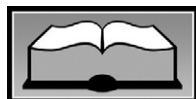


Review



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A Systematic Review of Behavioral Interventions to Promote Intake of Fruit and Vegetables

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ABSTRACT

Fruit and vegetable (F/V) intake in the United States remains below recommended levels despite evidence of the health benefits of regular consumption. Efforts to increase F/V intake include behavior-based interventions. A systematic review of MEDLINE PubMed and PsycINFO databases (2005–2010) was conducted to identify behavior-based intervention trials designed to promote F/V intake. Using predetermined limits and selection criteria, 34 studies were identified for inclusion. Behavior-based interventions resulted in an average increase in F/V intake of +1.13 and +0.39 servings per day in adults and children, respectively. Interventions involving minority adults or low-income participants demonstrated average increases in daily F/V consumption of +0.97 servings/day, whereas worksite interventions averaged +0.8 servings/day. Achieving and sustaining F/V intake at recommended levels of intake across the population cannot be achieved through behavior-based interventions alone. Thus, efforts to combine these interventions with other approaches including social marketing, behavioral economics approaches, and technology-based behavior change models should be tested to ensure goals are met and sustained.

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For the past several decades, public health policy statements have called for an increase in fruit and vegetable (F/V) consumption by US adults and children (1,2). The rationale for promoting greater intake

includes a potential reduction in risk for cancer (3), hypertension (4), cardiovascular disease (5-7), reduced inflammatory symptoms in those diagnosed with rheumatoid disease (8), and possibly a reduction in body weight (9) or adiposity (10). Despite the potential to improve overall health, daily intake of F/V remains well below recommended intake levels for most Americans (11,12). In fact, recent National Health and Nutrition Examination Survey data suggested that only 2.2% of men and 3.5% of women met current recommendations for daily intake of F/V (12). Efforts to increase intake commonly focus on behavior change. A 2002 review of randomized controlled trials with 40 or more participants reported on the efficacy of behavior-related interventions to enhance F/V intake. Of the 22 studies identified, 17 demonstrated significant increases in intake, with an average increase of 0.6 servings per day. This review noted that changing dietary behavior was more successful in populations with health conditions; and that goal setting and small groups tended to be more effective strategies for behavior change (13). Later, a 2005 review identified 44 behavior-based studies that measured F/V intake in adults with follow-up periods of at least 3 months. This review found increases in F/V intake that ranged from 0.1 to 1.4 servings per day. Consistent with the 2002 review, this review also noted that increases were greater in participants with pre-existing health conditions (14). Similar but generally less substantial change was also demonstrated for interventions targeting children (15).

What is apparent from the currently available literature is that developing a habit of F/V intake in the US population that meets current recommended intake levels will require significant changes in health behavior related to food choices (16). Behavior-based interventions that apply behavior theories or constructs (Figure 1) have demonstrated success not only for F/V intake, but also for tobacco cessation (17). The purpose of this systematic review is to update the earlier reviews that reported on the effect of behavior-based interventions to increase F/V consumption (13,14) with a focus on studies since 2005 and those not targeting individuals with pre-existing medical conditions. Further, this systematic review sought to identify limitations in current behavior-based

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Theory/construct	Brief description
Theory	
Diffusion of Innovations Theory	Spread of new ideas. Behavior change requires clear application of constructs, including knowledge (exposure), persuasion (attitude), decision (commitment), implementation (use), and confirmation (reinforcement).
Goal Attainment and Self-Regulation Theory	Suggests that behavior change is the result of setting specific goals and monitoring progress toward goals.
Health Belief Model/Health Promotion Model	It is the balance of perceived barriers and perceived benefits or risk-benefit that predicts behavior change.
PRECEDE-PROCEED	PRECEDE is diagnostic planning: predisposing, reinforcing, and enabling constructs in educational diagnosis and evaluation. PROCEED is the subsequent implementation and evaluation including policy, regulatory, and organizational constructs in educational and environmental development.
Social Cognitive Theory	Interaction among behavior, environment, and personal factors predicts behavior change (includes techniques such as modeling, skill training, self-monitoring, and contracting).
Social Influence Theory/Social Contextual Theory/Social Communication Theory Media Exposure Theory	Social context influences behavior change. Communication between parent-child. Cues in mass media affect attitudes and behavior change.
Social Ecological Model	Theory related to the relationships between individuals, social groups, and the environment or community.
Social Learning Theory	Behavior is established in observing and imitating those with direct influence, reinforcement, and punishment.
Theory of Reasoned Action/Theory of Planned Behavior	Process preceding behavior based on expectancy and intentions. Decision to behave in a certain way is the result of the likelihood of specific outcomes.
The Transtheoretical Model/ Stages of Change	Leading stage model in health behavior research; individuals reside at a given stage in relation to specific behavior change: precontemplation, contemplation, preparation, action, maintenance, and termination. Stage influences likelihood of behavior change.
Constructs	
Barriers	Perceived estimate of obstacles to behavior change including social, personal, and economic challenges.
Motivation	Behavior change is grounded in intrinsic and/or extrinsic motivation to make change; commonly uses motivational interview techniques.
Normative beliefs	Extent to which others of influence are in agreement.
Problem-solving	A non-routine activity aimed to change an undesirable activity or undesirable state of affairs; based in decision making and awareness of problems.
Reciprocal determination	Behavior can be changed or conditioned through operant conditioning of personal factors; reward and punishment.
Self-efficacy	A person's confidence in coping with barriers to change behavior; sense of control facilitates change.
Self-management	Engagement in self-monitoring of behavior influences behavior change.

Figure 1. Common behavior theories and constructs used to effect change in fruit and vegetable intake. Adapted from National Cancer Institute Behavioral Research Program (21). NOTE: Information from this figure is available online at www.adajournal.org as part of a PowerPoint presentation.

study designs and to suggest future directions for research and health promotion efforts targeting increased F/V intake.

METHODS

This systematic review was compliant with current recommendations of Preferred Reporting Items for Systematic Reviews and Meta-analysis Approach in reporting

the evidence in a specific topic area (18,19). This review included the search engines MEDLINE PubMed and PsycINFO, and employed the search terms fruit, vegetable, and behavior change. Limits were set to include only human, English, clinical trial, or randomized controlled trial, and studies with publication dates between 2005 and 2010. In addition, studies were identified through other sources, including consultation with experts in the

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