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Uptake, retention, and delivery of community dietary interventions within low socioeconomic populations

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ABSTRACT

Objectives: To evaluate levels of uptake and retention in community-based dietary interventions for low socioeconomic status (SES) populations, to identify barriers and facilitators of uptake and retention, and to compare the characteristics of interventions with optimal and suboptimal uptake and retention.

Method and measures: Databases were searched for relevant records published before March 2024. $N = 114$ papers met the inclusion criteria. Data were narratively synthesised, and intervention content was coded for behaviour change techniques (BCT).

Results: Uptake and retention were suboptimal at an average of 80 and 71%, respectively. Interventions with higher uptake and/or retention were shorter in duration, more likely to be group-based and more likely to include the BCT 'providing information about health consequences'. A thematic analysis of barriers and facilitators identified that logistical challenges, socioeconomic factors, and low motivation hindered uptake and retention, while social support, practical assistance, and the provision of tailored interventions facilitated it.

Conclusions: These results highlight the need to improve participant engagement and retention strategies in dietary interventions targeting low SES individuals by, for example, implementing different behaviour change techniques, altering the duration, setting or delivery of interventions and tailoring interventions to align them with the unique needs of this population group.

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KEYWORDS
Socioeconomic status; dietary interventions; uptake; retention; community-based

Main text introduction

Low socioeconomic status (SES) is a risk factor for obesity (Allen et al., 2017; Stringhini & Bovet, 2017) and associated non-communicable diseases such as cardiovascular disease or type II diabetes (Everson-Hock et al., 2013; North East Alliance, 2022). This

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arises from a complex interplay of individual (income, education, and employment) and systemic (cost of living, food access and social norms) factors, resulting in reduced access to financial, educational, social, and healthcare resources compared to those living with higher socioeconomic status (Chen & Miller, 2013). In high-income countries, socioeconomic disparities and level of deprivation play a key role in shaping differences in health outcomes (Davies et al., 2019). For example, individuals living in the most socioeconomically deprived areas of the UK are approximately 60% more likely to be obese and 40% more likely to have type 2 diabetes compared to those living in the least deprived areas (Connolly et al., 2000; Stringhini et al., 2013). While diet is a key modifiable determinant of body weight and disease risk, changing diet is difficult and may be particularly challenging for low SES individuals as a healthy diet has been shown to be unaffordable for the majority of low SES households (González et al., 2019; Scott et al., 2018). As the cost of 'healthy' food items continues to outpace the cost of 'unhealthy' foods, a nutritious diet is becoming increasingly challenging and disproportionately difficult for people in socioeconomically deprived areas to attain (Anderson, 2007; Clark, 2022; Hoenink et al., 2024; Larsen & Gilliland, 2009; Wood, 2022).

Dietary interventions designed for, and delivered in low SES communities try to offer a practical and cost-effective means of improving diet for those living with limited resources (Hagger & Weed, 2019). Some community-based dietary interventions try to support healthier eating, whereas others primarily aim to increase food access and food security (Gittelsohn et al., 2012; Maugeri et al., 2021; Mayén et al., 2016). Interventions in this setting are diverse and include dietary health information provision (Eicher-Miller et al., 2022; McKee et al., 2023), provision of food directly (e.g. emergency parcels), and provision of the equipment and resources needed to access healthier food, or offer practical training and demonstrations (such as affordable cooking classes) (Gittelsohn et al., 2012; Maugeri et al., 2021; Mayén et al., 2016). These approaches can help to improve dietary health by targeting a wide range of relevant environmental, physical, and socioeconomic factors associated with dietary behaviour (Eakin et al., 2007).

Community interventions offer a promising solution to dietary health issues in low SES communities, but their success depends on attracting and retaining participants. Inconsistent and suboptimal uptake and retention are common challenges in behaviour change interventions. For example, a review of recruitment and retention in weight management interventions in the UK found that uptake varies from 1 to 99% and retention from 35 to 98%, with retention lower in diet focused programmes relative to those combining diet and exercise (Gidlow et al., 2018)

These challenges are even more pronounced in low SES populations, who are more likely in general to drop out of interventions (Birch et al., 2022). Factors such as participation costs (e.g. travel or childcare) contribute to higher dropout rates and lower participation among low-income households (Ligthart et al., 2017). Consequently, it is possible that specific aspects of an intervention's delivery or content may either encourage or deter participation from low SES individuals.

The delivery of behavioural interventions can be characterised by their mode, frequency, and setting (e.g. face-to-face, online, weekly, daily, in the community, or within healthcare settings). In addition to delivery, interventions are defined by their

content, particularly in terms of the behaviour change techniques (BCTs) they contain/employ. The Behaviour Change Technique Taxonomy (Michie et al., 2013) provides an extensive hierarchical classification of the different techniques which can be used to promote behaviour change in interventions. It consists of 93 distinct techniques, which represent the 'active ingredients' of behavioural interventions. Each BCT offers a possible method of changing a chosen behaviour, for example setting dietary goals to increase healthy eating. While there is some evidence from weight management studies that interventions which include a larger number of BCTs in total, and/or certain specific BCTs (self-monitoring, feedback, social support and problem-solving) have higher retention rates in general (Gidlow et al., 2018), it is currently unknown whether particular BCTs are related to uptake or retention in community-based dietary interventions designed specifically for low SES adults. Similarly, while there is evidence that in-person methods may be preferable to virtual or distance interventions (Davies et al., 2020), little is known about how intervention delivery modes influence uptake and retention in low SES individuals.

Given the potential of community-based dietary interventions to support healthy eating among low SES individuals, it is crucial to assess current rates of uptake and retention in this group and to determine whether specific intervention content or modes of delivery are associated with higher or lower uptake and retention. Currently, there is a lack of robust evidence identifying factors that influence intervention uptake and retention in dietary interventions targeting low SES (Hagger et al., 2020; Hagger & Weed, 2019). In this context 'uptake' refers to the number of participants who enrol into an intervention study, while 'retention' denotes the number of participants who complete the intervention or remain engaged for the duration of the intervention. Identifying intervention features associated with higher uptake and retention among low SES individuals could inform the future design and delivery of more effective and engaging dietary interventions.

The current review aims to answer three research questions.

In community-based dietary interventions targeting individuals from low SES areas:

1. What are the levels of uptake and retention observed in the current literature?
2. What intervention techniques (BCTs) and/or modes of delivery are associated with high rates of uptake and retention?
3. What barriers and facilitators of uptake and retention are identified?

Materials and methods

Search strategy

This systematic review was conducted following the guidelines highlighted in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Literature searches were carried out on Scopus, Medline, APA PsycArticles, Web of Science, Embase and, PsycINFO for studies published before October 2022. The search has since been updated to March 2024. The review protocol was pre-registered with PROSPERO (ID: CRD42022376484). The search strategy and screening process

aimed to identify community-based dietary interventions targeting low SES individuals. Search terms included keywords and MeSH terms covering: the population of interest (low socioeconomic populations), the intervention of interest (dietary behaviour change interventions; defined as interventions, which aim to support people to adopt new or modify dietary behaviours), the context of interest (community-based), and the outcome of interest (uptake and/or retention). The full search strategy is available as a supplementary file. Hand searching was also used to search reference lists of systematic reviews that were identified during the initial search. Pre-specified inclusion criteria required studies to include a behaviour change intervention with at least one dietary component; recruit participants from exclusively low socioeconomic areas/populations (including individuals from geographical areas of deprivation, users of services designed for low SES individuals and low-income individuals); be set in the community; be conducted in high-income countries and be published in English. Formal cut-offs for what constituted 'low' SES were not applied as definitions vary widely depending on social, cultural, economic and geographical context. Instead, studies were included if authors explicitly reported that target participants were socioeconomically deprived, and details of the definitions used in each study were extracted. All primary empirical research designs were eligible for inclusion.

Screening

Search results from each database were combined in RefWorks (Proquest LLC, Ann Arbor, Michigan, USA), where duplicate articles were removed before importing into Rayyan (Ouzzani et al., 2016), a systematic reviewing software program for title and abstract screening. Titles and abstracts were independently double screened: the first author (AS) screened all records, and each remaining author (JA, JK, FT, OP) second screened 25%. Full texts of all retained papers were obtained and double-screened for eligibility (AS – 100%; JA, JK, FT, OP – 25% each). Agreement between reviewers was high at both screening stages (99.2% for title and abstract and 95.3% for full-text screening). Any conflicts were resolved through discussion with the option of escalating to a third reviewer if a resolution was not reached.

Data extraction

Key data extracted included rates of uptake and retention, mode(s) of engagement, mode(s) of intervention delivery, barriers, facilitators, study characteristics, population characteristics, intervention description, and intervention content. Data extraction was completed by the first author (AS – 100%), with 20% of papers double extracted (JA, JK, FT, OP – 5% each) as an accuracy check. Double extraction identified that while agreement was consistent for most variables, the level of detail extracted for intervention description, mode of engagement, mode of delivery, and barriers and facilitators varied between reviewers. Consequently, upon completion of the main data extraction, these variables were revisited and subject to full double extraction by three members of the review team (FT, JK, OP) to ensure completeness.

Data coding and synthesis

Where possible, uptake rate (%) was calculated using the number of participants enrolling in comparison to the target sample size, and the retention rate (%) was calculated using the number of participants completed versus those enrolled. Descriptive analysis was completed using SPSS v29 (IBM Corp, 2023).

Data relating to intervention content and delivery were coded using different behaviour change taxonomies and ontologies. To identify the 'active ingredients' of included interventions, two trained Behaviour Change Technique (BCT) coders (AS, JA) independently coded the content of all included interventions using the BCT V1 taxonomy (Michie et al., 2013) to determine the BCTs used in each. Mode(s) of intervention delivery and intervention setting were coded using the Behaviour Change Intervention Ontologies (BCIO), specifically the Mode of Delivery Ontology and the Setting and Source Ontology (Marques et al., 2023). These ontologies provide a system to code intervention characteristics that help to describe and compare the data in a narrative synthesis.

Due to the heterogeneous nature of the included studies, meta-analysis was not possible. Instead, data on uptake and retention, intervention content (BCTs), mode of delivery, timing and frequency of delivery and general intervention characteristics were narratively synthesised, following published guidance (Popay et al., 2006). This narrative synthesis included a four-way Venn diagram illustrating the shared and differing characteristics, content and delivery of interventions with higher and lower uptake and retention. For this, high uptake and retention interventions were defined as those that recruited 100% of the participants invited to the study and retained 80% of their participants throughout. The 100% threshold for high uptake was selected to reflect studies achieving their target sample sizes. The 80% retention threshold for high retention was derived from the existing literature (Crombie et al., 2018) which suggests that an uptake rate of 80% is sufficient to ensure a study's methodology is efficient and valid. Interventions were grouped into four subcategories based on these thresholds: high uptake, high retention, low uptake, and low retention. The BCTs for modes of delivery and for characteristics of interventions in each subcategory were counted, converted into percentiles and divided into quartiles. This quartile system was used to subcategorise the frequency of each characteristic's presence within interventions, indicating whether they appeared in <25% of interventions, 25-50% of interventions, 50-75% of interventions or >75% of interventions.

Thematic analysis of barriers and facilitators

Any barriers and facilitators to uptake or retention that were explicitly described by study authors in intervention reports were extracted and thematically analysed to identify themes and patterns. The extracted data were imported into NVivo (Lumivero, 2023) and coded following Braun and Clarke's six steps of thematic analysis (Braun & Clarke, 2006). Generated codes were grouped into themes, each accompanied by descriptive summaries to capture patterns within the data.

Case studies

Interventions with perfect (100%) uptake and retention were studied in detail and summarised as case studies to provide an in-depth overview of the content and characteristics of exemplar interventions that succeeded in optimising participant engagement in our target population.

