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Nutrition and packaging characteristics of toddler foods and milks in Australia

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Conflict of Interest

None.

Authorship

JM conceptualized the study, conducted the data collection, and analysed the data. GR, KC and JW provided input into the study design and methods. GR and JW provided input into the analyses of the data. JW conducted the data checks. All authors read and approved the final manuscript.

Ethical Standards Disclosure

Exemption for ethics was approved by the Deakin University Human Research Ethics Committee (2020-117), as the study involved no human participants.
Objective: To analyse nutritional and packaging characteristics of toddler specific foods and milks in the Australian retail food environment to identify how such products fit within the Australian Dietary Guidelines (ADG) and the NOVA classification.

Design: Cross-sectional retail audit of toddler foods and milks. On-pack product attributes were recorded. Products were categorised as (i) food or milk, (ii) snack food or meal, and (iii) snacks sub-categorised dependent on main ingredients. Products were classified as a discretionary or core food as per the ADG and level of processing according to NOVA classification.

Setting: Supermarkets and pharmacies in Australia

Results: A total of 154 foods and 32 milks were identified. 80% of foods were snacks, and 60% of foods were classified as core foods, while 85% were ultra-processed (UP). Per 100g, discretionary foods provided significantly more energy, protein, total and saturated fat, carbohydrate, total sugar and sodium (p<0.001) than core foods. Total sugars were significantly higher (p<0.001) and sodium significantly lower (p<0.001) in minimally processed foods than in ultra-processed foods. All toddler milks (n=32) were found to have higher energy, carbohydrate and total sugar levels than full fat cow’s milk per 100mL. Claims and messages were present on 99% of foods and all milks.

Conclusions: The majority of toddler foods available in Australia are UP snack foods, and do not align with the ADG. Toddler milks, despite being UP, do align with the ADG. A strengthened regulatory approach may address this issue.

Keywords: Audit, child, snack, food, environment, policy, marketing, claims, nutrition
Background

The food habits developed in early childhood influence future food preferences (into adulthood), growth and development, as well as the risk of chronic disease in adulthood. Dietary and feeding guidelines for young children have been designed to ensure young children meet their unique nutrition needs due to rapid growth and development. However, global research has shown that toddlers’ food intakes do not meet vegetable, total sugar and discretionary food recommendations, which may increase their risk of diet related disease. Recent research has also reported that a diet high in UP foods is associated with an increase in overall energy intake and consequent weight gain and risk of obesity, as well as an increased risk of cardiovascular disease, stroke, and even mortality in adults.

The availability of food within the broader food environment has been shown to be a driver of obesity, and food industry plays a pivotal role in helping to create food environments. Presently, many young children are exposed to an obesogenic food environment, which is characterised by heavy marketing of foods low in nutritional quality. Within the retail food environment, marketing comprises the 4 main P’s of marketing (product, place, promotion and price) with promotion including claims and messages. These claims and messages influence parental food purchases, and ultimately the toddler diet.

There has been substantial growth in the number of ready to eat, processed food products for toddlers (children aged 12-36 months), globally over the last 10 years, which have increased in popularity due their convenience, as well as marketing. These food products have been found to be high in total sugar and salt and as well as UP. In addition, many of these food products do not meet dietary recommendations for nutrient composition (such as sugar, salt and energy), texture and processing. Exposure to a range of food textures in early childhood (late infancy and early toddlerhood) has been shown to be key in the development of appropriate muscles required for mastication of foods as well as the acceptance of a range of food textures. There is also recent evidence linking high intakes of UP foods in young children to cardiometabolic risks, asthma, overweight and obesity, lower consumption of MP foods and lower overall diet quality. There is also evidence reporting an association between a lower intake of UP foods and higher rates of continued breastfeeding from birth to 24 months.
Paralleling this expansion in the toddler food market is the market for toddler milks. These are marketed for consumption by children aged 12-36 months, are an UP food product containing powdered milk, vegetable oils, sweeteners and vitamins and minerals. While the total kilojoules provided are nearly equivalent, the nutrient contributions differ between cow’s and toddler milks\(^{(32)}\), and they frequently have comparable total sugar levels to that of soft drinks\(^{(51)}\). Since their introduction in the 1980’s, both global sales of toddler milk\(^{(52)}\) and toddler milk product diversity within Australia\(^{(53-56)}\) have increased steadily. This increase is occurring despite the World Health Organization (WHO) stating that toddler milks are unnecessary for optimal child growth and development, something that safe and nutritious complimentary foods can achieve\(^{(57, 58)}\).

Infant (baby) and toddler food product audits have previously been conducted in Australia\(^{(31)}\), the USA\(^{(32)}\), and the UK\(^{(35, 36, 59)}\). Results from these audits highlight that the number and variety of foods and milk products for young children is vast, and that there is poor alignment with dietary recommendations\(^{(32, 59, 60)}\). Regular monitoring of this rapidly evolving market is essential to inform policy and practice and it is timely to update Australian data, last collected in 2013. The current study provides a contemporary and comprehensive snapshot of the retail toddler food and milk environment in Australia. The aim of this cross-sectional study was to investigate and describe the nutrition content, claims and messages of all commercially available toddler foods and milks within the Australian retail food environment.

