

1 **ABSTRACT**

2 **Objective:** Examine associations between childcare type and nutrition and oral health  
3 indicators.

4 **Design:** Cross-sectional data extracted from a longitudinal birth cohort. Parent-completed food  
5 frequency questionnaire and questions regarding oral health and childcare use. The associations  
6 between childcare type, classified into four groups: parent care only (PCO), formal childcare  
7 only (FCO), informal childcare only (ICO) or combination of care (F&I) and nutrition and oral  
8 health indicators were examined.

9 **Setting:** Home and childcare.

10 **Participants:** Families with children aged three (n=273) and four years (n=249) in Victoria,  
11 Australia.

12 **Results:** No associations were observed between childcare type and core food/beverage  
13 consumption or oral health indicators. For discretionary beverages, compared with children  
14 receiving PCO at age three years, children in FCO or F&I were less likely to frequently  
15 consume fruit juice/drinks (FCO: Adjusted Odds Ratio:0.41 95%CI: 0.17, 0.96, p=0.04; F&I:  
16 AOR:0.32, 95%CI: 0.14, 0.74, p=0.008). At age four years children receiving FCO or ICO  
17 were less likely to consume sweet beverages frequently compared with children receiving PCO.  
18 Fruit juice/drink (ICO: AOR:0.42, 95%CI: 0.19, 0.94, p= 0.03; FCO: AOR: 0.35, 95%CI: 0.14,  
19 0.88, p = 0.03), soft drink:(ICO: AOR: 0.23, 95%CI: 0.07, 0.74, p=0.01; FCO: AOR: 0.14,  
20 95%CI: 0.03, 0.76, p = 0.02).

21 **Conclusions:** Associations between childcare type and discretionary beverage intake were  
22 observed. Investigation into knowledge, attitudes and activities in formal and informal  
23 childcare settings is required to explore different health promotion practices that may influence  
24 nutrition and oral health.

## Introduction

A healthy diet during childhood is essential for optimal physical and cognitive growth and development<sup>(1)</sup>, which may reduce risk of many non-communicable diseases including diabetes, obesity, cardiovascular disease, certain cancers and oral disease<sup>(2)</sup>. The Australian Dietary Guidelines recommend that from 12 months of age children consume items daily from the five 'core' food groups: fruit, vegetables and legumes, meat and alternatives, cereals and dairy/alternatives and drink plenty of water<sup>(1)</sup>. Whilst intake of energy-dense and nutrient-poor discretionary items such as soft drink (sodas), cakes and biscuits should be limited<sup>(1)</sup>. Existing research shows a diet containing discretionary food and beverage items at a young age is associated with increased incidence of dental caries<sup>(3,4)</sup>, and obesity<sup>(5)</sup>.

In addition to diet, it is important to establish good oral hygiene habits at a young age to maintain a healthy mouth<sup>(6)</sup>. Despite being largely preventable, early signs of dental caries have been seen in children as young as 6-12 months of age<sup>(7)</sup> and recent data show 26.1% of Australian 5-6 year old children have at least one decayed tooth<sup>(8)</sup>. Early childhood caries can have wide-ranging negative short and long term consequences including pain, difficulty eating, and missing school<sup>(9,10)</sup> and is one of the best predictors of future decay<sup>(11)</sup>.

Children's early years of life are a critical period during which eating habits and food preferences are established<sup>(12,13)</sup> and evidence suggests that dietary patterns developed in these early years track through to adolescence and into adulthood<sup>(14)</sup>. The foods and beverages that children consume during these early years are influenced by a wide range of factors. In the very early years these are primarily influenced by parents and include feeding style, role modelling, food availability and parental beliefs and attitudes<sup>(15,16)</sup>. However, as children grow and spend time in a wider range of settings including childcare, environmental factors including peer and caregiver role modelling, television viewing and food sources (e.g. childcare) influence what they consume<sup>(15)</sup>.

In Australia, young children are cared for in a range of formal (e.g. long day care – centre-based childcare for all or part of the day, family day care – childcare based in the home of a registered childcare provider) and informal (e.g. relatives, friends) settings. Children between one and four years of age have the highest usage rates of childcare in Australia, with around 60% attending some sort of childcare<sup>(17)</sup>. At age three and four years respectively, 55% and 42% of children, attend formal childcare and around 37% attend informal childcare<sup>(17)</sup>.

Children attending formal childcare do so for an average of 15 hours a week, whilst children in informal childcare are there for on average 12 hours a week<sup>(18)</sup>.

The National Quality Framework (NQF; <https://www.acecqa.gov.au/nqf/about>), implemented in 2012, requires formal childcare services in Australia to promote healthy eating, and provide nutritious foods and beverages for children<sup>(19)</sup>. Whilst this is likely to influence oral health through regulating food and beverage consumption, there are no benchmarks that directly target oral hygiene behaviours such as tooth brushing. To meet the NQF benchmarks, many formal childcare services have developed nutrition policies and guidelines. In Australia, the Romp and Chomp Intervention<sup>(20,21,22)</sup> and the Start Right, Eat Right program<sup>(23)</sup> have shown the positive effect of policy and guidelines on the nutrition environment and food consumption in formal childcare settings. However, the extent to which these guidelines are adhered to across all settings is unclear, with recent evidence suggesting that discretionary items are available on a regular basis at childcare centres<sup>(24)</sup>.

