Identifying patterns of lifestyle behaviours among children of 3 years old

Lu Wang¹, Wilma Jansen¹,², Amy van Grieken¹, Eline Vlasblom³, Magda M. Boere-Boonekamp⁴, Monique P. L’Hoir⁵, Hein Raat¹

¹ Department of Public Health, Erasmus University Medical Center, Rotterdam, The Netherlands
² Department of Social Development, City of Rotterdam, Rotterdam, The Netherlands
³ TNO Child Health, Leiden, The Netherlands
⁴ Department of Health Technology and Services Research, Technical Medical Center, University of Twente, Enschede, The Netherlands
⁵ Department of Agrotechnology and Food Sciences, Subdivision Human Nutrition, Wageningen University & Research, Wageningen, The Netherlands

Correspondence: Hein Raat, Department of Public Health, Erasmus University Medical Center, PO Box 2040, 3000 CA Rotterdam, The Netherlands, Tel: +31 (0) 10 70 38 580, Fax: +31 (0) 107038474, e-mail: h.raat@erasusmc.nl

Background: To identify the patterns of lifestyle behaviours in children aged 3 years, to investigate the parental and child characteristics associated with the lifestyle patterns, and to examine whether the identified lifestyle patterns are associated with child BMI and weight status. Methods: Cross-sectional data of 2090 children 3 years old participating in the Dutch BeeBOFT study were used. Child dietary intakes, screen times and physical activity were assessed by parental questionnaire, and child weight and height were measured by trained professionals according to a standardized protocol. Latent class analysis was applied to identify patterns of lifestyle behaviours among children. Results: Three subgroups of children with distinct patterns of lifestyle behaviours were identified: the ‘unhealthy lifestyle’ pattern (36%), the ‘low snacking and low screen time’ pattern (48%) and the ‘active, high fruit and vegetable, high snacking and high screen time’ pattern (16%). Children with low maternal educational level, those raised with permissive parenting style (compared those with authoritative parents), and boys were more likely be allocated to the ‘unhealthy lifestyle’ pattern and the ‘active, high fruit and vegetable, high snacking and high screen time’ pattern (P < 0.05). No association was found between the identified lifestyle patterns and child BMI z-score at age 3 years. Conclusions: Three different lifestyle patterns were observed among children aged 3 years. Low maternal educational level, permissive parenting style and male gender of the child were associated with having unhealthy lifestyle patterns for the child.

Introduction

Childhood obesity is one of the major public health concerns nowadays due to its high prevalence and adverse physical and psychological outcomes.¹–³ Children’s lifestyle behaviours, including high intake of energy-dense nutrition-low foods (e.g. high intake of sugar-sweetened beverages, unhealthy snacks), high levels of sedentary behaviours (e.g. television viewing, computer use) and low level of physical activity are known to contribute to energy imbalance and therefore increase the risk of child overweight and obesity.⁴–⁶
Increasing evidence suggests that certain overweight-related lifestyle behaviours may co-occur or cluster in some subgroups of children.\textsuperscript{2,7–11} For example, Leech et al.\textsuperscript{8} identified three subgroups of children with distinct lifestyle patterns among Australian children 5–6 years (n = 362), the ‘most healthy’ group, the ‘energy-dense consumers who watch TV’ group and the ‘high sedentary behaviour/low moderate-to-vigorous PA’ group. Miguel-Bergeres et al.\textsuperscript{9} identified six subgroups of children with different lifestyle behaviour patterns among children aged 4–6 years from six European countries (n = 5357), one of which was characterized by the co-existence of unhealthy dietary intakes, high screen time and low physical activity level. Understanding the co-occurrence patterns of lifestyle behaviours is important, as multiple overweight-related lifestyle behaviours may have a synergic effect on the development of overweight and obesity.\textsuperscript{2,7,12} In addition, such information can inform intervention developers about which behavioural factors need to be targeted simultaneously. However, few studies have examined the co-occurring or clustering patterns of lifestyle behaviours among children younger than 5 years.\textsuperscript{9}

Parents play a pivotal role in shaping children’s lifestyle behaviours, especially for younger children. Insight in parental- and child-related factors associated with children’s lifestyle patterns will contribute to the development of effective interventions. Parenting style is one factor that may contribute to the development of children’s lifestyle behaviours.\textsuperscript{13,14} However, studies evaluating parenting style as a determinant of children’s lifestyle patterns are lacking. To address these gaps, this study aimed to (i) examine the clustering patterns of lifestyle behaviours among preschool children aged 3 years in a population-based sample from the Netherlands, (ii) examine the association of parental- and child-related factors with lifestyle patterns, including sociodemographic characteristics and parenting style and (iii) examine the association of the identified lifestyle patterns with children’s BMI and weight status.

