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Assessing the short-term effects of a scalable, community-based intervention for overweight and obese children: The MEND 5-7 programme.

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ABSTRACT

Objective The aim of this study was to report outcomes of the UK service level delivery of MEND (Mind,Exercise,Nutrition...Do it!) 5-7, a multicomponent community-based, healthy lifestyle intervention designed for overweight and obese children aged 5-7 years and their families.

Design Pre-post study design.

Setting Community venues at 37 locations across the UK.

Participants 440 overweight or obese children (42% boys; mean age 6.1 years; BMI z-score 2.86) and their parents/carers participated in the intervention.

Intervention MEND 5-7 is a 10-week, family-based, child weight-management intervention consisting of weekly group sessions. It includes positive parenting, active play, nutrition education and behaviour change strategies. The intervention is designed to be scalable and delivered by a range of health and social care professionals.

Primary and secondary outcome measures The primary outcome was BMI z-score. Secondary outcome measures included BMI, waist circumference, waist circumference z-score, children's psychological symptoms, parenting self-efficacy, physical activity and sedentary behaviours and the proportion of parents and children eating 5 or more portions of fruit and vegetables.

Results: 274 (62%) children were measured pre and post-intervention (baseline and 10-weeks). Post-intervention, mean BMI and waist circumference decreased by 0.5 kg/m^2 and 0.9 cm, while z-scores decreased by 0.20 and 0.20, respectively ($p<0.0001$). Improvements were found in children's psychological symptoms score (-1.6 units,$p<0.0001$), parent self-efficacy domains ($p<0.0001$), physical activity (+2.9 hours/week,$p<0.01$), sedentary activities (-4.1 hours/week,$p<0.0001$) and the proportion of parents and children eating 5 or more portions of fruit and vegetables per day (both $p<0.0001$). Attendance of the 10 sessions was 73% with a 70% retention rate.

Conclusions: These findings suggest that when implemented under service level conditions the MEND 5-7 programme was acceptable to families with beneficial effects on physical, behavioural and psychological outcomes when delivered at scale. Further investigation is warranted to establish if these findings are replicable under controlled conditions.

Article Summary

Article Focus

- Childhood obesity prevalence rates remain high in the UK and globally.
- To our knowledge there are no published, peer-reviewed weight management trials for children aged 5-7 in England.

Key messages

- The MEND 5-7 programme was acceptable to families and had beneficial effects on physical, behavioural and psychological outcomes when delivered at scale.
- This study demonstrates that a community-based intervention delivered by non-obesity specialists has the potential to provide a scalable and suitable care pathway for families of overweight and obese children.

Strengths and limitations

- A strength of the study is that it utilises 'real-world' data representative of childhood community based interventions that are scalable to reduce childhood obesity levels. An additional strength is that MEND 5-7 was delivered by community-based, non-obesity specialists in contrast to other studies that have used highly skilled professionals to deliver the intervention
- A limitation is that only 62% of participants who started the programme completed post programme measurements. This level of completion is not atypical for a pilot study or reports of service-level implementation but may be a source of bias that could lead to an overestimation of treatment effect.

INTRODUCTION

Childhood obesity is associated with adverse effects on short and long term health [1, 2]. Prevalence rates continue to be high globally and more specifically in the UK [3]. In 2005, the Department of Health initiated the National Child Measurement Programme (NCMP) to identify school children in Reception (typically aged 4-5 years) and Year 6 (aged 10-11 years) who are overweight or obese in England [4]. Since its inception, results from the NCMP have indicated high levels of overweight and obesity in both age groups - the most recent findings (school year 2010/2011) identifying 22.6% and 33.4% of Reception and Year 6 children as overweight or obese, respectively. Surveillance programmes have evolved into screening programmes with a large number of UK primary care trusts choosing to inform parents of their child's weight status. Although this practice is controversial it is also the case that identification may be a trigger for parents to initiate lifestyle change and/or seek professional support [5].

Research has indicated that there may be an effectiveness gradient with regard to the impact of child obesity treatment with age [6]. Generally, earlier treatment is associated with better outcomes following programmes that are less intensive. To be effective, it is recommended that interventions are multicomponent and include age-appropriate nutrition and physical activity with behaviour change strategies that are developmentally appropriate to the cognitive abilities of the child and the nature of relationships in the family life cycle. Although the availability of treatments is steadily increasing, there are significant disparities in the availability of treatments across the developmental continuum. In the UK only 8 out of 45 weight management schemes cover the 5 to 7 age range [7] and only four out of the 13 Department of Health approved Child Weight Management programmes are suitable for children under the age of 7 [8]. To our knowledge there are no published, peer-reviewed weight management trials for children aged 5-7 in England.

The aim of this study was to report outcomes from the UK service level delivery of MEND 5-7 (Mind, Exercise, Nutrition... Do it!), a multicomponent community-based healthy lifestyle intervention designed for overweight and obese children aged 5-7 years and their families.

METHODS

Recruitment

Families were recruited between 2009 and 2011 using a variety of techniques. MEND provides recruitment resources such as posters, flyers and letters that can be used within local networks to support the recruitment process. In addition, support is also provided detailing effective use of these resources. Children were eligible if they were classified as overweight or obese (BMI ≥91st percentile) according to the UK 1990 reference data [9]; had no apparent clinical conditions, comorbidities, physical disabilities or learning difficulties that would interfere with programme engagement and were aged between 5 and 7 years with at least one parent/carer who was able to attend each of the programme sessions

Study Design

The study employed an uncontrolled pre post design evaluating changes in anthropometric, psychosocial, physical activity and nutritional outcomes. This study reports the effects of the programme when delivered in UK community settings under service level conditions.

Study Intervention

The MEND 5-7 programme is a comprehensive, multi-component intervention designed to tackle obesity in childhood. The programme supports families by providing information on child nutrition (based on government healthy eating guidelines), active play and parenting practices to help parents practically integrate these recommendations into everyday life. The programme uses a non-diet approach to prevent unduly restrictive eating which can lead to problematic eating behaviours [10].

MEND 5-7 is based around key principles in health-related behaviour change and behavioural parent training programmes. These methods are drawn from evidence-based practices in child psychology and parenting interventions [11].

Reviews of behavioural treatments for childhood obesity show group-based interventions are the most commonly used delivery formats and are more effective than individual treatment sessions [12]. Groups are more efficient, provide greater opportunity for therapeutic interactions between participants, improve attendance rates and are cost-effective. Community groups provide greater access to minority ethnic groups, counter stigma, provide a social support network and aid the therapeutic process of problem-solving. These factors improve understanding of the condition, adherence to the intervention and implementation of changes in behaviour. Recognising the importance of family involvement for behaviour change, the programme requires a parent or carer to attend all sessions.

Structure and Content

The programme consists of 10 (one hour and forty-five minute duration) weekly group-based sessions delivered by two trained leaders and one optional assistant. The programme is held in community settings such as sports centres and schools for groups of 8-15 children and their parents/carers. The first and last sessions are allocated as introductory and graduation sessions, respectively, incorporating measurements and parental/carer questionnaire completion.

Each session has four components; ‘Power Time’ (20 minutes), ‘Healthy Families’ (25 minutes), ‘Active Play’ and ‘Parent/carer Workshop’ (during this time children take part in 60 minutes of physical activity and parents/carers attend a workshop). ‘Power Time’ is a joint parent/carer and child snack time designed to help parents incorporate evidence-based food exposure techniques into their daily routines to increase their child’s preferences for healthier foods. ‘Healthy Families’ is also a joint parent/carer and child session that focuses

on educating and promoting skills for everyday play, active family lifestyles and healthy family eating in the home environment. 'Active Play' is a child-only play session that takes place while the parents/carers are in their workshop. The focus is on fun and active participation. The aim is to provide children with positive experiences of being active in a supportive setting.

The parent/carer workshops include interactive activities and discussions focusing on nutrition, activity and behaviour change. Five of the parent/carer workshops focus on healthy eating and nutrition-related topics. Group discussions include practical training on understanding food and drink labels, fat and sugar content of foods and drinks, portion sizes, and managing fussy eating. The remaining workshops focus on family rules and routines, reducing screen time and overcoming barriers to physical activity.

Training

The MEND 5-7 programme is delivered by community-based health, education and physical activity professionals who attend a 2-day, face-to-face training course. The training is derived from established competency-based skills training methods [13] and includes direct teaching, role-play, guided discussion and multiple choice assessments. After training, all staff are required to complete an on-line assessment to gain certification to deliver the programme and pass an enhanced CRB (Criminal Records Bureau) check.

Following successful completion of the training, delivery teams are provided with four manuals, two for programme delivery, one for programme management and one for physical activity. These resources provide full details of session plans, objectives, direct teaching notes, desired outcomes, set-up and delivery requirements and all aspects of the physical activity programme component.

Outcome Measurements

Demographics

Socioeconomic status was determined based on home ownership [14], grouped as: 'owner occupied', 'private rented', 'social rented' and 'other'. Ethnic background was based on the UK census categorisation as outlined in the National Obesity Observatory Standard Evaluation Framework for weight management interventions [14].

