



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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12 **Assessing the short-term effects of a scalable, community-based intervention for**
13 **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/m² 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.

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

12 **Article Focus**

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

16 **Key messages**

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

22 **Strengths and limitations**

- 23 • A strength of the study is that it utilises 'real-world' data representative of childhood
24 community based interventions that are scalable to reduce childhood obesity levels. An
25 additional strength is that MEND 5-7 was delivered by community-based, non-obesity
26 specialists in contrast to other studies that have used highly skilled professionals to
27 deliver the intervention
- 28 • A limitation is that only 62% of participants who started the programme completed post
29 programme measurements. This level of completion is not atypical for a pilot study or
30 reports of service-level implementation but may be a source of bias that could lead to an
31 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.

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3 The aim of this study was to report outcomes from the UK service level delivery of MEND 5-
4 7 (Mind, Exercise, Nutrition... Do it!), a multicomponent community-based healthy lifestyle
5 intervention designed for overweight and obese children aged 5-7 years and their families.
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10 11 **METHODS**

12 13 **Recruitment**

14 Families were recruited between 2009 and 2011 using a variety of techniques. MEND
15 provides recruitment resources such as posters, flyers and letters that can be used within
16 local networks to support the recruitment process. In addition, support is also provided
17 detailing effective use of these resources. Children were eligible if they were classified as
18 overweight or obese (BMI $\geq 91^{\text{st}}$ percentile) according to the UK 1990 reference data [9]; had
19 no apparent clinical conditions, comorbidities, physical disabilities or learning difficulties that
20 would interfere with programme engagement and were aged between 5 and 7 years with at
21 least one parent/carer who was able to attend each of the programme sessions
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33 34 **Study Design**

35 The study employed an uncontrolled pre post design evaluating changes in anthropometric,
36 psychosocial, physical activity and nutritional outcomes. This study reports the effects of the
37 programme when delivered in UK community settings under service level conditions.
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43 44 **Study Intervention**

45 The MEND 5-7 programme is a comprehensive, multi-component intervention designed to
46 tackle obesity in childhood. The programme supports families by providing information on
47 child nutrition (based on government healthy eating guidelines), active play and parenting
48 practices to help parents practically integrate these recommendations into everyday life. The
49 programme uses a non-diet approach to prevent unduly restrictive eating which can lead to
50 problematic eating behaviours [10].
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3 MEND 5-7 is based around key principles in health-related behaviour change and
4 behavioural parent training programmes. These methods are drawn from evidence-based
5 practices in child psychology and parenting interventions [11].
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11 Reviews of behavioural treatments for childhood obesity show group-based interventions are
12 the most commonly used delivery formats and are more effective than individual treatment
13 sessions [12]. Groups are more efficient, provide greater opportunity for therapeutic
14 interactions between participants, improve attendance rates and are cost-effective.
15 Community groups provide greater access to minority ethnic groups, counter stigma, provide
16 a social support network and aid the therapeutic process of problem-solving. These factors
17 improve understanding of the condition, adherence to the intervention and implementation of
18 changes in behaviour. Recognising the importance of family involvement for behaviour
19 change, the programme requires a parent or carer to attend all sessions.
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30 31 **Structure and Content**

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33 The programme consists of 10 (one hour and forty-five minute duration) weekly group-based
34 sessions delivered by two trained leaders and one optional assistant. The programme is held
35 in community settings such as sports centres and schools for groups of 8-15 children and
36 their parents/carers. The first and last sessions are allocated as introductory and graduation
37 sessions, respectively, incorporating measurements and parental/carers questionnaire
38 completion.
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47 Each session has four components; 'Power Time' (20 minutes), 'Healthy Families' (25
48 minutes), 'Active Play' and 'Parent/carers Workshop' (during this time children take part in 60
49 minutes of physical activity and parents/carers attend a workshop). 'Power Time' is a joint
50 parent/carers and child snack time designed to help parents incorporate evidence-based food
51 exposure techniques into their daily routines to increase their child's preferences for
52 healthier foods. 'Healthy Families' is also a joint parent/carers and child session that focuses
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3 on educating and promoting skills for everyday play, active family lifestyles and healthy
4 family eating in the home environment. 'Active Play' is a child-only play session that takes
5 place while the parents/carers are in their workshop. The focus is on fun and active
6 participation. The aim is to provide children with positive experiences of being active in a
7 supportive setting.
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15 The parent/carer workshops include interactive activities and discussions focusing on
16 nutrition, activity and behaviour change. Five of the parent/carer workshops focus on healthy
17 eating and nutrition-related topics. Group discussions include practical training on
18 understanding food and drink labels, fat and sugar content of foods and drinks, portion sizes,
19 and managing fussy eating. The remaining workshops focus on family rules and routines,
20 reducing screen time and overcoming barriers to physical activity.
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29 **Training**

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31 The MEND 5-7 programme is delivered by community-based health, education and physical
32 activity professionals who attend a 2-day, face-to-face training course. The training is
33 derived from established competency-based skills training methods [13] and includes direct
34 teaching, role-play, guided discussion and multiple choice assessments. After training, all
35 staff are required to complete an on-line assessment to gain certification to deliver the
36 programme and pass an enhanced CRB (Criminal Records Bureau) check.
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39 Following successful completion of the training, delivery teams are provided with four
40 manuals, two for programme delivery, one for programme management and one for physical
41 activity. These resources provide full details of session plans, objectives, direct teaching
42 notes, desired outcomes, set-up and delivery requirements and all aspects of the physical
43 activity programme component.
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54 **Outcome Measurements**