Quality assessment

Each included study was quality assessed using the Standard Quality Assessment Criteria developed by Kmet and colleagues (Kmet et al., 2004) (AS – 100%; JA, JK, FT, OP – 20%). Due to the inclusion of both qualitative and quantitative papers, a formal risk of bias assessment was not appropriate for this review.

Results

Of the 3903 studies initially identified, 114 publications (containing 103 unique interventions) met the inclusion criteria and were eligible for this review. The screening and selection process is outlined in Figure 1. The full extraction table is available as a supplementary file.

Study characteristics

The study characteristics are summarised in Table 1. Intervention studies had an average sample size of $n = 226$ participants (SD: 304), with participants having an average age of 41.0 years (SD: 9). Most studies recruited predominantly female participants (94 out of 103 records), while only 7 studies had mainly male participants. Twenty-eight studies recruited mostly Black/African American participants, 21 White/Caucasian, 1 Native American, 5 Asian, 29 Hispanic/Latino and 30 other or unknown. Most studies were conducted in the USA ($N = 81$), followed by the UK ($N = 14$). Interventions focused on improving general healthy eating behaviours ($N = 41$), weight loss/management ($N = 31$), increasing fruit and vegetable consumption ($N = 29$), reducing the risk of obesity-related diseases ($N = 10$), or alleviating food insecurity ($N = 3$). The duration of interventions ranged from 2 to 288 wk, with a mean (M) duration of 28 wk (median: 16 wk).

Intervention uptake and retention

Of the 114 included records, 88 reported or provided sufficient information to calculate the rate of intervention uptake, while 110 reported or allowed the calculation of the rate of retention. Twenty-seven records that did not include this information were feasibility and/or pilot studies, which typically do not report sample size.

Overall, most interventions had suboptimal uptake and failed to reach their target sample size. The average participant uptake rate was 80% (SD: 46) (Figure 2), while only 28% of interventions (25 out of 88) achieved or exceeded their target sample size. Similarly, most interventions did not have optimal retention. The average

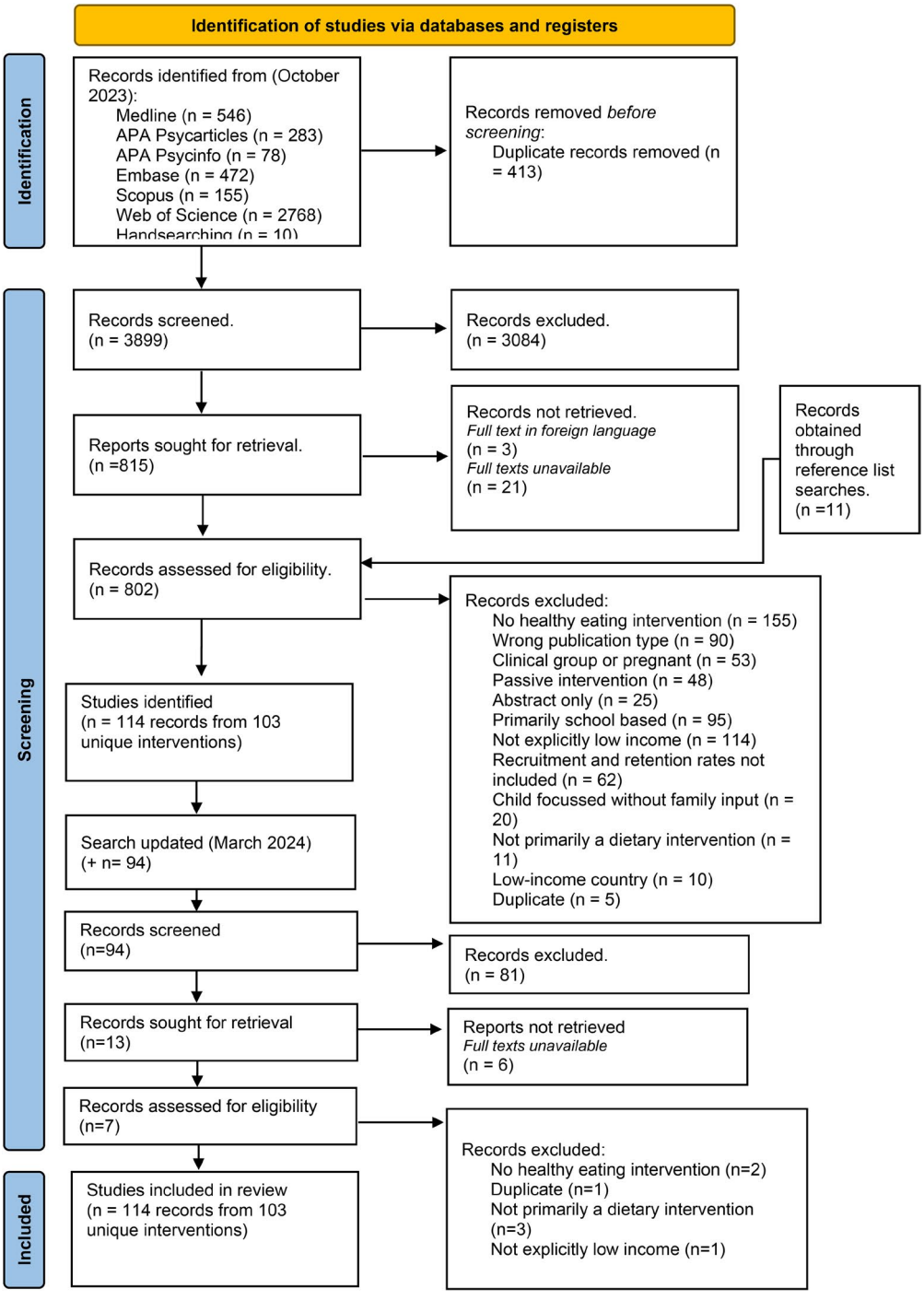

Figure 1. PRISMA 2020 flow diagram.

retention rate across the 110 included records was 72% (SD: 20%) (Figure 3), with only 33% of studies (36/110) retaining at least 80% of participants to the end of the intervention.

Table 1. Summary of study characteristics for included interventions.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Ackermann (Ackermann et al., 2015)	2015	Randomised comparative effectiveness trial	187 Female 70 male	52.5 ± 10.7	USA	Reaching Out to Prevent Increases in Diabetes (RAPID)	Weight loss (which reduces risk of type 2 diabetes)
Ahluwalia (Ahluwalia et al., 2007)	2007	Cluster randomised control trial	68 Female 39 male	50.8 ± 12.2	USA	Pathways to health	Increased fruit and vegetable consumption
Ambak (Ambak et al., 2018)	2018	Quasi-experimental intervention trial	167 Female	48 ± 13.1	Malaysia	My Body Fit and Fabulous (MyBFF@ home)	Weight loss
Anderson (J. V. Anderson et al., 2001)	2001	Multi-arm nonrandomised intervention trial	455 Female	42.81 ± 8.0	USA	Michigan Farmers' Market Nutrition Programme / Project FRESH	To increase fruit and vegetable consumption
Anderson (L. M. Anderson et al., 2014)	2014	Randomised pilot trial	46 Female	29.5 ± NR	USA	Parent Healthy Weight Programme with Worksite support via paid time off (PHWP-W)	Weight loss/maintenance
Anderson (J. D. Anderson et al., 2015)	2015	Intervention trial, feasibility trial	25 Female 8 male	30.4 ± 5.2	USA	Taking steps together	Increased fruit and vegetable consumption, increase exercise levels, decreased sugared beverage consumption and decreased screen time
Auslander (Auslander et al., 2002)	2002	Experimental control group design	138 Female	38.0 ± 9.4	USA	Eat well, live well	Reduce risk of type II diabetes
Basu (Basu et al., 2019)	2019	Randomised control trial	117 Female 59 male	41.2 ± 7.8	USA	NR	Increase fruit and vegetable consumption
Bihan (Bihan et al., 2012)	2012	Randomised control trial	42 Female 31 male	52.2 ± NR	France	NR	Increased fruit and vegetable consumption
Bowling (Bowling et al., 2016)	2016	Feasibility study, efficacy analysis intervention trial	401 female 24 male	44.4 ± 8.2	USA	Healthy foods, healthy families	Improve nutrition and dietary quality
Bruce (Bruce et al., 2017)	2017	Mixed methods study	NR	Adult (34.5 ± NR), Children (5.7 ± 3.2)	USA	Lunch at the library	Improve food security

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Bukman (Bukman et al., 2017)	2017	Quasi experimental intervention study	173 female 42 male	NR	Netherlands	MetSLIM	Decrease in waist circumference and cardiometabolic risk factors
Buller (Buller et al., 1999)	1999	Randomised trial	544 Female 1547 male	46.4 ± 9.6	USA	5 a Day (peer intervention) programme	Increase fruit and vegetable consumption
Buscail (Buscail et al., 2018)	2018	Randomised control trial	Adults (44 female, 1 male), children (24 female, 20 male)	43.1 ± 10.1	France	Fruits et légumes à la maison (FLAM)	Increase fruit and vegetable consumption
Buscemi (Buscemi et al., 2019)	2019	Quasi-experimental trial	89 Female 14 male	Adults (39.8 ± 6.4), Children (8.1 ± 2.2)	USA	Hip-hop to health	Weight loss/reduction in obesity
Bush (Bush et al., 2014)	2014	Non-randomised, retrospective, observational comparison of clinical data	386 Female 65 male	Adults (32.9, ± 8.6), children (5.5 ± 0.6)	UK	My choice weight management programme	Weight loss
Buyuktuncer (Buyuktuncer et al., 2014)	2014	Brief intervention study, pilot study	89 Female 35 male	41.1 ± 12.4	UK	Reconnecting food and health in Castlefields	Increase fruit and vegetable consumption
Cason-Wilkerson (Cason-Wilkerson et al., 2015)	2015	Qualitative study	35 Female 2 male	51.3 ± 17.9	USA	Healthy Living Programme (HeLP)	Weight loss/obesity treatment
Caspi (Caspi et al., 2017)	2017	Pilot study with pre-post comparisons	39 Female 6 male	NR	USA	Cooking matters	To increase cooking confidence
Cavallo (D. Cavallo et al., 2016)	2016	Feasibility/Pilot study	40 Female	42 ± 12.7	USA	InShape	Weight loss
Cavallo (D. N. Cavallo et al., 2021)	2021	Pilot study, feasibility study, pre-test post-test study	52 Female 2 male 1 transgender	30 ± 6.5	USA	INSHAPE CLE	Weight loss
Chatterjee (Chatterjee et al., 2018)	2018	Pilot study, feasibility case-controlled intervention trial	16 Female 4 male	46.5 ± 9.3	USA	Feastworthy	Improve food security and dietary behaviours of homeless families
Cheyne (Cheyne et al., 2020)	2020	Pilot study	174 Female 18 male	NR	USA	NR	Improve food security, dietary intake and reduce risk of type 2 diabetes
Clarke (Clarke et al., 2011)	2011	Field experiment	NR	48.5 ± 12.7	USA	Quick! help for meals	Increase consumption of vegetables

