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Preventing childhood obesity in early care and education settings: Lessons from two intervention studies

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Abstract

Background—Obesity prevention in young children is a public health priority. In the United States, nearly 10% of children less than five years of age are obese and most attend some form of out-of-home child care. While a number of interventions have been conducted in early care and education settings, few have targeted the youngest children in care or the less formal types of child care like family child care homes. Additionally, only two previous studies provided recommendations to help inform future interventions.

Methods—This paper presents lessons learned from two distinct intervention studies in early care and education settings to help guide researchers and public health professionals interested in implementing and evaluating similar interventions. We highlight two studies: one targeting children ages four to 24 months in child care centers and the other intervening in children 18 months to four years in family child care homes. We include lessons from our pilot studies and the ongoing larger trials.

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Results—To date, our experiences suggest that an intervention should have a firm basis in behavior change theory; an advisory group should help evaluate intervention materials and plan for delivery; and realistic recruitment goals should recognize economic challenges of the business of child care. A flexible data collection approach and realistic sample size calculations are needed due to high rates of child (and sometimes facility) turnover. An intervention that is relatively easy to implement is more likely to appeal to a wide variety of early care and education providers.

Conclusions—Interventions to prevent obesity in early care and education have the potential to reach large numbers of children. It is important to consider the unique features and similarities of centers and family child care homes and take advantage of lessons learned from current studies in order to develop effective, evidence-based interventions.

Keywords

intervention; obesity; physical activity

INTRODUCTION

Rates of obesity in early childhood have shown some improvement in recent years (Ogden *et al.* 2014), but are still of public health concern. In the United States (US), recent data show that 8.1% of children less than two years and 8.9% of children two to five years were obese (Ogden *et al.* 2014, Ogden *et al.* 2015). Obesity prior to five years of age may be especially persistent (Cunningham *et al.* 2014) and recent calls for intervention highlight this age group as a primary target (Institute of Medicine 2011). Since nearly two-thirds of children under five spend time in early care and education (Laughlin 2013), these settings represent an important opportunity for intervention (Benjamin Neelon and Briley 2011, Larson *et al.* 2011).

Three recent systematic reviews underscore the growing number of interventions targeting children in early care and education settings (Nixon *et al.* 2012, Zhou *et al.* 2013, Mikkelsen *et al.* 2014). However, most of these interventions targeted preschool-aged children and were implemented in the more formal child care centers (Nixon *et al.* 2012, Zhou *et al.* 2013). The youngest children—infants and toddlers—have received far less attention (Benjamin Neelon *et al.* 2014, de Silva-Sanigorski *et al.* 2010). One study intervening in infants and toddlers in child care centers is currently underway, but results are not yet available (Natale *et al.* 2013).

Additionally, few studies have focused on the less formal types of child care, such as family child care homes (Zhou *et al.* 2013), despite the fact that nearly 1.5 million children in the United States (US) spend time in this setting (Laughlin 2013). One previous study in Australia (Romp & Chomp) assessed a nutrition and physical activity intervention within a community that included family child care homes as one target settings. The researchers found lower rates of obesity in two-year-old children in the intervention homes compared to those in the comparison settings (de Silva-Sanigorski *et al.* 2010, de Silva-Sanigorski *et al.* 2011). However, this was a quasi-experimental and not a randomized controlled trial. Additionally, while the study included family child care homes as part of the community intervention, they were not the focus of the intervention. Thus, this study would be challenging to replicate and may not be effective without a larger community-based effort. A

study in the US evaluated an obesity prevention training for family child care home providers from 15 counties in Kansas (Trost *et al.* 2011) and observed increased knowledge for both nutrition and physical activity after the training. However, the primary outcome was based on provider self-report. Moreover, the intervention focused on teacher training only and did not target the children in care directly.

