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Science & Technology in childhood Obesity Policy

Science & Technology in childhood Obesity Policy

D8.1: Systematic review and evidence synthesis report

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Dissemination Level

PU	Public	☒
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Abbreviation	Definition
AMSTAR2	A MeaSurement Tool to Assess systematic Reviews, updated 2017
BMI	Body Mass Index
GRADE	Grading of Recommendations, Assessment, Development and Evaluations
Non-RCT	Non-randomised controlled trial
PICO	Population, intervention, comparison and outcome
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta- Analyses
PROGRESS-Plus	Characteristics that stratify health opportunities and outcomes, including ethnicity, education, socioeconomic index, and social capital.
PROSPERO	Prospective Register of Systematic Reviews
RCT	Randomised Controlled Trial
SEIFA	SocioEconomic Index For Areas (an Australian-developed index for community-level affluence/deprivation)
SES	Socioeconomic Status
STOP	Science & Technology in childhood Obesity Policy (Horizon 2020 project)

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1 Background

Excess bodyweight affects over a quarter of school-age pre-adolescents in Europe with several countries reporting a prevalence of overweight or obesity over 40%.[1] Childhood obesity has long-term detrimental effects on health, and social and economic consequences. It is directly linked with endocrine and orthopaedic complications and early onset of cardiovascular disease and type-2 diabetes; it affects children's psychosocial well-being by reducing self-esteem, quality of life and increasing social stigmatisation. Childhood obesity is an independent risk factor for adult obesity and its related complications.[2,3]

In order to reduce the prevalence of childhood overweight and obesity, two approaches are needed: (i) reducing the incidence of new cases through prevention, and (ii) reducing the number of existing cases through treatment and weight management services. In this review we will examine the latter approach, with a focus on pre-adolescent children. This is an area in which a substantial amount of research has been (and continues to be) undertaken, and the results have been reviewed and synthesised in many systematic reviews in the last decade. Surgical and pharmaceutical interventions are rarely considered in pre-adolescent children, while interventions on diet and physical activity are commonly undertaken but the results show only small average effects of interventions on sustaining individual weight loss or lowering group obesity prevalence. However, these trials have helped to identify features that are associated with a higher effectiveness of interventions. These include a focus younger children; a multidisciplinary approach; an intensive delivery; parental or family involvement; and a focus on preschool, school or group settings.[4–6]

Beyond looking at effectiveness, few systematic analyses have assessed the barriers to successful treatment in standard health care settings[7] and there is little evidence reported on the best practices for treating obesity in children living in socially or economically disadvantaged households (based on indicators such as occupation, income, education) or where other disparities may be expected (e.g. due to race, ethnic or migrant status). This may be considered surprising, given the clear evidence that the prevalence of overweight and obesity is strongly associated with socio-economic status in developed economies, and increasingly so in emerging economies, with higher prevalence levels found among children in lower-income households or with parents with lower educational levels. Measures to reduce health inequalities are written into many countries' health policy statements, and interventions that reduce overweight and obesity prevalence among children in lower social status households are clearly a means to achieve this.

The primary purpose of the present review is to focus on these latter issues by (1) examining the evidence for differential effectiveness of interventions to treat paediatric obesity in relation to these various potential sources of inequity, hereinafter referred to as 'social disparities', and (2) examining evidence on the challenging phases of the interventions such as recruitment, adherence and follow-up in relation to social disparities. It is designed to fulfil Task 8.1 of the STOP project, namely. *To conduct systematic analyses on the best practices management strategies in health care with specific focus on the challenging phases of the interventions: the recruitment, adherence and follow up. Specifically, to assess the feasibility of the interventions in socioeconomically disadvantaged household and migrants*.

An edited version of the present deliverable has been published in the peer-reviewed journal *Obesity Reviews* as Lobstein, T, Neveux, M, Brown, T, Kheng Chai L, Collins CE, Ells LJ, and Nowicka P, for the STOP project consortium. Social disparities in obesity treatment for children age 3–10 years: A systematic review. *Obesity Reviews*. 2021; 22:e13153. https://doi.org/10.1111/obr.13153

2 Methods

This paper focuses on social disparities (defined here as potential disparities in health which are linked to ethnicity, migrant status, educational status, household income, health insurance status or other socio-economic measure) in relation to paediatric obesity treatment and outcome, as provided through health care services to younger children (defined here as children aged between 3 and 10 years).

The search for evidence was undertaken in two stages: an examination of recently-published systematic reviews, and an examination of primary studies of paediatric obesity treatment. The two stages were found to be necessary when it became clear in pilot searches that the systematic reviews did not provide comprehensive evidence on social disparities in paediatric obesity treatment.

For stage 1 we undertook a systematic search for evidence on social disparities contained within systematic reviews of paediatric obesity treatment published in the last decade (2009 onwards). All systematic reviews of paediatric obesity treatment were examined and relevant information extracted to provide a narrative review. For each systematic review we examined the Methods, Results, Discussion and Conclusion sections in order to identify evidence relating to social disparities and the interpretation in each review.

For stage 2 we examined all the relevant primary studies of paediatric treatment that had been accepted for inclusion in the systematic reviews identified in stage 1. The primary studies were included according to a pre-agreed protocol based on a PICO (population, intervention, comparison and outcome) framework, shown in Table 1 below. Data were extracted from these studies according to a template (see Annex 1) designed to capture salient information to assist in answering the research question.

Inclusion criteria for primary studies were based on age (children aged between 3.0 and 9.9 years, see PICO table for exceptions), provided through health care services to children eligible for treatment for excess bodyweight, assessed in a controlled trial with at least six months of follow-up.

This review was registered with the PROSPERO International Prospective Register of Systematic Reviews (CRD42019128687).

Table 1: PICO framework and inclusion/exclusion criteria

PICO feature	Inclusion criteria	Notes
Population	Children 3.0 to 9.9 years of age eligible for treatment for overweight and obesity.	In studies that had children of 10 years or more, the study was included if the stated *average* age of the children in all arms of the study was <10y, or the stated age range implied *a mid-point* below 10y (e.g. “7-11y”).
Intervention(s)	Controlled interventions to treat overweight and obesity provided within or under the auspices health care services. Excluded: cohort and observational studies.	Randomised or cluster randomised controlled interventions must have minimum study period of six months including follow-up (three months for pharmaceutical interventions).
Comparison(s)	Placebo, usual care, waiting list, alternative treatment, lower dose or intensity of treatment, no treatment.	

Outcomes	Primary outcomes: Influence of social disparity or related PROGRESS-Plus variables, on changes in adiposity-related anthropological measurements including BMI (or BMI-z score) Secondary outcomes: Recruitment, adherence and follow-up data stratified by these social disparity variables.	Excluded outcomes: Changes in health-related behaviour, physical activity, food choices or dietary patterns. Excluded PROGRESS-Plus variables for gender or sexual identity, place of residence, disability social capital, or religion.

Search methods:

In stage 1, searches were undertaken in Medline, Cochrane Database, and Embase (Ovid) for systematic reviews focusing on socio-economic aspects of paediatric obesity treatment. Search terms are shown in the Annex below, and in brief form were (Child+ OR Pediatric) AND (Overweight OR Obes+) AND (Treatment or Management) limited to systematic reviews and/or meta-analyses, and published after 1/1/2009. From the identified publications, further potential reviews were sought by examining the references cited. In addition, a Google Scholar search (first 100 returns) was undertaken for additional reviews.

In stage 2, all primary studies of paediatric treatment which had been included for review in the systematic reviews examined in stage 1 were considered as eligible for further analysis. These primary studies were assessed according to the PICO eligibility criteria described in Table 1, above, and the included studies processed for data extraction.

Data extraction

In stage 1, text in each of the systematic reviews was examined and relevant sections extracted by one researcher and subsequently verified independently by a second researcher. Disagreements were resolved by discussion.

In stage 2, data from primary studies were extracted separately by two researchers independently using a standard data template. The completed templates for each study were then compared and differences resolved by discussion.

Evidence quality

In stage 1, where systematic reviews provided significant evidence on social or economic disparities in paediatric obesity treatment an AMSTAR2 rating scheme[8] was used as an evaluation tool, and reported below. In stage 2, where the individual studies extracted from the systematic reviews for further analysis provided stratified results based on social disparities, GRADE rating system was used as an evaluation tool, and reported below.

3 Results

The numbers of papers identified in each of the stages of the present review are shown in the PRISMA charts below. Figure 1(a) summarises the identification of 64 systematic reviews included in the present study, and Figure 1(b) shows the identification of 81 primary studies of paediatric obesity treatment, which had been included in the systematic reviews and which met the PICO inclusion criteria for stage 2 of the present review.

