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EvidenceSynthesis

IMPACT OF CHILDCARE PHYSICAL ACTIVITY (PA) AND NUTRITION POLICIES AND INTERVENTIONS ON PA, CONSUMPTION OF HEALTHIER FOODS, AND BODY WEIGHT OUTCOMES

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OVERVIEW

Obesity rates among children have nearly tripled in the last thirty years, and not even the youngest children have been spared (1, 2). Excess weight in childhood has been linked to insulin resistance, type 2 diabetes, hypertension, poor emotional health, and diminished social well-being. In addition, obese children are more likely to become obese adults, making childhood obesity a serious public health concern (2). Given the widespread use of out-of-home childcare facilities in Canada, and the considerable amount of time spent by preschoolers in these environments, this setting has great potential for the promotion of healthier weights (3). As such, development of policies and interventions aimed at promoting healthy physical activity (PA) and/or nutrition environments in these settings may be a promising strategy in the prevention of overweight and obesity. This evidence synthesis examines the impact of PA and nutrition policies and interventions in childcare and preschool settings on PA levels, consumption of healthier foods, and body weight outcomes.

For the purpose of this review, the term ‘‘childcare” and/or ‘‘preschool’’ referred to home and center-based care for preschool-aged children, ranging in age from two to six years old. It included early childhood education facilities, such as kindergartens, pre-schools, and nursery schools, in addition to privately run childcare centres, family childcare homes, daycares, centers operated by churches and other places of worship, and Head Start programmes.

METHODS

Review of Evidence. This synthesis report involved the collection of review articles from three databases (Ovid Medline, Ovid PsycINFO, Ovid ERIC) and a web search (the Rudd Center for Policy and Obesity, Bridging the Gap, Active Living Research, and Google Scholar). Additional studies were provided by the research team and an iterative search of PubMed related references was conducted. Lastly, a review of cited references from key articles was carried out. To be included in this synthesis report, reviews had to meet the following criteria: (1) English and French language reviews; (2) published after 2003; (3) comprehensive or systematic in nature, outlining explicit methods; (4) include policies or policy relevant

interventions; and (5) examine the impact of childcare PA and nutrition policies on PA levels, consumption of healthier food, and/or body weight outcomes, including Body Mass Index (BMI). The first round of screening involved reviewing titles and abstracts to remove irrelevant studies. The second-level screening consisted of a full review of remaining articles to ascertain relevance in relation to the inclusion criteria.

SYNTHESIS OF EVIDENCE

Characteristics of systematic reviews. Seven reviews met the criteria to be included in this synthesis report. While this synthesis aimed to focus on policies, only one review specifically discussed the impact of a policy in the childcare setting on the outcomes of interest (4). All reviews did, however, evaluated the impact of interventions with relevance and implications for policy on PA levels (1, 3, 5-8), consumption of healthier foods (3, 4, 6, 7), and/or body weight outcomes (3, 4, 6, 7). Moreover, two reviews (1, 3) examined factors related to the implementation of policy measures or state regulations, though this was beyond the scope of this synthesis. Six reviews (1, 3, 5-8) included studies that looked at the effect of PA specific interventions, three reviews (3, 4, 7) focused on nutrition specific interventions, and six others (1, 3, 4, 6-8) included combined PA and nutrition intervention strategies. For characteristics of reviews, refer to Table 1.

The AMSTAR appraisal tool (9, 10) was used to appraise the strength of evidence of systematic reviews included in this synthesis report. In accordance with the tool, the reviews were assigned a rating of low (0-4), moderate (5-8), or high quality (9-11). Two of the reviews (5, 8) were deemed to be of moderate quality, both scoring 5 out of 11 possible points. The remaining five reviews (1, 3, 4, 6, 7) were judged to be of low quality, receiving from 1 to 3 out of a possible 11 points.

IMPACT OF CHILDCARE PA AND NUTRITION POLICIES ON PA LEVELS, CONSUMPTION OF HEALTHIER FOOD, AND BODY WEIGHT OUTCOMES

Overall. Findings from the seven reviews in this synthesis indicate that childcare PA and nutrition interventions can result in positive outcomes related to PA levels and consumption of healthier foods. Positive outcomes related to body weight were limited, potentially due to short durations between intervention and follow-up measures. The majority of reviews included studies with PA interventions and PA plus nutrition interventions, and reported on a variety of outcomes, making it difficult to measure the relationship between intervention and outcome. Overall, however, review findings signaled to the strength of comprehensive multicomponent strategies, such as a providing a combination of PA opportunities and nutrition education (3, 4, 8). For an overview of review findings, refer to Table 2.