As interest in obesity prevention in early care and education grows, it is important to learn from current research to refine existing interventions and their evaluation efforts. However, only two previous studies offer such insight. One study included lessons learned from a physical activity intervention in child care centers in Canada (Goldfield *et al.* 2012). The researchers highlight the importance of engaging both the director and the teachers as gatekeepers to children's health and focusing on teacher knowledge and skills as potential targets for improvement. Additionally, the researchers recommend child-friendly measurement equipment (e.g., scales with stickers), contacting parents directly if ethical boards allow, and avoiding the summer and holiday months for recruitment and assessment. A second study presented recommendations from Romp & Chomp, the community-based intervention that included family child care homes in Australia (de Groot *et al.* 2010). While many of the recommendations addressed community-level intervention (e.g., building capacity and strong leadership within the community), two were relevant to early care and education. The researchers suggested focusing on professional development through teacher training and recommended an intervention guided by an appropriate theoretical framework (de Groot *et al.* 2010). However, neither study took place in the US. One presented lessons from a center-based physical activity intervention in three- to five-year-olds in Canada and the second included recommendations from a community-wide program in Australia that included family child care as one component of their intervention.

Here, we present lessons learned from two obesity prevention interventions in the US targeting distinct child care settings. Both interventions aim to prevent obesity by improving feeding and physical activity behaviors, enhancing interactions between providers and children, and creating healthier environments where children spend time. One intervention targets centers and the other intervenes within family child care homes.

MATERIALS AND METHODS

Overview

The Baby NAP SACC (Nutrition and Physical Activity Self-Assessment for Child Care) intervention is designed to promote healthy weight behaviors in children less than two years by improving the child care center and children's home environments and the interactions that take place between young children, their care providers, and their parents. The intervention is modeled after the NAP SACC program (Ammerman *et al.* 2007) and has shown favorable results in pilot testing (Benjamin Neelon *et al.* 2014). Baby NAP SACC is being evaluated using a cluster randomized controlled trial design with 640 children ages four to 24 months attending one of 80 centers in North Carolina. The intervention was launched in summer of 2013 with results available in late 2017. The Institutional Review Board of Duke University Medical Center reviewed and approved the study protocol.

The Keys (Keys to Healthy Family Child Care Homes) intervention targets family child care homes and is designed to improve the quality of foods served, increase the opportunities and support for physical activity, and promote providers as healthy role models for children. Keys is also being evaluated through a cluster randomized controlled trial with 450 children ages 18 months to four years attending one of 150 family child care homes in North Carolina (Ostbye *et al.* 2014). Keys began in the spring of 2013; study results will be available in late 2017. The Institutional Review Board of the University of North Carolina at Chapel Hill reviewed and approved the study protocol. Both studies were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Community Engagement

Both Baby NAP SACC and Keys elicit assistance from a community advisory group. Both used a group originally assembled for the NAP SACC intervention (Ammerman *et al.* 2007) consisting of center directors, various community stakeholders, and parents. For Baby NAP SACC, membership was expanded to include providers working in infant-only centers, additional directors, and parents of young children. For Keys, center directors were replaced with owners of family child care homes and additional community stakeholders working with family child care homes were invited to join. Feedback from these groups resulted in changes to study design, intervention materials and messages, and the delivery model.

In Baby NAP SACC this group helped simplify intervention materials and encouraged the coaches to hone in on important messages in a short amount of time. They emphasized the limited time available for intervention activities and encouraged the study team to identify specific priorities of the intervention. They also led us to change from a cohort approach to rolling enrollment. In Keys, the group provided insight into a relatively unstudied population—family child care home providers. They helped the team think through small but important details like what terminology providers used to identify themselves, preferences for communication, and strategies to build positive relationships with providers. They were also willing to review intervention materials to help ensure that content was relevant. Even though research teams on Baby NAP SACC and KEYS had experience working in child care, the community advisory groups helped tailor our approach to the specific settings and populations being targeted.