Methods

Data Collection

Two Melbourne suburbs formed the sampling frame for this study, which was conducted in November 2019. Retail premises to be audited comprised those most likely to provide foods and milks for toddlers. This included the four supermarket chains – Coles, Woolworths, Aldi and IGA – who collectively constitute 80% of the Australian supermarket share\(^{(61)}\), and one pharmacy – Chemist Warehouse, known to represent close to 25% of the total pharmacy share in Australia\(^{(62)}\). Two suburbs, each with flagship stores (largest stores with the most stock) for Coles and Woolworths (personal communication with both companies)\(^{(63)}\) were chosen to increase product capture. An internet search for toddler food products was also conducted via Coles and Woolworths online. Given online options may vary by location,
multiple flagship stores (at least two in each state or territory) were included in the online search to maximise product representation\(^{(63)}\). Online searches were also undertaken for all brands of toddler foods that had been identified by the supermarket in-store and online audits to capture products and varieties that could only be ordered online directly from manufacturers or third party websites. To ensure all toddler foods and milks (foods and milks/formula specifically marketed for children aged one to three years, or 12-36 months) were audited, products within the baby food aisle, the freezer aisles, as well as the refrigerated and health food aisles were checked for the inclusion criteria listed below.

Toddler foods and milks were relatively easy to identify from the product packaging, as most often the age was listed on the front or back as described below.

Inclusion criteria:

The following inclusion criteria were applied when selecting products for the analysis:

1. Products targeted to toddlers 12-36 months were identified by examining each product for the words baby, infant, toddler or tots or by an age range between 12-36 months on the packaging or advertising. Products labelled infant or baby were assessed by checking the label for an age indication, to ensure they were targeted to >12 months.

2. Products with the words “child”, “children” or “kids” were also visually inspected and then assessed as above to ensure they were targeting children <36 months.

3. Products with a listed age which crossed over the age range of 12-36 months were assessed individually for inclusion (e.g. 1-4 years, 1-5 years). Products which were labelled as suitable for both infants and toddlers (marketed from 6 months+), were included only if the nutrition information panel (NIP) included reference to a % daily amount for children above 12 months, and within the 12-36 month age range of interest. Products that were labelled as suitable for toddlers and older children (above 3 years) were evaluated on a case by case basis and were included if the majority of the age range was within the age range (12-36 months) of interest for this study.

For in-store data collection, a smartphone was used to photograph all product marketing from all sides of products. Photos were transferred onto a computer and visually examined by JM. Data were then extracted and collated into a spreadsheet. For online searches, the URL was recorded, and screen shots of the product/s were taken and data
extracted from the online information and product images. All data were manually entered into an excel spreadsheet for further analysis. A random sample of 20% of product data was cross checked by a second person (JW) against the photos. This data collection methodology has been used in similar research \cite{31}. Any missing information was confirmed via company websites or by contacting companies directly for more information.

Data extracted included brand name, nutrition information per 100g, serve size, stated texture, ingredients, unregulated claims and messages (e.g. taste, convenience, environmental, organic and other messages, which included messages from the company founder, recipe ideas, cross promotion of other products, and other messages such as “just as good as homemade”) and regulated claims (e.g. nutrition content, general and high level health claims). Where product lines were available in several different flavours, all flavours and varieties were identified and counted as separate products. Exact duplicates (same product and size) from multiple stores were cross-checked and entered as one item only.

Product categorisation

All products were categorised as follows:
FIGURE 1

All products n= 186

Toddler milks n=32

Toddler foods n= 154

Toddler meals n= 30

Savoury toddler meals n= 30

Chunky meal with meat, fish, poultry n= 23

Chunky meal with vegetables and cereal n= 7

Savoury toddler snack foods n= 23

Sweet toddler snack foods n= 101

Fruit puree n= 2

Other fruit sweetened snacks n= 2

Fruit juice n= 2

Vegetable based cereal foods n= 2

Other dairy foods n= 3

Fruit based cereal foods n= 4

Fruit chews n= 4

Dried fruit n= 4

Biscuits n= 12

Plain cereal finger foods n= 16

Yoghurt n= 26

Sweetened cereal finger foods n= 45
All products were first categorised as a food or a milk product. Foods were then further categorised as a meal or a snack food. All meals were classified as savoury and snack foods were classified as sweet or savoury, as reported by Garcia et al.\(^{(64)}\), and snack foods (sweet and savoury) were classified into subcategories based on main ingredients and aligned with the classification proposed in a 2019 WHO report\(^{(42)}\).

Foods were also categorised as to their dominant texture, which was based on either the texture as stated on the packaging (as determined by the manufacturer), or by visually inferring from the product image on the pack. The Australian Dietary Guidelines (ADG)\(^{(7)}\) and the Australian Bureau of Statistics discretionary food list and descriptions\(^{(65)}\) were used to classify all food as either five food group foods (referred to as core foods hereafter) or discretionary foods. Discretionary foods, according to the Australian Guide to Healthy Eating \(^{(66)}\) are products which are high in sugar, salt and/or fat and include cakes, biscuits, ice-cream, fast food and lollies and chocolates. Note that the recommended serve size for discretionary foods for toddlers aged 2-3 years is 7-10g, \(^{(7)}\) and for reference, one standard plain biscuit weighs approximately 18g. All foods were also classified as to their processing level (minimally-processed, processed or UP), based on the NOVA classification system\(^{(67, 68)}\). Discussion and consensus from all four researchers was sought for those products that were difficult to classify.

