

Strategies to promote health behaviors in parents with small children-A systematic review and realist synthesis of behavioral interventions

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Abstract

Objective: We aimed to identify strategies to improve dietary and physical activity behaviours for parents with small children.

Design: A systematic review and realist synthesis.

Methods: A systematic literature search was conducted in MEDLINE, Embase, CINAHL and PsycINFO in July 2021. Included studies: i) targeted one or both parents with at least one child (0-3 years), ii) aimed to improve diet and physical activity, and iii) reported on diet and physical activity outcomes. Intervention context, delivery and outcomes were extracted, and behaviour change techniques were coded. A programme theory was developed, and context-mechanism-outcome configurations were identified.

Results: In total, 17 interventions reported in 28 studies (19 effectiveness studies; nine protocols) were included. Nine interventions showed small improvements; in diet (n = 5), physical activity (n = 2) or both (n = 2) in mothers. The realist synthesis revealed three strategies to improve health behaviours: 1) using knowledge and role modelling to improve family dynamics, 2) providing various home-based activities to change home environment, and 3) offering flexible delivery, e.g. phone or website-based to increase social support.

Conclusion: Future interventions for parents with small children should consider involving the whole family, focusing on home-based, practical components and offering various delivery modes.

Systematic review registration: The protocol for the systematic review and realist synthesis was registered in Research Registry (registration ID: reviewregistry860) March 30th, 2020

Abbreviations:

NCD: Non-communicable disease

CMO: Context-Mechanism-Outcome

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BCT: Behaviour change technique

SES: Socioeconomic status

Introduction

Diabetes and other non-communicable diseases (NCDs) are increasing worldwide¹. Eating healthier diets and increasing physical activity levels have been emphasised as efficient strategies to prevent or delay onset of NCDs in adults²⁻⁴. The risk of NCDs accumulate throughout the life-course with specific stages in life being particularly sensitive for health promotion maintenance, e.g. in the transition to parenthood^{5,6}. When becoming a parent, physical activity levels have been shown to decrease for both mothers and fathers compared to non-parents at the same age⁵. Mothers also tend to increase their overall energy intake compared to women without children⁷. Further, it seems that parents gain weight in a steeper pace than non-parents at the same age⁸. Studies also suggest that hours of screen time, fruit and vegetable intake and intake of sugar-sweetened products cluster within families and the home environment^{9,10} making parents with small children an important target group for health promotion interventions.

Existing childhood obesity interventions aimed at improving health behaviours in children often involve the parents¹¹. Nevertheless, the health behaviours of parents are rarely assessed or reported¹². Studies suggest that health promotion interventions should target the whole family (mother, partner and child(ren)) rather than its individual members alone^{9,13} corresponding with recent recommendations to address numerous health behaviours to promote health or reduce incidence of type 2 diabetes in high-risk groups^{14,15}. Yet, little is known about how to promote health behaviours in parents with small children¹⁶, why identification of potential strategies to improve diet and physical activity in this target group is warranted.

Understanding how intervention programmes are delivered, and how they rely on context and mechanisms are important for the implementation and up-scaling of effective strategies for health behaviour change ¹⁷⁻¹⁹. Realist evaluation provides a framework for analysing the complexity of behavioural interventions by mapping a programme theory to illustrate how, for whom and in what context an intervention works ²⁰. By employing a programme theory, one seeks to understand the underlying processes leading to behaviour change by combining theory and empirical evidence to generate context-mechanism-outcome (CMO) configurations ^{18,21}. According to realist evaluation, mechanisms become active in a given context resulting in a specific outcome ²⁰. Inspired by this approach, realist synthesis is a useful method for identifying relevant contexts and mechanisms across interventions providing important insights for researchers and policymakers for the implementation of effective health promotion strategies. This study combined a systematic review and realist synthesis to identify strategies to improve dietary and physical activity behaviours for parents with small children in order to understand what works in these interventions, for whom and under which circumstances.

Methods

This systematic review and realist synthesis were conducted in accordance with the guideline for RAMSES (Realist And Meta-narrative evidence Syntheses: Evolving Standards) ²² and reported according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement ²³. The review protocol was registered in Research Registry on 30 March 2020 (Unique Identifying Number: reviewregistry860).

Search strategy

A systematic literature search was conducted in July 2021 in MEDLINE, Embase, CINAHL and PsycInfo databases. The search strategy, including all identified keywords and index terms, was developed for MEDLINE and adapted to the other databases (Table S1). There were no limitations on publication dates or language. The reference lists of all studies selected for critical appraisal were screened for additional studies. All identified citations were collated and uploaded to EPPI-Reviewer²⁴ and duplicates were removed. Three authors (AT, LJ, NHJ) and two research assistants independently conducted the screening process.

Studies were screened for inclusion based on 1) targeting at least one parent with child(ren) aged 0-3 years, 2) having an explicit aim of improving both dietary and physical activity behaviours, and 3) reporting on outcomes of diet and physical activity for at least one parent. The study designs of the interventions should be experimental or quasi-experimental, including both randomised and non-randomised controlled trials. We only included interventions targeting dietary and physical activity behaviours, as they have been more successful than single-component interventions in preventing type 2 diabetes for adults and weight loss in postpartum women^{3,25}. Studies were excluded if they only reported on dietary and physical activity outcomes for the child and not the parent(s). In addition, the study had to report results at least six months after intervention commencement independent of intervention duration to secure a measure of long-term health behaviour change. First, titles and abstracts were screened for eligibility. Then, the full text of selected citations was assessed against the inclusion criteria. Any disagreements between the three authors at each stage of the study selection process were resolved through discussion. Authors of included papers were contacted to request missing or additional data, if required.