Trial Design

Power and Sample Size—Sample size calculations require estimates of cluster size, intra-class correlations (ICC), and effect size. Both studies examined multiple scenarios regarding the number of facilities needed, and the number of children per facility. Centers enroll more children compared to homes; however, these children tend to be slightly older. While it may be possible to recruit clusters of ten three- to five-year-old children per center, clusters may need to be smaller when recruiting infants and toddlers. Calculations require knowledge of ICC and effect size, but there are limited child care studies with body weight outcomes to inform these estimates, and none in the youngest children (de Silva-Sanigorski *et al.* 2010, Fitzgibbon *et al.* 2005, Fitzgibbon *et al.* 2006). We did not use data from the pilot

studies to power the larger trials; neither pilot included child-level weight outcomes. Instead, the pilot studies were used to practice our measures and assess intervention receptivity. For Baby NAP SACC, we used an ICC of 0.01 for the primary weight-for-length z-score outcome. For Keys, we used an ICC of 0.12 for moderate to vigorous physical activity and 0.36 for Healthy Eating Index score. Baby NAP SACC calculations required 80 centers with eight children per center to achieve 90% power. For Keys, 150 family child care homes with three children per home yielded 90% power to detect intervention differences.

Recruitment—Recruitment for both studies requires engagement at multiple levels in order to enroll the director or owner of the facility and the children in care. Baby NAP SACC and Keys use an online database of child care facilities maintained by the state licensing and administrative agency to identify an initial recruitment pool. Invitations are mailed to these facilities, and followed by telephone calls. We learned in the pilot studies that centers and family child care homes prefer mailed correspondence and use email infrequently. While mailed invitations provide a soft introduction to the studies, follow up telephone calls are necessary. This was the case in the pilot studies as well. Once the director or owner is on board, recruitment materials are distributed to parents. Both the director or owner and parents sign written informed consent to participate. In Keys, these efforts are preceded by community-level engagement during which local organizations help spread the word about the study. This was one recommendation put forth from the advisory committee to aid in recruitment efforts. In addition, recruitment materials are usually delivered to facilities and parents in person to provide an opportunity for research staff to answer questions. Also, consistent with findings from Goldfield and colleagues (Goldfield *et al.* 2012), certain times of the year can be challenging for recruitment. These months include February, July, November, and December. Providers have conveyed that they have little time outside of daily work for additional responsibilities, and these sentiments seem elevated during these months.

To date in Baby NAP SACC, 26.2% of centers contacted elected to participate in the study (n=50). From those, we recruited an average of 7.7 children per center (somewhat below the target of 8.0 children; n=386). Thus far in Keys, 12.3% of family child care homes contacted have enrolled in the study (n=122). We recruited an average of 3.0 children per home (in line with the target; n=366). We anticipated this rate of enrollment based on data from each pilot study and could therefore plan accordingly.

Lastly, appealing incentives are necessary to help motivate directors and owners to participate. In general, providers have relatively modest incomes and many do not enjoy benefits such as sick and vacation time (McGrath 2007, Carson *et al.* 2010, Child Care Services Association 2012). Cash incentives are often by themselves insufficient. Both Baby NAP SACC and Keys also offer trainings on nutrition and physical activity that provide contact hour and continuing education credits from the state. These credits are a valued incentive, as they are required to maintain early childhood education credentials. The advisory committees from both studies highlighted the importance of these additional incentives.

Retention

As we learned in the pilot studies and the ongoing trials, cohort retention is particularly challenging due to facility closings and child turnover. Child care facilities often operate on very tight budgets and can go out of business within a relatively short period of time. Our previous studies, including the Baby NAP SACC pilot, suggest that approximately 10% of centers will close their doors within the study period (Benjamin Neelon *et al.* 2014, Ball *et al.* 2014). Fortunately, closing of facilities has been rare in Baby NAP SACC (none of 50 centers) and Keys (one of 122 homes). In Keys, five of the 122 owners have withdrawn from the study. In Baby NAP SACC, four of the 50 directors discontinued participation. Turnover in child enrollment within facilities has resulted in notable losses. Thus far, 22% of children in Baby NAP SACC and 55% in Keys have left the facility after baseline but before follow-up. Both studies follow an intention-to-treat approach and must therefore attempt to impute missing data or locate the children who left to conduct follow-up assessments. In Baby NAP SACC, 13% of children still provided data at follow-up even though they had left the center. Even if children can be located for follow-up, their intervention dose may be substantially reduced—especially if children leave shortly after randomization.