Claims and messages were classified according to Food Standard Australia New Zealand (FSANZ) Standard 1.2.7\(^{(69)}\); claims defined in this Standard were termed ‘regulated claims’ for the purposes of this study and were categorised as nutrition content claims and general and high level health claims. All other claims or messages were referred to as ‘unregulated claims’ and were sub-classified as taste/convenience, child-specific messaging, health-related ingredient claims (e.g. no added preservatives), natural, organic or environmental and other messages (e.g. messages or advice from company founder).

Nutrient content was derived from the nutrition information panel for all foods and milks. Where missing values for nutrients were encountered (toddler milks only, n=5), values were imputed using other data. For example, on toddler milks where total sugar was not displayed the corresponding carbohydrate value was used (as most milks had values for sugars and carbohydrate that were equivalent).
Data analysis

All analyses were conducted using SPSS (version 26, IBM Corp. NY). Descriptive statistics were used to report the proportion of foods in each category and subcategory, ADG and NOVA classification, sweet or savoury snack foods, age, texture, and claims and messages. Tests for normality on the nutritional values of foods were performed, and confirmed that data were not normally distributed, therefore non-parametric testing was undertaken. Median and interquartile range values for nutritional information were calculated from the nutrition information panel (NIP). Results were stratified by product type (meal or snack food), ADG and NOVA classification where appropriate. Mann-Whitney U-tests were conducted for testing nutrient differences and type of claims and messages frequency between core and discretionary foods, and Kruskal-Wallis tests were performed to test for differences in levels of nutrients and type of claims and messages frequency between NOVA groups (tested at a 5% significance level).

Results

Toddler Foods

General Characteristics

In total, there were 154 unique foods (including all distinct varieties and flavours) identified (Table 1), from 22 different manufacturers. Snack foods represented 80% of all foods. Of the snack foods, 81% were classified as sweet. Core foods represented 60% of products, and 85% of all foods were UP. Seventy one percent of all products were labelled specifically for the toddler years (12-36 month age range). The majority of foods identified required some mastication, which corresponded to the reported textures of chewy, chunky, crispy and crunchy accounting for 75% of all products. Sweet cereal based finger foods such as fruit based cereal or snack bars, were the most predominant snack food type. The most common core foods were yoghurts, meals, and sweetened rice biscuits, while fruit based cereal and snack bars and extruded puffs were the most common discretionary foods. The most common MP foods were fruit based “raw” ingredient balls, while meals were the most common processed food. Fruit based cereal and snack bars were the most common UP food identified,
followed by yoghurts. When classified according to both ADG and NOVA, yoghurts and meals were the most common core UP foods, while fruit based cereal and snack bars were the most common discretionary UP food.

TABLE 1

Nutrition characteristics

There was a wide variation in the nutrition information when analysed between product category, ADG and NOVA classification, as can be seen in Tables 2, 3 and 4 respectively. Analysis of the nutrition information per 100g for meals and snacks found snack foods to have significantly higher values for energy, fat, carbohydrate and total sugar (p<0.001), while meals were found to have significantly higher values for sodium (p<0.001) (Table 2). Total sugar represents a combination of intrinsic sugars (for fruit and yoghurts) and those sugars added to products (extrinsic sugars). Sixty-six percent (n=101) of all foods had some form of added sugar. Added sugar in the form of fruit pastes, purees or concentrates was found in 31% (n=40) of snacks, and 70% (n=21) of meals (no other forms of added sugar were found in toddler meals). In addition, 19% (n=23) of snacks had only sugars, such as maltodextrin, sugar or syrups added.

Per 100g, discretionary foods were found to have higher values for energy, protein, fat, saturated fat, carbohydrate, total sugar and sodium levels than core foods (p<0.001). Analysis of NOVA groups was more complex, and was compounded due to the low number of products in both MP and P categories. Analyses for significance of all pairwise combinations for all nutrition values as per the NIP per 100g were conducted for NOVA groups. Results showed that when comparing MP foods with UP foods, total sugars were significantly higher (p<0.001) and sodium significantly lower (p<0.001) in MP foods. In addition significantly higher levels of total sugar (p<0.001) and lower levels of sodium (p=0.014) was found in MP compared to processed foods. There were no significant differences found between medians for energy, protein, total fat, saturated fat and carbohydrates. As it would be expected that UP foods would be higher in energy, total fat and saturated fat as well as carbohydrates and total sugars than MP foods, further exploration of the sample of MP foods was undertaken, and seven foods (raw ingredient bars and balls) were identified that had high levels of energy, protein, total fat and sugars due to the use of vegetable oils (mainly coconut oil), nuts, seeds and dried fruits. In addition, four products
were dried fruit, which had high carbohydrate and total sugar levels, and two products were fruit drinks, which had very low levels of nutrients when compared to the other products in the MP category. These results demonstrate the highly variable sample within the MP category. There were no other statistically significant nutrition results found between NOVA groups.

TABLES 2, 3, 4

Claims and messages

Nearly all food products (99%) had some messages or claims on the packaging, with the total number of claims or messages per product ranging from zero to twenty six (Table 5). Products with high numbers of messages and claims (such as the product with 26) often had many allergen messages/claims on the package such as free from gluten, nut, dairy, soy and even shellfish, as well as kosher, halal and organic messages. Unregulated claims and messages such as lack of additives, preservatives, colours and flavours were more common than regulated claims such as low sugar or gluten free.