Data extraction and quality assessment

Data on the study design, participants, primary outcomes, physical activity and dietary measurements, intervention dose, theoretical grounding, types of delivery, behaviour change techniques (BCTs)²⁶ and summary of health behaviour change were extracted from the included studies (See Table S2). Study protocols were mainly used to extract information on the intervention, e.g. context, delivery and content. Study quality assessment were carried out using Risk of Bias 2 (RoB 2) tool for randomised trials²⁷ and Risk Of Bias In Non-randomised Studies of Interventions (ROBINS-I) tool for non-randomised studies²⁸. The interventions were rated to an aggregate score of 'weak', 'moderate' or 'strong' depending on the risk of bias, i.e. by assessing randomisation, intervention adherence, blinding and missingness etc. The quality assessment of the included studies was conducted independently by AT and one co-author (all co-authors assessed at least one study). If consensus was not reached between the two authors, a third author was included in the quality assessment. AT rated the relevance score.

Realist synthesis

A realist synthesis was conducted to build a programme theory and identify CMO configurations to develop strategies for improving diet and physical activity in parents with small children. Intervention descriptions of included interventions were read thoroughly in effectiveness studies and matched with protocols and other related papers published from the same intervention. Interventions were included if they provided relevant, rigorous information on context, mechanisms and outcomes to inform programme theory building²². Working from a realist evaluation approach, ineffective interventions (and related papers) are considered useful if they have a thorough description of why the intervention did not work, e.g. by providing information on whether certain intervention components were considered more acceptable to the target group than others. These learnings enable an understanding of how and why, and under which circumstances a specific intervention works. A 'relevance' score was added to the critical

assessment to decide whether the description of the intervention lived up to these criteria. If the intervention provided an extensive process evaluation, it was included in the realist synthesis, regardless of quality rating. Studies, which had no or weak information on context or mechanisms, were excluded from the realist synthesis.

An overall programme theory based on included interventions was developed by AT with inputs from KKN, HTM and NHJ and CMOs were identified iteratively as more related papers, e.g. process evaluations were identified. CMOs were mapped based on the effectiveness studies and compared with descriptions in the protocols to ensure precise descriptions of context and mechanisms. The context (C) was defined as study participants, e.g. 'mother and child' and the setting in which the intervention was delivered, e.g. 'group sessions'. The mechanisms (M) were mapped using the Behaviour Change Technique Taxonomy²⁶ to code the content of the interventions. The outcomes (O) represent the effects on diet and physical activity.

Two authors (AT, LJ) independently read the intervention description line-by-line and coded the BCTs. The BCT Taxonomy was created from psychological behaviour strategies prevalent in 191 interventions targeting individual health behaviour, and has been applied in various studies within the individual level²⁶. The BCTs were coded with a conservative approach, i.e. if the BCT was not obviously stated, it was coded as absent. Disagreements and doubts were discussed and resolved between the two authors. Process evaluations of the interventions were used to help identify which BCTs functioned as mechanisms in the specific context to improve diet and physical activity. Information on the specific BCTs from authors of included interventions was not sought, thus relying on published information only. However, authors were contacted for available process evaluations.

Results

Of 10,886 studies screened, 28 studies were included reporting on 17 interventions. Of the 28 studies, nine were study protocols ^{29–36} and 19 were effectiveness studies ^{37–53} (Fig. 1). Two interventions were both reported in two different effectiveness studies (N=4); from one intervention, two studies were published; one on mothers' outcomes ³⁷ and one on their partners ⁵³; and from another intervention two studies reported on dietary outcomes ⁴¹ and physical activity outcomes separately ⁵¹. Of the included interventions, seven out of 17 showed statistically significant results for dietary improvements in mothers ^{37,41,42,47,48,50,54} and four out of 17 showed statistically significant results for improved physical activity in mothers ^{42,51,52,55}. Only one intervention reported on fathers' health behaviours and found no statistically significant effect ⁵³.

[Insert Figure 1 Flow diagram of study selection]

[Insert Table 1 Key characteristics of included interventions in the systematic review of behavioural interventions targeting parents with small children (N=17)]

Intervention characteristics

Table 1 provides an overview of intervention characteristics and whether the interventions led to significant effects on either physical activity or dietary behaviours in mothers. Most interventions were evaluated using an RCT design (N=14) and three were investigated in a non-randomised quasi design. Thirteen studies were published after 2010, indicating an increased interest in the topic over the years. The interventions were predominantly carried out in the US (N=9). The number of participants varied from 40 to 1,450. Five interventions included less than 100 participants and five included more than 500 participants. Most interventions had weight loss in mothers as the primary outcome (N=12) and two interventions predominantly targeted health behaviours in the family. Three interventions aimed to lower child BMI and

included parents' health behaviours as secondary outcomes. Four interventions used objective measures to estimate physical activity levels and all interventions included subjective measures of diet.

Most interventions (N=10) were guided by Social Cognitive Theory. Three interventions targeted first-time parent(s), one intervention targeted mothers with a pre-schooler, and thirteen interventions targeted mothers only. Most interventions were delivered in multiple settings (N=11) whereof home-based delivery (N=9) or delivery through community centres (N=8) were most frequently used. Also, more interventions provided group- and individual sessions (N=10) rather than only group sessions (N=7). Intervention deliverers had often received training (N=15), and their professions were described as maternal/child health nurse (N=2), dietician alone (N=4) and with physiologist (N=1), healthcare professional or student (N=7) or not specified (N=4). Most interventions commenced less than six months after delivery (N=10). Intervention duration ranged from eight weeks to three years, most often between six to eleven months (N=9), with varying delivery intensity from weekly sessions (N=4) to one sessions every three months or less (N=6).