Although problematic, low retention rates are not uncommon. A systematic review of interventions targeting infants and toddlers for obesity prevention reported a median attrition rate of 32% from previous studies (Ciampa *et al.* 2010). Both Baby NAP SACC and Keys employ inclusion criteria to help mitigate these losses. Keys requires family child care homes to have been in business at least two years with no plans to close in the coming year to demonstrate business stability. This has resulted in a relatively small four percent loss of family child care homes. Baby NAP SACC, on the other hand, does not employ inclusion criteria for centers to help decrease attrition and has lost eight percent of centers. Instead, Baby NAP SACC excludes families who plan to leave their center within the next 12 months; attrition of families has been lower in Baby NAP SACC compared to Keys (22% versus 55%). These criteria were put in place based on our experience conducting the pilot studies. Both studies also provide separate monetary incentives for facilities and families at baseline and again at follow-up. One previous physical activity intervention recommended consistent positive reinforcement to increase participant morale and compliance (Goldfield *et al.* 2012). Despite these efforts, rates of attrition are concerning and warrant careful consideration for future studies.

Measurement—The primary outcome for Baby NAP SACC is child adiposity measured via skinfold thicknesses and weight-for-length z-scores. Secondary outcomes include physical activity measured using accelerometry and dietary intake measured through direct observation and parent report. For Keys, primary outcomes are child physical activity measured via accelerometry and dietary intake measured via direct observation in the family child care home. Secondary outcomes include child body mass index z-scores, provider weight-related behaviors, and environmental characteristics of the home.

Both Baby NAP SACC and Keys collect child-level data at two time points, sending data collectors into the center or home for two to three days at baseline and follow-up. During visits, data collectors take anthropometric measurements on the children and the director or

owner (and parent for Baby NAP SACC), observe the foods and beverages children consume in care, fit children with accelerometers to assess physical activity, observe the facility's physical and social environment, and distribute self-administered surveys to the director or owner. Baby NAP SACC also assesses infant and toddler teachers in the center. For Baby NAP SACC, baseline and follow-up assessments take place about nine months apart; for Keys, measures take place about ten to 12 months apart.

Specific needs of the study must be considered when selecting measures and deciding if modifications are needed. Obesity prevention researchers working in child care settings have the benefit of several measures with well-documented protocols and psychometric properties, such as the Environment and Policy Assessment and Observation (EPAO), which is a measure of the nutrition and physical activity environment in child care (Ward *et al.* 2008a) and the Diet Observation at Child Care, which is a measure of foods consumed by children in child care (Ball *et al.* 2007). Both Baby NAP SACC and Keys use these measures, but they have required slight modification. For example, the EPAO was originally designed for use in centers serving children two to five years of age; therefore, it was modified for Baby NAP SACC to capture elements of the physical environment and child-provider interactions that would be most relevant for children under two years of age (e.g., bottle feeding, minutes of tummy time). In Keys, the EPAO was modified to make it more relevant for use in family child care homes. For example, family child care homes generally have only a single provider and are less structured. The revised EPAO focuses on a single provider in a smaller setting (e.g., a sometimes single room for children versus multiple classrooms).