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Cluss (Cluss et al., 2010)	2010	Intervention trial	Adults (45 female, 3 male), children (25 female, 27 male)	NR	USA	Health Eating and Activity for Life Time Habits (HEALTH)	Obesity prevention
Cohen (Cohen et al., 2017)	2017	Quasi-experimental trial	151 female 26 male	Children (8.0 ± 2.2)	USA	Double Up Food Bucks (DUFB)	To improve healthy eating behaviours
Coleman (Coleman et al., 2010)	2010	Intervention trial	Parents (80 female, 2 male) Children (33 female, 29 male	38 ± NR	USA	Horton Hawks Stay Healthy (HHSH)	Type 2 Diabetes prevention
Craigie (Craigie et al., 2011)	2011	Feasibility study using an RCT design	29 Female	37.5 ± 8.6	Scotland	Weigh Well	Weight loss
Davis (Davis et al., 2013)	2013	Intervention trial	113 Female 97 male	30 ± 5.5	USA	The Healthy Hawks Programme	Reduce obesity/weight loss
Di Noia (Di Noia et al., 2019)	2019	Intervention trial	744 Female	Children: 10.0 ± 3.3	USA	NR	Improve fruit and vegetable uptake
Dombrowski (Dombrowski et al., 2020)	2020	Randomised control trial, Feasibility study	104 Male	50.9 ± 14.2	Scotland	Game of Stones	Weight loss
Draper (Draper et al., 2019)	2019	Pilot study	20 Female	NR	South Africa	Amagugu Asakhula (translates to "treasures that are still growing")	To promote healthy behaviours, including diet and physical activity
Draper (Draper et al., 2019)	2019	Feasibility and acceptability study	61 Female 23 male	35.6 ± NR	South Africa	Impilo neZenkolo (Health through faith)	Improved healthy lifestyle behaviours and outcomes (e.g., weight loss)
Eakin (Eakin et al., 2007)	2007	Randomised control trial	157 Female 43 male	48 ± 13	USA	Resources for Health	To improve diet and increase physical activity
Eicher-Miller (Eicher-Miller et al., 2009)	2009	Single blind randomised trial, pre post test	137 Female	41.5 ± 20.5	USA	Food Stamp Nutrition Education (FSNE)	To reduce food insecurity and insufficiency
Estrada Del Campo (Estrada Del Campo et al., 2019)	2019	Feasibility and acceptability study	36 Female	33 ± 5	USA	EnForma (translates to 'in form')	Reduced cardiovascular risk/ improved dietary quality
Evans (Evans et al., 2022)	2022	Pilot study	91 Female 6 male	30.9 ± 5.8	USA	Healthy beginnings SMS Intervention	Improving dietary health education
Ferreira (Ferreira et al., 2014)	2014	Intervention study	167 Female	51.8 ± 16.6	Brazil	NR	Improve the health and nutritional status of overweight women
Flynn (Flynn et al., 2013)	2013	Pre-post (non-controlled) study	53 Female 10 male	40.7 ± 10.9	USA	Raising the bar on nutrition	To promote weight loss and reduce breast cancer risk.

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Foley (Foley & Pollard, 1998)	1998	Review of pilot study	263 Female 347 male	53.5 ± NR	Australia	Food Cent$	To show low-income earners how to manage small food budgets to obtain value for money and a nutritious diet-
Foster (Foster et al., 2022)	2022	Randomised clinical trial	Adults (60 female, 2 male), children (31 female, 31 male)	Adults (32.6 ± 6.6), children (4.4 ± 0.7)	USA	We Can!	To reduce adiposity (measured by BMI)
Gans (Gans et al., 2018)	2018	Randomised control trial	622 Female 215 male	40.4 ± 12.9	USA	Live Well, Viva Bien	Increased fruit and vegetable intake
Gans (Gans et al., 2009)	2009	Randomised control trial	1567 Female 274 male	26 ± 5.2	USA	Your Healthy Life/Su Vida Saludable (YHL-SVS)	Lower fat and increase fruit and vegetable intake
Gilmore (Gilmore et al., 2017)	2017	Randomised control trial, pilot study	20 female	39.4 ± 6.3	USA	E-moms	Promote weight loss
Griffin (Griffin et al., 2019)	2019	Randomised control trial, feasibility study	29 male	NR	England, UK	Healthy dads, healthy kids	Weight management
Grutzmacher (Grutzmacher et al., 2019)	2019	Survival analysis trial (secondary data analysis)	NR	NR	USA	Text2BHealthy	Promote improved nutrition and physical activity
Havas (Havas et al., 2000)	2000	Crossover study	NR	51.8 ± 6.4	USA	WIC 5-a-day Promotion	Increase fruit and vegetable consumption
Hayashi (Hayashi et al., 2010)	2010	Randomised control trial	433 Female	27.5 ± 5.8	USA	Hearts of the Family (a WISEWOMAN project)	To reduce cardiovascular disease risk factors
Herman (Herman et al., 2008)	2008	Intervention trial	451 Female	48.8 ± 12.7	USA	Special Supplemental Nutrition Program (WIC)	Increase fruit and vegetable intakes
Hochsmann (Höchsmann et al., 2021)	2021	Cluster randomised control trial	398 Female 54 male	41 ± 9.4	USA	Promoting Successful Weight Loss in Primary Care in Louisiana (PROPEL)	Weight loss
Hopkins (Hopkins et al., 2022)	2022	Quasi-experimental trial	64 female 1 male	31.4 ± NR	USA	Simple Suppers	To improve diet and nutrition outcomes in caregivers and increase the frequency of family meals

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Hossain (Hossain et al., 2015)	2015	Pre-test, post-test intervention	143 Female 33 male	44.1 ± 13.	Australia	Red Apple Healthy Lifestyles Programme (RAHLP)	To promote sustainable changes in diet, exercise and shopping behaviours
Izumi (Izumi et al., 2018)	2018	Pre-post intervention study	23 Female 1 male	59 ± NR	USA	Community Supported Agriculture (CSA)	To increase access to and intake of vegetables
Jacobs (Jacobs et al., 2004)	2004	Follow up intervention	302 Female	50 ± 12.8	USA	WISEWOMAN (weight maintenance)	Maintaining previous weight loss
Joachim-Celestin (Joachim-Célestin et al., 2022)	2022	Pilot study, Feasibility study	99 Female	50 ± 9.8	USA	Full plate living lifestyle	Physical and mental health improvement
Johnson (Johnson et al., 2019)	2019	Cost effectiveness evaluation	56 Females	43.2 ± 7.9	USA	WISEWOMAN (Weight Watchers and Curves Complete)	Weight loss
Kassim (Kassim et al., 2017)	2017	Quasi-experimental trial	124 Female	27.2 ± NR	Malaysia	My Body is Fit and Fabulous at home (MyBFF@home)	To improve dietary and exercise behaviours
Kennedy (Kennedy et al., 1998)	1998	Mixed methods study	39 Female	54 ± 0.7	United Kingdom	Friends with Food (FWF)	Improved nutrition knowledge
Kerver (Kerver et al., 2022)	2022	Randomised factorial trial	Adults (NR) Children (245 female, 254 male)	Adults (29.8 ± 6.8) Children (4.1 ± 0.6)	USA	Simply dinner	Increase family meal frequency and dietary quality
Keyserling (Keyserling et al., 2008)	2008	Randomised control trial	118 Female	NR ± NR	USA	Enhanced WISEWOMAN project	Increased physical activity and improved diet
Klohe-Lehman (Klohe-Lehman et al., 2007)	2007	Intervention study	91 Female	37.8 ± 10.5	USA	NR	Improve food choices and retention to exercise
Ko (Ko et al., 2016)	2016	Pre-post intervention trial	39 Female 1 male	43.3 ± 7.4	USA	Nuestras Comidas	Increased fruit and vegetable consumption
Koniak-Griffin (Koniak-Griffin et al., 2015)	2015	Randomised control trial	111 Female	39.6 ± 6.7	USA	Mujeres Sanas y Precavidas (Healthy Women Prepared for Life)	Improve dietary health behaviours and reduced waist circumference
Kozica (Kozica et al., 2015)	2015	Randomised control trial	649 Female	NR	Australia	The Healthy Lifestyle Programme (HeLP-her)	To prevent weight gain

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Laroche (Laroche et al., 2022)	2022	Pilot study	NA	31 ± 4.47	USA	Living Well Together (LWT)	To increase physical activity and improve nutrition
Lawton (Lawton et al., 2022)	2022	Feasibility study	25 Female (caregivers)	39.7 ± 11.5	USA	SNAP-Ed (Adapted from Sesame Street's Food for Thought: Eating well on a budget)	To support and educate parents of children between the ages of 2–8 who may have limited access to affordable and nutritious food
Leahey (Leahey et al., 2018)	2018	Secondary data analysis of 2 randomised trials	61 Female	47.9 ± 14.9	USA	Internet Behavioural Weight Loss Treatment with Incentives (IBWL+$)	Weight loss
Leone (Leone et al., 2018)	2018	Randomised control trial	69 female 5 male	NR	USA	Veggie Van (VV)	Increase fruit and vegetable consumption
Lipton-Inga (Lipton-Inga et al., 2022)	2022	Quasi-experimental pragmatic pilot study, feasibility and acceptability study	Older children (56 female, 52 male), Younger children (42 female, 30 male)	Older children (11.6 ± 2.3) Younger children (5.9 ± 1.2)	USA	Kids n Fitness (KNF) and Kids n Fitness Junior (KNF-JR)	Weight loss
Loopstra (Loopstra, 2018)	2013	Qualitative interviews	NR	51 ± NR	Canada	NR	Participation in community gardens, kitchens, and a good food box programme.
Martin (K. Martin et al., 2012)	2012	Community-based participatory research	68 Female 47 male	51.8 ± 12	USA	Freshplace	To improve food security and increase fruit and vegetable intake
Martin (K. S. Martin et al., 2013)	2013	Randomised parallel group study	69 Female 44 male	52.2 ± 13.1	USA	Freshplace	To increase food security
McDonald (McDonald et al., 2020)	2020	Qualitative follow up study	105 Male	46.6 ± 15.0	Scotland, UK	Game of Stones	Weight loss
McRobbie (McRobbie et al., 2019)	2019	Randomised control trial	161 Female 60 male	NR ± NR	UK	Weight Action Programme (WAP)	Weight loss/weight management
Menne (Menne et al., 2016)	2016	Acceptability and feasibility trial	NR	44.4 ± 8	USA	Heart Health Programme	Improved heart related health outcomes through health behaviour change
Mohd Zaki (Mohd Zaki et al., 2018)	2018	Quasi experimental trial	169 Female	45.1 ± 10.8	Malaysia	My Body Fit and Fabulous (MyBFF@ home)	To improve body composition (BMI, waist circumference etc.)