Eight characteristics were identified more often in effective interventions versus non-effective interventions: 1) having a large sample size (>500 persons) (80% improved dietary behaviours in mothers (N=4), 2) aiming to lower child BMI (100% improved dietary behaviours in mothers) (N=3), 3) using parenting theories (66% improved dietary behaviours in mothers) (N=2), 4) targeting first-time parents (N=2) or multiparous mothers (N=1) (66% vs. 100% improved dietary behaviours in mothers), 5) a physiologist delivering the intervention (100% improved physical activity in mothers) (N=1), 6) intervention duration exceeding 12 months (60% improved dietary behaviours in mothers) (N=3), 7) contact frequency of one session per month or less (60% improved dietary behaviours in mothers) (N=5), 8) and long-term follow up for nine months or longer (80% improved dietary behaviours in mothers) (N=4).

Behaviour change techniques

The BCTs used in the included interventions are presented in Table 1. The interventions used between seven and 15 BCTs with no clear pattern between number of BCTs identified and significant positive effect on diet or physical activity. All interventions included the BCT: *information on health consequences* [5.1]. The BCTs *credible source* [9.1] (N=16), *goal setting (behaviour)* [1.1] (N=15) and *self-monitoring of behaviour* [2.1] (N=14) were also frequently used.

In interventions showing improvements in diet or physical activity ($\geq 60\%$), the following BCTs were most frequently identified: *review of behaviour goals* [1.5], *prompts/cues for behaviour* [7.1], *identification of self as role model* [13.1], *framing/reframing* [13.2], *focus on past success* [15.3] and *self-talk* [15.4].

Quality assessment

Of the 17 interventions, three received a 'strong' methodological quality rating^{48,54,55}, nine interventions were rated as 'moderate'^{37,39,41,43,45-47,49,52} and five were rated as 'weak'^{38,40,42,44,50} (See Table S3 and S4). Non-RCT studies were deemed of lowest quality due to higher risk of confounding and selection bias. Further, high attrition and low intervention attendance rates lowered the methodological quality of most interventions. For example, 47% did not attend one out of six individual sessions in *MAGDA*⁴⁶; in *AMP*, mothers attended on average 3.8 out of 8 healthy eating classes⁴⁸; and in *Fit Moms*, 53% of mothers did not complete any session (See Table S2).

Realist synthesis

Twelve out of the 17 interventions^{37-41,43-45,47,48,54,55} were included in the realist synthesis as they provided extensive information to inform programme theory building²² (See relevance score in Table S3 and S4). Ten

process evaluation papers ⁵⁶⁻⁶⁵ informed CMO patterns representing nine of the included interventions. Three interventions included in the realist synthesis had weak designs ^{38,40,44}, but were still included in the programme theory due to proficient process evaluation to inform CMO patterns. The programme theory (Fig. 2) provides an overview of all the contexts and mechanisms identified from included effectiveness studies and process evaluations. From the programme theory, three CMOs were identified as informing effective strategies to improve dietary and/or physical activity behaviours in parents with small children (Table 2 and Fig. 3).

[Insert Figure 2 Programme theory mapping context, mechanisms and outcomes and highlighting effective contexts and mechanisms for parents with small children]

[Insert Figure 3 Context-Mechanism-Outcome configurations for interventions targeting dietary and physical activity behaviours in parents with small children]

The identified CMOs revealed that home-based activities and group sessions were most appropriate delivery modes whereas role modelling and flexible social support were active mechanisms for health behaviour change in parents with small children. The three CMOs are described in detail below.

CMO 1: Role modelling and knowledge facilitation

The first CMO we identified was role modelling and knowledge facilitation. The mechanisms of combining role modelling (BCT 13.1) and knowledge facilitation for infant feeding (BCT 5.1; 9.1) seemed effective in improving dietary behaviours in mothers ^{37,47,48} especially when delivered to first-time parents (D, F) (Table 2, CMO 1). Parenting support theory and anticipatory guidance framed the *INFANT* intervention (D),

emphasising the need for knowledge building and parenting skills to shape children's behaviours³⁷. In *INFANT (D)*, programme service providers expressed in interviews that first-time parents participated in the intervention to gain knowledge and that the parents were more interested in infant feeding than adopting health behaviours themselves. After 12 months, intervention deliverers concluded that parents dropped out as they had gained sufficient confidence reducing their participation in later sessions⁵⁷. The mothers in *INFANT (D)* reported that they maintained health practices learned from the intervention when the health advice benefitted social situations, e.g. reduced stress at dinner situations by eating the same food as the baby⁵⁸. In the TOPS intervention (C), mothers who received healthy behaviour advice and no guidance on responsive parenting, increased their daily physical activity level. In contrast, these mothers also showed more hostile interactions with their child in mealtime situations⁵⁵ suggesting that focusing entirely on mothers' health behaviours, without considering social situations, may not improve dietary behaviours in mothers, and may even strain the contact with the child. Similarly, in the *Moms Online* intervention (O), first-time mothers were more concerned about family demands and did not consider individual health practices to benefit the family⁶². Mothers' motivation for healthy eating may be increased by focusing on child and family health, e.g. by providing education on the social- and health-related benefits (BCT 5.3) of adopting health promoting practices in the whole family (O)⁵⁸. Additionally, role modelling techniques (BCT 13.1) may be especially beneficial for adopting healthy eating. These mechanisms may further be supported if both parents are included in the intervention to positively affect family dynamics⁶⁶.