Physical activity and inactivity

Physical activity level and sedentary behaviours were assessed using items adapted from the 'outdoor playtime checklist' [15]. Physical activity was assessed by asking 'How much time did your child spend playing outside in the yard or street of your house (or the house of a friend, neighbour or relative), or at the park, playground, or outdoor recreation (e.g. swimming pool, zoo or amusement park), including while at day care or preschool?' Television viewing time and time spent playing computer/console game were assessed by asking 'How much time would you say your child spends watching television (including videos and DVD's), including time spent watching TV in other people's houses?' and 'How much time did your child spend playing Play-Station/X-box/Nintendo/Computer games (including watching a friend/brother/sister/adult play, and at other people's houses)?' Total sedentary activity was calculated from the addition of TV viewing time and time spent playing computer/console games. Answers were given in hours and minutes per day, based on typical days in the last month. Separate estimates were provided for weekday and weekend days.

Anthropometry

Body weight (kg) and height (cm) were measured using standardised procedures [16] and body mass index calculated as body weight(kg)/height(m^2). Waist circumference (cm) was measured 4 cm above the umbilicus [17]. BMI and waist circumference z-scores were calculated from UK national reference data [9, 18] using LMS growth software [19].

Fruit and vegetable consumption

Child and parent fruit and vegetable consumption were assessed by the daily frequency of portions consumed [20]. Questions were measured on a 7 point likert scale (less than one per week, one per week, two to three per week, four to six per week, one per day, two per day, or three or more per day) [20].

Parenting self-efficacy

Parenting self efficacy was measured using the subscales of 'Play and Enjoyment', 'Discipline and Boundary Setting' and 'Learning and Knowledge' taken from 'TOPSE' (Tool to Measure Parenting Self Efficacy) [21].

Strengths and Difficulties Questionnaire (SDQ)

The SDQ – Parent's Version [13] provides a measure of emotional distress in children and adolescents. The measure consists of 25 statements referring to behaviours associated with emotional difficulties, such as 'often has temper tantrums or hot tempers' and 'often lies or cheats'. Parents are asked to indicate how 'true' each statement is of their child on a 3 point likert scale (not true, somewhat true, certainly true). A 'total difficulties' score is generated, with higher scores indicating greater levels of emotional distress.

Data Cleaning and statistical analysis

Due to the data being collected under service level conditions by non-researchers, strict cleaning procedures were undertaken to ensure data quality. Outliers for anthropometric measurements were identified from visual analysis of histograms and scatterplots, resulting in 7 data sets being excluded. Participants were excluded from the activity analysis if the addition of reported daily physical activity and sedentary behaviour exceeded 16 hours, resulting in seven data sets being excluded.

Variable distribution was checked using the Kruskall-Wallis test for normality. Paired sample t-tests were employed to assess mean differences in the outcome variables from baseline to

3 months (end of intervention). Changes in the proportions for fruit and vegetable intake from baseline to the end of the intervention were assessed using the McNemar's test. Baseline differences for those who did and did not complete post programme measurements were examined using independent sample t-tests. Similarly, effects of gender pre-post programme were examined using independent sample t-tests. Statistical significance was set at $P < 0.05$. All analyses were conducted using SPSS 18.0 for Windows (SPSS, Chicago, IL).

RESULTS

Recruitment

Four hundred and forty children participated in MEND 5-7 programmes across 37 UK locations.

Baseline demographic and anthropometric characteristics

Fifty-eight percent were female, and 79% of participants were obese (BMI ≥ 98th centile). Thirty three percent of children were from non-white ethnic backgrounds with 57% reporting they did not own their home (Table 1).

Completers vs. non completers

There were no significant differences in baseline demographic and anthropometric characteristics between children with and without post programme measurements. Significant differences were evident in baseline comparisons of physical activity levels (15.0 ± 8.9 hours/week completers vs. 19.3 ± 13.7 hours/week non completers, $P < 0.01$). All other outcome measures were not significantly different at baseline.

Attendance and retention

Attendance data was available for 81% of participants. Mean attendance for the programme was 73% and retention rate (based on children attending at least 7 sessions) was 70%.

Outcome measures

Within subject differences in anthropometric, psychosocial and activity measures pre and post intervention are shown in Table 2. Significant reductions in BMI, BMI z-score, waist circumference, waist z-score and child total difficulties score (all $P < 0.0001$) post intervention were noted. Positive changes were also observed for TV time, sedentary activity ($P < 0.0001$) and physical activity ($P < 0.01$). Significant increases were observed in all parenting self-efficacy domains and the proportion of children and parents eating at least five fruit and vegetables per day (all $P < 0.0001$). There were no gender differences in any of the study outcomes.

DISCUSSION

This study examined outcomes following participation in the MEND programme for children aged 5-7 years old. The intervention demonstrated positive effects on children's weight status, diet and activity levels. Parents with pre-post data reported they were more confident and improvements in their perceptions of children's emotional well-being were found.

Children with pre-post data achieved a significant reduction in BMI z-score of -0.20 after ten weeks. Comparison between published interventions is problematic because zBMI scales attenuate absolute BMI change [22]. Equivalent changes in absolute BMI do not equate to equivalent changes in zBMI, such that children with higher baseline zBMI require greater changes in absolute BMI to produce equivalent changes in zBMI. Notwithstanding this limitation, consideration of zBMI changes in interventions with children of a comparable age-group provides an indication of the relative efficacy of an intervention. Outcomes reported in studies of GP-led behavioural treatment of individual families (LEAP intervention [23]) and in generic parenting programmes unmodified to deal with the specific needs of obese and overweight children (Triple P) have shown no significant reductions in measures of degree of obesity. A version of the Triple P programme specifically adapted for obesity (Lifestyle Triple P) showed a reduction of -0.11 at 20 weeks [24], the HICKUPS study of a multicomponent group-based parenting intervention reported a reduction of -0.36 at 6 months and the

PEACH study of a parent-only group intervention showed a reduction of -0.26 at 6 months [25, 26]. Interestingly, the results were similar to the unpublished three months data (-0.20) for children taking part in the randomised controlled trial of the MEND programme for 7 to 13 year old children [27] and it's national service level evaluation (-0.18) [28].

Generally, interventions that produce greater treatment effects are usually more intense and involve relatively higher levels of contact time [29]. The US preventive services task force (USPSTF) conclude that low intensity interventions – defined as those involving less than 25 hours direct professional contact time – are insufficient to have a positive impact on weight-status in obese and overweight children. Interestingly, the MEND 5-7 programme consists of 17.5 hours of face-to-face contact time and therefore falls into the category of a low intensity intervention. Despite this, participation in the programme was associated with significant reductions in zBMI (-0.20) comparable to interventions with much greater contact time.

MEND 5-7 was delivered by community-based, non-obesity specialists in contrast to other studies that have used highly skilled professionals to deliver the intervention [25, 26]. It has been recognised that a large proportion of childhood obesity interventions employ intensive programmes involving specialist dieticians and other health professionals [30]. Childhood obesity interventions are significantly more expensive when skilled professionals and additional contact hours are employed, and in an increasingly resource-constrained environment, these factors might limit the reach of evidence-based programmes [30]. The development of a clinically effective, low-intensity programme using non-specialist, community-based delivery staff could be a crucial strategy to meet the needs of younger children who are already overweight. The present results suggest that such a model is feasible and effective when implemented under service level conditions and suggest that MEND 5-7 may be a good candidate for large-scale implementation.

The UK Department of Health physical activity guidelines specify that children and young people (5-18 years old) should engage in 60 minutes of activity per day whilst minimising

sedentary behaviours [31]. Sedentary behaviours - in particular, time spent watching television - are associated with metabolic risk factors in children [32] and have been shown to predict BMI in early adulthood [33]. Independent of TV viewing time, higher levels of sedentary behaviours have been shown to lower levels of physical activity in children [34].

There is also evidence that participation in physical activity leads to health benefits [35] and lowers levels of overweight and obesity in children [36]. In this study, MEND 5-7 produced significant, positive changes in physical activity levels ($P < 0.01$), TV viewing time and sedentary activity levels ($P < 0.0001$). Parents reported children on the programme had reduced sedentary behaviour by an average of 4.1 hours, of which 3.4 hours was television viewing, and increased their physical activity levels by 2.9 hours per week. The concurrent reduction in sedentary activity and increase in physical activity following participation in the programme is thus very encouraging.

Some limitations of the study should be acknowledged. Only 62% of participants who started the programme completed post programme measurements. This level of completion is not atypical for a pilot study or reports of service-level implementation [37, 38] but may be a source of bias that could lead to an overestimation of treatment effect. Statistical analyses revealed that there were limited differences between those participants that completed the programme and those who did not. The data presented here are uncontrolled data representing the short-term impact of the intervention. Controlled studies of the impact beyond the ten week programme are needed to establish whether the present results are sustained and more effective than no or an alternative intervention. Whilst it is well documented that subjective measures of physical activity over-report when compared to more accurate objectively measured physical activity [39], subjective measurement can be a useful and cost effective tool when employed in a community-based programme if it is not feasible to obtain objective measurements [40]. The improvements found in physical activity and sedentary behaviours require supporting evidence using objective measurement.

