Caregiver's Provision of Non-Recommended Commercially Prepared Milk-Based Drinks to Infants and Toddlers

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ABSTRACT

Objective: Assess milk type provision (commercially prepared infant and toddler formula, cow's milk, and plant milk) to infants and toddlers, accounting for sociodemographic characteristics and marketing claims.

Participants: Caregivers (N = 1,645) of children (aged 6−36 months) recruited through online panels in 2017.

Methods: Cross-sectional survey analysis (system of probit equations) estimated associations between sociodemographics and agreement with marketing claims (independent variables) with milk type provision in the past month (binary dependent variable).

Results: Most caregivers (63%) of infants (aged 6−11 months) provided only breastmilk and/or commercially prepared infant formula. Sixty-five percent of caregivers of 12-month-old infants provided commercially prepared infant formula, and 47% provided cow's milk. Most caregivers (64%) of toddlers (aged 13−36 months) provided cow's milk; some also provided other non–recommended milk types (51%). Associations between milk types suggested milk-based drink provision should be evaluated as a pattern and not as independent behaviors (all *P*s < 0.048). Milk type provision was significantly associated with a child's age (months), household income, and race (all *P*s < 0.049). Including agreement with marketing claims reduced the significance of associations between milk type provision and some sociodemographic characteristics.

Conclusions and Implications: These findings suggest the need for additional expert guidance to discourage inappropriate and unnecessary milk for young children, provide strategies to transition from breastmilk (or commercially prepared infant formula) to cow's milk, and conduct outreach to communities at risk for health disparities about the dangers of serving milk that is not recommended for their child's age. Research is needed to understand how diverse populations interpret product claims and how marketing may perpetuate health disparities.

Key Words: dietary recommendations, early childhood, marketing, infant formula, toddler milk (*J Nutr Educ Behav.* 2021;53:643−653.)

INTRODUCTION

In 2018, the American Academy of Pediatrics participated in an expert panel to establish comprehensive guidance on optimal beverage consumption by young children (up to 5 years).[1] *Healthy Eating Research* (HER) convened the panel in recognition of the importance of healthy beverage intake in reducing the risk of diet-related chronic diseases, including obesity, type 2 diabetes, and dental caries. Experts counseled against serving cow's milk or other types of milk (other than breastmilk or commercially prepared infant formula) to infants (aged 6−12 months). For young children (aged from 12 months to 5 years), experts recommended plain cow's milk as a critical component of a healthy diet. Notably, 12-month-old children are included in both categories recognizing this age as a transitional period. The expert panel also counseled against serving any drinks with added sugar.[1] In addition, the National Academies of Sciences Engineering and Medicine published a summary of existing guidance on feeding infants and children in 2020.[2] The summary reports consistent indication that commercially prepared infant formula is not needed beyond 12 months of age. Moreover, the group found generally consistent recommendations against cow's milk before 9 months of age and no consistent recommendations for serving cow's milk to children

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aged 9−12 months. The findings also include consistent recommendations against sugar-sweetened beverages and plant milk from birth to 24 months of age.[2]

These recommendations also reflect the growing popularity of alternative milk and potential issues with serving them to young children. The HER panel established guidance for alternative milk for young children, recommending against providing toddler milk because of their added sugar content and higher cost than cow's milk. Toddler milk products (toddler formula or growing-up milk) are typically powdered milk-based products offered by commercially prepared infant formula manufacturers and marketed as beneficial for toddlers (aged 1−3 years).[3,4] Toddler milk represent the fastest-growing formula category in the US, with sales increasing 2.6 times from 2006 to 2015.[5] During this time, manufacturers also increased their advertising expenditures 4-fold,[6] with marketing claims that imply considerable benefits for toddlers' development and promote them as superior to cow's milk. Research in the US and other countries suggests considerable consumer confusion about the difference between commercially prepared infant formula and toddler milk.[3,7,8] One study reported that approximately 40% of toddler caregivers admitted serving a toddler milk to their child, and 11% of infant caregivers selected a toddler milk as the commercially prepared formula they served most often.[9]

