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Dietary intake of Indigenous Australian infants and young children in the Gomeroi gaaynggal cohort

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Abstract

Aim: The nutritional quality of foods consumed by infants and young children to complement breastfeeding or formula feeding influences growth and development. The aim of this study was to identify the dietary intake of Indigenous infants and young children in the Gomeroi gaaynggal cohort, and evaluate the nutritional adequacy of their intake compared with Australian recommendations.

Methods: Dietary intake was assessed using diet recalls at approximately 9-, 12- and 24-month visits. Nutrient values of foods were obtained from AUSNUT 2011-13 and nutrient intake compared to the Australian Nutrient Reference Values. Foods were categorised into food groups and intakes compared to the Australian Guide to Healthy Eating.

Results: A total of 206 infants and young children were included in the study. Of these, 95 individual children had dietary data collected between 7.6 and 24.7 months. Infant formula and breastfeeding rates were highest among infants (70% and 20%, respectively). Cow's milk intake was highest among young children (75%).

Infants and young children in the cohort met most macro- and micronutrient intake recommendations. Few young children met recommendation for iron (42%), no infant met recommendation for omega-3 fatty acids and almost all exceeded recommendation for sodium. Most young children met daily dairy and fruit recommendations although intake of discretionary foods was high.

Conclusions: This study found that diets of Indigenous infants and young children met most key nutrient reference targets. Potential target areas that require dietary optimisation have been identified and will be the focus of community-led strategies in adequate infant nutrition promotion.

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dietary intake, early childhood, foods, Indigenous, infants

1 | INTRODUCTION

Nutrition is an important contributor to optimal child growth and development during the first 1000 days of life.[1] Dietary intake during this period includes breastfeeding and/or formula feeding, and complementary feeding. The World Health Organization (WHO) recommends infants are exclusively breastfed for the first 6 months of life,[2,3] with continued breastfeeding to age two years, or for as long as mother and infant wish to continue. Formula feeding should be used for infants when breastfeeding is not possible.[4] At 6 months of age, breastfeeding may no longer be sufficient to fulfil the energy and micronutrient requirements of the infant[5] and complementary feeding becomes necessary.[5-7]

Inadequate complementary feeding is a leading cause of malnutrition in early life and can adversely influence growth and development.[8] Among vulnerable and low-income populations, including Indigenous populations globally, complementary feeding is often sub-optimal due to a lack of basic resources, including access to health services, adequate housing, family income, good physical environment and social support networks.[9] Although previous studies have shown sub-optimal dietary intake among Australians,[10,11] for Aboriginal and Torres Strait Islander peoples (hereafter respectfully Indigenous), optimising nutrition in the first 1000 days is an important mechanism to improve health status. Sub-optimal diets are associated with the leading risk factors contributing to the health gap between Indigenous and non-Indigenous Australians, namely obesity, hyperlipidaemia and hypertension.[12]

Prior to European colonisation, Indigenous Australian diets consisted of nutrient-dense, low energy foods which were protective against cardiovascular diseases and diabetes as a result of their high fibre and low saturated fat content.[13,14] The dispossession of homes and livelihoods of Indigenous Australians following colonisation[15] caused endemic disadvantage, greatly contributing to poor nutrition.[13] Indigenous people were forced to depend on rations provided through missions and government settlements,[14] which lacked fruit and vegetables, and contained refined foods that were dissimilar to the usual Indigenous diet,[13,16] compounding their inability to obtain good nutrition. The forced separation of children from their mothers also impacted on intergenerational transfer of childhood nutritional practices. Thus, malnutrition became prevalent among Indigenous infants and young children in the late 1960s and early 1970s, with early cessation of breastfeeding playing a contributory role.[13]