CONCLUSION

The MEND 5-7 programme appears to have had beneficial effects on physical, behavioural and psychological outcomes for children with pre-post data when implemented in UK community settings under service level conditions. High attendance and retention rates suggest the programme was acceptable to families. Coupled with a scalable delivery model using non-obesity specialists, these preliminary findings warrant further evaluation in a formal trial to establish if outcomes are replicable and sustained, potentially providing a scalable and suitable care pathway for families of overweight and obese children on a national level.

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Data Sharing Statement

no additional data available.

Ethical Approval

This study is a service evaluation and not within the remit of UK Ethics Committee governance. Parents consented to take part in the study and for use of their anonymised data.

Contributors

L Smith performed statistical analysis and contributed to writing the paper. P Chadwick co-developed the intervention and contributed to writing the paper, interpretation and analysis of

results. D Radley contributed to writing the paper and statistical analysis. M Kolotourou critically reviewed all parts of the paper and assisted in the interpretation and analysis of the results. C Gammon contributed to the interpretation of the results and critically reviewed all parts of the paper. J Rosborough co-developed the intervention and critically reviewed all parts of the paper. P Sacher co-developed the intervention, contributed to the interpretation of the results and writing the paper and critically reviewed all parts of the paper. All authors approved the final draft of the paper.

Competing interests

Dr. Lindsey Smith, Dr. Duncan Radley, Catherine Gammon and Jennifer Rosborough are employed full-time at MEND. Dr. Paul Chadwick is currently employed part-time as Clinical Director at MEND. Maria Kolotourou is employed part-time at MEND. Paul Sacher is currently employed as a Senior Research Fellow at the UCL Institute of Child Health as well as Chief Research and Development Officer at MEND. Dr Venediktos Kapetanakis serves as a consultant statistician to MEND.

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Table 1. Baseline demographic and anthropometric characteristics

	% (n[1]) or mean (SD)
Gender	
Males	42.0 % (185)
Females	58.0 % (255)
Ethnicity	
White – British	67.2 % (275)
Black	6.6 % (27)
Asian	19.6 % (80)
Mixed	5.1 % (21)
Other	1.5 % (6)
House ownership	
Owner occupied	43.2 % (162)
Private rented	25.9 % (97)
Social rented	30.1 % (113)
Other	0.8 % (3)
Age (years)	6.1 (0.8)
Weight (kg)	33.0 (7.9)
Height (cm)	120.7 (7.7)
BMI (kg/m^2)	22.5 (3.6)
BMI z-score	2.86 (0.91)
Waist circumference (cm)	70.4 (9.5)
Waist circumference z-score	3.13 (1.09)

[1] n = 440, baseline n may vary due to missing data and data cleaning procedures.

Table 2. Within subject changes at pre and post intervention

		Pre	Post	Difference	
	n[1]	Mean (SD)	Mean (SD)	Mean (CI)	P
Anthropometry					
BMI (kg/m^2)	274	22.5 (3.6)	22.1 (3.7)	-0.5 (-0.6 to -0.4)	<0.0001
BMI z-score	274	2.86 (0.90)	2.66 (0.94)	-0.20 (-0.23 to -0.17)	<0.0001
Waist circumference (cm)	267	70.9 (9.9)	69.9 (10.0)	-0.9 (-1.3 to -0.5)	<0.0001
Waist circumference z-score	267	3.16 (1.10)	2.96 (1.14)	-0.20 (-0.25 to -0.15)	<0.0001
Psychosocial indices					
Child total difficulties score (range 0-40)	212	10.8 (5.7)	9.2 (5.8)	-1.6 (-2.2 to -0.9)	<0.0001
Play and enjoyment score (range 0-60)	240	48.6 (10.4)	51.6 (9.1)	3.1 (1.9 to 4.2)	<0.0001
Discipline and boundaries score (range 0-60)	235	42.0 (11.9)	47.3 (9.7)	5.3 (4.0 to 6.6)	<0.0001
Learning and knowledge score (range 0-60)	238	48.7 (9.2)	51.1 (8.3)	2.5 (1.3 to 3.7)	<0.0001
Activity indices					
Sedentary activity (hours/week)	168	21.6 (12.8)	17.5 (10.8)	-4.1 (-6.1 to -2.2)	<0.0001
Physical activity (hours/week)	168	15.1 (8.8)	18.0 (9.4)	2.9 (1.2 to 4.7)	<0.01
TV time (hours/week)	168	16.6 (10.9)	13.2 (9.0)	-3.4 (-5.0 to -1.8)	<0.0001

[1] numbers vary due to missing data and data cleaning procedures

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Assessing the short-term outcomes of a community-based intervention for overweight and obese children: The MEND 5-7 programme.

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Assessing the short-term outcomes of a community-based intervention for overweight and obese children: The MEND 5-7 programme.

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Keywords: childhood, obesity, intervention, community programme

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ABSTRACT

Objective The aim of this study was to report outcomes of the UK service level delivery of MEND (Mind,Exercise,Nutrition...Do it!) 5-7, a multicomponent community-based, healthy lifestyle intervention designed for overweight and obese children aged 5-7 years and their families.

Design Repeated measures

Setting Community venues at 37 locations across the UK.

Participants 440 overweight or obese children (42% boys; mean age 6.1 years; BMI z-score 2.86) and their parents/carers participated in the intervention.

Intervention MEND 5-7 is a 10-week, family-based, child weight-management intervention consisting of weekly group sessions. It includes positive parenting, active play, nutrition education and behaviour change strategies. The intervention is designed to be scalable and delivered by a range of health and social care professionals.

Primary and secondary outcome measures The primary outcome was BMI z-score. Secondary outcome measures included BMI, waist circumference, waist circumference z-score, children's psychological symptoms, parenting self-efficacy, physical activity and sedentary behaviours and the proportion of parents and children eating 5 or more portions of fruit and vegetables.

Results: 274 (62%) children were measured pre and post-intervention (baseline; 10-weeks). Post-intervention, mean BMI and waist circumference decreased by 0.5 kg/m^2 and 0.9 cm, while z-scores decreased by 0.20 and 0.20, respectively ($p<0.0001$). Improvements were found in children's psychological symptoms (-1.6 units,$p<0.0001$), parent self-efficacy ($p<0.0001$), physical activity (+2.9 hours/week,$p<0.01$), sedentary activities (-4.1 hours/week,$p<0.0001$) and the proportion of parents and children eating 5 or more portions of fruit and vegetables per day (both $p<0.0001$). Attendance to the 10 sessions was 73% with a 70% retention rate.

Conclusions: Participation in the MEND 5-7 programme was associated with beneficial changes in physical, behavioural and psychological outcomes for children with complete sets

of measurement data, when implemented in UK community settings under service level conditions. Further investigation is warranted to establish if these findings are replicable under controlled conditions.

Article Summary

Article Focus

- Childhood obesity prevalence rates remain high in the UK and globally.
- To our knowledge there are no published, peer-reviewed weight management trials or service level evaluations for children aged 5-7 in England.

Key messages

- The MEND 5-7 programme has high attendance and retention rates and produced positive changes in physical, behavioural and psychological outcomes.
- This study demonstrates that a community-based intervention delivered by non-obesity specialists has a potentially valuable contribution to make as part of a comprehensive care pathway for families of overweight and obese children.

Strengths and limitations

Strengths

- By using service-level data this study contributes to the literature on appropriate targets for community level interventions.
- Most of the outcome literature on community-based child weight management programmes have been delivered by highly-skilled professionals under trial conditions. This limits the conclusions that can be drawn about whether such outcomes can be translated to community settings under different conditions of service delivery. The results of this paper suggest that outcomes similar to those achieved by controlled trials can be achieved under conditions of normal service delivery.

Limitations

- Only 62% of participants who started the programme completed post programme measurements. Although this level of completion is not atypical for reports of service-level implementation it is still possible that biases due to selective attrition could lead to an overestimation of treatment effect.

INTRODUCTION

Childhood obesity is associated with adverse effects on short and long term health [1, 2]. Prevalence rates continue to be high globally and more specifically in the UK [3]. In 2005, the Department of Health initiated the National Child Measurement Programme (NCMP) to identify school children in Reception (typically aged 4-5 years) and Year 6 (aged 10-11 years) who are overweight or obese in England [4]. Since its inception, results from the NCMP have indicated high levels of overweight and obesity in both age groups - the most recent findings (school year 2010/2011) identifying 22.6% and 33.4% of Reception and Year 6 children as overweight or obese, respectively. Surveillance programmes have evolved into screening programmes with a high proportion of UK primary care trusts choosing to inform parents of their child's weight status. Although this practice is controversial it is also the case that identification may be a trigger for parents to initiate lifestyle change and/or seek professional support [5].