Based on our experience conducting the pilot studies, we learned that training must not only familiarize data collectors with instruments, but also sensitize them to the child care environment. Child care facilities undergo regular inspections from the state licensing agency and can therefore be apprehensive about allowing research staff to observe in the facility. Providers are also very protective of the children in their care. While data collectors should be unobtrusive and observe without interacting with children, providers may see this as disrespectful if data collectors ignore children who try to engage with them. However, it is important to observe children in their natural environment and if the data collector is distracting, children may not behave normally. In both studies we ask data collectors to explain to children and providers that they have been instructed to conduct their work quietly and not engage with anyone during the observation (i.e., be a fly on the wall). Otherwise, providers and children may be tempted to engage with data collectors and disrupt the observation process. In Keys, data collectors have also been trained to be especially aware of asking permission of the provider before looking throughout the house or going into the yard, since the family child care home is often also their personal residence. This awareness arose from the Keys pilot study.

Additionally, some children may be absent on data collection days. Data collectors may need to return on additional days to assess children who were not present during the scheduled observations—especially in the summer and winter months when more children seem to be absent. It is important to anticipate and plan for these additional data collection visits when calculating the study timeline and budget.

Intervention

Design—The Baby NAP SACC intervention includes three complementary components: self-assessment by center directors and parents, and selection of areas for improvement; targeted technical assistance for directors and parents from a health coach; and training for providers who care for infants and toddlers in the center. The advisory group highlighted the importance of training providers and offering contact hour and continuing education credits through the state as additional incentive. The intervention takes place over six months. Ideally, theory is used to understand behavior change in both the child and the provider (also the parent in Baby NAP SACC). The Baby NAP SACC intervention includes components of Social Cognitive Theory (SCT) (Glanz *et al.* 2002) and the Socio-Ecological Framework (SEF) (McLeroy *et al.* 1998). SCT identifies several factors that affect behavior, with the environment as a primary influence (Glanz *et al.* 2002). The SEF highlights multiple levels of influence on health behaviors, including the interpersonal, organizational, community, and policy levels (McLeroy *et al.* 1998). Baby NAP SACC targets the interpersonal and organizational levels, and gives providers and parents the opportunity to assess and improve their environments. We honed the intervention components through pilot testing.

The Keys intervention is delivered through workshops, home visits, coaching calls, and educational toolkits and is implemented over nine months. These intervention components were tested and refined during the pilot study. The Keys intervention employs tenets of the SEF, SCT, and Self-Determination Theory (SDT) (Deci 1980). When applying the SEF, Keys focuses on the interpersonal level (provider-child interactions) and the environmental level (environmental supports) and target the owner to make improvements at these levels. SCT and SDT are then used to identify factors influencing the behaviors of owners such as behavioral capacity (knowledge and skills), self-efficacy, expectations and expectancies (attitudes and beliefs), and autonomy, competence, and relatedness. The Intervention Mapping (IM) (Bartholomew *et al.* 1998) approach also helps ensure consistent application of the theories. The IM approach includes a systematic, six-step method to intervention development, implementation, and evaluation. In Keys, this process helped ensure that the final intervention integrated the lessons learned from pilot work, remained grounded in theory, created content that would drive change in targeted behaviors, and incorporated appropriate measures into the evaluation. A recent paper provides additional detail about the IM process used in Keys (Mann *et al.* 2015).

Delivery—Both interventions (for the pilots and larger trials) employ a trained health behavior coach to work with providers on nutrition and physical activity behavior and environmental change. The coaches have advanced degrees in public health, counseling, or social work, and receive training from researchers on nutrition and physical activity intervention for young children.

The Baby NAP SACC intervention components are designed to engage the center director, teachers, and parents, since all are important gatekeepers to children's health. The parent component was added based on director feedback from the pilot study; directors highlighted the importance of reaching the families of the children in care for intervention. In Baby NAP SACC, coaches have an initial meeting and five follow-up meetings with the director, deliver

three workshops for the director and the teachers, and provide two hands on “real time” coaching sessions for teachers in the classroom. The “real time” coaching session was added based on our experience during the initial stage of intervention implementation for the larger trial—teachers requested more direct contact with the coach.

