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*The European Journal of Public Health*, Vol. 30, No. 6, 1115–1121

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 doi:10.1093/eurpub/ckaa109 Advance Access published on 12 July 2020  
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## Identifying patterns of lifestyle behaviours among children of 3 years old

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**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.  
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## Introduction

Childhood obesity is one of the major public health concerns nowadays due to its high prevalence and adverse physical and psychological outcomes.<sup>1–3</sup> 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.<sup>4–6</sup>

Increasing evidence suggests that certain overweight-related lifestyle behaviours may co-occur or cluster in some subgroups of children.<sup>7–11</sup> For example, Leech et al.<sup>8</sup> 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-Berges et al.<sup>9</sup> 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.<sup>7,12</sup> 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.<sup>9</sup>

Parents play a pivotal role in shaping children’s lifestyle behaviours,<sup>13</sup> 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.<sup>13,14</sup> 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 were used. The BeeBOFT study is a cluster randomized controlled trial for the primary prevention of overweight among children.<sup>15,16</sup> 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 6, 14 and 36 months, respectively. The questionnaires were instructed to be filled by the main caregivers (mother, father or others) of the child. For this study, we used data on children’s lifestyle behaviours at age 36 months. In total, parents of 2253 children returned the questionnaire at child age 36 months, among which 94% were filled by mothers. For this study, children with no missing value on the lifestyle variables ( $n = 2090$ ) were included for analyses.

Non-response analysis shows that compared with children included in this study, children excluded from this study due to non-response for the parental questionnaire and missing values were more likely to have lower maternal educational level, and non-Dutch ethnic background ( $P < 0.01$ , see [Supplementary table S1](#) for detailed data).

## 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 at child age 36 months, using Dutch questionnaires that have been used in previous studies (see [Supplementary table S2](#) for detail).<sup>17,18</sup> 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.<sup>19–24</sup> 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.<sup>23</sup> 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.<sup>23</sup> Children who were reported to have fresh fruit for one serving or less were classified as having a low fruit consumption.<sup>23</sup> Children who were reported to have vegetable for one serving spoon or less were classified as having a low vegetable consumption.<sup>23</sup> 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.<sup>19</sup> Children who were reported to have  $>1$  h of screen time on average per day were classified as having excessive screen time.<sup>20,21</sup>

### 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’ ( $BMI \geq 25$ ) or ‘obese’ ( $BMI \geq 30$ ).

### Parental characteristics

Parenting style was measured at child age 36 months, using a questionnaire used by a previous study.<sup>25</sup> 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 children’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.<sup>25</sup> 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.<sup>25</sup>

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.<sup>26</sup> Age and gender adjusted BMI z-scores were calculated using the WHO Growth Standard.<sup>27</sup> 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.<sup>28,29</sup>

## Statistical methods

Latent class analysis was applied to identify patterns of lifestyle behaviours, based on dichotomized lifestyle behaviour indicators.<sup>30,31</sup> 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.<sup>30</sup> Supplementary table S4 presents the model fit statistics of the 1- to 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'.<sup>30</sup>

## 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 fruits (<2 serving per day) and vegetables (< 2 serving per day) and were more likely to have excessive screen time ( $\geq 1$  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

**Table 1** Characteristics of the parents and children in our study population ( $n = 2090$ )

Variables	<i>n</i>	Frequency (%) / mean (SD)
Maternal educational level	2070	
$\leq 4$ years secondary school		208 (10.1)
$> 4$ years secondary school or middle level vocational training		732 (35.4)
University or above		1130 (54.6)
Maternal weight status	2079	
Normal		1379 (66.3)
Overweight		519 (25.0)
Obesity		181 (8.7)
Child ethnic background, Dutch	2090	1756 (84.1)
Child gender, male	2057	1059 (51.5)
Child age 36 months, mean (SD)	2090	36.7 (2.2)
Parenting style	2053	
Authoritative		828 (40.3)
Permissive		301 (14.7)
Authoritarian		529 (25.8)
Neglectful		395 (19.2)
Number of days using childcare	2073	
0–0.5 day		160 (7.7)
1–2 days		1056 (50.5)
2.5–3.5 days		582 (27.9)
4 and more days		275 (13.2)
Study condition	2090	
Control condition		730 (34.9)
'BBOFT+' Intervention		621 (29.7)
'E-health4Uth' Intervention		739 (35.4)

Note:: A child's ethnic background was defined according to the ethnic backgrounds of his/her parents. A parent was classified as non-Dutch if one of his/her own parents was born outside the Netherlands. If one or both of the child's parents were classified as non-Dutch, that child's ethnic background was non-Dutch.