TABLE 5

Core foods had a slightly higher mean number of claims and messages (of any type) than discretionary foods. Core foods had significantly more regulated health claims than discretionary foods (p=0.001) (Figure 2), with no significant difference in total unregulated claims and messages between core and discretionary foods. However there were significant differences when claims and messages within sub-categories were analysed by core or discretionary foods. Discretionary foods displayed more child specific messages (p<0.001) and organic or natural messages (p=0.028), while core foods had more taste claims (p=0.009), general level health claims (p<0.001), and environmental claims and messages (p=0.003). The distribution of the number of claims and messages between NOVA groups was non-significant and is also shown in Figure 2.
Toddler Milks

General Characteristics

In total, there were 32 toddler milks identified from 15 different brands. The most common age listed on the product packaging was targeted at toddlers aged 12 months or 1 year and above (65%), then 1-3 years or 12-36 months (25%) followed by two years and above (10%).

Nutrition characteristics

Per 100mL, compared to full fat cow’s milk, the mean energy content of toddler milk was higher, while the mean protein, total fat and saturated fat levels were lower (Table 6). Additionally, the mean carbohydrate and total sugar levels in toddler milk was almost double that of cow’s milk, and mean sodium and calcium levels were found to be lower in toddler milk than cow’s milk. Compared to Fanta soft drink (Australia) (70) (which was used to compare total sugar content, as per previous research) (51), toddler milks were found to be
higher in total energy and carbohydrate, with nearly as much total sugar. Added sugars (such as maltodextrin, glucose syrup, and added lactose) were present in 90% (n=29) of toddler milks. Of note, six milks had missing values for either total sugar or saturated fat on the Nutrition Information Panel (NIP) (which is non-compliant with FSANZ standard 1.2.8)\(^{(71)}\).

TABLE 6

Claims and messages

Claims and messages were present on all toddler milks, ranging from two to twenty six claims (Table 7). Unregulated health related claims and messages (e.g. no artificial colours or flavours, partially hydrolysed whey protein, added probiotics) were found on all toddler milks, while other messages (e.g. dental care, recipe ideas, cross-promotion of other products) were found on 81% of milks. Regulated claims were found on 91% of all toddler milks, with nutrition content claims such as high levels of vitamins or minerals being common, and general level health claims such as zinc for immunity and iron for energy were identified on 75% of milks. Both regulated and unregulated claims were heavily used (around 14 claims, with an average of six unregulated and eight regulated claims per product per product) in the Australian toddler milk market. This can be further broken down into an average of five general level health claims (regulated), three nutrition content claims (regulated) two health related ingredient messages (unregulated), one child specific message, one environmental message or claim, and two other messages (unregulated) per toddler milk.

TABLE 7

Discussion

This study extends a 2013 analysis of the toddler food and milk environment for Australian children, providing a more nuanced and detailed evaluation of the contemporary commercial food and milk environment targeting this age group in 2019\(^{(31)}\). Results demonstrate that the toddler food environment in Australia is comparable to that of other countries in terms of the high prevalence of snacks (80%), as well as the predominance of sweetened foods\(^{(31,32,64)}\).
Currently, NIP labels in Australia are only required to state the total sugar content, with no differentiation between added and naturally occurring (intrinsic) sugars. In addition, there is no adequate definition of added sugar available in Australia, however, work is currently underway to develop this for labelling purposes. Added sugar (determined by the ingredient list using international standards\(^{(42, 72, 73)}\) was present in 66\% of all foods, with sources such as fruit pastes, purees or concentrates being the predominant form of added sugar. These results are similar to research conducted in the USA\(^{(74)}\). Recommendations from the USA study called for policy action on added sugar in toddler foods, which is echoed in the results from the current study. The current study also demonstrates that more than half of all toddler foods in the Australian retail food environment are core foods (60\%), as well as the vast majority (85\%) are UP, with 79\% of core foods classified as UP. This mis-alignment of the ADG and NOVA classification may potentially be causing adverse health outcomes in children as many core foods are being promoted through the ADG as healthy, yet are UP, which have been associated with adverse health outcomes\(^{(13-16)}\). Further, the retail market for toddler milks has been expanding globally and this study found that, in the Australian context, a diverse range of manufacturers are competing in the sector, with 32 toddler milks from 15 different brands identified.

Analysis of the nutrient information per 100g from toddler foods showed a wide range of energy for snack foods. This was due to the large variety in the types of snack foods with fruit and cereal bars, biscuits, dried fruit and raw bars and balls having higher energy content than other snack foods such as extruded puffs and rice crackers.

Our results clearly demonstrated that discretionary foods were of poorer nutritional quality than core foods, which is not surprising, as discretionary foods are not part of the ADG five food (core) groups due mainly to their nutrient composition\(^{(7)}\). Analysis of nutrition quality between NOVA groups was not straightforward, and the outcomes of analysis were not as expected. Per 100g, total sugar was significantly lower and sodium was significantly higher in UP foods when compared to MP foods, as well as between processed and MP foods respectively. There were no significant differences in other nutrients between each of the NOVA groups. This was unexpected, as studies of population diets have shown that high energy consumption from UP foods is associated with higher intakes of sugar\(^{(45)}\). UP sugars were present in many of the foods in this audit, which, when added during processing classify the product as UP\(^{(68)}\). Of note was that many of the MP foods contained coconut oil, nuts, seeds and dried fruit. The use of dried fruit as an ingredient can explain the high sugar results observed in these foods. Despite dried fruit being considered a core food within the ADGs,
there are recommendations to limit intake, as well as coconut oil being specifically identified as being inconsistent with ADG recommendations due to it’s high saturated fat content(7). This suggests that further regulatory efforts may be needed to curb the heavy reliance on dried fruits and vegetable oils in these types of toddler foods. Considerable research into the health outcomes and marketing of UP foods has begun to emerge, however, no previous research has conducted these types of analyses on toddler foods.