To date, center compliance has been high with 77% completing two thirds or more of the intervention components. For parents, the intervention includes two phone-based coaching sessions. Parent participation to date has been lower than expected, with only 45% completing at least one session. The intervention also provides a number of tangible items placed in and around the center and home, including four children’s books with original artwork that promote healthy eating and active play and were developed for this intervention, custom balls, posters, and play equipment—all with targeted messages for young children.

The Keys intervention targets the family child care home’s owner, with coaches providing three workshops and twelve coaching contacts. Coaches help providers select goals for behavior change, monitor progress, and address barriers. Thus far, nearly 85% of the family child care home owners have completed all workshops and 69% have completed all coaching visits. The intervention also provides tangible items like water bottles, exercise bands, and pedometers for the providers, and children’s books.

Delivery of an intervention, even one that provides one-on-one support, results in issues with time and scheduling. Directors and owners report having little time for intervention activities. This same feedback was provided in the pilot studies and the larger trials. Coaches find that it requires two to six attempts to complete activities like a telephone intervention call. Coaches may need to allow participants the flexibility of omitting some elements but returning later to complete other aspects of the intervention.

Researchers must also consider the organizational structure of the child care facility and how it may impact their willingness and ability to take part in the intervention. Center directors also report obstacles from owners, especially if their center is associated with a chain of businesses. Family child care home providers have more discretion, since they are the business owners. However, their time can be more limited and intervention activities may be seen as competing with time needed to care for children. This concern was echoed in both the pilot studies and the ongoing interventions. It is important for researchers to be respectful and acknowledge these limitations to help ensure intervention success.

RESULTS

The primary recommendations stemming from our experiences thus far include development of a promising intervention rooted in behavior change theory; a broad-based advisory group to help evaluate the intervention and plan for delivery; and realistic recruitment goals and strategies that recognize the challenges and constraints associated with the business of child care. These recommendations apply to behavior change interventions in general and are especially true for interventions targeting young children. Additionally, for intervention delivery and data collection, a flexible approach is needed. Researchers should allow for

substantial attrition when considering sample size calculations, especially of children. Child care is a somewhat unpredictable environment and therefore requires flexibility. An intervention that is relatively easy to implement and has been developed for dissemination is more likely to appeal to a variety of providers.

DISCUSSION

Both Baby NAP SACC and Keys are based on our previous experience developing and evaluating interventions for child care, including several prior studies with the NAP SACC intervention (Ammerman *et al.* 2007, Ward *et al.* 2008b, Alkon *et al.* 2014). This experience developing and conducting the NAP SACC intervention helped inform future work with Baby NAP SACC and Keys. Although NAP SACC targeted three- to five-year-old children in child care centers, there were a number of areas of overlap that helped us design and implement the current studies. While the Baby NAP SACC and Keys interventions share some similarities to NAP SACC, both studies have expanded their intervention to new populations. These new studies have allowed us to examine which of our previous research methods (e.g., recruitment, data collection, intervention delivery) remain effective and what issues arise that necessitate modification to approaches used previously.

CONCLUSIONS

While Baby NAP SACC and Keys are ongoing, our experiences with the pilot studies and larger trials to date may inform other researchers and public health professionals interested in developing, implementing, and evaluating interventions to prevent obesity in young children in early education and care settings.

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Abbreviations

DOCC	Diet Observation at Child Care
EPAO	Environment and Policy Assessment and Observation
IM	Intervention Mapping
US	United States

References

- Alkon A, Crowley AA, Neelon SE, Hill S, Pan Y, Nguyen V, Rose R, Savage E, Forestieri N, Shipman L, Kotch JB. Nutrition and physical activity randomized control trial in child care centers improves knowledge, policies, and children's body mass index. *BMC Public Health*. 2014; 14:1471–2458.
- Ammerman AS, Ward DS, Benjamin SE, Ball SC, Sommers JK, Molloy M, Dodds JM. An intervention to promote healthy weight: Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) theory and design. *Prev Chronic Dis*. 2007; 4:A67. [PubMed: 17572971]