**Methods**

**Study population**

Data from the BeeBOFT study was used. The BeeBOFT study is a cluster randomized controlled trial for the primary prevention of overweight among children.\textsuperscript{15,16} A total of 51 regional Youth Health Care (YHC) teams covering both rural and urban regions in the Netherlands participated in the study and were randomly allocated to the three study arms. The Medical Ethics Committee of the Erasmus Medical Center concluded that the Dutch Medical Research Involving Human Subjects Act (in Dutch: Wet medisch-wetenschappelijk onderzoek met mensen) did not apply to the research proposal of BeeBOFT (proposal number MEC-2008-250), and therefore had no objection to the execution of this study.

From January 2009 through September 2010, 7985 parent–child dyads were invited to participate in the study by the 51 regional YHC teams during the first home-visit at 2–4 weeks after child birth. A total of 3003 parent–child dyads provided written informed consent for participation in this 3-year study and returned the baseline questionnaire. The parents were invited to fill in a questionnaire at child age 36 months, among which 2253 children returned the questionnaire at child age 36 months, using Dutch questionnaires that contained beverages, unhealthy snack foods, fruits, vegetables, physical activity and screen time were measured by parental questionnaires that have been used in previous studies (see Supplementary table S2 for detail).\textsuperscript{17,18} When answering the questions, parents were asked to report the average condition during the past 4 weeks. Each lifestyle variable was dichotomized into favourable vs. unfavourable categories according to current nutrition and physical activity guidelines.\textsuperscript{19–24} Children who were reported to consume sugar-containing drinks for >2 cups per day were classified as having a high consumption of sugar-containing drinks.\textsuperscript{25} Children who were reported to eat unhealthy snacks for two servings or more per day were classified as having a high consumption of unhealthy snacks.\textsuperscript{25} Children who were reported to have fresh fruit for one serving or less were classified as having a low fruit consumption.\textsuperscript{25} Children who were reported to have vegetable for one serving or less were classified as having a low vegetable consumption.\textsuperscript{25} Children who were active for 5 or more days per week and >1 h per day were classified as physically active, while those who did not meet this criterion were classified as having a low level of physical activity.\textsuperscript{19} Children who were reported to have >1 h of screen time on average per day were classified as having excessive screen time.\textsuperscript{20,21}

**Sociodemographic characteristics**

Information on maternal age and educational level, parity and child’s gender and ethnic background were assessed by baseline questionnaire. We used maternal body weight and height reported at child age 36 months (or at child age 6 months in case of missing) to calculate maternal BMI (weight in kilograms divided by squared body length in metres). The maternal weight status was then classified as ‘normal’ (BMI < 25), ‘overweight’ (BMI ≥ 25) or ‘obese’ (BMI ≥ 30).

**Parental characteristics**

Parenting style was measured at child age 36 months, using a questionnaire used by a previous study.\textsuperscript{25} Two dimensions of parenting were measured: ‘parental warmth’ (6 items), which addresses the frequency with which parents displayed warm affectionate, and ‘parental control’ (5 items), which addresses the frequency with which parents set and enforce clear expectations and limits for their child’s behaviour (see Supplementary table S3 for details). The Cronbach’s alpha for was 0.83 for ‘parental warmth’, and 0.62 for ‘parental control’ dimension. Warmth and control scores were dichotomized at median value in the population and combined to define the four categorical parenting styles.\textsuperscript{25} The combination of high warmth and high control was classified as authoritative; low warmth and high control as authoritarian; high warmth and low control as permissive; and low warmth and low control as neglectful.\textsuperscript{26}

The questionnaire at child age 36 months assessed the numbers of half days and full days per week the child using childcares (e.g. daycare centre, childminders, baby sitters, playgroups), which was then categorized as < 1, 1–2.5, 3–3.5, and 4 days and above.

