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# A parent-based intervention to promote healthy eating and active behaviours in pre-school children: evaluation of the MEND 2–4 randomized controlled trial

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## Summary

Background: There is a paucity of studies evaluating targeted obesity prevention interventions in pre-school children.

Objectives: We conducted a randomized controlled trial to evaluate the efficacy of a parent-based obesity prevention intervention for pre-schoolers – MEND (Mind, Exercise, Nutrition . . . Do It!) 2–4 on child diet, eating habits, physical activity/sedentary behaviours, and body mass index (BMI).

Methods: Parent–child dyads attended 10 weekly 90-min workshops relating to nutrition, physical activity and behaviours, including guided active play and healthy snack time. Assessments were conducted at baseline, immediately post-intervention, and 6 and 12 months post-intervention; child intake of vegetables, fruit, beverages, processed snack foods, fussiness, satiety responsiveness, physical activity, sedentary behaviour and neophobia were assessed via parent proxy report. Parent and child height and weight were measured.

Results: Two hundred one parent–child dyads were randomized to intervention ($n = 104$) and control ($n = 97$). Baseline mean child age was 2.7 (standard deviation [SD] 0.6) years, and child BMI-for-age $z$-score (World Health Organization) was 0.66 (SD 0.88). We found significant positive group effects for vegetable ($P = 0.01$) and snack food ($P = 0.03$) intake, and satiety responsiveness ($P = 0.047$) immediately post-intervention. At 12 months follow-up, intervention children exhibited less neophobia ($P = 0.03$) than controls.

Conclusion: Future research should focus on additional strategies to support parents to continue positive behaviour change. ACTRN12610000200088.

**Keywords:** Child, healthy eating, obesity prevention, physical activity, pre-school.

## Introduction

Intervening in the pre-school years with effective prevention strategies is now recognized as an essential step in combating the obesity epidemic across the lifespan (1) at a time when eating and physical activity habits become established (2,3). However, there is a paucity of strategies aimed directly at pre-school children; a recent Cochrane review identified only eight obesity prevention interventions with children aged 0–5 years, reporting a marginally significant improvement in body mass index $z$-score (zBMI) and little to no effect on dietary, physical activity and sedentary behaviours (4). Furthermore, only four studies assessed maintenance of the intervention effect. Hence, there is an urgent need to develop and test the immediate and long-term effectiveness of prevention programmes for pre-school children. Such programmes need to be family-based (5), because the primary social force that influences young children's health behaviour and development is the parent (6).

The MEND (Mind, Exercise, Nutrition . . . Do It!) 2–4 programme was designed to address this need for a healthy lifestyle programme in the early childhood years as well as a secondary obesity prevention initiative. This programme is delivered to parents and their children aged 2–4 years and was developed on the foundation of the success of the MEND school-aged obesity intervention (7).

The primary aim of the current study was to evaluate the immediate and long-term effects of the MEND 2–4 programme on child dietary intake and eating habits. A secondary aim was to evaluate the effect of MEND 2–4 on child physical activity/sedentary behaviours, zBMI and food neophobia. In relation to the primary aim, it was hypothesized that intervention group (IG) children (who, with their parent, took part in MEND 2–4) would (i) demonstrate greater consumption of fruit and vegetables, a decrease in consumption of high sugar beverages, and energy dense snack foods and (ii) exhibit less problematic eating habits, specifically higher satiety responsiveness and less fussiness when compared with the control group. In relation to the secondary aim, it was hypothesized that children in the intervention would exhibit (iii) increased time spent being physically active, and greater decreases in time spent in sedentary behaviours, specifically screen time; (iv) lower zBMI and (v) less neophobia (aversion to new foods) compared with controls.

## Methods

This randomized controlled trial was conducted between May 2010 and December 2012 in Victoria, Australia, approved by the Deakin University Human Ethics Research Ethics Committee (2009-180) and registered on the Australian New Zealand Clinical Trials Registry (ACTRN12610000200088) (8). Outcomes not addressed here will be presented in future papers.

### Participant recruitment

We sourced participants through community events, local newspaper and magazine advertisements, flyers distributed through kindergartens/pre-schools/childcares, maternal and child health centres, and medical centres. Families were eligible if their child was aged 20–42 months at baseline (wait-list children would still be ≤4 years when receiving the programme), and if parents were aged ≥ 18 years and could read and write English (with the assistance of an interpreter if required). There were no other qualifying or exclusion criteria. Informed consent was obtained from each parent.

