HEALTH EDUCATION RESEARCH

Vol.35 no.6 2020
Pages 574–583
Advance Access published 1 October 2020

An exploration of constructs related to dissemination and implementation of an early childhood systems-level intervention

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Received on February 2020; editorial decision on September 2020; accepted on September 2020

Abstract

Obesity and overweight in early childhood have detrimental impacts on children's health and development. Changing policy, system and environmental features focused on physical activity and healthy eating behaviors as part of health promotion interventions can play a key role in prevention strategies in early childhood education settings. These types of changes can have broad reach and are often sustained over time, which allows for impact on children who enter the early childhood education setting year after year. However, there is currently a gap between the generation of evidence for health promotion programs and their application into practice. This study used qualitative methods to evaluate intervention-, organizational- and individual-level factors within a dissemination and implementation framework that may be related to the implementation of a health-promoting intervention in early childhood education settings. Intervention-level factors, including feasibility and adaptability, organizational-level factors, including staff and leadership engagement, and individual-level factors, including attitudes, skills and knowledge, were identified as constructs that impacted the successful implementation of the intervention. These findings provide insight into core dissemination and implementation constructs that should be targeted by obesity prevention interventions in early childhood education settings to ensure maximum impact on sustainable behavior change.

Introduction

Obesity and overweight in early childhood have detrimental impacts on children's health and development [1]. Children who are overweight at age five are four times more likely to be overweight in eighth grade compared to children who are not overweight at age five [2]. This trend is associated with chronic disease later in adulthood, so addressing nutrition- and physical activity-related behaviors in the first five-years of life is crucial for maintaining health throughout the life course [3]. Therefore, there is a need for multi-level interventions in early childhood to not only target individual-level factors to promote the early adoption of healthy eating and physical activity behaviors, but also focus on changing environments in which young children live, play and learn.

The number of children under six who spend an average of 30 h a week in non-parental care in the United States is over 11 million [4]. This makes center-based care an important setting to focus early childhood obesity prevention efforts. Changing policy, system and environmental (PSE) features focused on physical activity and healthy eating behaviors can play a key role in prevention strategies in early childhood education (ECE) settings because of their broad reach (all children in an ECE setting) and because they can be sustained over

doi:10.1093/her/cyaa038

time, which allows for impact on children who enter the ECE setting year after year [5, 6]. In other words, making ongoing, foundational PSE changes can produce behavior changes that create long-term impacts.

One example of an intervention that incorporated the implementation of PSE's to address early childhood obesity prevention is the Culture of Wellness in Preschools (COWP) program, which is currently being implemented in over 120 ECE settings in Colorado. The COWP program has five program components: classroom-based nutrition education, classroom-based physical activity education, staff health promotion, a parent wellness workshop series component and a strategic planning process, called the COWP PSE Change Process, which is utilized to implement health-promoting PSE changes. Since 2012, the COWP PSE Change Process has been successful in implementing an average of 4.7 PSE changes per ECE setting related to healthy eating and physical activity into ECE settings [7]. This planning tool is an adaptation of Intervention Mapping [8] and is aligned with community-based participatory research (CBPR) principles [9].

The COWP PSE Change Process involves convening an ECE center-specific interdisciplinary wellness team comprised of an average of five members including ECE teachers, directors, education supervisors and kitchen and human resources staff. University researchers are trained as PSE facilitators and lead wellness teams through one-hour monthly meetings using three change-making strategies to implement PSE changes in ECE settings: (i) wellness teams conduct 'a strengths and needs assessment' of their ECE center or home related to current healthy eating and physical activity policies, environments and practices, (ii) wellness teams 'prioritize potential PSE changes' based on importance and feasibility and (iii) wellness teams develop 'action plans' with specific action steps for implementation and sustainability of their highest priority PSE changes. Table I shows a summary of the three key change-making strategies involved in the COWP PSE Change Process. Additional information about the COWP PSE Change Process has also been previously published [7].

The COWP PSE Change Process is an example of an evidence-based program that leads to the effective implementation of health-promoting PSE changes in ECE centers. However, it is unclear which core components of the PSE Change Process result in the uptake of the program and implementation of sustainable changes in diverse ECE settings. Dissemination and implementation (D&I) science is a distinct discipline along the research-to-practice continuum that focuses on the adoption, adaptation, delivery and sustainment of evidence-based practices that have been implemented into practice [10]. Implementation science specifically addresses the methods used to promote the uptake of evidence-based practices and programs and incorporates aspects of quality improvement using a multidisciplinary approach [11].