**Child anthropometrics**

Child’s weight and height at age 3 years were measured by YHC professionals according to standardized protocols.\textsuperscript{26} Age and gender adjusted BMI z-scores were calculated using the WHO Growth Standard.\textsuperscript{27} At the age of 3 years, each child was classified as being ‘normal weight’, or ‘overweight/obese’ using international Obesity Task Force age- and gender-specific cut-off values.\textsuperscript{28,29}

**Measurements**

**Children’s lifestyle behaviours**

Children’s lifestyle behaviours including the consumption of sugar-containing beverages, unhealthy snack foods, fruits, vegetables, physical activity and screen time were measured by parental questionnaires that have been used in previous studies (see Supplementary table S2 for detail).\textsuperscript{17,18} When answering the questions, parents were asked to report the average condition during the past 4 weeks. Each lifestyle variable was dichotomized into favourable vs. unfavourable categories according to current nutrition and physical activity guidelines.\textsuperscript{19–24} Children who were reported to consume sugar-containing drinks for >2 cups per day were classified as having a high consumption of sugar-containing drinks.\textsuperscript{25} Children who were reported to eat unhealthy snacks for two servings or more per day were classified as having a high consumption of unhealthy snacks.\textsuperscript{25} Children who were reported to have fresh fruit for one serving or less were classified as having a low fruit consumption.\textsuperscript{25} Children who were reported to have vegetable for one serving or less were classified as having a low vegetable consumption.\textsuperscript{25} Children who were active for 5 or more days per week and >1 h per day were classified as physically active, while those who did not meet this criterion were classified as having a low level of physical activity.\textsuperscript{19} Children who were reported to have >1 h of screen time on average per day were classified as having excessive screen time.\textsuperscript{20,21}

**Sociodemographic characteristics**

Information on maternal age and educational level, parity and child’s gender and ethnic background were assessed by baseline questionnaire. We used maternal body weight and height reported at child age 36 months (or at child age 6 months in case of missing) to calculate maternal BMI (weight in kilograms divided by squared body length in metres). The maternal weight status was then classified as ‘normal’ (BMI < 25), ‘overweight’ (BMI ≥ 25) or ‘obese’ (BMI ≥ 30).

**Parental characteristics**

Parenting style was measured at child age 36 months, using a questionnaire used by a previous study.\textsuperscript{25} Two dimensions of parenting were measured: ‘parental warmth’ (6 items), which addresses the frequency with which parents displayed warm affectionate, and ‘parental control’ (5 items), which addresses the frequency with which parents set and enforce clear expectations and limits for their child’s behaviour (see Supplementary table S3 for details). The Cronbach’s alpha for was 0.83 for ‘parental warmth’, and 0.62 for ‘parental control’ dimension. Warmth and control scores were dichotomized at median value in the population and combined to define the four categorical parenting styles.\textsuperscript{25} The combination of high warmth and high control was classified as authoritative; low warmth and high control as authoritarian; high warmth and low control as permissive; and low warmth and low control as neglectful.\textsuperscript{26}

The questionnaire at child age 36 months assessed the numbers of half days and full days per week the child using childcares (e.g. daycare centre, childminders, baby sitters, playgroups), which was then categorized as < 1, 1–2.5, 3–3.5, and 4 days and above.

**Child anthropometrics**

Child’s weight and height at age 3 years were measured by YHC professionals according to standardized protocols.\textsuperscript{26} Age and gender adjusted BMI z-scores were calculated using the WHO Growth Standard.\textsuperscript{27} At the age of 3 years, each child was classified as being ‘normal weight’, or ‘overweight/obese’ using international Obesity Task Force age- and gender-specific cut-off values.\textsuperscript{28,29}
**Statistical methods**

Latent class analysis was applied to identify patterns of lifestyle behaviours, based on dichotomized lifestyle behaviour indicators. Children that were assigned to the same latent class shared similar patterns of lifestyle behaviours. To identify the optimal number of latent classes, a series of latent class models with a total number of 1–6 classes were evaluated. Supplementary table S4 presents the model fit statistics of the 1–6-class latent class models, including Loglikelihood values, Akaike’s Information Criterion (AIC) and Bayesian Information Criterion (BIC). Both AIC and BIC reached the lowest value at the 3-class model. With further consideration of the model interpretability, eventually the 3-class latent class model was adopted for subsequent analysis.