Physical activity (PA) levels. Six of the seven reviews included in this synthesis were relevant to PA levels in childcare settings (1, 3, 5-8), and all of them reported at least modestly positive impacts. Review findings indicate that this is the case for single component PA interventions, such as introduction of PA into all preschool classroom activities (6), as well as combined PA and nutrition strategies, such as increased PA time and nutritional education sessions (1). Relevant factors identified within reviews to successfully increase PA levels included increasing the availability and quality of play equipment (1, 5, 6), allocating time for organized PA sessions (1), staff education and training (1), integrating opportunities for PA into classroom curriculum (1, 3), and PA sessions that lasted at least 30 minutes (6). It should be noted that in at least one review (8), while positive improvements were reported, children's PA levels were still low, not approaching the recommended 180 min/day criteria outlined in the review.

Consumption of healthier foods. Four of the seven included reviews were relevant to the consumption of healthier foods in childcare settings (3, 4, 6, 7). All four reviews included studies with combined PA and nutrition interventions, such as classroom PA and nutrition education activities, and programs to reduce sedentary time outside of the classroom. In addition, three reviews included studies looking at single component nutrition strategies, such as nutritional education sessions and food tastings for children. All of the reviews reported positive outcomes on consumption of healthier foods. Measures related to consumption included children's mealtime behaviors, dietary preferences and quality (3), increased fruit or vegetable consumption (4, 6) and decreased consumption of unhealthy snacks (6, 7). Strategies identified within the reviews as successfully impacting outcomes often included one or more of the following strategies: modifying foodservice practices (3), offering training workshops to staff (6), and classroom-based education for students (3). Increases in consumption of healthier foods were additionally found to be greater in multicomponent studies, indicating that comprehensive strategies may be the most successful (4).

Weight Outcomes. Four of the seven included reviews examined the impact of childcare PA and nutrition interventions on weight related outcomes (3, 4, 6, 7). Within the included reviews, studies involved both singly focused PA and nutrition strategies as well as combined interventions, and sought to promote healthier weights through reduced sedentary behavior, increased PA levels, and improved nutrition. Within reviews, weight outcomes were determined through measures such as body mass index (BMI) (3, 4, 6, 7), skinfolds (6), % body fat (3, 6), and prevalence of overweight and obesity (4, 6). Ultimately, while some reviews indicated modest improvements in BMI or weight outcomes, the findings were mixed or inconclusive overall. For example, of the six studies that focused on weight related outcomes in the review by Kreichauf et al. (6), only two reported positive effects. Of five studies assessing the impact on child weight assessment in Larson et al. (3), only two showed evidence of success. Further, of seven papers measuring child BMI as a primary outcome measure in Lessard et al. (7), only one found a significant effect on BMI. A reasonable explanation for these mixed/inconclusive results might be that

the short duration of interventions made it difficult to measure longer term anthropometric outcomes, while changes to food consumption and PA levels were more quickly recognized (4).

ADDITIONAL CONSIDERATIONS

Findings from a number of reviews indicated an important relationship regarding the role of parental and preschool teachers' attitudes and behaviours on the effectiveness of PA and nutrition interventions in childcare and preschool settings (1, 7). As identified in the review by Ward et al. (1), preschool teacher behaviors (e.g., prompts, participation), knowledge (e.g., education, training), attitudes (e.g., enjoyment of physical activity), or personal characteristics (e.g., BMI, physical fitness, or socioeconomic status) may be important drivers for adoption of healthy behaviours amongst children. Findings from the review by Mikkelsen et al. (4) illustrated that younger children, in particular, are greatly influenced by role models. Further, the review by Lessard (7) identified parents to be an important part of childcare-based strategies for obesity prevention, even if many studies did not specifically measure behavior at home. With an increasing focus on childcare-based obesity prevention interventions, future research should consider behavior outside the childcare environment as an important measure of the success of a policy or intervention. Without information on how policies/ interventions offered in the childcare setting impact the overall health of children, including behavior in the home, researchers could be incorrectly classifying policies and interventions as ineffective.

