

Literature review of family-based childhood obesity interventions (2007-2014)

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## Background

A literature review of family-based interventions designed to reduce childhood obesity was conducted in Spring 2014. Additional information from these articles (e.g., theoretical underpinnings, behavioural change techniques, and digital supports) was gathered in May 2017. The purpose of this literature review was to undertake a new search, focusing on family-based childhood obesity intervention studies that included a weight-related outcome.

## Literature Review

### Methods

Five academic databases (Academic Search Complete, Medline, Web of Science, CINAHL, and PsycINFO) were searched. The search strategy included free-text keyword searches using commonly used terms. Given the primary focus of this literature review, main search terms were organized into three concepts: (1) child, adolescent, youth, pediatric (2) family-based intervention, family intervention, and (3) obesity, overweight, BMI, adiposity, weight change<sup>1</sup>, with predetermined limits of English language articles published between 2007 and 2017. The initial search strategy was developed in Medline, and was adapted for the remaining databases. Relevant grey literature sources were also searched for details of intervention and implementation processes (e.g., manuals, training, etc). Academic databases were searched on May 29, 2017 and grey literature source searches were completed between May 29 and June 5, 2017.

To begin, duplication of references occurred, before reference titles and abstracts were reviewed for relevancy (where necessary, a brief review of the methods section was undertaken). Articles were included if they targeted overweight/obese children (e.g., intervention was not universally implemented), consisted of a family-based intervention (e.g., both children and their parents participated), and had a weight-related (e.g., BMI z-score, body composition) outcome. After references were narrowed, a full review of each manuscript was undertaken. A data extraction table was pre-designed and used to pull key information from each article. For all studies, information pertaining to study design, measures, and findings were extracted (See Spreadsheet 1 – High Level Overview). Further information was extracted (e.g., frequency and length of contact, session content etc.) for each study that showed a positive change in at least one weight-related outcome (See Spreadsheet 2 – Intervention Details and Spreadsheet 3 – Dose Details). This review was informed by the PRISMA guidelines.

### Findings

Forty-three<sup>2</sup> papers met the inclusion criteria and were counted in this literature review. Most of the studies were conducted in the United States (n=19) or Europe (n=17), with the remainder from Australia/New Zealand (n=3), Canada (n=2), Mexico (n=1), and Taiwan (n=1). Of these studies, around 80% showed a positive change (e.g., reduction) in a weight-related outcome (e.g., BMI z-score, waist circumference) pre- to post-intervention, however, the vast majority of these were within-group changes since a control group was not included. Findings from papers that included a significant between-group (e.g., intervention group versus control group) and/or between-treatment (e.g., family-

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<sup>1</sup> Keyword search terms were more comprehensive than indicated here, however, MeSH terms were not used.

<sup>2</sup> Excluding the systematic and/or meta-analytic review papers (n=6) discussed below.

based intervention versus parent-only intervention) (n=17 total studies, n=15 unique studies) difference in at least one weight-related outcome are discussed in more detail below.

### *Study Characteristics of Effective Intervention Programs*

For the most part, studies showing a significant between-group and/or between-treatment weight-related difference included participants between 8-14 years old; only a few of these studies included young children and/or older adolescents, thus the findings are limited to these groups. All studies included boys and girls, and generally tended to have larger samples (e.g., 70-200+ participants). Where reported, session attendance was quite high and attrition relatively low. Effective interventions were conducted in Europe (n=8), USA (n=5), Mexico (n=1), and New Zealand (n=1), usually in a primary care or community based setting.

### *Content and Delivery Characteristics of Effective Intervention Programs*

About one-third (n=4) of the intervention programs lasted for less than six months (e.g., 2-4 months), however, the remainder ranged in duration from 6 months to two years long. Most interventions occurred weekly, at least to begin, before moving to monthly or less (e.g., bi-monthly, every three months) in some cases. For the studies that mentioned session length, most were between 1 and 2 hours long. Slightly more than two-thirds (n=11) of studies indicated that they were informed by theory (e.g., Social Cognitive Theory, Trans-theoretical Model) or took a specific approach (e.g., health-centered versus weight-centered) to intervention design, and nearly all (n=12) used behavioural modification techniques. Frequently noted behavioural modification techniques included: goal setting, self-monitoring, reinforcement, stimulus control, problem solving, and modeling.