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Nakamura (Nakamura et al., 2017)	2017	Randomised control trial	157 female 169 male	35.3 ± 12.9	Japan	Diet and Exercise Practices Project	To increase vegetable intake
Neter (Neter et al., 2020)	2020	Randomised control trial	111 Female 52 male	NR	Netherlands	NR	To improve dietary intake
Neuenschwander (Neuenschwander et al., 2013)	2013	Randomised trial	111 Female 12 male	20.6 ± NR	USA	NR	Improvement in nutrition related health behaviours such as fruit and vegetable intake
Nicholson (Nicholson et al., 2011)	2011	Longitudinal study	191 Female	27 ± 6.8	USA	MOMS (Making our Mealtimes Special)	To improve nutritional quality of meals provided by mothers during childhood
Nitzke (Nitzke et al., 2007)	2007	Randomised control trial	1238 Female 786 male	48 ± 13.1	USA	NR	Increase fruit and vegetable consumption
Nollen (Nollen et al., 2008)	2008	Cluster randomised control trial	68 female 39 male	39.4 ± 16.2	USA	Pathways to Health	Increased fruit and vegetable consumption
O'Connor (O'Connor et al., 2020)	2020	Randomised waitlist-controlled trial	Adults (0 female, 19 male) children (16 female, 15 male)	Adults (36.8 ± 7.6) children (8.8 ± 2.3)	USA	Papás Saludables Niños Saludables	Weight loss/obesity prevention in father and children
O'Loughlin (O'Loughlin et al., 1998)	1998	Randomised control trial	327 Female 257 male	NR	Canada	NR	Improve eating habits
Ordway (Ordway et al., 2018)	2018	Prospective longitudinal cohort study using data from 2 RCTs	92 Female	19.6 ± 2.8	USA	Minding the Baby (MTB)	To support the health, mental health and development of mothers and children
Orr (Orr & McCamley, 2017)	2017	Mixed methods evaluation	NR	NR	England, UK	Eatwell for Life (EWL)	Increase nutritional knowledge, cooking confidence and healthy eating
Pallesen (Pallesen et al., 2019)	2019	Feasibility study, mixed method study	150 Female	45.3 ± 12.3	Denmark	NR	To improve dietary behaviour and increase awareness of healthy cooking practices
Parra-Medina (Parra-Medina et al., 2011)	2011	Randomised control trial	136 Female	51.3 ± 9.8	USA	Heart Healthy and Ethnically Relevant Lifestyle Trial (HHER Lifestyle)	Reduced dietary fat intake and increased moderate to vigorous physical activity
Peerbhoy (Peerbhoy et al., 2008)	2008	Intervention evaluation	NR	NR	UK	Family fit	Improved lifestyle health (activity, diet and physiological)

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Perignon (Perignon et al., 2017)	2017	Evaluation trial	80 female 16 male	48.4 ± 7.7	France	Opticourses	Improve nutritional quality of food purchases
Perkins-Porras (Perkins-Porras et al., 2005)	2005	Parallel group randomised control trial	Pre-contemplation (35 female, 34 male) contemplation (27 female, 27 male) preparation (104 female, 44 male)	Pre-contemplation (47.7 ± 13.4) contemplation (45.3 ± 13) preparation (40.4 ± 13.9)	England, UK	NR	To overcome barriers to increasing fruit and vegetable intake
Power (Power et al., 2019)	2019	Cluster randomised control trial	174 Female	NR	USA	Fit Moms/Mamás Activas	Weight loss
Qin (Qin et al., 2023)	2023	Randomised control trial	90 Female	41.3 ± 14.4	USA	SNAP-Ed	Improve healthy decision making
Quintiliani (Quintiliani et al., 2021)	2021	Feasibility study	43 Female 7 male	46.0 ± 12.6	USA	CuesWeight	Weight/obesity management
Regnier (Régnier et al., 2018)	2018	Qualitative study	8 Female	42.8 ± 6.4	France	NutCracker	Providing cooking and nutritional advice
Ritten (Ritten et al., 2016)	2016	Pre-post study	12 Female 4 male	47 ± NR	USA	FLIP-FLOP (Fit living in progress, fighting lifelong obesity patterns)	Improve general healthy eating behaviours
Rivera (Rivera et al., 2016)	2016	Randomised control trial	262 Female 26 male	32.5 ± 11.5	USA	SNAP-Ed	Increase food security
Samuel-Hodge (Samuel-Hodge et al., 2020)	2020	Feasibility study	86 Female 19 male	61.9 ± 10.5	USA	Carolina Heart Alliance Networking for Greater Equity (CHANGE)	Reduce cardiovascular disease risk factors such as blood pressure and body weight
Samuel-Hodge (Samuel-Hodge et al., 2013)	2013	Pragmatic clinical trial	126 Female	50.8 ± 0.7	USA	Weight-Wise II	Weight loss
Sharma (Sharma et al., 2019)	2019	Quasi-experimental trial	635 Female 37 male	31.2 ± 6.9	USA	Coordinated Approach to Child Health Early Childhood (CATCH-EC)	Improve BMI scores, improve healthy eating and exercise retention
Srivastava (Srivastava et al., 2018)	2018	Pilot study	NA	Adults (33 ± NR) children (9 ± NR)	USA	Shape Up and Eat Right (SUPER)	Weight loss, improved eating behaviours and reduced sedentary activity
Steele (Steele et al., 2017)	2017	Retrospective analysis	1368 Female 561 male	48.6 ± 13.8	UK	Aintree LOSS	Weight management

(*Continued*)

Table 1. Continued.

First author (ref)	Year	Study design	Sex	Age (years) (mean ± SD)	Country of participation	Intervention name	Aim of intervention
Steptoe (Steptoe et al., 2004)	2004	Randomised control trial	64 Female 44 male	44.3 ± 14.4	England	NR	Increased fruit and vegetable consumption and increased self efficacy to eat healthier
Surkan (Surkan et al., 2012)	2012	Randomised control trial	203 Female	26.3 ± 6	USA	Just For You (JFY)	Reduce depressive symptoms
Tomayko (Tomayko et al., 2016)	2016	Community-based participatory research, randomised trial	Adults (145 female, 5 male) Children (70 female, 80 male)	Adult (32.3 ± 8.5) children (4.0 ± 0.9)	USA	Healthy children, strong families	Improvements in child and adult weight status, diet and exercise behaviours and self-efficacy
Tripicchio (Tripicchio et al., 2018)	2018	Intervention trial	Children (12 female, 34 male) adults (46 female, 0 male)	Adults (NR ± NR) children (9.6 ± 0.5)	USA	Healthy Hawks Primary Plus	Improved exercise and dietary behaviours
Trude (A. C. Trude et al., 2018)	2018	Randomised control trial	149 female 131 male	NR	USA	B'More Health Communities for Kids (BHCK)	Increased fruit and vegetable consumption and purchasing
Trude (A. C. B. Trude et al., 2018)	2018	Randomised control trial	Adults (188 female, 11 male) children (109 female, 90 male)	Adults (29.4 ± 9.1) children (11.7 ± 1.4)	USA	B'more Healthy Communities for Kids (BHCK)	Participation in obesity prevention activities and recall of exposure to materials
Weiss (Weiss et al., 2021)	2021	Pilot study	113 Female 23 male	NR	USA	Wellness Rising	Changes in dietary behaviour and health indicators
Wilcox (Wilcox et al., 2011)	2011	Randomised trial	80 Female	38.6 ± 7.2	USA	Sisters Taking Action for Real Success (STARS)	To reduce bodyweight and waist circumference
Winkleby (Winkleby et al., 1997)	1997	Randomised controlled cluster trial	207 Female 35 male	32.33 ± NR	USA	Stanford Nutrition Action Programme (SNAP)	Reducing dietary fat intake
Wrieden (Wrieden et al., 2007)	2007	Mixed methods programme evaluation	100 Females 13 males	32.3 ± 10.2	Scotland, UK	CookWell Programme	To increase cooking confidence and food preparation methods
Wright (Wright et al., 2013)	2013	Randomised control trial	Children (9 female, 15 male) adults (23 female, 1 male)	Children (10.9 ± 1.3) adults (40.3 ± 7.6)	USA	Healthy Eating and Activity Today (HEAT)	Reduced BMI
Yeh (Yeh et al., 2022)	2022	Pre-test post-test trial, quasi experimental study	Low exposure (3644 female, 995 male) high exposure (819 female, 228 male)	Low exposure (46.9 ± 14.1) high exposure (48.6 ± 14.1)	USA	Tu Salud ¡Si Cuenta!	Increase fruit and vegetable consumption and increase physical activity levels

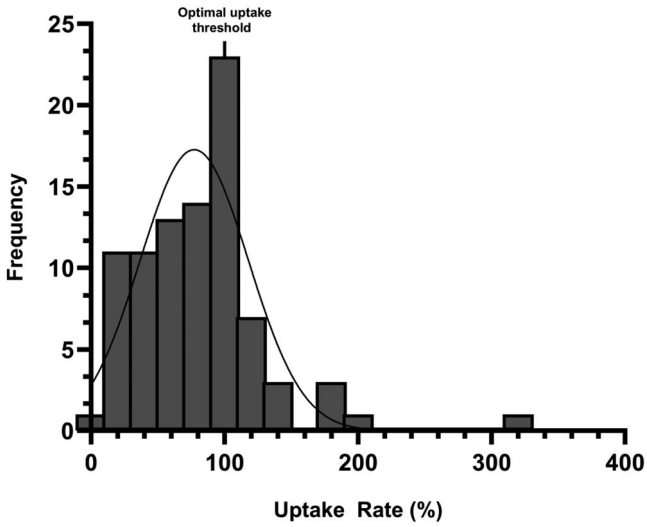

Figure 2. Distribution of uptake rate (%) of included records.

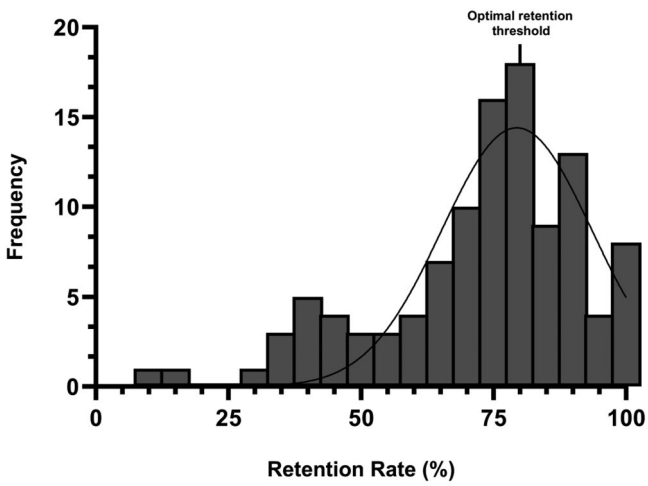

Figure 3. Distribution of retention rate (%) of included records.

Characteristics of optimal and suboptimal interventions

Tables 2–5 provide a summary of intervention characteristics within each classified group of interventions (high uptake, high retention, low uptake, low retention).

Venn diagram showcasing shared and differing characteristics of included interventions

An illustration of the shared and differing characteristics and delivery modes of the included interventions included is shown in Figure 4. This figure shows a Venn diagram summarising components from the BCIO and BCT taxonomy. Components highlighted in green appeared in over 75% of interventions. For instance, the BCT 4.1

Table 2. Summary of intervention characteristics of included interventions with high uptake.

First author (ref)	Year	Intervention name	Duration of intervention	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Buller	1999	5 a Day (peer intervention) programme	72		X	2	2	9
Izumi	2018	Community Supported Agriculture (CSA)	23	Weekly	X	3	2	12
Auslander	2002	Eat well, live well	16	Different components with different frequencies	X	3	3	7
Gilmore	2017	E-Moms	6	Weekly		3	3	10
Keyserling	2008	Enhanced WISEWOMAN project	52		X	4	4	9
Peerbhoy	2008	Family Fit	14			2	2	9
Martin	2012	Freshplace	52	Bi-weekly	X	3	2	6
Martin	2013	Freshplace	52	Bi-weekly	X	3	2	0
Joachim-Celestin	2022	Full Plate Living Lifestyle	8	Weekly	X	1	4	8
Dombrowski	2020	Game of Stones	52	Daily	X	2	5	14
McDonald	2020	Game of Stones	52	Daily	X	2	5	11
Bowling	2016	Healthy Foods, Healthy Families	17	Infrequently	X	4	2	11
Hayashi	2010	Hearts of the Family (a WISEWOMAN project)	25	Infrequently		2	2	8
Leahey	2018	Internet Behavioural Weight Loss Treatment with Incentives (IBWL+$)	12	Different components with different frequencies	X	3	1	7
Ambak	2018	My Body Fit and Fabulous (MyBFF@home)	24	Monthly		1	2	7
Zaki	2018	My Body Fit and Fabulous (MyBFF@home)	24	Monthly		1	2	9
Nitzke	2007	NR	52	Monthly		5	2	9
Noia	2019	NR	8	Weekly	X	2	2	9
Steptoe	2004	NR			X	2	3	4
Ackermann	2015	Reaching Out to Prevent Increases in Diabetes (RAPID)	52	Different components with different frequencies		5	1	9
Hopkins	2022	Simple Suppers	10	Weekly	X	4	4	9
Rivera	2016	SNAP-Ed	4	Weekly	X	2	2	3
Qin	2022	SNAP-Ed	4	Weekly	X	3	2	4
Kozica	2015	The Healthy Lifestyle Programme (HeLP-her)	52	Monthly		6	3	12
McRobbie	2019	Weight Action Programme (WAP)	8	Weekly	X	5	4	9
Samuel-Hodge	2013	Weight-Wise II	16	Weekly	X	4	3	12

'instruction on how to perform the behaviour' and weekly intervention sessions were common across all subcategories. However, BCT 5.1 'information about health consequences' was most frequent in interventions with high uptake and retention but also appeared in over half of lower interventions. This helped inform the following narrative syntheses.