Toddler milks were found to have similar levels of total energy, and nearly twice the levels of carbohydrates and total sugar, than full fat cow’s milk, and higher levels of carbohydrates and nearly as much sugar as the Australian formulation of Fanta soft drink which has around 7.9 grams of sugar per 100mL. This aligns with international research on infant and follow on formulas, which reported many toddler milks have high total sugar levels, some nearly double the sugar levels of the UK formulation of Fanta Orange (UK) (which has around 4.6 grams of sugar per 100mL)(51). Added sugars (extrinsic sugars) were present in 90% of toddler milks, which was only evident by carefully reading the ingredient list, with two toddler milks had maltodextrin and lactose as the two main ingredients. These levels of nutrients (with the exception of added sugar) may be appropriate for toddlers who genuinely need toddler milk as a supplement, however, they are not appropriate nor recommended, for healthy toddlers, as identified by the WHO(75, 76). In Australia, toddler milks are present in the general food supply as they meet the requirements for a supplemental product(77), which means they are meant to be used in special circumstances and to address certain health conditions, and are not intended for use by the healthy toddler population. Toddler milks are however, currently marketed as being necessary for the general toddler population in Australia and elsewhere(27, 78-81).

Also of note from the current study was that greater than 50% of all foods had some form of added sugar. This was mainly in the form of fruit, namely pastes, purees or concentrates (31% of snacks, and 70% of meals). This parallels previous research from the US(32) which found not only, that over 80% of snack foods for toddlers are sweetened, but also that 53% of bite-sized meals for toddlers had added sweeteners (non-specific if fruit based or other). The widespread use of sweetening ingredients in these foods will mask any inherent bitter or sour tastes present(e.g. from vegetables) and lead to a predominance of sweet taste across the product range. Although children are innately predisposed to like sweet foods, and dislike bitter or sour tasting food, taste preferences are modifiable through repeated and diverse sensory exposures such that with repeated exposure to bitter and sour tastes, which are often found in vegetables and some fruits, children can develop a greater
liking of them, and this is associated with their greater consumption\(^{(83, 84)}\). The predominance of sweetened products in the toddler food environment is therefore of concern as children who consume high amounts of these foods will be given less of an opportunity to learn to like a wide range of tastes\(^{(84)}\). Furthermore, research has reported that preferences and dietary intake patterns formed in infancy and early toddlerhood, track into later toddlerhood\(^{(6, 85)}\). This reaffirms the importance of acceptance of a variety of foods (flavours and textures included) in the first few years of life – something that the current mix of toddler foods is not supporting.

The development of healthy eating behaviours, including acceptance of a range of foods which align with dietary guidelines requires children to be repeatedly exposed to foods that vary in their sensory qualities\(^{(86)}\) which includes taste and flavour but also texture. Exposure to a variety of food textures in early childhood has been shown to be important to support the development of appropriate chewing muscles required for mastication of foods as well as the acceptance of foods of varying textures\(^{(43, 44)}\). Yoghurts, while contributing essential vitamins and minerals to the toddler diet, comprised 20% of foods from the current study and were found to be smooth in texture as well as sweet. Repeated exposure to sweet foods with smooth textures has been reported to delay or inhibit the development of healthy eating behaviours\(^{(44, 86, 87)}\). The majority of products (76%) in this study were found to have textures which required mastication, however, package descriptions were used to identify texture rather than an objective measure of texture.

In the current study, there were significantly more unregulated health related ingredient claims on UP compared to MP foods and more unregulated other messages on MP compared to UP foods. There were no other significant differences in the type or total number of regulated or unregulated claims or messages between processing levels of foods found. Core foods were found to have significantly more taste, environmental, and general level health claims and regulated claims overall than discretionary foods, while discretionary foods were found to have significantly more child specific and organic or natural messages than core foods. However, as previously mentioned, 43% of core foods were also classified as UP. These findings could suggest that manufacturers of core foods are attempting to differentiate them from discretionary or junk foods by including more regulated health claims to appear “better for you”, or “healthier”. On the other hand, in an effort to differentiate, discretionary foods may be more likely selling their organic and child specific attributes, both of which are unregulated, without overselling their health attributes\(^{(88)}\). Examining how on-pack marketing influences consumer choice when choosing food for young children needs to be a focus for
this age group, as it will contribute to policy considerations relating to toddler food and drink marketing.

Many of the claims and messaging present on toddler milks have little scientific evidence to support them such as DHA to support brain development or prebiotics to support digestion\(^{(32, 89, 90)}\). Our results are similar to results from the USA, which demonstrated that toddler milk labels included an average of four nutrition-related and three child-developmental messages per product (not including environmental, organic or other unregulated claims)\(^{(32)}\). Claims and messages are an important tool for marketing toddler milks to parents in a market where it is hard to differentiate products due to regulations around formulations. This result highlights that the policy void around unregulated claims may be creating an unintended marketing opportunity that may further confuse parents and put young children’s health at risk. This is another area for future research.

Understanding the correlates of toddler’s food intakes and food preferences is central to informing our understanding of the opportunities to shape these behaviours. This study demonstrated not only that foods and milks specifically for toddlers are commonplace in the Australian retail context, but also that the toddler food environment is abundant with products which contradict the Australian Dietary Guidelines nutritionally and also by processing level\(^{(91)}\). Results from this study and previous research have shown that there is considerable information displayed on toddler food product packaging. Previous research has also demonstrated that consumers use product packaging to make decisions about which foods to purchase. More information, specifically relating to toddler products, is needed about how these packaging attributes are influencing different types of consumers, to inform strategies for (i) assisting consumers to make health promoting choices, such as through education, and (ii) changing food regulation to determine permitted product attributes on food packaging.