When examining the impact of childcare policies and interventions, it is also important to consider the role of socioeconomic status. Mikkelsen et al. (4), reviewed several educational and multicomponent interventions targeted towards preschools, kindergartens, and daycare facilities with children of low-income families. Three of these studies offered positive results, especially related to the consumption of fruits and vegetables, supporting the notion that early education establishments may be a promising setting to not only decrease childhood obesity, but also decrease health inequities.

LIMITATIONS

Findings from this synthesis provide support for the use of childcare PA and nutrition interventions to improve physical activity, promote healthy eating, and potentially body weight outcomes. However, challenges remain in terms of the strength of evidence available. One commonly addressed limitation among the reviews was the use of meta-analyses to compare identical factors in non-identical studies (e.g. PA measured using a variety of different operational definitions in different contexts) (5, 6). Reviews indicated a paucity of research in this area (1, 6-8), as well as a potential for publication bias (7). Further, studies which represent a minority of the population (e.g., low socioeconomic status) were identified as a barrier, as their results may not be generalizable to other groups, and relevant findings are difficult to extract within a review (8). Further, the search strategy used to inform this analysis may

not have been comprehensive enough to capture all of the literature relevant to interventions of interest. Considering this, there is potential that relevant reviews were excluded from this synthesis.

Reviews identified a number of limitations specific to their included studies. Some of these included low response rates (4), lack of controls (4), small sample sizes (3, 4), use of unreliable assessment tools (3), and studies of variable quality (1). Commonly identified within the reviews were challenges in short durations between exposure and follow-up, making it difficult to determine long-term impacts (4-6). As previously mentioned, this may factor most heavily in the assessment of body weight outcomes.

FUTURE RESEARCH

While the reviews included in this synthesis indicate positive findings, they also highlight a number of areas in need of further research. First, there is a clear need for more primary research in this area. In particular, additional research is required at the policy level that clearly measures the impact of existing childcare policies on outcomes of interest, in addition to examining policy implementation factors. Given the paucity of research focused on Canadian childcare settings, future studies in this area would be especially useful. Second, future research is needed to determine the ways in which role models such as teachers influence the uptake of policies and interventions in preschools and kindergartens. If it is determined, for example, that preschool/kindergarten children's PA is associated with teacher prompts or participation in activities, then an important intervention strategy would be the provision of staff training in these key behaviors (1, 8). In turn, these findings could provide key policy implications, such as the development of standardized teacher/staff requirements and training. Third, future research should consider behavior outside the childcare environment as an important measure of the success of an intervention. Without information about whether and how behavior at home is mediated by these interventions, they may be incorrectly classified as ineffective (7). Lastly, as reviews identified comprehensive strategies as most promising overall, it would be useful to extrapolate the combination of components, which are most successful, on what schedule, at what level, and for which set of outcomes. Results from these types of studies could provide policymakers with valuable information on how best to target policies/interventions in the childcare setting, and how best to involve parents and teachers.

CONCLUSIONS

This evidence synthesis indicates that physical activity and nutrition childcare interventions are likely to contribute to increased levels of physical activity and increased consumption of healthier food, though further research is required at the policy level. In the majority of reviews, this was the case for both primary PA or nutrition interventions, as well as combined PA/nutrition schemes, although evidence was suggestive of greater success in comprehensive multi-component strategies. Evidence on the

effectiveness of these strategies as they relate to body weight outcomes was limited, although this is likely due to the short duration of studies, making it difficult to draw conclusions of longer-term effects. Ultimately, while research in this area remains in its infancy, there is evidence to support policy action in this area.

Table 1. Characteristics of reviews evaluating the impact of childcare physical activity and nutrition policies and/or interventions on physical activity levels, consumption of healthier food, and BMI or body weight outcomes