CMO 2: Home-based delivery and group sessions

The second CMO focused on delivering home-based activities supplemented by a social support component, e.g. group sessions, which seemed to be an effective strategy for improving diet and physical activity in mothers with high socioeconomic status (SES) (D, F, G, K)^{37,41,48,51} (Table 2, CMO 2). These interventions were

most often guided by Social Cognitive Theory and provided reinforcement (e.g. stroller, yoga mat) (BCT 7.1 + 12.5), self-monitoring (pedometer) (BCT 2.3), observational learning (DVDs) (BCT 4.1 + 6.1), and knowledge (fridge magnet, portion plate, menu planners) (BCT 5.1) (G, K) ^{41,48}. Mothers highlighted DVDs (BCT 6.1), instructions on budgeting food shopping (BCT 4.1) and pedometers (BCT 12.5) as useful to promote awareness, skills and increase confidence and support dietary and physical activity behaviours (D, G) ^{58,59}. Home-based components were emphasised by mothers as useful due to accessibility and easily adoption of dietary behaviours, especially if they could not attend group sessions (D, G) ^{58,59}. For example, mothers with a toddler and a pre-schooler in the *KAN-DO* intervention (K) increased availability of healthy foods in the home, which was hypothesised by the authors to be an effective mechanism to improve dietary behaviours in mother and child ⁴⁸. In an evaluation of the environmental facilitators for physical activity in the TOPS intervention (C), it was found that turning off the TV, increasing engagement with the child and being outside were positively associated with higher physical activity counts ⁶⁴. This amplifies the hypothesis that restructuring the social environment (BCT 12.2) is a feasible strategy for increasing physical activity. For interventions which showed no health behaviour change (A, O, J), lack of practical and emotional partner support were common barriers for adopting health behaviours ^{56,62,63}. Home-based activities such as DVDs were beneficial for mothers' knowledge creation when they watched it with their partner at home as it increased their feelings of social support (BCT 3.1) (D) ⁵⁸. Thus, a potent strategy for health behaviour change in parents with small children may be to use home-based components to affect home environments, skills, confidence and increase partner support.

Irrespective of the characteristics of participating parents, group sessions were found to increase knowledge and facilitate emotional support (A, D, E, G), but only when the group environment was positive and reassuring (D, E, G) ^{56,58,59} (See Table 2, CMO 2). However, mothers with high SES participating in

group sessions seemed to be more reluctant to request specific information, e.g. on how to fit diet and physical activity practices around family activities (BCT 4.1), and what kind of exercise and diet was fit for the home and/or with their children (BCT 12.2) (G) ⁵⁹. In the *REFRESH* intervention (G), staff used workshops to challenge mothers' misconceptions about health behaviours (13.2) and in the group setting provided mothers with new perspectives which increased mothers' confidence and knowledge ⁵⁹. The authors of *REFRESH* (G) suggested that the playgroup setting may have had a dual effect by enforcing "a relaxed, family-friendly group environment easing mothers' tendency to ask questions, which in turn increased knowledge and confidence. According to Social Cognitive Theory these mechanisms enhance self-efficacy ("the belief that the person can practice a desired outcome") through 'social modelling' and 'mastery experiences' ⁶⁶. Mothers in *INFANT* (D) expressed a feeling of collective efficacy in attending group sessions which seemed to increase attendance rates ⁵⁸. As such, providing group sessions with reassuring environments may be a feasible strategy to increase emotional support and may affect physical activity and diet if conversations challenge parents' perceptions of health.

CMO 3: Website- and phone-based delivery

The third and final CMO identified in the programme theory was website- and phone-based delivery. Providing individual counselling through websites and phone calls predominantly to mothers with low SES and/or high-ethnic diversity seemed to increase emotional support (N,O) and self-monitoring (A, B, J, L). Yet only the *INTER-ACT* intervention (B) found improvements in mothers' dietary behaviours ^{38,43,45,48,55,55} (Table 2, CMO 3). The *INTER-ACT* intervention (B) enhanced mothers' restrained eating and reduced uncontrolled eating and energy intake by providing mothers with face-to-face coaching supported by an app to monitor physical activity and weight (BCT 2.3) ⁵⁴. The app provided possibilities for self-tracking of physical activity; however, in the development of the app, mothers in the target group indicated that they were more

motivated to register their diet than their physical activity levels (92% vs. 56%) and that the app rarely could compete with their other devices⁶⁵. In *Fit Moms* (L), the 'Web Diary' a self-monitoring tracking section (BCT 2.3) and the 'Discussion Forum' providing social interaction (BCT 3.3) were the most used components and more frequent use of the website was associated with greater weight loss in mothers at 12 months⁴³. Despite targeting the most common barriers for physical activity in this group, providing pedometers and objectively measuring physical activity, the authors of *Fit Moms* (L) found no effect on physical activity. Instead, they hypothesised that dietary changes were under-reported by mothers and that tailoring of website-based interventions, e.g. by including partner support, might be useful for multi-cultural groups⁶⁰. Interestingly, mothers in *Fit Moms* most frequently registered their weight, but learnings from process evaluations of the included interventions (A, E, O) indicate that mothers' feelings about weight vary from important to less of a priority^{45,62,67} suggesting that websites should provide various content. Mothers in *Moms Online* (O) reported that phone calls (besides a website) gave them a sense of accountability with intervention deliverers, who provided assistance in prioritising their own health³⁸. Despite the advantage of website-based components demanding no physical attendance, only one (L) out of three interventions secured a high retention rate (87.4%)⁴³. For example, mothers in *Swan* (A) reported that even though they could book group sessions according to their own schedules (through websites), they still experienced that time, access and childcare were barriers for attendance⁶⁸. As such, websites, apps and phone calls may possess the potential to increase knowledge facilitation and emotional support. Yet, content should be tailored, work beyond or with available apps and tracking devices and be supplemented by other health promotion strategies to increase chances of health behaviour change.

[Insert Table 2 Strategies to improve physical activity and dietary behaviours in parents with small children with illustrative examples from effectiveness studies and process evaluations]

Discussion

This systematic review and realist synthesis aimed to identify strategies that improve dietary and physical activity behaviours in parents with small children. Nine out of 17 interventions improved health behaviours (five improved diet only, and two improved physical activity, and two improved both) in mothers. Health behaviour change effects were small for mothers and limited evidence exist on changing fathers' health behaviours. From the realist synthesis, three CMOs were identified revealing three potential strategies for improving health behaviours in parents with small children: 1) provide knowledge and role modelling techniques which benefit family dynamics and child health, 2) deliver various home-based activities to change the home environment, 3) provide flexible social support, e.g. through group sessions, phone calls, apps or a website. The BCTs which contributed to these strategies were: *self-monitoring of behaviour* [2.3], *social support (emotional)* [3.3], *instructions on how to perform behaviour* [4.1], *information about health consequences* [5.1], *information about social and environmental consequences* [5.3], *demonstration of behaviour* [6.1], *prompts/cues for behaviour* [7.1], *credible source* [9.1], *restructuring the social environment* [12.2], *adding objects to the environment* [12.5], *identification of self as role model* [13.1] and *framing/reframing* [13.2].