Overall, our results show that this situation is not isolated to Australia. With the results from the current study, there is now a solid body of work which demonstrates that the global toddler food environments are problematic in terms of promoting unhealthy diets and food habits.

Public health messages supporting and educating parents and caregivers to create healthier meals and snacks for toddlers, and how to read on-pack information may help them evade the plethora of unhealthy and unnecessary foods and milks being targeted to this age group. In addition, further regulatory approaches, similar to those for infant foods and formulas, such as limiting ingredients and claims, and ensuring that toddler milks are clearly labelled as a supplementary food not intended for general use, could reduce consumer
confusion and result in ultra-processed toddler foods being replaced by less processed, more core food based alternatives.

Strengths and limitations:

An important strength of this study is that it has comprehensively audited the toddler food environment in Australia, including a range of stores and locations, replicating previously used methodology. In addition, this is the first study to also classify toddler food products against the NOVA classification, providing another perspective on this product category. To our knowledge this is the only study which has applied both the Australian Dietary Guidelines and the NOVA classification to toddler foods. Both the NOVA classification system and the ADG are appropriate for assessing toddler foods as evidence is emerging on the health implications of UPF\textsuperscript{(13-16, 45, 46, 50)}, and through the results of this study it is clear that many foods which are highly processed are being encouraged through our current ADG. This misalignment is potentially causing harm.

In addition this is the only Australian audit inclusive of toddler milks. Previous research in this area has focused on the Health Star rating and nutritional profiles\textsuperscript{(31, 64)} of a combination of baby (infant) and toddler foods and milks. By undertaking a comprehensive audit of the toddler retail food environment, a baseline for future research has been established. In addition, the findings from the current study can be useful in policy discussions, as well as consumer education and health promotion interventions around early childhood obesity prevention.

Limitations include the cross-sectional nature of this study, lending itself to one time point only, as well as products potentially being missed due to unavailability at the time of data collection. This could be mitigated though ongoing monitoring of the food supply. Misclassification of foods as core or discretionary may have occurred as the AUSNUT 2011-2013 database is not an accurate depiction of the current food supply. In addition, other research\textsuperscript{(92)} has also recognised the problematic nature of applying the NOVA classification to the AUSNUT database of foods for two main reasons. The first is that the AUSNUT 2011-2013 database is not reflective of the current food supply, and second, as there are many additives and processes which are used to manufacture foods, some judgment must be used when applying the NOVA classification for some food products. The NOVA system,
however, still remains the most relied upon classification system for information on the relationships between health outcomes and level of food processing\(^{(93)}\).

Conclusion

Child nutrition is fundamentally important for growth, development and a child’s future health. This study found that there are a large number of toddler specific foods and milks present in the Australian food retail environment, with 83\% of foods available for toddlers being sweet, UP snack foods. There is no specific regulation in Australia relating to toddler foods, and whilst toddler milks do fall under FSANZ standard 2.9.3, the intended consumers of these milks do not necessarily represent the actual consumers, due to misleading marketing through compelling media promotion and on-pack attributes. On pack claims and messages were many and varied across the spectrum of products audited, which may make it difficult for consumers to accurately evaluate the healthiness of toddler food and milk products. This then creates a situation in which consumers may struggle to make informed choices about food purchases for their young children, which then raises the question as to whether changes to regulation would make this choice easier for consumers. The frequent use of both regulated and unregulated claims across the spectrum of available foods in tandem with the high proportion of foods being classified as both core and UP, could mean that identifying a healthier choice may be difficult for consumers. The results of this study provide important substrate for policy and practice in the Australian context.

List of abbreviations:

- WHO – World Health Organization
- ADG – Australian Dietary Guidelines
- FSANZ – Food Standards Australia New Zealand
- NIP – Nutrition Information Panel
- UP – Ultra-processed
- MP- Minimally-processed
References


5. Bell LK, Jansen E, Mallan K et al. (2018) Poor dietary patterns at 1–5 years of age are related to food neophobia and breastfeeding duration but not age of introduction to solids in a relatively advantaged sample. *Eat Behav* 31, 28-34.


48. Karnopp EV, Vaz JD, Schafer AA et al. (2017) Food consumption of children younger than 6 years according to the degree of food processing. *J Pediatr (Rio J)* 93, 70-78.


Tables:

