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REVIEW

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The impact of Allied Health Professionals on the primary and secondary prevention of obesity in young children: A scoping review

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Summary

Allied Health Professionals (AHPs) have the capacity to promote healthy behaviours in young children through routine 'contact points', as well as structured weight management programmes. This scoping review aims to evaluate the impact of AHPs in the prevention of obesity in young children. Databases were searched for relevant evidence between 1st January 2000 and 17th January 2022. Eligibility criteria included primary evidence (including, but not limited to; randomized controlled trials, observational studies, service evaluations) evaluating the impact of AHPs on the primary and secondary prevention of obesity in young children (mean age under 5 years old). AHP-related interventions typically demonstrated improvements in outcomes such as nutritional behaviour (e.g. lower sweetened drink intake), with some reductions in screen time. However, changes in weight outcomes (e.g. body mass index (BMI) *z*-score, BMI) in response to an AHP intervention were inconsistent. There was insufficient data to determine moderating effects, however tentative evidence suggests that those with a lower socioeconomic status or living in an underprivileged area may be more likely to lose weight following an AHP intervention. There was no evidence identified evaluating how AHPs use routine 'contact points' in the prevention of obesity in young children. AHP interventions could be effective in optimizing weight and nutritional outcomes in young children. However, more research is required to determine how routine AHP contact points, across the range of professional groups may be used in the prevention of obesity in young children.

KEYWORDS
Allied Health Professionals, childhood obesity, exercise, nutrition, physical activity, weight management

1 | INTRODUCTION

According to the World Health Organization (WHO), an estimated 39.2 million children under the age of 5 years old were living with overweight or obesity in 2019.[1] Living with overweight and obesity in childhood may lead to the development of several comorbidities including musculoskeletal conditions,[2] cardiovascular risk factors (e.g. hypertension, insulin resistance and hyperlipidaemia),[3]

respiratory conditions (e.g. sleep apnoea and asthma)[4,5] and digestive diseases (e.g. non-alcoholic fatty liver disease).[6] There may also be subclinical alterations in relation to cardiovascular (e.g. cardiac morphology and function)[7,8] and metabolic outcomes (i.e. physiological indicators of metabolic syndrome)[9] in children and adolescents living with obesity. Obesity in childhood may also track into adulthood,[10] and manifest into non-communicable diseases such as type 2 diabetes and cardiovascular disease.[11,12] As such, the prevention of childhood obesity is a public health priority. Children under 5 years are undergoing a key period of development in which they are constantly learning and adhering to new behaviours, which provides an ideal opportunity to promote healthy weight-related behaviours, potentially preventing the incidence of obesity later in life.[13]

All healthcare professionals and organizations have a role to play in promoting the health and wellbeing of the population. In England, this is guided by the 'Make Every Contact Count' (MECC) approach to behaviour change, in which every interaction between healthcare professionals/organizations and the public should be seen as an opportunity to engage in conversations regarding health.[14] Included in this are Allied Health Professionals (AHPs), who work across several sectors related to health, social care, education, justice, voluntary sector, housing, academia, business and private practice. These professionals have a strategic role in the promotion of health and wellbeing in the early years.[15] The contact points between AHPs and children under 5 years old vary considerably in the type of care, and are primarily coordinated via health visitor referral, where deemed necessary. However, these contact points may represent an ideal opportunity to MECC and promote a healthy lifestyle. In addition, many AHPs have the skillset to both design and implement weight management programmes outside of routine contact points, which may be a useful strategy in the prevention of childhood obesity. As such, it is necessary to evaluate the role of AHPs in the prevention of childhood obesity in young children. These findings may be useful for guiding both policy and practice. As such, this scoping review aimed to evaluate the evaluate the impact of AHPs in the prevention of childhood obesity in young children.

2 | METHODS

This protocol was prospectively registered on the Open Science Framework (https://osf.io/2kdr6/). The methodological approach to this scoping review was underpinned by the JBI reviewers manual[16] and PRISMA-ScR guidelines.[17]

This work was commissioned by the Office for Health Improvement and Disparities (OHID) to inform UK policy and practice. Subsequent findings are considered and framed with a UK context and similar healthcare systems in mind. Despite this, any findings and associated learning from this study are applicable in multiple international contexts.

2.1 | Search strategy

MEDLINE, PsycINFO, CINAHL and ERIC were searched via EBSCOhost for relevant evidence between 1st January 2000 and 17th January 2022. Date was limited from 2000-present to capture interventions subsequent to the rise in the number of children with overweight, under 5 years old, as outlined by the United Nations Children's Fund, WHO and World Bank estimates.[18] No language restrictions were applied during the searches to overcome any indexing errors, however English language was an inclusion criterion for this review. Searches were conducted using a combination of synonyms, wildcards and relevant MeSH terms for population, weight, allied health professionals and interventions. The full search strategy can be found in Data S1. Grey literature databases, policy and guidance documents, as well as other online resources were searched for evidence. Reference lists of relevant studies and review articles were screened to identify any further eligible studies.

2.2 | Eligibility criteria

The scoping review included any primary evidence (including, but not limited to; randomized controlled trials, observational studies, service evaluations) evaluating the impact of AHPs on the primary (i.e. recruiting children predominantly living with a healthy weight) and secondary prevention (i.e. recruiting children exclusively living with overweight/obesity) of obesity in young children with a mean age of under 5 years old. Additional eligibility criteria included: interventions/programmes/services related to one of the 14 AHP roles, as specified in the 'AHPs into action' strategy document published for 2017–2021.[19] These include: art therapy, podiatry, dietetics, drama therapy, music therapy, occupational therapy, operating department practice, orthoptics, osteopathy, paramedic practice, physiotherapy, prosthetics and orthotics, radiography (diagnostic and therapeutic) and speech and language therapy. Studies included child populations with a mean age under 5 years old to align with the early years foundation stage.[20] Studies reported a relevant weight outcome (e.g. body mass index [BMI], BMI *z*-score, prevalence) in children. Studies included children of any weight status (unless exclusively underweight) to capture both primary and secondary prevention of childhood obesity, as well as to replicate free living populations. Eligible AHP interventions/programmes may be conducted in any relevant setting including primary and secondary care, home, virtual (online), industry, local authority, social care, schools, nurseries and wider community. Eligible studies were conducted geographically where findings were deemed relevant to OHID policy and practice (the prospectively registered eligible areas were: Europe, Australia, Canada and United States). Studies were published and/or available in the English language.