Research has indicated that there may be an effectiveness gradient with regard to the impact of child obesity treatment with age [6]. Generally, earlier treatment is associated with better outcomes following programmes that are less intensive. To be effective, it is recommended that interventions are multicomponent and include age-appropriate nutrition and physical activity with behaviour change strategies that are developmentally appropriate to the cognitive abilities of the child and the nature of relationships in the family life cycle [7, 8]. Although the availability of treatments is steadily increasing, there are significant disparities in the availability of treatments across the developmental continuum. In the UK

only 8 out of 45 weight management schemes cover the 5 to 7 age range [9] and only four out of the 13 Department of Health approved Child Weight Management programmes are suitable for children under the age of 7 [10]. To our knowledge there are no published, peer-reviewed weight management trials or service level evaluations for children aged 5-7 in England. This leaves a gap in the understanding of the outcomes that is possible to achieve for overweight and obese children in this age range in a UK setting.

The aim of this study was to report outcomes from the UK service level delivery of MEND 5-7 (Mind, Exercise, Nutrition... Do it!), a multicomponent community-based healthy lifestyle intervention designed for overweight and obese children aged 5-7 years and their families.

METHODS

Recruitment

Families were recruited between 2009 and 2011 using a variety of techniques. MEND provides recruitment resources such as posters, flyers and letters that can be used within local networks to support the recruitment process. In addition, support is also provided detailing effective use of these resources. Children were eligible if they were classified as overweight or obese (BMI ≥91st percentile) according to the UK 1990 reference data [11]; had no apparent clinical conditions, comorbidities, physical disabilities or learning difficulties that would interfere with programme engagement and were aged between 5 and 7 years with at least one parent/carer who was able to attend each of the programme sessions

Study Design

The study employed an uncontrolled repeated measures design evaluating changes in anthropometric, psychosocial, physical activity and nutritional outcomes. This study reports the outcomes of participating children with complete pre- and post-intervention data when delivered in UK community settings under service level conditions.

Study Intervention

The MEND 5-7 programme is a comprehensive, multi-component intervention designed to tackle obesity in childhood. The programme supports families by providing information on child nutrition (based on government healthy eating guidelines), active play and parenting practices to help parents practically integrate these recommendations into everyday life. The programme uses a non-diet approach to prevent unduly restrictive eating which can lead to problematic eating behaviours [7].

MEND 5-7 is based around key principles in health-related behaviour change and behavioural parent training programmes. These methods are drawn from evidence-based practices in child psychology and parenting interventions [12].

Reviews of behavioural treatments for childhood obesity show group-based interventions are the most commonly used delivery formats and are more effective than individual treatment sessions [13]. Groups are more efficient, provide greater opportunity for therapeutic interactions between participants, improve attendance rates and are cost-effective[13]. Community groups provide greater access to minority ethnic groups, counter stigma, provide a social support network and aid the therapeutic process of problem-solving [14]. These factors improve understanding of the condition, adherence to the intervention and implementation of changes in behaviour. Recognising the importance of family involvement for behaviour change, the programme requires a parent or carer to attend all sessions.

Structure and Content

The programme consists of 10 (one hour and forty-five minute duration) weekly group-based sessions delivered by two trained leaders and one optional assistant. The programme is held in community settings such as sports centres and schools for groups of 8-15 children and their parents/carers. The first and last sessions are allocated as introductory and graduation

sessions, respectively, incorporating measurements and parental/carer questionnaire completion.

Each session has four components; 'Power Time' (20 minutes), 'Healthy Families' (25 minutes), 'Active Play' and 'Parent/carer Workshop' (during this time children take part in 60 minutes of physical activity and parents/carers attend a workshop). 'Power Time' is a joint parent/carer and child snack time designed to help parents incorporate evidence-based food exposure techniques into their daily routines to increase their child's preferences for healthier foods. 'Healthy Families' is also a joint parent/carer and child session that focuses on educating and promoting skills for everyday play, active family lifestyles and healthy family eating in the home environment. 'Active Play' is a child-only play session that takes place while the parents/carers are in their workshop. The focus is on fun and active participation. The aim is to provide children with positive experiences of being active in a supportive setting.

The parent/carer workshops include interactive activities and discussions focusing on nutrition, activity and behaviour change. Five of the parent/carer workshops focus on healthy eating and nutrition-related topics. Group discussions include practical training on understanding food and drink labels, fat and sugar content of foods and drinks, portion sizes, and managing fussy eating. The remaining workshops focus on family rules and routines, reducing screen time and overcoming barriers to physical activity.

Training

The MEND 5-7 programme is delivered by community-based health, education and physical activity professionals who attend a 2-day, face-to-face training course. The training is derived from established competency-based skills training methods [15] and includes direct teaching, role-play, guided discussion and multiple choice assessments. After training, all

staff are required to complete an on-line assessment to gain certification to deliver the programme and pass an enhanced CRB (Criminal Records Bureau) check.

Following successful completion of the training, delivery teams are provided with four manuals, two for programme delivery, one for programme management and one for physical activity. These resources provide full details of session plans, objectives, direct teaching notes, desired outcomes, set-up and delivery requirements and all aspects of the physical activity programme component.

Outcome Measurements

Demographics

Socioeconomic status was determined based on home ownership [16], grouped as: 'owner occupied', 'private rented', 'social rented' and 'other'. Ethnic background was based on the UK census categorisation as outlined in the National Obesity Observatory Standard Evaluation Framework for weight management interventions [16].

Physical activity and inactivity

Physical activity level and sedentary behaviours were assessed using items adapted from the 'outdoor playtime checklist' [17]. Physical activity was assessed by asking 'How much time did your child spend playing outside in the yard or street of your house (or the house of a friend, neighbour or relative), or at the park, playground, or outdoor recreation (e.g. swimming pool, zoo or amusement park), including while at day care or preschool?' Television viewing time and time spent playing computer/console game were assessed by asking 'How much time would you say your child spends watching television (including videos and DVD's), including time spent watching TV in other people's houses?' and 'How much time did your child spend playing Play-Station/X-box/Nintendo/Computer games (including watching a friend/brother/sister/adult play, and at other people's houses)?' Total sedentary activity was calculated from the addition of TV viewing time and time spent playing

computer/console games. Answers were given in hours and minutes per day, based on typical days in the last month. Separate estimates were provided for weekday and weekend days.

Anthropometry

Body weight (kg) and height (cm) were measured using standardised procedures [18] and body mass index calculated as body weight(kg)/height(m^2). Waist circumference (cm) was measured 4 cm above the umbilicus [19]. BMI and waist circumference z-scores were calculated from UK national reference data [11, 20] using LMS growth software [21].

Fruit and vegetable consumption

Child and parent fruit and vegetable consumption were assessed by the daily frequency of portions consumed [22]. Questions were measured on a 7 point likert scale (less than one per week, one per week, two to three per week, four to six per week, one per day, two per day, or three or more per day) [22].

Parenting self-efficacy

Parenting self efficacy was measured using the subscales of 'Play and Enjoyment', 'Discipline and Boundary Setting' and 'Learning and Knowledge' taken from 'TOPSE' (Tool to Measure Parenting Self Efficacy) [23].

Strengths and Difficulties Questionnaire (SDQ)

The SDQ – Parent's Version[24]] is a widely used measure of emotional distress in children and adolescents. The measure consists of 25 statements referring to behaviours associated with emotional difficulties, such as 'often has temper tantrums or hot tempers' and 'often lies or cheats'. Parents are asked to indicate how 'true' each statement is of their child on a 3 point likert scale (not true, somewhat true, certainly true). A 'total difficulties' score is generated, with higher scores indicating greater levels of emotional distress. Measures of

psychological distress were included to evaluate the impact of the intervention upon children's well-being and to ensure that physical health outcomes were not achieved at the expense of well-being.

Data Cleaning and statistical analysis

Due to the data being collected under service level conditions by non-researchers, comprehensive cleaning procedures were undertaken to ensure data quality. Outliers for anthropometric measurements were identified from visual analysis of histograms and scatterplots. Visual analysis enabled identification of seven observations that were inconsistent with other observations in the data set. After comparison to reference growth charts, these seven data sets were excluded due to biologically unlikely increases in height of over 5.5 cm over the course of the pre and post measurement sessions. Participants were excluded from the activity analysis if the addition of reported daily physical activity and sedentary behaviour exceeded 16 hours, resulting in seven data sets being excluded.

Variable distribution was checked using the Kruskall-Wallis test for normality. Paired sample t-tests were employed to assess mean differences in the outcome variables from baseline to 3 months (end of intervention). Changes in the proportions for fruit and vegetable intake from baseline to the end of the intervention were assessed using the McNemar's test. Baseline differences for those who did and did not complete post programme measurements were examined using independent sample t-tests. Similarly, effects of gender pre-post programme were examined using independent sample t-tests. Statistical significance was set at $P < 0.05$. All analyses were conducted using SPSS 18.0 for Windows (SPSS, Chicago, IL).