Little is known about the nutrient intakes of Indigenous children under 2 years. It is important however to determine whether infants in this age group are meeting key nutrient targets required for growth and development and cognitive function, due to their increased risk of chronic disease. Achieving nutrient recommendations is an important component of infant and young child feeding.[17] According to the 2012 to 2013 Australian Aboriginal and Torres Strait Islander health survey, the majority of children aged 2 years and above, did not meet recommendations for serves of wholegrain cereals, meat, vegetables and dairy.[12] More than half met the recommended intake of fruits, but the majority also reported consuming nearly 50% more than the recommended limit for discretionary foods.[12] Although there is no national data on the nutritional intake of Indigenous infants under 2 years of age, Indigenous infants and young children aged 6 to 36 months in remote communities were reported to not be meeting the Australian Guide to Healthy Eating (AGHE) recommendations.[18,19] Nutritional intakes from first foods were also suboptimal, with a high consumption of discretionary foods and low fruit and vegetable intake.[18,19] Notably, an individual or group may fail to meet the AGHE, but still achieve the recommended nutrient intake levels.[20] The AGHE,[21] and the Nutrient Reference Values (NRV),[22] developed by the National Health and Medical Research Council (NHMRC) serve as a guide for Australians about healthy diet components to prevent chronic diseases, and to provide nutrient recommendations for various age groups to prevent nutrient deficiencies, respectively. The AGHE, developed on the NRV platform, translates recommendations from the dietary guidelines into daily servings from the five core food groups to assist the population in meeting their recommended intake according to the NRV.[20]

This study aimed to identify the foods (and beverages) consumed by Indigenous infants and young children, at

9, 12 and 24 months of age in the Gomeroi gaaynggal cohort, and to determine the nutritional adequacy of their dietary intakes compared to the AGHE and NRV recommendations.

2 | METHODS

The Gomeroi gaaynggal cohort was a prospective longitudinal cohort of Indigenous Australian mother-child dyads which began recruitment in 2010. The study followed women through pregnancy until their children are 10 years of age. The program aimed to improve pregnancy and birth outcomes of Indigenous women, and to better understand factors that impact on their health and the health of their children. The study was primarily located in Tamworth, New South Wales (NSW) Australia. Further details of the Gomeroi gaaynggal cohort have been reported elsewhere.[23,24]

Ethical approval for this study was obtained from Hunter New England Research Ethics Committee (08/05/21/4.01), New South Wales, Human Research Ethics Committee (HREC/08/HNE/129) and Aboriginal Health and Medical Research Council (654/08).

Further approval was obtained from the Gomeroi gaaynggal steering committee to ensure that the presentation and interpretation of the data was culturally appropriate.

Participants were recruited by Indigenous research assistants at the antenatal services of Tamworth Rural Referral Hospital and provided written informed consent to participate in the pregnancy and follow-up studies. Women were eligible to participate if they were pregnant and self-identified as Indigenous, or the father of the infant identified as an Indigenous Australian. Participants attended up to four postpartum visits in the infant's first year (3, 6, 9 and 12 months), and one visit during each subsequent year, to a total of five visits in the infant's first 2 years. The dietary intake of Indigenous infants and young children in the Gomeroi gaaynggal cohort was assessed using dietary data obtained at 9, 12 and 24 month visits. The days of study visit for each age group occured at 230 to 320 days (9 months), 321 to 548 days (12 months), and 549 to 913 days (24 months).

For this analysis, infants and young children were categorised into age groups according to those used in the NRV and the AGHE. Infants and young children were categorised into two groups (7-12 months and 1-3 years) for the NRV and three groups (7-12 months, 1-2 years and 2-3 years) for the AGHE. For infants who had two visits within a single age category, the mean intake at these visits was calculated and used for the analyses.