Other experts raise concerns about unproven and potentially misleading claims on toddler milk and infant formula.[9,10] Previous research showed that the majority of caregivers of infants incorrectly believed that commercially prepared infant formula can be better for babies' digestion and brain development than breastmilk and that it can provide nutrition not present in breastmilk (52% and 62%, respectively), promises that are commonly implied in marketing for these products.[9] Similarly, 60% of toddlers' caregivers misperceived that toddler milk provide nutrition to toddlers that they do not get from other foods.[9] In that study, agreement with these marketing claims increased the odds of serving commercially prepared infant formula and/or toddler milk to infants and toddlers.[9]

The HER expert panel also advised that a plant milk (eg, rice, nuts, oat milk) should not replace cow's milk unless medically indicated to meet specific dietary preferences (eg, vegan diets).[1] The National Academies report also included consistent recommendations against plant milk from birth to 24 months of age.[2] However, sales of plant milk have also grown rapidly in the US, increasing by 61% from 2012 to 2017.[11] Most plant milk are not considered an adequate substitute for cow's milk because of a lack of evidence that added nutrients in these products are comparable to those that occur naturally in cow's milk and often contain added sugars.[12−14] Nutrient deficiencies have been reported on infants fed exclusively with plant-based milk, including rickets, kwashiorkor, and metabolic alkalosis.[15] One study found that 4.5% of young children (aged 2−4 years) consumed plant milk on a given day, but research has not assessed consumption by children aged < 2 years.[16,17]

The objective of this study was to assess the prevalence of serving non-recommended milk beverages (ie, toddler milk and plant milk) in place of and in addition to recommended milk-based products (including commercially prepared infant formula and cow's milk) for infants (aged 6−11 months) and toddlers (aged 13−36 months). The authors examined 12-month-old children separately to account for the inclusion of this age group in both infant and toddler guidance on serving commercially prepared infant formula and cow's milk. It also examined differences in milk provision patterns by household income and caregiver race/ethnicity, as well as participants' agreement with marketing claims.

METHODS

This study used a cross-sectional online survey of US primary caregivers of infants (aged 6−11 months), infants in transition (aged 12 months), and toddlers (aged 13−36 months). The large nonprobability sample (n = 1,645) included a diverse sample of participants for meaningful comparisons between demographic groups. This analysis reports the incidence of caregivers' provision of commercially prepared infant formula, toddler milk, cow's milk, and plant milk in the past month. The survey also assessed other feeding practices, attitudes about products, and marketing claims.[9]

Survey Participants

Participants were recruited through a national online survey panel (Innovate, Calabasas, CA) and another panel of Hispanic households (Offerwise, Ashburn, VA). Both panels provide members with nonmonetary incentives for voluntary survey participation. Members receive points for completing surveys and redeem them for incentives, such as online gift cards and charitable donations.

The panel companies invited caregivers with at least one 6−36-month-old child to participate in this survey. A random sample of 600 participants was requested with augments to obtain minimum numbers of Black non-Hispanic (n = 400), Asian Pacific Islander (n = 180), and Hispanic (n = 600; English- and Spanish-speaking) participants. Quota sampling ensured approximately equal numbers of respondents by child's age group (6−11, 12−23, and 24−36 months) and household income group ($15,000−$39,999, $40,000−$74,999, and > $75,000). This recruiting plan allowed for meaningful comparisons between groups of interest.[18] Panel members who agreed to participate received a link to the 30-minute online survey (participants could choose English or Spanish) delivered via Qualtrics software (version 2016, Qualtrics, 2016). Data collection occurred from April to June, 2017. The University of Connecticut's Institutional Review Board approved all measures and procedures.

Survey Measures and Design

Survey items were pretested using a convenience sample of 20 caregivers of young children (aged 6−36

months). In 1-on-1 cognitive interviews, researchers tested the survey administration process and asked caregivers to think out loud while responding to each survey question and then answer probes to identify any comprehension, interpretation, or recall issues.[19,20]

Selection of child. Participants were screened for children living in their households aged between 6 and 36 months and responsibility regarding feeding decisions. Children with a disease or condition that requires a special diet (eg, lactose intolerance) were excluded (n = 233). Participants with more than 1 eligible child selected the child with the most recent birthday.

Patterns of milk type provision. Participants answered whether they had ever breastfed their child and at what age they stopped breastfeeding. They then selected all types of milk they served their child in the past month, including commercially prepared infant formulas, other formulas or powdered milk, regular milk (ie, cow's milk), nondairy milk (eg, almond, coconut, and soy), other (fill-in), and none of the above (including exclusive breastfeeding). To address potential confusion about the difference between commercially prepared infant formula and toddler milk,[6] the survey provided multiple examples of brand names (eg, Enfamil, Enfagrow, and Similac Go & Grow) and did not use the term toddler milk.

