Tracking food consumption frequency of children from age 4 to 6 years: the Pacific Islands Families study

Fa’asisila Savila, Victor Obolonkin, Elaine Rush

ABSTRACT

AIM: To report longitudinal food frequency consumption and evaluate tracking of food frequency among a cohort of New Zealand-born Pacific children.

OBJECTIVE: Identify the most commonly consumed foods and estimate tracking among Pacific children aged 4 and 6 years.

METHOD: A qualitative food frequency questionnaire was administered to n>1,000 caregivers of children aged 4 and 6 years. Consumption scores were developed from averaged frequency of daily food. Foods and food groups were examined for tracking.

RESULTS: Caregivers completed questionnaires for 646 children at both ages. Twelve most frequently consumed foods were identified, accounting for up to 25% of all food consumed daily. Across ages 4 and 6, the association for frequency of the most frequently consumed foods was moderate ($r^2=0.53$). Food groups: breads and cereals; meat and alternates; and vegetables and fruit constituted approximately 72% of all foods consumed daily. The association of frequency of consumption within food groups across the two measurement periods was strong ($r^2=0.96$).

CONCLUSIONS: Pacific children consume similar foods that track from age 4 through age 6 years.

Optimal maternal and early childhood food contributes to healthy cognitive and physiological growth of the child. On the other hand, poor diet can lead to rapid growth and chronic disease, and behaviours like skipping breakfast can impact negatively on cognitive function. Of particular concern is the growing prevalence of childhood obesity, attributed to an environment that supports inactivity and the consumption of nutrient-poor and energy-dense foods.

Maternal feeding styles determine infant dietary patterns during a time when food and taste preferences are developing. Furthermore, studies have documented the tracking (or stability) of children’s food patterns throughout childhood and into adulthood. Using principal components analysis, Northstone and Emmett (2008) observed three predominant food patterns over four ages—3, 4, 7 and 9 years: processed (high fat and sugar content, processed and convenience foods); traditional (meat, poultry, potato and vegetables); and health conscious (salads, vegetables, fish, pasta and rice). Foods in the traditional pattern loaded highly from age 4 to 9 years, yet foods in the processed pattern loaded highly at every age. Overall, the literature provides good evidence for the tracking of childhood food patterns for predominantly Anglo-Saxon cohorts, but less attention has been paid to other ethnic groups.

Because food beliefs and behaviours are structured within cultural contexts defined by ethnicity, ethnic group research can highlight distinct socio-cultural food and diet patterns not captured in general surveys. Furthermore, ethnic-specific knowledge can inform public health...
strategies to improve the health status of all ethnic groups equitably. Early research of Tokelauan (Polynesian) children and adults, both in the islands and New Zealand, highlighted significant changes in food choices due to migration and number of years lived in New Zealand. Traditional island food staples of coconut, fish, taro and breadfruit were replaced with bread, cereals and meat, having a marked impact on nutritive and energy intakes. An increased variety of food choices compared with island foods was another important change. Poor access and cost of imported island foods in New Zealand were the main environmental determinants of the nutritional change.

More recent studies have found marked relationships between body mass index and specific behaviours, such as breakfast eating and purchasing of school food from dairy and takeaway stores among Pacific children (5–14 years) in particular. However, longitudinal food patterns for children of Pacific ethnicity have never been reported and this paper is an effort to address this lack in research.

Relationships between food frequency and body composition at age 4 years and growth from age 6 weeks to 4 years among children from the Pacific Islands Families (PIF) study, have been reported previously. At age 4 years, bread (1.32 times/day), milk (0.86), breakfast cereal (0.83) and apples or pears (0.83) were the four most frequently consumed foods. A majority of children drank standard (full-fat) milk (85%), ate white bread only (77%) and a small proportion rarely consumed milk at all (7%). The New Zealand Food and Nutrition Guidelines for healthy children and young people (2–18 years) recommended daily fruit consumption was achieved by 60% of children, but by only 35% for vegetable consumption. Only 5% reported eating traditional Pacific foods, such as taro and green banana, similar to the pattern seen in the earlier studies of Tokelauan migrants. This nutrition transition may be a contributing factor in the objectively measured rapid growth and high prevalence of overweight (70%) in this cohort at age 10 years.