Breastfeeding, infant formula and complementary feeding data were used to analyse the total dietary intake of children in the study. These were obtained by a qualified dietitian, collected via interviewer-administered surveys, using a 24-hour dietary recall and infant feeding recall as previously described.[24] Parents acted as a proxy for reporting their infant's intake. Data obtained from the participants were stored in REDCap (Research Electronic Data Capture, v8.8 Vanderbilt University), a secure web-based application designed to support data capture for research studies.[25]

The infant feeding recall questionnaire, collected information on the feeding practices of the infant during all visits in the child's first year. It obtained details about breastfeeding initiation, duration, and timing of introduction of infant formula, cow's milk, milk substitutes and solid foods. Infant feeding recall questions were devised from the NSW Child Health Survey 2001[26] and the 1995 National Nutrition Survey.[27] Only information on behaviours and no nutrient information was derived from the infant feeding recall in this study.

Multiple-pass method 24-hour recalls were collected at each visit, with a total of three recalls collected from participants who attended all visits.[28] The parent was asked to report the type and amounts of foods which included meals prepared, fluids and supplements the infant consumed from midnight to midnight in the 24 hours preceding the day of interview.

The recall data were entered by a dietitian into ASA24-Australia, a web-based 24 hour recall software.[29,30] The Australian Food and Nutrient Database (AUSNUT) 2011-13[31] was used to convert the food intake into estimates of nutrient intake. Individual food items, which are summarised according to the proportion of consumption, were categorised into food groups according to the AGHE, using the first three digits of the specific eight-digit numeric food identification code of AUSNUT 2011-13, which generates nutrients.[32] Food group intakes were derived from the AGHE standard serving sizes.[21] For food items not specified in the AGHE, equivalent serving sizes were derived based on similar energy values of food within the same food group in the AGHE.

As breastmilk was unable to be entered in ASA24-Australia, a volume of 442 g/d was assigned to each breastfed infant and based on the NHMRC breastfeed reference for partially breastfed infants above 9 months of age.[7] Nutrient values for breastmilk were taken from the AUSNUT 2011-13 database and added to the nutrient intake obtained from other foods consumed.

Total daily nutrient intakes were compared to the NRV to determine what percentage of infants (aged 7.6-24.7 months) were meeting nutrient requirements. Nutrients such as protein, iron, omega-3 fatty acids and sodium were prioritised for analysis due to their role in growth and development, cognition and risk of non-communicable diseases.[33-35] Infants and young children with an energy intake above 2 standard deviations from the mean for that age category were determined implausible and were removed from the dataset. Food group intake of infants and young children was compared to the AGHE.[21]

Data was tested for normality. Data that was not normally distributed was reported as median (interquartile range [IQR]). Data manipulation and descriptive analyses were performed using Stata 15.1/IC (Stata Corp., College Station, Texas).

3 | RESULTS

A total of 206 infants attended at least one of the 9-, 12- and 24-months visits (Figure S1). Of these, 95 individual children had dietary data resulting in a total of 161 dietary recalls, and 130 total recalls after mean intake of infants with two visits in each category was obtained and records with implausible energy intakes were removed. Sixty recalls were obtained from infants aged 7 to 12 months, while 54 and 16 recalls were obtained from infants and young children aged 1 to 2 years and 2 to 3 years, respectively. Thirty-nine infants had two recalls while three infants had recalls in all three age categories.

The percentage of infants who were breastfed declined between 7 to 12 months and 1 to 3 years, from 20% to 10% (Figure 1). Consumption of infant formula also declined with age from 70% at 7 to 12 months, to 10% at 1 to 3 years. As infant formula and breast milk intake declined between 7 to 12 months to 1 to 3 years, there was an increase in cow's milk consumption from 66% to 75%, respectively. Only 5% of infants at 7 to 12 months consumed both infant formula and breastmilk while 15% consumed neither breastmilk nor formula. Foods other than breastmilk were introduced to infants at a median age of 5 months (IQR 4-6) and infant formula at 4.5 months (IQR 2-7).