Frequency of serving milk types. Participants then reported the frequency they provided regular milk and/or nondairy milk using a 6-item frequency scale (from once in the past month to more than once per day). If participants reported providing commercially prepared infant formula and/or other formulas or toddler milk in the past month, they first identified the specific product they served most often (from package images and names of products from all brands provided). They then answered the frequency they provided the product served most often. This process accounted for potential confusion between commercially

prepared infant formula and toddler milk.

Agreement with expert recommendations and marketing claims. Participants selected their agreement with various statements and claims about commercially prepared infant formulas, toddler milk, and other drinks for either infants or toddlers (7-point Likert scale from strongly disagree to strongly agree).

Caregivers of infants rated their agreement with 4 marketing claims commonly found on regular infant formula packages: (1) infant formulas can provide nutrition that babies do not get from breastmilk; (2) infant formulas can be better for babies' digestion than breastmilk; (3) infant formulas can be better for babies' brain development than breastmilk, and (4) infant formulas help babies grow.[1,3–5,9] Toddler caregivers saw 1 toddler milk product claim (adapted from common claims on toddler milk): toddler formulas or powdered milk provide nutrition that toddlers do not get from other food and drinks.[1,3–5,9] Because of high covariance between the 4 infant formula marketing claims (α = 0.81), researchers averaged them to create a scale for agreement with infant formula claims. Researchers categorized responses to the commercially prepared informant formula claims scale and the toddler milk claim as agree ($\geq$ 5) or neutral/disagree (< 5).

Caregiver demographics. Finally, participants reported demographic information including household income, race, and ethnicity, which was self-reported by the parents of the children from a list including non-Hispanic White, non-Hispanic Black, Hispanic, Asian or Pacific Islander, Native American (including Alaskan), biracial or multiracial (specify), or other (please specify). Participants selecting Hispanic ethnicity also answered the Short Acculturation Scale for Hispanics to assess language preference, ranging from 1 (only Spanish) to 5 (only English). In accordance with Short Acculturation Scale for Hispanics methodology, participants scoring $\leq$ 3.0 were classified as less acculturated.[21,22]

Statistical Analysis

The data analyses for this paper were generated using SAS (version 9.4, SAS Institute Inc, 2013). Descriptive statistics include incidence and frequency of provision of milk type and combinations of milk types served. Model 1: a system of probit equations estimated the regression coefficients for provision of each milk type (binary outcome variables) and child age (in months), household income, and race/ethnicity as predictors, with separate models for infants (aged 6−11 months) and toddlers (aged 13−36 months); 12-month-old children were excluded from these analyses. As food choices cannot be assumed to be independent, this method accounts for the possibility that some predictor variables (eg, child age in months, household income, and race/ethnicity) are jointly determined with the outcome variables (binary variables of the provision of each milk type) and allows for correlation of error components across equations for each type of milk.[23] In addition, the regression coefficients were used to estimate the predicted probability of serving each milk type by child's age and household demographics, accounting for other milk types served to infants (Supplementary Table 1) and toddlers (Supplementary Table 2). Model 2: included the same system of probit models as model 1 with the addition of a binary dummy variable indicating agreement with marketing claims. *Post hoc* power analysis from a general linear model using SAS with milk types as dependent and sociodemographic characteristics as independent variables, at alpha = 0.05 and n = 1,607 showed that all comparisons were well powered ($\geq$ 0.8), with the exception of nondairy milk provision by race (power = 0.22).