In contrast to the regulations in formal childcare settings, there are no requirements to have such structured guidelines in informal childcare. Anecdotal evidence suggests parents may have formal or informal agreements regarding their expectations for their child's nutrition and oral health, with those who provide informal childcare, however there is little evidence for the impact of these on the childcare environment or outcomes for their child.

Most interventions with nutrition outcomes have focused on formal childcare settings or preschools and the role that nutrition plays in obesity<sup>(20,25,26)</sup>. The literature exploring oral health and childcare has primarily focussed on policies and practices in formal childcare settings<sup>(27,28,29)</sup>, rather than oral health outcomes for children. There is some research examining nutrition outcomes for children in different types of childcare. In the United States, data from 10,700 children in the Early Childhood Longitudinal Study showed that a greater time spent in non-relative or centre-based childcare was associated with a lower consumption of soft drinks, and that vegetable consumption was positively associated with time spent in centre-based childcare<sup>(30)</sup>.

Poor oral health can have a profound impact on children's health and quality of life. Behaviours that influence oral health, such as dietary intake, dental visiting and oral hygiene are influenced by the environment children are exposed to. Many preschool children attend some sort of childcare; however, little is known about the relationship between childcare, oral health and dietary intake. The aims of this study were to 1) examine consumption of foods and beverages

and oral health factors when children are aged three and four years old and 2) explore associations between type of childcare and a) food and beverage consumption and b) oral health factors.

## **Methods**

### *Study Design*

#### *The VicGen Birth Cohort study*

The VicGen birth cohort study was established to explore the development of early childhood caries<sup>(31)</sup>. The study was designed to have an emphasis on social disadvantage (e.g. low income, low education), cultural diversity and a mix of locations (metropolitan, regional and rural) and as such participants were recruited from seven local government areas (administrative divisions within a state) in the western corridor of Victoria, Australia. Nurses from the Maternal and Child Health Service in these areas invited families who were attending their newborn's two or four-week health check to participate in the study. Exclusion criteria included: intention to move from the area in the next 12 months, children requiring specialist paediatric childcare, severe illness in family, and presence of parental mental illness. Over a two-year period, 466 newborn infants were recruited into Phase I of the study, and data were collected at child age one, six, twelve and eighteen months (waves 1 to 4). Parents were then asked if they wished to continue in Phase II, involving a further three waves at child age three, four and five years. Each of the seven waves comprised a child oral examination, child saliva sample and a parent completed questionnaire. One oral health professional and one research assistant attended each study visit, with the majority conducted at the participant's home. A small number of study visits were conducted at MCH centres or community halls. A detailed description of the study has been published<sup>(31)</sup>.

Data for the current analysis came from wave five (age three years) and six (age four years), collected between February 2012 and January 2015. These waves contained the information on childcare required for analysis. The VicGen study was a longitudinal cohort, however there were several children for whom data were only available at wave five or wave six. Therefore, to maximise the available N in this paper, data were analysed as two cross-sectional samples.

### *Questionnaire*

A paper-based questionnaire was mailed to the child's primary caregiver (majority mothers) to complete approximately two weeks prior to the study visit for each wave of data collection. Researchers collected the completed questionnaire when they conducted the study visit. In cases where the participant had not completed the questionnaire, they were supplied a reply-paid envelope for return via mail. A food frequency questionnaire, asking capturing the usual weekly consumption of 46 foods and beverages (no time frame specified) known to influence oral health was included in the questionnaire. The questionnaire has been validated for use with children in this age group but did not capture all foods and beverages that children may have consumed. Parents were asked to report how often their child usually consumed 15 core foods (e.g. fruit, vegetables, cereal), 18 discretionary foods (e.g. hot chips, lollies/chocolate, cakes) and 13 beverages (e.g. water, milk, fruit juice). There were eight discrete response options for foods ranging from never to  $\geq 4$  times/day, whilst for beverages, parents were asked to report how often per day or week or month their child consumed the item. The questionnaire also collected information on the parent's rating of their child's oral health (five-point scale: poor to excellent), child tooth brushing frequency; and dentist/dental clinic visit frequency. The type of childcare (none (parent only), family day care, childcare centre, paid babysitter/nanny, grandparent, relative, friend/neighbour, other) that the child had received in the last month was also collected. The number of hours per week spent in each childcare type was collected in wave six only.

### *Data handling and analysis*

The independent variable, type of childcare, was collapsed into four categories: *parent only* (had not used any form of childcare), *formal childcare only* (family day care, childcare centres) *informal childcare only* (paid baby sitter/nanny, grandparents, relatives, friends/neighbours), and *mixed formal/informal* (a combination of the two categories). As the number of hours was only collected at wave six, the duration of time in childcare was not included in both analyses. For children attending informal and formal care, a sensitivity analysis was conducted to examine the potential influence of the proportion of time spent in these types of childcare.

The most commonly consumed foods and beverages were included in the analysis (discretionary foods:  $\geq 19\%$  consuming at least once a week, core foods  $\geq 75\%$  consuming at least once/week (except for meat/fish and bread), beverages:  $\geq 10\%$  reported to consume

beverage). Water was excluded from analysis due to the lack of variation in consumption frequency. Cut off points were determined after examining the spread of responses in the data.