RESULTS

Recruitment

Four hundred and forty children participated in MEND 5-7 programmes across 37 UK locations.

Baseline demographic and anthropometric characteristics

Fifty-eight percent were female, and 79% of participants were obese (BMI ≥ 98th centile). Thirty-three percent of children were from non-white ethnic backgrounds with 57% reporting they did not own their home (Table 1).

Completers vs. non completers

There were no significant differences in baseline demographic and anthropometric characteristics between children with complete sets of measurement data and those without. Significant differences were evident in baseline comparisons of physical activity levels (15.0 ± 8.9 hours/week completers vs. 19.3 ± 13.7 hours/week non completers, P < 0.01). All other outcome measures were not significantly different at baseline.

Attendance and retention

Attendance data was available for 81% of participants. Mean attendance for the programme was 73% and retention rate (based on children attending at least 7 sessions) was 70%.

Outcome measures

Within subject differences in anthropometric, psychosocial and activity measures pre and post intervention are shown in Table 2. Significant reductions in BMI, BMI z-score, waist circumference, waist z-score and child total difficulties score (all P < 0.0001) post intervention were noted. Positive changes were also observed for TV time, sedentary activity (P < 0.0001) and physical activity (P < 0.01). Significant increases were observed in all parenting self-efficacy domains and the proportion of children and parents eating at least five fruit and vegetables per day (all P < 0.0001). There were no gender differences in any of the study outcomes.

DISCUSSION

This study examined outcomes following participation in the MEND programme for children aged 5-7 years old. Positive changes were observed for children's weight status, diet and activity levels and emotional well-being. Parents also reported an increase in self-efficacy in relation to their parenting role.

Most of the outcome literature on child weight management programmes has been reported under trial conditions. Outcomes reported in studies of GP-led behavioural treatment of individual families (LEAP intervention [25]) and in generic parenting programmes unmodified to deal with the specific needs of obese and overweight children (Triple P) have shown no significant reductions in measures of degree of obesity. A version of the Triple P programme specifically adapted for obesity (Lifestyle Triple P) showed a reduction of -0.11 at 20 weeks [26], the HICKUPS study of a multicomponent group-based parenting intervention reported a reduction of -0.36 at 6 months and the PEACH study of a parent-only group intervention showed a reduction of -0.26 at 6 months [27, 28].

In the current study, children with complete sets of measurement data had a significant reduction in BMI z-score of -0.20 after ten weeks. The results presented here were similar to the unpublished three months data (-0.20) for children taking part in the randomised controlled trial of the MEND programme for 7 to 13 year old children [29] and it's national service level evaluation (-0.18) [30]. Although not directly comparable to the treatment effects reported in experimental studies using intention-to-treat analysis this study suggests that community level interventions delivered under conditions of normal service delivery may achieve similar results to those obtained in clinical trials.

Generally, interventions that produce greater treatment effects are more intense and involve relatively higher levels of contact time [31]. The US preventive services task force (USPSTF) conclude that low intensity interventions – defined as those involving less than 25 hours direct professional contact time – are insufficient to have a positive impact on weight-status

in obese and overweight children. The MEND 5-7 programme consists of 17.5 hours of face-to-face contact time and demonstrated significant reductions in zBMI for the 62% of children with complete sets of measurement data. Contrary to USPTS recommendations this suggests that clinically meaningful outcomes may be achievable by low intensity interventions.

MEND 5-7 has been designed to be delivered by community-based, non-obesity specialists in contrast to other studies that have used highly skilled professionals to deliver the intervention [27, 28]. A large proportion of childhood obesity interventions employ intensive programmes involving specialist dieticians and other health professionals [32]. Childhood obesity interventions are significantly more expensive when skilled professionals and additional contact hours are employed. In an increasingly resource-constrained public-sector environment, these factors might limit the potential reach of evidence-based programmes [32]. The development of a clinically effective, low-intensity programme using non-specialist, community-based delivery staff could be a crucial strategy to meet the needs of younger children who are already overweight. The present results suggest that clinically meaningful outcomes may be achievable by low intensity interventions delivered by non-specialist staff. Further research would be desirable to explore whether these initially promising data could be independently replicated under service level conditions.

The UK Department of Health physical activity guidelines specify that children and young people (5-18 years old) should engage in 60 minutes of activity per day whilst minimising sedentary behaviours [33]. Sedentary behaviours - in particular, time spent watching television - are associated with metabolic risk factors in children [34] and have been shown to predict BMI in early adulthood [35]. Independent of TV viewing time, higher levels of sedentary behaviours have been shown to lower levels of physical activity in children [36].

There is also evidence that participation in physical activity leads to health benefits [37] and lowers levels of overweight and obesity in children [38]. In this study, participation in MEND 5-7 was associated with significant, positive changes in physical activity levels ($P < 0.01$), TV viewing time and sedentary activity levels ($P < 0.0001$). Parents reported children on the programme had reduced sedentary behaviour by an average of 4.1 hours, of which 3.4 hours was television viewing, and increased their physical activity levels by 2.9 hours per week. Such reductions in sedentary activity and increase in physical activity during participation in the programme is very encouraging.

Some limitations of the study should be acknowledged. Only 62% of participants who started the programme completed post programme measurements. This level of completion is not atypical for a pilot study or reports of service-level implementation [39, 40] but may be a source of bias that could lead to an overestimation of treatment effect. Statistical analyses revealed that there were limited differences between those participants that completed the programme and those who did not. The data presented here are uncontrolled data representing the short-term impact of the intervention for children with complete sets of measurement data. Controlled studies of the impact beyond the ten week programme are needed to establish whether the present results are sustained and more effective than no or an alternative intervention. Whilst it is well documented that subjective measures of physical activity over-report when compared to more accurate objectively measured physical activity [41], subjective measurement can be a useful and cost effective tool when employed in a community-based programme if it is not feasible to obtain objective measurements [42]. The improvements found in physical activity and sedentary behaviours require supporting evidence using objective measurement.

CONCLUSION

Participation in the MEND 5-7 programme was associated with beneficial changes in physical, behavioural and psychological outcomes for children with complete sets of measurement data, when implemented in UK community settings under service level conditions. The findings presented warrant further evaluation in a formal trial to establish if the observed outcomes would have occurred in the absence of intervention, are replicable across varying ethnic and socioeconomic groups, are sustainable and are cost-effective, Further, process evaluation of programme implementation will also establish if the delivery model, using non-obesity specialists, can provide a scalable and suitable care pathway for families of overweight and obese children on a national level.

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Data Sharing Statement

No additional data available.

Ethical Approval

This study is a service evaluation and not within the remit of UK Ethics Committee governance. Parents consented to take part in the study and for use of their anonymised data.

Contributors

L Smith performed statistical analysis and contributed to writing the paper. P Chadwick co-developed the intervention and contributed to writing the paper, interpretation and analysis of results. D Radley contributed to writing the paper and statistical analysis. M Kolotourou critically reviewed all parts of the paper and assisted in the interpretation and analysis of the results. C Gammon contributed to the interpretation of the results and critically reviewed all parts of the paper. J Rosborough co-developed the intervention and critically reviewed all parts of the paper. P Sacher co-developed the intervention, contributed to the interpretation of the results and writing the paper and critically reviewed all parts of the paper. All authors approved the final draft of the paper.

Competing interests

Dr. Lindsey Smith, Dr. Duncan Radley, Catherine Gammon and Jennifer Rosborough are employed full-time at MEND. Dr. Paul Chadwick is currently employed part-time as Clinical Director at MEND. Maria Kolotourou is employed part-time at MEND. Paul Sacher is currently employed as a Senior Research Fellow at the UCL Institute of Child Health as well as Chief Research and Development Officer at MEND. Dr Venediktos Kapetanakis serves as a consultant statistician to MEND.

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Table 1. Baseline demographic and anthropometric characteristics

	% (n[1]) or mean (SD)
Gender	
Males	42.0 % (185)
Females	58.0 % (255)
Ethnicity	
White – British	67.2 % (275)
Black	6.6 % (27)
Asian	19.6 % (80)
Mixed	5.1 % (21)
Other	1.5 % (6)
House ownership	
Owner occupied	43.2 % (162)
Private rented	25.9 % (97)
Social rented	30.1 % (113)
Other	0.8 % (3)
Age (years)	6.1 (0.8)
Weight (kg)	33.0 (7.9)
Height (cm)	120.7 (7.7)
BMI (kg/m^2)	22.5 (3.6)
BMI z-score	2.86 (0.91)
Waist circumference (cm)	70.4 (9.5)
Waist circumference z-score	3.13 (1.09)

[1] n = 440, baseline n may vary due to missing data and data cleaning procedures.