RESULTS

The sample participants (N = 1,645) were mostly female, aged 25−44 years, married, with at least some college education, and approximately half had household incomes < $40,000 (Table 1). Because of sampling procedures, participants were diverse in race/ethnicity. Of the original 2,426 participants, 13% did not meet inclusion criteria, and 14% did not

Table 1. Sociodemographic Characteristics of Caregivers of Children Aged 6−36 Months (n = 1,645) (2017)

| | Age of Child | | | | | | | | | |
| | Infants, 6−11 mo | | Infants in Transition, 12 mo | | Young Toddlers, 13−23 mo | | Older Toddlers 24−36 mo | | Total | |
Characteristics[a]	n	%	n	%	n	%	n	%	n	%
Sample	555	100	55	100	501	100	534	100	1,645	100
Caregiver race/ethnicity										
White non-Hispanic	157	28	21	38	169	34	190	36	537	33
Black non-Hispanic	171	31	11	20	109	22	76	14	367	22
Hispanic: more acculturated[23]	69	12	6	11	66	13	87	16	228	14
Hispanic: less acculturated	82	15	13	24	70	14	114	21	279	17
Asian	65	12	4	7	76	15	51	10	196	12
Mixed/other	11	2	0	0	11	2	16	3	38	2
Household income[b]										
< $40,000	245	44	32	58	220	44	252	47	749	46
$40,000−$74,000	174	31	10	18	149	30	160	30	493	30
> $75,000	131	24	13	24	130	26	121	23	395	24
Caregiver gender										
Female[b]	441	79	46	84	430	86	430	81	1,347	82
Male	110	20	8	15	97	19	97	18	312	19
Caregiver education										
High school or GED	94	17	19	35	128	26	128	24	369	22
Some college or 2-y college	210	38	15	27	188	38	188	35	601	37
College graduate or higher	251	45	21	38	218	44	218	41	708	43
Caregiver age, y										
18−24	78	14	9	16	76	15	72	13	235	14
25−34	308	55	33	60	290	58	271	51	902	55
35−44	154	28	10	18	166	33	157	29	487	30
> 45	15	3	3	5	21	4	34	6	73	4
Marital status										
Single	132	24	15	27	108	22	122	23	377	23
Married	423	76	40	73	393	78	412	77	1,268	77
Child gender										
Female	282	51	32	58	234	47	262	49	810	49
Male	273	49	23	42	267	53	272	51	835	51

[a]Caregivers of children aged 6−36 months, who had responsibility for feeding their child without dietary restrictions recruited via online panels; [b]Does not total 100% because of missing data.

complete the survey for a completion rate of 72%. Data for an additional 107 participants were excluded because of inconsistent responses.

Patterns of Milk Type Provision

Approximately two-thirds of caregivers reported serving the types of milk that experts recommend for their infant or toddler (Table 2), including breastfeeding and/or serving commercially prepared infant formula with no other milk type to infants and serving cow's milk to toddlers in the past month. Approximately two thirds of caregivers for infants in transition (aged 12 months) provided any commercially prepared infant formula, approximately a quarter provided commercially prepared infant formula with cow's milk, and 15% provided cow's milk only.

However, more than one third of infant caregivers surveyed reported serving at least 1 non-recommended milk type to their infant in the past month, including toddler milk and/or cow's milk, and most reported providing them daily (Table 3). Furthermore, the majority of toddler caregivers did not follow expert recommendations to provide only cow's milk to their children in the past month. Of the non-recommended milk types, toddler caregivers reported serving commercially prepared infant formula most often, followed by toddler milk and plant milk. Approximately one-half of those who served commercially prepared toddler milk or infant formula to their toddler reported serving it daily. For both age groups, caregivers tended to provide non-recommended milk types in addition to recommended types, including commercially prepared infant formula for infants and plain cow's milk for toddlers.

Associations of Child and Household Demographics With the Type of Milk Provided

Provision of milk types. The models to predict the provision of different milk types to infants (aged 6−11 months) (Table 4) and toddlers (aged 13−36 months) (Table 5)

Table 2. Patterns of Milk Type Provision to Infants Aged 6−11 Months (n = 544) and Toddlers Aged 13−36 Months (n = 1,008) (2017)[a]

Milk Type	With or Without Cow's Milk		No Cow's Milk	
	n	%	n	%
Infants aged 6−11 mo, n = 544				
Ever breastfed	508	93		
Recommended milk only				
Exclusive breastfeeding	111	20		
Commercially prepared infant formula (including breastmilk supplementation)	230	42		
Total recommended only	341	63		
Not recommended milk				
Any toddler milk	122	22		
Any cow's milk	109	20		
Plant milk	39	7		
Total not recommended	203	37		
Combinations of milk served				
Commercially prepared infant formula and toddler milk	100	18		
Commercially prepared infant formula and cow's milk	97	18		
Commercially prepared infant formula, cow's milk, and toddler milk	28	5		