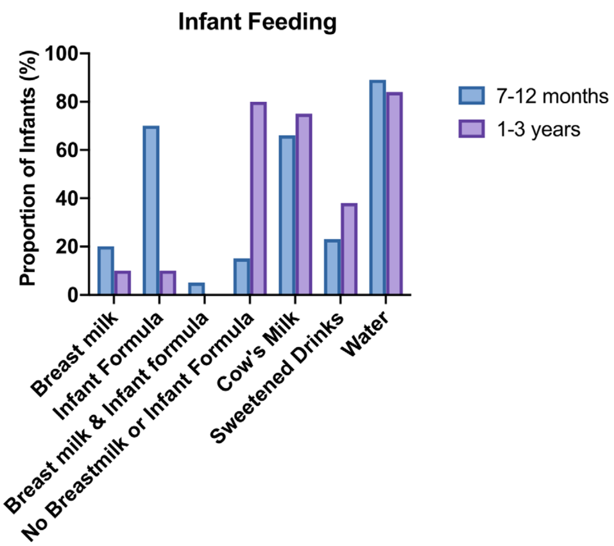

FIGURE 1 Breastmilk, infant formula and drinks consumed by infants and young children at all age points. Sweetened beverages include cordials and soft drinks

The majority of infants at 7 to 12 months met iron and zinc requirements but none met requirements for omega-3 fatty acids. All infants had an adequate intake of protein and most met their energy and carbohydrate requirements (Table 1). The majority of infants achieved an adequate intake for most micronutrients including vitamin A, calcium and folate. All infants at 7 to 12 months exceeded their sodium requirement. The median intake of sodium was 809 mg at the 7 to 12 months, above the recommended intake of 170 mg.

At 1 to 3 years of age, the majority of young children met zinc requirements, while few met requirements for iron. All young children achieved the estimated average requirement (EAR) for protein requirements while most met their energy requirements (Table 2). Of the micronutrient requirements, the majority of young children met their recommended folate and calcium requirements. The sodium intake of all young children was higher than recommended. The median intake for sodium was 1155 mg, 4-fold higher than the recommended intake of 300 mg, and higher than the recommended upper level of intake of 1000 mg.[22]

Of the infants and young children, most met the AGHE daily recommended servings of dairy while more than half aged 7 to 12 months and 1 to 2 years achieved recommended servings of fruits (53% and 57%, respectively). Few infants and young children achieved serving recommendations for grains (Table 3). At 1 to 2 years and 2 to 3 years infants and young children, exceeded AGHE recommended limits for discretionary foods (70% and 94%, respectively).

Dairy products consumed by infants and young children most often included yoghurt, cheese, and milk. Vegetables most often consumed by infants and young children included potatoes, cauliflower, cabbage, carrots and peas (Table 4).

4 | DISCUSSION

Most infants in the Gomeroi gaaynggal cohort achieved adequate food and nutrient intakes compared with the AGHE and NRV. Specifically, most infants met macronutrient recommendations, although the intake of iron and omega-3 fatty acids was commonly suboptimal. Few infants in the study were breastfed after 7 to 12 months and many consumed infant formula. Further details of

TABLE 1 Nutrient intake from all foods of infants at 7 to 12 months (n = 60) compared to nutrient reference value recommendations