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57 Demographics
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3 Socioeconomic status was determined based on home ownership [14], grouped as: 'owner
4 occupied', 'private rented', 'social rented' and 'other'. Ethnic background was based on the
5 UK census categorisation as outlined in the National Obesity Observatory Standard
6 Evaluation Framework for weight management interventions [14].
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10 11 12 13 Physical activity and inactivity

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

47 Body weight (kg) and height (cm) were measured using standardised procedures [16] and
48 body mass index calculated as $\text{body weight(kg)/height(m}^2\text{)}$. Waist circumference (cm) was
49 measured 4 cm above the umbilicus [17]. BMI and waist circumference z-scores were
50 calculated from UK national reference data [9, 18] using LMS growth software [19].
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58 Fruit and vegetable consumption

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3 Child and parent fruit and vegetable consumption were assessed by the daily frequency of
4 portions consumed [20]. Questions were measured on a 7 point likert scale (less than one
5 per week, one per week, two to three per week, four to six per week, one per day, two per
6 day, or three or more per day) [20].
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10 11 12 Parenting self-efficacy

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14 Parenting self efficacy was measured using the subscales of 'Play and Enjoyment',
15 'Discipline and Boundary Setting' and 'Learning and Knowledge' taken from 'TOPSE' (Tool
16 to Measure Parenting Self Efficacy) [21].
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20 21 22 Strengths and Difficulties Questionnaire (SDQ)

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24 The SDQ – Parent's Version [13] provides a measure of emotional distress in children and
25 adolescents. The measure consists of 25 statements referring to behaviours associated with
26 emotional difficulties, such as 'often has temper tantrums or hot tempers' and 'often lies or
27 cheats'. Parents are asked to indicate how 'true' each statement is of their child on a 3 point
28 likert scale (not true, somewhat true, certainly true). A 'total difficulties' score is generated,
29 with higher scores indicating greater levels of emotional distress.
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40 41 42 **Data Cleaning and statistical analysis**

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44 Due to the data being collected under service level conditions by non-researchers, strict
45 cleaning procedures were undertaken to ensure data quality. Outliers for anthropometric
46 measurements were identified from visual analysis of histograms and scatterplots, resulting
47 in 7 data sets being excluded. Participants were excluded from the activity analysis if the
48 addition of reported daily physical activity and sedentary behaviour exceeded 16 hours,
49 resulting in seven data sets being excluded.
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56 Variable distribution was checked using the Kruskal-Wallis test for normality. Paired sample
57 t-tests were employed to assess mean differences in the outcome variables from baseline to
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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 \geq 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 \pm 8.9 hours/week completers vs. 19.3 \pm 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

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3 PEACH study of a parent-only group intervention showed a reduction of -0.26 at 6 months
4 [25, 26]. Interestingly, the results were similar to the unpublished three months data (-0.20)
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6 for children taking part in the randomised controlled trial of the MEND programme for 7 to 13
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8 year old children [27] and it's national service level evaluation (-0.18) [28].
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13 Generally, interventions that produce greater treatment effects are usually more intense and
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15 involve relatively higher levels of contact time [29]. The US preventive services task force
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17 (USPSTF) conclude that low intensity interventions – defined as those involving less than 25
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19 hours direct professional contact time – are insufficient to have a positive impact on weight-
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21 status in obese and overweight children. Interestingly, the MEND 5-7 programme consists of
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23 17.5 hours of face-to-face contact time and therefore falls into the category of a low intensity
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25 intervention. Despite this, participation in the programme was associated with significant
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27 reductions in zBMI (-0.20) comparable to interventions with much greater contact time.
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30 MEND 5-7 was delivered by community-based, non-obesity specialists in contrast to other
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32 studies that have used highly skilled professionals to deliver the intervention [25, 26]. It has
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34 been recognised that a large proportion of childhood obesity interventions employ intensive
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36 programmes involving specialist dieticians and other health professionals [30]. Childhood
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38 obesity interventions are significantly more expensive when skilled professionals and
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40 additional contact hours are employed, and in an increasingly resource-constrained
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42 environment, these factors might limit the reach of evidence-based programmes [30]. The
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44 development of a clinically effective, low-intensity programme using non-specialist,
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46 community-based delivery staff could be a crucial strategy to meet the needs of younger
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48 children who are already overweight. The present results suggest that such a model is
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50 feasible and effective when implemented under service level conditions and suggest that
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52 MEND 5-7 may be a good candidate for large-scale implementation.
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56 The UK Department of Health physical activity guidelines specify that children and young
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58 people (5-18 years old) should engage in 60 minutes of activity per day whilst minimising
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3 sedentary behaviours [31]. Sedentary behaviours - in particular, time spent watching
4 television - are associated with metabolic risk factors in children [32] and have been shown
5 to predict BMI in early adulthood [33]. Independent of TV viewing time, higher levels of
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7 sedentary behaviours have been shown to lower levels of physical activity in children [34].
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11 There is also evidence that participation in physical activity leads to health benefits [35] and
12 lowers levels of overweight and obesity in children [36]. In this study, MEND 5-7 produced
13 significant, positive changes in physical activity levels ($P < 0.01$), TV viewing time and
14 sedentary activity levels ($P < 0.0001$). Parents reported children on the programme had
15 reduced sedentary behaviour by an average of 4.1 hours, of which 3.4 hours was television
16 viewing, and increased their physical activity levels by 2.9 hours per week. The concurrent
17 reduction in sedentary activity and increase in physical activity following participation in the
18 programme is thus very encouraging.
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29 Some limitations of the study should be acknowledged. Only 62% of participants who started
30 the programme completed post programme measurements. This level of completion is not
31 atypical for a pilot study or reports of service-level implementation [37, 38] but may be a
32 source of bias that could lead to an overestimation of treatment effect. Statistical analyses
33 revealed that there were limited differences between those participants that completed the
34 programme and those who did not. The data presented here are uncontrolled data
35 representing the short-term impact of the intervention. Controlled studies of the impact
36 beyond the ten week programme are needed to establish whether the present results are
37 sustained and more effective than no or an alternative intervention. Whilst it is well
38 documented that subjective measures of physical activity over-report when compared to
39 more accurate objectively measured physical activity [39], subjective measurement can be a
40 useful and cost effective tool when employed in a community-based programme if it is not
41 feasible to obtain objective measurements [40]. The improvements found in physical activity
42 and sedentary behaviours require supporting evidence using objective measurement.
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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