Table 2. Within subject changes at pre and post intervention

	n[1]	Pre	Post	Difference	
		Mean (SD)	Mean (SD)	Mean (CI)	P
Anthropometry					
BMI (kg/m^2)	274	22.5 (3.6)	22.1 (3.7)	-0.5 (-0.6 to -0.4)	<0.0001
BMI z-score	274	2.86 (0.90)	2.66 (0.94)	-0.20 (-0.23 to -0.17)	<0.0001
Waist circumference (cm)	267	70.9 (9.9)	69.9 (10.0)	-0.9 (-1.3 to -0.5)	<0.0001
Waist circumference z-score	267	3.16 (1.10)	2.96 (1.14)	-0.20 (-0.25 to -0.15)	<0.0001
Psychosocial indices					
Child total difficulties score (range 0-40)	212	10.8 (5.7)	9.2 (5.8)	-1.6 (-2.2 to -0.9)	<0.0001
Play and enjoyment score (range 0-60)	240	48.6 (10.4)	51.6 (9.1)	3.1 (1.9 to 4.2)	<0.0001
Discipline and boundaries score (range 0-60)	235	42.0 (11.9)	47.3 (9.7)	5.3 (4.0 to 6.6)	<0.0001
Learning and knowledge score (range 0-60)	238	48.7 (9.2)	51.1 (8.3)	2.5 (1.3 to 3.7)	<0.0001
Activity indices					
Sedentary activity (hours/week)	168	21.6 (12.8)	17.5 (10.8)	-4.1 (-6.1 to -2.2)	<0.0001
Physical activity (hours/week)	168	15.1 (8.8)	18.0 (9.4)	2.9 (1.2 to 4.7)	<0.01
TV time (hours/week)	168	16.6 (10.9)	13.2 (9.0)	-3.4 (-5.0 to -1.8)	<0.0001

[1] numbers vary due to missing data and data cleaning procedures

Assessing the short-term ~~effects~~ outcomes of a ~~scalable,~~ community-based intervention for overweight and obese children: The MEND 5-7 programme.

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Keywords: childhood, obesity, intervention, community programme

Word count: 3,112~~2,977~~

ABSTRACT

Objective The aim of this study was to report outcomes of the UK service level delivery of MEND (Mind,Exercise,Nutrition...Do it!) 5-7, a multicomponent community-based, healthy lifestyle intervention designed for overweight and obese children aged 5-7 years and their families.

Design Repeated measures~~Pre-post study design.~~

Setting Community venues at 37 locations across the UK.

Participants 440 overweight or obese children (42% boys; mean age 6.1 years; BMI z-score 2.86) and their parents/carers participated in the intervention.

Intervention MEND 5-7 is a 10-week, family-based, child weight-management intervention consisting of weekly group sessions. It includes positive parenting, active play, nutrition education and behaviour change strategies. The intervention is designed to be scalable and delivered by a range of health and social care professionals.

Primary and secondary outcome measures The primary outcome was BMI z-score. Secondary outcome measures included BMI, waist circumference, waist circumference z-score, children's psychological symptoms, parenting self-efficacy, physical activity and sedentary behaviours and the proportion of parents and children eating 5 or more portions of fruit and vegetables.

Results: 274 (62%) children were measured pre and post-intervention (baseline; 10-weeks). Post-intervention, mean BMI and waist circumference decreased by 0.5 kg/m^2 and 0.9 cm, while z-scores decreased by 0.20 and 0.20, respectively ($p<0.0001$). Improvements were found in children's psychological symptoms (-1.6 units,$p<0.0001$), parent self-efficacy ($p<0.0001$), physical activity (+2.9 hours/week,$p<0.01$), sedentary activities (-4.1 hours/week,$p<0.0001$) and the proportion of parents and children eating 5 or more portions of fruit and vegetables per day (both $p<0.0001$). Attendance to the 10 sessions was 73% with a 70% retention rate.

Conclusions: Participation in the MEND 5-7 programme was associated with beneficial changes in physical, behavioural and psychological outcomes for children with complete sets

of measurement data, when implemented in UK community settings under service level conditions~~These findings suggest that when implemented under service level conditions the MEND 5-7 programme was acceptable to families with beneficial effects on physical, behavioural and psychological outcomes when delivered at scale~~. Further investigation is warranted to establish if these findings are replicable under controlled conditions.

Article Summary

Article Focus

- Childhood obesity prevalence rates remain high in the UK and globally.
- To our knowledge there are no published, peer-reviewed weight management trials or service level evaluations for children aged 5-7 in England.

Key messages

- The MEND 5-7 programme has high attendance and retention rates~~was acceptable to families~~ and ~~had~~ produced positive changes in~~beneficial effects on~~ physical, behavioural and psychological outcomes~~ when delivered at scale~~.
- This study demonstrates that a community-based intervention delivered by non-obesity specialists has ~~the~~ a potentially valuable contribution to make ~~potential to provide a scalable and suitable~~ as part of a comprehensive care pathway for families of overweight and obese children.

Strengths and limitations

Strengths

- ~~A strength of the study is that it utilises 'real-world' data representative of childhood community based interventions that are scalable to reduce childhood obesity levels.~~ By using service-level data this study contributes to the literature on appropriate targets for community level interventions.

- Most of the outcome literature on community-based child weight management programmes have been delivered by highly-skilled professionals under trial conditions. This limits the conclusions that can be drawn about whether such outcomes can be translated to community settings under different conditions of service delivery. The results of this paper suggest that outcomes similar to those achieved by controlled trials can be achieved under conditions of normal service delivery. ~~An additional strength is that MEND 5-7 was delivered by community-based, non-obesity specialists in contrast to other studies that have used highly skilled professionals to deliver the intervention~~

Limitations

- Only 62% of participants who started the programme completed post programme measurements. Although this level of completion is not atypical for reports of service-level implementation it is still possible that biases due to selective attrition ~~but may be a source of bias that~~ could lead to an overestimation of treatment effect.

INTRODUCTION

Childhood obesity is associated with adverse effects on short and long term health [1, 2]. Prevalence rates continue to be high globally and more specifically in the UK [3]. In 2005, the Department of Health initiated the National Child Measurement Programme (NCMP) to identify school children in Reception (typically aged 4-5 years) and Year 6 (aged 10-11 years) who are overweight or obese in England [4]. Since its inception, results from the NCMP have indicated high levels of overweight and obesity in both age groups - the most recent findings (school year 2010/2011) identifying 22.6% and 33.4% of Reception and Year 6 children as overweight or obese, respectively. Surveillance programmes have evolved into screening programmes with a high proportion of UK primary care trusts choosing to inform parents of their child's weight status. Although this practice is controversial it is also the case that identification may be a trigger for parents to initiate lifestyle change and/or seek professional support [5].

Research has indicated that there may be an effectiveness gradient with regard to the impact of child obesity treatment with age [6]. Generally, earlier treatment is associated with better outcomes following programmes that are less intensive. To be effective, it is recommended that interventions are multicomponent and include age-appropriate nutrition and physical activity with behaviour change strategies that are developmentally appropriate to the cognitive abilities of the child and the nature of relationships in the family life cycle [7, 8]. Although the availability of treatments is steadily increasing, there are significant disparities in the availability of treatments across the developmental continuum. In the UK only 8 out of 45 weight management schemes cover the 5 to 7 age range [9] and only four out of the 13 Department of Health approved Child Weight Management programmes are suitable for children under the age of 7 [10]. To our knowledge there are no published, peer-reviewed weight management trials or service level evaluations for children aged 5-7 in England. This leaves a gap in the understanding of the outcomes that is possible to achieve for overweight and obese children in this age range in a UK setting.

The aim of this study was to report outcomes from the UK service level delivery of MEND 5-7 (Mind, Exercise, Nutrition... Do it!), a multicomponent community-based healthy lifestyle intervention designed for overweight and obese children aged 5-7 years and their families.

METHODS

Recruitment

Families were recruited between 2009 and 2011 using a variety of techniques. MEND provides recruitment resources such as posters, flyers and letters that can be used within local networks to support the recruitment process. In addition, support is also provided detailing effective use of these resources. Children were eligible if they were classified as overweight or obese (BMI ≥91st percentile) according to the UK 1990 reference data [11]; had no apparent clinical conditions, comorbidities, physical disabilities or learning difficulties

that would interfere with programme engagement and were aged between 5 and 7 years with at least one parent/carer who was able to attend each of the programme sessions

Study Design

The study employed an uncontrolled repeated measures design evaluating changes in anthropometric, psychosocial, physical activity and nutritional outcomes. This study reports the outcomes ~~effects~~ of participating children with complete pre- and post-intervention data ~~the programme~~ when delivered in UK community settings under service level conditions.

Study Intervention

The MEND 5-7 programme is a comprehensive, multi-component intervention designed to tackle obesity in childhood. The programme supports families by providing information on child nutrition (based on government healthy eating guidelines), active play and parenting practices to help parents practically integrate these recommendations into everyday life. The programme uses a non-diet approach to prevent unduly restrictive eating which can lead to problematic eating behaviours [7].