Mechanisms

Our findings suggest that activating role modelling behaviours and knowledge creation seem to improve dietary behaviours in in first-time mothers. Further, the realist synthesis revealed that mothers are more

likely to adopt health behaviours, e.g. role modelling practices if they also benefit family dynamics and especially their child's health⁵⁸. A realist synthesis of family-based childhood obesity interventions by Enridge et al. identified role modelling, goal setting, motivational counselling and restructuring the physical environment as means for promoting health behaviour change in children⁶⁹. Enridge et al. highlighted the intervention 'Taking Steps Together' targeting children aged 5-13 years, where parents role modelled health behaviours with a focus on playful aspects and joy resulting in increased physical activity levels and increased fruit and vegetable intake in the whole family⁷⁰. Correspondingly, a realist synthesis by Hnatiuk et al. revealed that there was a greater chance of increasing children's physical activity levels if parents also increased theirs⁷¹ underlining the ripple effect that may exist when targeting all family members as opposed to individual-focused interventions. Providing instructions on how to role model health behaviours sensitive to social situations in combination with providing knowledge on the benefits for family health may be an effective strategy for health behaviour change maintenance in parents with small children.

In the qualitative process evaluations of included interventions, mothers expressed that social support, especially practical, and emotional partner support functioned as barriers^{56,58,62,63} and enablers^{58,62,68,72} for programme attendance. Yet, no interventions in this review included the BCT *social support (practical)* [3.2], not even interventions involving both parents. A review of reviews by Greaves and colleagues found that including social support (usually from family members) was effective in promoting health behaviours in individuals at risk for type 2 diabetes⁷³. Studies have highlighted the lack of partner involvement in interventions and its potential to promote circumstances for health behaviour change, e.g. for prevention of type 2 diabetes in mothers and prevention of obesity in children^{71,74,75}. Similar to the findings of this review, studies suggest that parents are less prone to engage in health behaviour change if interventions focus on parents' health behaviours exclusively⁷⁶. Consistent with Social Cognitive Theory,

social norms and the physical environment play an important role in affecting health behaviour⁶⁶. In the transition to parenthood, environmental factors and social relations may overrule individual factors in relation to health behaviour practices due to increased demands of the child in its early years^{5,77}. Thus, facilitating practical social support by involving the interpersonal environment (especially the family) may serve as a potent strategy for health behaviour change in parents with small children.

Context and delivery

The findings from this review suggest that the context in which interventions are delivered is important for activating specific mechanisms for health behaviours in parents with small children. Mostly, mothers expressed a need for flexible intervention delivery due to barriers for attendance, e.g. childcare and family demands^{39,56} and inclusion of home-based activities seemed to improve adoption of health behaviours. In contrast, Greaves et al. did not identify any specific setting as more feasible than others for effective behaviour change components for at-risk adults of type 2 diabetes⁷³. According to Social Cognitive Theory, home-based activities may activate self-efficacy by enabling practicing behaviours under stress-free conditions⁷⁸. Pamungkas and colleagues found that home-based interventions, which were effective in improving dietary behaviours in children, often had a high degree of parental involvement⁷⁹. By providing activities in the home, e.g. DVDs or fridge magnets, parents are exposed to instructions on how to translate health practices to the home creating more awareness and possible collective efficacy towards healthy home environments. Yet, as suggested by an evaluation of contextual factors in the TOPS intervention, physical activity in this group may also be improved by facilitating activities outside the home and reducing screen time⁶⁴.

Many of the interventions in this review provided tailored intervention content, but recruitment, engagement and retention were still major challenges. Issues with recruitment and retention among mothers after delivery are well documented in the literature⁸⁰. To overcome these challenges and reach mothers with low SES, some of the identified interventions adopted an IT-based component^{81,82}. In the *Fit Moms* intervention, which was successful in achieving weight loss in postpartum mothers, self-monitoring and social support were primarily used to track health and interact with other mothers⁶⁰. Van Rhoon and colleagues found that including more interactive features strengthened the likelihood of health behaviour change maintenance in adults with high risk of diabetes. Especially, online health coaching was identified in effective digital interventions by Van Rhoon⁸³. Considering the stress, exhaustion and increasing demands on new parents' well-being when having an infant⁸⁴, it should be thoroughly considered how health behaviour interventions are designed to avoid unintended harms. For example, studies show that low retention rates in mothers with low SES and/or from deprived areas are associated with high stress-levels and depressive symptoms⁶⁷. Group sessions may be most feasible for activating social support and changing normative beliefs, but phone- and website-based delivery may be able to replace emotional support and knowledge facilitation in parents with additional family demands. However, the results of this study suggest that these strategies only have potential if combined with other BCTs, e.g. *self-monitoring of behaviour* [3.2]. Thus, providing counselling through websites, phone calls or group sessions may be effective in activating emotional support and knowledge, but should be combined with other strategies to affect health behaviours in parents with small children.