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3 results. D Radley contributed to writing the paper and statistical analysis. M Kolotourou
4 critically reviewed all parts of the paper and assisted in the interpretation and analysis of the
5 results. C Gammon contributed to the interpretation of the results and critically reviewed all
6 parts of the paper. J Rosborough co-developed the intervention and critically reviewed all
7 parts of the paper. P Sacher co-developed the intervention, contributed to the interpretation
8 of the results and writing the paper and critically reviewed all parts of the paper. All authors
9 approved the final draft of the paper.
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17 **Competing interests**

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20 Dr. Lindsey Smith, Dr. Duncan Radley, Catherine Gammon and Jennifer Rosborough are
21 employed full-time at MEND. Dr. Paul Chadwick is currently employed part-time as Clinical
22 Director at MEND. Maria Kolotourou is employed part-time at MEND. Paul Sacher is
23 currently employed as a Senior Research Fellow at the UCL Institute of Child Health as well
24 as Chief Research and Development Officer at MEND. Dr Venediktos Kapetanakis serves
25 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 outcomes of a community-based intervention for overweight and obese children: The MEND 5-7 programme.

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Manuscripts

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3 **Assessing the short-term outcomes of a community-based intervention for**
4 **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 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/m² 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

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3 of measurement data, when implemented in UK community settings under service level
4 conditions. Further investigation is warranted to establish if these findings are replicable
5 under controlled conditions.
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10 11 12 13 **Article Summary**

14 **Article Focus**

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

18 19 20 21 22 **Key messages**

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

28 29 30 31 32 33 **Strengths and limitations**

34 35 36 **Strengths**

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

45 46 47 48 49 50 51 52 53 54 55 **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

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3 only 8 out of 45 weight management schemes cover the 5 to 7 age range [9] and only four
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5 out of the 13 Department of Health approved Child Weight Management programmes are
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7 suitable for children under the age of 7 [10]. To our knowledge there are no published, peer-
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9 reviewed weight management trials or service level evaluations for children aged 5-7 in
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11 England. This leaves a gap in the understanding of the outcomes that is possible to achieve
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13 for overweight and obese children in this age range in a UK setting.
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17 The aim of this study was to report outcomes from the UK service level delivery of MEND 5-
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19 7 (Mind, Exercise, Nutrition... Do it!), a multicomponent community-based healthy lifestyle
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21 intervention designed for overweight and obese children aged 5-7 years and their families.
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24 25 **METHODS**

26 27 **Recruitment**

28
29 Families were recruited between 2009 and 2011 using a variety of techniques. MEND
30
31 provides recruitment resources such as posters, flyers and letters that can be used within
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33 local networks to support the recruitment process. In addition, support is also provided
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35 detailing effective use of these resources. Children were eligible if they were classified as
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37 overweight or obese (BMI $\geq 91^{\text{st}}$ percentile) according to the UK 1990 reference data [11];
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39 had no apparent clinical conditions, comorbidities, physical disabilities or learning difficulties
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41 that would interfere with programme engagement and were aged between 5 and 7 years
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43 with at least one parent/carer who was able to attend each of the programme sessions
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46 47 **Study Design**

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49 The study employed an uncontrolled repeated measures design evaluating changes in
50
51 anthropometric, psychosocial, physical activity and nutritional outcomes. This study reports
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53 the outcomes of participating children with complete pre- and post-intervention data when
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55 delivered in UK community settings under service level conditions.
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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

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3 sessions, respectively, incorporating measurements and parental/carer questionnaire
4 completion.
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9 Each session has four components; 'Power Time' (20 minutes), 'Healthy Families' (25
10 minutes), 'Active Play' and 'Parent/carer Workshop' (during this time children take part in 60
11 minutes of physical activity and parents/carers attend a workshop). 'Power Time' is a joint
12 parent/carer and child snack time designed to help parents incorporate evidence-based food
13 exposure techniques into their daily routines to increase their child's preferences for
14 healthier foods. 'Healthy Families' is also a joint parent/carer and child session that focuses
15 on educating and promoting skills for everyday play, active family lifestyles and healthy
16 family eating in the home environment. 'Active Play' is a child-only play session that takes
17 place while the parents/carers are in their workshop. The focus is on fun and active
18 participation. The aim is to provide children with positive experiences of being active in a
19 supportive setting.
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33 The parent/carer workshops include interactive activities and discussions focusing on
34 nutrition, activity and behaviour change. Five of the parent/carer workshops focus on healthy
35 eating and nutrition-related topics. Group discussions include practical training on
36 understanding food and drink labels, fat and sugar content of foods and drinks, portion sizes,
37 and managing fussy eating. The remaining workshops focus on family rules and routines,
38 reducing screen time and overcoming barriers to physical activity.
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48 **Training**