Exclusion criteria included: Systematic reviews, meta-analyses and narrative reviews. Evidence evaluating children who are exclusively underweight were excluded given the differing purpose of

interventions/programmes aimed at those children experiencing 'failure to thrive'.

2.3 | Screening and data extraction

Titles and abstracts of identified papers were screened in duplicate by two independent researchers to evaluate eligibility. Full texts of potentially relevant studies were then retrieved and reviewed in duplicate for eligibility by two independent reviewers, with any disputes resolved by a third reviewer. Where multiple publications of the same intervention/study reported different follow-up durations and findings, all publications were included in the review. Where the most recent publication from an intervention/programme includes all follow-up time points (i.e. reporting data previously published, as well as new data), only the latest publication was included to avoid replication of data in the present review. A standardized, pre-piloted electronic form (Microsoft Excel) was used to extract data. Using the template for intervention description and replication (TIDieR) checklist,[21] the data extracted included specific details about the participants, concept, context, methods and key findings relevant to the review questions. Data was extracted by one reviewer, with a subset (20%) checked for accuracy by a second reviewer (100% accuracy obtained).

2.4 | Data analyses and quality assessment

Data were analysed via narrative synthesis and tabulated results. Primary outcome data included a weight outcome (BMI, BMI z-score, prevalence of obesity), as well as other obesity-related behaviours (nutrition, physical activity, screen time) in response to AHP interventions and/or routine 'AHP' contact points. Nutrition (e.g. fruit and vegetable intake, sweet and savoury snack intake), physical activity (e.g. step count), and screen time (e.g. the amount of sedentary time watching TV, playing on iPads, electronic games devices, etc.), were extracted due to their role in the development of obesity and associated non-communicable diseases.[22,23] Where possible, a variety of moderators such as ethnicity, socioeconomic status, geography, and weight status were described narratively to determine their influence on the effectiveness of interventions.

Due to the variety of study designs in the scoping review, the methodological quality of the studies was assessed using an adapted Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies[24]. Each study was assessed in relation to six criteria: selection bias, design, confounders, blinding, data collection methods, withdrawals and dropouts. Each component was assessed as 'weak', 'moderate' or 'strong'. If a study received a 'weak' rating for two or more components, it was judged to be 'weak' overall. If a study received one 'weak' rating and the rest 'moderate' or 'strong', it was deemed 'moderate', and those with no 'weak' ratings and at least four 'strong' ratings, were deemed 'strong' overall.

3 | RESULTS

3.1 | Study selection

A total of 2485 records were identified from searching MEDLINE, PsycINFO, CINAHL and ERIC databases. After duplicates were removed, 1653 records were screened based on title and abstract. A total of 1624 records were excluded and 29 full texts were retrieved for screening. Following full text review, five studies were identified as eligible for inclusion in the review.[25–29] An additional 12 studies were identified via citation searching of included papers and relevant reviews.[30–41] This number was higher than may typically be expected, largely due to an absence of terminology related to AHPs or AHP-related roles within the title, abstract, key words and indexing of these studies. A total of 17 studies were therefore eligible for inclusion in this review. A PRISMA flow chart of the study selection process can be found in Figure 1. A list of records which were excluded at the full text stage and the reasons for this are included in Table S1.

No grey literature sources were identified for inclusion within this review via manual search. However, discussion with experts/professionals in the area did provide access to an unpublished preliminary report on the 'Jump Start Tots' programme based in Ayrshire, Scotland.[42] In addition, AHP case studies were identified via the UK Royal Society for Public Health.[43] An unpublished conference poster was also provided that evaluated occupational therapist's perceptions of their role in the prevention of childhood obesity.[44] These documents did not meet the eligibility criteria for the present review but are considered within the discussion.

3.2 | Characteristics of included studies

Characteristics of included studies are detailed in Table 1. Additional characteristics are outlined in Table S2 but are summarized here. Of the 17 studies included in this review, 14 were randomized controlled trials,[25–33,35,36,38,40,41] one was a non-randomized observational comparison group design,[39] one was a pre-post-intervention study[37] and one was a cross-sectional quasi-randomized trial.[34] A total of 14 studies evaluated interventions/programmes related to dietitians[26–29,31–33,35–41] and one study evaluated an occupational therapist-related intervention.[25] One study evaluated a multidisciplinary intervention related to dietitians and physiotherapists,[30] and one study evaluated an intervention related to both dietitians and 'other' AHPs.[34] Eight studies were conducted in the United States,[25,28,29,31,37,39–41] six in Australia,[26,27,32–35] one in the United Kingdom,[38] Netherlands[30] and France.[36] Four studies were conducted in a childcare setting (i.e. preschool),[25,31,36,40] five studies in child health clinics or centres,[30,33,37–39] two at first time parents group meetings,[26,32] two online,[27,41] two in primary care paediatric offices[28,29] and two in a multi-setting environment.[34,35] Ten studies recruited children irrespective of weight status,[25,27–29,34–37,40,41] five did not report the weight status of children,[26,31–33,39] one study recruited only children living with overweight and obesity,[30] and one