Intervention setting

The environments in which participants were recruited were coded using the BCIO ontology for intervention settings (Marques et al., 2023; Norris et al., 2020). Identified settings included healthcare, research and various community facilities. In all four subcategories (high and low uptake and retention), community settings – such as local community centres and community hubs - were used in 50% or more of interventions, suggesting they are the preferred setting in this context. Healthcare settings were used in fewer than 50% of interventions. No specific settings were uniquely or predominantly linked to interventions with high uptake or retention. Interventions with higher retention employed a similar number of settings ($M = 1.5$) compared to those with lower retention ($M = 1.7$). However, interventions with higher uptake rates used, on average, more settings ($M = 2.7$) than those with lower uptake ($M = 1.5$).

Frequency and timing of intervention sessions

Across all four subcategories (high/low uptake and retention), over 75% of interventions implemented weekly sessions. The average intervention duration ranged from 24 to 33 wk. Interventions with higher rates of uptake and retention were, on average, shorter (28 wk in the high uptake group; 24 wk in the high retention group) than those with lower rates of uptake (30 wk) and retention (33 wk).

Mode of intervention delivery

Interventions were delivered through a range of modes across all subcategories, but more than 50% of interventions used in-person, face-to-face delivery (BCIO:011003). Group-based intervention delivery (BCIO:011057) was used in over 50% of the studies with higher retention but in fewer than 50% of the interventions with lower uptake and retention. Less frequently used modes of delivery included at-a-distance (BCIO:011004, interventions not delivered face-to-face), audio calls (BCIO:011022, interventions primarily delivered via phone call), printed publications (BCIO:011008, interventions delivered using printed materials such as posters, diaries etc.), individual-based (BCIO:011055, interventions where users are independent and do not take part in a group setting) and 'pull' interventions (BCIO:011063, where users are encouraged to seek their own information as opposed to being given information). None of the less frequently used modes of delivery were positively associated with uptake or retention, but many were included only in a single or small number of interventions.

Table 3. Summary of intervention characteristics of included interventions with high retention.

First author (ref)	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Buller (Buller et al., 1999)	1999	5 a day (peer intervention) programme	72	NR	X	2	1	9
Sharma (Sharma et al., 2019)	2019	Coordinated Approach to Child Health Early Childhood (CATCH-EC)	96	Different components with different frequencies		4	1	6
Quintiliani (Quintiliani et al., 2021)	2021	CuesWeight	12	Different components with different frequencies	X	6	1	7
Auslander (Auslander et al., 2002)	2002	Eat Well, Live Well	16	Different components with different frequencies	X	3	2	7
Gilmore (Gilmore et al., 2017)	2017	E-Moms	6	Weekly		3	2	10
Estrada Del Campo (Estrada Del Campo et al., 2019)	2019	EnForma (translates to 'in form')	7	Infrequently	X	4	2	5
Keyserling (Keyserling et al., 2008)	2008	Enhanced WISEWOMAN project	52		X	4	3	9
Peerbhoy (Peerbhoy et al., 2008)	2008	Family Fit	14			2	1	9
Martin(K. Martin et al., 2012)	2012	Freshplace	52	Bi-weekly	X	3	1	6
Wright (Wright et al., 2013)	2013	Healthy Eating and Activity Today (HEAT)	12	Weekly		4	2	5
Cason-Wilkerson (Cason-Wilkerson et al., 2015)	2015	Healthy Living Programme (HeLP)	12	Weekly	X	2	1	8
Buscemi (Buscemi et al., 2019)	2019	Hip-Hop to Health	6	Weekly	X	2	1	23
Leahey (Leahey et al., 2018)	2018	Internet Behavioural Weight Loss Treatment with Incentives (IBWL+$)	12	Different components with different frequencies	X	3	0	7
Koniak-Griffin (Koniak-Griffin et al., 2015)	2015	Mujeres Sanas y Precavidas (Healthy Women Prepared for Life)	24	Different components with different frequencies	X	4	1	5
Ambak (Ambak et al., 2018)	2018	My Body Fit and Fabulous (MyBFF@home)	24	Monthly		1	2	7
Bihan (Bihan et al., 2012)	2012	NR	2	Weekly		2	1	4
Loopstra (Loopstra & Tarasuk, 2013)	2013	NR				5	2	3
Neter (Neter et al., 2020)	2020	NR	12	One off session	X	5	2	3

(*Continued*)

Table 3. Continued.

First author (ref)	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Steptoe (Steptoe et al., 2004)	2004	NR			X	2	2	4
Ko (Ko et al., 2016)	2016	Nuestras Comidas	8	Bi-weekly	X	2	1	13
Nollen (Nollen et al., 2008)	2008	Pathways to Health	8	Infrequently	X	5	0	23
Hochsmann (Höchsmann et al., 2021)	2021	Promoting Successful Weight Loss in Primary Care in Louisiana (PROPEL)	104	Different components with different frequencies		4	1	4
Hossain (Hossain et al., 2015)	2015	Red Apple Healthy Lifestyles Programme (RAHLP)				3	1	11
Eakin (Eakin et al., 2007)	2007	Resources for Health	24	Infrequently		4	1	1
Hopkins (Hopkins et al., 2022)	2022	Simple Suppers	10	Weekly	X	4	3	9
Kerver (Kerver et al., 2022)	2022	Simply Dinner	8	Infrequently		3	3	8
Wilcox (Wilcox et al., 2011)	2011	Sisters Taking Action for Real Success (STARS)	28	Weekly	X	4	2	20
Lawton (Lawton et al., 2022)	2022	SNAP-Ed (Adapted from Sesame Street's Food for Thought: Eating well on a budget)	3	Daily	X	5	1	4
Winkleby (Winkleby et al., 1997)	1997	Stanford Nutrition Action Programme (SNAP)	6	Weekly		5	1	6
Yeh (Yeh et al., 2022)	2022	Tu Salud ¡Si Cuenta!	9			3	1	3
Jacobs (Jacobs et al., 2004)	2004	WISEWOMAN (weight maintenance)	52	Bi-monthly		3	1	5
Gans (Gans et al., 2009)	2009	Your Healthy Life/Su Vida Saludable (YHL-SVS)	13	Monthly	X	3	3	8
Grutzmacher (Grutzmacher et al., 2019)	2019	Text2BHealthy	36	Weekly		3	1	7

Table 4. Summary of intervention characteristics of included interventions with low uptake.

First author	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Steele	2017	Aintree LOSS	288	Different components with different frequencies		2	1	9
Trude	2019	B'More Health Communities for Kids (BHCK)	24		X	8	2	7
Trude	2018	B'more Healthy Communities for Kids (BHCK)	28	Different components with different frequencies		5	1	4
Samuel-Hodge	2020	Carolina Heart Alliance Networking for Greater Equity (CHANGE)	16	Monthly		5	4	3
Sharma	2019	Coordinated Approach to Child Health Early Childhood (CATCH-EC)	96	Different components with different frequencies		4	1	6
Quintiliani	2021	CuesWeight	12	Different components with different frequencies	X	6	1	7
Nakamura	2017	Diet and Exercise Practices Project	5	Weekly	X	2	1	10
Cohen	2017	Double Up Food Bucks (DUFB)	20	Monthly	X	2	1	9
Estrada Del Campo	2019	EnForma (translates to 'in form')	7	Infrequently	X	4	2	5
Chatterjee	2018	Feastworthy	12	Weekly		2	2	1
Buscail	2018	Fruits et légumes à la maison (FLAM)	52	Monthly		2	2	7
Evans	2022	Healthy Beginnings SMS Intervention	12	Weekly	X	3	1	11
Griffin	2019	Healthy Dads, Healthy Kids	9	Weekly		2	2	4
Wright	2013	Healthy Eating and Activity Today (HEAT)	12	Weekly		4	2	5
Cason-Wilkerson	2015	Healthy Living Programme (HeLP)	12	Weekly	X	2	1	8
Parra-Medina	2011	Heart Healthy and Ethnically Relevant Lifestyle Trial (HHER Lifestyle)	52		X	3	2	8
Buscemi	2019	Hip-Hop to Health	6	Weekly	X	2	1	23
Coleman	2010	Horton Hawks Stay Healthy (HHSH)	10	Weekly	X	4	3	3
Cavallo	2016	InShape	20	Different components with different frequencies	X	4	1	9
Cavallo	2021	INSHAPE CLE	12	Daily	X	3	2	15
Surkan	2012	Just For You (JFY)	52	Infrequently		4	1	11
Lipton-Inga	2022	Kids n Fitness (KNF) and Kids n Fitness Junior (KNF-JR)	6	Weekly	X	2	3	14
Gans	2018	Live Well, Viva Bien	52	Bi-weekly	X	3	2	12
Bukman	2017	MetSLIM	52	Infrequently		4	2	0

(*Continued*)

Table 4. Continued.

First author	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Ordway	2018	Minding the Baby (MTB)	104	Weekly		4	2	2
Nicholson	2011	MOMS (Making our Mealtimes Special)			X	1	2	2
Koniak-Griffin	2015	Mujeres Sanas y Precavidas (Healthy Women Prepared for Life)	24	Different components with different frequencies	X	4	1	5
Kassim	2017	My Body is Fit and Fabulous at home (MyBFF@home)	24	Infrequently		4	2	11
Ferreira	2014	NR				2	2	7
Basu	2019	NR	8	Weekly		2	1	14
Bihan	2012	NR	2	Weekly		2	1	4
Cheyne	2020	NR	24	Infrequently	X	2	1	6
Klohe-Lehman	2007	NR	24	Monthly	X	0	1	14
Loopstra	2013	NR				5	2	3
Neter	2020	NR	12	One off session	X	5	2	3
Neuenschw	2013	NR	52	Weekly	X	2	2	2
Ko	2016	Nuestras Comidas	8	Bi-weekly	X	2	1	13
Regnier	2018	NutCracker				2	1	5
Perign	2017	Opticourses	12	Bi-weekly	X	3	2	11
O'Conr	2020	Papás Saludables Niños Saludables	10	Weekly	X	5	2	10
Ahluwalia	2007	Pathways to Health	24	Infrequently	X	2	0	17
Ilen	2008	Pathways to Health	8	Infrequently	X	5	0	23
Hochsmann	2021	Promoting Successful Weight Loss in Primary Care in Louisiana (PROPEL)	104	Different components with different frequencies		4	1	4
Hossain	2015	Red Apple Healthy Lifestyles Programme (RAHLP)		-		3	1	11
Eakin	2007	Resources for Health	24	Infrequently		4	1	1
Srivastava	2018	Shape Up and Eat Right (SUPER)	52	Monthly	X	3	1	6
Kerver	2022	Simply Dinner	8	Infrequently		3	3	8
Wilcox	2011	Sisters Taking Action for Real Success (STARS)	28	Weekly	X	4	2	20
Lawton	2022	SNAP-Ed (Adapted from Sesame Street's Food for Thought: Eating well on a budget)	3	Daily	X	5	1	4

(*Continued*)

Table 4. Continued.