The aim of this investigation was to report food frequency information of New Zealand-born Pacific children aged 4 and 6 years from the aforementioned PIF study. The objectives were to identify the foods being consumed before attending school (age 4 years) and one year after starting school (age 6 years) and to estimate tracking of consumption of food combinations. We hypothesised that consumption of similar foods would track and that, based on a high prevalence of overweight, a high frequency of energy dense foods (high in fat and/or refined carbohydrates) would persist across the two measurement periods (ages 4 and 6 years).

Materials and methods

Detailed descriptions of the birth cohort are presented elsewhere. Briefly, in 2000, 1,398 full-term babies (22 pairs of twins) were recruited via their mothers (n=1,376) at birth for the PIF study. A child was eligible if they were full-term and at least one of the birth parents identified with a Pacific Island ethnicity. At baseline, the child cohort represented between a quarter and one-third of all eligible children born in the South Auckland region in 2000. In 2013, over one-third (36.3%) of the total New Zealand Pacific resident population were in the local community board areas of South Auckland. The four main usually resident Pacific ethnic groups in New Zealand—Samoan, Tongan, Niuean and Cook Island Māori—were broadly represented in the original child cohort.

Families were first visited when the children were 6 weeks old, with follow-ups at ages 1, 2, 4, and 6 years. At the age 4 and 6 year assessments, 1,048 and 1,001 caregivers (representing 1,066 and 1,019 children respectively) were given a qualitative 111 item food frequency questionnaire (FFQ) used in the 2002/03 Children’s Nutrition Survey. (Three subsequent follow-ups have occurred since the 6 years assessment, but are not relevant to this investigation, as food frequency data was not collected).

The FFQ prompted caregivers to account the frequency of eating 111 food items “over the last 4 weeks” for their child. Possible responses were: “Never or less than once a month”; “1 to 3 times a month”; “1 to 2 times
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Table 1: Weighting chart. Food frequency and weighting factor used to standardise to daily consumption.21

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never or less than once a month</td>
<td>0.005</td>
</tr>
<tr>
<td>1 to 3 times a month</td>
<td>0.066667</td>
</tr>
<tr>
<td>1 to 2 times a week</td>
<td>0.214286</td>
</tr>
<tr>
<td>3 to 4 times a week</td>
<td>0.5</td>
</tr>
<tr>
<td>5 to 6 times a week</td>
<td>0.785714</td>
</tr>
<tr>
<td>Once a day</td>
<td>1</td>
</tr>
<tr>
<td>2 or more times a day</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2: Food groups. Classification of the 111 foods in the food frequency questionnaire by group and major nutrient, according to nutrient and energy density.

<table>
<thead>
<tr>
<th>Class</th>
<th>Total</th>
<th>Higher nutrient, lower energy</th>
<th>Lower nutrient, higher energy</th>
<th>Example of Lower nutrient, higher energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit and vegetable</td>
<td>27</td>
<td>26</td>
<td>1</td>
<td>Tomato sauce</td>
</tr>
<tr>
<td>Meat &amp; alternates</td>
<td>27</td>
<td>18</td>
<td>9</td>
<td>Sausage roll</td>
</tr>
<tr>
<td>Dairy</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td>Cheese</td>
</tr>
<tr>
<td>Fat</td>
<td>8</td>
<td>1</td>
<td>7</td>
<td>Mayonnaise</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>40</td>
<td>11</td>
<td>29</td>
<td>Biscuits</td>
</tr>
</tbody>
</table>