Multinomial logistic regression models were applied to examine the associations of the parental and child characteristics with the lifestyle patterns identified by the latent class model, including maternal educational level, maternal weight status, parenting styles, child ethnic background, child gender, days using childcare per week and study condition (the intervention or control conditions), adjusted for child exact age (in months), respondent of the questionnaire (mother, father or others) at the time of questionnaire measurement.

The associations of the lifestyle patterns with child BMI z-score and weight status were examined by a linear regression model and a logistic regression model respectively. Both models were adjusted for maternal educational level, maternal weight status, parenting styles, child ethnic background, child gender, child exact age, days using childcare per week, respondent of the questionnaire and study condition.

All the analyses were performed using SAS version 9.4. Latent class analysis was performed with the package ‘PROC LCA’.

**Results**

Table 1 presents the characteristics of our study population. Of the 2090 children included in the study, 51% were boys, 84% were of Dutch ethnic background. For the mothers, 33% were categorized as being overweight or obese, and 10% had a low educational level.

Three subgroups of children with distinct lifestyle patterns were identified, which included 36%, 48%, and 16% of the children, respectively (table 2). Children allocated to the ‘unhealthy lifestyle’ pattern (class 1) were more likely to have excessive consumptions of sugar-containing drinks (> 2 cups per day) and unhealthy snacks (>1 serving per day) and insufficient consumptions of fruit (<2 serving per day) and vegetables (<2 serving per day) and were more likely to have excessive screen time (>1 h per day) and insufficient physical activity level (<1 h per day). Children in the ‘low snacking and low screen time’ pattern (class 2) had low probabilities of having excessive sugar-containing drink and unhealthy snack consumptions, and were less likely to have excessive screen time. Children in the ‘active, high fruit and vegetable, high snacking and high screen time’ pattern (class 3) were more likely to have excessive consumptions of sugar-containing drink and unhealthy snacks and excessive screen time, and less like to report insufficient consumptions of fruit and vegetables and insufficient physical activity level.

With the ‘low snacking and low screen time’ pattern as the reference group, factors significantly (P < 0.05) associated with both the ‘unhealthy lifestyle’ pattern and the ‘active, high fruit and vegetable, high snacking and high screen time’ pattern in the univariate models (table 3) included lower maternal educational level, maternal obesity, permissive parenting style (compare to authoritative parenting style), and male gender of the child. In addition, an authoritarian parenting style was associated with lower probability of being allocated to the ‘active, high fruit and vegetable, high snacking and high screen time’ pattern. In the multivariate model, all the above associations remained significant expected for maternal obesity.

As shown in table 4, there was no significant association between the lifestyle patterns and child BMI and weight status (overweight vs. normal weight) at age 36 months (all P > 0.1).

**Discussion**

We identified three patterns of lifestyle behaviours among 3-year-old children in a population-based sample from the Netherlands: the...
Study conditions