49 The MEND 5-7 programme is delivered by community-based health, education and physical
50 activity professionals who attend a 2-day, face-to-face training course. The training is
51 derived from established competency-based skills training methods [15] and includes direct
52 teaching, role-play, guided discussion and multiple choice assessments. After training, all
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3 staff are required to complete an on-line assessment to gain certification to deliver the
4 programme and pass an enhanced CRB (Criminal Records Bureau) check.
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9 Following successful completion of the training, delivery teams are provided with four
10 manuals, two for programme delivery, one for programme management and one for physical
11 activity. These resources provide full details of session plans, objectives, direct teaching
12 notes, desired outcomes, set-up and delivery requirements and all aspects of the physical
13 activity programme component.
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19 20 21 **Outcome Measurements**

22 Demographics

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

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35 Physical activity level and sedentary behaviours were assessed using items adapted from
36 the 'outdoor playtime checklist' [17]. Physical activity was assessed by asking 'How much
37 time did your child spend playing outside in the yard or street of your house (or the house of
38 a friend, neighbour or relative), or at the park, playground, or outdoor recreation (e.g.
39 swimming pool, zoo or amusement park), including while at day care or preschool?'
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3 computer/console games. Answers were given in hours and minutes per day, based on
4 typical days in the last month. Separate estimates were provided for weekday and weekend
5 days.
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10 Anthropometry

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

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

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

47 The SDQ – Parent's Version[24]] is a widely used measure of emotional distress in children
48 and adolescents. The measure consists of 25 statements referring to behaviours associated
49 with emotional difficulties, such as 'often has temper tantrums or hot tempers' and 'often lies
50 or cheats'. Parents are asked to indicate how 'true' each statement is of their child on a 3
51 point likert scale (not true, somewhat true, certainly true). A 'total difficulties' score is
52 generated, with higher scores indicating greater levels of emotional distress. Measures of
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3 psychological distress were included to evaluate the impact of the intervention upon
4 children's well-being and to ensure that physical health outcomes were not achieved at the
5 expense of well-being.
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10 11 **Data Cleaning and statistical analysis**

12 Due to the data being collected under service level conditions by non-researchers,
13 comprehensive cleaning procedures were undertaken to ensure data quality. Outliers for
14 anthropometric measurements were identified from visual analysis of histograms and
15 scatterplots. Visual analysis enabled identification of seven observations that were
16 inconsistent with other observations in the data set. After comparison to reference growth
17 charts, these seven data sets were excluded due to biologically unlikely increases in height
18 of over 5.5 cm over the course of the pre and post measurement sessions. Participants were
19 excluded from the activity analysis if the addition of reported daily physical activity and
20 sedentary behaviour exceeded 16 hours, resulting in seven data sets being excluded.
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33 Variable distribution was checked using the Kruskal-Wallis test for normality. Paired sample
34 t-tests were employed to assess mean differences in the outcome variables from baseline to
35 3 months (end of intervention). Changes in the proportions for fruit and vegetable intake from
36 baseline to the end of the intervention were assessed using the McNemar's test. Baseline
37 differences for those who did and did not complete post programme measurements were
38 examined using independent sample t-tests. Similarly, effects of gender pre-post programme
39 were examined using independent sample t-tests. Statistical significance was set at $P <$
40 0.05. All analyses were conducted using SPSS 18.0 for Windows (SPSS, Chicago, IL).
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51 **RESULTS**

52 **Recruitment**

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54 Four hundred and forty children participated in MEND 5-7 programmes across 37 UK
55 locations.
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Baseline demographic and anthropometric characteristics

Fifty-eight percent were female, and 79% of participants were obese (BMI \geq 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 \pm 8.9 hours/week completers vs. 19.3 \pm 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