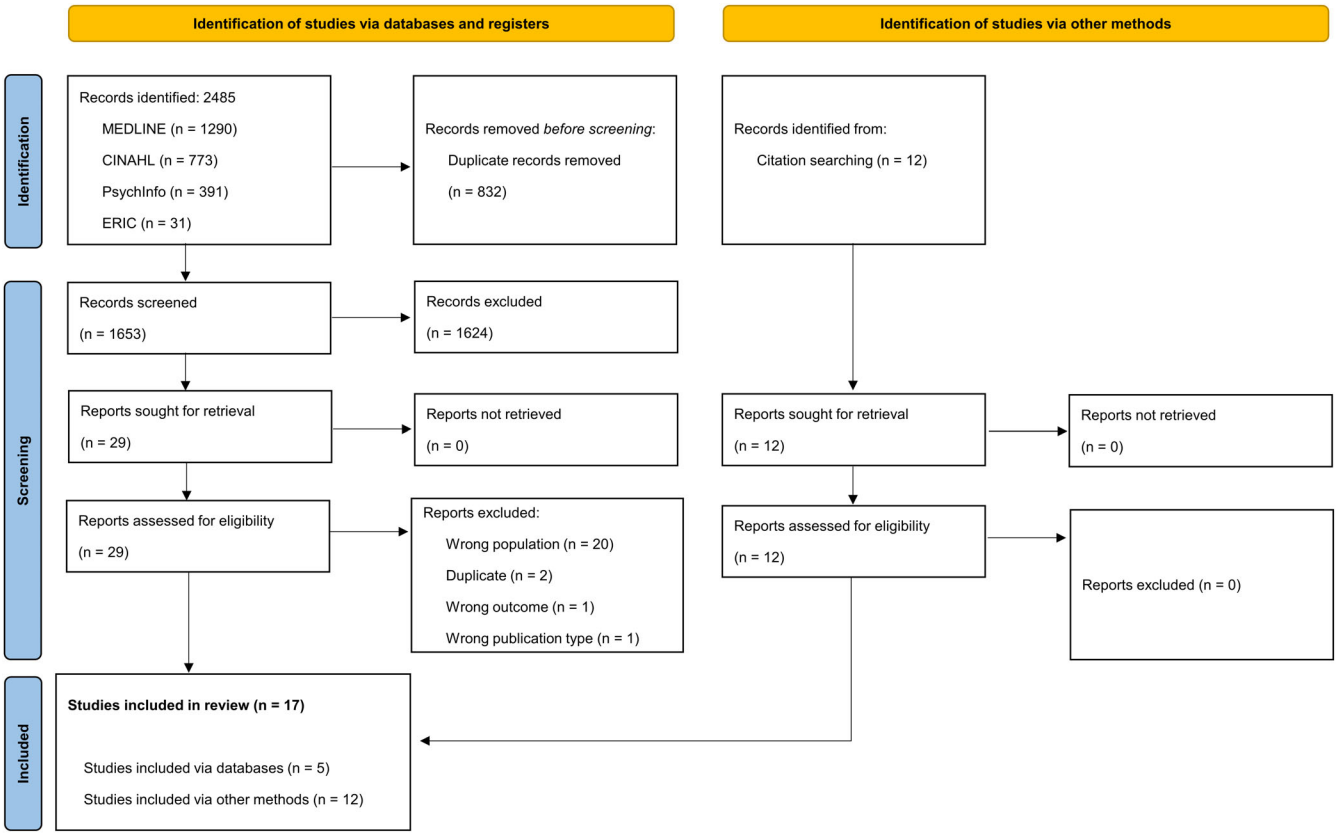

FIGURE 1 PRISMA flow chart

study conducted a direct comparison between children living with overweight/obesity and mixed weight status.[38] Intervention duration ranged from 6 weeks to 3 years (mean = 8.3 months). Follow-up duration ranged from 6 weeks to 3.5 years (mean = 15.9 months). Mean age of participants ranged from 6 days to 4.9 years. Overall, there was a mean of 48% boys and 52% girls included in this review.

Of the 17 studies, 11 reported BMI *z*-score.[25,26,29,30,32–36,38,40] Of those that did not report BMI *z*-score, three reported BMI for age percentile,[28,37,39] and three reported BMI.[27,31,41] A total of 10 studies also reported on a nutrition-related outcome,[26–30,32,34,37,38,40] 12 studies reported on a physical activity outcome,[25–27,29–32,34,37,38,40,41] six studies reported on a screen time-related outcome[26–29,32,34] and six studies reported other variables (sleep, parent feeding practice, gross motor skills).[25,27,29,33,38,41]

A summary of weight outcomes, as well as nutrition and physical activity are outlined in Table 2. These findings are presented in full in Table S3, with the addition of screen time, maternal feeding practice, gross motor skills and blood pressure.

Due to the different designs of included studies, there is some between study variance in the comparisons made regarding outcome variables (e.g. intervention vs. control group, pre vs. post). To optimize readability, the data are broadly described here, but exact comparisons for each study are detailed in Table 2.

3.3 | Weight outcomes

Of the 11 studies to report BMI *z*-score, seven studies reported no change,[25,26,29,32,33,35,40] and four reported a reduction in BMI *z*-score[30,34,36,38] in those exposed to the intervention. In the three studies that reported BMI-for-age percentile, one study showed no change,[28] one study showed a decrease,[39] and one study showed an increase in response to the intervention.[37] In the three studies that reported BMI, all studies showed no difference in response to the intervention.[27,31,41]

Of note, of the 10 studies recruiting children irrespective of weight status (i.e. primary prevention strategies), two reported reductions in a weight outcome,[34,36,39] seven reported no change[25,27–29,35,40,41] and one reported an increase in a weight outcome.[37] Of the two studies recruiting children living exclusively with overweight and/or obesity (i.e. secondary prevention strategies), all studies reported reductions in a weight outcome.[30,38]

3.4 | Obesity-related behaviour outcomes

Of the 10 studies reporting nutrition-related outcomes, nine studies showed some improvement in eating behaviour,[26–29,32,34,37,38,40] whilst only one study showed no change.[30] Of the 12 studies reporting physical activity-related outcomes, nine studies showed no