All outcome variables were dichotomised. Foods and beverages were collapsed into the following categories: core items (cheese, yoghurt, banana, fruit, vegetables, plain milk): <once a day,  $\geq$ once day; discretionary items (muesli/fruit bars, ice cream, sweet biscuits, cakes/muffins, lollies/chocolate, potato chips, hot chips, savoury biscuits, fruit juice, cordial, soft drink, flavoured milk): <twice a week,  $\geq$ twice a week. Food and beverage items were collapsed based on the current Australian Dietary Guidelines<sup>(1)</sup> and clinical judgement of a practicing paediatric dietitian (personal communication). Oral health variables were collapsed into the following: brushing frequency:  $\leq$ once/day, >once/day; parent rating of child oral health: poor/fair/good, very good/excellent; child has ever visited a dental clinic: yes/no. Oral health items were collapsed based on current recommendations for best oral health care practice<sup>(32)</sup>.

Descriptive statistics were used to examine the childcare type used at each age. The Chi-square statistic and the Fishers exact test (where cell frequency  $\leq 5$ ) were used to examine associations between the type of childcare and outcome variables at each age. Variables with significant associations were examined using univariable and multivariable logistic regression. Analyses were adjusted for variables which may influence nutrition and oral health, including child age, child gender, family health childcare card status at child age three and four years (a means tested card entitling the holder to certain concessions such as reduced cost medications), and area (metropolitan, regional, rural) in which child was born (collected at baseline). Baseline area was included because accurate residential location was not available when children were three and four years of age. Analyses were conducted using Stata 14 with a significance level of  $p < 0.05$ .

## **Results**

### *Sample characteristics*

Table 1 displays the sample characteristics and the type of childcare used in the previous month at age three and four years. The breakdown of child gender, health care card status and area of residence at birth was similar at each wave. The most common type of childcare at each age was a mixture of formal and informal childcare. Compared to age three years, parent only care

was more common at age four years (14.3% vs 19.3%) and formal only childcare was less common (16.5 vs 29.3%). There were 241 families with valid data at age three and four years and 42.3% of these reported using a different type of childcare at age four compared to age three.

## INSERT TABLE 1

### *Core and discretionary foods and beverages*

Table 2 shows the frequency of consumption of food and beverage items according to childcare type at age three and four years. No significant associations between childcare type and consumption frequency were observed in any of the core foods at either age. For discretionary items after adjusting for covariates, significant associations between childcare type and consumption frequency were observed for ice cream, potato chips (crisps), and flavoured milk (age three years only); fruit juice (age three and four years). Hot chips and soft drink neared significance ( $p = 0.07$  and  $0.06$  respectively), and it was decided to include them in the logistic regression models for further exploration.

At age three years, in adjusted models, children who were in formal childcare or a mixture of informal and formal childcare were less likely to consume fruit juice twice a week or more, compared to children who were in parent only care (FCO Adjusted Odds Ratio: 0.41 95%CI: 0.17, 0.96,  $p=0.04$ ), (F&I AOR: 0.32, 95%CI: 0.14, 0.74,  $p=0.008$ ). Children who were receiving formal childcare only, were 71 % less likely to be consuming ice cream (95%CI: 0.10, 0.83,  $p = 0.02$ ) at least twice a week, than children who were in parent only care (Table 3).

At age four years, in adjusted models, similar trends were seen for two sweet beverages. Children who were receiving formal childcare only or informal childcare only, were less likely to be consuming soft drink (FCO AOR: 0.14, 95%CI: 0.03, 0.7,  $p=0.02$ ; ICO AOR: 0.23, 95%CI: 0.07, 0.74,  $p=0.01$ ) and fruit juice/fruit drink (FCO AOR: 0.35, 95%CI: 0.14, 0.88,  $p=0.01$ ; ICO OR: 0.42, 95%CI: 0.19, 0.94,  $p = 0.03$ ) at least twice per week compared to children in parent only care.

The sensitivity analysis for children who spend time in both formal and informal childcare, showed no significant association between soft drink or fruit juice/drink consumption and the proportion of time children spend in either type of childcare each week.

**INSERT TABLE 2**

**INSERT TABLE 3**

### *Oral Health*

No associations were seen in brushing frequency, oral health rating or dental visiting when comparing childcare types (Table 4). Low rates of optimal tooth brushing were seen across all childcare types at age three and four years, with 51% or less reported to be brushing twice a day. Low rates of dental visiting were also seen with around 45% of children reported to have never been to a dentist or dental clinic by four years of age.

**INSERT TABLE 4**

## Discussion

This research has explored food and beverage consumption and oral health related factors in a cohort of Australian children aged three and four years. It has shown associations between the types of childcare these children experience and the frequency with which they consume particular discretionary foods and beverages. No associations were observed between childcare type and core food consumption, tooth-brushing, dental visiting or parent-reported child oral health status. However, childcare type was significantly associated with consumption of discretionary items, particularly sweet beverages - fruit juice/fruit drink and soft drink, and ice cream across these ages, which are associated with increased risk of dental disease.