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3 This study examined outcomes following participation in the MEND programme for children
4 aged 5-7 years old. Positive changes were observed for children's weight status, diet and
5 activity levels and emotional well-being. Parents also reported an increase in self-efficacy in
6 relation to their parenting role.
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12 Most of the outcome literature on child weight management programmes has been reported
13 under trial conditions. Outcomes reported in studies of GP-led behavioural treatment of
14 individual families (LEAP intervention [25]) and in generic parenting programmes unmodified
15 to deal with the specific needs of obese and overweight children (Triple P) have shown no
16 significant reductions in measures of degree of obesity. A version of the Triple P programme
17 specifically adapted for obesity (Lifestyle Triple P) showed a reduction of -0.11 at 20 weeks
18 [26], the HICKUPS study of a multicomponent group-based parenting intervention reported a
19 reduction of -0.36 at 6 months and the PEACH study of a parent-only group intervention
20 showed a reduction of -0.26 at 6 months [27, 28].
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33 In the current study, children with complete sets of measurement data had a significant
34 reduction in BMI z-score of -0.20 after ten weeks. The results presented here were similar to
35 the unpublished three months data (-0.20) for children taking part in the randomised
36 controlled trial of the MEND programme for 7 to 13 year old children [29] and it's national
37 service level evaluation (-0.18) [30]. Although not directly comparable to the treatment
38 effects reported in experimental studies using intention-to-treat analysis this study suggests
39 that community level interventions delivered under conditions of normal service delivery may
40 achieve similar results to those obtained in clinical trials.
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51 Generally, interventions that produce greater treatment effects are more intense and involve
52 relatively higher levels of contact time [31]. The US preventive services task force (USPSTF)
53 conclude that low intensity interventions – defined as those involving less than 25 hours
54 direct professional contact time – are insufficient to have a positive impact on weight-status
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3 in obese and overweight children. The MEND 5-7 programme consists of 17.5 hours of face-
4 to-face contact time and demonstrated significant reductions in zBMI for the 62% of children
5 with complete sets of measurement data. Contrary to USPTS recommendations this
6 suggests that clinically meaningful outcomes may be achievable by low intensity
7 interventions.
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15 MEND 5-7 has been designed to be delivered by community-based, non-obesity specialists
16 in contrast to other studies that have used highly skilled professionals to deliver the
17 intervention [27, 28]. A large proportion of childhood obesity interventions employ intensive
18 programmes involving specialist dieticians and other health professionals [32]. Childhood
19 obesity interventions are significantly more expensive when skilled professionals and
20 additional contact hours are employed. In an increasingly resource-constrained public-sector
21 environment, these factors might limit the potential reach of evidence-based programmes
22 [32]. The development of a clinically effective, low-intensity programme using non-specialist,
23 community-based delivery staff could be a crucial strategy to meet the needs of younger
24 children who are already overweight. The present results suggest that clinically meaningful
25 outcomes may be achievable by low intensity interventions delivered by non-specialist staff.
26 Further research would be desirable to explore whether these initially promising data could
27 be independently replicated under service level conditions.
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43 The UK Department of Health physical activity guidelines specify that children and young
44 people (5-18 years old) should engage in 60 minutes of activity per day whilst minimising
45 sedentary behaviours [33]. Sedentary behaviours - in particular, time spent watching
46 television - are associated with metabolic risk factors in children [34] and have been shown
47 to predict BMI in early adulthood [35]. Independent of TV viewing time, higher levels of
48 sedentary behaviours have been shown to lower levels of physical activity in children [36].
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3 There is also evidence that participation in physical activity leads to health benefits [37] and
4 lowers levels of overweight and obesity in children [38]. In this study, participation in MEND
5 5-7 was associated with significant, positive changes in physical activity levels ($P < 0.01$), TV
6 viewing time and sedentary activity levels ($P < 0.0001$). Parents reported children on the
7 programme had reduced sedentary behaviour by an average of 4.1 hours, of which 3.4
8 hours was television viewing, and increased their physical activity levels by 2.9 hours per
9 week. Such reductions in sedentary activity and increase in physical activity during
10 participation in the programme is very encouraging.
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22 Some limitations of the study should be acknowledged. Only 62% of participants who started
23 the programme completed post programme measurements. This level of completion is not
24 atypical for a pilot study or reports of service-level implementation [39, 40] but may be a
25 source of bias that could lead to an overestimation of treatment effect. Statistical analyses
26 revealed that there were limited differences between those participants that completed the
27 programme and those who did not. The data presented here are uncontrolled data
28 representing the short-term impact of the intervention for children with complete sets of
29 measurement data. Controlled studies of the impact beyond the ten week programme are
30 needed to establish whether the present results are sustained and more effective than no or
31 an alternative intervention. Whilst it is well documented that subjective measures of physical
32 activity over-report when compared to more accurate objectively measured physical activity
33 [41], subjective measurement can be a useful and cost effective tool when employed in a
34 community-based programme if it is not feasible to obtain objective measurements [42]. The
35 improvements found in physical activity and sedentary behaviours require supporting
36 evidence using objective measurement.
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55 CONCLUSION

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

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37 Additional programmes were funded from a variety of sources including local Leisure
38 Providers and Private Sector Companies.
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45 **Data Sharing Statement**

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47 No additional data available.
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51 **Ethical Approval**

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3 This study is a service evaluation and not within the remit of UK Ethics Committee
4 governance. Parents consented to take part in the study and for use of their anonymised
5 data.
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9 10 **Contributors**

11
12 L Smith performed statistical analysis and contributed to writing the paper. P Chadwick co-
13 developed the intervention and contributed to writing the paper, interpretation and analysis of
14 results. D Radley contributed to writing the paper and statistical analysis. M Kolotourou
15 critically reviewed all parts of the paper and assisted in the interpretation and analysis of the
16 results. C Gammon contributed to the interpretation of the results and critically reviewed all
17 parts of the paper. J Rosborough co-developed the intervention and critically reviewed all
18 parts of the paper. P Sacher co-developed the intervention, contributed to the interpretation
19 of the results and writing the paper and critically reviewed all parts of the paper. All authors
20 approved the final draft of the paper.
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31 32 **Competing interests**

33
34 Dr. Lindsey Smith, Dr. Duncan Radley, Catherine Gammon and Jennifer Rosborough are
35 employed full-time at MEND. Dr. Paul Chadwick is currently employed part-time as Clinical
36 Director at MEND. Maria Kolotourou is employed part-time at MEND. Paul Sacher is
37 currently employed as a Senior Research Fellow at the UCL Institute of Child Health as well
38 as Chief Research and Development Officer at MEND. Dr Venediktos Kapetanakis serves
39 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)

¹n = 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

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3 | **Assessing the short-term ~~effects~~ outcomes of a ~~scalable~~, community-based**
4 **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 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/m² 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].