TABLE 1 Characteristics of included studies

Citation	Study details and country	Setting/location	Programme/ intervention details	AHP role and involvement	Follow-up duration and outcomes
Bellows et al. (2013)[25]	Programme evaluation (RCT) Mighty moves (United States)	Childcare (preschool)	PA intervention delivered by classroom teachers to children 18 weeks, 4 day/ week, for 15 min	Occupational therapist designed intervention and trained/supported teachers	18 weeks BMI *z*-score, BMI, gross motor skills, step count
Bocca et al. (2014)[30]	Programme evaluation (RCT) (Netherlands)	Groningen Expert Center for Kids with Obesity Outpatient Clinic	Multidisciplinary lifestyle intervention programme for parents (dietary and counselling) and children (dietary and PA) 16 weeks, dietary advice (6× 30 min), PA (12× 60 min), counselling (6× 120 min)	Dietitian and physiotherapist delivered/guided intervention	12, 18 and 36 months BMI *z*-score, body composition, nutritional intake, PA
Bonis et al. (2014)[31]	Programme evaluation (RCT) NAP SACC programme (United States)	Childcare (preschool)	Nutrition and PA education to childcare staff and parents/carers 6-month intervention, 4 workshops	Dietitian provided training, support and materials to staff and parents	6 months BMI, waist circumference, PA
Campbell et al. (2013)[26]	Intervention (RCT)	First time parents group meetings	Infant feeding, PA and sedentary behaviours intervention for new parents	Dietitian delivered the intervention	16 months,[26] 2 and 3.5 years[32]
Hesketh et al. (2020)[32]	Melbourne INFANT programme (Australia)		15-month intervention, 6× 2-h sessions		BMI *z*-score, nutritional intake, PA, screen time
Daniels et al. (2015)[33]	Intervention (RCT) NOURISH trial (Australia)	Child health clinics (mothers recruited on postnatal wards)	Healthy eating intervention for parents 6 months, 2× 12-week modules (6 sessions per module)	Dietitian delivered intervention	6 months, 2 and 3.5 years BMI *z*-score, maternal feeding practice
de Silva-Sanigorski et al. (2010)[34]	Programme evaluation (Cross-sectional quasi-experimental design) Romp and Chomp (Australia)	Multi-setting (childcare, health services, sports coordinating bodies, home-based)	Community-wide nutrition and PA programme targeted at children and families Large scale, 4-year intervention	Dietitian and 'other' AHPs provided support and implemented aspects of the programme	3 years (based on anthropometric measures) BMI *z*-score, BMI, weight status Nutritional intake, PA, screen time
Hammersley et al. (2019)[27]	Programme evaluation (RCT) Time2bHealthy (Australia)	Online	Nutrition, PA, screen time and sleep programme for parent and child. 6 months, 6 online modules completed over 11 weeks followed by 12 weeks support	Dietitian designed the sessions and provided support to participants	6 months BMI, nutritional intake, PA, screen time, sleep, parent feeding practice
Hart et al. (2016)[35]	Programme evaluation (RCT)		Healthy body image and eating pattern,	Dietitian designed some resources	6 weeks BMI *z*-score

(Continues)

TABLE 1 (Continued)

Citation	Study details and country	Setting/location	Programme/ intervention details	AHP role and involvement	Follow-up duration and outcomes
	Confident body, confident child (Australia)	Home based with independent workshops	family-based programme. 6-week access to resources (booklet, poster, book, website, 2-h workshop)		
Jouret et al. (2009)[36]	Intervention (RCT) (France)	Childcare (preschool)	Nutrition, PA and screen time education programme for parents and teachers 2 years, 10× 20 min sessions	Dietitian designed and implemented educational sessions	2 years BMI *z*-score, prevalence of overweight
Klohe-Lehman et al. (2007)[37]	Programme evaluation (pre vs. post intervention study) (United States)	Free classes for mothers (recruited from WIC, and public health clinics)	Nutrition, PA and healthy lifestyle behaviour programme for mothers 8 weeks, weekly 2-h sessions	Dietitian led the sessions	24 weeks (BMI), 8 weeks (all other) BMI for age percentile, Nutritional intake, PA
Lanigan et al. (2016)[38] *Additional data obtained from Lanigan* et al. *(2013)*[45]	Programme evaluation (RCT) TrimTots (United Kingdom)	Sure start centres (health, learning and childcare)	A multicomponent, family-based programme including diet, PA, and behaviour change 6-month intervention, twice weekly, 2-h sessions	Dietitian	2 years BMI *z*-score, PA, eating behaviour
Machuca et al. (2016)[39]	Programme evaluation (non-randomized observational comparison group design) (United States)	Health centre (Well Baby Group)	Nutrition, responsive parenting, supportive family relationships, and maternal mental health intervention for mothers ∼18 months, 11 group care sessions	Dietitian led the group sessions	∼2 years BMI for age percentile
Natale et al. (2014)[40]	Programme evaluation (RCT) Healthy Inside, Healthy Outside (HI-HO) (United States)	Childcare (preschool)	Nutrition, PA and screen time intervention for parent, teacher and child 6-month intervention, teacher (2× PA training session), parent (monthly nutrition and PA educational dinner, newsletters, 6× home activities)	Dietitian delivered parent-based sessions on nutrition	3, 6 and 12 months BMI *z*-score, nutritional intake, PA
Schwartz et al. (2007)[28]	Programme evaluation (RCT) (United States)	Primary care paediatric offices	Motivational interviewing intervention targeted at parents 6-month intervention, motivational interview session at months 1 and 3	Dietitian delivered the intervention	6 months BMI percentile, nutritional intake, screen time

TABLE 1 (Continued)

Citation	Study details and country	Setting/location	Programme/ intervention details	AHP role and involvement	Follow-up duration and outcomes
Sun et al. (2017)[41]	Programme evaluation (RCT) (United States)	Online	Nutrition, PA, screen time tablet-based intervention targeted at families 8-week intervention, weekly 30-min interactive online modules	Dietitian designed the resources and somewhat involved in delivery	3 and 6 months BMI, child feeding, FEAHQ, PA
Tucker et al. (2019)[29]	Programme evaluation (RCT) (United States)	Primary care paediatric offices	Nutrition, health behaviour and counselling intervention targeted at parents and children 6-month intervention, 4× monthly visits with dietitian, health behaviour conversations with physician, counselling with social worker	Dietitian delivered educational sessions on healthy behaviours and nutrition	6 months BMI, BMI z-score, FNPA, PA, screen time, sleep, parent feeding practice