In the current study, intake of core foods and beverages such as fruit, vegetables and milk were similar across the different types of childcare. Across all childcare groups, many children consumed fruit and vegetables less than once a day (30 - 51% of children aged 3 years and 19 - 33% of children aged four years). The dietary guidelines recommend children of this age consume 2 ½ to 4 ½ servings of vegetables and 1 to 1½ servings of fruit each day. It is unlikely that children who do not consume these items daily are meeting their recommended intake<sup>(33)</sup>. A substantial proportion of children were consuming discretionary items twice a week or more and the results suggest that many children are consuming multiple discretionary items more than twice a week. The dietary guidelines recommend children aged under eight years avoid discretionary items or restrict consumption to ½ a serving per day<sup>(34)</sup>. The cumulative intake of multiple discretionary items suggests that many children in this study are exceeding these recommendations. Discretionary food consumption can displace core foods, which contain the nutrients and energy children need to develop<sup>(34,35)</sup>. Discretionary foods also tend to be high in salt and sugar and regular provision may encourage children to develop a preference for these flavours<sup>(36)</sup>. There is evidence that children's dietary intake may track across time<sup>(14,37)</sup> and high consumption of discretionary items can lead to excessive energy intake. In the long term this can cause weight gain and increase the risk of diabetes, cardiovascular disease and tooth decay<sup>(38,39)</sup>.

At three years of age, compared with children receiving parent only care, children attending formal childcare only were 59% less likely to be consuming fruit juice/drink and 71% less likely to be consuming ice cream. Children attending a mixture of formal and informal childcare were 68% less likely to be consuming fruit juice/drink. At four years of age, associations were only seen with sweetened beverages – fruit juice/drink and soft drink- with

children attending either formal childcare only or informal childcare only, 58-86% less likely to be consuming these beverages compared with children in parent only care. Although these results were statistically significant, the wide confidence intervals indicate the magnitude of association may be much smaller (as low as 4%) or higher (88%) than observed. Fruit juices and fruit drinks tend to be perceived as healthier than soft drinks<sup>(40)</sup>, despite being similar in terms of energy density, sugar content and the detrimental effect on teeth<sup>(41)</sup>. Although 100% fruit juice may have some beneficial nutrients and are counted as one serve of fruit in the Australian Dietary Guidelines<sup>(1)</sup>, they lack the fibre and are less satiating than a piece of whole fruit<sup>(42,43)</sup>. Additionally, young children innately preference sweet flavours<sup>(36)</sup>, so providing fruit juice and fruit drinks at an early age can encourage them to preference these beverages over water and milk.

There are few published studies comparing dietary intake by type of childcare and those that exist focus on formal childcare settings rather than informal childcare. In Finland and Canada, children in formal childcare were less likely to consume soft drink compared to those not in childcare, but no difference in fruit juice consumption was observed<sup>(44,45)</sup>. This is interesting considering both fruit juice and soft drink were less likely to be consumed by children attending care in the current study. The timing of data collection may provide some explanation for these differences, with data from Canada and Finland collected in the mid-2000's whilst data for VicGen were collected from 2011 onwards. The increased focus on childhood obesity rates in the early to mid-2000s<sup>(46,47)</sup> encouraged the introduction of nutrition policies in many early childhood services<sup>(48)</sup>. Policies tended to promote water and milk as the only beverages offered to children in these settings, whilst discouraging sweet beverages, including fruit juice<sup>(21,49,50)</sup>. Compared the Canadian and Finnish children in these studies, children in the VicGen study may have been more likely to be attending childcare where beverage policy may have been implemented for many years.

In addition to childcare centre policies, in early 2012, the National Quality Framework introduced new quality standards across formal childcare settings in Australia, which included guidelines in relation to the provision of nutritious foods in formal childcare settings<sup>(19)</sup>. Childcare services are assessed on seven quality areas and given a rating, which they must display at their centre. Services must meet a certain standard or be working towards the standard to continue operating. The implementation of this framework commenced around the same time as three-year-old data collection in this study and it is likely that the potential effects of the framework were not immediately seen as services worked towards meeting the

benchmarks. The nutrition component of the NQF is relatively small, and the degree to which services adhere to these guidelines is unclear, with recent research showing discretionary foods are regularly offered at childcare centres<sup>(24)</sup>. This is additionally complicated across family day care services, where childcare providers give childcare out of their own home to a small number of children. The ratio of food provided by the childcare provider to food provided by parents may vary across different family day care services.

The reasons for consumption differences between children attending informal childcare only or a mixture of formal and informal childcare are more difficult to ascertain given the lack of existing evidence about what occurs in informal childcare settings. We theorised that formal childcare policy and guidelines may account for the associations seen with children in a mixture of childcare types. However, a sensitivity analysis was conducted to explore this, at age four years, and there were no associations between the proportion of time children spent in each type of childcare and their consumption of soft drink or fruit juice/drink. This suggests that factors across the formal and informal childcare environment may influence beverage intake for these children. Additionally, the differences seen between informal childcare only and parent only care warrant further exploration. Grandparent care is the most common type of informal childcare used in Australia<sup>(17)</sup> however there is little published evidence about food and beverage consumption in this environment. Traditionally, grandparents have been considered treat-givers and parents tend to report their children are likely to receive unhealthy foods and beverages from grandparents<sup>(51)</sup>. However, emerging research has challenged this with grandparents have reported the healthiness of an item as the main influence on the foods and beverages they provide to their grandchildren<sup>(52)</sup>. Additional evidence suggests that as the amount of time a grandparent cares for their grandchild each week increases, they tend to provide more parent-like care, where unhealthy foods and beverages are limited<sup>(53)</sup>. Further research into grandparent childcare is warranted to explore the provision of foods and beverages in this environment.