Nutrient	Requirement (EER[a], EAR[b] or AI[c])	Meeting requirements (%)	Median	IQR
Energy[a] (kJ/d) (boys)	2800 to 3500	89	4183	3578 to 4627
Energy[a] (kJ/d) (girls)	2500 to 3500	91	3669	3235 to 4055
Macronutrients				
Protein[c] (g/d)	14	100	40	28 to 60
Carbohydrate[c] (g/d)	95	82	136	101 to 189
Total fat[c] (g/d)	30	73	40	29 to 56
Micronutrients				
Total LC n-3 PUFAs[c] (mg/d)	500	0	73	31 to 115
Iron[b] (mg/d)	7	73	12	7 to 18
Zinc[b] (mg/d)	2.5	100	7.2	4.9 to 12.1
Vitamin A[c] (μg/d)	430	90	1130	835 to 1667
Thiamin[c] (mg/d)	0.3	95	1.2	0.7 to 1.8
Riboflavin[c] (mg/d)	0.4	93	1.8	1.2 to 2.6
Niacin[c] (mg/d)	4	98	13	9 to 19
Vitamin B6[c] (mg/d)	0.3	95	0.7	0.5 to 1.1
Vitamin B12[c] (μg/d)	0.5	98	2.2	1.8 to 4.1
Folate[c] (μg/d)	80	98	341	261 to 567
Vitamin C[c] (mg/d)	30	93	110	78 to 173
Calcium[c] (mg/d)	270	95	881	630 to 1129
Phosphorus[c] (mg/d)	275	98	817	584 to 1278
Potassium[c] (mg/d)	700	100	1629	1241 to 2667
Sodium[c] (mg/d)	170	100	809	485 to 1278

[a]Estimated energy requirements. The average dietary energy intake that is predicted to maintain energy balance in a healthy adult of defined age, gender, weight, height and level of physical activity, consistent with good health. In children and pregnant and lactating women, the EER is taken to include the needs associated with the deposition of tissues or the secretion of milk at rates consistent with good health.[22]
[b]Estimated average requirement. Daily nutrient level estimated to meet the requirements of half the healthy individuals a particular life stage and gender group.[22]
[c]Adequate intake. The average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate.[22]
LC n-3 PUFAs, long chain omega 3 polyunsaturated fatty acids.

breastfeeding and formula feeding patterns in the cohort have been reported in previous studies.[24]

Adequate complementary feeding practices in infants are important to prevent malnutrition, improve growth and development, and reduce the risk of infections.[5] This study found that 20% of infants in the cohort were breastfed at 7 to 12 months, with a further decline at 1 to 3 years. Similar studies in Indigenous Australians also report a decline in breastfeeding rate. In a New South Wales study, only 15% of Indigenous infants received breastmilk at 6 months, with a mean breastfeeding duration of 8 weeks.[36] Similarly, 27% and 73% of Indigenous infants in a South Australia study were being breastfed and formula fed, respectively, at 26 weeks.[37] The decline in breastfeeding at 7 to 12 months, could be attributed to the establishment of complementary feeding during this period, as complementary feeding began at 4.5 months in more than half of the infants and may influence the intake of breastmilk. Other factors reported in previous studies include mothers resuming work and being busy with other children.[37]

Diet quality greatly influences the variety and quantity of micronutrients that are consumed.[38] Suboptimal intake of important micronutrients such as omega-3 fatty acids, iron and excessive consumption of sodium were the main dietary challenges identified in this study. The high sodium intake may expose infants to an increased risk of developing hypertension.[39]

Iron deficiency causes anaemia,[40] but may be improved after intervention.[41] Studies have shown that a combined deficiency of omega-3 fatty acids and

TABLE 2 Nutrient intake from all foods of infants and young children between 1 and 3 years (n = 70) compared to nutrient reference value recommendations

Nutrient	EAR[a] or AI[b]	Meeting requirements (%)	Median	IQR
Energy[a] (kJ/d) (boys)	3500 to 4400	79	5326	3600 to 6211
Energy[a] (kJ/d) (girls)	3200 to 4200	97	5310	4560 to 7147
Macronutrients				
Protein (g)[a]	14	100	55	36 to 67
Carbohydrate (g/d)	NA	—	150	116 to 197
Total fat (g/d)	NA	—	46	35 to 59
Micronutrients				
Total LC n-3 PUFAs[b] (mg/d)	40	70	70	36 to 104
Iron (mg/d)[a]	9	40	7	5 to 10
Zinc (mg/d)[a]	2.5	97	7.4	5.7 to 10.2
Vitamin A (mcg/d)[a]	210	93	683	463 to 987
Thiamin (mg/d)[a]	0.4	93	1.2	0.8 to 1.7
Riboflavin (mg/d)[a]	0.4	96	1.9	1.4 to 2.7
Niacin (mg/d)[a]	5	97	13	9 to 19
Vitamin B6 (mg/d)[a]	0.4	90	0.8	0.6 to 1.1
Vitamin B12 (mcg/d)[a]	0.7	97	3.9	2.6 to 5.7
Folate (mcg/d)[a]	120	96	371	266 to 498
Vitamin C (mg/d)[a]	25	81	53	30 to 115
Calcium (mg/d)[a]	360	90	881	630 to 1129
Phosphorus (mg/d)[a]	380	96	1050	712 to 1389
Potassium (mg/d)[a]	2000	57	2091	1517 to 2549
Sodium (mg/d)[b]	300	99	1155	851 to 1840