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5 Research has indicated that there may be an effectiveness gradient with regard to the
6 impact of child obesity treatment with age [6]. Generally, earlier treatment is associated with
7 better outcomes following programmes that are less intensive. To be effective, it is
8 recommended that interventions are multicomponent and include age-appropriate nutrition
9 and physical activity with behaviour change strategies that are developmentally appropriate
10 to the cognitive abilities of the child and the nature of relationships in the family life cycle [7,
11 8]. Although the availability of treatments is steadily increasing, there are significant
12 disparities in the availability of treatments across the developmental continuum. In the UK
13 only 8 out of 45 weight management schemes cover the 5 to 7 age range [9] and only four
14 out of the 13 Department of Health approved Child Weight Management programmes are
15 suitable for children under the age of 7 [10]. To our knowledge there are no published, peer-
16 reviewed weight management trials or service level evaluations for children aged 5-7 in
17 England. This leaves a gap in the understanding of the outcomes that is possible to achieve
18 for overweight and obese children in this age range in a UK setting.
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35 The aim of this study was to report outcomes from the UK service level delivery of MEND 5-
36 7 (Mind, Exercise, Nutrition... Do it!), a multicomponent community-based healthy lifestyle
37 intervention designed for overweight and obese children aged 5-7 years and their families.
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43 **METHODS**

44 **Recruitment**

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

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

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22 The MEND 5-7 programme is a comprehensive, multi-component intervention designed to
23 tackle obesity in childhood. The programme supports families by providing information on
24 child nutrition (based on government healthy eating guidelines), active play and parenting
25 practices to help parents practically integrate these recommendations into everyday life. The
26 programme uses a non-diet approach to prevent unduly restrictive eating which can lead to
27 problematic eating behaviours [7].
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37 MEND 5-7 is based around key principles in health-related behaviour change and
38 behavioural parent training programmes. These methods are drawn from evidence-based
39 practices in child psychology and parenting interventions [12].
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45 Reviews of behavioural treatments for childhood obesity show group-based interventions are
46 the most commonly used delivery formats and are more effective than individual treatment
47 sessions [13]. Groups are more efficient, provide greater opportunity for therapeutic
48 interactions between participants, improve attendance rates and are cost-effective[13].
49 Community groups provide greater access to minority ethnic groups, counter stigma, provide
50 a social support network and aid the therapeutic process of problem-solving [14]. These
51 factors improve understanding of the condition, adherence to the intervention and
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3 implementation of changes in behaviour. Recognising the importance of family involvement
4 for behaviour change, the programme requires a parent or carer to attend all sessions.
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8 9 **Structure and Content**

10 The programme consists of 10 (one hour and forty-five minute duration) weekly group-based
11 sessions delivered by two trained leaders and one optional assistant. The programme is held
12 in community settings such as sports centres and schools for groups of 8-15 children and
13 their parents/carers. The first and last sessions are allocated as introductory and graduation
14 sessions, respectively, incorporating measurements and parental/carers questionnaire
15 completion.
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25 Each session has four components; 'Power Time' (20 minutes), 'Healthy Families' (25
26 minutes), 'Active Play' and 'Parent/carers Workshop' (during this time children take part in 60
27 minutes of physical activity and parents/carers attend a workshop). 'Power Time' is a joint
28 parent/carers and child snack time designed to help parents incorporate evidence-based food
29 exposure techniques into their daily routines to increase their child's preferences for
30 healthier foods. 'Healthy Families' is also a joint parent/carers and child session that focuses
31 on educating and promoting skills for everyday play, active family lifestyles and healthy
32 family eating in the home environment. 'Active Play' is a child-only play session that takes
33 place while the parents/carers are in their workshop. The focus is on fun and active
34 participation. The aim is to provide children with positive experiences of being active in a
35 supportive setting.
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49 The parent/carers workshops include interactive activities and discussions focusing on
50 nutrition, activity and behaviour change. Five of the parent/carers workshops focus on healthy
51 eating and nutrition-related topics. Group discussions include practical training on
52 understanding food and drink labels, fat and sugar content of foods and drinks, portion sizes,
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3 and managing fussy eating. The remaining workshops focus on family rules and routines,
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5 reducing screen time and overcoming barriers to physical activity.
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8 9 **Training**

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11 The MEND 5-7 programme is delivered by community-based health, education and physical
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13 activity professionals who attend a 2-day, face-to-face training course. The training is
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15 derived from established competency-based skills training methods [15] and includes direct
16
17 teaching, role-play, guided discussion and multiple choice assessments. After training, all
18
19 staff are required to complete an on-line assessment to gain certification to deliver the
20
21 programme and pass an enhanced CRB (Criminal Records Bureau) check.
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25 Following successful completion of the training, delivery teams are provided with four
26
27 manuals, two for programme delivery, one for programme management and one for physical
28
29 activity. These resources provide full details of session plans, objectives, direct teaching
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31 notes, desired outcomes, set-up and delivery requirements and all aspects of the physical
32
33 activity programme component.
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36 37 **Outcome Measurements**