<table>
<thead>
<tr>
<th></th>
<th>'E-health4Uth' vs. control</th>
<th>Ref</th>
<th>'BBOFT+' vs. control</th>
<th>Ref</th>
<th>1.11 (0.87–1.40)</th>
<th>0.88 (0.65–1.20)</th>
<th>1.03 (0.80–1.32)</th>
<th>0.86 (0.62–1.20)</th>
<th>0.91 (0.66–1.23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal educational level</td>
<td>Low vs. high</td>
<td>Ref</td>
<td>1.54 (1.26–1.89)</td>
<td>1.62 (1.23–2.14)</td>
<td>1.51 (1.22–1.88)</td>
<td>1.59 (1.19–2.12)</td>
<td>1.11 (0.87–1.40)</td>
<td>0.88 (0.65–1.20)</td>
<td>1.03 (0.80–1.32)</td>
</tr>
<tr>
<td>Parenting style</td>
<td>Permissive vs. authoritative</td>
<td>Ref</td>
<td>1.62 (1.20–2.18)**</td>
<td>1.71 (1.19–2.45)**</td>
<td>1.59 (1.17–2.16)**</td>
<td>1.60 (1.10–2.32)**</td>
<td>1.03 (0.80–1.31)</td>
<td>0.65 (0.46–0.91)</td>
<td>0.89 (0.62–1.28)</td>
</tr>
<tr>
<td>Parenting style</td>
<td>Authoritative vs. authoritative</td>
<td>Ref</td>
<td>1.04 (0.82–1.32)</td>
<td>0.64 (0.46–0.90)**</td>
<td>1.02 (0.80–1.31)</td>
<td>0.65 (0.46–0.91)</td>
<td>0.89 (0.62–1.28)</td>
<td>0.89 (0.62–1.28)</td>
<td>0.89 (0.62–1.28)</td>
</tr>
<tr>
<td>Parenting style</td>
<td>Neglectful vs. authoritative</td>
<td>Ref</td>
<td>1.18 (0.91–1.54)</td>
<td>0.94 (0.66–1.33)</td>
<td>1.18 (0.90–1.55)</td>
<td>0.89 (0.62–1.28)</td>
<td>0.89 (0.62–1.28)</td>
<td>0.89 (0.62–1.28)</td>
<td>0.89 (0.62–1.28)</td>
</tr>
<tr>
<td>Number of days using childcare</td>
<td>1–2 vs. &lt;0.5</td>
<td>Ref</td>
<td>0.97 (0.67–1.41)</td>
<td>0.74 (0.47–1.17)</td>
<td>1.06 (0.71–1.57)</td>
<td>1.01 (0.61–1.68)</td>
<td>0.97 (0.61–1.57)</td>
<td>1.01 (0.61–1.68)</td>
<td>0.97 (0.61–1.68)</td>
</tr>
<tr>
<td>Number of days using childcare</td>
<td>2.5–3.5 vs. &lt;0.5</td>
<td>Ref</td>
<td>0.78 (0.53–1.15)</td>
<td>0.69 (0.42–1.11)</td>
<td>0.94 (0.62–1.43)</td>
<td>1.07 (0.63–1.84)</td>
<td>0.97 (0.61–1.57)</td>
<td>1.01 (0.61–1.68)</td>
<td>0.97 (0.61–1.68)</td>
</tr>
<tr>
<td>Number of days using childcare</td>
<td>≥4 vs. &lt;0.5</td>
<td>Ref</td>
<td>1.28 (0.83–1.97)</td>
<td>0.92 (0.53–1.58)</td>
<td>1.40 (0.89–2.21)</td>
<td>1.17 (0.65–2.12)</td>
<td>1.28 (0.83–1.97)</td>
<td>1.17 (0.65–2.12)</td>
<td>1.28 (0.83–1.97)</td>
</tr>
<tr>
<td>Sugar-containing drink consumption</td>
<td>&gt;2 cups per day</td>
<td>0.40</td>
<td>0.76</td>
<td>0.02</td>
<td>0.72</td>
<td>&lt;0.001</td>
<td>0.63</td>
<td>0.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Unhealthy snack consumption</td>
<td>&gt;1 serving per day</td>
<td>0.39</td>
<td>0.65</td>
<td>0.14</td>
<td>0.59</td>
<td>&lt;0.001</td>
<td>0.63</td>
<td>0.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fruit consumption</td>
<td>&lt;2 serving per day</td>
<td>0.59</td>
<td>0.80</td>
<td>0.55</td>
<td>0.21</td>
<td>&lt;0.001</td>
<td>0.63</td>
<td>0.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Vegetable consumption</td>
<td>&lt;2 servings per day</td>
<td>0.68</td>
<td>0.87</td>
<td>0.66</td>
<td>0.32</td>
<td>&lt;0.001</td>
<td>0.63</td>
<td>0.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Screen time</td>
<td>≥1 h per day</td>
<td>0.43</td>
<td>0.59</td>
<td>0.25</td>
<td>0.63</td>
<td>&lt;0.001</td>
<td>0.63</td>
<td>0.17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Physical activity</td>
<td>&lt;1 h per day</td>
<td>0.63</td>
<td>0.83</td>
<td>0.64</td>
<td>0.63</td>
<td>&lt;0.001</td>
<td>0.63</td>
<td>0.17</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Notes: For both the univariate and the multivariate models, the ‘low snacking, low screen time’ pattern (class 2) was taken as the reference group. All the models were adjusted for child exact age at the time of questionnaire measurement. For maternal educational level, ‘low’ refers to ‘≤4 years secondary school’, ‘middle’ refers to ‘>4 years secondary school or middle level vocational training’, and ‘high’ refers to ‘University or above’.

a: For the univariate models, each independent variable (the parental and child characteristics) were entered into the model separately to assess its association with the outcome variable (lifestyle behaviour patterns).

b: For the multivariate model, all the independent variables were entered into the model simultaneously to assess the independent association between each parental- and child-related factors and the lifestyle patterns.