Figure 1 (a) PRISMA chart for stage 1: systematic reviews

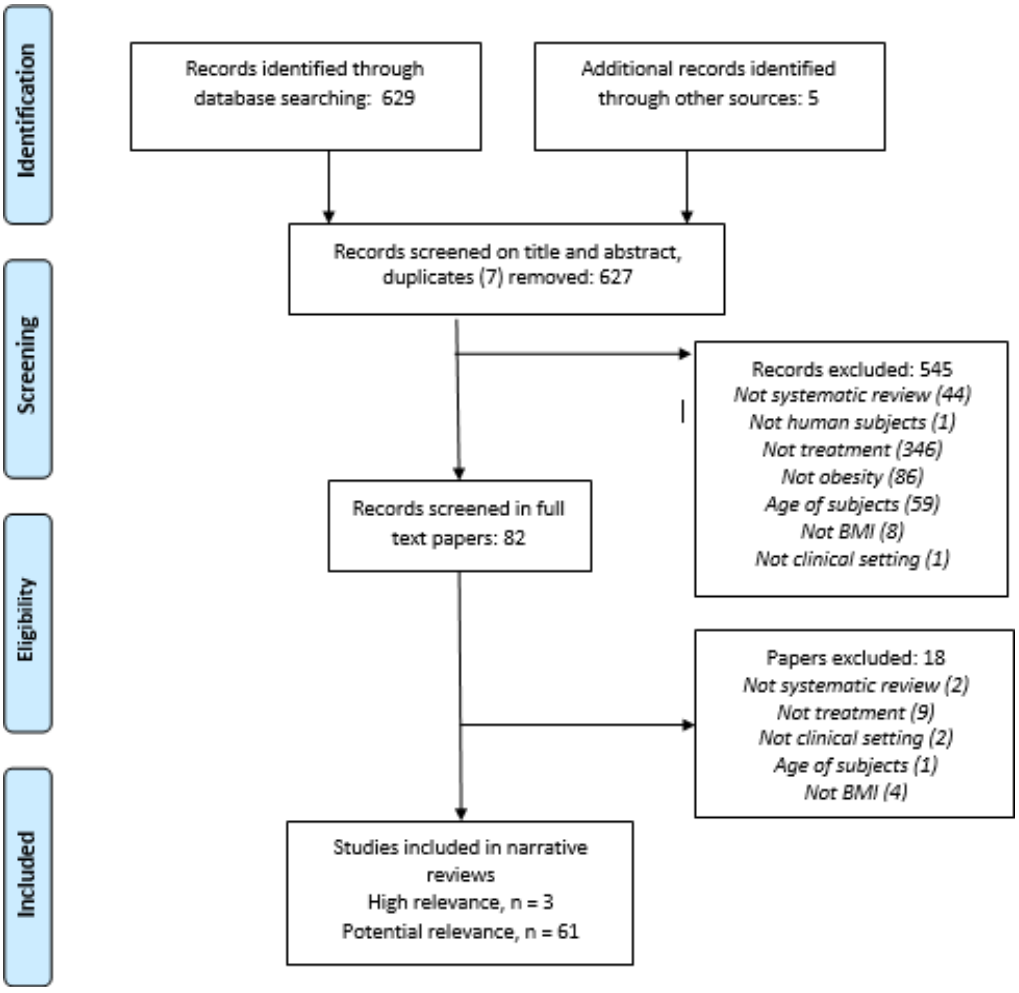
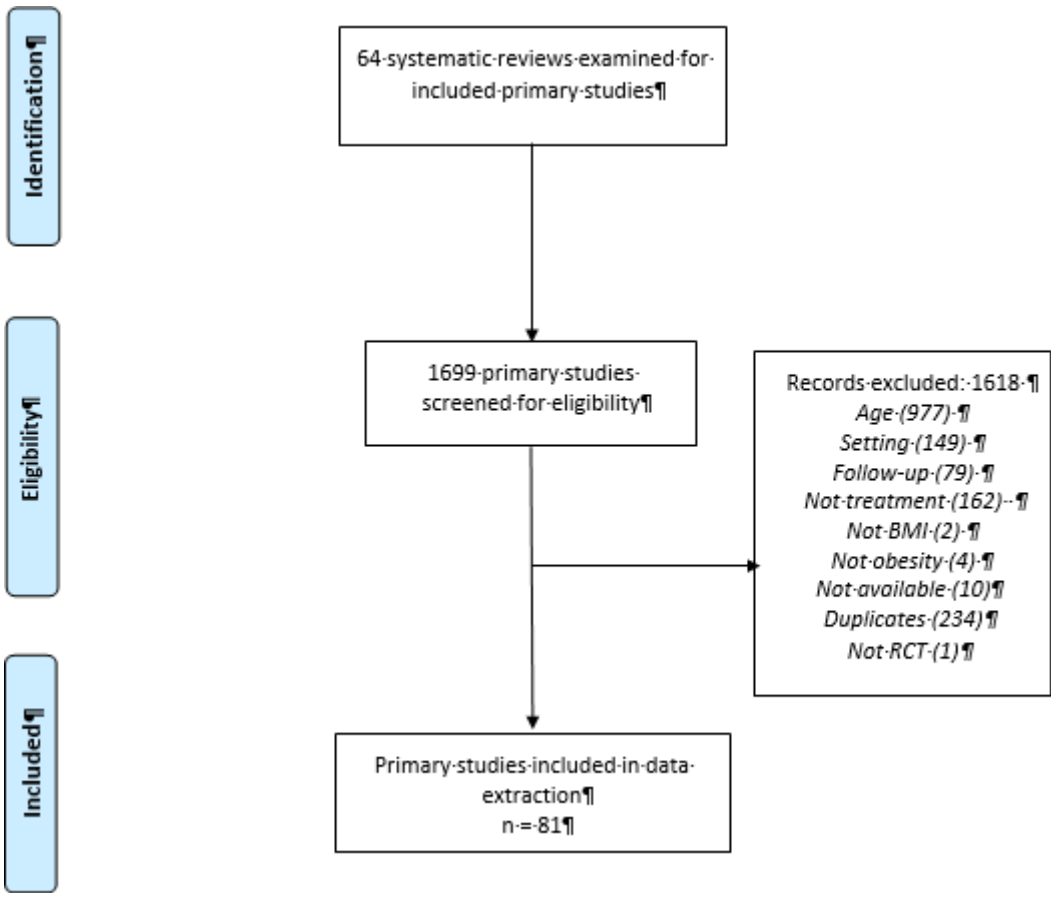


Figure 1 (b) PRISMA chart for stage 2: primary studies



Results from systematic reviews

A preliminary search identified three systematic reviews of potentially high relevance as they focused on social disparities in paediatric obesity treatment. One of these (Brown 2015)[9] reviewed interventions among South Asian children in the UK, and included one primary study of treatment in younger children. A second one (Hillier-Brown 2014)[10] reviewed interventions to reduce SES inequalities in obesity in children, and included four primary studies of treatment interventions in younger children. The third review (Ligthar 2017)[11] examined social disparities in paediatric weight management, and included six primary studies in younger children in health-care settings and with adequate follow-up.

Table 2 shows the narrative text extracted from these three systematic reviews. It can be seen that the quantity of information is remarkably limited and the level of detail poor. The interpretation provided by the authors in their narrative text needs to be taken in the context of the critical appraisal shown in the third column, where it can be seen that the applicability of the authors' comments to the population of interest (children under age 10 years, treated for obesity through paediatric services) is limited.

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Table 2 Summary statements from three key systematic reviews identified in stage 1

Review	Key statements in the review's text	Comments and AMSTAR2 quality concerns
Brown T, Smith S, Bhopal R, Kasim A, Summerbell C. Diet and Physical Activity Interventions to Prevent or Treat Obesity in South Asian Children and Adults: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health*. 2015;12(1):566-594. doi:10.3390/ijerph120100566[9]	Abstract: "*There was no evidence that interventions were more or less effective according to whether the intervention was set in South Asia or not, or by socio-economic status.*" Conclusions: "*One high quality RCT in South Asian children found that a school-based physical activity intervention that was delivered within the normal school day which was culturally sensitive, was effective. There is also evidence of culturally appropriate approaches to, and characteristics of, effective interventions in adults which we believe could be transferred and used to develop effective interventions in children.*"	No PICO shown. Duplicate data extraction not stated. Risk of bias and publication bias not mentioned in Discussion. Only 3 RCT studies of children. Results for South Asians were not compared with non-South Asians. Review included adults, and included preventive interventions. Of 7 studies, none complied with present reviews' PICO criteria. AMSTAR2: LOW
Hillier-Brown FC, Bambra CL, Cairns J-M, Kasim A, Moore HJ, Summerbell CD. A systematic review of the effectiveness of individual, community and societal level interventions at reducing socioeconomic inequalities in obesity amongst children. *BMC Public Health*. 2014;14(1):834. doi:10.1186/1471-2458-14-834[10]	Abstract: "*At the individual level (n = 4), there was indicative evidence that screen time reduction and mentoring health promotion interventions could be effective in reducing inequalities in obesity. For the community level interventions (n = 17), evidence was inconclusive - with some studies suggesting that school-based health promotion activities and community-based group-based programmes were effective in reducing obesity - others not. Societal level evaluations were few (n = 1). However, there was no evidence to suggest that any of these intervention types increase inequalities and several studies found that interventions could at least prevent the widening of inequalities in obesity. … The review has found only limited evidence although some individual and community based interventions may be effective in reducing socio-economic inequalities in obesity-related outcomes amongst children but further research is required, particularly of more complex, societal level interventions and amongst adolescents.*" Discussion: "*Treatment interventions are more likely to show positive effects than prevention ones. [A] targeted approach … has limitations as even when interventions are effective amongst low income groups they are only able to reduce the health inequalities gap, they have little effect on the wider social gradient.*"	No PICO shown. Quality of studies was assessed but not reported. Risk of bias and publication bias not mentioned in Discussion. Review included preventive and treatment interventions. Age range 6–12 years old. Race/ethnicity not examined. Of 23 studies, 2 complied with present reviews' PICO criteria. AMSTAR2: LOW

Ligthart KAM, Buitendijk L, Koes BW, van Middelkoop M. The association between ethnicity, socioeconomic status and compliance to pediatric weight-management interventions – A systematic review. *Obes Res Clin Pract*. 2017;(5):1-51. doi:10.1016/j.orcp.2016.04.001[11]	Discussion: "*We found that Black ethnicity seems to be associated with higher intervention dropout and that low family income appears to be associated with lower compliance with the intervention. … The associations between other ethnicities (such as White and Hispanic and White and other ethnic minorities) and SES categories and intervention or study dropout and non-compliance were mainly non-significant. … In the literature, ethnicity and SES are considered to be related: ethnic minorities often have a lower SES than Whites … This relationship was reflected in our study results; outcomes for ethnicity and SES pointed in the same direction. Studies that reported on both ethnicity and SES found corresponding associations with study and intervention dropout and non-compliance. …"* *"As most of the studies included in this review were performed in the United States (USA), their findings may be hard to generalise to other populations as the social position of ethnic minorities differs between countries…..[D]ue to discrimination, racial segregation between African Americans and white Americans remains a big issue in politics and public life …. These and other ethnic aspects may influence participation, non-compliance and dropout in childhood obesity interventions in the USA in different extents than in other countries."* Strengths and limitations: "*Most studies assessing pediatric weight-management programs did not report study or intervention dropout or non-compliance; if dropout or non-compliance were reported, very few studies reported its association with SES or ethnicity. … [Thus] only limited literature on this association was available, and the external validity of our results was affected, making it hard to generalise our findings. Another factor that added complexity to the analysis of our findings was the fact that definitions of dropout and non-compliance differed broadly within the included studies. This wide spectrum of definitions made it difficult to compare study outcomes and to draw firm conclusions. In addition, subgroups of SES and ethnicity within the studies were often small. Due to those small sample sizes there often was limited power to obtain significant differences, even though associations between SES, ethnicity and study or intervention dropout and non-compliance might have been present. … Another limitation in our review is the diversity among the included studies. For example the length of the applied interventions differed from 10 weeks up to 5 years. Also the follow-up period over which dropout and non-compliance were reported differed enormously with a follow-up range between 10 weeks and 3years. This is likely to impact the dropout and non-compliance outcomes; as an effect of time, dropout and non-compliance may logically be higher in studies with a longer follow-up time. Finally, there are several variables that might have influenced the compliance and drop-out ratio's, such as recruitment method for the intervention, self-efficacy, motivation and willingness to change of child and parent. It was however not possible to take these variables into account."*	No PICO shown. Review included adolescents up to age 20 years. Some interventions included non-obese children. Publication bias not mentioned in Discussion. Of 30 studies, 6 complied with present reviews' PICO criteria. AMSTAR2: MODERATE

It can be seen that the evidence provided from these reviews is severely limited. Few of the studies examined met the inclusion criteria set out in the PICO table (table 1) for the present review. As the review by Ligthart et al[11] noted, most studies were small in scale and therefore the opportunity to examine the effects of interventions on sub-groups defined by social disparities was very limited.

The paucity of results from these three reviews led the authors to examine the remaining 61 systematic reviews addressing paediatric treatment identified in the literature search.