Milk Type	With Cow's Milk		No Cow's Milk	
	n	%	n	%
Infants in transition aged 12 months, n = 55				
Any cow's milk	26	47		
Only cow's milk	8	15		
Cow's milk with other milk types	18	33		
No milk (any type)	4	7		
Combinations of milk served				
Any toddler milk	8	15	10	18
Any commercially prepared infant formula	15	27	21	38
Any plant milk	4	7	2	4
Commercially prepared infant formula and toddler milk	5	9	6	11
Younger toddlers aged 13−23 mo, n = 490				
Any cow's milk	318	65		
Only cow's milk (recommended)	70	14		
Cow's milk with other milk types	248	51		
No milk (any type)	10	2		
Combinations of milk served				
Any toddler milk	136	28	85	17
Any commercially prepared infant formula	162	33	117	24
Any plant milk	73	15	22	4
Commercially prepared infant formula and toddler	71	14	48	10
Older toddlers aged 24−36 mo, n = 518				
Any cow's milk	325	63		
Only cow's milk (recommended)	141	27		
Cow's milk with other milk types	184	36		
No milk (any type)	15	3		
Combinations of milk served				
Any toddler milk	109	21	103	20
Any commercially prepared infant formula	106	20	120	23
Any plant milk	71	14	31	6
Commercially prepared infant formula and toddler milk	55	11	51	10

[a]Caregivers of children aged 6−36 months who had responsibility for feeding their child without dietary restrictions recruited via online panels.

Table 3. Frequency of Milk Type Provision to Infants Aged 6–11 Months (n = 544) and Toddlers Aged 13–36 Months (n = 1,008) (2017)[a]

Milk Type	Infants, 6–11 mo	Infants in Transition, 12 mo	Young Toddlers, 13–23 mo	Older Toddlers, 24–36 mo
Commercially prepared infant formula[b]	n = 328	n = 29	n = 213	n = 182
Monthly	5	17	25	29
Weekly	24	10	22	24
Daily	71	72	54	47
Toddler milk[b]	n = 54	n = 9	n = 115	n = 110
Monthly	11	33	17	26
Weekly	20	22	30	23
Daily	69	44	54	51
Cow's milk	n = 109	n = 26	n = 310	n = 314
Monthly	9	23	9	7
Weekly	28	19	19	22
Daily	63	58	72	71
Plant milk	n = 39	n = 6	n = 93	n = 101
Monthly	15	50	33	16
Weekly	33	50	38	48
Daily	51	0	29	37

[a]Caregivers of children 6–36 months of age, who had responsibility for feeding their child without dietary restrictions recruited via online panels; [b]Product served most often.

Note: Values are %.

demonstrated relationships between the provision of some types. For infants, provision of commercially prepared infant formula was associated with an increased probability of providing cow's milk ($P = 0.003$) but not toddler milk or plant milk, whereas providing toddler milk ($P < 0.001$) and/or cow's milk ($P < 0.001$) predicted also serving plant milk. For toddlers, providing cow's milk was positively related to providing plant milk ($P = 0.02$) but negatively associated with providing toddler milk ($P = 0.001$) and commercially prepared infant formula ($P < 0.001$). Providing toddler milk was also related to an increased probability of providing plant milk ($P = 0.02$).

Child's age. Predicted probabilities in model 1, before inclusion of agreement with marketing claims (Table 4) show that, after controlling for associations between types of milk served, child's age (in months) increased the probability of serving cow's milk to infants ($P = 0.04$) and decreased the probability of serving commercially prepared infant formula to toddlers ($P < 0.001$). However, age was not related to the provision of other milk types. In addition, after controlling for

associations between types of milk, child's age in months, annual income, and racial or ethnic background in model 2 agreement with marketing claims increased the probability of serving all milk types to infants and toddler milk and cow's milk to toddlers.

