (eg, FV consumption), baseline and postintervention weight status (eg, mean body mass index, percent overweight/obese), and moderating variables. Theoretical basis was judged from descriptions of the interventions;

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