For each of the 61 reviews we extracted information on social disparities. We examined the Methods section of each review for the description of the data they recorded from their eligible studies, the Results tables describing the individual studies included in the review, and the Results, Discussion and Conclusion text for the interpretation of the evidence in the review. As Annex 2 shows, of the additional 61 systematic reviews, 34 made no reference to social disparity-relevant variables, a further 11 reviews referred to social disparity variables in the Methods or results tables, but did not discuss or interpret these variables in their Results or Discussion text.

The remaining 16 reviews referred to social disparities in their Results or Discussion text. In many cases this was only briefly mentioned, as can be seen in Table 3, which quotes the relevant text from the 16 reviews.

Table 3 Summary from 17 systematic reviews which include social disparity variables in their text

Reviews	Statements in the review's Results or Discussion text
Bond 2009[12], Bond 2011[13]	Of the three studies included in this pair of reviews "*[t]he differing results from the Hip-Hop Jr communities indicate the importance of sensitivity to the cultural context. This trial took great care to be culturally sensitive to the minority groups it was working with. The Hip-Hop Jr authors identified several components from their pilot work that were important in engaging these families: easy and safe access to the programme; being situated in the preschool that the children were already attending; having the parental element take place in the home; encouraging identification between those delivering the intervention and participants; addressing cognitive and environmental barriers to exercise and dietary change; emphasis on modelling lifestyle change; and consideration of all levels of literacy*"
Colquitt 2016[14]	*"Five of the seven trials reported ethnicity. … Five trials reported socioeconomic status using different indicators (Hollingshead score, Hollingshead classification, family income, non-manual social class, or parental educational attainment). No trials investigated all-cause mortality, morbidity, or socioeconomic effects."*
Eisenberg 2013[15]	(Review focused on interventions targeting Latino population groups, suitable for application in Mexico.) *"There is evidence to infer from the six interventions that healthy eating is an important intervention component when targeting the treatment of childhood*

	obesity in Mexico, as all of the successful interventions targeted healthy eating behaviors in some capacity. Furthermore, most of the interventions also included parental participation in part of the intervention alongside their children. This may also have contributed to the children's BMI reduction because it is recognized that parents and the home environment can influence children's dietary and physical activity behaviors. As such, parental components should be highly considered in designing obesity interventions. However, in terms of intervention duration, dose frequency, study design, and other characteristics, the present review shows mixed results on which combination of the aforementioned characteristics is most effective."
Ells 2015[5]	*"Despite the publication of a number of observational studies examining bariatric surgery in young people under 18 years … only one RCT was identified … Whilst this study reported on weight, health-related quality of life and adverse events, further data on the participant socioeconomic status and ethnic origin may have enhanced the wider applicability of the findings. The authors state their uncertainty as to whether the study population is an accurate reflection of the general obese adolescent population, since it may have attracted a subset of the community amenable to the availability of free treatment."*
Foster 2015[16]	Narrative contains no discussion of social disparities, but the Results section notes in passing that one study (Taveras et al 2011) using motivational interviewing, found no change in BMI at 1 year compared with controls but "*a post hoc analysis showed significant effects on BMI in female subjects … and those in households with incomes less than $50,000"*. The Taveras study is reported in table 4, below.
Kitzmann 2011[17]	*"[M]ore research will be needed to explore the role of socioeconomic status and ethnicity in these treatment outcome studies. In the current review, only about a third of studies reported information about participants' socioeconomic status, and even fewer programs – 4 of 31 – provided information about participants' race. However, these variables may be important to consider both in terms of who needs treatment and what kind of treatment would work best. …. Minority and majority families may also benefit from different formats of family-based intervention."*
Ling 2016[18]	*"This review did not evaluate the effects of demographics, such as sex, ethnicity/race, socioeconomic status, parents' education, marital and employment status, on intervention effects. Further efforts should explore the potential influence of these factors on intervention effects."*
Loveman 2015[19]	*"No trials reported socio-economic effects."*
McDonagh 2014[20]	*"Race and ethnicity distribution was not reported in a consistent manner across the studies, with 3 not reporting these data at all: 1 in Iran, 1 in Turkey, and 1 in Mexico.1,20,26 Three studies reported enrolling more than 90% white children,19,22,28 while the remainder reported a more mixed population including a study from Australia, where 64% were ethnically Indian subcontinent or Pacific Islanders".* *"Our analysis of subgroups indicated that the beneficial effects of metformin may be smaller in those whose baseline BMI was below 35, in studies with more girls or higher mean age (adolescents), in those of Hispanic ethnicity, in those with acanthosis nigricans, and in those who have tried and failed diet and exercise programs in the past."*
Mead 2016[21]	*"No trials investigated socioeconomic effects."*
Mead 2017[22]	*"No trials reported on all-cause mortality, morbidity or socioeconomic effects."*

Nagle 2013[23]	(Review focused on interventions targeting Latino population groups, suitable for application in Latin America.) "*[T]here is evidence that interventions in the healthcare setting can be effective in creating positive anthropometric changes in obese and overweight children in Latin America. Interventions with components to increase physical activity and healthy eating behaviors in the healthcare setting could be utilized to supplement larger obesity prevention efforts."*
Oude Luttikhuis 2009[4]	*"With many of the studies included in this review, it is unlikely that the implications for practice can be directly extrapolated from one group to another. The practicalities of delivering effective advice on lifestyle changes to obese children and adolescents will vary with the wide span of social, ethnic and economic circumstances, as well as with the many variations in available resources for local health service delivery. … The findings from many of the included studies may be non-generalisable owing to sampling problems - the majority of research in the field has been conducted in motivated, middle class, Caucasian populations…. The failure to address and measure vital and important psychological and social factors in these intervention studies hinders the potential for intervention effectiveness."*
Park 2009[24]	*"The results of this review must be interpreted with caution: the studies were short-term and based on small samples; participants were mainly from the U.S., and large portions were from ethnic backgrounds known to be at increased risk of metabolic disorders, limiting the generalizability of findings; and the studies presented unadjusted measures without any intention-to-treat analyses, which may have overestimated treatment effects."*
Staniford 2012[25]	*"A large number of studies did not identify the ethnicity (49.2%) or the socio-economic status (67.2%) of the participants and in studies that identified these demographics, samples with a majority of white participants (36.1%), from middle to upper class backgrounds (21.3%), were the most common."* *"Limited research has addressed recommendations to actively recruit and tailor treatment interventions to ethnically diverse and immigrant populations … When reported, studies generally involved white, middle/upper class samples. Future research targeting diverse populations, specifically groups with the highest prevalence of obesity are still required to avoid taking a ''one size fits all'' approach."*
Viner 2010[26]	Results section notes that *"subjects were predominantly white or Hispanic"* but this is not referred to in the Discussion.

From the text cited in the systematic reviews we find that there is considerable difficulty reaching general conclusions on the forms and approaches to paediatric obesity treatment suitable for different social subgroups within a general population.

The review authors note that many studies involve better-off families with higher levels of general functioning, with resources to make changes to their health behaviour, with parenting skills and capacity to ensure good family involvement in the treatment programme. Studies of sub-groups, such as Latino or Mexican populations are inconclusive, and do not demonstrate whether specific treatment requirements may be advantageous.

Results from primary studies

The systematic reviews were not able to answer the research questions with a high level of confidence. We therefore examined the 1699 primary studies cited in the systematic reviews, and from these identified 81 which fulfilled the PICO criteria in table 1 for data extraction (see PRISMA chart in figure 1(b) above). These 81 studies are listed in Annex 3, with the relevant information summarised from the data extraction templates used for each study.

Of the 81 studies identified, 37 did not mention any social disparities. The remaining 44 studies stated that some social disparity measure had been taken at baseline but the large majority of these 44 studies did not describe BMI-relevant outcomes in relation to the social disparity measures taken. Only five studies had undertaken some quantitative analysis of treatment outcomes in relation to one or another measure of social disparity, and a summary is given in table 4. Furthermore, while a majority of studies (75 out of 81) reported gender data at baseline, only 13 reported stratified results based on gender. While gender differences may be important, and may interact with social disparities in treatment outcomes, it is beyond the scope of the present review and will not be analysed further here. It is recommended as an area for further research (see Discussion).

Table 4 Influence of social disparities on treatment outcomes reported in primary studies identified in stage 2

Study (ref)	Stratified outcomes, as published	Comments and GRADE rating concerns
Broccoli 2016[27]	Motivational interviewing *"had a positive long-term effect on 0–24BMI in children whose mother had a high (0–24BMI 0.73% [95%CI 1.65 to 0.18]) or medium (0–24BMI 0.31% [95% CI 0.74 to 0.13]) level of education, whereas it had a negative long-term effect in children whose mother had a low level of education (0–24BMI 0.66% [95% CI 0.08 to 1.23) (interaction test P = .008). The same results were observed in the short term."* Mothers' education had an *"important role in determining the outcome. Whereas benefits disappeared after the 12-month follow-up visit for children whose mothers had spent >13 years at school, the effects of intervention seem counterproductive in the long term for children whose mothers had received <13 years of education."*	Not blinded RCT, same practitioners used for treatment and usual care, apparent dose-response over educational gradient, effect observed in short (1 year) and long (2 years) term, controls received normal care (advice without motivational interviews). Adequate sample size. GRADE: MODERATE
Epstein 2008[28]	*"Socioeconomic status was a statistically significant moderator of zBMI change (group X SES X months; p=0.01). This effect was explored by dividing the sample based on SES into 2 groups at the mean SES and by examining changes in zBMI by group. For the low SES group, statistically significant between-group differences were observed from baseline to*	RCT, overall dose-response shown, large sample, sustained effect over 1 year. Adequate sample size. GRADE: HIGH

	6m, 12m, 18m and 24m, while no statistically significant between-group differences in zBMI changes were observed for the high SES group."	
Golan 1998[29]	*"The correlation analyses suggested that a better economic status was related to a better treatment outcome in both the experimental and control groups."* No further details provided.	RCT. Two types of intervention compared. Small sample sizes, and 30% attrition in one group. Form of SES measure not stated. Overweight measure defined as 20% above 50th centile for age, gender and height (USA). GRADE: POOR
Golley and Margerey 2007a[30]	*"No association between change in BMIz score from baseline to 12 months and indicators of socioeconomic status (all SEIFA indices p>0.05)."*	Blinded RCT, control is waiting list group, two levels of intervention, dose-response shown, effects sustained over 1 year. Small sample sizes. GRADE: HIGH
Taveras 2011[31]	*"In post-hoc stratified analyses, we observed statistically significant intervention effects on BMI among participants in households with annual incomes $50,000 or less (-0.93 kg/m^2; 95% CI: -1.60, -0.25; p=0.01) but not in higher income households (0.02 kg/m^2; 95% CI: -0.30, 0.33; p=0.92)."* BMI at baseline vs 1 year: • $50,000 or less, usual care: 19.9 (0.4) vs 21.3 (0.5) • $50,000 or less, intervention: 19.6 (0.3) vs 20.0 (0.4) • $50,001 or more, usual care 19.0 (0.2) vs 19 2 (0.2) • $50,001 or more, intervention: 19.0 (0.2) vs 19.3 (0.2)	RCT. No overall significant effect over 1 year. Adequate sample size. GRADE: MEDIUM

One study found no significant differential outcomes between social disparity groups. Of the four studies finding differential social disparity-related outcomes in their results, two (Broccoli 2016,[27] Golan 1998 AJCN[32]) found better response to the intervention among children of higher-educated mothers compared with children of lower-educated mothers, whereas two studies (Epstein 2008,[28] Taveras 2011[31]) showed better weight management (reduced BMI or reduced BMIz) for the lower socio-economic intervention group than for the higher socio-economic intervention group.