MEND 5-7 is based around key principles in health-related behaviour change and behavioural parent training programmes. These methods are drawn from evidence-based practices in child psychology and parenting interventions [12].

Reviews of behavioural treatments for childhood obesity show group-based interventions are the most commonly used delivery formats and are more effective than individual treatment sessions [13]. Groups are more efficient, provide greater opportunity for therapeutic interactions between participants, improve attendance rates and are cost-effective[13]. Community groups provide greater access to minority ethnic groups, counter stigma, provide a social support network and aid the therapeutic process of problem-solving [14]. These factors improve understanding of the condition, adherence to the intervention and

implementation of changes in behaviour. Recognising the importance of family involvement for behaviour change, the programme requires a parent or carer to attend all sessions.

Structure and Content

The programme consists of 10 (one hour and forty-five minute duration) weekly group-based sessions delivered by two trained leaders and one optional assistant. The programme is held in community settings such as sports centres and schools for groups of 8-15 children and their parents/carers. The first and last sessions are allocated as introductory and graduation sessions, respectively, incorporating measurements and parental/carer questionnaire completion.

Each session has four components; 'Power Time' (20 minutes), 'Healthy Families' (25 minutes), 'Active Play' and 'Parent/carer Workshop' (during this time children take part in 60 minutes of physical activity and parents/carers attend a workshop). 'Power Time' is a joint parent/carer and child snack time designed to help parents incorporate evidence-based food exposure techniques into their daily routines to increase their child's preferences for healthier foods. 'Healthy Families' is also a joint parent/carer and child session that focuses on educating and promoting skills for everyday play, active family lifestyles and healthy family eating in the home environment. 'Active Play' is a child-only play session that takes place while the parents/carers are in their workshop. The focus is on fun and active participation. The aim is to provide children with positive experiences of being active in a supportive setting.

The parent/carer workshops include interactive activities and discussions focusing on nutrition, activity and behaviour change. Five of the parent/carer workshops focus on healthy eating and nutrition-related topics. Group discussions include practical training on understanding food and drink labels, fat and sugar content of foods and drinks, portion sizes,

and managing fussy eating. The remaining workshops focus on family rules and routines, reducing screen time and overcoming barriers to physical activity.

Training

The MEND 5-7 programme is delivered by community-based health, education and physical activity professionals who attend a 2-day, face-to-face training course. The training is derived from established competency-based skills training methods [15] and includes direct teaching, role-play, guided discussion and multiple choice assessments. After training, all staff are required to complete an on-line assessment to gain certification to deliver the programme and pass an enhanced CRB (Criminal Records Bureau) check.

Following successful completion of the training, delivery teams are provided with four manuals, two for programme delivery, one for programme management and one for physical activity. These resources provide full details of session plans, objectives, direct teaching notes, desired outcomes, set-up and delivery requirements and all aspects of the physical activity programme component.

Outcome Measurements

Demographics

Socioeconomic status was determined based on home ownership [16], grouped as: 'owner occupied', 'private rented', 'social rented' and 'other'. Ethnic background was based on the UK census categorisation as outlined in the National Obesity Observatory Standard Evaluation Framework for weight management interventions [16].

Physical activity and inactivity

Physical activity level and sedentary behaviours were assessed using items adapted from the 'outdoor playtime checklist' [17]. Physical activity was assessed by asking 'How much time did your child spend playing outside in the yard or street of your house (or the house of

a friend, neighbour or relative), or at the park, playground, or outdoor recreation (e.g. swimming pool, zoo or amusement park), including while at day care or preschool?' Television viewing time and time spent playing computer/console game were assessed by asking 'How much time would you say your child spends watching television (including videos and DVD's), including time spent watching TV in other people's houses?' and 'How much time did your child spend playing Play-Station/X-box/Nintendo/Computer games (including watching a friend/brother/sister/adult play, and at other people's houses)?' Total sedentary activity was calculated from the addition of TV viewing time and time spent playing computer/console games. Answers were given in hours and minutes per day, based on typical days in the last month. Separate estimates were provided for weekday and weekend days.

Anthropometry

Body weight (kg) and height (cm) were measured using standardised procedures [18] and body mass index calculated as body weight(kg)/height(m^2). Waist circumference (cm) was measured 4 cm above the umbilicus [19]. BMI and waist circumference z-scores were calculated from UK national reference data [11, 20] using LMS growth software [21].

Fruit and vegetable consumption

Child and parent fruit and vegetable consumption were assessed by the daily frequency of portions consumed [22]. Questions were measured on a 7 point likert scale (less than one per week, one per week, two to three per week, four to six per week, one per day, two per day, or three or more per day) [22].

Parenting self-efficacy

Parenting self efficacy was measured using the subscales of 'Play and Enjoyment', 'Discipline and Boundary Setting' and 'Learning and Knowledge' taken from 'TOPSE' (Tool to Measure Parenting Self Efficacy) [23].

Strengths and Difficulties Questionnaire (SDQ)

The SDQ – Parent's Version[24]] ~~provides~~ is a widely used ~~a~~ measure of emotional distress in children and adolescents. The measure consists of 25 statements referring to behaviours associated with emotional difficulties, such as 'often has temper tantrums or hot tempers' and 'often lies or cheats'. Parents are asked to indicate how 'true' each statement is of their child on a 3 point likert scale (not true, somewhat true, certainly true). A 'total difficulties' score is generated, with higher scores indicating greater levels of emotional distress. Measures of psychological distress were included to evaluate the impact of the intervention upon children's well-being and to ensure that physical health outcomes were not achieved at the expense of well-being.

Data Cleaning and statistical analysis

Due to the data being collected under service level conditions by non-researchers, comprehensive cleaning procedures were undertaken to ensure data quality. Outliers for anthropometric measurements were identified from visual analysis of histograms and scatterplots. Visual analysis enabled identification of seven observations that were inconsistent with other observations in the data set. After comparison to reference growth charts, these seven data sets were excluded due to biologically unlikely increases in height of over 5.5 cm over the course of the pre and post measurement sessions. Participants were excluded from the activity analysis if the addition of reported daily physical activity and sedentary behaviour exceeded 16 hours, resulting in seven data sets being excluded.

Variable distribution was checked using the Kruskall-Wallis test for normality. Paired sample t-tests were employed to assess mean differences in the outcome variables from baseline to 3 months (end of intervention). Changes in the proportions for fruit and vegetable intake from baseline to the end of the intervention were assessed using the McNemar's test. Baseline differences for those who did and did not complete post programme measurements were

examined using independent sample t-tests. Similarly, effects of gender pre-post programme were examined using independent sample t-tests. Statistical significance was set at $P < 0.05$. All analyses were conducted using SPSS 18.0 for Windows (SPSS, Chicago, IL).

RESULTS

Recruitment

Four hundred and forty children participated in MEND 5-7 programmes across 37 UK locations.

Baseline demographic and anthropometric characteristics

Fifty-eight percent were female, and 79% of participants were obese (BMI ≥ 98th centile). Thirty-three percent of children were from non-white ethnic backgrounds with 57% reporting they did not own their home (Table 1).

Completers vs. non completers

There were no significant differences in baseline demographic and anthropometric characteristics between children with complete sets of measurement data and those without. Significant differences were evident in baseline comparisons of physical activity levels (15.0 ± 8.9 hours/week completers vs. 19.3 ± 13.7 hours/week non completers, $P < 0.01$). All other outcome measures were not significantly different at baseline.

Attendance and retention

Attendance data was available for 81% of participants. Mean attendance for the programme was 73% and retention rate (based on children attending at least 7 sessions) was 70%.

Outcome measures

Within subject differences in anthropometric, psychosocial and activity measures pre and post intervention are shown in Table 2. Significant reductions in BMI, BMI z-score, waist

circumference, waist z-score and child total difficulties score (all P < 0.0001) post intervention were noted. Positive changes were also observed for TV time, sedentary activity (P < 0.0001) and physical activity (P < 0.01). Significant increases were observed in all parenting self-efficacy domains and the proportion of children and parents eating at least five fruit and vegetables per day (all P < 0.0001). There were no gender differences in any of the study outcomes.

DISCUSSION

This study examined outcomes following participation in the MEND programme for children aged 5-7 years old. Positive changes were observed for~~The intervention demonstrated positive effects on~~ children's weight status, diet and activity levels and emotional well-being. Parents also reported an increase in self-efficacy in relation to their parenting role.

Most of the outcome literature on child weight management programmes has been reported under trial conditions. Outcomes reported in studies of GP-led behavioural treatment of individual families (LEAP intervention [25]) and in generic parenting programmes unmodified to deal with the specific needs of obese and overweight children (Triple P) have shown no significant reductions in measures of degree of obesity. A version of the Triple P programme specifically adapted for obesity (Lifestyle Triple P) showed a reduction of -0.11 at 20 weeks [26], the HICKUPS study of a multicomponent group-based parenting intervention reported a reduction of -0.36 at 6 months and the PEACH study of a parent-only group intervention showed a reduction of -0.26 at 6 months [27, 28].