Household income. Household income was also related to the types of milk provided to infants. In model 1, caregivers from middle- and lower-income households were more likely to provide commercially prepared infant formula than caregivers in higher-income households ($P = 0.03$ and $P = 0.01$, respectively). In addition, caregivers in middle-income households were more likely to provide toddler milk than caregivers in lower-income households ($P = 0.03$). Infant caregivers in the middle-income group were more likely to provide plant milk than caregivers from higher-income households ($P = 0.02$) and lower-income households ($P < 0.001$). With the addition of the marketing claim variable in model 2, all relationships between household income and milk type provision remained significant except for that between income and toddler milk provision ($P = 0.056$). For toddlers, higher-income households

were less likely to provide cow's milk ($P < 0.001$ for lower- and middle-income households) while more likely to provide toddler milk ($P < 0.001$ for lower- and middle-income households) and commercially prepared infant formula ($P < 0.001$ compared with lower-income households). Plant milk provision was also associated with household income, with caregivers from middle- and higher-income households more likely to provide plant milk than those in lower-income households ($P < 0.001$). These significant relationships remained after the addition of the marketing claim variable in model 2.

Racial and ethnic background: Infant caregivers. There were some differences in milk type provision by race/ethnicity for infant caregivers (Table 4) (model 1). Compared with non-Hispanic White caregivers, Asian caregivers were more likely to provide commercially prepared infant formula ($P = 0.01$) and cow's milk ($P < 0.001$), and Hispanic caregivers (less acculturated [$P = 0.003$] and more acculturated [$P = 0.02$]) were less likely to provide cow's milk. *Post hoc* comparisons with Bonferroni adjustments (Supplementary Table) showed that Asian ($P < 0.001$) and

Table 4. Associations of Child and Household Demographics With Type of Milk Provided to Infants Aged 6−11 Months (n = 544) (2017)

| | Model 1: Milk Type Provision and Sociodemographics | | | | | | | | | | | | Model 2: Milk Type Provision, Sociodemographics, and Agreement With Marketing Claims | | | | | | | | | | | |
| | Commercially Prepared Infant Formula | | | Toddler Milk | | | Cow's Milk | | | Plant Milk | | | Commercially Prepared Infant Formula | | | Toddler Milk | | | Cow's Milk | | | Plant Milk | | |
Independent Variable	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P
Provision of milk types																								
Commercially prepared infant formula																								
Toddler milk	0.15	−0.03 to 0.33	0.11										0.11	−0.07 to 0.30	0.22									
Cow's milk	0.29	0.10 to 0.48	0.003	0.17	0.00 to 0.33	0.047							0.27	0.08 to 0.46	0.006	0.16	−0.01 to 0.32	0.07						
Plant milk	0.18	−0.07 to 0.42	0.15	0.47	0.29 to 0.65	< 0.001	0.49	0.30 to 0.67	< 0.001				0.16	−0.10 to 0.43	0.23	0.50	0.29 to 0.70	< 0.001	0.46	0.27 to 0.65	< 0.001			
Child age, mo[a]	0.00	−0.07 to 0.08	0.94	0.05	−0.03 to 0.13	0.20	0.09	0.00 to 0.17	0.04	0.06	−0.05 to 0.16	0.29	0.00	−0.07 to 0.07	0.99	0.05	−0.03 to 0.12	0.24	0.08	0.00 to 0.17	0.05	0.06	−0.05 to 0.17	0.30
Household Income																								
> $75,000 (comparison group)																								
$40,000 to $74,999	0.43	0.12 to 0.75	0.01	0.13	−0.31 to 0.31	0.40	0.30	−0.04 to 0.63	0.08	0.53	0.09 to 0.96	0.02	0.44	0.12 to 0.76	0.01	0.15	−0.17 to 0.46	0.36	0.31	−0.02 to 0.65	0.07	0.56	0.10 to 1.02	0.02
< $39,999	0.34	0.04 to 0.65	0.03	−0.19	−0.51 to 0.13	0.24	0.03	−0.31 to 0.38	0.85	−0.27	−0.74 to 0.20	0.26	0.39	0.08 to 0.71	0.01	−0.15	−0.47 to 0.17	0.37	0.06	−0.28 to 0.41	0.72	−0.27	−0.77 to 0.24	0.30
Racial or ethnic background																								
White non-Hispanic (comparison group)																								
Black non-Hispanic	0.22	−0.08 to 0.53	0.15	0.28	−0.02 to 0.58	0.07	0.29	−0.02 to 0.60	0.07	−0.43	−0.85 to 0.00	0.05	0.07	−0.27 to 0.40	0.70	0.12	−0.20 to 0.45	0.46	0.16	−0.18 to 0.50	0.35	−0.63	−1.12 to −0.15	0.01
Hispanic: less acculturated	−0.26	−0.64 to 0.11	0.17	−0.36	−0.82 to 0.09	0.12	−1.12	−1.87 to −0.37	0.004	−0.16	−0.75 to 0.43	0.59	−0.26	−0.64 to 0.12	0.18	−0.35	−0.80 to 0.11	0.14	−1.11	−1.87 to −0.35	0.004	−0.20	−0.84 to 0.45	0.54
Hispanic: more acculturated	−0.14	−0.53 to 0.25	0.48	−0.23	−0.68 to 0.22	0.31	−0.72	−1.32 to −0.13	0.02	−0.26	−0.90 to 0.38	0.42	−0.13	−0.52 to 0.26	0.52	−0.21	−0.66 to 0.24	0.37	−0.70	−1.30 to −0.10	0.02	−0.27	−0.95 to 0.42	0.44
Asian	0.59	0.14 to 1.04	0.01	−0.08	−0.49 to 0.34	0.72	0.77	0.38 to 1.16	< 0.001	0.07	−0.46 to 0.60	0.80	0.42	−0.06 to 0.89	0.09	−0.25	−0.69 to 0.19	0.26	0.63	0.22 to 1.04	0.003	−0.12	−0.69 to 0.46	0.69
Marketing claims																								
Neutral or disagree (comparison group)																								
Agree													0.35	0.08 to 0.63	0.01	0.37	0.09 to 0.66	0.01	0.30	−0.01 to 0.61	0.06	0.41	0.00 to 0.82	0.05