Due to the potential impact of PSE obesity prevention programs in ECE centers, program evaluation is critical to assess effectiveness and allocation of limited resources, but is often limited [12]. This could be attributed to the complexity of these programs and the focus on outcomes-driven evaluation designs [12]. A Cochrane review focusing on obesity prevention programs called for a strengthening of evaluation by taking more of a D&I approach, and encompassing more process and implementation factors [11]. The use of qualitative methods in D&I research can help inform how to translate evidence-based programs into practice because these methods can generate robust details that could not be gathered from quantitative data alone [10, 13,]. Qualitative data can help researchers better understand core implementation factors and can be utilized to assess community needs and inform the implementation of research in understudied or underserved populations [10]. Although qualitative methods alone should not form the basis of an evaluation, these methods are often under-utilized in D&I research.

The field of D&I research has grown substantially in recent years, leading to the creation of numerous frameworks and theories to help guide D&I efforts [14]. Figure 1 displays the COWP D&I framework, which was developed based on two D&I models that contained constructs particularly

Table I. *The three key strategies that comprise the Culture of Wellness in Preschools (COWP) Policy System and Environment (PSE) Change Process*

Strategy	Purpose	Activities
1	Conduct strengths and needs assessment	• Review menu of health-promoting best practices • Rate current status of best practices in preschool center (not implemented, partially implemented, fully implemented) • Identify current status of center-based wellness policy
2	Prioritize Policy, System, and Environment (PSE) changes	• Rate potential PSE changes using a importance and feasibility rating system • Select top PSE changes to implement based on overall ratings
3	Plan for action	• Develop an action plan for each PSE change: identify action steps, point person, needs, and deadlines • Plan for dissemination of PSE changes • Discuss sustainability of PSE changes and develop plan • Finalize updated wellness policy

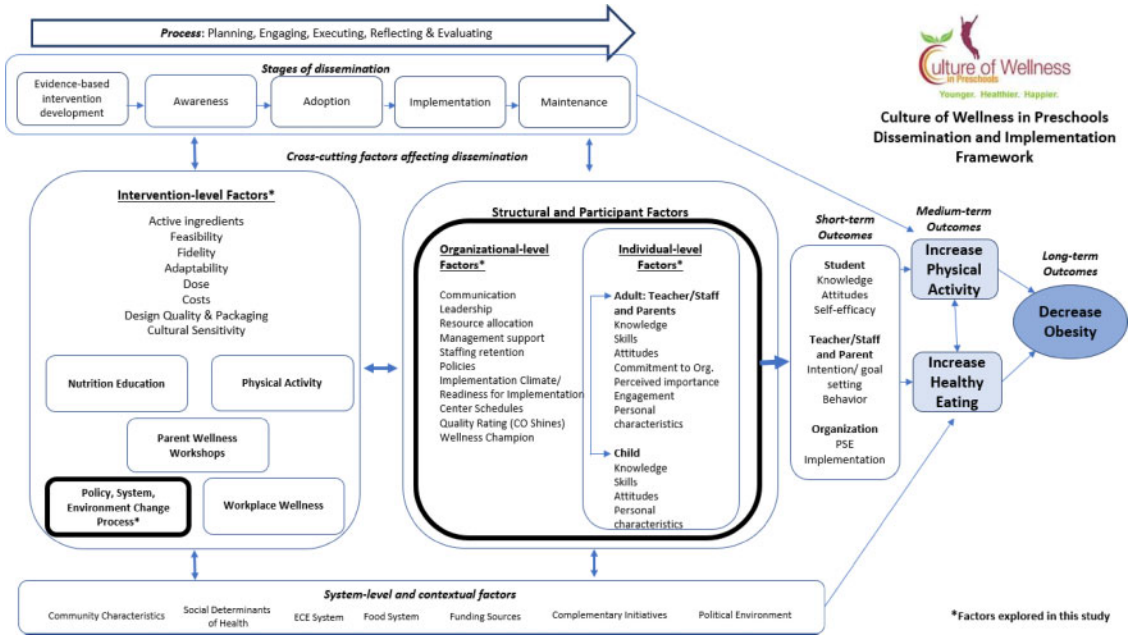

Fig. 1. Culture of Wellness in Preschools (COWP) Dissemination & Implementation Framework highlighting the intervention-, organizational- and individual-level constructs that were evaluated for this study related to one component of the COWP program: The COWP Policy, System and Environment (PSE) Change Process.

relevant to early child obesity interventions, as well as COWP program-specific constructs. These two frameworks include the Consolidated Framework for Implementation Research (CFIR) [14] and a dissemination framework developed by Dreisinger et al. [15]. The purpose of the COWP D&I framework is to help conceptualize, measure and track factors related to D&I of the multiple components

of the overall COWP program. The primary objective of this study was to use qualitative methods to evaluate intervention-, organizational- and individual-level constructs within the COWP D&I framework related to implementation of the COWP PSE Change Process, one component of the COWP program, in ECE settings.