Abbreviations: AHP, Allied Health Professionals; BMI, body mass index; PA, physical activity; FEAHQ, Family Eating and Activity Habits Questionnaire; FNPA, food, nutrition and physical activity questionnaire; RCT, randomized controlled trial.

improvement in response to the intervention,[25–27,29,30,32,34,40,41] whilst three studies showed increases in physical activity.[31,37,38] Of the six studies to report screen time, three showed reductions in screen time in response to an intervention,[26,29,34] whilst the other three showed no change in screen time.[27,28,32] Of the studies to report other outcomes, four showed improvements in maternal feeding practice (i.e. the behaviour of the mother that influences children's eating),[27,29,33,41] one study showed improvements in gross motor skills[25] and one showed reductions in blood pressure.[38] Two studies showed no change in sleep-related outcomes.[27,29]

3.5 | Moderating factors

Due to substantial heterogeneity in reporting, it was not possible to provide an assured narrative synthesis on the impact of sociodemographic characteristics such as ethnicity, geography or socioeconomic status. However, individual studies provide included in this review provide some insight into the influence of socioeconomic status and weight status. In this regard, Jouret et al.[36] found that a multidisciplinary intervention in children who lived in underprivileged areas significantly reduced BMI z-score and the prevalence of overweight, whereas no change in these outcomes was observed in those children not living in underprivileged areas. In addition, Klohe-Lehman et al.[37] conducted a weight loss intervention for mothers and determined the subsequent effects on the prevention of obesity in their infant offspring. They demonstrated that the children of mothers with less than a high school education were more likely to have a child whose BMI-for-age percentile decreased in response to the intervention, compared with mothers with partial college or college education. With regards to weight status, Lanigan et al.[38] demonstrated that a multidisciplinary intervention significantly reduced BMI z-score and waist circumference in children living with overweight and obesity, but no differences were observed when recruiting children irrespective of weight status.

3.6 | Methodological quality of included studies

Twelve studies included within this scoping review were judged to be weak in relation to the quality assessment[25,26,29–32,34–37,39,40] (Table S4). This was largely due to the lack of blinding of participants and/or study personnel to intervention and/or research question, as well as a lack of evidence provided in relation to the validity and reliability of data collection tools related to BMI (i.e. stadiometers, scales). Specifically, studies generally did not report validity and reliability measures of tools utilized, as would be expected to be deemed moderate or strong for the 'data collection methods' criterion. The remaining five studies achieved a moderate score for quality assessment.[27,28,33,38,41] There were no included studies that received an overall quality assessment score of strong. Studies generally performed well in relation to selection bias, design, confounders and withdrawals/dropouts.

TABLE 2 Summary of main findings

Citation	Weight outcomes	Nutrition	Physical activity
Bellows et al. (2013)[25]	*Intervention* vs. *Control* BMI *z*-score: ↔	NR	*Intervention* vs. *Control* PA behaviour: ↔
Bocca et al. (2014)[30]	*Intervention* vs. *Control* *Overall* BMI *z*-score: ↓	*Intervention* vs. *control* *Overall* Nutrition-related behaviour: ↔	*Intervention* vs. *control* *Overall* PA behaviour: ↔
Bonis et al. (2014)[31]	*Intervention* vs. *Control and Pre* vs. *Post* (*Intervention and control*) BMI: ↔	NR	*Intervention* vs. *control* PA behaviour: ↑
Campbell et al. (2013)[26] (16-month follow-up) Hesketh et al. (2020)[32] (2 and 3.5 year follow-up)	*Intervention* vs. *Control* *All time points* BMI *z*-score: ↔	*Intervention* vs. *Control* *All time points* Nutrition-related behaviour: ↑	*Intervention* vs. *Control* *All time points* PA behaviour: ↔
Daniels et al. (2015)[33]	*Intervention* vs. *Control* (*group and group x time effect*) *All time points* BMI *z*-score: ↔	NR	NR
de Silva-Sanigorski et al. (2010)[34]	*Intervention* vs. *Control* *2-year-old children* BMI *z*-score: ↔ *3.5-year-old-children* BMI *z*-score: ↓	*Intervention* vs. *Control* Nutrition-related behaviour: ↑	*Intervention* vs. *Control* PA behaviour: ↔
Hammersley et al. (2019)[27]	*Intervention* vs. *Control* BMI: ↔	*Intervention* vs. *Control* Nutrition-related behaviour: ↑	*Intervention* vs. *Control* PA behaviour: ↔
Hart et al. (2016)[35]	*Intervention* (*resource and workshop*) vs. *Control* BMI *z*-score: ↔	NR	NR
Jouret et al. (2009)[36]	*Intervention* (*EPIPOI-2*) vs. *control* BMI *z*-score Not in underprivileged area: ↔ Underprivileged area: ↓	NR	NR
Klohe-Lehman et al. (2007)[37]	*Intervention* (*pre* vs. *post*) BMI-for-age percentile: ↑	*Intervention* (*pre* vs. *post*) Nutrition-related behaviour: ↑	*Intervention* (*pre* vs. *post*) PA behaviour: ↑
Lanigan et al. (2016)[38]	*Intervention* vs. *Control* *Children with BMI ≥ 91st centile* *2 years* BMI *z*-score: ↓ *Children with any weight status* BMI *z*-score: ↔	*Intervention* vs. *Control* *Children with BMI ≥ 91st centile* Nutrition-related behaviour: ↑	*Intervention* vs. *Control* *Children with BMI ≥ 91st centile* PA behaviour: ↑ *Children with any weight status* PA behaviour: ↑
Machuca et al. (2016)[39]	*Intervention* vs. *Control* Prevalence of overweight/obesity (BMI-for-age percentile ≥85): ↓	NR	NR
Natale et al. (2014)[40]	*Intervention* vs. *Control* BMI *z*-score: ↔	*Intervention* (*pre* vs. *post*) Nutrition-related behaviour: ↑	*Intervention* vs. *Control* PA behaviour: ↔
Schwartz et al. (2007)[28]	*Intervention* vs. *Control* BMI for age percentile: ↔	*Intervention* vs. *control* Nutrition-related behaviour: ↑	NR
Sun et al. (2017)[41]	*Intervention* (*pre* vs. *post*) BMI: ↔	NR	*Intervention* vs. *Control* PA behaviour: ↔