Results

Of the total child cohort (n=1,398), the caregivers of 1,066 (age 4 years) and 1,019 (age 6 years) children were located and asked to complete the FFQ. From these caregivers, 907 and 801 FFQ were returned, corresponding to response rates of 64.9% and 57.3% at age 4 and 6 years respectively (Table 3). The caregivers of 646 children (327 female, 319 male) returned FFQ at both age bands and the results presented here are based on these FFQ. Analyses were confined to these FFQ so that individual (child) foods could be tracked reliably from one measurement period to the next. Probability values for bias in the distribution of respondents versus non-respondents using Chi-squared tests suggested no significant differences (p>0.05) between the two groups at any stage. This indicated that our sample was representative of our original baseline cohort. Due to the high number of variables (foods), our sample was too small to carry out analyses representative of the Pacific ethnic groups.
Table 3: Gender of children whose parents participated at age 4 and 6 years

<table>
<thead>
<tr>
<th>Participation at age 4 years</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No</td>
<td>%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>x&lt;sup&gt;2&lt;/sup&gt; p value</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>444</td>
<td>65.2%</td>
<td>237</td>
<td>34.8%</td>
<td>0.81</td>
</tr>
<tr>
<td>Male</td>
<td>463</td>
<td>64.5%</td>
<td>254</td>
<td>35.4%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>907</td>
<td>64.9%</td>
<td>491</td>
<td>35.1%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participation at age 6 years</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>No</td>
<td>%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>x&lt;sup&gt;2&lt;/sup&gt; p value</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>397</td>
<td>58.3%</td>
<td>284</td>
<td>41.7%</td>
<td>0.46</td>
</tr>
<tr>
<td>Male</td>
<td>404</td>
<td>56.3%</td>
<td>313</td>
<td>43.7%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>801</td>
<td>57.3%</td>
<td>597</td>
<td>42.7%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participation at both age 4 and 6 years&lt;sup&gt;b&lt;/sup&gt;</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>327</td>
<td>48.0%</td>
<td>354</td>
<td>52.0%</td>
<td>0.19</td>
</tr>
<tr>
<td>Male</td>
<td>319</td>
<td>44.5%</td>
<td>398</td>
<td>55.5%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>646</td>
<td>46.2%</td>
<td>752</td>
<td>53.8%</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Row percent
<sup>b</sup> FFQ returned for the same children at both measurement periods

Figure 1: Association of average consumption per day of the top 12 most frequently consumed foods from age 4 to 6 years
Frequency of foods

Across both measurements, 12 most frequently consumed foods (the top 12 foods) were identified, with bread, breakfast cereal and rice representing the top three most frequently eaten foods (Figure 1). The top 12 foods accounted for up to 25% of all food consumed on average per day. Overall, frequency of consumption of the top 12 foods remained moderately stable ($r^2=0.53$) across the two measurement periods.

Of the top 12 foods, the average frequency of eating bread and rice was the least likely to have changed, both remaining close to equilibrium across the two measurement periods. On average, breakfast cereal was the only food to have increased from 0.8 to 1.0 per day by age 6. Overall, the eating frequency of the remaining nine of the top 12 foods decreased. For example, milk and fruit (apples and pears, oranges and mandarins, bananas) decreased substantially from 0.9 and 0.8 respectively at age 4 to 0.3 times per day at age 6.

At ages 4 and 6, chicken was the only meat item identified in the 12 most frequently consumed foods. Snack foods, such as crisps and noodles (eg, 2 minute Noodles), remained popular. Food drinks (eg, Milo™) and powdered fruit drinks (eg, Raro™), which have sugar as a major component, were also frequently consumed foods at both ages.

Frequency of food groups

From age 4 to age 6 years, the average daily consumption of food groups, was very stable ($r^2=0.96$) (Figure 2). The food group cereals and breads (26.5%) comprised the largest percentage of daily food portions across both measurement periods. Around one fifth of daily portions consisted of the meat and alternates (meats) food group, and a quarter consisted of the vegetables (~15%) and fruit (~10%) food groups.

Discussion

For the first time, our investigation has provided a longitudinal account of food frequency patterns for a cohort of children of Pacific ethnicity. Our objectives were to investigate the reported food frequency data of these children, to identify common foods and assess whether consumption patterns (similar foods) tracked.