[a]Estimated average requirement. Daily nutrient level estimated to meet the requirements of half the healthy individuals a particular life stage and gender group.[22]
[b]Adequate intake. The average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate.[22]
LC n-3 PUFAs, long chain omega 3 polyunsaturated fatty acids.

iron in infants could exacerbate cognitive deficits.[34] Both omega 3 fatty acids and iron are important for optimal growth and cognitive function.[34,35] Future research that is community-led will investigate the association between these nutrient deficiencies and major developmental milestones among Indigenous Australians.

Although this study did not look at the relationship between food consumption in accordance with the AGHE and nutrient intakes, evidence has shown that insufficient food consumption in accordance with the AGHE is associated with suboptimal nutrient intake.[42] The low intake of iron and omega-3 fatty acids found among this population could be attributed to many infants not meeting the recommendation for grains or meat and its alternatives. Furthermore, this study found that gold standard infant formula was a major contributor of omega 3 fatty acids in infants rather than omega 3 fatty acid rich foods such as fish and seafood alternatives. However, the proportion of omega 3 fatty acids in the formula is less than the daily requirement for the age group as it is expected that infants would have commenced solid food intake which will complement the nutrient intake from formula feeding.

Excessive consumption of discretionary foods in children, particularly during complementary feeding, increases the risk of obesity and the development of non-communicable diseases including diabetes, hypertension, obesity and renal diseases.[43] It is also associated with an increased risk of developing micronutrient deficiencies.[44] Infant consumption of discretionary foods in this study was high, and likely contributed to the excess sodium intake.

TABLE 3 Infants and young children meeting their serving size recommendations according to the Australian Guide to Healthy Eating at 7 months through to 3 years of age

		7 to 12 months (n = 60)				1 to 2 years (n = 54)				2 to 3 years (n = 16)			
Category	Recommended Serves/d[a]	Number who ate food in category (%)	% meeting recommended serves or more among all infants	Median Serves	IQR	Number who ate food in category (%)	% meeting recommended serves or more among all young children	Median serves	IQR	Number who ate food in category (%)	% meeting recommended serves or more among all young children	Median serves	IQR
Fruit	0.5 (7 mo-2 y) 1 (2-3 y)	32 (53%)	32 (53%)	4.6	2.5 to 10.0	39 (72%)	31 (57%)	1.1	0.6 to 1.8	13 (81%)	8 (50%)	1.0	0.7 to 1.6
Vegetables	1.5 to 2 (7-12 mo) 2 to 3 (1-2 y) 2.5 (2-3 y)	35 (58%)	33 (55%)	5.5	3.6 to 7.9	29 (54%)	14 (26%)	1.9	0.6 to 3.2	9 (56%)	6 (38%)	2.6	1.9 to 3.2
Meat and alternatives	1 (7 mo-3 y)	19 (32%)	14 (23%)	1.6	0.6 to 3.1	28 (52%)	14 (26%)	1.1	0.5 to 1.5	9 (56%)	4 (25%)	0.7	0.6 to 1.5
Grains	1.5 (7-12 mo) 4 (1-3 y)	28 (47%)	3 (5%)	0.9	0.4 to 1.2	50 (93%)	7 (13%)	2.2	1.3 to 3.5	15 (94%)	4 (25%)	3.9	2.3 to 4.1
Infant cereal	1 (7-12 mo)	9 (15%)	6 (10%)	1.3	0.4 to 2.0	—	—	—	—	—	—	—	—
Infant formula/ Breastmilk[b]	1 (7-12 mo)	46 (77%)	38 (63%)	1.6	1.3 to 2.8	—	—	—	—	—	—	—	—
Dairy	0.5 (7-12 mo) 1 to 1.5 (1-3 y)	36 (60%)	36 (60%)	4.8	2.2 to 8.5	42 (78%)	34 (63%)	2.3	1.1 to 4.1	14 (88%)	13 (81%)	4.1	2.2 to 4.6
Fats and Oils	0–1 (1-3 y)	—	—	—	—	4 (7%)	4 (7%)	0.2	0.2 to 0.4	3 (19%)	3 (19%)	0.9	0.5 to 1.0
Discretionary[c]	0–1 (1-3 y)	—	—	—	—	50 (93%)	38 (70%)	2.1	1.2 to 3.5	16 (100%)	15 (94%)	3.1	1.9 to 4.8