### Study design

All eligible participants were allocated randomly to either the IG or the wait-list control group (WLC). Randomization was conducted by a researcher not involved in data management using a randomized treatment allocation schedule produced by computer algorithm. Parent–child dyads were randomized in blocks pertaining to their local community site. Participants were informed of group allocation via opaque envelopes after collection of baseline anthropometric measures, but prior to returning questionnaires. Necessarily, programme facilitators and participants were not blinded to the treatment group; however, all data were collected by blinded researchers. The allocation ratio was 1:1, albeit group numbers varied slightly by site.

The intervention began immediately post the baseline assessment. Follow-up assessments were conducted immediately post-intervention (i.e., 10 weeks post-baseline, Time 2), and at 6 (Time 3) and 12 months (Time 4) post-intervention; study duration was 15 months. All assessments were conducted at the community venues where MEND 2–4 was held, or at the participant's home. All measures were assessed at each time point, with the exception of parent height, weight and demographic variables (baseline only). A voucher draw (supermarket vouchers worth AUD$50–$250) encouraged participant retention.

### Intervention

Details of the intervention have been published (8). The MEND 2–4 intervention was underpinned by learning and social cognitive theories (7) and involved 10 weekly 90-min workshops relating to nutrition, physical activity, parenting and lifestyle behaviours. Each programme group consisted of parent–child dyads and one to three MEND 2–4 trained programme leaders. Each session included three sections: (i) 30 min of guided active play; (ii) 15 min of healthy snack time based on an evidence-based, exposure technique to promote acceptance of fruit and vegetables and (iii) 45 min of supervised creative play activities for the children while parents attended an interactive education and skill development session. Guided active play involved games played with children and parents together that could be easily replicated at home. Healthy snack time centred on a role model (puppet called 'Max Moon') who encouraged children to sniff, touch, lick and taste fresh fruit and vegetables. Parents received weekly handouts. At one site with a high number of Vietnamese and Cambodian native speakers, interpreters fluent in Vietnamese/Khmer attended sessions. All sessions and materials were presented in English. Supporting Information File S1 presents a description of behaviour change techniques used in the intervention.

Programme leaders were community team members (e.g., maternal and child health nurse, childcare worker); no prior experience in dealing with overweight or obesity was necessary. Prior to starting with a group, leaders were trained by MEND Australia via a 2-day intensive workshop, and were monitored regularly to ensure their practice was in accordance with guidelines.

### Control group

The WLC group did not receive any intervention, but were offered the programme at study completion.

### Outcome assessments

#### *Primary outcomes*

*Child daily dietary intake* was assessed via the Eating and Physical Activity Questionnaire (9). This measure asked about vegetables, fruit, beverages (water, milk, sweet drinks), and processed snack foods. Quantities were in general household measures and referred to usual servings per day for vegetables and servings eaten 'yesterday' for vegetables, fruit, beverages, and snacks. Standard serving sizes were based on the Australian Guide to Healthy Eating (10).

#### *Child eating habits*

The Children's Eating Behaviour Questionnaire assessed markers of child eating habits (11). Two subscales that measured fussiness and satiety responsiveness were used for this study. Responses were scored on a 5-point Likert scale. Cronbach's alphas ranged from 0.86 to 0.93 for fussiness and 0.77 to 0.83 for satiety.

### Secondary outcomes

*Physical activity and sedentary behaviours.* Child screen time (i.e., time spent in front of a television, computer, tablet or video game), sedentary behaviour and physical activity behaviours were assessed using the Physical Activity Questionnaire for pre-school-aged children (Pre-PAQ), which provides a list of 24 different types of physical and sedentary activities and requires parents to report time spent in the activities their child did 'yesterday' (weekday) and 'last weekend' (i.e., Saturday and Sunday) (12). A 3-day mean for the activities was calculated (average of one weekday, Saturday and Sunday). The activities were categorized into sedentary behaviour and moderate to vigorous physical activity.