38 39 **Demographics**

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41 Socioeconomic status was determined based on home ownership [16], grouped as: 'owner
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43 occupied', 'private rented', 'social rented' and 'other'. Ethnic background was based on the
44
45 UK census categorisation as outlined in the National Obesity Observatory Standard
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47 Evaluation Framework for weight management interventions [16].
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50 51 **Physical activity and inactivity**

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53 Physical activity level and sedentary behaviours were assessed using items adapted from
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55 the 'outdoor playtime checklist' [17]. Physical activity was assessed by asking 'How much
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57 time did your child spend playing outside in the yard or street of your house (or the house of
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3 a friend, neighbour or relative), or at the park, playground, or outdoor recreation (e.g.
4 swimming pool, zoo or amusement park), including while at day care or preschool?
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7 Television viewing time and time spent playing computer/console game were assessed by
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9 asking 'How much time would you say your child spends watching television (including
10 videos and DVD's), including time spent watching TV in other people's houses?' and 'How
11 much time did your child spend playing Play-Station/X-box/Nintendo/Computer games
12 (including watching a friend/brother/sister/adult play, and at other people's houses)?' Total
13 sedentary activity was calculated from the addition of TV viewing time and time spent playing
14 computer/console games. Answers were given in hours and minutes per day, based on
15 typical days in the last month. Separate estimates were provided for weekday and weekend
16 days.
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25 26 27 Anthropometry

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29 Body weight (kg) and height (cm) were measured using standardised procedures [18] and
30 body mass index calculated as $\text{body weight(kg)/height(m}^2\text{)}$. Waist circumference (cm) was
31 measured 4 cm above the umbilicus [19]. BMI and waist circumference z-scores were
32 calculated from UK national reference data [11, 20] using LMS growth software [21].
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44 Child and parent fruit and vegetable consumption were assessed by the daily frequency of
45 portions consumed [22]. Questions were measured on a 7 point likert scale (less than one
46 per week, one per week, two to three per week, four to six per week, one per day, two per
47 day, or three or more per day) [22].
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52 53 54 Parenting self-efficacy

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

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7 The SDQ – Parent’s Version[24]] provides is a widely used a measure of emotional distress
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9 in children and adolescents. The measure consists of 25 statements referring to behaviours
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11 associated with emotional difficulties, such as ‘often has temper tantrums or hot tempers’
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13 and ‘often lies or cheats’. Parents are asked to indicate how ‘true’ each statement is of their
14
15 child on a 3 point likert scale (not true, somewhat true, certainly true). A ‘total difficulties’
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17 score is generated, with higher scores indicating greater levels of emotional distress.
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19 Measures of psychological distress were included to evaluate the impact of the intervention
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21 upon children’s well-being and to ensure that physical health outcomes were not achieved at
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23 the expense of well-being.
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25 26 27 **Data Cleaning and statistical analysis**

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29 Due to the data being collected under service level conditions by non-researchers,
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31 comprehensive cleaning procedures were undertaken to ensure data quality. Outliers for
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33 anthropometric measurements were identified from visual analysis of histograms and
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35 scatterplots. Visual analysis enabled identification of seven observations that were
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37 inconsistent with other observations in the data set. After comparison to reference growth
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39 charts, these seven data sets were excluded due to biologically unlikely increases in height
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41 of over 5.5 cm over the course of the pre and post measurement sessions. Participants were
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43 excluded from the activity analysis if the addition of reported daily physical activity and
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45 sedentary behaviour exceeded 16 hours, resulting in seven data sets being excluded.
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49 Variable distribution was checked using the Kruskal-Wallis test for normality. Paired sample
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51 t-tests were employed to assess mean differences in the outcome variables from baseline to
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53 3 months (end of intervention). Changes in the proportions for fruit and vegetable intake from
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55 baseline to the end of the intervention were assessed using the McNemar’s test. Baseline
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57 differences for those who did and did not complete post programme measurements were
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3 examined using independent sample t-tests. Similarly, effects of gender pre-post programme
4 were examined using independent sample t-tests. Statistical significance was set at $P <$
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6 0.05. All analyses were conducted using SPSS 18.0 for Windows (SPSS, Chicago, IL).
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10 **RESULTS**

11 **Recruitment**

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13 Four hundred and forty children participated in MEND 5-7 programmes across 37 UK
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15 locations.
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20 **Baseline demographic and anthropometric characteristics**

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22 Fifty-eight percent were female, and 79% of participants were obese (BMI \geq 98th centile).
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24 Thirty-three percent of children were from non-white ethnic backgrounds with 57% reporting
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26 they did not own their home (Table 1).
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30 **Completers vs. non completers**

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32 There were no significant differences in baseline demographic and anthropometric
33
34 characteristics between children with complete sets of measurement data and those without.
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36 Significant differences were evident in baseline comparisons of physical activity levels (15.0
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38 \pm 8.9 hours/week completers vs. 19.3 \pm 13.7 hours/week non completers, $P <$ 0.01). All other
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40 outcome measures were not significantly different at baseline.
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46 **Attendance and retention**