First author	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Winkleby	1997	Stanford Nutrition Action Programme (SNAP)	6	Weekly		5	1	6
Yeh	2022	Tu Salud ¡Si Cuenta!	9			3	1	3
Leone	2018	Veggie Van (VV)	24	Weekly		5	1	5
Foster	2022	We Can!	24	Different components with different frequencies	X	3	1	3
Craigie	2011	Weigh Well	12	Monthly		4	3	0
Havas	2000	WIC 5-a-day Promotion	24	Infrequently	X	4	1	17
Jacobs	2004	WISEWOMAN (weight maintenance)	52	Bi-monthly		3	1	5
Johnson	2019	WISEWOMAN (Weight Watchers and Curves Complete)	12	Weekly	X	0	1	9
Gans	2009	Your Healthy Life/Su Vida Saludable (YHL-SVS)	13	Monthly	X	3	3	8

Table 5. Summary of intervention characteristics of included interventions with low retention.

First author (ref)	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Steele	2017	Aintree LOSS	288	Different components with different frequencies		2	1	9
Trude	2019	B'More Health Communities for Kids (BHCK)	24		X	8	2	7
Trude	2018	B'more Healthy Communities for Kids (BHCK)	28	Different components with different frequencies		5	1	4
Samuel-Hodge	2020	Carolina Heart Alliance Networking for Greater Equity (CHANGE)	16	Monthly		5	4	3
Izumi	2018	Community Supported Agriculture (CSA)	23	Weekly	X	3	1	12
Nakamura	2017	Diet and Exercise Practices Project	5	Weekly	X	2	1	10
Cohen	2017	Double Up Food Bucks (DUFB)	20	Monthly	X	2	1	9
Chatterjee	2018	Feastworthy	12	Weekly		2	2	1
Martin	2013	Freshplace	52	Bi-weekly	X	3	1	0
Buscail	2018	Fruits et légumes à la maison (FLAM)	52	Monthly		2	2	7
Joachim-Celestin	2022	Full Plate Living Lifestyle	8	Weekly	X	1	3	8
Dombrowski	2020	Game of Stones	52	Daily	X	2	4	14
McDonald	2020	Game of Stones	52	Daily	X	2	4	11
Evans	2022	Healthy Beginnings SMS Intervention	12	Weekly	X	3	1	11
Griffin	2019	Healthy Dads, Healthy Kids	9	Weekly		2	2	4
Bowling	2016	Healthy Foods, Healthy Families	17	Infrequently	X	4	1	11
Parra-Medina	2011	Heart Healthy and Ethnically Relevant Lifestyle Trial (HHER Lifestyle)	52		X	3	2	8
Hayashi	2010	Hearts of the Family (a WISEWOMAN project)	25	Infrequently		2	1	8
Coleman	2010	Horton Hawks Stay Healthy (HHSH)	10	Weekly	X	4	3	3
Cavallo	2016	InShape	20	Different components with different frequencies	X	4	1	9
Cavallo	2021	INSHAPE CLE	12	Daily	X	3	2	15
Surkan	2012	Just For You (JFY)	52	Infrequently		4	1	11
Lipton-Inga	2022	Kids n Fitness (KNF) and Kids n Fitness Junior (KNF-JR)	6	Weekly	X	2	3	14
Gans	2018	Live Well, Viva Bien	52	Bi-weekly	X	3	2	12
Bukman	2017	MetSLIM	52	Infrequently		4	2	0
Ordway	2018	Minding the Baby (MTB)	104	Weekly		4	2	2
Nicholson	2011	MOMS (Making our Mealtimes Special)			X	1	2	2
Zaki	2018	My Body Fit and Fabulous (MyBFF@home)	24	Monthly		1	2	9
Kassim	2017	My Body is Fit and Fabulous at home (MyBFF@home)	24	Infrequently		4	2	11
Ferreira	2014	NR				2	2	7
Basu	2019	NR	8	Weekly		2	1	14
Cheyne	2020	NR	24	Infrequently	X	2	1	6
Klohe-Lehman	2007	NR	24	Monthly	X	0	1	14

(*Continued*)

Table 5. Continued.

First author (ref)	Year	Intervention name	Duration of intervention (weeks)	Timing/Frequency	Incentive identified?	Number of modes of delivery implemented	Number of recruitment settings utilised	Number of behaviour change technique's identified in intervention
Neuenschw	2013	NR	52	Weekly	X	2	2	2
Nitzke	2007	NR	52	Monthly		5	2	9
Noia	2019	NR	8	Weekly	X	2	1	9
Regnier	2018	NutCracker				2	1	5
Perign	2017	Opticourses	12	Bi-weekly	X	3	2	11
O'Conr	2020	Papás Saludables Niños Saludables	10	Weekly	X	5	2	10
Ahluwalia	2007	Pathways to Health	24	Infrequently	X	2	0	17
Ackermann	2015	Reaching Out to Prevent Increases in Diabetes (RAPID)	52	Different components with different frequencies		5	1	9
Srivastava	2018	Shape Up and Eat Right (SUPER)	52	Monthly	X	3	1	6
Rivera	2016	SNAP-Ed	4	Weekly	X	2	1	3
Qin	2022	SNAP-Ed	4	Weekly	X	3	1	4
Kozica	2015	The Healthy Lifestyle Programme (HeLP-her)	52	Monthly		6	2	12
Leone	2018	Veggie Van (VV)	24	Weekly		5	1	5
Foster	2022	We Can!	24	Different components with different frequencies	X	3	1	3
Craigie	2011	Weigh Well	12	Monthly		4	3	0
McRobbie	2019	Weight Action Programme (WAP)	8	Weekly	X	5	3	9
Samuel-Hodge	2013	Weight-Wise II	16	Weekly	X	4	2	12
Havas	2000	WIC 5-a-day Promotion	24	Infrequently	X	4	1	17
Johnson	2019	WISEWOMAN (Weight Watchers and Curves Complete)	12	Weekly	X	0	1	8

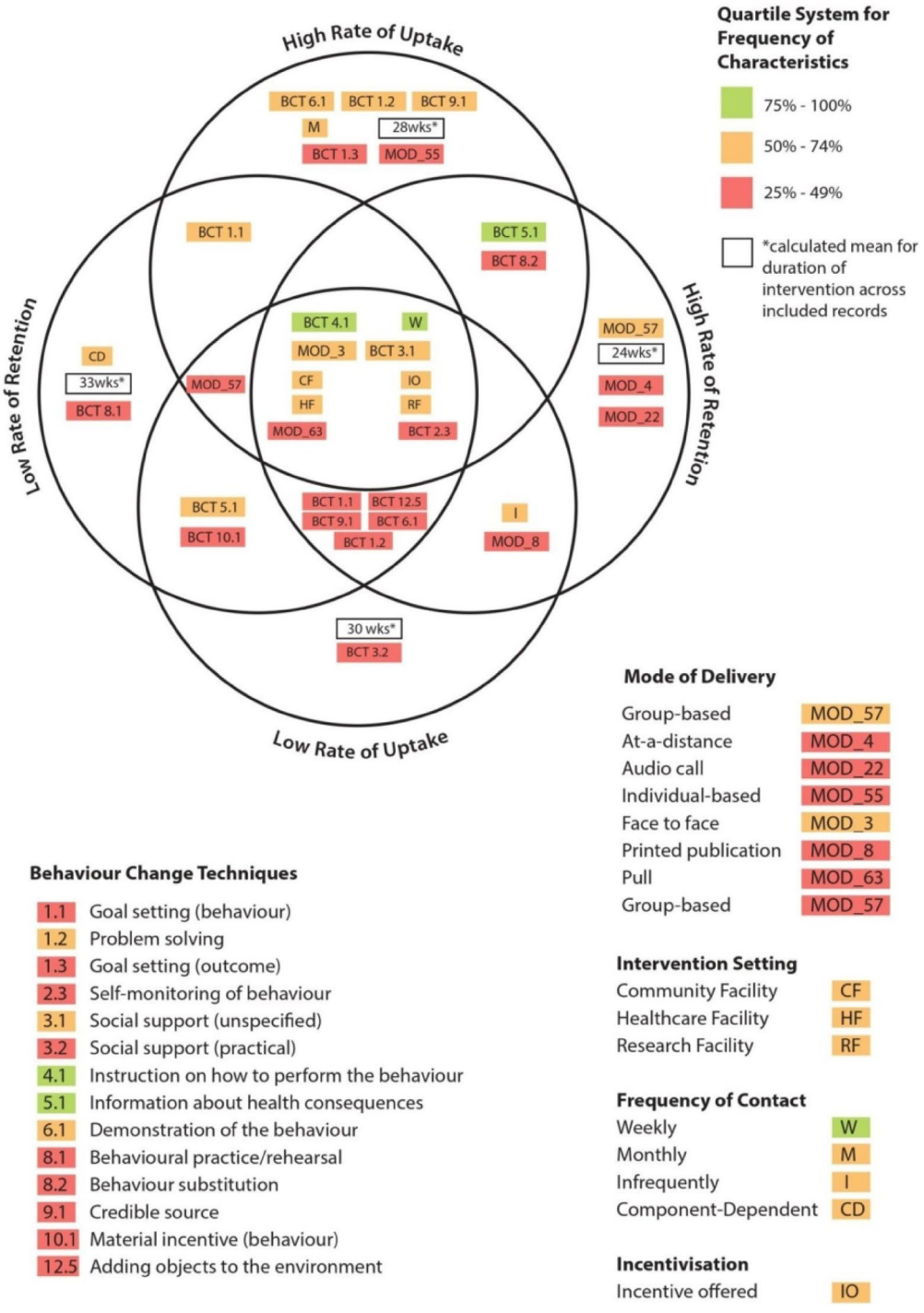

Figure 4. Venn diagram showcasing shared and differing characteristics of included interventions techniques and mode(s) of delivery.

Behaviour change content of interventions

Interventions were coded for behaviour change techniques using the BCT Taxonomy (Michie et al., 2013). *Giving instructions on how to perform the behaviour* (BCT 4.1) was identified in over 75% of the interventions across all four subcategories. Other frequently identified BCTs, appearing in 50–75% of interventions regardless of group, included *unspecified social support* (BCT 3.1), *goal setting for behaviours* (BCT 1.1) and *problem-solving* (BCT 1.2).

Providing information about health consequences (of engaging with the target behaviour) (BCT 5.1) appeared in over 75% of the interventions with high uptake and high retention, indicating this may be a useful component for encouraging and maintaining participation. Similarly, around 50% of interventions with higher uptake and retention utilised *behaviour substitution* (BCT 8.2) a technique where participants are encouraged to replace an unhealthy behaviour with a healthier substitute. Vote counting tables illustrating the BCTs identified in interventions with higher uptake and retention are shown in Tables 6 and 7.

Reported barriers and facilitators to uptake and retention

The thematic analysis of barriers and facilitators to uptake and retention, as described by the study authors, identified three themes. This analysis is based on all 114 records.

Theme 1: logistical and financial challenges

Logistical issues such as lack of reliable transportation, scheduling conflicts, and financial constraints were frequently described as hindering participants from actively participating in and engaging with interventions. Regardless of their motivation to attend, participants were often restricted by the timing or location of the interventions. Factors like having a low income, job changes and competing life stressors were also described as contributing to a challenging environment for intervention engagement. Participants generally were restricted by the 'lifestyle burden' of living with low SES, for example, experiencing stress associated with food insecurity or having to work multiple jobs or extended hours. These stressors were exacerbated by additional challenges, such as finding affordable childcare during intervention sessions and the cost of travelling to interventions, such as the cost of a bus ticket.