Table 1 – Proportion of toddler foods by sub-category or classification

<table>
<thead>
<tr>
<th>Sub-category or classification</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food category</strong></td>
<td></td>
</tr>
<tr>
<td>Snack</td>
<td>124 (80)</td>
</tr>
<tr>
<td>Meal</td>
<td>30 (20)</td>
</tr>
<tr>
<td><strong>ADG classification</strong></td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>93 (60)</td>
</tr>
<tr>
<td>Discretionary</td>
<td>61 (40)</td>
</tr>
<tr>
<td><strong>Processing level (NOVA)</strong></td>
<td></td>
</tr>
<tr>
<td>Minimally Processed</td>
<td>17 (11)</td>
</tr>
<tr>
<td>Processed</td>
<td>6 (4)</td>
</tr>
<tr>
<td>Ultra-processed</td>
<td>131 (85)</td>
</tr>
<tr>
<td><strong>Core foods</strong></td>
<td></td>
</tr>
<tr>
<td>Minimally-processed</td>
<td>15 (16)</td>
</tr>
<tr>
<td>Processed</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Ultra-processed</td>
<td>73 (79)</td>
</tr>
<tr>
<td><strong>Discretionary Foods</strong></td>
<td></td>
</tr>
<tr>
<td>Minimally-processed</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Processed</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Ultra-processed</td>
<td>58 (95)</td>
</tr>
<tr>
<td><strong>Snack food types</strong></td>
<td></td>
</tr>
<tr>
<td>Sweetened cereal based finger food*</td>
<td>45 (36)</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>28 (23)</td>
</tr>
<tr>
<td>Plain cereal based finger food*</td>
<td>16 (13)</td>
</tr>
<tr>
<td>Biscuits (including rusks)</td>
<td>12 (10)</td>
</tr>
<tr>
<td>Dried fruit</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Fruit chews or chewy fruit snack</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Fruit sweetened snacks otherwise not defined</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Fruit + cereal**</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Fruit puree</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Other dairy</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Vegetables + cereal</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Fruit juice</td>
<td>2 (2)</td>
</tr>
<tr>
<td><strong>Snack foods</strong></td>
<td></td>
</tr>
<tr>
<td>Sweet</td>
<td>100 (81)</td>
</tr>
<tr>
<td>Savoury</td>
<td>24 (19)</td>
</tr>
</tbody>
</table>

*Cereal is the main ingredient. **Fruit is the main ingredient.
Table 2 – Median (Interquartile range) nutrition information per 100g for meals and snacks

<table>
<thead>
<tr>
<th></th>
<th>Meals n= 30</th>
<th>Minimum and maximum values</th>
<th>Snacks n= 124</th>
<th>Minimum and maximum values</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy kJ</td>
<td>418 (153)</td>
<td>218-634</td>
<td>1561.5 (1481)</td>
<td>119-2380</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Protein g</td>
<td>4.4 (2)</td>
<td>2-8</td>
<td>5.45 (3.5)</td>
<td>0-16</td>
<td>0.054</td>
</tr>
<tr>
<td>Fat g</td>
<td>3.2 (3.2)</td>
<td>1-10</td>
<td>6.35 (12.6)</td>
<td>0-34</td>
<td>0.008</td>
</tr>
<tr>
<td>Saturated fat g</td>
<td>1.6 (1.7)</td>
<td>0-6</td>
<td>2.35 (2.7)</td>
<td>0-22</td>
<td>0.080</td>
</tr>
<tr>
<td>Carbohydrate g</td>
<td>10.6 (4.8)</td>
<td>8-20</td>
<td>61.1 (59.1)</td>
<td>5-93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total sugar g</td>
<td>2.6 (1)</td>
<td>1-5</td>
<td>13.6 (29.8)</td>
<td>1-75</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sodium mg</td>
<td>105 (26.3)</td>
<td>12-154</td>
<td>46 (148)</td>
<td>0-1160</td>
<td>0.061</td>
</tr>
</tbody>
</table>
Table 3 – Median (Interquartile range) nutrition information per 100g for core and discretionary foods

<table>
<thead>
<tr>
<th></th>
<th>Core n=93</th>
<th>Minimum and maximum values</th>
<th>Discretionary n=61</th>
<th>Minimum and maximum values</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy kJ</td>
<td>388 (1130)</td>
<td>119-2110</td>
<td>1766 (398)</td>
<td>1190-2380</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Protein g</td>
<td>4.2 (2.3)</td>
<td>0-13</td>
<td>6.9 (4.1)</td>
<td>1-16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Fat g</td>
<td>3.1 (3.7)</td>
<td>0-32</td>
<td>11.5 (10.5)</td>
<td>1-34</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Saturated fat g</td>
<td>1.6 (1.6)</td>
<td>0-22</td>
<td>2.8 (3.8)</td>
<td>0-22</td>
<td>0.001</td>
</tr>
<tr>
<td>Carbohydrate g</td>
<td>11 (42.2)</td>
<td>5-93</td>
<td>64.3 (10.3)</td>
<td>30-79</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total sugar g</td>
<td>5.7 (8.3)</td>
<td>1-75</td>
<td>22.7 (31.7)</td>
<td>1-69</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sodium mg</td>
<td>46 (88.3)</td>
<td>1-319</td>
<td>122 (197)</td>
<td>0-1160</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Table 4—Median (Interquartile range) nutrition information per 100g for foods across NOVA groups