TABLE 2 (Continued)

Citation	Weight outcomes	Nutrition	Physical activity
Tucker et al. (2019)[29]	*Intervention* (*pre* vs. *post*) BMI *z*-score: ↔	*Intervention* (*pre* vs. *post*) Nutrition-related behaviour: ↑	*Intervention* (*pre* vs. *post*) PA behaviour: ↔

Note: Where available, BMI *z*-score has been used as the preferable measure of weight. Where a study has reported a positive change in ≥1 nutrition-related behaviour, this has been deemed an overall positive effect (↑) (e.g. ↑ fruit intake). In addition, where a study has reported a positive change in ≥1 physical activity-related behaviour, this has been deemed an overall positive effect (↑). Effect sizes were deemed directional when the CIs did not span zero. Detailed findings including all variables and comparisons are outlined in Table S4. BMI, body mass index; PA, physical activity; NR, not reported.

4 | DISCUSSION

4.1 | Main findings

This scoping review aimed to examine the impact of AHPs in the prevention of childhood obesity in young children. In response to AHP-related interventions/programmes, findings from the present review demonstrated inconsistent changes in weight outcomes (e.g. BMI *z*-score, BMI, BMI-for-age percentile) in response to an AHP intervention.

There was insufficient data to determine definitive moderating effects, however some individual studies did suggest that those with a lower socioeconomic status or living in an underprivileged area may be more likely to lose weight following an AHP intervention.[36,37] These findings could be attributed to increased sensitivity to interventions in families with low socioeconomic status, due to reduced exposure to healthcare systems and obesity prevention information.[36] These findings are likely important given evidence which demonstrates an increased prevalence of children living with overweight and obesity in most, compared with least deprived areas.[46–48] These data also provide evidence to support the need to fight against health inequalities/disparities. Notably, there was no evidence evaluating how routine 'contact points' are used to prevent obesity in young children.

Findings from this scoping review somewhat contrast data from a large meta-analysis outlining 'moderate' to 'certain' evidence that a combination of diet and physical activity interventions (not exclusively AHP-related) reduced BMI and BMI *z*-score in children aged 0–5 years.[49] The discrepant findings in this review may be attributed to the predominant use of primary prevention strategies (i.e. recruiting children predominantly living with a healthy weight). In such scenarios, maintenance of a healthy weight (i.e. no change in weight outcomes) is likely the optimal outcome. There is tentative evidence to suggest that those studies involved in the secondary prevention of childhood obesity (i.e. recruiting children exclusively living with overweight/obesity) may be effective at reducing BMI *z*-score.[30,38]

Interestingly, Brown et al.[49] demonstrated that single dietary or physical activity interventions alone did not alter obesity-related outcomes in children aged 0–5 years. This highlights the importance of a multidisciplinary approach to the prevention of childhood obesity. In studies identified through this scoping review, that did use multiple AHP roles (e.g. dietitian and physiotherapist), significant reductions in obesity-related outcomes were observed.[30,34]

Some improvements in obesity-related behaviours were observed in children following an AHP intervention, particularly in relation to nutrition outcomes such as lower sugar sweetened snacks and drink intake.[26,32,34,37,40] These findings demonstrate the benefit of AHP-related interventions beyond a weight outcome, as sugar intake has been identified as a risk factor for the development of overweight/obesity later in life.[50] The improvements in nutrition outcomes may be explained by the predominant use of dietetic expertise to design and implement interventions/programmes. Some improvements in screen time were also observed,[26,29,34] which has also been associated with a reduced risk of childhood overweight/obesity.[51] In contrast, more infrequent improvements were observed in physical activity. These inconsistent findings may be a result of minimal AHP input to the design of physical activity interventions. More widespread use of other AHPs such as physiotherapists and occupational therapists may improve the efficacy of these interventions and the associated outcomes.

Collectively, these findings suggest that AHPs may have an important role in promoting healthy behaviours and optimal weight management. Input from AHPs into the design and/or implementation of primary and secondary prevention strategies may contribute to reduced incidence of overweight/obesity in young children. This is of vital importance to public health given the potential development of sub-clinical disease in children living with overweight and/or obesity.[7,8] In addition, obesity may also track into adulthood and lead to the development of clinical disease such as type 2 diabetes.[10–12]

4.2 | Implications for policy and practice

A whole systems approach to the prevention of childhood obesity warrants consideration. This approach encourages local stakeholders, including communities to come together, evaluate current practice and identify opportunities for change. Stakeholders then agree actions to bring about sustainable, long-term systems change.[52] The key steps in facilitating systems level change are outlined in Figure 2. A resource to inform local authorities on a whole systems approach to obesity prevention in the early years foundation stage has been detailed previously.[53] This is largely focussed on universal checks from health visitors and public health nurses, as well as ensuring childcare and education settings are promoting a healthy lifestyle. Data from this scoping review provide support for the use of AHPs for both training