The Broccoli study[27] noted that, for the children of lower-educated mothers, the intervention led to a greater weight gain than the control – i.e. the intervention was potentially harmful for these children. Both the Epstein[28] and Taveras[31] interventions note an interaction between social disparity and outcome effect. In the Taveras study,[31] both the control and intervention groups with the lower social status showed BMI increases, greater for the controls (usual care) than for the intervention, while in the higher social status group there was no significant change in BMI for either control or intervention children. It appears the intervention countered a significant rise in BMI experienced by lower social status children over the period. In the Epstein study,[28] children in higher socio-economic households showed BMIz declines over the two-year study, both the control and intervention groups, while for the children in lower socio-economic households, the intervention group showed a BMIz decline over the period but not the control group.

The Broccoli study[27] was administered by family paediatricians using motivational interviewing techniques, consisting of five sessions over a seven-month period. The Taveras 'High Five for Kids' study[31] involved frequent contact with health professionals through home visits and telephone contact, tailored educational materials and resources for physical activity. In the Epstein study,[28] the intervention focused on screen time, with reduced TV watching as the main instrument in tackling sedentary behaviour and resulting BMI. In all studies, parents and family members were closely involved.

The small study by Golan (1998)[32] found better responses to the intervention among higher socio-economic groups (undefined). The interventions were either parent-focused or child-focused. The Golley and Magerey (2007a)[30] study showed no detectable difference in response to the interventions between sub-groups' differentiated by the Australian SEIFA (Socio Economic Index for Areas) index. The intervention consisted of a parental involvement programme, with one group having seven additional intensive lifestyle support sessions and sessions for children.

Results concerning recruitment, adherence, drop-out and follow-up

From both the systematic reviews and the primary studies, we extracted statements referring to recruitment, of participants adherence to treatment, drop-out from treatment, and availability for follow-up, in relation to the social disparities of interest in this study. A total of 15 documents contained relevant material.

Table 5 provides a brief summary of the text and quantitative data found in the 15 documents. Loss to recruitment or to treatment due to factors stated as 'no time', 'no transport' or similar were disregarded unless these were linked to the subjects' family status regarding social disparities.

Table 5 Reviews and studies providing social disparities-related statements on recruitment, adherence, drop-out or follow-up.

Review or study (ref)	Summary of evidence
Barkin 2011[33]	Maternal education: *"... the completers and non-completers did not differ significantly on variables of interest."*
Davis 2013[34]	*"The clinical implications of this study are many. First, for rural families facing the issue of pediatric obesity, telemedicine or other methods of interactive televideo seem to be feasible for the delivery of empirically supported interventions. Families from rural areas who commit to this type of intervention are likely to show up for treatment and to encounter few technical difficulties."*
Jang 2015[35]	*"Although none of the studies we reviewed discussed the reason for high attrition, prior research has found that high attrition was associated with low socio-economic status, the single-parent family, and ethnic minorities ... Further research is indicated to develop methods to ameliorate these discrepancies, particularly since studies included in this review did not reach families of diverse race/ethnicity or low socioeconomic status. ... Understanding family dynamics within a family system and how this relates to intervention program participation is also important to address in order to eliminate obstacles. In addition, family and social support as well as culturally relevant intervention programs should be considered in future research as a means to enhance program participation and effectiveness."*
Kelishadi 2008[36]	*"Participants were selected by a randomization procedure from among obese children referred from different health care centres and schools, taking into consideration the proportion of the different clusters in the city to avoid socioeconomic bias."*
Kirk 2012[37]	*"Children were recruited from referrals to a pediatric weight management programme at Cincinnati Children's Hospital Medical Center (CCHMC) who lacked health insurance coverage for the CCHMC program."*
Kitzmann 2006[17]	*"It is important to note that families who have participated in research on family-based interventions for pediatric obesity are likely to be relatively high functioning. These families must show a certain level of organization and cohesion to successfully initiate participation in an intervention program and to complete the program over the course of many weeks. In this sense, current research on family-based interventions for pediatric obesity could be considered a form of efficacy research in that the treatments are being implemented with families who are relatively well positioned to take advantage of the program. Tests of these interventions in a wider range of families would thus constitute a form of research on effectiveness rather than efficacy. We believe that a more general family focus may be a helpful framework for modifying*

	these programs so that they also may be implemented with a wider range of families. Some families – such as those characterized by destructive conflict or poor parenting skills, or those experiencing multiple stressors associated with socioeconomic disadvantage – may need more basic support and preparation in order for treatment to be effective. For these families, intervention programs may need to include a greater emphasis on conflict resolution, basic parenting skills, and stress reduction so that parents are in a better position to influence their children's eating and exercise. As such, we are arguing for a more ecological approach to treatment, one that focuses not just on the immediate context of parent-child interactions but also on the larger social context of the family and community. This ecological perspective has been shown to be useful in targeting behavior problems in high-risk youth … and is becoming increasingly common as a perspective for understanding and treating children's behaviors related to physical health."
Lochrie 2013[38]	*"Compared with those who completed the study, those who did not complete the study had significantly lower SES, were less likely to be living with both biological parents, and caregivers were less likely to be married."*
Nagle 2013[23]	(Review focused on interventions targeting Latino population groups, suitable for application in Latin America.) "*The healthcare setting facilitates interaction with health professionals who are knowledgeable about the health effects of obesity. … One limitation of this approach, however, is that it assumes that individuals have regular access to healthcare. Therefore, this setting would not be ideal for populations and communities that do not have regular access to clinics and/or do not seek out healthcare on a regular basis."*
Resnicow 2015[39]	*"We lost ~30% of the baseline sample. Although this was the anticipated range of attrition and consistent with previous studies, the fact that those lost to follow-up differed on several demographic variables (e.g. race, income and education) limits generalizability."* *"The retained cohort was similar to those lost to follow-up with regard to BMI percentile, age, and gender. However, those lost to follow-up were significantly more likely to be black or Hispanic patients and to come from households with <$40 000 income and lower parental education. There were also more likely to have Medicaid."*
Taveras 2011[31]	*"Although we attempted to match pediatric sites to obtain similar participant characteristics in intervention and usual care, unbalanced participant characteristics at baseline occurred. This imbalance may have also affected differences in parent obesity and household income."*
Taylor 2013[40]	*"Multivariate regression predicting intervention uptake showed pacific ethnicity and university degree influenced uptake – see table II. Socioeconomic status differed in intervention participants (n=197) 4.9(2.8) vs non-participants (n=74), 5.4 (2.9). Information on the socioeconomic status of their place of residence using the New Zealand Index of Deprivation (ranges from 1 – least deprived to 10 – most deprived). Few differences in demographic variables were observed between intervention participants and non-participants with age, sex, ethnicity, maternal BMI, or household structure differing little*

	by intervention uptake (Table III). However, non-participants were more likely to be from homes in more deprived areas (P=0.039) and participant mothers also tended to be more highly educated (P=0.051, Table III).”
Theim 2012[41]	*“The present study examined data at baseline and at post-weight loss treatment, as well as 2-year follow-up weight outcomes. Families in which both the preadolescent and parent were missing Hypothetical High Risk Situation Inventory at baseline (n=27) were excluded from analyses.”*
Wake 2013[42]	Family disadvantage score reported by Retained N=107, 1030 (56.8) vs Lost n=11, 1022 (57.9)
Walker 2012[43]	*“Children with private insurance appeared to have a benefit in that they were less likely to drop out compared to children with public insurance.”*
West 2010[44]	*“Although the sociodemographic characteristics of the sample were typical for the Australia general population, participants were mainly white, well-educated for parents with moderate levels of employment and income. The sample included some sole-parent and low-income families, and some children of mixed ethnicity; however, further research is needed to clarify whether similar findings would be obtained with higher-risk families (e.g. families experiencing poverty, minority families or parents from non-English speaking background.”*

Few generalisable conclusions can be made from these extracted texts. Participation in paediatric treatment (and perhaps especially in controlled trials of paediatric interventions), requires a degree of commitment, family resources and capacity, and motivation from the family and the child. Jang (2015)[35] notes the importance of understanding family dynamics and how they may relate to intervention program participation, and that family and social support as well as culturally relevant intervention programs should be considered. Kitzmann (2006)[17] adds that families who have participated in research trials are likely to be relatively high functioning, and must show a certain level of organisation and cohesion to participate in an intervention program and to complete the program over the course of many weeks. Kitzmann adds: “*Some families – such as those characterized by destructive conflict or poor parenting skills, or those experiencing multiple stressors associated with socioeconomic disadvantage – may need more basic support and preparation in order for treatment to be effective. For these families, intervention programs may need to include a greater emphasis on conflict resolution, basic parenting skills, and stress reduction”.*[17]

4 Discussion

The objective of this review was to assess the evidence of differential effectiveness of interventions undertaken through health services to treat paediatric obesity with a particular focus on social disparities, and the potential impact of social disparity during the challenging phases of the interventions such as recruitment, adherence and follow-up. This review started on the premise that it would be a 'review of reviews' looking specifically at the influence of social and economic variables on treatment effectiveness, as defined in current systematic reviews of the issue. Since 2009, only three reviews considering possible social disparities have been published and their conclusions are unable to provide convincing answers to the present research question. Broadening the review to include a further 61 systematic reviews of paediatric treatment published since 2009 did not add significantly to the evidence base.

We then examined the source material for the systematic reviews, namely the primary studies included in those reviews and complying with the PICO criteria for the present review, shown in table 1. Of the 81 studies identified and examined, there still remained only a small amount of evidence, and this was generally not of high quality.

There are limitations in the present review. In particular, we have included primary studies of paediatric treatment only if they were included in one or another of the 64 identified systematic reviews. A more exhaustive search for all potential primary studies might have captured additional studies, especially if they were published after the most recent of the systematic reviews included here. To address this, we undertook a rapid review for recent primary studies using Medline, restricted to studies published after 1/1/2018. The search terms are shown in Section 7, Supplemental material, below. The results showed 88 records (77 direct records and 11 in a recent systematic review), of which 79 were rejected on title, four on abstract and four on full text, as they did not fulfil the PICO requirements.

The remaining study, by Hoffman et al (2018)[155], was inspected for evidence of social disparities in the process indicators or weight-related outcomes. The study reported a spread of participants from households with incomes below $20,000 (38%), $20,000 to $49,999 (30%) and $50,000-plus (32%), and across parental education indicators and racial groups (12% white, 49% African American, 36% Hispanic). The authors did not describe BMI-relevant outcomes in relation to the social disparity measures taken, but they noted that the intervention was designed to be applicable to a 'low income and diverse population', by being flexible and relatively unstructured, with adaptable enrolment and attendance schedules: *"This flexibility is a strength in terms of inclusivity, but the lack of structure and accountability is also a limitation"*.