*Child zBMI.* Anthropometric measurements of both parent and child height and weight were collected by one of two researchers trained in anthropometry according to the method described by the International Society for the Advancement of Kinanthropometry (13). Height was measured without shoes to the nearest 0.1 cm using a portable Handy Height Scale (PE27, Mentone Educational, Australia), and weight was measured in light clothing without shoes to the nearest 0.1 kg using Charder Professional Scales (MS-4600, Medshop Australia). Intraclass correlation coefficients (ICC) indicated a high level of measurement reliability (ICCs of 1.0 for both height and weight for parents and children). BMI was calculated and classified according to World Health Organization criteria (14–16), where children above +1 standard deviation (SD) are 'at risk of overweight', above +2 SD are overweight and children above +3 SD are obese.

*Child food neophobia.* Pliner's (17) measure of food neophobia in children assessed children's reaction to new or unfamiliar foods. Item scores were totalled to create an index of neophobia. Cronbach's alphas ranged from 0.90 to 0.93.

### Demographics

Child and parent date of birth and child sex were recorded. The following parental demographic information was also collected: caregiver status, marital status, educational attainment, annual family income, location of birth, occupation, whether currently in paid employment, and whether working full-time or part-time.

## Sample size calculation and statistical analyses

Data to inform sample size calculations were obtained from a 5-year longitudinal population-based survey of Australian pre-school children's physical activity ($n = 950$) (18). As there were no quantitative dietary recommendations for children <4 years old in Australia at the time of the study, we adopted a 25% increase in vegetable consumption as a minimum target (19). One hundred parents in each group were necessary to detect a 25% difference in vegetable consumption between IG and WLC, significant at alpha = 0.05, with a power of 0.8. Accounting for 20% attrition, the final sample required was 250 parent–child dyads.

Changes in dietary habits, indicators of physical activity/sedentary behaviour, zBMI and neophobia were assessed using linear mixed modelling with the restricted maximum likelihood estimator. This approach utilizes conditional maximum likelihood to estimate values of missing outcomes based on the observed data, thus retaining all participants who provided baseline data. Missing values of baseline measurements were imputed using mean imputation (20).

All analyses were conducted using modified intention-to-treat following CONSORT Statement guidelines, excluding participants who were randomized, but did not provide any useable data (21). Analyses were conducted using Stata Version 12 (Stata Special Edition. Released 2011, StataCorp., College Station, TX, USA). Nominal level of statistical significance was set at $\alpha = 0.05$.

# Results

Eleven sites ran 20 MEND 2–4 intervention programmes across metropolitan and regional areas. Programmes were implemented as intended. Figure 1 presents the flow of participants. An average of 4.6 families participated in each programme.

Height and weight data are available for the 28 randomized participants who declined to participate in the study ('non-participants') – these participants attended the baseline anthropometric measurement, eligibility and randomization session (were aware of group allocation) and took the questionnaire home to complete it, but subsequently withdrew from the study prior to the commencement of the intervention and no further data were collected from these participants. Mann–Whitney test showed no difference in median parent BMI between participants and non-participants ($P = 0.20$). A larger proportion of the non-participant parents were classified as obese (44.4%) compared with participants (17.9%; Fisher's exact test = 10.317, $P = 0.01$).

Individuals who withdrew from the study after the baseline assessment were more likely to be stay-at-home parents, not employed, not married, not finished secondary school, have an annual family income below $45 000, and be of Asian ethnicity than participants who remained in the study; there were no differences on any other variables.

Baseline demographic variables for each group are presented in Table 1. Mean parent age for the entire sample was 35.0 (range 21.4–46.4, SD 4.9) years. Mean child age was 2.7 (range 1.8–4.2, SD 0.6) years. Mean parent BMI was 25.9 kg $m^{-2}$ (range 17.3–48.2, SD 5.6), and mean child zBMI was 0.66 (range –1.58–2.91, SD 0.88). Intervention parent–child dyads attended an average of 7.75 (out of 10) sessions, with 82% attending seven or more sessions.