Author	Years	Study design	Types of studies included	Number of studies (PA and nutrition)	Location of Studies	Relevant Outcomes (outcome measures)	AMSTAR ranking
Gordon et al., 2013	2004 - 2011	Meta-analysis	Randomized controlled trial (6) Clustered randomized design (5) Pre-post design (2) Quasi-experimental (1) Non-randomized controlled prospective study (1)	PA (15)	United States (11) Scotland (1) Australia (1) Belgium (1) Israel (1)	Physical Activity	5/11 (Moderate)
Kreichauf et al., 2012	1998 - 2009	Critical Narrative Review	Controlled pre-post design (1) Cluster randomized controlled trial (5) Longitudinal controlled trial (1) Group randomized controlled study(1) Random class assignment (1)	PA (10) PA + Nutrition (1)	Thailand (1) Greece (1) Germany (2) US (6) Scotland (1) Israel (1)	Physical Activity Weight outcomes	1/11 (Weak)
Larson et al., 2011	2001 - 2010	Comprehens-ive Review	Observational (8) Survey/ questionnaire (11) Case study/time sampling (1) Focus group (1) Quasi-experimental (4) Pre-experimental (7) Randomized controlled trial (10)	PA (20) Nutrition (15) PA + Nutrition (7)	United States (11)	Physical Activity Consumption of healthier food Weight outcomes	3/11 (Weak)
Lessard, 2012	1983 - 2009	Critical Review	Pre and post-test (8) Survey /questionnaire (2) Controlled trial (1) Observational (1)	PA (4) Nutrition (6) PA + Nutrition (2)	United States (12)	Physical Activity Consumption of healthier food Weight outcomes	2/11 (Weak)
Mehtala et al., 2014	1993 - 2013	Systematic Review	Pilot RCT (3) Cluster RCT (11) Feasibility study (1) Non-randomized CT (1) Pre-post design (2) 2 arm parallel cluster RCT (1) Preliminary study (two cross-	PA (22) PA + Nutrition (1)	United States (17) Belgium (2) Switzerland (1) Scotland (1) Australia (1) Israel (1)	Physical Activity	5/11 (Moderate)

			sectional samples) (1) Alternate day intervention exposure (1) Quasi-experimental (pre-test/ post-test) (1) Pilot within-subject design (1)				
Mikkelsen, et al., 2014	1980 - 2013	Systematic Review	Randomized controlled trial (11) Pre and post study (2) Randomized controlled trial (1) Quasi- experimental (9) Cluster randomized controlled trial (3)	Nutrition (23) PA + Nutrition (3)	North America (17) South America (1) Asia (5) Europe (3)	Consumption of healthier food Weight outcomes	3/11 (Weak)
Ward et al., 2010	2004 - 2008	Systematic Review	Randomized controlled trial (7) Pre and post-test (1) Modified crossover (1)	PA (8) PA + Nutrition (1)	United States (7) Israel (1) Scotland (1)	Physical Activity	2/11 (Weak)

Table 2. Overview of findings of reviews evaluating the impact of childcare physical activity and nutrition policies and/or interventions on physical activity levels, consumption of healthier food, and BMI or body weight outcomes

Author	Policy / Intervention Description	Physical Activity Levels	Consumption of Healthier Foods	BMI or Weight-Related	Overall Conclusions
Gordon et al., 2013	- 7 studies focused solely on PA and 4 studies also included nutritional education as part of their interventions. - 2 interventional studies modified the play environment by providing additional portable play equipment and playground markings.	- Interventions that focused on PA alone had a moderate statistically significant effect. - Interventions involving environmental changes (e.g., play equipment, floor markings) had a large statistically significant effect on MVPA. - Interventions that included PA plus education or education alone were non-significant.	N/R	N/R	- Overall, interventions had a small-to-moderate effect on general PA and a moderate effect on moderate-to-vigorous PA (MVPA). - The greatest effects for MVPA were identified for interventions that were less than 4 weeks in duration, were offered in an early learning environment, were led by teachers, involved outdoor activity, and incorporated unstructured activity.
Kreichauf et al., 2012	- 11 interventions focused on environmental play interventions for PA, such as play equipment, floor markings - 4 focused on PA plus education.	- 9 of 15 interventions focused on PA reported positive outcomes, with one reporting mixed-to-moderate results. - Studies reporting positive PA outcomes had sessions that lasted at least 30 min.	1 intervention focused on consumption outcomes reported positive results.	2 of the 6 studies focused on BMI or weight related outcomes reported positive results.	- Findings support the importance of teachers' knowledge about PA and motor development in their ability to support children's learning and development. - Portable play equipment like balls and other objects seems likely to stimulate more PA. - Simply adding playground markings or providing more free play time did not result in any significant impacts.