The oral health variables used in this study were selected to capture parent reports of overall oral health, dental visiting patterns and oral hygiene behaviours. While no significant relationship was observed between childcare type and any of these variables, this analysis has identified oral practices that fall short of recommendations. To maintain good oral hygiene, teeth should be brushed twice a day<sup>(54)</sup>, however at age three years, only 30-40% of children across all childcare types were brushing their teeth more than once a day, and this increased only slightly by age four years. These results suggest oral health promotion strategies targeted

at families during this time were not eliciting the desired behaviours in this group and reasons for this need to be explored. It is also recommended that children visit a dental professional by the time they are two years old<sup>(54)</sup>. In 2011, all children under 12 year of age were eligible for general dental services through the public system and had priority access<sup>(55)</sup>, however only 18-36% of three year-olds and just over 50% of four year-olds in this sample had visited a dental professional. Some families considered the oral health check they received as part of the VicGen study to be sufficient, as reported anecdotally during study visits. Geographical barriers may have also played a role, given that a large proportion of this cohort resided in rural areas and only two-thirds of those eligible for public dental care in rural areas live within a 20km radius of a public dental clinic<sup>(56)</sup>. The reasons behind not visiting a dental professional are likely to be multi-factored and will be explored in further publications from the VicGen study.

In Victoria, most parents will receive oral health information from the Maternal and Child Health Service at their child's 8, 12 and 18-month health checks. However, there is limited published evidence around the implementation and effectiveness of other oral health promotion strategies in different childcare settings in Victoria. There is evidence around the effectiveness of an outreach program where dental professionals visit preschools and reduce barriers to attending dental services<sup>(57)</sup>, which could theoretically be applied to childcare services. Currently, Smiles 4 Miles<sup>(58)</sup> and the Achievement Program<sup>(59)</sup> are two ongoing programs run state-wide that have a focus on oral health promotion. At the time of data collection however, very few childcare services were participating in Smiles 4 Miles, with the focus on participation of kindergartens. The Achievement Program, whilst targeting childcare services, was in its infancy at this stage, with oral health messaging starting to be incorporated into the program. The potential influences of these programs are unlikely to have had an effect by the time of data collection for the VicGen cohort, but families may be influenced by the structure and expansion of these programs over time.

The results presented must be interpreted in the context of the limitations of this research. The sample includes participants from metropolitan, regional and rural Victoria, but may not necessarily be representative of the broader population. The food frequency questionnaire captures a broad range of core and discretionary foods and beverages, however as it was designed for use in relation to oral health it only measures the frequency with which items are consumed, not the actual amount as no serving size was specified. Also, parents may not always know what their child is consuming if they are not in their care. The care-type measure is also

relatively crude. Parents reported childcare during a typical week over the last month, which may not represent the childcare their child usually receives. Additionally, both measures were parent -reported and thus open to bias compared with more objective measures. There may also be potential differences in the types of informal childcare (e.g. grandparents vs nannies vs friends) that make a difference to these outcomes that are not captured in these data.

## **Conclusion**

The present study demonstrated that, in three and four-year-old children, attending childcare is associated with less frequent consumption of soft drinks and fruit juice/drink, but not associated with the consumption of core foods or most discretionary foods. Childcare was not associated with the oral health and hygiene indicators; overall however, many children were not brushing their teeth twice daily and had not yet seen a dental professional, both of which are recommended for good oral health. Further investigation of healthy eating and oral health in the childcare environment is needed, particularly in informal childcare. There is little understanding of what and how different factors in the informal care environment help or hinder the promotion of healthy eating and good oral health and hygiene. Gaining insight into this environment will help to ascertain which strategies may be transferable to other childcare settings, **and potentially parent-only care**, as well as identifying areas where care providers may require additional support. **Further research with families who do not use childcare is also warranted, to explore the reasons for more frequent consumption of some discretionary items by children in this environment. Understanding factors unique to this context will help identify if and how existing child nutrition and oral health messages reach families, and the barriers and enablers to promote healthy behaviours in parent-only care.**

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Table 1 Sample characteristics of VicGen participants at age three and four years

	Age 3 years N=273	Age 4 years N=249
Child age, mean [sd] years	3.3 [0.2]	4.1 [0.2]
Child sex, n (%)		
<i>Female</i>	129 (47.3)	117 (47.0)
<i>Male</i>	144 (52.7)	132 (53.0)
Health Care Card, n (%)		
<i>Yes</i>	65 (23.8)	59 (23.7)
<i>No</i>	207 (75.8)	188 (75.5)
<i>Missing</i>	1 (0.4)	2 (0.8)
Area <sup>1</sup> , n (%)		
<i>Metro</i>	158 (57.9)	142 (57.0)
<i>Regional</i>	44 (16.2)	41 (16.5)
<i>Rural</i>	71 (26.0)	66 (26.5)
<i>Missing</i>	- -	- -
Childcare type <sup>2</sup> , n (%)		
<i>Parent only</i>	39 (14.3)	48 (19.3)
<i>Formal only</i>	80 (29.3)	41 (16.5)
<i>Informal only</i>	58 (21.3)	65 (26.1)
<i>Informal and formal</i>	95 (34.8)	92 (37.0)
<i>Missing</i>	1 (0.4)	3 (1.2)

<sup>1</sup>Area child was born; <sup>2</sup>31 children had valid data at age 3 years but not age four years, five children had valid data at age four years but not age three years.