Outcomes

The fact that the included interventions were more successful in improving dietary behaviours than physical activity is consistent with the wider literature ²⁵. One explanation may be that the included interventions mostly relied on dieticians delivering the intervention which may have increased the focus on diet on the expense of physical activity ³⁷. As indicated in one of the studies, it may also be of greater interest to mothers to improve dietary habits than physical activity ⁶⁵. Further, it may be easier for mothers to limit their intake of unhealthy foods than to increase consumption of fruit and vegetables and increase physical activity levels ³⁷. For example, preparing salads and fruits as well as the higher cost of many healthy foods demand more time and money compared to reducing intake of fatty foods. Similarly, Moura and colleagues found that parents' experience healthy meal preparation to demand more energy making parents' succumb to their children's preferences for more unhealthy, non-complex meals ⁸⁵.

Strengths and limitations

This study included a double screening of more than 10,000 references to identify interventions that aimed to improve dietary and physical activity behaviours in families with small children (0-3 years). Systematically assessing the characteristics of each included study provided insights into how interventions in this life period work, for whom and under which circumstances. Due to expected heterogeneity between interventions, e.g. various measures of physical activity and dietary intake, delivery and content, a realist synthesis was chosen because this method considers the complexity of behavioural interventions. Related papers published on the same intervention were searched iteratively allowing identification of CMOs and active BCTs. Three authors independently coded the BCTs reported across effectiveness- and protocol studies strengthening internal reliability. A thorough quality assessment was also completed, which revealed a need for increased attention towards strong intervention designs in this target group. The realist synthesis provided in-depth understandings of the complex interactions between context, mechanisms and outcomes strengthening the

evidence behind the recommended strategies, which can be used by policymakers, practitioners and researchers seeking to improve health behaviours in parents with small children.

Consistent with literature on coding of BCTs⁸⁶, there was a high discrepancy in intervention coding between authors. Disagreements were resolved through four rounds of re-reading intervention descriptions and re-confirming BCTs. The BCT taxonomy has not (yet) been applied to other ecological levels, e.g. interpersonal (the family level) or the community level leaving out social and/or environmental factors important for parenthood. Also, we only included interventions targeting both physical activity and diet. Including interventions focusing on physical activity and diet separately may have given a broader understanding of potential strategies to promote health behaviours in parents with small children.

Key recommendations and conclusions

This systematic review and realist synthesis accumulated and analysed interventions targeting health behaviours in parent(s) with small children (0-3 years). The observed improvements in dietary and physical activity behaviours were small and only shown in mothers. Based on the findings, we recommend researchers and practitioners to:

- Engage both parents by focusing on child health and role modelling to increase parents' participation and engagement
- Secure a strong, social support component, especially practical support, e.g. daily chores and childcare
- Include various delivery modes especially home-based activities with multiple BCTs
- Consider IT-based components to activate emotional support and knowledge. However, this should not stand alone, but be coupled with, e.g. self-monitoring, role modelling, prompts/cues or practical support

Future interventions will benefit from adding resources to developing interventions, e.g. by exploring what partners/fathers consider barriers and facilitators for health behaviour change at the family-level to tailor intervention delivery and content appropriately. Further, as recommended by the Medical Research Council, process evaluations should be conducted as they contribute valuable information to understand active context and mechanisms⁸⁷. Lastly, acknowledging the ongoing discussion on realist methodology, we reside with Bonell et al. that realist-principled methods are useful to investigate relevant context, mechanism and outcomes and that systematic reviews can be strengthened by relying on mixed methods^{18,88}.

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Tables and Figure Legends

Tables

Table 1: Key characteristics of included interventions in the systematic review of behavioural interventions targeting parents with small children (N=17)

Table 2: Table 2 Strategies to improve physical activity and dietary behaviours in parents with small children with illustrative examples from effectiveness studies and process evaluations

Figures

Figure 1: Flow diagram of study selection

Figure 2: Programme theory mapping context, mechanisms and outcomes highlighting effective contexts and mechanisms for parents with small children

Legend:

A SWAN ⁴⁵; **B**: INTER-ACT ^{54,89}, **C**: TOPS ⁵⁵, **D**: INFANT ³⁷, **E**: Mothers in Motion ⁴⁰, **F**: PRIMROSE ⁴⁷, **G**: REFRESH ⁴¹, **J**: Active Mothers Postpartum (AMP) ³⁹, **K**: KAN-DO ⁴⁸, **L**: Fit Moms ⁴³, **N**: First Steps for Mommy and Me ⁴⁴, **O**: Moms Online ³⁸. Orange boxes indicate mode of delivery which were highlighted in process evaluations as important for health behaviour change and blue boxes indicate BCTs which acted as active mechanisms to improve health behaviour in the intervention. Green boxes indicate interventions (A-Q) which showed significant effects in improving dietary and/or physical activity.

Figure 3: Context-Mechanism-Outcome configurations for interventions targeting dietary and physical activity behaviours in parents with small children

Legend:

A: SWAN ⁴⁵; **B**: INTER-ACT ⁵⁴, **C**: TOPS ⁵⁵, **D**: INFANT ³⁷; **E**: Mothers in Motion ⁴⁰, **F**: PRIMROSE ⁴⁷, **G**: REFRESH ⁴¹, **J**: Active Mothers Postpartum (AMP) ³⁹, **K**: KAN-DO ⁴⁸, **L**: Fit Moms ⁴³, **N**: First Steps for Mommy and Me ⁴⁴, **O**: Moms Online ³⁸. Dashed arrows indicate hypothesised associations (from interventions which showed no significant health behaviour change).