Several types of practical support were identified as facilitating engagement. These included interventions that provide financial support to offset costs, provide logistical support to attend, and enhance accessibility by ensuring sessions are held in a location accessible by public transport. Interventions were more likely to retain participants when they actively addressed these barriers, providing practical support that made participation easier and more accessible.

Theme 2: motivating individuals and communities; social support and goal setting

Challenges such as lack of personal motivation, family resistance to dietary changes, and social norms were described as negatively impacting participants' willingness to

Table 6. Vote counting table of the BCT's used in interventions with high uptake.

Study characteristics		Behaviour change techniques																																						
First author	Year	BCT_1.1	BCT_1.2	BCT_1.3	BCT_1.4	BCT_1.5	BCT_2.1	BCT_2.2	BCT_2.3	BCT_2.4	BCT_2.5	BCT_2.7	BCT_3.1	BCT_3.2	BCT_3.3	BCT_4.1	BCT_4.2	BCT_4.4	BCT_5.1	BCT_5.3	BCT_5.6	BCT_6.1	BCT_6.2	BCT_7.1	BCT_8.1	BCT_8.2	BCT_8.7	BCT_9.1	BCT_10.1	BCT_10.2	BCT_10.3	BCT_10.6	BCT_11.2	BCT_11.3	BCT_12.1	BCT_12.3	BCT_12.5	BCT_15.1	BCT_15.3
Buller	1999								X				X	X		X										X	X							X	X	X			
Izumi	2018	X	X				X		X				X			X	X		X			X			X								X	X					
Auslander	2002														X	X	X		X	X	X							X											
Gilmore	2017	X														X			X					X	X			X	X			X			X		X		
Keyserling	2008	X	X	X		X							X			X			X			X			X														
Peerbhoy	2008	X														X			X			X			X	X			X						X		X		
Martin	2012		X													X			X			X				X		X											
Martin	2013																																						
Joachim-Celestin	2022	X	X										X			X			X									X		X	X								
Dombrowski	2020	X		X	X		X		X				X			X			X			X			X			X	X	X							X		
McDonald	2020											X	X	X		X	X		X			X			X			X	X								X		
Bowling	2016	X		X					X							X			X			X			X			X		X			X	X					
Hayashi	2010	X	X	X	X								X		X	X								X															
Leahey	2018		X	X					X							X			X									X					X						
Ambak	2018	X	X	X									X			X			X									X											
Zaki	2018							X					X	X		X		X	X	X						X		X											
Nitzke	2007	X	X										X			X			X			X			X	X		X											
Noia	2019	X	X	X		X		X					X		X	X			X																				
Steptoe	2004								X							X			X							X													
Ackermann	2015		X										X			X			X		X	X			X				X			X							
Hopkins	2022		X								X	X	X			X			X			X			X			X											
Rivera	2016																												X							X	X		
Qin	2022	X														X			X			X																	
Kozica	2015	X	X						X		X		X			X			X		X	X			X			X										X	
McRobbie	2019	X	X			X		X	X				X			X			X																				X
Samuel-Hodge	2013	X			X			X	X	X			X			X			X			X	X			X											X		

Table 7. Vote counting table of the BCT's used in interventions with low retention.

Study characteristics		Behaviour change techniques																																																				
First author	Year	BCT_1.1	BCT_1.2	BCT_1.3	BCT_1.4	BCT_1.5	BCT_1.6	BCT_1.7	BCT_1.8	BCT_2.1	BCT_2.2	BCT_2.3	BCT_2.4	BCT_2.5	BCT_2.7	BCT_3.1	BCT_3.2	BCT_3.3	BCT_4.1	BCT_4.2	BCT_5.1	BCT_5.3	BCT_5.6	BCT_6.1	BCT_7.1	BCT_7.5	BCT_8.1	BCT_8.2	BCT_8.3	BCT_8.7	BCT_9.1	BCT_9.2	BCT_9.3	BCT_10.1	BCT_10.3	BCT_10.4	BCT_10.6	BCT_10.8	BCT_10.10	BCT_11.2	BCT_11.3	BCT_12.1	BCT_12.2	BCT_12.3	BCT_12.4	BCT_12.5	BCT_13.1	BCT_13.2	BCT_13.4	BCT_14.3	BCT_15.1	BCT_15.3	BCT_16.3
Buller	1999											X				X	X		X									X		X											X	X		X									
Sharma	2019		X													X	X		X		X											X																						
Quintiliani	2021															X			X		X			X			X							X												X								
Auslander	2002																	X	X	X	X	X	X								X																						
Gilmore	2017	X																	X		X				X		X				X			X			X						X				X						
Estrada Del Campo	2019	X															X		X		X				X																												
Keyserling	2008	X	X	X		X										X			X		X			X			X																										
Peerbhoy	2008	X																	X		X			X			X	X						X								X				X							
Martin	2012		X																X		X			X				X			X																						
Wright	2013															X			X					X							X													X										
Cason-Wilkerson	2015															X			X		X			X		X	X														X					X							
Buscemi	2019	X	X		X	X		X			X	X			X	X	X	X	X			X	X				X	X		X	X			X						X						X	X	X				
Leahey	2018		X	X								X							X		X										X									X													
Koniak-Griffin	2015		X																X		X													X												X							
Ambak	2018	X	X	X												X			X		X										X																						
Bihan	2012											X				X			X		X																																
Loopstra	2013															X																		X												X							
Neter	2020																		X		X																													X		
Steptoe	2004											X							X		X							X																								
Ko	2016		X															X	X		X	X	X					X					X	X	X											X			X		X		
Nollen	2008	X	X			X			X	X	X	X	X			X	X	X	X	X	X							X								X	X					X	X	X	X		X						X
Hochsmann	2021	X														X			X		X																																
Hossain	2015											X	X		X				X		X			X	X													X	X											X		X
Eakin	2007																																	X																			
Hopkins	2022		X											X	X	X			X		X			X			X				X																						
Kerver	2022																		X		X			X			X	X	X												X									X		
Wilcox	2011	X	X	X	X	X	X				X	X	X			X			X	X	X	X	X				X			X						X												X			X	
Lawton	2022						X			X																					X	X																					
Winkleby	1997		X																X		X			X							X										X												
Yeh	2022																X		X																						X												
Jacobs	2004															X			X		X			X																						X							
Gans	2009	X	X													X			X		X										X					X						X												
Eakin	2007																																	X																			
Hopkins	2022		X											X	X	X			X		X			X			X				X																						
Kerver	2022																		X		X			X			X	X	X												X									X		
Wilcox	2011	X	X	X	X	X	X				X	X	X			X			X	X	X	X	X				X			X						X												X			X	
Lawton	2022						X			X																					X	X																					
Winkleby	1997		X																X		X			X							X										X												
Yeh	2022																X		X																						X												
Jacobs	2004															X			X		X			X																						X							
Gans	2009	X	X													X			X		X										X					X						X												
Eakin	2007																																	X																			
Hopkins	2022		X											X	X	X			X		X			X			X				X																						
Kerver	2022																		X		X			X			X	X	X												X									X		
Wilcox	2011	X	X	X	X	X	X				X	X	X			X			X	X	X	X	X				X			X						X												X			X	

engage in healthy eating interventions. Participants in included studies reported, for example, that their families were resistant to change, and this consequently limited their motivation to participate. Tailoring interventions to participants' specific needs, preferences, and cultural backgrounds - such as including bilingual content, culturally adapted programs, and personalised approaches - was described as a key facilitator of engagement. Additionally, motivational messaging, goal-setting practices, and positive reinforcement from setting and achieving health goals were all identified as helpful strategies. Social factors, including social connections, community engagement, and peer support were described as facilitating engagement in healthy eating interventions. The role of group dynamics, shared knowledge, and supportive networks was also emphasised, with participants being described as more likely to engage with interventions when they had the support of others.

Theme 3: environmental and systemic obstacles

Factors like the ready availability of fast food in the surrounding environment, inconvenient shop hours, and challenges relating to the fidelity of the intervention (i.e. whether providers adhered to the protocols and design of the programme) contributed to lower program uptake. In some cases, interventions offered discounts for markets with unsuitable operating times for participants, limiting their uptake, whereas fast food was described by some participants as more readily available and an easier option.

Case study of optimal interventions

Two interventions (Leahey et al., 2018; Peerbhoy et al., 2008) were identified as having optimal uptake (100%+) and optimal retention (100%). Interventions recruiting above their targets could obtain an uptake score above 100%. The features of these interventions are fully summarised in Table 8. In terms of shared characteristics both interventions were relatively short in duration (12 and 14 wk) compared to the other interventions reviewed, which had an average duration of 24–33 wk. Both interventions used BCT 4.1 (*instruction on how to perform the behaviour*) and BCT 5.1 (*information about health consequences*) reflecting the fact that they provided participants with the information needed to perform a specific behaviour such as consuming more fruit and vegetables or cooking healthier meals. They also both gave participants explicit information about the possible health outcomes associated with maintaining their current health behaviour. However, it is important to acknowledge that there is some overlap between the characteristics of the most and least optimal interventions, as identified in Figure 4. For example, the optimal interventions both include self-monitoring which is also a predominant characteristic of suboptimal interventions.

Standard quality assessment

The mean quality score (maximum score of 1) of all included records was 0.77, ranging from 0.39 to 0.96. The median quality score was 0.79, indicating that the quality scores are evenly distributed. Most studies (69%, 79/114) received a quality score

Table 8. Case study of interventions with optimal uptake and retention (100%).

	Leahey et al. (2018)	Peerbhoy et al. (2008)
Participants	61 Lower income females, aged 18–70 (M: 39.7, SD: 11.5) from the USA who are identified as at risk or already living with obesity.	34 UK families consisting of a total of 90 participants, with 48 adults and 42 young people
Intervention name	Internet Behavioural Weight Loss Treatment with Incentives (IBWL+$)	Family Fit
Intervention description	Participants attended a single group visit at the start of the 3-month intervention where they set weight, diet and exercise goals and were taught self-monitoring skills. A weight loss goal was prescribed each week, with the aim of losing 5–10% of their bodyweight throughout the intervention. Calorie goals depended on baseline weight and exercise goals increased from 50 minutes per week to 250 minutes per week gradually throughout the intervention. At the end of the visit, participants were introduced to the intervention website (accessible from a desktop or tablet). The intervention website included weekly lessons with information on reducing calories, increasing activity and behaviour change (e.g., goal setting).	The programme was developed with the aim to be a holistic lifestyle intervention targeting both diet and exercise. Exercise programmes were prescribed, and guidance was provided on increasing habitual exercise levels. For diet, guidance was provided on how to improve nutritional intake. The programme aimed to involve entire families with the hope that all members of a family could be supportive in promoting healthier lifestyles. Activities included: • Diet and exercise advice and plans provided by Family Fit officer • Group/family activities such as walking • Self monitoring with pedometers
Uptake	The researchers exceeded their sample size goal of 58 by recruiting 61 participants, with an uptake rate of 105%.	They recruited 34 families out of the 34 targeted with an uptake rate of 100%.
Retention	The researchers retained all 61 of their participants, with a retention rate of 100%.	– All 34 families completed the study, so the retention rate of this study was 100%.
Mode(s) of recruitment	Advertisements through employers and media outlets were used to recruit potential participants.	Participants were recruited via primary health care professionals, who provided information about the study and invited them to provide consent
Frequency of contact and duration	12 Weeks with different components offered at different frequencies.	Over 14 weeks, with an unspecified frequency of contact.
Mode(s) of delivery	Group visit with goal setting and self-monitoring skills followed by ~12 weekly online lessons accessed through an intervention website which incorporated self-monitoring. Incentives offered for both engaging and for losing weight.	Exercise programmes were prescribed, and guidance was provided on increasing habitual exercise levels. For diet, guidance was provided on how to improve nutritional intake. Activities included diet and exercise advice and plans provided by Family Fit officer, group/family activities such as walking and self-monitoring with pedometers.
Incentive offered?	– Every time a women submitted ≥5 days of self-monitoring information into the website, they received a small incentive which ranged from $1 – $10. A total of $45 could be earned. Those who lost 5–10% or >10% of their bodyweight or more were entered into a $50 or $100 raffle, respectively.	None
Behaviour change techniques	2.3 (Self-monitoring of behaviour), 4.1 (instruction on how to perform the behaviour), 5.1 (information about health consequences), 9.1 (credible source), 11.2 (reduce negative emotions).	4.1 (instruction on how to perform the behaviour), 5.1 (information about health consequences) 6.1 (demonstration of the behaviour), 8.1 (behavioural practice/rehearsal), 8.2 (behaviour substitution), 10.1 (material incentive, behaviour), 12.1 (restructuring the physical environment), 12.5 (adding objects to the environment).
Barriers	None reported.	Lack of participant self-confidence and self-motivation to engage with prescribed elements, lack of time available to attend, shift working, lack of education, perceived lack of baseline fitness, seasonality (winter), availability of fast food in the local area inhibits healthy eating.
Facilitators	Financial incentives offered.	Engagement of allied health workers, an ethos of family support, focused time with participants initially, being flexible when supporting families, collective support (whole family), awareness of whole family's health status at baseline.

above 0.75, indicating good quality (34) and few (3%, 4/114) received a quality score below 0.5, indicating medium quality. Common factors which limited quality scores were related to inadequate reporting of sampling strategy and data collection methods.