<table>
<thead>
<tr>
<th></th>
<th>MP n=17</th>
<th>Minimum and maximum values</th>
<th>P n=6</th>
<th>Minimum and maximum values</th>
<th>UP n=131</th>
<th>Minimum and maximum values</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy kJ</td>
<td>1512 (530)</td>
<td>119-1950</td>
<td>430 (557.5)</td>
<td>250-1810</td>
<td>1440 (1424)</td>
<td>218-2380</td>
<td>0.162</td>
</tr>
<tr>
<td>Protein g</td>
<td>4.1 (4.8)</td>
<td>0-13</td>
<td>5.0 (3.8)</td>
<td>2-12</td>
<td>4.9 (3)</td>
<td>1-16</td>
<td>0.221</td>
</tr>
<tr>
<td>Fat g</td>
<td>7.7 (22.9)</td>
<td>0-32</td>
<td>4.0 (5.4)</td>
<td>1-10</td>
<td>5.0 (9.7)</td>
<td>1-34</td>
<td>0.746</td>
</tr>
<tr>
<td>Saturated fat g</td>
<td>0.9 (17)</td>
<td>0.22</td>
<td>1.6 (3)</td>
<td>0-4</td>
<td>2.2 (2.1)</td>
<td>0-22</td>
<td>0.747</td>
</tr>
<tr>
<td>Carbohydrate g</td>
<td>55 (23)</td>
<td>7-81</td>
<td>10.5 (19.6)</td>
<td>8-71</td>
<td>56.8 (57.4)</td>
<td>5-93</td>
<td>0.238</td>
</tr>
<tr>
<td>Total sugar g</td>
<td>40.4 (19.4)</td>
<td>7-75</td>
<td>1.6 (2.1)</td>
<td>1-4</td>
<td>7.4 (19.5)</td>
<td>1-69</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sodium mg</td>
<td>8 (8.3)</td>
<td>1-75</td>
<td>93 (84.3)</td>
<td>12-118</td>
<td>79 (122)</td>
<td>0-1160</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

(P-UP 0.009, MP-UP <0.001, MP <0.001)
Table 5- Number (%) and range of claims and messages on toddler foods

<table>
<thead>
<tr>
<th>Claim or message type</th>
<th>Number (%) of products displaying claim or message within claim category or sub-category</th>
<th>Range of number of claims or messages on individual products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any claims or messages (n=1613)</td>
<td>152 (99)</td>
<td>0-26</td>
</tr>
<tr>
<td><strong>All Unregulated</strong> claims and messages (n=1400)</td>
<td>152 (99)</td>
<td>0-24</td>
</tr>
<tr>
<td>Health related ingredient claims (Unregulated) (n=687)</td>
<td>144 (94)</td>
<td>0-14</td>
</tr>
<tr>
<td>Other messages (Unregulated) (n= 430)</td>
<td>113 (73)</td>
<td>0-8</td>
</tr>
<tr>
<td>Child specific messages (Unregulated) (n=108)</td>
<td>63 (41)</td>
<td>0-6</td>
</tr>
<tr>
<td>Natural and organic claims (Unregulated) (n=88)</td>
<td>65 (42)</td>
<td>0-3</td>
</tr>
<tr>
<td>Environmental claims (Unregulated) (n=87)</td>
<td>83 (54)</td>
<td>0-2</td>
</tr>
<tr>
<td><strong>All regulated</strong> claims (n=213)</td>
<td>109 (71)</td>
<td>0-4</td>
</tr>
<tr>
<td>Nutrition content claims (Regulated) (n=166)</td>
<td>94 (61)</td>
<td>0-4</td>
</tr>
<tr>
<td>General health claims (Regulated) (n= 47)</td>
<td>25 (16)</td>
<td>0-3</td>
</tr>
</tbody>
</table>

*N(%) = frequency of claims or messages*
Table 6: Mean nutrition value (standard deviation) of toddler milk compared with cow’s milk and soft drink, per 100ml

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Toddler milk mean (n=32)</th>
<th>Woolworths full fat milk</th>
<th>Fanta soft drink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kJ)</td>
<td>275 (40)</td>
<td>264</td>
<td>137</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>2.1 (0.6)</td>
<td>3.3</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>2.8 (0.5)</td>
<td>3.4</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Saturated fat (g)</td>
<td>1.1 (0.5)</td>
<td>2.2</td>
<td>0</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>8.9 (3.0)</td>
<td>4.8</td>
<td>7.9</td>
</tr>
<tr>
<td>Sugar (g)</td>
<td>7.1 (1.6)</td>
<td>4.8</td>
<td>7.9</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>26.2 (7.2)</td>
<td>44</td>
<td>1.1</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>107 (30)</td>
<td>117</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 7 - Number (%) and range of claims and messages on toddler milks, n=32

<table>
<thead>
<tr>
<th>Claim or message type</th>
<th>Number (%) of products displaying claim or message within claim category or sub-category</th>
<th>Range of number of claims or messages on individual products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of claims n= 445</td>
<td>32 (100)</td>
<td>2-26</td>
</tr>
<tr>
<td>Total number of unregulated claims and messages n= 183</td>
<td>32 (100)</td>
<td>2-13</td>
</tr>
<tr>
<td>Health related ingredient claims (Unregulated) n= 86</td>
<td>31 (97)</td>
<td>1-8</td>
</tr>
<tr>
<td>Other messages (Unregulated) n=47</td>
<td>26 (81)</td>
<td>0-5</td>
</tr>
<tr>
<td>Child specific messages (Unregulated) n=21</td>
<td>12 (38)</td>
<td>0-5</td>
</tr>
<tr>
<td>Environmental claims (Unregulated) n=22</td>
<td>22 (69)</td>
<td>0-1</td>
</tr>
<tr>
<td>Natural and organic claims (Unregulated) n=3</td>
<td>3 (9)</td>
<td>0-1</td>
</tr>
<tr>
<td>Total number of regulated claims n=262</td>
<td>29 (91)</td>
<td>0-19</td>
</tr>
<tr>
<td>General health claims (Regulated) n= 175</td>
<td>24 (75)</td>
<td>0-12</td>
</tr>
<tr>
<td>Nutrition content claims (Regulated) n=87</td>
<td>23 (72)</td>
<td>0-18</td>
</tr>
</tbody>
</table>

*N(%) = frequency of claims or messages*