Larson et al., 2011	- 18 studies evaluated interventions: 4 focused on nutrition outcomes, 7 focused on PA or sedentary activity outcomes, and 7 addressed a combination of nutrition and activity outcomes. - 2 studies looked at parental perceptions and practices relevant to obesity prevention - Most interventions provided curriculum enhancements or classroom education for children, and 7 programs also included a component designed to educate and engage parents in making positive changes at home - 5 of the interventions targeted environmental factors such as improvements in foodservice practices, and playground environments.	- Of the 10 interventions designed to assess an influence on children's PA or sedentary activity behaviors, 7 interventions found a positive effect. - Interventions that successfully improved PA outcomes included integrating additional opportunities for PA into classroom curriculum.	- All 4 of the interventions designed to assess an influence on children's mealtime behaviors, dietary preferences, or dietary quality, found a positive effect. - Interventions that successfully improved consumption outcomes included one or more of the following strategies: modifying foodservice practices, providing classroom-based nutrition education, and engaging parents through educational newsletters or activities.	- 5 studies assessed impact on child weight, but only 2 showed evidence of success. - The 2 interventions that showed an effect included multiple components to address nutrition, PA, and sedentary behaviors.	- Interventions that address behaviors relating to both energy intake and energy expenditure are likely to have the greatest influence. - Although it is likely that interventions in childcare facilities will need to be complimented by environmental changes in other settings to produce sustained changes in weight status, this initial work has provided some evidence that interventions in childcare settings have the potential to influence the development of obesity among preschool-aged children.
Lessard, 2012	- All 12 studies looked at interventions. Primary interventions included PA opportunities, nutrition education, and changes to the home environment. - Multi-component interventions included curriculum changes to	3 studies measured PA, and all three reported positive effects in the childcare setting.	3 studies measured changes to consumption of healthy or unhealthy eating, and all reported positive effects in the childcare setting.	7 papers measured child BMI as a primary outcome measure, but only 1 study found a significant program effect on BMI	With an increasing focus on childcare-based obesity prevention interventions, future research should consider behavior outside the childcare environment as an important measure of the success of an intervention. Without information about whether and how behavior at home is impacted

	increase PA opportunities, portable playground equipment, food service modifications, and nutritional curriculum changes and education.				by these interventions, we could be incorrectly classifying interventions as ineffective.
Mehtala et al., 2014	- All 23 reviews looked at interventions. 22 included PA, and 1 focused on PA and nutrition. - Interventions included structured PA, playground/time modifications, teacher involvement, parental involvement, and knowledge, beliefs, motor skills, aerobic fitness, and self-efficacy.	14 studies found increases in PA levels or reductions in sedentary time, although the changes were modest. Still, children's PA remained low and did not approach the 180 min/day criteria. It may be that more intensive multilevel and multicomponent interventions based on a comprehensive model are needed.	N/R	N/R	Future studies should pay more attention to the PA training of teachers, offering them more tools for promoting the level of PA engaged in by children during their attendance at childcare.
Mikkelsen, et al., 2014	- 26 included studies: 8 single intervention studies, 11 educational interventions and 7 multicomponent studies. - Single intervention studies involved the modification of a single factor in the environment to promote fruit or vegetable intake and preferences in children. - Educational interventions involved training of teachers or nutritional educators, to increase children's knowledge of healthy	N/R	Healthy eating interventions were found to influence vegetable consumption; however single exposure strategies were insufficient. Over half of the educational interventions and 6/8 multicomponent interventions resulted in an increase in vegetable consumption. The increase in consumption was greater in the multicomponent studies which could indicate that the more comprehensive	Effectiveness of interventions on anthropometric change were inconclusive. The single interventions did not include measures of BMI and considering how short the duration of the interventions were, it might also be difficult to find change in anthropometric measures. None of the other interventions that used anthropometric measurements found an effect on BMI, with the exception of one, which	The majority of interventions found promising results when targeting the consumption of healthy foods or when attempting to increase children's knowledge of healthy eating, providing sufficient evidence in support of using preschool settings for the prevention of chronic disease by making behavioural and lifestyle changes. Interventions are more likely to be successful if they take actions on several levels.

	eating. - Multicomponent interventions included a number of environmental components, such as availability of fresh water, fruits, and vegetables, food modifications in the canteen, and healthy school policies.		the intervention strategy, the more likely the intervention is to be successful.	found an effect on serum cholesterol.	
Ward et al., 2010	- All 9 studies looked at interventions - 7 of the studies provided some type of organized adult- directed movement experience. - 2 were classified as environmental (adding extra outdoor playtime or additional equipment setup on the play yard).	More than half the studies reported a positive change in physical activity levels, whether the focus was PA across the entire day or PA while at child care sites.	N/R	N/R	Promise is shown by interventions that allocate time for organized PA sessions, that integrate PA across the curriculum, that provide adequate PA training to staff, or that supplement portable equipment to create novel play spaces.

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