Discussion

Community interventions have the potential to improve dietary behaviours in low SES groups (Everson-Hock et al., 2013; Hagger et al., 2020; Hagger & Weed, 2019; Maugeri et al., 2021; Pirotta et al., 2019), but this depends on successfully attracting and retaining participants. This review aimed to quantify uptake and retention rates in community-based dietary interventions targeting low SES individuals and to identify key intervention characteristics, barriers, and facilitators influencing these outcomes. Our findings indicate that while uptake and retention in low SES groups are moderate, they vary widely and are often suboptimal. Most interventions reported retention rates below the 80% threshold typically required for study validity (Crombie et al., 2018; Fewtrell et al., 2008; Schulz & Grimes, 2002). This aligns with previous research showing that uptake and retention vary widely across diet and weight focused interventions (Gidlow et al., 2018) and that retention is often suboptimal in low SES populations (Birch et al., 2022; Pirotta et al., 2019).

This review also highlights key differences between interventions with high and low levels of uptake and retention. Interventions with higher retention rates were generally shorter in duration, suggesting that less intensive interventions may be more feasible and appealing for low SES participants. However, it is important to recognise that while shorter programmes may be associated with better retention, they may not provide sufficient exposure to intervention content to drive meaningful behaviour change (Franks et al., 2012). This points to a potential trade-off, where shorter interventions may keep participants engaged but could limit their long-term effectiveness. As interventions can only be truly effective if they deliver adequate levels of active content and are successful in attracting and retaining their target population, it is likely that any intervention duration must be long enough to ensure essential content is delivered but short enough to ensure participants do not drop out. Our findings suggest that a 24–26 week intervention (based on the average duration of the optimal interventions) may be the optimum duration for recruiting and retaining participants, as well as achieving meaningful outcomes. However, this would need to be evaluated in future research. The findings also indicate that interventions using multiple recruitment settings were more likely to report higher uptake. This observation, however, is inconsistent with previous literature; Gidlow et al. (2018) found no relationship between the number of recruitment methods used and uptake rates in weight management interventions within the general public. It is possible, however, that lower SES individuals benefit from greater exposure to multiple recruitment pathways, such as word of mouth and seeing flyers in their local community centres, as they may have fewer opportunities to encounter information about research studies in their daily lives. Additionally, group-based interventions were more frequently observed among those with better retention, suggesting that social support may play a role in sustaining participation. Borek et al. (2018) found that group-based dietary and physical activity interventions were associated with greater engagement

and clinically meaningful weight loss. While our review does not establish causal relationships, these findings suggest that future interventions for low SES populations may benefit from multiple recruitment sources, shorter programme durations (where duration is sufficient to deliver adequate content), and a group-based approach to enhance uptake and retention.

In terms of intervention content, both high and low uptake and retention interventions employed a similar number of behaviour change techniques (BCTs). However, one technique—providing information about the health consequences of a target behaviour (e.g. highlighting how consuming certain foods can lead to poor health outcomes)—was notably more common in interventions with higher uptake and retention. Implementation of this BCT is designed to change participants' behaviour by increasing knowledge and beliefs about the consequences of changing (or not changing) behaviour to strengthen intentions (Ajzen, 1991) and/or increasing perceived susceptibility or vulnerability to poor health outcomes (Carey et al., 2019; Johnston et al., 2021; Rosenstock, 1974). Analysis of data from 122 healthy eating and physical activity interventions revealed that interventions which combined information about the links between behaviour and health with information about the consequences of acting [or not], along with follow-up prompts, were the most effective in bringing about change (Dusseldorp et al., 2014). It is possible that the effectiveness of such interventions is enhanced because these BCTs help retain participants long enough to ensure adequate exposure to active content. 'Information about health consequences' is a BCT that has been found to be less frequently included in diet and activity interventions aimed at weight management, but when included, appears exclusively in interventions with higher rates of retention (Gidlow et al., 2018), suggesting that it may aid continued participation. It has also been identified as a key BCT for engaging and promoting behaviour change within interventions in broader contexts such as diabetes care (Presseau et al., 2015) and chronic condition management (Lin et al., 2022). This suggests that while providing information about health consequences may be an effective strategy for engagement and retention, its impact likely depends on how it is integrated within the intervention. The presence of behaviour change techniques in all interventions such as self-monitoring, for example, could hinge on the presence of complementary elements like goal setting, feedback, or social support. When implemented with additional guidance and support these techniques may enhance participant uptake and retention. Conversely, in the absence of social support or in the presence of external challenges—such as competing life priorities or socioeconomic barriers—their effectiveness may be limited. This highlights the importance of not only selecting effective BCTs but also ensuring that interventions are designed and delivered in ways that align with participants' needs and contexts.

Thematic analysis of potential barriers and facilitators of uptake and retention in this review identified overlapping socioeconomic and logistical factors as key barriers for low SES populations. Logistical barriers included travelling to interventions due to financial constraints and coordinating childcare which in itself presents complex challenges related to cost, sourcing reliable providers and scheduling. This aligns closely with existing literature highlighting that pragmatic, logistical challenges relating

to the cost of participation, such as childcare or transport negatively impact participation (Ligthart et al., 2017). The thematic analysis also suggested that factors such as social and practical support act as facilitators to uptake and retention by counteracting barriers identified. Overall, the barriers and facilitators identified appeared to operate by influencing participants' perceived ability or opportunity to participate (e.g. where timing and location made it difficult to schedule attendance vs. flexible scheduling was offered) or by influencing motivation to participate (e.g. through family resistance to change vs social support and encouragement from others). These findings align with the Capability Opportunity Motivation-Behaviour (COM-B) (Barker et al., 2016) framework which proposes that in order to engage with a target action, people need to want to do it (motivation), feel able to do it (capability) and have feasible opportunities to do it (opportunity). In future research, the COM-B framework could be used to further explore the relative importance of different aspects of capability, opportunity and motivation for uptake and retention in this population.

Strengths and limitations

The present study is the first to our knowledge to synthesise the existing evidence on uptake and retention in community-based dietary interventions targeting low SES individuals. With an escalating cost of living crisis disproportionately affecting the food choices and dietary patterns of low SES individuals (Townsend, 2006; Vazquez & Cubbin, 2020), it is increasingly important that interventions are optimised in ways that make them more attractive to, and more feasible for this population to engage with. The review used robust systematic review methodology (e.g. double, independent screening), increasing confidence that the included studies represent a comprehensive picture of the available evidence. Similarly, trained coders used established classification taxonomies to extract and compare intervention characteristics across interventions. Several limitations can also be identified in the evidence used in this review and the review process. Uptake and retention rates were not reported for all interventions identified by the initial search, so the results reported necessarily reflect a subset of interventions in this area. The identified studies varied in their design, target outcomes, and participants. As a result, it was not possible to quantitively synthesise the study data using meta-analysis. While most studies were of high quality, 30% of included records received a quality assessment score below 0.75 and 3% below 0.5 indicating that the quality of some of the included studies was poor. Any factors which may have influenced uptake and retention, but which were not explicitly discussed by study authors or readily classified from intervention descriptions were not identified or explored in this review. This reflects broader challenges in the reporting of behavioural interventions (Hills, 2004), which, due to their complex nature, frequently encounter difficulties in reporting all relevant details within the restricted word limits of academic journals. Reporting guidelines such as TIDieR (Hoffmann et al., 2014) have greatly improved descriptions of published interventions where they have been used. However, they are currently underutilised across the evidence base, limiting the quality of intervention reports and inevitably the quality of evidence syntheses based on these reports.

The records included in this review were predominantly conducted with female participants and based in Western, high-income countries. There are too few records with primarily male participants and/or based in non-Western countries to make any meaningful comparisons. The limited representation of non-Western contexts is likely due to two key factors. First, our inclusion criteria required studies to be conducted in high-income countries, which excluded much of central Africa and parts of South America. Second, most of the current research on food provision and intervention in the context of low SES is being conducted in Western countries. This may, in part, reflect cultural differences in eating practices and responses to socioeconomic inequalities. For example, in some non-Western countries, such as China, collectivist values prioritise food sharing and communal meals which may shape both responses to food insecurity and approaches to food provision, potentially leading to fewer individual-focused interventions of the kind typically reported in Western literature. These cultural and systemic differences may help explain the lower prevalence of non-Western studies in our search. Future research should explore how such factors influence intervention design, delivery, uptake, and retention, particularly in non-Western settings.

It is also possible that factors which improve uptake or retention could reduce intervention effectiveness. For example, while shorter interventions might be more appealing to and feasible for participants, this might reduce effectiveness by limiting the amount or depth of content that can be delivered. The present study did not assess intervention effectiveness as the purpose of the review was to understand the ways in which interventions are delivered, and to identify possible drivers of uptake and retention. Before considering the effectiveness of a given intervention, it is important to ensure the intended population are engaging with its content. Effectiveness, however, should be explored in future research. Finally, this review only studied low-SES interventions and so did not draw comparisons between high and low SES interventions.

Conclusions

In conclusion, in community-based dietary interventions targeting low socioeconomic populations, both average intervention uptake and retention were suboptimal. These results highlight the need to improve participant engagement with dietary interventions for low SES populations. We identify several features of interventions that appear to be associated with higher levels of uptake and retention in this population: interventions being group-based, of shorter duration and using multiple recruitment methods. Future research should test the utility of these features more robustly and further explore the unique challenges faced by low socio-economic populations so that interventions can be tailored further to their specific needs and circumstances. Tailoring interventions to specific needs, utilising optimised content and delivery modes, and addressing the barriers identified in this review could enhance the effectiveness of future interventions.

Author contributions

Abigail Stephen, conceptualisation, formal analysis, investigation, methodology and drafted manuscript. All other authors conceptualisation, methodology, investigation and reviewed and approved the final version of the manuscript

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No potential conflict of interest was reported by the author(s).

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Data availability statement

All data generated or analysed during this study are included in this published article [and its supplementary information files]. The protocol and search strategy were pre-registered on PROSPERO (ID: CRD42022376 484).

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