Many of the interventions required children and their parents to attend sessions together, although some were designed specifically for either parents or children, alone. The majority of interventions emphasized nutrition, physical activity, and behavioural modification; approximately two-thirds of interventions focused on all three aspects together, with the remaining interventions addressing either one or two of these areas. Around half of the interventions included a physical activity component where children engaged in regular exercise as part of the program. All of the interventions were facilitated by professionals (e.g., dietitians, pediatricians) as opposed to lay persons, and most (n=10) were delivered using a multidisciplinary team approach.

### *Implementation Processes of Effective Intervention Programs*

Participants were predominantly referred to study personnel by their physician, recruited from primary care/specialty health clinics, or notified about the program using other methods (e.g., posters, flyers, media). Around half of the studies used multiple recruitment strategies. Less than half (n=6) of the studies mentioned that study personnel were trained prior to delivering sessions; of those that did, time spent in training sessions ranged from 5 hours to 5 days (only one study offered booster training mid-way through the intervention). Eight studies noted the use of a manual, either for the interventionist or the participants; manuals were provided to ensure consistent delivery of all sessions. Only three studies (two of which used supervision) stated having implementation support. One study used digital supports in the form of PowerPoint presentations that were accessible to families who missed sessions. Otherwise, supports like Facebook, texting, or the internet were not implemented in any of the effective intervention programs.

### *Findings of Effective Intervention Programs*

Generally, studies included in this review found a between-group and/or between-treatment difference using either BMI (about 1/3<sup>rd</sup> of studies) or BMI z-score/SDS (about 2/3<sup>rd</sup> of studies) as the weight-related outcome; however the magnitude of change ranged from study to study. Other weight-related outcomes where significant differences were found included: weight, percent overweight, weight for height, waist circumference, skinfold thickness, and total body fat mass, for example. More than half of the studies found significant between-group and/or between-treatment differences for more than one weight-related measure. For studies that tracked participants over time, significant findings were still evident at follow-up but reduced.

### *Review of Systematic and/or Meta-Analytic Papers*

A total of six systematic and/or meta-analytic review papers of family-based childhood obesity prevention intervention programs were found and included here. In general, these reviews focused on randomized controlled trials and concluded that family-based interventions were more effective in terms of weight reduction, however, effect sizes were variable (e.g., small through large), and most were reduced over time. Effect sizes were noted as being different based on the chosen weight-related measure. For instance, one review found that effect sizes were larger when BMI percentile was the outcome measure as opposed to BMI z-score and % overweight. Overall, conclusions regarding initial and follow-up weight loss should be interpreted with caution given the significant attrition and resultant missing data that is seen over time. Moreover, one review paper noted that very few studies included ethnically/racially diverse samples, which limits the generalizability of findings.

### Key Conclusions from Systematic and/or Meta-Analytic Reviews

- Use theory in conceptualizing study designs; suggest using child BMI z score as outcome measure; use measures that take into account changes in child height.
- Interventions targeting both parenting skills and nutrition/physical activity education showed more statistically significant results with larger effect sizes; family-based interventions that demonstrated child weight loss (both short and long term) were more likely to target weight change/management in the child and the parent/family; preliminary evidence that therapy with individual families and therapy delivered via in-person contacts related to larger effect sizes.
- Consider conducting an intent-to-treat analysis (e.g., including all participants regardless of their drop out status or adherence to the study protocol); examining how family (e.g., family dynamics, family functioning, family competence, family resilience and family worldview) mediates treatment effects; designing differential interventions for each gender and including culturally specific components.
- Weight management interventions above a 26 estimated contact hours were generally effective in reducing excess weight in children and adolescents after 6 to 12 months, typically with absolute BMI z score reductions of 0.2 or more (~range 0.1-0.77) compared with little or no reduction in control groups; intervention period should be at least 6 months; follow-up assessment time points at 1-year and ideally again at 24 months post-randomization.