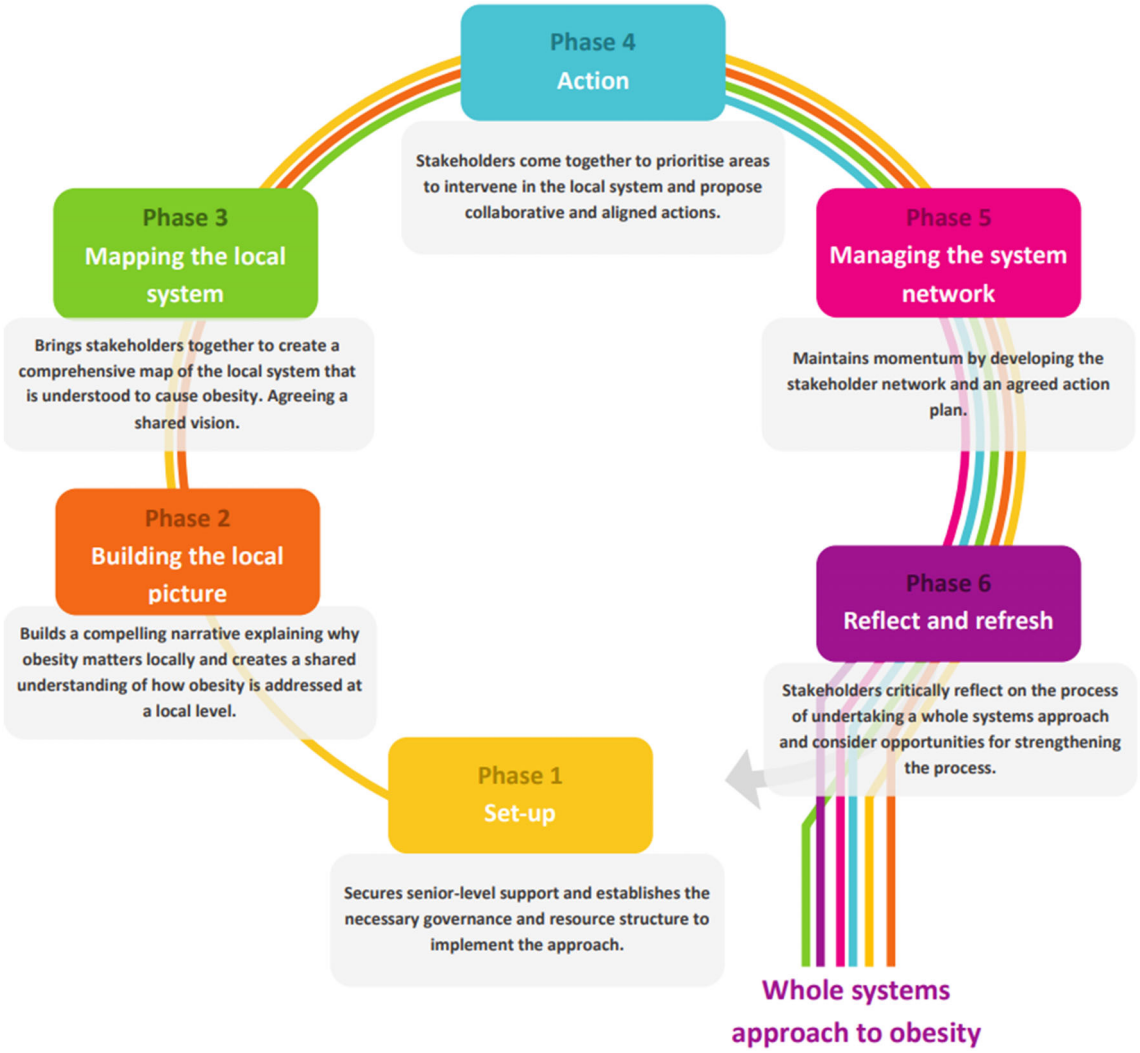

FIGURE 2 Whole systems approach to obesity[52]

staff and/or implementing healthy lifestyle interventions/programmes in a childcare setting. However, it is important to consider these interventions/programmes holistically when integrating into a whole systems approach.[52] A collaborative approach between all stakeholders (AHP bodies, local authorities, childcare/education facilities) could be established to determine the most effective action for AHPs in the prevention of obesity in young children. It is also important to consider the coproduction of relevant interventions with target families to ensure they are tailored to need.

AHP interventions can be integrated into a whole systems approach successfully. The Jumpstart tots programme[42] suggests that health visitors may play a key role in referring children to relevant programmes, such as those included in this review. This has also been demonstrated via the 'Healthy little eaters' dietetic case study, aimed at tackling childhood obesity in the London Borough of Kent.[43] This 8 week programme demonstrated improvements in nutritional outcomes such as fruit and vegetable consumption and salt intake.[43] Similar programmes may be informed by the Medical Research Council and National Institute for Health Research framework to help researchers work with stakeholders to identify key and impactful research questions, and subsequently design and conduct appropriate research.[54] This collaborative approach may overcome some of the limitations of the present review, such as the short follow-up durations.

Whilst there is a lack of research evaluating the role AHPs have in the prevention of childhood obesity during routine 'contact points' with young children, this is clearly still an ideal opportunity to MECC and promote a healthy lifestyle.[14] The biggest barriers reported by AHPs to initiating healthy lifestyle conversations with patients are confidence, context (i.e. the AHPs skill to gauge with the client what lifestyle health conversation is appropriate), time and signposting.[55] Training and improvements to signposting were identified as the most common solutions in overcoming the barrier to these conversations and reiterates the importance of MECC training for AHPs. Surprisingly, 61.5% of AHPs reported not having training on health conversations or MECC as part of a survey conducted by the Royal Society for Public Health in 2015.[55] The requirement for AHP training is further highlighted in a recent conference poster evaluating occupational therapists' perceptions of their role in the prevention of childhood

TABLE 3 A summary of the practical and policy implications discussed within the report, as well as the research recommendations

Practical/policy considerations	Research recommendations
All AHPs (not just dietitians) have a role to play in the prevention of obesity in young children. AHPs may contribute to the prevention of obesity in young children through weight management programmes/services and/or via opportunistic 'contact points'.	Future research evaluating AHP-related interventions/programmes should be developed using the MRC and NIHR framework.[54] Authors of these studies may work with stakeholders to establish the most appropriate methodological approach to evaluate impactful research objectives. These principles are not limited to a research setting and may also apply to other wider obesity work undertaken by relevant stakeholders.
AHPs have the knowledge and skillset to train staff in settings/facilities in which contact with young children is common (e.g. childcare). Trained staff in relevant settings may then lead healthy lifestyle interventions/programmes for these children. AHPs may also implement these programmes themselves	Future research in this area may consider highlighting the role of AHPs in interventions/programmes via enhanced indexing and/or wording of published literature. This would allow for improved detection of AHP-related literature and thus easier synthesis and evaluation of evidence in relation to the role of AHPs in the prevention of childhood obesity.
All AHP governing bodies may consider MECC training to ensure all AHPs are equipped to discuss obesity prevention. In addition, all AHPs should be provided with relevant signposting resources to improve the efficacy of these interactions. This training may also be facilitated by Universities, as well as employers when training students and staff respectively.	Future research may consider evaluating the impact of wider AHP roles in the prevention of childhood obesity.
AHP-related obesity prevention programmes are of benefit for the prevention of obesity in young children, but integration into a whole system (i.e. health visitors, childcare, education, local councils) approach to obesity is important to establish a collaborative and effective approach to the prevention of childhood obesity.	Further research may determine the effectiveness of using routine AHP 'contact points' for healthy lifestyle conversations and the subsequent prevention of childhood obesity.
A compassionate approach to weight management support should be provided in all settings and scenarios. This may be facilitated via use of the Obesity Canada 5 As guidelines for paediatric obesity management.	Further research may be conducted to evaluate how receptive parents of young children are to engage in opportunistic discussions about weight. It may be beneficial to conduct this research in coproduction with both patients and AHPs to determine the barriers and enablers to implementation of these conversations.