Methods

All study-related instruments and activities were approved by a University Institutional Review Board (Protocol #19-0734).

Participants

ECE centers were randomly selected for this evaluation study from a sample of 53 partner ECE centers who had participated in the COWP PSE Change Process in the past two years (September 2016–January 2019). Probabilistic stratified sampling was used to select these centers [16]. The sample was stratified by type of center (public school-based versus community-based, including Head Start) since the researchers wanted to have representation from these two types of centers. ECE centers were then randomly selected from each stratum. A final sample of 20 ECE directors or COWP wellness champions (e.g. primary point of contact at the site including lead teachers or supervisors who were part of the wellness team) when directors were not accessible or available, participated in an interview with a member of the research team. Wellness Champions were individuals who communicated information about the COWP program throughout their workplace and promoted the implementation of PSE changes.

Instruments

Structured interviews were completed using a 14-item interview protocol was developed based on the COWP D&I framework to understand characteristics related to the successful implementation of the COWP PSE Change Process in ECE centers. The COWP D&I framework was based on the Consolidated Framework for Implementation Research (CFIR) [14] and a framework developed by Dreisinger et al. [15]. The CFIR was developed to address the overlapping theories and constructs, as well as the inconsistency of definitions used in existing D&I frameworks. The result was a framework that is meta-theoretical, including constructs from synthesis of existing theories. The final framework has five main domains with 37 constructs [14]. The framework developed by Dreisinger et al. was the only framework found that was developed specifically for an obesity prevention program. This framework was based on the Diffusion of Innovations theory. The primary focus was the dissemination of an initiative, including the systematic identification of a set of key variables that contribute to readiness for widespread distribution [15]. Each of these frameworks provided key constructs for the COWP D&I model. More information about the development of the D&I framework and associated constructs used for this program can be found in a subsequent article (‘pending’). For the interview protocol in this study, questions related to D&I constructs at the individual (e.g. attitudes, skills), organizational (e.g. communication, leadership engagement) and intervention (e.g. feasibility, adaptability) levels. For example, directors were asked the following questions: ‘What skills did you and your staff need to implement PSE changes at your center?’ (individual), ‘During the PSE meetings, describe the communication between members of the wellness team/staff’ (organizational) and ‘How difficult or easy was it for your center to participate in the PSE process?’ (intervention).

Data collection

Four University Research Assistants (RAs) were trained in qualitative research methods, including applied practice with the interview protocol, and conducted the interviews between March and July of 2019. Interviews ranged from 30 to 90 min. RAs completed all interviews at participants’ respective ECE centers during the school day. All interviews were recorded and transcribed using OTTER transcription software [17]. Within 24 h of recording,

the RAs reviewed and edited the transcriptions to ensure comprehension by the data analysis team and added notes and memos.

Data analysis

Two graduate students who had previous training in qualitative data analysis reviewed and independently coded the interview transcripts using Atlas.ti software [18]. Deductive coding was utilized, and codes were determined *a priori* based on the developed COWP D&I framework. Each construct was given an operational definition and the construct table served as the codebook for the analysis for both coders. Prior to beginning the analysis, the research team, including both coders and the co-investigators, reviewed and agreed upon the operational definitions that would be used to code all interviews. To confirm the codebook and to ensure concordant coding, the coders coded three of the same interviews prior to coding the remaining transcripts and compared results. If discordance was present, the coders and investigators worked together to reach consensus on the coding structure. After concordance was reached, the updated codebook was used to complete the coding for the remaining transcripts.

The remaining 17 transcripts were equally split between the two primary coders. Each coder re-read the transcripts line by line in order to identify the underlying themes and concepts. The pre-defined codes were utilized by the coders to label and identify single or multiple lines in the transcript that identified underlying themes. The coders single-, double- or triple-coded lines within the transcript. The codebook was updated as new ideas, themes and theoretical constructs emerged; discussion occurred between the coders and the lead investigators to confirm any additions to the codebook throughout the process.