### *Overall Lessons Learned*

Many authors, across all 43 intervention studies, provided lessons learned and future recommendations. For instance, some studies cited frequent in-person contact supplemented with office- or home-based visits, phone calls, social-networking, or web-based activities as a potential way to keep participants engaged and compliance higher; essentially, authors recommended offering a range of ways for participants to engage in the program. Other studies indicated that standardization of facilitator training and program materials is key for delivery, particularly to help provide structure to group discussions related to problem-solving and positive coping strategies. Practical concerns, for example, program location and its impact on participant transportation, as well as the day of the week a program is offered (e.g., weekday versus weekend), were also noted as being important to consider. And finally, motivation was mentioned as key and for future programs to increase participant ownership of the program in order to improve families' abilities to identify their own strengths/weaknesses along their path to better health.

### **Conclusion**

This literature review of family-based childhood obesity prevention intervention programs published between 2007 and 2014 included 43 intervention studies and 6 systematic and/or meta-analytic review papers. Of the selected intervention studies, 15 unique studies were found to have significant between-group and/or between-treatment differences for at least one weight-related outcome. This review suggests that family-based interventions can have a positive impact on weight-related outcomes amongst children; there were many shared characteristics of effective interventions however, comparisons between programs were difficult due to the range of outcome measures used.

**Summary of Effective Intervention Programs – Literature Search Articles (n=15 unique studies)**

Duration of Intervention

0-<6 months = 4/15 studies  
 6 months = 5/15 studies  
 >6-12 months = 4/15 studies  
 >12 months = 2/15 studies

Total Study Time (Intervention plus Follow-Up)

6-<12 months = 3/15 studies  
 12 months = 6/15 studies  
 >12 months-2 years = 5/15 studies  
 >2 years = 1/15 studies

\*As described in the articles -- 6 studies included family components alone; 4 studies included both child-only and parent-only components; 2 studies included both child-only and family components; 1 study included both parent-only and family components and; 2 studies included child-only, parent-only, and family components.

Table 1. Reported initial frequency of sessions for studies with child-only (n=7 studies), parent-only (n=5 studies), and family (n=10 studies) intervention activities.

	Child-only (5,8,16, 19, 29)	Parent-only (16, 19)	Family (6, 8, 25)
1 time per week	5 studies	2 studies	3 studies
2 times per week	1 study <sup>(10)</sup>	--	3 studies <sup>(22, 32, 33)</sup>
1 time every 2 weeks	1 study <sup>(29)</sup>	1 study <sup>(10)</sup>	1 study <sup>(12)</sup>
1 time per month	--	1 study <sup>(5)</sup>	3 studies <sup>(8, 29, 38)</sup>
1-2 times every 3 months	--	--	2 studies <sup>(24, 29)</sup>
1 time per intervention	--	1 study <sup>(6)</sup>	--
Daily	1 study <sup>(24)</sup>	--	1 study <sup>(22, 22)</sup>

Note: n=14 studies provided enough detail to be categorized by at least one aspect of the intervention; some studies had multiple intervention groups and/or activities, so were included more than once. For example, Chen et al (2010) had separate components for children (1x/week) and parents (1x/month) and is included under both the child-only and parent-only columns; 6 studies (8, 16, 19, 25, 33, 38) slowed session frequency (e.g., weekly to biweekly) during the intervention period but this is not reflected here.

Table 2. Reported initial session length for studies with child-only (n=7 studies), parent-only (n=4 studies), and family (n=8 studies) intervention activities.

	Child-only	Parent-only	Family
0-60 minutes	4 studies <sup>(5, 18, 24, 29)</sup>	1 study <sup>(18)</sup>	5 studies <sup>(6, 8, 22, 33, 33, 38)</sup>
>60-<120 minutes	3 studies <sup>(16,19, 29, 29)</sup>	2 studies <sup>(16,19)</sup>	3 studies <sup>(12, 22, 25)</sup>
≥2 hours	2 studies <sup>(8, 24)</sup>	1 study <sup>(5)</sup>	1 study <sup>(32)</sup>

Note: n=14 studies provided enough detail to be categorized by at least one aspect of the intervention; some studies had multiple intervention groups and/or activities, so were included more than once. For example, Reinehr et al (2010) had multiple components for children (90 min PA, 90 min nutrition, 30 min counseling) and is included under the child-only column more than once; session length may have decreased over time corresponding with a decreased frequency of sessions but this is not reflected here.

Table 3. Estimated number of sessions for studies with child-only (n=8 studies), parent-only (n=7 studies), and family (n=12 studies) intervention activities.