**P < 0.0001,***: P < 0.001, **: P < 0.01.

The co-occurrence of unhealthy lifestyle behaviours, including unhealthy dietary intakes, high screen time, and low physical activity level among certain subgroups of children have been noted by various studies among children of different age groups and regions.9,11,32 These co-occurrence patterns reveal the high correlations between sedentary behaviours (e.g. TV viewing and computer use) and the consumption of sugar-containing drinks and unhealthy snacks. The proposed mechanism for the correlations included the promoting effect of beverage and snack commercials on the consumption of these foods,33 and the provision of a context during

'reactive lifestyle' pattern, the 'low snacking and low screen time' pattern, and the 'active, high fruit and vegetable, high snacking, high screen time' pattern. Boys, children with lower maternal educational and those being raised with permissive parenting style were more likely to have an 'unhealthy lifestyle' pattern, and an 'active, high fruit and vegetable, high snacking, high screen time' pattern, compare with girls, children with higher maternal education, and those being raised with authoritative parenting styles. There was no difference in the distribution of BMI or the risk of overweight between the subgroups of children with different lifestyle patterns.
sediency activities that promote passive snacking. The co-occurrence of unhealthy behaviours is also likely to be a result of parental influence, as this pattern has been shown to exist in the adult population. Further, parents who allow their child to watch TV may also provide the child sugar-containing drinks and unhealthy snacks.

About half of the children were allocated to the 'low snacking and low screen time' group, which is considered as relative healthier group. However, children in this group commonly had insufficient fruit and vegetable consumptions and physical activity level. A similar lifestyle pattern has been observed in a sample of 1773 children aged 3–6 years from eight European countries (the 'low beverage consumption and low sedentary' pattern). Such a pattern might reveal that insufficient fruit and vegetable intakes and low physical activity levels are widespread issues and should be addressed universally in the population. The 'active, high fruit and vegetable, high snacking, and high screen time' lifestyle pattern is similar to the 'sporty media-oriented mixed eaters' pattern reported in a previous study from Belgium. Further studies are needed to understand the rationale for the co-occurrence of both healthy and unhealthy intakes, and high screen time and high level of physical activities in this group.

Both the 'unhealthy lifestyle' and 'active, high fruit and vegetable, high snacking and high screen time' patterns were characterized by high consumptions of unhealthy snacks and sugaring drinks, and high screen time, and the two patterns share similar correlates of parental and child characteristics. The associations between the less healthy lifestyle patterns with lower maternal educational level are accordance with the previous research. Our results suggest that children with permissive parents are more likely to have lifestyle patterns characterized by high consumptions of unhealthy snacks and sugar-containing beverages, than those with authoritative parents. Our finding is consistent with previous research investigating the associations of parenting style with individual lifestyle behaviours, that an authoritative parenting style is associated with more favourable lifestyles behaviours. In addition, parents may restrict the unhealthy lifestyle behaviours such as sugar-containing drink consumption and unhealthy snack consumption of the overweight or obese children. Further, it is a limitation of our study that only BMI was measured to represent the adiposity of children. Since BMI is an indicator for both fat mass and fat free mass, it could be that children in the unhealthy lifestyle group had lower muscle mass and higher fat mass compared with children with relatively healthier lifestyles.

This study was subjected to some limitations. First, information on children’s lifestyle behaviour variables were self-reported by parents through questionnaires. In addition, the questions concerning unhealthy snacks and fruit consumption did not measure serving size. Future studies with more accurate measurement of children’s lifestyle behaviours are warranted to confirm our finding. Second, our study sample is relatively highly educated, containing predominantly Caucasian, compared with those excluded due to loss of follow-up, and therefore caution is needed when generalizing results. Third, variations in the variables included, and the way in which the lifestyle behaviours were dichotomized may hinder the comparison between studies. Fourth, this study used data from an intervention trial. However, we found no association between the intervention groups and the lifestyle patterns (see Table 2). In addition, we have replicated the latent class analyses using data from the control group only, and comparable lifestyle patterns were generated (Supplementary table S3). Finally, given the limitation of observational studies, we could not determine the causal relationships but only associations.