Once all transcripts had been coded, the coding tree, containing idea nodes, theme nodes and theoretical construct nodes, was finalized and reviewed by the research team. The fully coded project was also explored for theoretical constructs. This process involved running queries to better understand the quantitative representation of each theme and idea that had emerged, looking at differences in the emerged concepts by sub-groups and exploring responses by characteristics of participants. The data were iteratively reviewed, coded and discussed among the research team until a final set of themes emerged.

Results

Table II displays the characteristics of the ECE centers represented by the interview participants. ECE centers were located throughout five urban

Table II. *Characteristics of early care and education centers and interview participants (n = 20 centers, one interview/center)*

ECE settings and interview participants (n = 20)	n	%
ECE center schedule		
Academic	12	60.0
Year-round	8	40.0
Type of ECE center		
Community-based	8	40.0
Head Start	2	10.0
School-based	10	50.0
ECE center county location		
El Paso	10	50.0
Adams	1	5.0
Arapahoe	2	10.0
Pueblo	5	25.0
Teller	2	10.0
Colorado Shines quality rating[a]		
1	1	5.0
2	8	40.0
3	5	25.0
4	6	30.0
5	0	0.0
Interview participant role		
Director	15	75.0
Wellness champion	5	25.0
	Mean	SD
Number of children served	78	76.7

[a]Rating of 1 means that it is a licensed child care, in good standings with the state; To advance to Level 2, a program must complete certain activities, which prepare the program to advance toward the high-quality ratings of Levels 3–5 in the future; Programs with higher ratings (Levels 3–5) have gone through a process to demonstrate quality in all areas of program operations (see https://www.coloradoshines.com).

counties in Colorado. Three quarters (75%) of interview participants were directors, and 25% were COWP wellness champions including lead teachers and supervisors.

The qualitative data were grouped into themes based on three levels within the COWP D&I framework: Intervention-, Organizational- and Individual-level factors. Codes, definitions, protocol questions and sample quotes are presented in Table III. At the 'intervention level', adaptability and feasibility were two of the most frequent codes that emerged from the data and were often related in context in the interviews. These data suggest that the adaptability, or flexibility, of the COWP PSE Change Process was one of the key factors that made the program successful. For example, one director said, 'just bringing our team together to really work through what we needed to do and have a lot of freedom to really pick what those things were; I didn't feel like we were guided that this is what you had to do, like a black and white type of thing. It was more fluid. And it really involved what we needed here, to make our program or wellness program better. So, the process was a great process for our team to work through.' This highlights the importance of the adaptability of the COWP PSE Change Process. Another director further highlighted this point: 'I think the main thing was that we were given some freedom of how it was going to come together.'

Interview participants also perceived the COWP PSE Change Process and implementation of PSE changes to be highly feasible at their centers. One particular aspect of the COWP PSE Change Process that participants commented on was the PSE changes to support nutrition education programming in the classroom, as highlighted by this quote, 'Oh, I think they [nutrition-related PSE changes] were pretty easy to implement. We really enjoyed in fact, the nutrition education, and I think it was the most fun for us, because we really got out there.' The feasibility of the intervention was also high because centers chose the number of PSE changes that they felt were doable. One director said, 'I think if you would have said you've got to do 10 things off this list. I would have probably said, "I'm sorry".'

'Organizational-level codes' that were most frequently coded in the data included staff and leadership engagement. Higher levels of staff and leadership engagement in the COWP PSE Change Process may have led to an increased likelihood of sustainable PSE changes and resulting behavior change. For example, one director said, 'I just think, as a team, and especially in this term, we've been, like, eating healthier, maybe serving healthier snacks.' The participants also shared that the center-based wellness teams emphasized the importance of having regular meetings to keep the team motivated and engaged. One said, 'Checking in, and just this is important, let's make sure we keep this up... kind of that motivation piece.' This resulted from staff and leadership engagement in the intervention. A key component related to the success of the COWP PSE Change Process may also be director engagement. One director mentioned the impactful role of their personal involvement in motivating the center staff, 'I started going into the classrooms and just started doing the squats and challenging everybody to do it with me, and once the kids saw the teachers joined in and it was just fun.' One wellness champion also mentioned how important is was to have all the staff invested in the program and present at staff meetings. She said, 'I think that is was an excellent idea to have all the staff present so that we can implement it [PSE Change] throughout the whole center.'