	Child-only	Parent-only	Family
<10 sessions	2 studies <sup>(5,10)</sup>	3 studies <sup>(5,8, 29)</sup>	6 studies <sup>(10, 12,18, 22, 24, 29)</sup>
10-25 sessions	4 studies <sup>(8,16, 18, 19)</sup>	4 studies <sup>(10,16,18,19)</sup>	5 studies <sup>(6,8,8,25,32, 38)</sup>
26-40 sessions	1 study <sup>(29)</sup>		1 study <sup>(22)</sup>
41-55 sessions	2 studies <sup>(10, 24, 24)</sup>	--	--
>55 sessions	--	--	1 study <sup>(33)</sup>

Note: n=15 studies provided enough detail to be categorized by at least one aspect of the intervention; some studies had multiple intervention groups and/or activities, so were included more than once. For example, Diaz et al (2010) had one child-only (12 sessions), one parent-only (6 sessions), and two family (21 sessions and 12 sessions) intervention activities and is included in all three columns; approximate total number of sessions per study, combining all intervention activities regardless of participant group: <10 sessions=1/15 studies; 10-25 sessions= 6/15 studies; 26-40 sessions=2/15 studies; 41-55 sessions=3/15 studies; >55 sessions=3/15 studies; Kokkvoll et al., (2014/2015) did not report number of “sessions” for day-long activities, thus total number of sessions are underestimated in this case.

Table 4. Estimated number of intervention contact hours for studies with child-only (n=6 studies), parent-only (n=4 studies), and family (n=9 studies) intervention activities.

	Child-only	Parent-only	Family
<15 hours	1 study <sup>(5)</sup>	1 study <sup>(5)</sup>	4 studies <sup>(6, 8,12, 38)</sup>
15-25 hours	4 studies <sup>(8,16,18,19)</sup>	3 studies <sup>(16,18,19)</sup>	1 study <sup>(25)</sup>
26-40 hours	--	--	1 study <sup>(32)</sup>
≥65-100 hours	--	--	2 studies <sup>(29, 33)</sup>
>100 hours	1 study <sup>(24)</sup>	--	1 study <sup>(22)</sup>

Note: n=14 studies provided enough detail to be categorized by at least one aspect of the intervention; some studies had multiple intervention groups and/or activities, so were included more than once. For example, Janicke et al (2008) had both child-only and parent-only sessions (18 hours each) and is included in both columns; approximate total number of contact hours per study, combining all intervention activities regardless of participant group: <15 hours=4/14 studies; 15-25 hours=1/14 studies; 26-40 hours=4/14 studies; 41-55 hours=1/14 studies; >55hours=4/14 studies; many studies did not provide complete information regarding contact hours, thus total number of contact hours are underestimated in some cases.

#### Theory/Theoretical Underpinnings

Behavioural/Solution Oriented Therapy = 3 studies

Health Belief Model = 1 study

Motivational Interviewing = 2 studies

Social Cognitive Theory = 2 studies

Self-Determination Theory = 1 study

Trans-theoretical model = 1 study

Other – Braet’s cognitive behavioural treatment = 1 study

Other – Epstein’s family-based treatment = 2 studies

Other – Health-centred approach = 1 study

11/15 studies were informed by theory or took a specific approach to intervention design (<5 studies were informed by multiple theories at once).

### Behavioural Modification Techniques

Cognitive restructuring = 3/15 studies

Commitment contracting = 4/15 studies

Contingency management (e.g., stimulus control/positive reinforcement/contingent attention) = 6/15 studies

Goal setting = 11/15 studies

Incentives = 1/15 studies

Modeling = 2/15 studies

Problem solving = 4/15 studies

Role playing = 1/15 studies

Self-regulation (e.g., self-monitoring, self-awareness, self-instructions) = 7/15 studies

Skill mastery (e.g., decision making, coping) = 5/15 studies

12/15 studies used at least one behavioural modification technique; 11/12 studies used >1 technique.