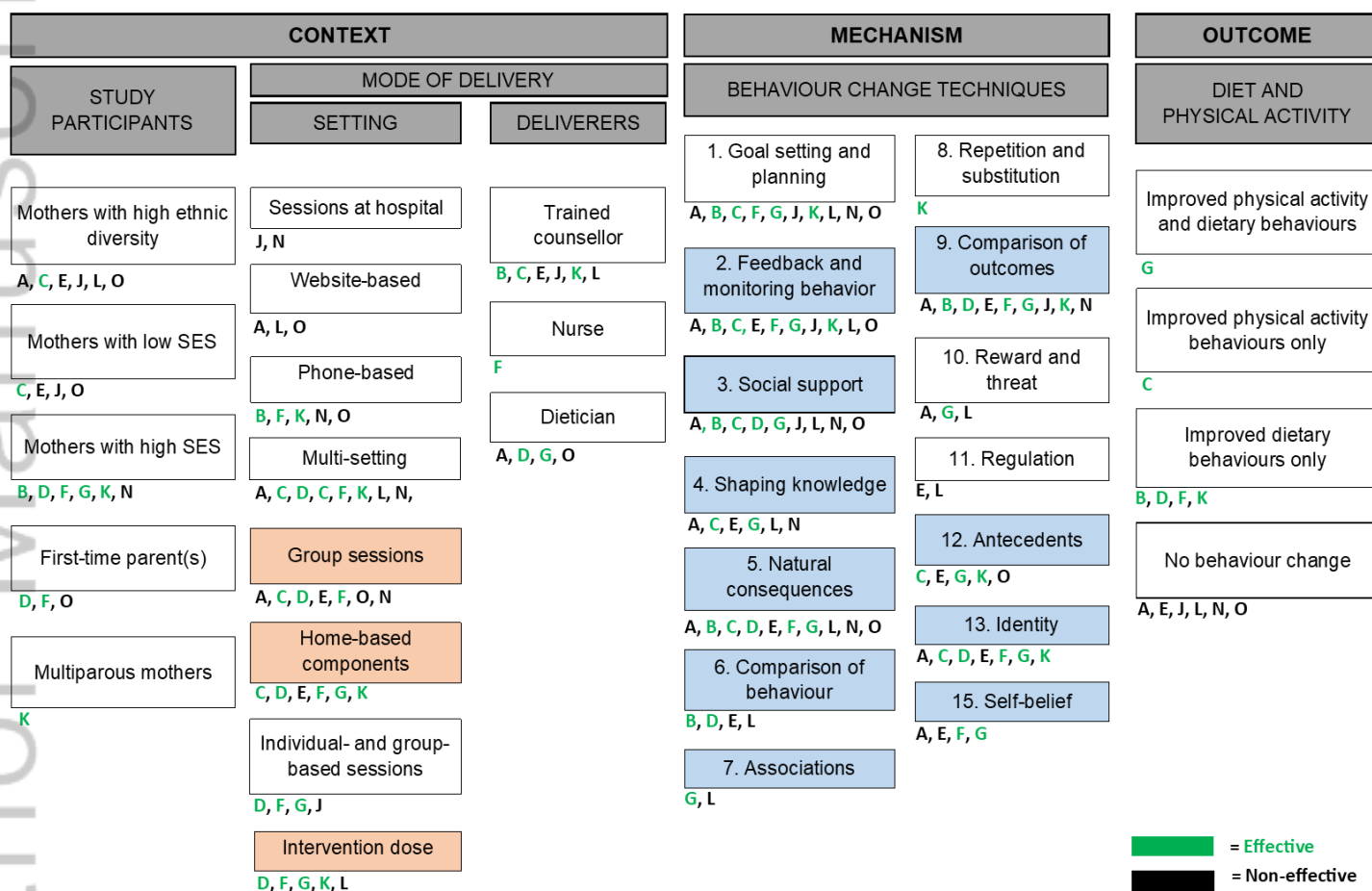
Supporting information

Supplementary Document 1: Search strategy: MEDLINE

Supplementary Table 2: Descriptive characteristics of included interventions

Supplementary Table 3: Results of risk of bias assessment using revised Cochrane risk-of-bias tool for randomized trials (RoB 2)

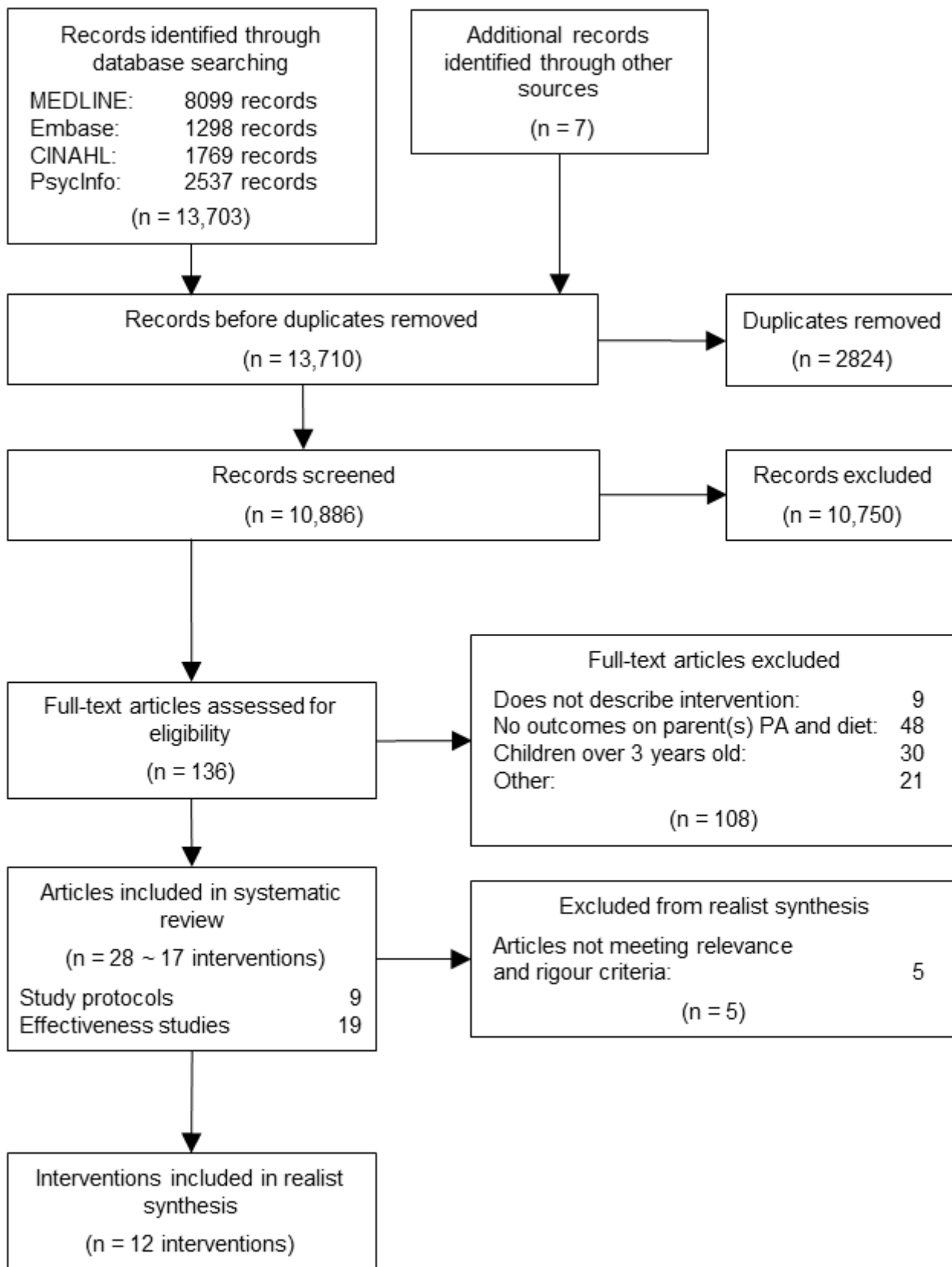
Supplementary Table 4: Results of duplicate quality assessment of studies, using the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool

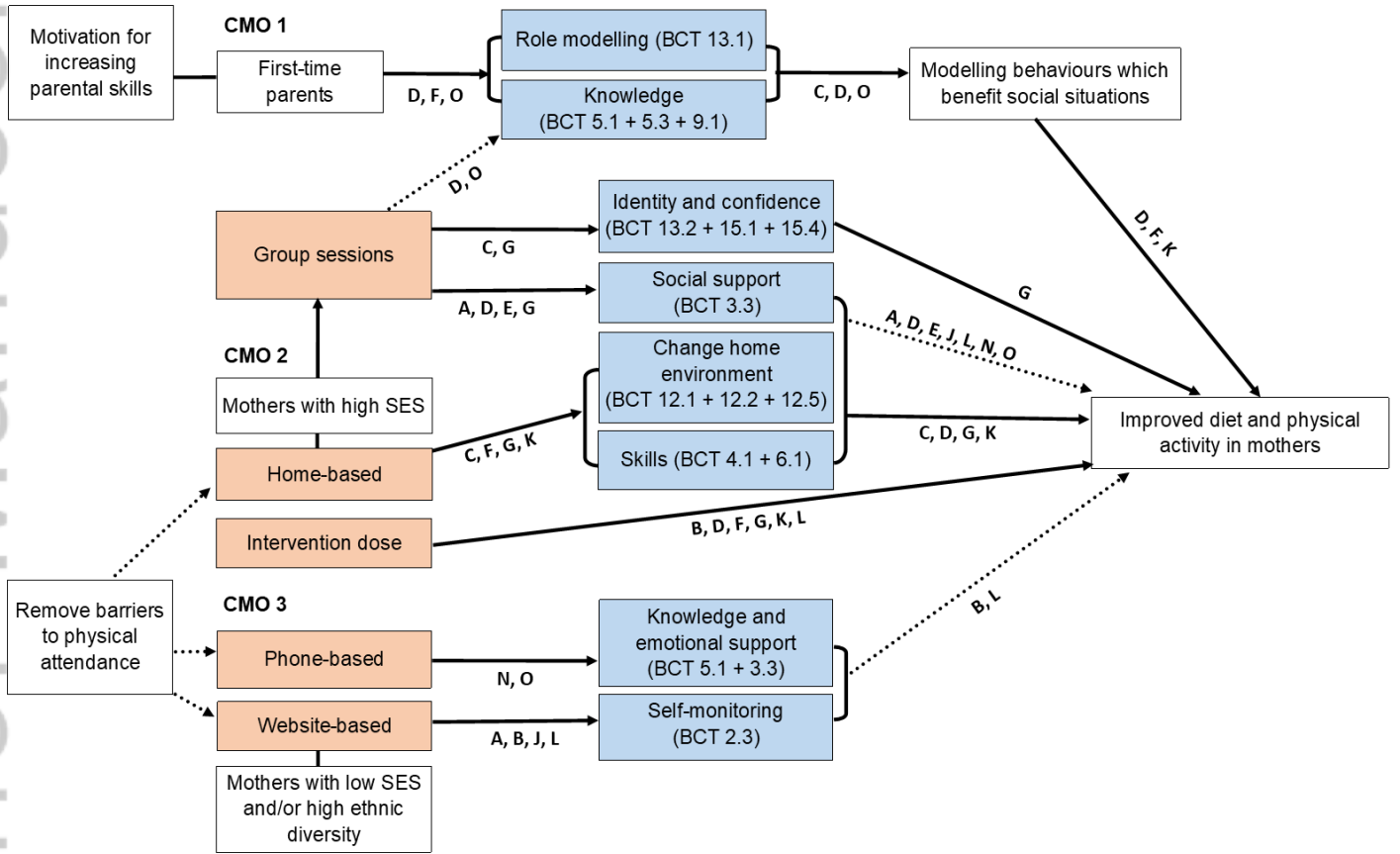


= Effective
 = Non-effective

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Figure 1: Flow diagram of study selection





OBR_13359_Figure 3 Context-Mechanism-Outcome configurations for interventions targeting dietary and physical activity.tif