CI indicates confidence interval.

[a]Months of age included as a continuous variable in the model, beta refers to the change per additional month of age.

Note: Results from the system of simultaneous probit models with provision of milk type (binary outcome variables) and demographic differences as predictors for a sample of caregivers of children aged 6 to 36 months, who had responsibility for feeding their child without dietary restrictions recruited via online panels. Beta coefficients and CI are reported; significance was set at $P < 0.05$. *Post hoc* power analysis showed that plant milk comparisons by race were underpowered; therefore, caution when interpreting these findings is warranted.

Table 5. Associations of Child and Household Demographics With Type of Milk Provided to Toddlers Aged 13−36 Months (n = 1,008) (2017)

Independent Variable	Model 1: Milk Type Provision and Sociodemographics												Model 2: Milk Type Provision, Sociodemographics, and Agreement With Marketing Claims											
	Cow's Milk			Toddler Milk			Commercially Prepared Infant Formula			Plant Milk			Cow's Milk			Toddler Milk			Commercially Prepared Infant Formula			Plant Milk		
	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P	Beta	CI	P
Provision of milk types																								
Cow's milk																								
Toddler Milk	−0.16	−0.25 to −0.06	0.001										−0.18	−0.28 to −0.08	0.001									
Commercally prepared infant formula	−0.38	−0.47 to −0.28	< 0.001	−0.03	−0.14 to 0.07	0.536							−0.41	−0.50 to −0.31	< 0.001	−0.05	−0.15 to 0.05	0.36						
Plant milk	0.14	0.03 to 0.24	0.02	0.15	0.03 to 0.27	0.02	−0.05	−0.16 to 0.06	0.34				0.15	0.03 to 0.27	0.01	0.14	0.03 to 0.26	0.02	−0.07	−0.18 to 0.03	0.17			
Child age, mo[a]	0.00	−0.01 to 0.01	0.63	−0.01	−0.02 to 0.01	0.37	−0.03	−0.04 to −0.02	< 0.001	0.00	−0.01 to 0.02	0.61	0.00	−0.01 to 0.01	0.61	0.00	−0.02 to 0.01	0.40	−0.03	−0.04 to −0.01	< 0.001	0.00	−0.01 to 0.02	0.59
Household income																								
> $75,000 (comparison group)																								
$40,000−$74,999	0.47	0.25 to 0.69	< 0.001	−0.62	−0.83 to −0.40	< 0.001	−0.17	−0.39 to 0.05	0.13	−0.13	−0.36 to 0.10	0.26	0.47	0.25 to 0.70	< 0.001	−0.62	−0.84 to −0.40	< 0.001	−0.17	−0.38 to 0.05	0.13	−0.13	−0.36 to 0.10	0.27
< $39,999	0.40	0.20 to 0.61	< 0.001	−0.76	−0.96 to −0.55	< 0.001	−0.36	−0.57 to −0.15	0.001	−0.55	−0.78 to −0.32	<.001	0.41	0.20 to 0.62	0.00	−0.73	−0.94 to −0.52	< 0.001	−0.33	−0.54 to −0.13	0.001	−0.55	−0.78 to −0.32	< 0.001
Racial or ethnic background																								
White non-Hispanic (comparison group)																								
Black non-Hispanic	0.07	−0.17 to 0.31	0.58	0.07	−0.16 to 0.30	0.02	0.66	0.42 to 0.89	< 0.001	0.19	−0.06 to 0.43	0.14	0.06	−0.18 to 0.30	0.62	0.15	−0.09 to 0.38	0.22	0.55	0.32 to 0.79	< 0.001	0.20	−0.05 to 0.45	0.11
Hispanic: less acculturated	−0.86	−1.11 to −0.62	< 0.001	−0.86	−1.11 to −0.62	0.01	0.34	0.09 to 0.58	0.007	−0.40	−0.71 to −0.09	0.01	−0.87	−1.11 to −0.63	< 0.001	0.32	0.08 to 0.56	0.01	0.31	0.07 to 0.55	0.01	−0.40	−0.70 to −0.09	0.01