[a]Serve size weight equivalents (7-12 mo): (a) Fruits 20 g; (b) Vegetables 20 g; (c) Meat and alternatives 30 g; (d) Grains: bread equivalent 40 g; infant cereal (dried) 20 g; (e) Dairy: cheese 10 g; Yoghurt 20 mL (f) Breastmilk or formula 600 mL. Serve size weight equivalents (1-3 y): (a) Vegetables: whole vegetables (including potatoes, green leafy or orange vegetables) 75 g; (b) Fruits: fruits (whole/canned) 150 g, fruit juice 125 mL; (c) Grains (Bread and cereals): slice bread or bread roll 40 g, cooked rice/pasta/noodles/quinoa/semolina 75 to 120 g, cooked porridge 120 g, cereal flakes 30 g, English muffin or scone 35 g; (d) Dairy: milk 250 mL, hard cheese 40 g, ricotta cheese 120 g, yoghurt 200 g, soy/rice milk 250 mL; (e) Meat and alternatives: cooked lean meats (beef/veal/pork/lamb/kangaroo) 65 g, poultry (chicken or turkey) 80 g, fish fillet 100 g, eggs (2 large) 120 g, nuts/seeds/peanut/almond butter 30 g; (f) Discretionary (food portion equivalent to 600 kJ): regular ice cream 75 g, salty crackers 30 g, sweet biscuits 2 to 3 pieces, doughnut 40 g, jam/honey 60 g, fries 60 g, pies/meat pies/other savoury pies 60 g, potato crisps/corn chips 30 g, peanut butter 25 g, hamburger 60 g, fat spread 20 g, chocolate 25 g, sausages 55 g, cakes/ sweet pies/tarts/other sweet pastries 40 g.

[b]Breastmilk volume was derived using a volume of 442 g/d for each breastfed infant.

[c]600kJ.

TABLE 4 Summary of food items consumed from food groups by infants and young children