- Ciampa PJ, Kumar D, Barkin SL, Sanders LM, Yin HS, Perrin EM, Rothman RL. Interventions aimed at decreasing obesity in children younger than 2 years: a systematic review. *Arch Pediatr Adolesc Med*. 2010; 164(12):1098–104. [PubMed: 21135337]
- Child Care Services Association. North Carolina Child Care Workforce Study. 2012. Available at: http://www.childcareservices.org/_downloads/research/WorkforceReport2013/WorkforceReport_2013.pdf
- Ball SC, Benjamin SE, Ward DS. Development and reliability of an observation method to assess food intake of young children in child care. *J Am Diet Assoc*. 2007; 107:656–661. [PubMed: 17383271]
- Ball SC, Gillman MW, Mayhew M, Namenek Brouwer RJ, Benjamin Neelon S. Physical Activity and Weather-Related Practices of Child Care Centers From Two States. *J Phys Act Health*. 2014; 12(2): 238–44. [PubMed: 24763142]
- Bartholomew LK, Parcel GS, Kok G. Intervention mapping: a process for developing theory- and evidence-based health education programs. *Health Educ Behav*. 1998; 25:545–563. [PubMed: 9768376]
- Benjamin Neelon SE, Briley ME. Position of the American Dietetic Association: Benchmarks for Nutrition in Child Care. *Journal of the American Dietetic Association*. 2011; 111:607–615. [PubMed: 21443997]
- Benjamin Neelon SE, Taveras EM, Ostbye T, Gillman MW. Preventing obesity in infants and toddlers in child care: results from a pilot randomized controlled trial. *Matern Child Health J*. 2014; 18:1246–1257. [PubMed: 24065371]
- Carson RL, Baumgartner JJ, Matthews RA, Tsouloupas CN. Emotional exhaustion, absenteeism, and turnover intentions in childcare teachers: examining the impact of physical activity behaviors. *J Health Psychol*. 2010; 15:905–914. [PubMed: 20472609]
- Ciampa PJ, Kumar D, Barkin SL, Sanders LM, Yin HS, Perrin EM, Rothman RL. Interventions aimed at decreasing obesity in children younger than 2 years: a systematic review. *Arch Pediatr Adolesc Med*. 2010; 164(12):1098–104. [PubMed: 21135337]
- Cunningham SA, Kramer MR, Narayan KM. Incidence of childhood obesity in the United States. *N Engl J Med*. 2014; 370:403–411. [PubMed: 24476431]
- de Groot FP, Robertson NM, Swinburn BA, De Silva-Sanigorski AM. Increasing community capacity to prevent childhood obesity: challenges, lessons learned and results from the Romp & Chomp intervention. *BMC Public Health*. 2010; 10:1471–2458.
- de Silva-Sanigorski A, Elea D, Bell C, Kremer P, Carpenter L, Nichols M, Smith M, Sharp S, Boak R, Swinburn B. Obesity prevention in the family day care setting: impact of the Romp & Chomp intervention on opportunities for children's physical activity and healthy eating. *Child Care Health Dev*. 2011; 37:385–393. [PubMed: 21276039]
- de Silva-Sanigorski AM, Bell AC, Kremer P, Nichols M, Crellin M, Smith M, Sharp S, De Groot F, Carpenter L, Boak R, Robertson N, Swinburn BA. Reducing obesity in early childhood: results from Romp & Chomp, an Australian community-wide intervention program. *Am J Clin Nutr*. 2010; 91:831–840. [PubMed: 20147472]
- Deci ER, Rm. Self-determination theory: When mind mediates behavior. *Journal of Mind and Behavior*. 1980; 1(1):33–43.
- Fitzgibbon ML, Stolley MR, Schiffer L, Van Horn L, Kauferchristoffel K, Dyer A. Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. *J Pediatr*. 2005; 146:618–625. [PubMed: 15870664]
- Fitzgibbon ML, Stolley MR, Schiffer L, Van Horn L, Kauferchristoffel K, Dyer A. Hip-Hop to Health Jr. for Latino preschool children. *Obesity (Silver Spring)*. 2006; 14:1616–1625. [PubMed: 17030973]
- Glanz, DK.; Rimer, BK.; Lewis, FM. *Health Behavior and Health Education: Theory, Research, and Practice*. Jossey-Bass; San Francisco: 2002.
- Goldfield GS, Harvey A, Grattan K, Adamo KB. Physical activity promotion in the preschool years: a critical period to intervene. *Int J Environ Res Public Health*. 2012; 9(4):1326–42. [PubMed: 22690196]
- Institute of Medicine. *Early Childhood Obesity Prevention Policies*. The National Academies Press; Washington, DC: 2011.