Table 2. Food and beverage consumption frequency by childcare type at age three and four years of the VicGen cohort.

Core foods and beverages, n (%)	Age 3 years (N=272 <sup>1</sup> )			Age 4 years (N=246 <sup>1</sup> )		
	<once/day	≥once/day	p <sup>2</sup>	<once/day	≥once/day	p <sup>2</sup>
<b>Cheese</b>						
Parent only	24 (61.5)	15 (38.5)	0.12	33 (68.8)	14 (29.2)	0.65
Formal only	63 (78.8)	16 (20.3)		32 (78.1)	8 (19.5)	
Informal only	41 (70.7)	15 (25.9)		46 (70.8)	19 (29.2)	
Formal and informal	63 (66.3)	32 (33.7)		70 (76.1)	22 (23.9)	
<b>Yoghurt</b>						
Parent only	29 (74.4)	9 (23.8)	0.33	34 (70.8)	13 (27.1)	0.61
Formal only	59 (73.8)	19 (23.8)		32 (78.1)	8 (20.0)	
Informal only	44 (75.9)	14 (24.1)		52 (80.0)	13 (20.0)	
Formal and informal	62 (65.3)	33 (34.7)		66 (71.7)	25 (27.2)	
<b>Banana<sup>5</sup></b>						
Parent only	31 (79.5)	8 (20.5)	0.52	- -	- -	
Formal only	70 (87.5)	9 (11.3)		- -	- -	
Informal only	47 (81.0)	11 (19.0)		- -	- -	
Formal and informal	76 (80.0)	16 (16.8)		- -	- -	
<b>Fruit<sup>4</sup></b>						
Parent only	19 (48.7)	19 (48.7)	0.09	15 (31.3)	32 (66.7)	0.48
Formal only	24 (30.0)	54 (67.5)		7 (17.1)	33 (80.5)	
Informal only	23 (39.7)	35 (60.3)		16 (24.6)	48 (73.9)	
Formal and informal	27 (28.4)	66 (69.5)		22 (23.9)	70 (76.1)	
<b>Vegetables (not potato)</b>						
Parent only	22 (56.4)	17 (43.6)	0.38	21 (43.8)	27 (56.3)	0.95
Formal only	34 (42.5)	45 (56.3)		17 (41.5)	23 (56.1)	
Informal only	31 (53.5)	27 (46.6)		27 (41.5)	38 (58.5)	
Formal and informal	42 (44.2)	53 (55.8)		42 (45.7)	49 (53.3)	
<b>Plain milk</b>						
Parent only	4 (10.3)	35 (89.7)	0.87	7 (14.6)	41 (85.4)	0.49
Formal only	13 (16.3)	66 (82.5)		3 (7.3)	37 (90.2)	
Informal only	8 (13.8)	49 (85.5)		8 (12.3)	56 (86.2)	
Formal and informal	14 (14.7)	80 (84.2)		16 (17.4)	74 (80.4)	
<b>Discretionary foods and beverages, n (%)</b>						
	≥twice/week	<twice/week	p	≥twice/week	<twice/week	p
<b>Muesli bars/fruit sticks/roll-ups</b>						
Parent only	10 (25.6)	28 (71.8)	0.44	9 (18.8)	36 (75.0)	0.63
Formal only	12 (15.0)	66 (82.5)		8 (19.5)	29 (70.7)	