Finally, at the 'individual level', interview participants talked about the impact of their own knowledge, attitudes and skills, as well as the knowledge, attitudes and skills of their staff and coworkers. Individuals who participated in the COWP PSE Change Process reported that it empowered them, and increased their knowledge regarding the importance of nutrition and physical activity. One director said, 'It gave me a better vision of where we were as a center, how nutrition was important to us, and how physical activity was important to us.' This reinforced the director's personal motivation related to prioritizing nutrition and physical activity PSE changes. The directors' attitudes related to the importance of the COWP PSE Change Process and the impact it has on both the children and families also

Table III. *Dissemination and implementation constructs related to implementation of the Culture of Wellness in Preschools (COWP) Policy, System and Environment (PSE) Change Process in early care and education settings*

D&I construct	D&I definition	Protocol sample question	Representative quote
Intervention-level			
Feasibility	Perceived difficulty of implementation (complexity)	How difficult or easy was it for your center to participate in the COWP PSE Change Process?	'I think if you would have said you've got to do 10 things off this list. I would have probably said, "I'm sorry".'
Adaptability	The degree to which an intervention can be adapted, tailored, refined or reinvented to meet local needs	In what ways could the PSE process be changed to better meet your needs or the needs of the center?	'I think the main thing was that we were given some freedom of how it was going to come together.'
Organizational-level			
Staff engagement	Staff engagement and/or support for external/new programs	During the PSE meetings, describe the communication between members of the wellness team/staff.	'I think that is was an excellent idea to have all the staff present so that we can implement it [PSE Change] throughout the whole center.'
Leadership engagement	Commitment, involvement and accountability of leaders and managers with the implementation	In what ways were you (or the director) involved in the PSE process?	'I started going into the classrooms and just started doing the squats and challenging everybody to do it with me, and once the kids saw the teachers joined in and it was just fun.'
Individual-level			
Knowledge	Individuals' familiarity with facts, truths and principles related to the intervention	What did you learn, if anything, by going through the PSE process?	'It gave me a better vision of where we were as a center, how nutrition was important to us, and how physical activity was important to us.'
Attitudes	Perceived importance	How do you think your center benefitted, if at all, from implementing the changes from the PSE process at your center?	'I think it's buy-in from the staff. Because if your staff doesn't buy in to the importance of it, they're not going to send the information home, they're not going to practice what they preach, they're not going to participate like they should.'
Skills	Individual own capabilities to execute courses of action to achieve implementation goals	What skills did you and your staff need to implement PSE changes at your center?	'We need effective communication skills, that's for sure'

had an influence on the success of the program. One director shared, 'this [perceived importance] really helped me to get that information out there to families about healthy eating, healthy living and healthy activities other than, you know, what the families are doing because of the impact on motor skills with our little ones. So, this gave me a way to get information out to them that hopefully we can stop this

trend.' Attitudes of the staff also increased the success of the program. One director said, 'I think it's buy-in from the staff. Because if your staff doesn't buy in to the importance of it, they're not going to send the information home, they're not going to practice what they preach, they're not going to participate like they should.' Finally, successful implementation of the COWP PSE Change Process was related to individual's communication skills. For example, one director said, 'We need effective communication skills, that's for sure. Yeah, the ability to organize and prioritize, was just very helpful and deciding what was more important or what was next.' Good communication helped the wellness team work cohesively to implement the COWP PSE Change Process and sustain PSE changes.

Discussion

Currently, there is a gap between the generation of knowledge, development of evidence-based interventions and the application of these practices into real-world settings [10, 11]. D&I research addresses this looming disconnect between current knowledge about what works, and practice in the community [19, 20]. The primary objective of this study was to evaluate key D&I constructs related to the successful implementation of the evidence-based COWP PSE Change Process in ECE settings. The use of qualitative methods to inform key D&I constructs was a novel component of the study and elucidated complexities and provided rich descriptions that could not have been captured using solely quantitative methods. Among this randomly selected sample of ECE providers, key factors at the intervention-, organizational- and individual-level from the COWP D&I framework were identified that translated to successful implementation of the COWP PSE Change Process in ECE settings.