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

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

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17 This study examined outcomes following participation in the MEND programme for children
18 aged 5-7 years old. Positive changes were observed for~~The intervention demonstrated~~
19 ~~positive effects on~~ children's weight status, diet and activity levels and emotional well-being.
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21 Parents also reported an increase in self-efficacy in relation to their parenting role.
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29 Most of the outcome literature on child weight management programmes has been reported
30 under trial conditions. Outcomes reported in studies of GP-led behavioural treatment of
31 individual families (LEAP intervention [25]) and in generic parenting programmes unmodified
32 to deal with the specific needs of obese and overweight children (Triple P) have shown no
33 significant reductions in measures of degree of obesity. A version of the Triple P programme
34 specifically adapted for obesity (Lifestyle Triple P) showed a reduction of -0.11 at 20 weeks
35 [26], the HICKUPS study of a multicomponent group-based parenting intervention reported a
36 reduction of -0.36 at 6 months and the PEACH study of a parent-only group intervention
37 showed a reduction of -0.26 at 6 months [27, 28].
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49 In the current study, children with complete sets of measurement data had a significant
50 reduction in BMI z-score of -0.20 after ten weeks. The results presented here were similar to
51 the unpublished three months data (-0.20) for children taking part in the randomised
52 controlled trial of the MEND programme for 7 to 13 year old children [29] and it's national
53 service level evaluation (-0.18) [30]. Although not directly comparable to the treatment
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3 effects reported in experimental studies using intention-to-treat analysis this study suggests
4 that community level interventions delivered under conditions of normal service delivery may
5 achieve similar results to those obtained in clinical trials.
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11 Generally, interventions that produce greater treatment effects are more intense and involve
12 relatively higher levels of contact time [31]. The US preventive services task force (USPSTF)
13 conclude that low intensity interventions – defined as those involving less than 25 hours
14 direct professional contact time – are insufficient to have a positive impact on weight-status
15 in obese and overweight children. The MEND 5-7 programme consists of 17.5 hours of face-
16 to-face contact time and demonstrated significant reductions in zBMI for the 62% of children
17 with complete sets of measurement data. Contrary to USPTS recommendations this
18 suggests that clinically meaningful outcomes may be achievable by low intensity
19 interventions. (-0.20) comparable to interventions with much greater contact time.
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31 MEND 5-7 has been designed to be delivered by community-based, non-obesity specialists
32 in contrast to other studies that have used highly skilled professionals to deliver the
33 intervention [27, 28]. A large proportion of childhood obesity interventions employ intensive
34 programmes involving specialist dieticians and other health professionals [32]. Childhood
35 obesity interventions are significantly more expensive when skilled professionals and
36 additional contact hours are employed. In an increasingly resource-constrained public-sector
37 environment, these factors might limit the potential reach of evidence-based programmes
38 [32]. The development of a clinically effective, low-intensity programme using non-specialist,
39 community-based delivery staff could be a crucial strategy to meet the needs of younger
40 children who are already overweight. The present results suggest that clinically meaningful
41 outcomes may be achievable by low intensity interventions delivered by non-specialist staff.
42 Further research would be desirable to explore whether these initially promising data could
43 be independently replicated ~~such a model is feasible and effective when implemented~~ under
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3 service level conditions ~~and suggest that MEND 5-7 may be a good candidate for large scale~~
4 ~~implementation.~~
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9 The UK Department of Health physical activity guidelines specify that children and young
10 people (5-18 years old) should engage in 60 minutes of activity per day whilst minimising
11 sedentary behaviours [33]. Sedentary behaviours - in particular, time spent watching
12 television - are associated with metabolic risk factors in children [34] and have been shown
13 to predict BMI in early adulthood [35]. Independent of TV viewing time, higher levels of
14 sedentary behaviours have been shown to lower levels of physical activity in children [36].
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18 There is also evidence that participation in physical activity leads to health benefits [37] and
19 lowers levels of overweight and obesity in children [38]. In this study, participation in MEND
20 5-7 ~~produced~~ was associated with significant, positive changes in physical activity levels (P
21 < 0.01), TV viewing time and sedentary activity levels ($P < 0.0001$). Parents reported
22 children on the programme had reduced sedentary behaviour by an average of 4.1 hours, of
23 which 3.4 hours was television viewing, and increased their physical activity levels by 2.9
24 hours per week. Such reductions in sedentary activity and increase in physical activity during
25 participation in the programme is very encouraging.
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41 Some limitations of the study should be acknowledged. Only 62% of participants who started
42 the programme completed post programme measurements. This level of completion is not
43 atypical for a pilot study or reports of service-level implementation [39, 40] but may be a
44 source of bias that could lead to an overestimation of treatment effect. Statistical analyses
45 revealed that there were limited differences between those participants that completed the
46 programme and those who did not. The data presented here are uncontrolled data
47 representing the short-term impact of the intervention for children with complete sets of
48 measurement data. Controlled studies of the impact beyond the ten week programme are
49 needed to establish whether the present results are sustained and more effective than no or
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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 oin physical, behavioural and psychological outcomes for children with complete sets of measurementpre-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, the se preliminary findings presented warrant further evaluation in a in a formal trial to te establish if outeomes 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

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3 Director at MEND. Maria Kolotourou is employed part-time at MEND. Paul Sacher is
4 currently employed as a Senior Research Fellow at the UCL Institute of Child Health as well
5 as Chief Research and Development Officer at MEND. Dr Venediktos Kapetanakis serves
6 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)

¹n = 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 Mean (SD)	Post Mean (SD)	Difference 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