Core foods and beverages, n (%)	Age 3 years (N=272 <sup>1</sup> )			Age 4 years (N=246 <sup>1</sup> )		
	<once/day	≥once/day	p <sup>2</sup>	<once/day	≥once/day	p <sup>2</sup>
Informal only	13 (22.4)	44 (75.9)		19 (29.2)	45 (69.2)	
Formal and informal	23 (24.2)	72 (75.8)		25 (27.2)	67 (72.8)	
<b>Ice Cream</b>						
Parent only	11 (28.2)	28 (71.8)	<b>0.009</b>	18 (37.5)	27 (56.3)	0.13
Formal only	9 (11.3)	70 (87.5)		8 (19.5)	32 (78.1)	
Informal only	19 (32.8)	39 (67.2)		24 (36.9)	41 (63.1)	
Formal and informal	16 (16.8)	79 (83.2)		25 (27.2)	67 (72.8)	
<b>Sweet biscuits</b>						
Parent only	15 (38.5)	22 (56.4)	0.96	21 (43.8)	25 (52.1)	0.50
Formal only	35 (43.8)	43 (53.8)		23 (56.1)	17 (41.5)	
Informal only	25 (43.1)	33 (56.9)		27 (41.5)	37 (56.9)	
Formal and informal	43 (45.3)	52 (54.7)		43 (46.7)	48 (52.2)	
<b>Cakes/muffins</b>						
Neither care type	9 (23.1)	30 (76.9)	0.86	10 (20.8)	37 (77.1)	0.97
Formal only	17 (21.3)	60 (75.0)		10 (24.4)	29 (70.7)	
Informal only	15 (25.9)	42 (72.4)		16 (24.6)	49 (75.4)	
Formal and informal	26 (27.4)	69 (72.6)		21 (22.8)	69 (75.0)	
<b>Lollies/chocolates</b>						
Parent only	20 (51.3)	19 (48.7)	0.80	21 (43.8)	26 (54.2)	0.62
Formal only	33 (41.3)	45 (56.3)		14 (34.2)	26 (63.4)	
Informal only	28 (48.3)	30 (51.7)		31 (47.7)	34 (52.3)	
Formal and informal	43 (45.3)	52 (54.7)		38 (41.3)	54 (58.7)	
<b>Potato chips /twisties/cheezels</b>						
Parent only	15 (38.5)	23 (59.0)	<b>0.02</b>	8 (16.7)	39 (81.3)	0.48
Formal only	20 (25.0)	58 (72.5)		9 (22.0)	30 (73.2)	
Informal only	11 (19.0)	47 (81.0)		9 (13.9)	56 (86.2)	
Formal and informal	15 (15.8)	80 (84.2)		21 (22.8)	71 (77.2)	
<b>Hot chips</b>						
Parent only	13 (33.3)	26 (66.7)	0.07	6 (12.5)	41 (85.4)	0.12
Formal only	12 (15.0)	66 (82.5)		6 (14.6)	33 (80.5)	
Informal only	10 (17.2)	48 (82.8)		16 (24.6)	49 (75.4)	
Formal and informal	14 (14.7)	81 (85.3)		10 (10.9)	82 (89.1)	
<b>Savoury biscuits</b>						
Parent only	30 (76.9)	9 (23.1)	0.55	34 (72.3)	13 (27.7)	0.20
Formal only	67 (85.9)	11 (14.1)		36 (90.0)	4 (10.0)	
Informal only	44 (80.0)	11 (20.0)		52 (80.0)	13 (20.0)	
Formal and informal	73 (78.5)	20 (21.5)		76 (82.6)	16 (17.4)	

Core foods and beverages, n (%)	Age 3 years (N=272 <sup>1</sup> )			Age 4 years (N=246 <sup>1</sup> )		
	<once/day	≥once/day	p <sup>2</sup>	<once/day	≥once/day	p <sup>2</sup>
Fruit juice/Fruit drink						
Parent only	28 (71.8)	11 (28.2)	<b>0.05</b>	29 (60.4)	19 (39.6)	<b>0.04</b>
Formal only	40 (50.0)	38 (47.5)		14 (34.2)	26 (63.4)	
Informal only	32 (55.2)	25 (43.1)		25 (38.5)	38 (58.5)	
Formal and informal	43 (45.3)	51 (53.7)		48 (52.2)	43 (46.7)	
Cordial <sup>3</sup>						
Parent only	7 (18.0)	31 (79.5)	0.52	9 (18.8)	37 (77.1)	0.44
Formal only	8 (10.0)	70 (87.5)		4 (9.8)	36 (87.8)	
Informal only	7 (12.1)	49 (84.5)		14 (21.5)	48 (73.9)	
Formal and informal	16 (16.8)	78 (82.1)		16 (17.4)	75 (81.5)	
Soft drink						
Parent only	10 (25.6)	29 (74.4)	0.23	13 (27.1)	35 (72.9)	0.06
Formal only	12 (15.0)	67 (83.8)		4 (9.8)	36 (87.8)	
Informal only	8 (13.8)	50 (86.2)		6 (9.2)	58 (89.2)	
Formal and informal	11 (11.6)	83 (87.4)		17 (18.5)	74 (80.4)	
Flavoured Milk						
Parent only	6 (15.4)	33 (84.6)	<b>0.021</b>	10 (20.8)	38 (79.2)	0.59
Formal only	19 (23.8)	59 (73.8)		10 (24.4)	31 (75.6)	
Informal only	22 (37.9)	36 (62.1)		19 (29.2)	45 (69.2)	
Formal and informal	17 (17.9)	78 (82.1)		28 (30.4)	63 (68.5)	

<sup>1</sup>N varies due to missing values; <sup>2</sup>Chi-squared value or Fishers exact (where frequency ≤5); <sup>3</sup>Syrup mixed with water; <sup>4</sup>Age 3: fresh fruit, excluding banana; Wave six: Fresh or stewed fruit, <sup>5</sup>Banana was included as a separate item in the three-year-old questionnaire, but not in the four-year-old questionnaire.