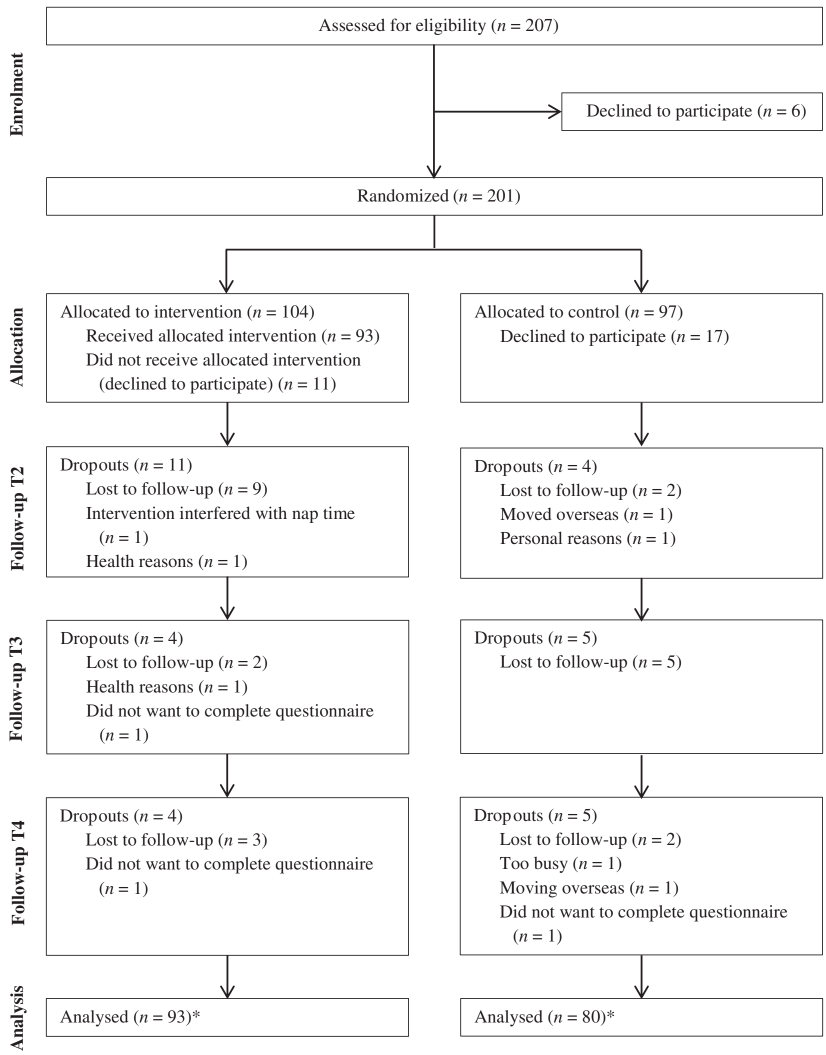


**Figure 1** Flow of participants. *All participants who returned a questionnaire were included in the analyses.

## Primary outcomes

Means and SDs for IG and WLC participants for dietary intake and eating habits at each assessment point are presented in Table S1. Unstandardized regression coefficients, 95% confidence intervals (95% CIs) and *P*-values for group differences are also presented in Table S1. At Time 2, there were significant group differences for intake of vegetables (on the servings 'yesterday' variable, $P = 0.01$), high-energy snack foods ($P = 0.03$), and satiety responsiveness ($P = 0.047$), but not for any other dietary behaviour or eating habits variables. These differences were not sustained.

## Secondary outcomes

Means and SDs for IG and WLC control participants for physical activity, sedentary behaviour, child zBMI and neophobia at each assessment point are presented in Table S1. Unstandardized regression coefficients, 95% CIs and *P*-values for group differences are also presented in Table S1. Analysis showed lower food neophobia in the IG than WLC at Time 2 ($P = 0.05$; marginally significant) and Time 4 ($P = 0.03$), but there were no other group differences in any of these variables at Times 2, 3 or 4.

# Discussion

In line with our hypotheses, we found that the IG children ate more vegetables and less snack foods, and were more responsive to satiety cues than WLCs immediately post-intervention, and that neophobia was lower in the IG than WLC at 12 months post-intervention. In contrast to our hypotheses, the intervention had no effect on sedentary behaviour, physical activity and zBMI.

Our findings are consistent with those reported by Monasta *et al*. (22) who reported that interventions were not able to reduce overweight/obesity or limit weight gain in pre-school children. Monasta *et al*. also reported that small effects had been observed in some cases for proxy variables such as dietary and/or physical activity and sedentary behaviours, which is consistent with our findings.