We found that for both age bands, 12 food items represented the most frequently consumed foods comprising a quarter (25%) of food eaten every day. Across the cohort, the consumption frequency of these foods remained moderately stable ($r^2=0.53$). Further, in separate analyses (not shown), we found that within individuals, the 12 most frequently consumed foods tracked highly and the association across the age bands was strong ($r=0.72$; $p<0.001$).

Reported daily frequency of consumption in nine of the top 12 foods decreased.
Rice and bread remained stable, and only breakfast cereal increased. Overall, consumption within food groups tracked strongly ($r^2 = 0.96$), cereals, breads and meats comprising nearly half of all daily food, followed by vegetables and fruit making a further quarter.

Based on a high prevalence (80%) of overweight and rapid growth among this cohort, we hypothesised an energy dense food pattern consistent with a high frequency of refined carbohydrates, fats and meats. Higher energy refined carbohydrates constituted around a quarter (26.1%; $n=29$) of all food in the FFQ where cereals and breads contributed to a quarter of all daily food. Bread was the single largest contributor of energy intake for all New Zealand children, reflected as the most frequently consumed food item in this investigation. Persistent consumption of white bread (85.5% at 6 years), rice and snacks across both age bands supports our hypothesis of an energy dense food pattern by way of refined carbohydrates.

In terms of the fats food group, daily intake was low (~2%) with higher energy fat foods comprising only 6.3% ($n=7$) of FFQ items. As a result, this food group alone was not likely to contribute significantly to an energy dense food pattern. However, dietary fat may be derived from eating meats, dairy and ready-made foods, such as fried potatoes (crisps or hot chips), contributing some fat as energy intake. One-third of meats (9/27) and dairy (3/9) foods were classified as lower-nutrient/higher-energy foods, equivalent to 10.8% of all FFQ items. Meats constituted one-fifth of all daily food consumed at age 6. In separate analyses of the economic living standard index with the cohort, 41% of respondents reported buying cheaper cuts of meat with a higher fat content “a lot” to keep food costs down. Dairy foods made up around 9% of daily food by age six and the overwhelming milk of choice (91.2%) was the standard full-fat variety. Fat, dairy and meats constituted on average 30% of all food consumed daily, lending further support to our hypothesis of an energy dense food pattern via derived total fat intake.

A positive finding in our study may be the increased frequency of breakfast cereal consumption over the two measurement periods. In the Children's Nutrition Survey (CNS2002/03), breakfast consumption was shown to have a significant association with better nutrient intakes compared with non-breakfast consumption, yet Pacific children who consumed breakfast also had higher energy and carbohydrate intakes. Compared with other ethnic groups, Pacific children had the lowest levels of breakfast consumption and lack of breakfast was associated with a higher BMI. However, breakfast consumption was also negatively correlated with socioeconomic deprivation and age, such that older children (11–14 years) living in the most deprived circumstances were less likely compared with younger (5–6 years), less deprived children to consume breakfast. As most Pacific people live with high deprivation, the reported increase in the frequency of breakfast consumption in the latter age group is inconsistent with prior research.

However, our findings are consistent with current evidence of dietary patterns in studies comprising of predominantly Anglo-Saxon children, which point to a tendency for food patterns to track through childhood. In addition, the information gleaned from our investigation provides valuable knowledge about maternal/family feeding practices and prompts further questions around environmental factors that might contribute to food availability.

**Strengths and limitations**

One of the main strengths of this study is the longitudinal nature of the data, allowing identification of the most frequently consumed foods from age 4 to 6 years—a critical transition time from pre-school to after the first year at school. Regular measurement of consumption is necessary for reliable assessments of food patterns, since dietary habits are dynamic and shaped by environmental features including the growth of commercially-manufactured foods. Lastly, longitudinal dietary patterns provide valuable indicators of nutrition related chronic illnesses (eg, obesity and diabetes) throughout the life-course.