Table 3. Univariable and multivariable logistic regression for the indicator variable against each food and beverage outcome

	Univariable				Multivariable <sup>1</sup>			
	n	OR	95%CI	p	n	OR	95%CI	p
<b>Age 3 years</b>								
Flavoured milk	270				262			
Parent only		Ref				Ref		
Formal only		1.77	[0.64, 4.87]	0.27		1.68	[0.59, 4.80]	0.33
Informal only		3.36	[1.21, 9.31]	<b>0.02</b>		2.44	[0.84, 7.04]	0.10
Formal and informal		1.19	[0.43, 3.31]	0.73		0.80	[0.27, 2.33]	0.68
Fruit juice/fruit drink	268				260			
Parent only		Ref				Ref		
Formal only		0.41	[0.18, 0.95]	<b>0.04</b>		0.41	[0.17, 0.96]	<b>0.04</b>
Informal only		0.50	[0.21, 1.20]	0.12		0.51	[0.21, 1.27]	0.15
Formal and informal		0.33	[0.15, 0.74]	<b>0.007</b>		0.32	[0.14, 0.74]	<b>0.008</b>
Ice Cream	271				262			
Parent only		Ref				Ref		
Formal only		0.33	[0.12, 0.88]	<b>0.03</b>		0.29	[0.10, 0.83]	<b>0.02</b>
Informal only		1.24	[0.51, 3.01]	0.63		1.04	[0.40, 2.69]	0.94
Formal and informal		0.52	[0.21, 1.24]	0.14		0.45	[0.17, 1.17]	0.10
Potato chips/ twisties/cheezels	269				260			
Parent only		Ref				Ref		
Formal only		0.53	[0.23, 1.21]	0.13		0.72	[0.30, 1.72]	0.46
Informal only		0.36	[0.14, 0.90]	<b>0.03</b>		0.52	[0.19, 1.38]	0.19
Formal and informal		0.29	[0.12, 0.67]	<b>0.004</b>		0.43	[0.17, 1.09]	0.07
Hot chips	270				261			
Parent only		Ref				Ref		
Formal only		0.36	[0.15, 0.90]	<b>0.03</b>		0.46	[0.18, 1.18]	0.11
Informal only		0.42	[0.16, 1.08]	0.07		0.60	[0.22, 1.64]	0.32
Formal and informal		0.35	[0.14, 0.83]	<b>0.02</b>		0.53	[0.21, 1.35]	0.18
<b>Age 4 years</b>								
Soft drink	243				227			
Parent only		Ref				Ref		
Formal only		0.30	[0.09, 1.01]	0.05		0.14	[0.03, 0.76]	<b>0.02</b>
Informal only		0.28	[0.10, 0.80]	<b>0.02</b>		0.23	[0.07, 0.74]	<b>0.01</b>
Formal and informal		0.62	[0.27, 1.41]	0.26		0.64	[0.27, 1.54]	0.32
Fruit juice/fruit drink	242				226			
Parent only		Ref				Ref		
Formal only		0.35	[0.15, 0.84]	<b>0.02</b>		0.35	[0.14, 0.88]	<b>0.03</b>
Informal only		0.43	[0.20, 0.93]	<b>0.03</b>		0.42	[0.19, 0.94]	<b>0.03</b>
Formal and informal		0.73	[0.36, 1.49]	0.39		0.89	[0.43, 1.84]	0.75

<sup>1</sup>Models adjusted for child age, child gender, health care card (yes/no) and area.

**Table 4.** Distribution of oral health measures by childcare type at age three and four years of the VicGen cohort.

	Age three years (N=272) <sup>1</sup>			Age 4 years (N=246) <sup>1</sup>		
	≤once/day	>once/day	p <sup>2</sup>	≤once/day	>once/day	p <sup>2</sup>
<b>Brushing frequency, n (%)</b>						
Parent only	25 (64.1)	14 (35.9)	0.62	28 (58.3)	20 (41.7)	0.29
Formal only	48 (60.0)	31 (38.8)		26 (63.4)	14 (34.2)	
Informal only	37 (63.8)	21 (36.2)		32 (49.2)	33 (50.8)	
Formal and informal	66 (69.5)	28 (29.5)		58 (63.0)	34 (37.0)	
<b>Parent rating of child's oral health, n (%)</b>	<b>Poor/Fair/Good</b>	<b>Very good/Excellent</b>	<b>p<sup>2</sup></b>	<b>Poor/Fair/Good</b>	<b>Very good/Excellent</b>	<b>p<sup>2</sup></b>
Parent only	16 (41.0)	22 (56.4)	0.99	14 (29.2)	34 (70.8)	0.76
Formal only	33 (41.3)	47 (58.8)		15 (36.6)	26 (63.4)	
Informal only	25 (43.1)	33 (56.9)		19 (29.2)	46 (70.8)	
Formal and informal	41 (43.2)	54 (56.8)		32 (34.8)	59 (64.1)	
<b>Child has ever been to dentist/dental clinic, n (%)</b>	<b>Yes</b>	<b>No</b>	<b>p<sup>2</sup></b>	<b>Yes</b>	<b>No</b>	<b>p<sup>2</sup></b>
Parent only	7 (18.0)	31 (79.5)	0.17	26 (54.2)	22 (45.8)	0.95
Formal only	25 (31.3)	54 (67.5)		22 (53.7)	19 (46.3)	
Informal only	14 (24.1)	44 (75.9)		32 (49.2)	33 (50.8)	
Formal and informal	34 (35.8)	61 (64.2)		49 (53.3)	43 (46.7)	

<sup>1</sup> N varies due to missing values, <sup>2</sup>Chi-squared or Fishers exact (where frequency ≤5), without missing values