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**Table 1** Descriptive characteristics of the study population at baseline

| | *n* | Control | *n* | Intervention |
|---|---|---|---|---|
| Child age, mean (SD), years | 78 | 2.8 (0.60) | 93 | 2.7 (0.56) |
| Parent age, mean (SD), years | 76 | 35.1 (5.14) | 91 | 35.0 (4.73) |
| Child sex, *n* (%) | 78 | | 93 | |
| Female | | 37 (47.4) | | 49 (52.7) |
| Male | | 41 (52.6) | | 44 (47.3) |
| WHO Child BMI, mean (SD) | 77 | 0.65 (0.82) | 93 | 0.66 (0.94) |
| WHO Child BMI classification, n (%) | 77 | | 93 | |
| Normal weight | | 50 (64.9) | | 56 (60.2) |
| At risk for overweight | | 25 (32.5) | | 31 (33.3) |
| Overweight | | 2 (2.6) | | 6 (6.5) |
| Obese | | 0 (0.0) | | 0 (0.0) |
| Parent BMI, mean (SD) | 78 | 25.7 (5.40) | 92 | 26.2 (5.71) |
| Parent BMI classification, n (%) | 78 | | 92 | |
| Underweight | | 3 (3.8) | | 1 (1.1) |
| Normal weight | | 37 (47.4) | | 50 (29.4) |
| Overweight | | 27 (34.6) | | 22 (23.9) |
| Obese | | 11 (14.1) | | 19 (11.2) |
| Marital status, *n* (%) | 77 | | 93 | |
| Married/*de facto* | | 69 (89.6) | | 87 (93.5) |
| Never married/single | | 8 (10.4) | | 6 (6.5) |
| Highest level of education, *n* (%) | 77 | | 92 | |
| Year 11 or below | | 9 (11.7) | | 10 (10.9) |
| Year 12 or equivalent | | 7 (9.1) | | 10 (10.9) |
| Certificate/diploma | | 15 (19.5) | | 20 (21.7) |
| Bachelor degree or higher | | 46 (59.7) | | 52 (56.5) |
| Annual family income (AUD$), *n* (%) | 73 | | 92 | |
| $ < 450 000 | | 15 (20.5) | | 13 (14.1) |
| $45 001–85 000 | | 24 (32.9) | | 38 (41.3) |
| $85 001–125 000 | | 20 (27.4) | | 25 (27.2) |
| $ >125 000 | | 14 (19.2) | | 16 (17.4) |
| Location of parent's birth, *n* (%) | 76 | | 92 | |
| Australia or New Zealand | | 56 (73.7) | | 71 (77.2) |
| Europe | | 2 (2.6) | | 4 (4.3) |
| Asia | | 8 (10.5) | | 8 (8.7) |
| Other | | 10 (13.2) | | 9 (9.8 |
| Parent occupation status, *n* (%) | 77 | | 92 | |
| Stay-at-home parent | | 30 (39.0) | | 43 (46.7) |
| Working | | 44 (57.1) | | 46 (50.0) |
| Maternity leave | | 0 (0.0) | | 2 (2.2) |
| Student | | 3 (3.9) | | 1 (1.1) |
| Currently in paid employment, *n* (%) | 77 | | 92 | |
| Yes | | 36 (46.8) | | 50 (54.3) |
| No | | 41 (53.2) | | 42 (45.7) |
| Work full-time or part-time, *n* (%)* | 32 | | 47 | |
| Full-time | | 5 (15.6) | | 2 (4.3) |
| Part-time | | 27 (84.4) | | 45 (95.7) |

*Computed for parents that reported that they were currently in paid employment.

Our findings also accord with those reported by Fitzgibbon *et al*. (23). Similar to MEND 2–4, their 14-week trial involved a parental component and addressed comparable weekly themes. Immediately post-intervention, they found no difference in zBMI between intervention and control children. However, in contrast to our findings, they reported positive intervention effects on physical activity and screen time. Also in contrast to our findings, Fitzgibbon *et al*. did not find an intervention effect on any dietary variables. These differences may be due to a use of different intervention behaviour change strategies, which have been shown to be important contributors to weight management (24). The initial positive intervention effect on vegetable and snack food intake and response to satiety cues was not sustained at follow-up. In an unpublished reflection of participation in the programme, parents requested booster sessions, which could address this drop off in healthy food-related behaviours. In contrast, neophobia was only improved at 12 months post-intervention. Parents reported that the food-tasting strategy continued to be used post-intervention; continual exposure and repetition of this technique may have resulted in a gradual increase in a child's willingness to try new foods. This is supported by research that suggests it can take 15 exposures of a new food before it is accepted (25).