**Table 2** The probabilities of reporting each unfavourable lifestyle behaviours in the total sample and in each lifestyle patterns

Unfavourable lifestyle behaviours	Total sample (n = 2090)	Class 1 'unhealthy lifestyle' (n = 762, 36%)	Class 2 'low snacking and low screen time' (n = 996, 48%)	Class 3 'active, high fruit and vegetable, high snacking and high screen time' (n = 332, 16%)	P-values <sup>a</sup>
Sugar-containing drink consumption >2 cups per day	0.40	0.76	0.02	0.72	<0.001
Unhealthy snack consumption >1 serving per day	0.39	0.65	0.14	0.59	<0.001
Fruit consumption <2 serving per day	0.59	0.80	0.55	0.21	<0.001
Vegetable consumption <2 serving spoons per day	0.68	0.87	0.66	0.32	<0.001
Screen time ≥1 h per day	0.43	0.59	0.25	0.63	<0.001
Physical activity <1 h per day	0.63	0.83	0.64	0.17	<0.001

a: The difference between groups was compared using Chi-square test.

**Table 3** The associations of parental and child characteristics with children's lifestyle patterns: results from multinomial logistic regression models (n = 2090)

	Univariate models <sup>a</sup>			Multivariate model <sup>b</sup>	
	Class 2, 'low snacking and low screen time'	Class 1, 'unhealthy lifestyles'	Class 3, 'active, high fruit and vegetable, high snacking and high screen time'	Class 1, 'unhealthy lifestyles'	Class 3, 'active, high fruit and vegetable, high snacking and high screen time' OR (95% CI)
		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Maternal educational level					
Low vs. high	Ref	1.54 (1.26–1.89)	1.62 (1.23–2.14)	1.51 (1.22–1.88)	1.59 (1.19–2.12)
Middle vs. high	Ref	2.07 (1.47–2.92)**	3.25 (2.18–4.84)***	1.98 (1.37–2.84)**	2.94 (1.91–4.53)***
Maternal weight status					
Overweight vs. normal	Ref	1.28 (1.03–1.60)	1.06 (0.79–1.44)	1.23 (0.97–1.55)	1.00 (0.73–1.37)
Obese vs. normal	Ref	1.49 (1.05–2.10)	1.63 (1.06–2.51)	1.35 (0.94–1.94)	1.46 (0.93–2.29)
Parenting style					
Permissive vs. authoritative	Ref	1.62 (1.20–2.18)**	1.71 (1.19–2.45)***	1.59 (1.17–2.16)**	1.60 (1.10–2.32)**
Authoritarian vs. authoritative	Ref	1.04 (0.82–1.32)	0.64 (0.46–0.90)**	1.03 (0.80–1.31)	0.65 (0.46–0.91)
Neglectful vs. authoritative	Ref	1.18 (0.91–1.54)	0.94 (0.66–1.33)	1.18 (0.90–1.55)	0.89 (0.62–1.28)
Child ethnic background					
Non-Dutch vs. Dutch	Ref	0.77 (0.59–1.00)	0.95 (0.68–1.33)	0.76 (0.58–1.01)	0.88 (0.62–1.27)
Child gender					
Boy vs. girl	Ref	1.26 (1.04–1.52)*	1.30 (1.01–1.67)*	1.25 (1.02–1.52)*	1.28 (0.99–1.66)
Number of days using childcare					
1–2 vs. ≤0.5	Ref	0.97 (0.67–1.41)	0.74 (0.47–1.17)	1.06 (0.71–1.57)	1.01 (0.61–1.68)
2.5–3.5 vs. ≤0.5	Ref	0.78 (0.53–1.15)	0.69 (0.42–1.11)	0.94 (0.62–1.43)	1.07 (0.63–1.84)
≥4 vs. ≤0.5	Ref	1.28 (0.83–1.97)	0.92 (0.53–1.58)	1.40 (0.89–2.21)	1.17 (0.65–2.12)
Study conditions					
'BBOFT+' vs. control	Ref	1.11 (0.87–1.40)	0.88 (0.65–1.20)	1.03 (0.80–1.32)	0.86 (0.62–1.20)
'E-health4Uth' vs. control	Ref	0.99 (0.79–1.24)	0.86 (0.64–1.15)	1.01 (0.80–1.28)	0.91 (0.66–1.23)

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.

\*\*\*:  $P < 0.0001$ ,

\*\* :  $P < 0.001$ ,

\* :  $P < 0.05$ .

'unhealthy 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.

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.<sup>9,11,32</sup> 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,<sup>33</sup> and the provision of a context during

**Table 4** The association between the lifestyle patterns and child BMI z-score and weight status at child age 36 months ( $n = 1309$ )

	Child BMI z-score		Child overweight	
	Mean (SD)	$\beta$ (95% CI) <sup>a</sup>	$n$ (%)	OR (95% CI) <sup>b</sup>
Class 1, 'Unhealthy lifestyle'	-0.45 (0.97)	-0.10 (-0.22, 0.02)	29 (5.92)	0.87 (0.52, 1.46)
Class 2, 'Low snacking and low screen time'	-0.34 (1.05)	Ref	46 (7.32)	Ref
Class 3, 'Active, high fruit and vegetable, high snacking, high screen time'	-0.34 (1.02)	0.02 (-0.14, 0.18)	13 (6.81)	0.93 (0.46, 1.89)