obesity in Wales.[44] Occupational therapists often lack the confidence to discuss obesity with children and families, but also feel that BMI is a confusing measure for obesity in children and therefore struggle to identify when a child is living with overweight or obesity.[44] Occupational therapists also feel they could work as part of multidisciplinary teams (e.g. specialist obesity teams, public health or community) to tackle childhood obesity. These observations are supported by a recent review which found that primary care providers inconsistently implemented recommended practices.[56] Barriers and enablers were identified at the provider (i.e. lack of knowledge) and organizational level (i.e. lack of training).[56] The professional bodies representing AHPs may consider relevant training to increase the prevalence and effectiveness of these conversations. The Henry project is a preventative childhood obesity programme aimed at training health professionals (e.g. health visitors, nursery nurses) and community workers (e.g. children's centre staff) to work more effectively with families of pre-school aged children.[57] The improvements in skills, knowledge and confidence in these populations[58] suggests that this may represent a viable model for the training of AHPs in the prevention of obesity.

Obesity Canada present guidance for paediatric obesity management which warrants consideration for AHPs in their routine 'contact points' with parents and/or young children.[59] This approach encourages more discussion of health-related behaviours, and less of a focus on numbers on the scale. The Canadian framework may provide an appropriate template for AHPs in discussions with parents of young children:

- *Ask* – ask permission to discuss weight
- *Assess* – obesity-related risk and potential 'root causes' of weight gain
- *Advice* – on obesity risks, discuss treatment benefits and options
- *Agree* – on a realistic smart plan to achieve health behaviour outcomes
- *Assist* – in addressing drivers and barriers, offer education and resources, refer to provider, and arrange follow-up

These guidelines may provide a useful framework for conducting health promoting conversations with parents of young children. The scope of these conversations is not limited to dietitians, and should be implemented by all AHPs where possible. Future research should be conducted to evaluate how receptive parents of young children are to engage in opportunistic discussions about weight, particularly during interactions in which that is not the primary purpose of the 'contact point'. This research may be designed in coproduction with both patients and AHPs to understand the barriers and enablers to these interactions. A summary of the key practical considerations and research recommendations are provided in Table 3.

5 | LIMITATIONS

Although this report provides some valuable insight into the role of AHPs in the prevention of obesity in young children, some limitations must be acknowledged. The majority of included studies have been conducted evaluating the dietitian's role in the prevention of childhood obesity, with limited research elucidating the role of other AHPs. In addition, there appears to some geographical bias in the evidence obtained given the large number of studies derived from countries such as United States and Australia. Application of these findings may be somewhat limited for countries in which vastly different healthcare systems exist. *Albeit*, these findings present a useful opportunity for countries to learn from alternate healthcare systems to optimize policy and practice. Interventions/programmes typically occurred outside of routine practice therefore it is difficult to determine how these interventions currently integrate into routine healthcare via routine contact points. The follow-up duration of included studies was also generally short, suggesting a need for more evidence to determine how these early life interventions influence long-term development of obesity into adolescence and adulthood. Of the 12 studies evaluating physical activity in young children, 4 studies used non-objective measures, such as questionnaires. These questionnaires were commonly completed by parents of young children, who may be susceptible to social desirability bias.[60] Future research evaluating physical activity levels in young children should use objective measures such as accelerometers, as these have shown to be valid when used with similar aged children.[61]

From a scoping review methodology perspective, it was difficult to identify all studies related to AHPs, due to some studies only specifying an AHP role within the methods of the main text. The search strategy for the present review was designed to detect AHP-related terminology within the title and abstract and/or relevant indexed terms. This limitation was mitigated with grey literature searches, citation searching and consultation with professional bodies. Future primary research authors should consider including AHP and their respective roles in the key words to help promote the role and facilitate identification of evidence for future reviews in the area. Studies in which we were unable to identify via our formal search had a more general description of interventions/programmes within the title and abstract, without explicitly acknowledging the professionals who designed and/or implemented them. In addition, the quality of included studies was generally assessed as 'weak', primarily due to an absence of validity and reliability considerations, as well as the low prevalence of blinding outcome assessors and participants to allocation. It is however, difficult to blind participants to an intervention of this nature. Finally, weight was not the primary outcome of some interventions, and may to some extent, explain the inconsistent findings observed, as studies may not have been adequately powered to detect a weight change where it is a secondary outcome measure.

6 | CONCLUSION

Findings from the present scoping review demonstrate that AHPs have an important role in the prevention of obesity in young children, with evidence to suggest their role may be particularly important within families living in socio-economic deprivation. However, more research is required to determine how routine AHP contact points may be used in the prevention of obesity in young children, across the range of allied health professional practices.

AUTHOR CONTRIBUTIONS

All authors contributed to the design of the study. Alex Griffiths, Jamie Matu and Tamara Brown conducted the systematic search of the literature. Alex Griffiths, Rob Brooks, Rebecca Haythorne and Gill Kelly were involved in study selection and data analysis. All authors contributed to the interpretation of data. Alex Griffiths wrote the manuscript. All authors provided critical feedback and approved the manuscript.

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CONFLICT OF INTEREST

No conflict of interest was declared.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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