Food category (proportion of participants consuming foods within the food groups)	Food items
Beverages (10.6%)	Water Cordials Soft drinks and flavoured mineral water
Cereal and cereal products (15.3%)	Breads Breakfast cereals Pasta and pasta products
Cereal based products and dishes (8.0%)	Savoury biscuits Sweet biscuits Mixed cereal dishes Pastries
Fats and oils (4.1%)	Butters Margarine and table spreads Dairy blends
Fish and seafood products and dishes (0.8%)	Packed fish and seafoods Homemade and takeaway fish and seafoods products
Fruit products and dishes (11.2%)	Pome fruits (Apple, Pear) Berries Citrus fruits Tropical fruits (Banana and Pineapple) Stone fruits (Peaches and Nectarines)
Egg products and dishes (0.2%)	Eggs
Meat and poultry products and dishes (6.7%)	Poultry Beef, sheep and pork Processed meats Mixed dishes with poultry as major component Sausages, Frankfurts and Saveloys
Milk products and dishes (13.4%)	Cow milk Yoghurt Cheese Custards
Vegetable products and dishes (9.7%)	Potatoes Cabbage, cauliflower Carrot Peas and beans Tomato and tomato products Mixed vegetable dishes
Snack foods (1.4%)	Potato snacks Corn snacks
Confectionery and cereal/nut/fruit/seed bars (1.6%)	Chocolate and chocolate-based confectionery Fruit, nut and seed-bars Muesli bars
Infant and formula foods (9.9%)	Infant formula Human breast milk Infant cereal products Infant foods Infant drinks

The high intake of discretionary food among infants could be influenced by maternal dietary choices. Lee et al., reported that the diets of mothers in the Gomeroi gaaynggal cohort are high in energy-dense, nutrient poor foods,[45] and most mothers had up to five times more than the recommended serving of discretionary foods.

Therefore, the dietary intakes of the mothers could be reflected in the dietary intakes of the infants.

The intake of discretionary foods among this cohort of Indigenous women and children could be attributed to the cultural influence of foods on the parents as it is well established that custom, tradition and belief play a major role in choice and decision making.[46] Other factors that influence nutrition and health include physical environment, individual characteristics and behaviours, social and economic environment, support networks, genetics and access to health services.[47,48] The long-standing impact of colonisation on this population may also influence dietary choice.[12] Studies have shown that the food systems and food knowledge of Indigenous peoples have been continued to be affected by ongoing manifestations of colonialism, which have led to severe health inequities and disproportionate rates of nutrition-related health outcomes.[49] These factors are all complex and may not be overcome easily, but it is essential that they are recognised as influencing the choices made by parents on behalf of their children.

In interpreting the results from this study, it should be noted that this study took place in a small region of New South Wales and thus the conclusions may not be generalisable to all Indigenous Australian infants. Although the multiple-pass method was used for the collection of the 24-hours recalls, a limitation of this study was the use of one dietary recall for each infant at each visit. As a result, intakes at each time point are only the average of a single day and may not be reflective of usual intake.

These findings suggest that the dietary intakes of most nutrients in Indigenous infants in the Gomeroi gaaynggal cohort are adequate and meet the NRV and AGHE recommendations, with the exception of omega 3 fatty acids, iron and sodium. Implementation of Indigenous-led strategies will ensure suboptimal diet areas are optimised to prevent deficiencies.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Oyepeju M. Onifade, Tracy Schumacher, Megan E. Rollo, Clare E. Collins, Kirsty G. Pringle and Kym M. Rae contributed to the methodological design of the study. Oyepeju M. Onifade and Tracy Schumacher performed data analysis. Oyepeju M. Onifade prepared the manuscript. Oyepeju M. Onifade, Tracy Schumacher, Megan E. Rollo, Kirsty G. Pringle, Clare E. Collins and Kym M. Rae contributed to the revision of the manuscript, tables and figures. Members of the *Gomeroi gaaynggal* advisory committee have provided significant cultural knowledge to guide the research study, contributed to the design of the study and the interpretation of the data, as well as reviewing and approving the final manuscript. All authors contributed to reviewing, editing and approving the final version of the manuscript. The content of this manuscript has not been published elsewhere. The authors wish to pay their respects to Elders past, present, and emerging, and also extend that respect to any Indigenous readers. The authors would like to acknowledge Lyniece Keogh, Kathryn Sutherland, Jodie Herden, Paris Knox, Loretta Weatherall and Stella Sands (all Gomeroi women), Simon Munro, Dr Amy Ashman and Dr Yu Qi Lee who have helped with this study. The authors would like to gratefully recognise the women who dedicate their time to participate in the Gomeroi gaaynggal study.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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