From the material examined we can make a number of observations.

- There is a remarkable lack of high-quality evidence concerning the influence of social disparities on the effectiveness of paediatric obesity treatment, and on recruitment, drop-out and follow-up issues in relation to social disparities.
- Where base-line data on social disparities are collected in treatment trials, they are heterogeneous in nature, and may include ethnicity or racial descriptors, household income, parents' education, a composite index of deprivation used in one country only, or an indirect indicator such as health insurance status. We found no evidence of data collected for migrant status for the younger children included in this review.

- Where baseline data are collected and reported, there is often no further analysis: results are not differentiated by social sub-group, and it may only be assumed that the results are presented after adjusting out the social disparity measures.
- The most commonly reported ethnicity (when reported) is Caucasian/white, followed by African-American or Black, and Hispanic or Latino. These categories reflect the dominance of treatment studies undertaken in the USA. Indeed, out of the 81 studies identified and examined, only 20 (24.7%) were from European countries including Greece, Norway, the Netherlands, Italy, the UK, Finland, Switzerland, Denmark, Germany, Belgium and Portugal. This suggests a lack of robust evidence across European countries to promote treatment interventions and halt the rising trends of childhood obesity across the region.
- Our findings are similar to those of Staniford et al (2012)[25] who reviewed 61 studies of paediatric obesity treatment (including adolescents) and noted that 41 of the studies (67%) did not report socio-economic status and 30 (49%) did not report ethnicity. Of those reporting socio-economic status, 13 studied children from upper- and middle-class households, 3 from lower-class and 4 from mixed class. Of those reporting ethnicity, 22 studied children of white/Caucasian background, 3 African-American, 2 diverse ethnicity, and 4 others.
- Follow-up attendance was reported in only a fifth of the individual studies (17 out of 82) and adherence in just over a third (32 out of 82) of the studies. This could compromise the evaluation of effectiveness of interventions and the reliability of results.
- In reviews and papers that refer to attendance, drop-out and follow-up, there are few discussions concerning sub-groups, and their conclusions are largely speculative. Key points arising are: the ability to attend sessions over extended periods of time, the lack of rapid results for the child and subsequent loss of interest, and the dynamics of families in different cultural environments and under economically stressful conditions.

5 Conclusion

It can be seen that there is an extraordinary lack of information on social and economic influences on childhood obesity treatment administered through health services. This is despite the overwhelming evidence of disparities in obesity prevalence which shows, in most countries, higher levels among families with lower incomes or parental education and in certain ethnic groups. The causes of these disparities are likely to be linked to the success or failure of paediatric treatment, yet are rarely mentioned in the reviews and studies examined in the present report.

The lack of high-quality information on differential treatment impact among socially disparate groups must hamper the development of good practices and coherent national guidance on paediatric obesity treatment. Use of weight management and obesity treatment services is likely to be affected by familial attitudes to overweight in children, their understanding of the underlying causes of weight gain, their motivation to make family-level changes, and above all the resources they may have available to make and maintain these changes. Pharmaceutical interventions and bariatric surgery remain relatively rare approaches for paediatric obesity treatment, and most interventions rely on behaviour change, supported by family practices, where the social and cultural context is likely to be of high significance in the treatment success. Even the pharmaceutical and surgical approaches require behaviour changes to ensure sustained effectiveness. Finally,

while gender was not a variable of focus throughout our analysis, it should receive further attention in future studies to understand whether it impacts inequalities and the effectiveness of childhood obesity treatment.

The interventions themselves need to be culturally and socially sensitive, avoiding stigma, encouraging motivation, recognising barriers and reinforcing opportunities. Providing treatments that are attractive, that encourage repeat attendance, that motivate sustained change, that are achievable within the resources the family can offer, requires a degree of understanding of the children being treated and their families, yet it appears from this review that this understanding is rarely attempted or applied. This indicates lost opportunity for the funders of paediatric services and medical research trials.

There is a clear and continuing high level of policy concern over health inequities and universal health coverage, at global, European and member state level. Action to mitigate inequalities needs evidence, yet this need for evidence is not being met. Many studies, paid for with public funds or philanthropic donors appear not to be collecting the relevant information, and here it is imperative on the research funders to make sure that such information is a key focus of future research.

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7 Supplementary Material

Research Questions

Is successful treatment for paediatric obesity and paediatric weight management delivered by health care professionals in a setting linked to the provision of health care services for children aged less than ten years affected by socio-demographic characteristics?

Sub-questions:

(a) Are the management strategies for recruitment to obesity treatments for children aged less than ten years influenced by socio-demographic characteristics?

(b) Are the management strategies for adherence to obesity treatments for children aged less than ten years influenced by socio-demographic characteristics?

(c) Are the management strategies for follow-up in obesity treatment for children aged less than ten years influenced by socio-demographic characteristics?

Summary of search details for systematic reviews

Search terms for systematic reviews in last 10 years for paediatric obesity treatment (not restricted by socioeconomic disparity).

Example for PubMed/Medline

((((("pediatrics"[MeSH Terms] OR "pediatrics"[All Fields] OR "pediatric"[All Fields]) OR ("child"[MeSH Terms] OR "child"[All Fields])) AND (("obesity"[MeSH Terms] OR "obesity"[All Fields]) OR ("overweight"[MeSH Terms] OR "overweight"[All Fields]))) AND (("therapy"[Subheading] OR "therapy"[All Fields] OR "treatment"[All Fields] OR "therapeutics"[MeSH Terms] OR "therapeutics"[All Fields]) OR ("organization and administration"[MeSH Terms] OR ("organization"[All Fields] AND "administration"[All Fields]) OR "organization and administration"[All Fields] OR "management"[All Fields] OR "disease management"[MeSH Terms] OR ("disease"[All Fields] AND "management"[All Fields]) OR "disease management"[All Fields]))) AND ("systematic review"[Publication Type] OR "systematic reviews as topic"[MeSH Terms] OR "systematic review"[All Fields]) AND (Review[ptyp] AND "2009/06/08"[PDat] : "2019/06/05"[PDat])

Summary of search details for primary studies 2018-2019

Medline search terms for paediatric obesity treatment linked to socioeconomic disparity.

(("pediatric obesity"[MeSH Terms] OR ("pediatric"[All Fields] AND "obesity"[All Fields]) OR "pediatric obesity"[All Fields]) AND ("therapy"[Subheading] OR "therapy"[All Fields] OR "treatment"[All Fields] OR "therapeutics"[MeSH Terms] OR "therapeutics"[All Fields]) AND ("socioeconomic factors"[MeSH Terms] OR ("socioeconomic"[All Fields] AND "factors"[All Fields]) OR "socioeconomic factors"[All Fields] OR "inequality"[All Fields])) AND ("2018/01/01"[PDAT] : "3000/12/31"[PDAT])

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Annex 1:

Data extraction template for stage 3 analyses of individual studies

	Reported in baseline data? If so, how defined (e.g. parents born abroad, father's occupation, household income)	Stratified results reported? If so summarise results published.	Discussion or comment? Copy the text from the report stating authors' discussion and conclusion, or note that the authors made no statement	Any other comment or notes
Place of residence				
Race / ethnicity				
Occupation (parental)				
Gender				
Religion				
Education (parental)				
Socioeconomic status				
Social capital				
Age				
Disability				
Sexual orientation				
Any other dimension of disadvantage or inequity for which a health impact may be anticipated				
Recruitment				
Adherence/ dropout				
Follow-up				

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Annex 2

Systematic reviews analysed in stages 1 and 2

(n=no; y=yes; SES=socio-economic disparities; eth=ethnicity disparities)

First author, year	Title of review	Social disparities mentioned or implied in Methods	Social disparities in Tables	Social disparities in results or discussion text	Studies reviewed	Of which, primary studies complying with PICO	Primary studies not complying with PICO, and reason (number)
High apparent relevance							
Brown 2015[9]	Diet and physical activity interventions to prevent or treat obesity in South Asian children and adults: a systematic review and meta-analysis.	y (eth)	y (eth)	y (SES, eth)	7	0	7: Age (4) Not treatment (2) Setting (1)
Hillier-Brown 2014[10]	A systematic review of the effectiveness of individual, community and societal level interventions at reducing socioeconomic inequalities in obesity amongst children	y (SES)	y (SES)	y (SES)	23	2	21: Age (1) Setting (1) Not treatment (19)
Ligthart 2017[11]	The association between ethnicity, socioeconomic status and compliance to pediatric weight-management interventions — A systematic review	y (SES)	y (SES)	y (SES)	30	6	24: Age (20) Setting (1) Follow-up (3)
Additional systematic reviews							
Aguilar Cordero 2015[45]	[Rebound effect of intervention programs to reduce overweight and obesity in children and adolescents; systematic review]	n	n	n	19	3	16: Age (16)
An 2009[46]	Web-based weight management programs for children and adolescents: a systematic review of randomized controlled trial studies.	n	y (eth)	n	8	0	8: Age (6) Not treatment (1) BMI (1)

Azevedo 2016[47]	The effectiveness of sedentary behaviour interventions for reducing body mass index in children and adolescents: systematic review and meta-analysis.	n	n	n	67	7	60: Age (17) Setting (9) Follow-up (4) Not treatment (30)
Bhuyan 2015[48]	Integration of public health and primary care: A systematic review of the current literature in primary care physician mediated childhood obesity interventions.	n	n	n	9	4	5: Age (4) Follow-up (1)
Black 2013[49]	Bariatric surgery for obese children and adolescents: a systematic review and meta-analysis.	n	n	n	23	0	23: Age (23)
Bond 2009,[12] Bond 2011[13]	Systematic review of the effectiveness and cost-effectiveness of weight management schemes for the under-fives: a short report. (2009) Systematic review of the effectiveness of weight management schemes for the under fives. (2011)	n	n	y (eth)	3	0	3: Setting (3)
Brufani 2012[50]	Systematic review of metformin use in obese nondiabetic children and adolescents.	n	n	n	11	0	11: Age (11)
Burchett 2018[51]	Lifestyle weight management programmes for children: A systematic review using Qualitative Comparative Analysis to identify critical pathways to effectiveness.	n	y (eth)	n	23	16	7: Age (4) Setting (3)
Colquitt 2016[14]	Diet, physical activity, and behavioural interventions for the treatment of overweight or obesity in preschool children up to the age of 6 years.	y (SES)	n	y (SES)	7	7	0
Czernichow 2010[52]	Efficacy of weight loss drugs on obesity and cardiovascular risk factors in obese adolescents: a meta-analysis of randomized controlled trials.	n	n	n	8	0	8: Age (8)
Darling 2017[53]	Systematic Review and Meta-Analysis Examining the Effectiveness of Mobile Health Technologies in Using Self-Monitoring for Pediatric Weight Management.	n	y (eth)	n	16	1	15: Age (13) Not treatment (2)
DIET-CO in press[6]	Effectiveness of Dietary Interventions for Children and Adolescents with Overweight and Obesity	n	n	n	159	31	128: Age (106) Setting (11) Follow-up (10) Not available (1)