- Larson N, Ward DS, Neelon SB, Story M. What Role Can Child-Care Settings Play in Obesity Prevention? A Review of the Evidence and Call for Research Efforts. *Journal of the American Dietetic Association*. 2011; 111:1343–1362. [PubMed: 21872698]
- Laughlin, L. Who's minding the kids? Child care arrangements: Spring 2011. United States Census Bureau; Washington DC: 2013.
- Mann CM, Ward DS, Vaughn A, Benjamin Neelon SE, Long Vidal LJ, Omar S, Namenek Brouwer RJ, Østbye T. Application of the Intervention Mapping protocol to develop Keys, a family child care home intervention to prevent early childhood obesity. *BMC Public Health*. 2015; 15(1):1227. [PubMed: 26654726]
- Mcgrath BJ. Identifying health and safety risks for childcare workers. *Aaohn J*. 2007; 55:321–325. [PubMed: 17847626]
- McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988; 15:351–377. [PubMed: 3068205]
- Mikkelsen MV, Husby S, Skov LR, Perez-Cueto FJ. A systematic review of types of healthy eating interventions in preschools. *Nutr J*. 2014; 13:56. [PubMed: 24906305]
- Natale R, Scott SH, Messiah SE, Schrack MM, Uhlhorn SB, Delamater A. Design and methods for evaluating an early childhood obesity prevention program in the childcare center setting. *BMC Public Health*. 2013; 13:1471–2458.
- Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA*. 2014; 311:806–814. [PubMed: 24570244]
- Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of Obesity Among Adults and Youth: United States, 2011–2014. *NCHS Data Brief*. 2015; (219):1–8.
- Ostbye T, Mann CM, Vaughn AE, Namenek Brouwer RJ, Benjamin Neelon SE, Hales D, Bangdiwala SI, Ward DS. The Keys to healthy family child care homes intervention: Study design and rationale. *Contemp Clin Trials*. 2014; 8:81–89. [PubMed: 25460337]
- Trost SG, Messner L, Fitzgerald K, Roths B. A nutrition and physical activity intervention for family child care homes. *Am J Prev Med*. 2011; 41:392–398. [PubMed: 21961466]
- Ward D, Hales D, Haverly K, Marks J, Benjamin S, Ball S, Trost S. An instrument to assess the obesogenic environment of child care centers. *Am J Health Behav*. 2008a; 32:380–386. [PubMed: 18092898]
- Ward DS, Benjamin SE, Ammerman AS, Ball SC, Neelon BH, Bangdiwala SI. Nutrition and physical activity in child care: results from an environmental intervention. *Am J Prev Med*. 2008b; 35:352–356. [PubMed: 18701236]
- Ward DS, Vaughn A, McWilliams C, Hales D. Interventions for increasing physical activity at child care. *Med Sci Sports Exerc*. 2010; 42:526–534. [PubMed: 20068495]
- Zhou YE, Emerson JS, Levine RS, Kihlberg CJ, Hull PC. Childhood obesity prevention interventions in childcare settings: systematic review of randomized and nonrandomized controlled trials. *Am J Health Promot*. 2013; 28:e92–e103. [PubMed: 24200332]