Considering the attenuated success of interventions similar to ours (4,26), future obesity prevention strategies might involve a systems approach (27). This would include the child and family environment, while concurrently aiming at modifications on a physical, cultural, economic, social and legislative level (28). Programmes implemented in translational settings such as community groups and pre-school classrooms provide sustainability and cost benefits to intervention implementation (23); MEND 2–4 meets this need and so could be implemented more broadly. The MEND 2–4 programme can be delivered by any allied health professional after training and comes with a complete resource kit, making it accessible and translatable into community settings.

## Limitations and strengths

Self-selected sample and differential dropout may have influenced our findings. Indeed, although parents who signed up to participate, but withdrew prior to completing the baseline questionnaire were no more likely to be overweight or obese than parents that continued with the study, the proportion of obese non-participants was greater among those allocated to the intervention than the control group. It is likely that this difference has occurred by chance, given the randomized design. Furthermore, there was a tendency for individuals of lower socioeconomic status to withdraw from the study. Such individuals may be less likely to see the value in continuing the study after intervention completion (29) or experience travel difficulties (e.g., lack of access to a car) that could affect attendance at the intervention and data collection.

Additionally, we were unable to recruit a sample size necessary to achieve sufficient power, albeit 48% of families who expressed interest signed up to the study. Reasons for not taking part were predominately related to practicalities such as inconvenient programme days/times. Furthermore, the programme was only presented in English. Although we used 'randomization diagram' to help explain the study, language barriers may nonetheless have limited participation of some families.

Finally, despite targeting recruitment strategies at families who were at high risk of being in need of an obesity prevention intervention, children in our study sample fell mainly in the healthy weight range. As MEND 2–4 was designed as a secondary obesity prevention strategy, it may have its greatest effect on children who are already overweight or overweight at recruitment. Unfortunately, families with children who were already overweight/obese failed to take part in the study, possibly because there was a chance of being randomized to the control group. If the programme had reached at 'at-risk' populations, its effectiveness may be magnified (30).

Some key strengths of MEND 2–4 have been identified. These include its replicability, allowing the programme to be delivered by appropriately trained community practitioners. The community-based setting of the study and the absence of stringent exclusion criteria mean that our results are likely to have good external validity. Of the families, 82% attended ≥7 sessions, indicating that the programme was well accepted. This level of programme attendance, and data from unpublished qualitative interviews where all 20 interviewed parents commented that intervention length was acceptable, suggests a free programme of this duration is feasible (for parents) and may be as effective if shortened to seven sessions. However, given the limited success of the intervention with respect to primary outcomes, it is unclear what effect a less intensive intervention may have on long-term diet and physical activity behaviours.

In conclusion, the MEND 2–4 programme had no effect on child BMI, aligning with the findings of other similar studies. Future research should consider additional strategies to support parents of pre-school children to foster positive behaviour change in relation to obesogenic risk factors so as to improve child outcomes in the long term, including weight gain management; these strategies should be embedded within a systems approach to obesity prevention in the pre-school years.

# Conflict of Interest Statement

The authors declare no conflict of interest.

# Acknowledgements

HS, MM and BS conceived the study. BH was the Research Assistant appointed to manage the study and wrote the paper. LB conducted the primary analyses of the data. All authors critically revised the paper for intellectual content and read and approved the final draft. This study was funded by an Australian Research Council Linkage Grant (ARC LP100100049). We would like to thank Madeline Freeman, Director, and her team at the Better Health Company (formerly MEND Australia) for their partnership with this project, and all the community teams that ran the MEND 2–4 programmes. Finally, we are indebted to our participants for their support and commitment to this study.

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

**File S1.** Behaviour Change Techniques used in the MEND 2–4 Intervention.

**Table S1.** Means (M) and standard deviations (SD) by group, unstandardized regression coefficients, 95% confidence intervals, and P-values for treatment effects for child dietary intake and eating habits (primary outcomes), and physical activity, sedentary behaviour, body mass index z-score (zBMI) and neophobia (secondary outcomes)