Eisenberg 2013[15]	Interventions to increase physical activity and healthy eating among overweight and obese children in Mexico.	y (eth)	y (eth)	y (eth)	6	1	5: Age (2) Setting (3)
Ells 2015[5]	Surgery for the treatment of obesity in children and adolescents.	y	n	y (SES, eth)	1	0	1: Age (1)
Ewald 2014[54]	Parent-only interventions in the treatment of childhood obesity: a systematic review of randomized controlled trials.	n	n	n	6	3	3: Age (3)
Foster 2015[16]	Treatment Interventions for Early Childhood Obesity: A Systematic Review.	n	n	y (SES)	6	6	0
Friedrich 2012[55]	Effect of interventions on the body mass index of school-age students.	n	n	n	23	0	23: Age (10) Not treatment (13)
García-Hermoso 2015[56]	Effects of Aerobic Plus Resistance Exercise on Body Composition Related Variables in Pediatric Obesity: A Systematic Review and Meta-Analysis of Randomized Controlled Trials.	y (eth)	n	n	9	1	8: Age (8)
Gow 2014[57]	Impact of dietary macronutrient distribution on BMI and cardiometabolic outcomes in overweight and obese children and adolescents: a systematic review.	n	n	n	14	1	13: Age (12) Follow-up (1)
Heerman 2017[58]	The dose of behavioral interventions to prevent and treat childhood obesity: a systematic review and meta-regression.	n	n	n	258	51	207: Age (130) Setting (69) Follow-up (3) Not treatment (3) Not obesity (1) Unavailable full-text (1)
Ho 2012[59]	Effectiveness of lifestyle interventions in child obesity: systematic review with meta-analysis.	n	n	n	36	5	31: Age (25) Setting (4) Follow-up (2)
Ho 2013a[60]	Impact of dietary and exercise interventions on weight change and metabolic outcomes in obese children and adolescents: a systematic review and meta-analysis of randomized trials.	n	n	n	15	3	12: Age (7) Follow-up (5)
Ho 2013b[61]	Best practice dietetic management of overweight and obese children and adolescents: a 2010 update of a systematic review.	n	n	n	70	12	58: Age (49) Setting (3) Follow-up (6)

Jang 2015[35]	Evaluating Intervention Programs Targeting Parents to Manage Childhood Overweight and Obesity: A Systematic Review Using the RE-AIM Framework.	n	y (SES, eth)	y (SES, eth)	7	4	3: Age (1) Follow-up (2)
Jebeile 2019[62]	Treatment of obesity, with a dietary component, and eating disorder risk in children and adolescents: A systematic review with meta-analysis.	n	n	n	30	1	29: Age (25) Setting (1) Follow-up (3)
Jull 2013[63]	Parent-only vs. parent-child (family-focused) approaches for weight loss in obese and overweight children: a systematic review and meta-analysis.	n	n	n	4	1	3: Age (3)
Kaakinen 2018[64]	Technology-based counseling in the management of weight and lifestyles of obese or overweight children and adolescents: A descriptive systematic literature review.	n	n	n	28	0	28: Age (20) Setting (4) Follow-up (1) Not treatment (3)
Kelley 2013[65]	Effects of exercise in the treatment of overweight and obese children and adolescents: a systematic review of meta-analyses.	n	n	n	2	0	2: Age (2)
Kelley 2014[66]	Effects of exercise on BMI z-score in overweight and obese children and adolescents: a systematic review with meta-analysis.	n	y (eth)	n	10	1	9: Age (8) Follow-up (1)
Kelley 2015[67]	Exercise and BMI in Overweight and Obese Children and Adolescents: A Systematic Review and Trial Sequential Meta-Analysis.	n	n	n	20	2	18: Age (15) Followup (2) Not obesity (1)
Kitzmann 2011[17]	Family-Based Interventions for Pediatric Obesity: Methodological and Conceptual Challenges From Family Psychology.	n	y (SES, eth)	y (SES, eth)	31	8	23: Age (20) Follow-up (2) Not available (1)
Knowlden 2012[68]	Systematic review of family and home-based interventions targeting paediatric overweight and obesity.	n	n	n	8	7	1: Age (1)
Lentferink 2018[69]	Efficacy of Metformin Treatment with Respect to Weight Reduction in Children and Adults with Obesity: A Systematic Review.	n	n	n	15	0	15: Age (15)
Lewis 2017[70]	Searching for Evidence of an Anti-Inflammatory Diet in Children: A Systematic Review of Randomized Controlled Trials for Pediatric Obesity Interventions With a Focus on Leptin, Ghrelin, and Adiponectin.	n	y (eth)	n	26	3	23: Age (21) Follow-up (2)
Liber 2013[71]	Effects of inulin-type fructans on appetite, energy intake, and body weight in children and adults: systematic review of randomized controlled trials.	n	n	n	19	0	19: Age (19)

Ling 2016[18]	Interventions to prevent and manage overweight or obesity in preschool children: A systematic review.	y (eth)	y (eth)	y (SES, eth)	32	6	26: Not treatment (26)
Loveman 2015[19]	Parent-only interventions for childhood overweight or obesity in children aged 5 to 11 years.	y (SES)	n	y (SES)	20	12	8: Age (8)
Martin 2013[72]	Effective behaviour change techniques in the prevention and management of childhood obesity.	n	n	n	17	5	12: Age (6) Not obesity (1) Not treatment (5)
McDonagh 2014[20]	Systematic review of the benefits and risks of metformin in treating obesity in children aged 18 years and younger.	y (eth)	y (eth)	y (eth)	14	0	14: Age (14)
Mead 2016[21]	Drug interventions for the treatment of obesity in children and adolescents.	y (SES)	n	y (SES)	21	0	21: Age (21)
Mead 2017[22]	Diet, physical activity and behavioural interventions for the treatment of overweight or obesity in school children from the age of 6 to 11 years.	y (SES)	n	y (SES)	70	28	42: Age (42)
Nagle 2013[23]	Interventions for the treatment of obesity among children and adolescents in Latin America: a systematic review.	y (eth)	y (eth)	y (eth)	4	0	4: Age (3) Folllow-up (1)
Nguyen 2011[73]	A review of electronic interventions for prevention and treatment of overweight and obesity in young people.	n	y (eth)	n	21	0	21: Age (6) Follow-up (1) Not treatment (14)
Nooijen 2017[74]	Effectiveness of interventions on physical activity in overweight or obese children: a systematic review and meta-analysis including studies with objectively measured outcomes.	n	n	n	33	6	27: Age (15) Follow-up (1) Not treatment (11)
O'Connor 2017[75]	Screening for Obesity and Intervention for Weight Management in Children and Adolescents: Evidence Report and Systematic Review for the US Preventive Services Task Force.	n	n	n	59	19	40: Age (35) Setting (5)
Oude Luttikhuis 2009[4]	Interventions for treating obesity in children. Cochrane Systematic Review.	y (SES)	n	y (SES)	64	12	52: Age (48) Setting (4)
Park 2009[24]	Metformin for obesity in children and adolescents: a systematic review. Diabetes Care.	n	n	y (eth)	5	0	5: Age (5)
Sargent 2011[76]	Components of primary care interventions to treat childhood overweight and obesity: a systematic review of effect.	n	n	n	17	5	12: Age (11) Setting (1)
Sbruzzi 2013[77]	Educational interventions in childhood obesity: a systematic review with meta-analysis of randomized clinical trials.	n	y (eth)	n	26	3	23: Age (5) Not treatment (18)

Smith 2013[78]	Health information technology in screening and treatment of child obesity: A systematic review.	n	n	n	5	1	4: Age (3) Setting (1)
Staniford 2012[25]	Treatment of Childhood Obesity: A Systematic Review.	n	y (SES, eth)	y (SES, eth)	61	7	54: Age (30) Setting (4) Follow-up (20)
Sung-Chan 2013[79]	Family-based models for childhood-obesity intervention: a systematic review of randomized controlled trials.	n	n	n	15	2	13: Age (9) Setting (2) Follow-up (1) Not treatment (1)
Turner 2015[80]	Prevention and treatment of pediatric obesity using mobile and wireless technologies: a systematic review.	n	y (eth)	n	32	1	31: Age (27) Not BMI (2) Not treatment (2)
van der Kruk 2013[81]	Obesity: a systematic review on parental involvement in long-term European childhood weight control interventions with a nutritional focus.	n	n	n	24	4	20: Age (10) Setting (2) Not treatment (8)
van Hoek 2014[82]	Effective interventions in overweight or obese young children: systematic review and meta-analysis.	n	n	n	27	11	16: Age (1) Setting (2) Follow-up (5) Not obesity (1) Unavailable full text (7)
Viner 2010[26]	Efficacy and safety of anti-obesity drugs in children and adolescents: systematic review and meta-analysis.	n	y (eth)	y (eth)	14	0	14: Age (14)
Wahi 2011[83]	Effectiveness of interventions aimed at reducing screen time in children: a systematic review and meta-analysis of randomized controlled trials.	n	n	n	13	1	12: Age (2) Setting (8) Not treatment (2)
Whitlock 2010[84]	Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF.	n	n	n	20	3	17: Age (16) Setting (1)
Wu 2016[85]	The effect of interventions targeting screen time reduction: A systematic review and meta-analysis.	n	n	n	14	2	12: Age (4) Setting (5) Follow-up (1) Not treatment (2)
Yoong 2016[86]	Systematic review and meta-analysis of interventions targeting sleep and their impact on child body mass index, diet, and physical activity.	n	y (eth)	n	8	1	7: Age (5) Setting (1) Follow-up (1)
Zalewski 2015[87]	The effect of glucomannan on bodyweight in overweight or obese children and adults: a systematic review of randomized controlled trials.	n	n	n	6	0	6: Age (6)