In the current study, children with complete sets of measurement data had a significant reduction in BMI z-score of -0.20 after ten weeks. The results presented here were similar to the unpublished three months data (-0.20) for children taking part in the randomised controlled trial of the MEND programme for 7 to 13 year old children [29] and it's national service level evaluation (-0.18) [30]. Although not directly comparable to the treatment

effects reported in experimental studies using intention-to-treat analysis this study suggests that community level interventions delivered under conditions of normal service delivery may achieve similar results to those obtained in clinical trials.

Generally, interventions that produce greater treatment effects are more intense and involve relatively higher levels of contact time [31]. The US preventive services task force (USPSTF) conclude that low intensity interventions – defined as those involving less than 25 hours direct professional contact time – are insufficient to have a positive impact on weight-status in obese and overweight children. The MEND 5-7 programme consists of 17.5 hours of face-to-face contact time and demonstrated significant reductions in zBMI for the 62% of children with complete sets of measurement data. Contrary to USPTS recommendations this suggests that clinically meaningful outcomes may be achievable by low intensity interventions. ~~(-0.20) comparable to interventions with much greater contact time.~~

MEND 5-7 has been designed to be delivered by community-based, non-obesity specialists in contrast to other studies that have used highly skilled professionals to deliver the intervention [27, 28]. A large proportion of childhood obesity interventions employ intensive programmes involving specialist dieticians and other health professionals [32]. Childhood obesity interventions are significantly more expensive when skilled professionals and additional contact hours are employed. In an increasingly resource-constrained public-sector environment, these factors might limit the potential reach of evidence-based programmes [32]. The development of a clinically effective, low-intensity programme using non-specialist, community-based delivery staff could be a crucial strategy to meet the needs of younger children who are already overweight. The present results suggest that clinically meaningful outcomes may be achievable by low intensity interventions delivered by non-specialist staff. Further research would be desirable to explore whether these initially promising data could be independently replicated ~~such a model is feasible and effective when implemented~~ under

service level conditions ~~and suggest that MEND 5-7 may be a good candidate for large-scale implementation.~~ .

The UK Department of Health physical activity guidelines specify that children and young people (5-18 years old) should engage in 60 minutes of activity per day whilst minimising sedentary behaviours [33]. Sedentary behaviours - in particular, time spent watching television - are associated with metabolic risk factors in children [34] and have been shown to predict BMI in early adulthood [35]. Independent of TV viewing time, higher levels of sedentary behaviours have been shown to lower levels of physical activity in children [36].

There is also evidence that participation in physical activity leads to health benefits [37] and lowers levels of overweight and obesity in children [38]. In this study, participation in MEND 5-7 ~~produced~~ was associated with significant, positive changes in physical activity levels ($P < 0.01$), TV viewing time and sedentary activity levels ($P < 0.0001$). Parents reported children on the programme had reduced sedentary behaviour by an average of 4.1 hours, of which 3.4 hours was television viewing, and increased their physical activity levels by 2.9 hours per week. Such reductions in sedentary activity and increase in physical activity during participation in the programme is very encouraging.

Some limitations of the study should be acknowledged. Only 62% of participants who started the programme completed post programme measurements. This level of completion is not atypical for a pilot study or reports of service-level implementation [39, 40] but may be a source of bias that could lead to an overestimation of treatment effect. Statistical analyses revealed that there were limited differences between those participants that completed the programme and those who did not. The data presented here are uncontrolled data representing the short-term impact of the intervention for children with complete sets of measurement data. Controlled studies of the impact beyond the ten week programme are needed to establish whether the present results are sustained and more effective than no or

an alternative intervention. Whilst it is well documented that subjective measures of physical activity over-report when compared to more accurate objectively measured physical activity [41], subjective measurement can be a useful and cost effective tool when employed in a community-based programme if it is not feasible to obtain objective measurements [42]. The improvements found in physical activity and sedentary behaviours require supporting evidence using objective measurement.

CONCLUSION

Participation in ~~The~~ the MEND 5-7 programme was associated with ~~appears to have had~~ beneficial changes ~~effects o~~in physical, behavioural and psychological outcomes for children with complete sets of measurement~~pre-post~~ data, when implemented in UK community settings under service level conditions. ~~High attendance and retention rates suggest the programme was acceptable to families.~~ T~~Coupled with a scalable delivery model using non-obesity specialists, t~~he ~~se preliminary~~ findings presented warrant further evaluation in a ~~in a~~ formal trial to ~~to~~ establish if ~~outcomes~~ the observed outcomes would have occurred in the absence of intervention, are replicable across varying ethnic and socioeconomic groups, are sustainable and are ~~and sustained,~~ cost-effective, Further, process evaluation of programme implementation will also establish if the delivery model, using non-obesity specialists, can provide a scalable and suitable care pathway for families of overweight and obese children on a national level.

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Data Sharing Statement

No additional data available.

Ethical Approval

This study is a service evaluation and not within the remit of UK Ethics Committee governance. Parents consented to take part in the study and for use of their anonymised data.

Contributors

L Smith performed statistical analysis and contributed to writing the paper. P Chadwick co-developed the intervention and contributed to writing the paper, interpretation and analysis of results. D Radley contributed to writing the paper and statistical analysis. M Kolotourou critically reviewed all parts of the paper and assisted in the interpretation and analysis of the results. C Gammon contributed to the interpretation of the results and critically reviewed all parts of the paper. J Rosborough co-developed the intervention and critically reviewed all parts of the paper. P Sacher co-developed the intervention, contributed to the interpretation of the results and writing the paper and critically reviewed all parts of the paper. All authors approved the final draft of the paper.

Competing interests

Dr. Lindsey Smith, Dr. Duncan Radley, Catherine Gammon and Jennifer Rosborough are employed full-time at MEND. Dr. Paul Chadwick is currently employed part-time as Clinical

Director at MEND. Maria Kolotourou is employed part-time at MEND. Paul Sacher is currently employed as a Senior Research Fellow at the UCL Institute of Child Health as well as Chief Research and Development Officer at MEND. Dr Venediktos Kapetanakis serves as a consultant statistician to MEND.

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Table 1. Baseline demographic and anthropometric characteristics

	% (n[1]) or mean (SD)
Gender	
Males	42.0 % (185)
Females	58.0 % (255)
Ethnicity	
White – British	67.2 % (275)
Black	6.6 % (27)
Asian	19.6 % (80)
Mixed	5.1 % (21)
Other	1.5 % (6)
House ownership	
Owner occupied	43.2 % (162)
Private rented	25.9 % (97)
Social rented	30.1 % (113)
Other	0.8 % (3)
Age (years)	6.1 (0.8)
Weight (kg)	33.0 (7.9)
Height (cm)	120.7 (7.7)
BMI (kg/m^2)	22.5 (3.6)
BMI z-score	2.86 (0.91)
Waist circumference (cm)	70.4 (9.5)
Waist circumference z-score	3.13 (1.09)

[1] n = 440, baseline n may vary due to missing data and data cleaning procedures.

Table 2. Within subject changes at pre and post intervention

	n[1]	Pre	Post	Difference	
		Mean (SD)	Mean (SD)	Mean (CI)	P
Anthropometry					
BMI (kg/m^2)	274	22.5 (3.6)	22.1 (3.7)	-0.5 (-0.6 to -0.4)	<0.0001
BMI z-score	274	2.86 (0.90)	2.66 (0.94)	-0.20 (-0.23 to -0.17)	<0.0001
Waist circumference (cm)	267	70.9 (9.9)	69.9 (10.0)	-0.9 (-1.3 to -0.5)	<0.0001
Waist circumference z-score	267	3.16 (1.10)	2.96 (1.14)	-0.20 (-0.25 to -0.15)	<0.0001
Psychosocial indices					
Child total difficulties score (range 0-40)	212	10.8 (5.7)	9.2 (5.8)	-1.6 (-2.2 to -0.9)	<0.0001
Play and enjoyment score (range 0-60)	240	48.6 (10.4)	51.6 (9.1)	3.1 (1.9 to 4.2)	<0.0001
Discipline and boundaries score (range 0-60)	235	42.0 (11.9)	47.3 (9.7)	5.3 (4.0 to 6.6)	<0.0001
Learning and knowledge score (range 0-60)	238	48.7 (9.2)	51.1 (8.3)	2.5 (1.3 to 3.7)	<0.0001
Activity indices					
Sedentary activity (hours/week)	168	21.6 (12.8)	17.5 (10.8)	-4.1 (-6.1 to -2.2)	<0.0001
Physical activity (hours/week)	168	15.1 (8.8)	18.0 (9.4)	2.9 (1.2 to 4.7)	<0.01
TV time (hours/week)	168	16.6 (10.9)	13.2 (9.0)	-3.4 (-5.0 to -1.8)	<0.0001

[1] numbers vary due to missing data and data cleaning procedures