Intervention-level D&I constructs from the COWP D&I framework include feasibility, adaptability, costs, design packaging and quality, active ingredients (primary curriculums used for each COWP component), fidelity, dose, accountability and cultural sensitivity. Adaptability and feasibility were two codes that appeared to be most salient during the exploratory data analysis process. Previous studies that have utilized a D&I framework have similarly recognized the importance of adaptability, or flexibility, of a program to meet the needs of the specific target community and increase feasibility [21, 22]. The COWP PSE Change Process is grounded in CBPR methods, which emphasizes that translation of research into practice requires understanding the community and working with community members who are directly affected by the intervention outcomes [23, 24]. For example, the COWP PSE Change Process involves ECE center-based wellness teams selecting PSE changes that will most readily be implemented in their centers from menus of best practices, highlighting the inherent flexibility of this process. The team also prioritizes potential PSE changes based on importance and feasibility in order to identify the PSE changes that will be most feasible for their center. These data suggest that adaptability and feasibility are the two most important intervention-level constructs that lead to successful implementation of the COWP PSE Change Process.

Numerous organizational-level D&I constructs from the COWP D&I framework were also probed in the protocol including: leadership engagement, resources allocation, management support, staffing retention, policies, implementation climate, readiness for implementation, center schedules, quality rating, wellness champion, staff buy-in and family engagement. In this study, staff and leadership engagement were the two codes that appeared to be most prominent and impactful on successful implementation of this program. The COWP PSE Change Process requires participation from both leaders and staff members on center-specific wellness teams since one of the key tenants of the strategic planning tool is formation of an interdisciplinary team with diverse stakeholders. This often includes directors, supervisors, teachers, human resources, cooks and support staff. Uyeda et al. [24] evaluated a multicomponent obesity prevention program using a D&I framework and similarly found that when working in school systems, multiple levels of buy-in are crucial to the successful implementation of an

intervention. Previous studies that have looked at obesity prevention program implementation in ECE- and school-based settings using qualitative methods also identified the importance of both director and teacher buy-in and engagement in the successful implementation of external programs [25, 26]. These findings are also concurrent with organizational theory, which has emphasized the importance of setting characteristics, including leadership engagement and support, for the uptake and implementation of new and innovative changes [15].

Finally, interview participants were asked about individual-level constructs from the D&I framework which included attitudes, knowledge, skills, personal characteristics and commitment to organization. Attitudes, knowledge and skills were identified as key individual-level factors that impacted successful implementation of the COWP PSE Change Process. Minimal research has been done to gain understanding of the interplay between individuals and the organization within which they work and how this impacts systems-level change, particularly in ECE settings [14]. Organizational change starts with individual behavior change and individual-level knowledge, attitudes and self-efficacy have been widely studied as the three most common individual measures in health behavior theories . The findings in this study align with these theories, as well as past D&I work that points to the impact of these personal attributes on successful implementation of interventions in diverse settings [14].

This study is not without limitations. The relatively small sample size may limit the generalizability of these findings. However, the use of random sampling increases the validity of these data. Additionally, the authors acknowledge that a complexity of factors intervene and interact, beyond what is measured in the COWP D&I framework, that may impact the success of implementation. The framework adapted intervention-, organizational- and individual-level constructs from two widely used D&I frameworks to ensure these findings can be compared to related D&I findings. A final limitation of this study is that the interviews were limited to just center directors and wellness champions. The perceptions of additional staff members, including administrators, food service workers, assistant teachers and education supervisors would shed further insight into D&I constructs that may impact the implementation and sustainability of PSE changes in ECE settings.

Past qualitative studies have identified organizational-level barriers related to program implementation, including time constraints of teachers and the lack of resources or ongoing training in school-based settings [25, 26]. Therefore, next steps include the use of mixed-methods to better understand the key constructs and barriers related to successful implementation of the COWP PSE Change Process in diverse ECE settings. These findings will inform model revision of the COWP D&I framework to best fit the ECE population. Scalability of the COWP PSE Change Process is also a primary goal of the research team. Scale-up strategies that include determinants at the intervention-, organizational- and individual-level are needed to translate to sustainable behavior change related to healthy eating and physical activity in ECE settings [27, 28]. Potential scalability options for the COWP PSE Change Process include: train-the-trainer models, cross-setting learning and collaboration, increased incentives to participation, alignment with quality rating systems and internal regulations, and the use of online learning systems. Lastly, the research team hopes to expand the D&I lens that we have applied to the COWP PSE Change Process to the entire multi-level, multi-strategy COWP intervention and connect this to individual-level outcomes (healthy eating and physical activity), which to our knowledge has not been done in the literature yet. Still short of these future next steps, we feel the findings presented in this article provide insight into core D&I constructs that should be targeted by obesity prevention interventions in ECE settings to ensure maximum impact on sustainable healthy eating and physical activity behavior change.

Funding

Temple Hoyne Buell Foundation (9394).

Conflict of interest statement

None declared.

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