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Annex 3

Text on social disparities in 81 studies of paediatric obesity treatment

Study (ref)	Statements
Alves 2008[88]	*The socio-economic and biological characteristics of the participants, in-line with the intervention and control groups, are in Table 1. There weren't any significant differences between groups in relation to age, BMI, number of siblings or place of residency, school attendance, income per capita, maternal years of schooling, daily hours spent watching TV and present in the home of a TV and refrigerator.* *Our study, despite being a randomised and controlled design, focused on marginalised socio-economic populations and that lives in a food-risk situation, presents some methodological limitations.* ["As características socio-economicas e biológicas dos participantes, de acordó com os grupos intervencao e controle, enctram-se na Tabela 1. Nao houve diferencia significativa entre os grupos em relacao a idade, IMC, numero de irmaos no domicilio, cor, frecuencia a escola, renda per capita, anos de escolaridade materna, hora diarias gastas assistindo a TV e presenca no domicilio de TV e refrigerador." "Nosso estudo, apesar de ter tido um desenho randomizado e controlado, focalizando uma populacao socio-economicamente marginalizada e que sobrevive em uma situacao de risco alimentar, apresenta algunas limitacoes metodológicas."]
Aragona 1975[89]	*"The amount of money deposited was based on a sliding scale of income versus number of dependents. For example, a family with four dependents and a $9000 annual net income would deposit $36 for the 12-week treatment period; a family with six dependents and a $7000 annual income would deposit $12. The range of deposits was $12 to $30. Parents were also told that if they dropped out of the program without first consulting the experimenters, their deposits would not be refunded."* *"Parents in the response-cost plus reinforcement group also kept a daily food diary and graphed daily caloric intake and weight of their children. These parents were given a response-cost contract that required them to deposit a specified amount of money with the experimenters. Since treatment consisted of a 12-week period, these parents were required to deposit a sum equal to 12 times the amount of the weekly level set by the sliding-income scale. They could redeem the money in 12 weekly instalments as follows: 25% weekly for attendance, 25% weekly for bringing completed graphs and charts to the meeting, and 50% weekly for their child losing the predetermined amount of weight as set by the contract.* *"Every six weeks the unearned, surplus money was divided among successful parents, who received bonus money, the amount being determined by how often during the preceding six weeks their child had met weight-loss criterion."* *"The children in the response-cost plus reinforcement group lost an average of 11.3 pounds. Children in the response-cost only group averaged a weight loss of 9.5 pounds; children in the control group gain 0.9 pounds. This analysis showed a significant effect for treatment ($F=12.42$, $df = 2/9$, $p<0.01$)."*

	"A Newman-Keuls test for unequal n's (Winer, 1971) was performed between all pairs of mean net gains or losses. This test indicated that the response-cost plus reinforcement, and response-cost only groups, lost significantly more weight than the control group ($p < 0.01$ and $p < 0.05$ respectively), but were significantly different from one another." *"The present study demonstrated that behavior-modification techniques can be successfully used to enable parents to help their children lose weight. At the end of treatment, there was no significant difference between the two experimental groups, probably because parents in the response-cost only group reinforced their children's weight loss."*
Barkin 2011[33]	Not discussed
Bathrellou 2010[90]	Not discussed
Benestad 2016[91]	*"Limitations include the predominance of European white children and the lack of data on socioeconomic status and adherence to the follow-up in the municipalities."*
Berry 2014[92]	*"Obesity in ethnically diverse low-income children and adults continues to increase. Interventions that improve children's and parents' nutrition and exercise knowledge and teach coping skills are needed. This study was designed to provide ethnically diverse low-income children and parents with a strong foundation in nutrition and exercise knowledge and help them learn problemsolving."* *"Exercise behaviors appear to be hard to change, particularly in low-income households and single-parent families and for adults working multiple jobs. A number of factors may influence children's activity, such as being a 'latch-key' child, neighbourhood safety, lack of facilities or opportunities, or lack of parental support."*
Bocca 2012[93]	Not discussed
Boles 2010[94]	Not discussed
Broccoli 2016[27]	Motivational interviewing *"had a positive long-term effect on b. 0–24BMI in children whose mother had a high (b. 0–24BMI −0.73% [95%CI −1.65 to 0.18]) or medium (b. 0–24BMI −0.31% [95% CI −0.74 to 0.13]) level of education, whereas it had a negative long-term effect in children whose mother had a low level of education (b. 0–24BMI 0.66% [95% CI 0.08 to 1.23) (interaction test P = .008). The same results were observed in the short term."* Mothers' education had an *"important role in determining the outcome. Whereas benefits disappeared after the 12-month follow-up visit for children whose mothers had spent >13 years at school, the effects of intervention seem counterproductive in the long term for children whose mothers had received <13 years of education."*
Cohen 2016[95]	*"StnTx had families with lower household incomes ($p = 0.018$) and fathers with lower education ($p = 0.005$) compared to ModTx and Ctrl."* *"There were imbalances in family income and father's education."*
Collins 2011[96]	Not discussed
Davis 1994[97]	Not discussed
Dalton 2013[98]	*"The inclusion of a lower SES sample (i.e., majority enrolled in public health insurance) and utilization of a nationally recommended program (i.e., NIH We Can!) may also be considered strengths.*
Davis 2011[99]	Not discussed

Davis 2013[34]	Not discussed
de Mello 2004[100]	*"57.9% of them came from families with a family income of up to six times the national minimum wage."*
de Niet 2012[101]	Not discussed
Duffy 1993[102]	Not discussed
Epstein 1981[103]	Not discussed
Epstein 1985[104]	Not discussed
Epstein 2004[105]	*"The mean (+- SD) Hollingshead Four Factor Index of Social Status score for these families was 45.6 +- 10.20."*
Epstein 2008[28]	*"Socioeconomic status was a statistically significant moderator of zBMI change (group x SES x months; P=.01). This effect was explored by dividing the sample based on SES into 2 groups at the mean SES and by examining changes in zBMI by group. For the low SES group, statistically significant between-group differences were observed from baseline to 6 months (P=0.002), 12 months (p=.02), 18 months (P=.04), and 24 months (P=.05), while no statistically significant between-group differences in zBMI change were observed for the high SES group."* *"The changes in zBMI were moderated by child SES, with the intervention working best for families of lower SES. Children from families of higher SES showed reductions in zBMI whether they were in the intervention group or the control group. Families of lower SES showed large and sustained zBMI differences between the intervention and control families throughout the 2 years of measurement of -0.17, -0.20, -0.17, and -0.26 at 6, 12, 18, and 24 months respectively. The observation that the intervention worked better for families of low SES are at greater risk of becoming obese adults than children of higher SES. Perhaps families of higher SES were more aware than families of lower SES of information linking television viewing to weight in children, and perhaps families of higher SES had the familial resources and parenting skills needed to modify television viewing without use of TV allowance. No differences in family characteristics between groups of lower SES vs higher SES were found, including no difference in the breakdown among families of minority races/ethnicities in the lower (22.6%) and higher (22.2%) SES groups. Future research should explore differences between SES groups that may mediate these effects."* *"Data on use of the television and computer, such as to entertain children or for educational purposes, may provide insights into how reducing television and computer use moderated the effects of the intervention among families of lower SES."*
Esfarjani 2013[106]	Not discussed
Farpour-Lambert 2009[107]	Not discussed
Gerards 2015[108]	Not discussed
Ghergherehchi 2012[109]	Not discussed
Golan 1998++[29,32,110]	*"The correlation analyses suggested that a better economic status was related to a better treatment outcome in both the experimental and control groups." (1998)*

	"It may be that families with higher socioeconomic status may benefit more from parent training (experimental program) than families from a lower socioeconomic level. Further research is needed to investigate the effectiveness of the proposed intervention in a socioeconomic class other than the middle class." (1998) *"There were also no differences in socioeconomic status, parental education and occupation." (1998)*
Golan 2006[111]	*"No statistically significant differences between the groups were detected in any of the baseline characteristics measured, including socio-economic status."*
Goldfield 2001[112]	Not discussed
Golley 2007[30]	*"There were no significant differences in socioeconomic status (SEIFA indices) between children who enrolled in the study and the 151 who were screened but did not enrol (P > .05)."* *"There was no association between change in BMI z score from baseline to 12 months and indicators of socioeconomic status (all SEIFA indices, P > .05)."*
Graves 1988[113]	Not discussed
Haemer 2013[114]	*"Other characteristics may be associated with treatment success, including parental weight status or more detailed measures of socioeconomic status than insurance status."*
Hamilton-Shield 2014[115]	*"Details of families randomised to the intervention, and who had agreed to be approached about the qualitative study, were sent to the qualitative team. The intervention was then to purposefully sample families who varied in relation to age and gender of the study child, and whether or not the study parent was obese. Within this sampling approach, we aimed for maximum variation in relation to social class and ethnicity."*
Hughes 2008[116]	*"The cost (for 1 patient) of delivering the novel intervention was £108 ($192 US) and £29 ($52) for the standard treatment."* *"Systematic reviews have recommended that future treatment programs be both generalizable and evidence-based, using the elements of treatment likely to be most effective from previous studies. In addition, treatment programs that use a more behavioural approach to changing lifestyle in children are more likely to be successful in the treatment of overweight and other chronic childhood diseases than more traditional, didactic approaches to treatment; therefore, we used these recommendations to develop a generalizable, best-practice behavioral intervention delivered by a single paediatric dietitian in an office-based setting, thereby making the manpower burden and treatment costs generalizable (less than $200 per patient)."*
Iannuzi 2009[117]	*"There was a similar distribution of socioeconomic status in the two groups of children as assessed by their parents' educational qualification."*
Janicke 2016[118]	*"We implemented a brief intervention due to concerns that barriers to attending weekly meetings for low-income families would make it difficult to attend a longer program. Despite our efforts to reduce these barriers, participant attendance at the BFI group meetings (55%) was lower than expected.* *"The lower than expected rates of participants attendance are consistent with the pediatric weight-management literature, which shows poor attendance and treatment completion for families of children enrolled in Medicaid (Zeller et al., 2004). It is likely that a variety of life circumstances commonly experienced by families from economically disadvantaged backgrounds made attending weekly treatment*

	sessions on a consistent basis difficult for participants. A number of participating parents and guardians reported changing jobs, taking a second job, or changing working schedules that required shift hours that greqtly limited session attendance. Some families reported transportation difficulties due to automobile troubles and inadequate finances to pay for car repairs, or because they were dependent on others for car rides to treatment meetings. A surprising number of families missed meetings because of illness or poor health of family members. These stressors also often lead to practical considerations for families. Most notably, a number of single parents reported that because they worked two jobs or were dealing with other family health issues or stress, they had limited time to prepare healthier meals. Rather, they served or purchased meals based on convenience." *"Beyond individual family factors, there were community-level factors associated with living in economically disadvantaged areas that appeared to impact participants' abilities to fully participate in the intervention."* *"Given higher rates of obesity, as well as the lack of resources and effective treatment options available for children and families from economically disadvantaged backgrounds, such BFI programs could increase the services available to families."*
Kalavainen 2007[119]	*"Social class was defined by the highest school education achieved by either the mother or father: 'low' to those who attended school for ≤ 9 years; 'middle' to those who attended school for 10-12 years; and 'high' to those who achieved an advanced level of education (≥13 years)."* *"For the remaining 69 cases, multivariate analyses were performed with adjustment for gender, baseline weight for height, mother's BMI and social class of the family."* *"In the analysis of covariance, the difference between the two treatment groups remained significant for BMI changes, and among the selected confounders (gender, mother's BMI, social class of the family and baseline BMI), there were no significant associations with BMI change."*
Kelishadi 2008[36]	Not discussed
Kelishadi 2009[120]	Not discussed
Kirk 2012[37]	Not discussed
Lanigan 2013[121]	Not discussed
Larsen 2015[122]	Not discussed
Lochrie 2013[38]	*"Attrition did not differ significantly between the IG and EF. Of the 130 families who were randomized, 88 (45 IG; 43 EG) completed the post-treatment evaluation, and 72 (32 IG; 40 EG) completed the follow-up evaluation. Compared with those who completed the study, those who did not completed the study had significantly lower SES, were less likely to be living with both biological parents, and caregivers were less likely to be married."* *"With regard to SES, our sample was a middle-class sample. Future studies should address having more availability and flexibility in scheduling of sessions and locations of sessions to engage more low-SES families. This impact would be better assessed and addressed using different resource people and resource mediums."*