Note: All the models adjusted for maternal educational level, maternal BMI, parenting styles, child ethnic background, child gender, child exact age, days of using childcare and study conditions.

a: Results from linear regression model.

b: Results from logistic regression model.

sedentary activities that promotes passive snacking.<sup>34</sup> 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.<sup>35</sup> Further, parents who allow their child to watch TV may also provide the child sugar-containing drinks and unhealthy snacks.<sup>36</sup>

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).<sup>37</sup> 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.<sup>32</sup> 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.<sup>9</sup> 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, while a permissive parenting style is associated with less healthy lifestyles of children.<sup>13,14,38</sup> It is possible that permissive parents are more likely to cater their children's preferences, e.g. on the consumption of snacks and sugar-containing drinks, and TV/computer watching, rather than place many demands on these behaviours.<sup>13</sup>

Our findings confirm that the co-occurrence of multiple overweight-related lifestyle behaviours can already be observed in children as young as 3 years. Public health practitioners should consider how the lifestyle behaviours co-occur and which background characteristics are associated with the co-occurring patterns of lifestyle behaviours in order to develop better targeted interventions to improve children's lifestyle behaviours tailored to different groups.

We found no association between the lifestyle patterns and children's BMI or weight status. Previous findings with regard to the association between lifestyle patterns and children's weight status are inconsistent<sup>7,8,32,37,39</sup>; while some studies have found evidence of possible synergistic effect of multiple unhealthy behaviours on

childhood overweight,<sup>8</sup> others found no association,<sup>32</sup> or even reverse association.<sup>39</sup> A possible explanation for the lack of association between the lifestyle patterns and children's BMI or weight status may include the younger age of our study population. The adverse effect of multiple unhealthy lifestyle behaviours on child BMI or weight status may accumulate and manifest at later ages.<sup>40</sup> This might represent an opportunity for the primary prevention of overweight, as we would be able to prevent the accumulation of unhealthy lifestyle behaviours. In addition, parents may restrict the unhealthy behaviours such as sugar-containing drink consumption and unhealthy snack consumption of the overweight or obese children.<sup>39</sup> 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.<sup>39</sup>

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 S5). 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.

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*The European Journal of Public Health*, Vol. 30, No. 6, 1121–1127

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doi:10.1093/eurpub/ckaa113 Advance Access published on 19 July 2020

## Non-parental care in childhood and health up to 30 years later: ONS Longitudinal Study 1971–2011

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**Background:** Children who spend time in non-parental care report worse health later in life on average, but less is known about differences by type of care. We examined whether self-rated health of adults who had been in non-parental care up to 30 years later varied by type of care. **Methods:** We used longitudinal data from the office for National Statistics Longitudinal Study. Participants were aged <18 and never-married at baseline of each census year from 1971 to 2001. Separately for each follow-up period (10, 20 and 30 years later), multi-level logistic regression was used to compare self-rated health outcomes by different care types. **Results:** For combined census years, sample sizes were 157 896 dependent children with 10 years of follow-up, 166 844 with 20 years of follow-up and 173 801 with 30 years of follow-up. For all follow-up cohorts, longitudinal study members who had been in care in childhood, had higher odds of rating their health as 'not good' vs. 'good'; with highest odds for residential care. For example, 10-year follow-up odds ratios were 3.5 (95% confidence interval: 2.2–5.6) for residential care, 2.1 (1.7–2.5) for relative households and 2.6 (2.1–3.3) for non-relative households, compared with parental households after adjustment for childhood demographics. Associations were weakest for 10-year, and strongest for 20-year, follow-up. Additional adjustment for childhood social circumstances reduced, but did not eliminate, associations. **Conclusion:** Decades after children and young people are placed in care, they are still more likely to report worse health than children who grew up in a parental household.

## Introduction

In March 2019, ~78 children per 10 000 and 109 children per 10 000 were looked-after by local authorities in England<sup>1</sup> and Wales, respectively.<sup>2</sup> This represents a lower rate than the 1970s,<sup>3</sup> 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,<sup>4</sup> and changes to admission criteria favouring home care over residential care except in more severe or complex cases.<sup>5</sup>

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,<sup>6–13</sup> than children from the general population. This includes not only mental<sup>6–13</sup> and physical health<sup>3,9,14,15</sup> but also increased mortality.<sup>3</sup> 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,<sup>16–19</sup> but a recent meta-analysis found children in residential care had worse psychosocial outcomes than children living in non-residential care.<sup>20</sup> Possible explanations include

residential care putting children, particularly young children, at risk of attachment disorder and developmental delays.<sup>21</sup> 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.<sup>22</sup> Various theories explaining these findings, include minimization of trauma through residing with kin,<sup>16</sup> more regular contact with a parent<sup>18</sup> and selection into care type by health-related factors.<sup>20</sup>

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.<sup>13</sup> 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<sup>8,9,15</sup> self-rated health (SRH)<sup>9</sup> and mortality<sup>3</sup> 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