### **Summary of Other Systematic Reviews**

#### **Berge et al., 2011**

##### Duration of Intervention

0-<6 months = 4/20 studies

6 months = 9/20 studies

>6-12 months = 6/20 studies

>12 months = 1/20 studies

#### **O'Connor et al., 2017**

##### Estimated Contact Hours

0-5 hours = 14/36 studies

6-25 hours = 7/36 studies

26-51 hours = 9/36 studies

≥52 hours = 6/36 studies

Most of the lifestyle-based weight loss trials were conducted in a primary care (43%) or other health care (43%) setting; trials with the most contact hours and largest effects were not conducted in primary care settings; the number of sessions ranged from 1 to 122, and estimated contact hours ranged from 0.25 to 122 over 2.25 to 24 months; weight management interventions above a threshold of 26 estimated contact hours were generally effective in reducing excess weight in children and adolescents after 6 to 12 months, typically with absolute BMI z score reductions of 0.2 or more (~range 0.1-0.77) compared with little or no reduction in control groups.

#### **Sung-Chan et al., 2013**

##### Duration of Intervention

0-<6 months = 8/14 studies

6 months = 3/14 studies

>6-12 months = 1/14 studies

>12 months = 2/14 studies

Initial Frequency of Sessions (Child, Parent, or Family)\*

1 time per week = 6/14 studies

2 times per week = 2/14 studies

Monthly = 1/14 studies

\*Only nine studies reported on initial frequency of sessions; 2 studies slowed session frequency (e.g., weekly to biweekly) during the intervention period.

Length of Sessions (Child, Parent, or Family)\*

0-60 minutes = 2/14 studies

>60-90 minutes = 4/14 studies

>90 minutes-2 hours = 2/14 studies

\*Only eight studies reported on length of sessions

Behavioural Modification Techniques

Contingency management (e.g., stimulus control/positive reinforcement/contingent attention) = 4/14 studies

Self-regulation (e.g., self-monitoring, self-awareness, self-instructions) = 5/14 studies

5/14 studies used at least one behavioural modification technique; 4/5 studies used >1 technique.

**Wilfley et al., 2007**

Duration of Intervention

0-<6 months = 9/14 studies

6 months = 2/14 studies

>6-12 months = 1/14 studies

>12 months = 2/14 studies

Initial Frequency of Sessions (Child, Parent, or Family)\*

1 time per week = 10/14 studies

2 times per week = 4/14 studies

Daily = 1/14 studies

\*More than one intervention (with varying frequency of sessions) was reported for one study; 4 studies slowed session frequency (e.g., weekly to biweekly) during the intervention period.

Behavioural Modification Techniques

Contingency management (e.g., stimulus control/positive reinforcement/contingent attention) = 10/14 studies

Self-regulation (e.g., self-monitoring, self-awareness, self-instructions) = 9/14 studies

11/14 studies used at least one behavioural modification technique; 8/11 studies used >1 technique.

## Mobile-/E-Health Physical Activity Interventions - Systematic Reviews

### Key Conclusions

- A behavioural theory or model should be used in the planning and development stages of the intervention (theories that account for inter- and intra-individual change over time may be a better fit); interventions that were grounded in behavior change theory and utilized an investigator-initiation strategy were more likely to show significant between-group differences and larger effect sizes.
- Mobile-/e-health interventions tend to be part of a broader behaviour change intervention relying on more traditional methods (e.g., face-to-face contact); interventions should be supplemented with individual tailoring and interpersonal support, such as from parents, to enhance intervention effectiveness.
- User profiles, goal setting, real-time feedback, social support networking, and online expert consultation are useful strategies to encourage behaviour change; disruptive prompts and auditory signals, text messaging, and competition-based strategies limited engagement.
- Native apps (as opposed to web apps) allow for a greater degree of flexibility and complexity to intervention designers; and, intervention compliance was higher when app rather than hard copy diaries of physical activity were used.
- Objective measures of physical activity should be used when possible; compliance was higher when objectively measured physical activity was connected to feedback and goal setting; inclusion of advanced sensors (e.g., integrated accelerometer and GPS devices) holds promise for more accurate assessment of physical activity behavior in real time.

### Overall Conclusions re family-based childhood obesity prevention interventions

- Intervention length: 3-6 months, Follow-up timeframe: 12+ months
- Initial frequency: 1 time per week (perhaps PA 2x/week), Session length: 60-90 minutes
- Number of sessions: ~15-30, Total contact hours: 25+ hours
- Design intervention based on theory, but which one?
- Targeted mobile-/e-health interventions can be included as part of a larger intervention
- Include diet, physical activity, and behaviour change management components
- Important behavioural modification techniques
  - Contingency management
  - Goal setting
  - Self-regulation
  - Skill mastery

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