Looney 2014[123]	*"Overall child participants were 8.0+- 1.8 years with 68.2% females, and 72.7% white and caretakers were aged 38.8 +- 8.3 years with 35.1% reporting a college degree and 54.8% an annual income greater than $50 000. No significant differences were found between the conditions in demographics."*
Luna-Ruiz 2007[124]	Not discussed
Markert 2014[125]	Not discussed
Magarey 2011[126]	*"The mean Socio Economic Index for Areas was higher for participants from Sydney (1055 +- 80) than participants from Adelaide (999 +- 66). […] There was a significant site effect for BMI z-score only (P=0.004), reflecting the higher baseline values in Sydney compared with Adelaide."*
Mazzeo 2014[127]	*"Programs like NOURISH are needed as most previous research has not included samples with large numbers of African American and low-income families (Golan & Cros, 2004; Janicke et al., 2009), not targeted parents exclusively (Epstein, Valoski, Wing, & McCurley, 1994), and not explicitly incorporated material sensitive to African American cultural values (Walker-Sterling, 2005)."*
McCallum 2007[128]	*"The location of participating practices covered the sociodemographic spectrum, with the median practice close to the 50th centile (range from <10th to >90th centile) on the Index of Relative Socio-economic Disadvantage."* *"The strengths of the study include its randomized design, the strong uptake by families and GP practices spanning the range of socioeconomic status, follow-up for more than a year and the high retention ate."*
Moens 2012[129]	*"The familial socio-economic situation was calculated using the Hollingshead Index of Social Position (ISP), which includes parents' education and occupation and results in an ISP-total score and five social position indexes (Hollingshead, 1975). In order to avoid cells with expected count less than five, we recorded the five social position indexes into three social classes (upper and upper middle int o "high", middle into "middle", and lower middle and lower into "low")."* *"Finally, we did not differentiate the outcomes between families who were well positioned to benefit from the program and those who experienced multiple stressors associated with socio economic disadvantage, as suggested in the review by Kitzmann and Beech (2006). Future research should focus on familial predictors of successful weight stabilization in respect of the improvement of family based interventions for childhood obesity, taking into account variability in the larger social context of the family."*
Nova 2001[130]	*"Our study was performed in Northern Italy. As obesity is a multifactorial phenomenon with cultural, ethnical and social components, the conclusions of our report do not automatically apply to obesity control programs in different environmental conditions where further research is needed."*
O'Connor 2013[131]	*"Forty parent-child dyads enrolled from June 2008 to January 2009: the majority were Hispanic (82.5%), Spanish speaking (57%), with a family income less than $30 000/year (65%)."* *"Helping HAND, an intervention in keeping with the 'Prevention Plus' model, was a feasible intervention given low programme attrition (20%), overall participant satisfaction and appropriate content as illustrated by the high percentage of participants selecting each potential behaviour to target. This is noteworthy given the high risk, primarily low-income, Hispanic population. Thus, Prevention Plus interventions in primary care are feasible alternatives to more intensive community or tertiary care treatment programmes (US Preventive Services Task Force & Barton 2010) and should be further evaluated for efficacy and effectiveness in fully powered RCTs."*

	"Targeting parenting practices is a promising intervention for child obesity prevention (Harvey-Berino & Rourke 2003)> While other obesity treatment programmes have been evaluated in paediatric primary care (Sargent et al. 2011), only one (LAUNCH) (Stark et al. 2011) was delivered in clinics and focused on parenting, but targeted primarily white preschool children from higher socioeconomic families." *"Low income, mostly Hispanic families from one regional Medicaid and CHIP Health Plan participated and it is not clear that these findings could be generalized to other ethnic minority children, with other health plans, or in other regions of the USA."*
Parillo 2012[132]	Not discussed
Pedrosa 2011[133]	Not discussed
Quattrin 2012[134]	*"Yearly family income was $65 729 (+- 30 061) with 8.3% of the households reporting a yearly income <$20 000."*
Quattrin 2014[135]	*"The sample included 27% minorities with a mean yearly income of all families of $65 729 +- $3068 (8.3% families <$20 000)."*
Racine 2010[136]	Not discussed
Raynor 2012[137]	*"Families received $20 for completing each of the 6- and 12-month assessments."* *"Attendance at growth-monitoring appointments did not differ among the groups. Compliance with attendance (5.8 +- 2.5 sessions) and turning in monitoring diaries was 72.5%, with no intervention difference occurring. Retention at 6- and 12-month follow-up for ZBMI was 91.9% and 90.1% respectively, with no intervention difference occurring."* *"Results indicated that in both trials, all interventions showed significant improvements in child weight status from 0 to 6 months that were either maintained from 6 to 12 months (Trial 1) or continued to improve from 6 to 12 months (Trial 2)."*
Resnicow 2015[39]	*"Parents reported household income by using 8 contiguous categories that were collapsed into <$40 000 and ≥$40 000."* *"Overall, ~68% of parents reported household income at or above $40 000 income. Approximately 39% of the sample reported at least a college education, with group 2 having lower rates than groups 1 and 3. Group 2 was less likely to have private insurance and more likely to have Medicaid coverage."* *"Loss to follow-up were significantly more likely to be black or Hispanic parents and to come from households with <$40 000 income and lower parental education. They were also more likely to have Medicaid."*
Rifas-Shiman 2017[138]	*"Children in intervention clinics had a higher percent of racial/ethnic minorities (53 vs. 30%), an obese parent (61 vs. 44%) and lived in lower income households (35 vs 20% ≤$50 000/year)."*
Saelens 2013[139]	Not discussed
Shalitin 2009[140]	*"The participation of both sites allowed us to include participants from the center of the country (SCMC) and from its southern part (Soroka Medical Center). The cultural background of the participants from the two areas does not differ, whereas the socioeconomic status of the population from the center of the country is usually higher than that form the southern part, although we did not evaluate this among our participants."*
Siwik 2013[141]	Not discussed
Stark 2011[142]	*"We estimate that the cost of providing this intervention would be $1,276 based upon estimates that 10 group therapy sessions as $75.00 each would be $750.00 and 8 home visits estimated at $65.80 each. The cost of home visits were estimated using the Bureau of Labor*

	Statistics of the 75th percentile hourly rate for a social worker ($29.25) plus 50% overhead ($14.63) for an hourly rate of $43.87, for an average charge of $65.80 per 90-min home visit. This seems a reasonable cost given the high cost of treating the health conditions associated with obesity. Moreover, while this intervention is approximately $1,100 more than the cost of a detailed office visit with a paediatrician (approximately $150), LAUNCH was more effective in reducing obesity than the one-time visit."
Stark 2014[143]	Not discussed
Small 2014[144]	Not discussed
Taveras 2011[31]	*"In post-hoc stratified analyses, we observed statistically significant intervention effects on BMI among females (-0.38 kg/m^2; 95% CI: -0.73, -0.03) but not males (0.04kg/m^2; 95% CI: -0.55, 0.63; p=0.89) and among participants in households with annual incomes $50,000 or less (-0.93 kg/m^2; 95% CI: -1.60, -0.25; p=0.01) but not in higher income households (0.02 kg/m^2; 95% CI: -0.30, 0.33; p=0.92)."*
Taveras 2015[145]	Not discussed
Taylor 2015[146]	Not discussed
Theim 2012[41]	Not discussed
Van Grieken 2013+[147,148]	Not discussed
Vignolo 2008[149]	Not discussed
Wafa 2011[150]	Not discussed
Wake 2009[151]	*"The location of participating practices covered the sociodemographic spectrum, with the median practice close to the 50th centile (range from <10th to >90th centile) on the Index of Relative Socio-economic Disadvantage."* *"Strength of the study include it randomised design, the objective measures of anthropometry and physical activity, the strong uptake by families and GP practices spanning the range of socioeconomic status, follow-up for a full year, and the extremely high retention rate."*
Wake 2013[42]	Not discussed
Walker 2012[43]	*"Other barriers such as travel distance to our clinic and low socioeconomic status may have also contributed to the drop out rate."*
West 2010[44]	*"Analyses were not conducted at the level of site due to several factors: firstly, all sites were in the same city that drew on the same general population (no rural vs. urban differences); secondly, the same therapist was used to run all groups across all sites reducing the likelihood of site-by-therapist interactions; and thirdly, all sites were mixed with respect to SES status of parent. Other Triple P trials (e.g., Leung, Sanders, Ip, & Lau, 2006; McTaggart & Sanders, 2007) show little evidence that SES predicts treatment outcome of parents completing Group Triple P."* *"Although the sociodemographic characteristics of the sample were typical for the Australian general population, participants were mainly white, well-educated parents with moderate levels of employment and income. The sample included some sole-parent and low-income families, and some children of mixed ethnicity; however, further research is needed to clarify whether similar findings would be obtained with higher-risk families (e.g., families experiencing poverty, minority families or parents form non-English speaking backgrounds."*
Wilfley 2007[152]	Not discussed

Williams 2010[153]	*"Significant differences between the attendance groups were observed in terms of income (F[2 ,154] = 5.16, p<.01), such that noncompleters had lower incomes than partial completers and completers. No differences in income were found between partial completers and completers."* *"One-way analysis of covariance was used to test for differences in family functioning between the 3 attendance groups, controlling for race/ethnicity, parent marital status, and income."* *"Sociodemographic factors appear to play a significant role determining the extent of families' participation. Lower family income and living in a single parent household were both associated with poorer session attendance. These influences represent structural factors that likely serve as barriers to regular attendance through their association with problem such as lack of transportation and child care."* *"treatment programs targeting high risk, economically disadvantaged obese youth should consider cultural factors that affect participation as well as structural barriers to treatment participation."*
Wright 2012[154]	*"Both groups were similar in that there were more girls, more children from the 4th grade, and more parents with an elementary school education and with an annual income at or below the federal poverty level of $0-$15K/year."* *"Process measures through focus groups indicated that by 12-months post-intervention, parents perceived that coordination of the program at the school level was high, with excellent support from the school principal and active participation of school administrators, community and parents. This, coupled with the fact that 251 children participated in 50% or more of the intervention, indicates that there is great interest and support from the schools, and thus feasibility of implementing the program is high for schools that are similar in racial/ethnic, geographic, and income status."* *"Although children from lower SES populations have been found to have higher rates of obesity, few research studies, like the current study, have been conducted in these populations, and fewer have been done in Mexican-American populations. Additional studies in low-income racial/ethnic populations should be done to understand further the effects of CSHP on these populations."* *"This intervention holds great promise in preventing obesity among Mexican-American children living in low-income communities."*