Conclusion

Our findings confirm that co-occurrence of lifestyle behaviours can be observed among children aged 3 years. Lower maternal educational level, permissive parenting style and male gender of the child were associated with having unhealthy lifestyle patterns for the child. We found no association between the lifestyle patterns and children’s BMI or weight status. Our findings underline the importance of designing and implementing interventions that consider the diversity of lifestyle patterns and associated determinants.

Supplementary data

Supplementary data are available at EURPUB online.
Funding
The BeeBOFT study was funded by a grant from ZonMW, the Netherlands Organization for Health Research and Development (grant number 50-50110-96-491).

Conflicts of interest: None declared.

Key points
- Clustering of lifestyle behaviour can be observed among children as young as 3 years.
- Lower maternal educational level, permissive parenting style and male gender of the child are associated with having unhealthy lifestyle patterns for the child.
- The diversity of lifestyle patterns and associated determinants should be considered when designing and implementing interventions that aim at improving children’s health behaviours.

References
27. World Health Organization. WHO Child Growth Standards: Length/Height for Age, Weight-for-Age, Weight-for-Length, Weight-for-Height and Body Mass Index-for-Age, Methods and Development. 2006.
Non-parental care in childhood and health up to 30 years later: ONS Longitudinal Study 1971–2011

Emily T. Murray1, Rebecca Lacey1, Barbara Maughan2, Amanda Sacker1

1 Research Department of Epidemiology and Public Health, University College London, London, UK
2 Institute of Psychiatry, Psychology & Neuroscience, MRC Social, Genetic and Developmental Psychiatry Centre, King’s College London, London, UK

Correspondence: E.T. Murray, Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 7HB, UK, Tel: +44 (0) 20 31 08 3339, Fax: +44(0)20 7813 0242, e-mail: emily.murray@ucl.ac.uk

Introduction

In March 2019, ~78 children per 10 000 and 109 children per 100 000 were looked-after by local authorities in England1 and Wales, respectively.2 This represents a lower rate than the 1970s,3 but the absolute number of children in non-parental care have been steadily increasing for the past decade. Suggested reasons for these phenomena include fewer children entering care but those that do tending to stay longer,4 and changes to admission criteria favouring home care over residential care except in more severe or complex cases.5

Based on evidence predominantly from the UK but also from the USA, Australia and Sweden, it is known that people who have spent part of their childhood in out-of-home care report significantly more adverse outcomes later in life, including worse health,6–15 than children from the general population. This includes not only mental6–13 and physical health,6,8,14,15 but also increased mortality.5 Evidence shows correlations between care type and later health might differ depending on the type: mental health is consistently worse for children in non-parental care compared with general population children,16–18 but a recent meta-analysis found children in residential care had worse psychosocial outcomes than children living in non-residential care.20 Possible explanations include

residential care putting children, particularly young children, at risk of attachment disorder and developmental delays.21 A few studies have shown that children in residential care have more mental health problems than those placed with non-relatives, while those in relative households have fewer problems still.22 Various theories explaining these findings, include minimization of trauma through residing with kin,19 more regular contact with a parent18 and selection into care type by health-related factors.20

Research investigating later life health differentials by care type are limited. We are only aware of one study, using the 1970 British Cohort Study, which investigated health outcomes at the age of 30 years.13 They showed that residential care childhood was related to higher rates of depression and lower life satisfaction, than foster care (relative and non-relative combined); even after adjustment for pre-care family background. A few other studies have shown that middle-aged adults who had spent time in non-parental care had worse mental health,8,9,15 self-rated health (SRH)9 and mortality1 than children who had not been in non-parental care, but in these studies care status was collected retrospectively and not split by care type.

We improve on these studies by using the prospectively collected nationally representative Office for National Statistics Longitudinal Study (ONS LS) to examine whether children in various types of care settings (residential care, relative household, unrelated