Another strength of our study is the comparatively high response rate, especially for an ethnic group characteristically known as “hard to reach”.
studies are challenged by natural attrition, resulting in missing participants, due to loss at follow-up. Missing participants include: families who have requested withdrawal; relocated from study location; become ineligible (eg, reported deceased); or excluded from analysis (eg, twin siblings). We report unconditional response rates where the denominator is based on the original sample of 1,398, yielding response rates of 64.9% and 57.3% (age 4 and age 6, respectively). Conditional response rates—where the denominator is based on number of participants contacted at follow-up (n=1,066; n=1,019)—were much higher, corresponding to 85.1% (n=907) and 78.6% (n=801) at age 4 and 6, respectively.

A limitation of our study is that despite some evidence of a high intake of energy dense foods, this study does not prove an association with obesity. We did not carry out a case-control study and neither was food frequency linked with weight status. Studies of this nature are anticipated in ongoing research within the cohort.

As with many nutrition surveys, another limitation of this study is that children’s food patterns were reported by proxy, via parents or caregivers. In this study, 98% (4 years) and 96% (6 years) of respondents were mothers. Although FFQ have good validity and reliability for measuring children’s food intake through parental reporting, parents have limited knowledge of food consumed outside of the home. Nevertheless, most foods eaten by children in this age group are obtained from within the home and any food consumed beyond the home setting would be minimal.

Our results show a reduction in nine of the top 12 foods by age 6, suggesting at least two contributing factors. Firstly, as children age, food frequency may be further dispersed across foods other than those most commonly consumed at age 4. However, there was no evidence of increases in consumption of all other foods and correlation coefficients show strong tracking of frequency of all food groups.

Secondly, regardless of frequency, increases in portion size of the more staple foods, such as bread, may be under-reported. The inability to accurately measure portion size is a well-known limitation of FFQs and respondents of FFQs are more likely to under-report overall food intake, whereas individual food items are subject to over-reporting.

Another potential limitation of this study is the age of the FFQ and data. Parental and children’s food options and choices may have changed since the time these data were collected. Therefore, these findings may not be representative of the foods that Pacific children consume currently. However, this is difficult to ascertain due to a lack of comprehensive surveys of children’s food intake since CNS2002/03. The current Food and Nutrition Guidelines for Children and Young People is based on CNS2002/03 which, as stated earlier, used the same FFQ as this study. Indeed, the surveys discussed here are the most recent large-scale food surveys for Pacific children in New Zealand.

Finally, we made no adjustments for potential seasonal variations in food availability, socioeconomic and demographic variables. Both surveys (4 and 6 years) were carried out over a period of 18 months, meaning that any variation in seasonal foods should have been partially compensated. Additionally, food storage, hot-house technology and importing allows for year-round availability of most fruit and vegetables, though imported and off-season foods can be more costly. Adjustments for socioeconomic status were not prioritised because the data were skewed at the lower end of the socioeconomic strata. At baseline, only a quarter (27%) of mothers had post-school qualifications and most households (92%) had incomes lower than NZ$50,000 per annum. In terms of demographic variables, there were no significant differences when adjusting for gender or ethnicity. However, more pertinent was establishing—for Pacific children—overall preschool food patterns and how well these foods and food groups tracked overtime. These factors are important for helping to explain the high prevalence of overweight and obesity across the cohort regardless of gender or ethnicity.

**Conclusion**

Our study showed that, for Pacific children living in New Zealand, from pre-school (age 4 years) to the second year of school (age 6 years), food choices and
frequency remained relatively consistent. Cross-sectionally and longitudinally, the same proportion of foods from each food group was consumed, where 12 foods accounted for one quarter of all food consumed daily.

For Pacific children, the high intake of low fibre/nutrient content of the most frequently eaten white bread and rice, noodles and crisps, are what advocates and policy makers should address at this critical period of growth.


16. Kumanyika SK. Environmental influences on childhood obesity: ethnic and cultural influences in context. Physiol Behav. 2008 Apr 22;94(1):61-70