Hispanic: more acculturated	−0.21	−0.46 to 0.04	0.10	−0.21	−0.46 to 0.04	0.59	0.45	0.21 to 0.70	<0.001	−0.03	−0.31 to 0.24	0.81	−0.21	−0.46 to 0.04	0.10	0.03	−0.22 to 0.28	0.80	0.42	0.17 to 0.66	0.001	−0.03	−0.31 to 0.24	0.82
Asian	0.03	−0.24 to 0.31	0.82	0.03	−0.23 to 0.30	0.04	0.58	0.31 to 0.85	< 0.001	−0.04	−0.35 to 0.27	0.80	0.02	−0.26 to 0.30	0.88	0.18	−0.09 to 0.45	0.20	0.49	0.22 to 0.76	< 0.001	−0.03	−0.34 to 0.28	0.85
Marketing claims																								
Neutral or disagree (comparison group)																								
Agree													0.04	−0.15 to 0.23	0.68	0.51	0.32 to 0.70	< 0.001	0.35	0.17 to 0.54	< 0.001	−0.06	−0.27 to 0.15	0.60

CI indicates confidence interval.

[a]Months of age included as a continuous variable in the model, beta refers to the change per additional month of age.

Note: Results from the system of simultaneous probit models with provision of milk type (binary outcome variables) and demographic differences as predictors for a sample of care-givers of children aged 6−36 mo, who had responsibility for feeding their child without dietary restrictions recruited via online panels. Beta coefficients and CI are reported, significance was set at $P < 0.05$. *Post hoc* power analysis showed that plant milk comparisons by race were underpowered; therefore, caution when interpreting these findings is warranted.

Black ($P = 0.02$) caregivers were significantly more likely to provide commercially prepared infant formula compared with Hispanic caregivers (both less acculturated and more acculturated), whereas those who identified as Asian were more likely to provide it than more acculturated Hispanics ($P = 0.005$). Black caregivers were more likely to provide toddler milk than less acculturated ($P = 0.006$) and more acculturated ($P = 0.03$) Hispanic caregivers, but not compared to non-Hispanic White caregivers. Asian caregivers were more likely to provide cow's milk than other ethnicities (vs Black [$P = 0.01$], vs both more acculturated and less acculturated Hispanics [$P < 0.001$]). With the addition of the marketing claim in model 2, the difference between White and Asian caregivers in providing commercially prepared infant formula became non-significant ($P = 0.08$), but all other significant differences remained.

Racial and ethnic background: Toddler caregivers. Compared with White non-Hispanic caregivers (Table 5) (model 1), less acculturated Hispanic caregivers were less likely to provide cow's milk ($P < 0.001$), whereas Black non-Hispanic ($P = 0.02$), Asian ($P = 0.04$), and less acculturated Hispanic ($P = 0.01$) caregivers were more likely to provide toddler milk. *Post hoc* comparisons with Bonferroni adjustments (Supplementary Table) showed Black non-Hispanic were more likely to provide commercially prepared infant formula than less acculturated Hispanics ($P = 0.04$). Less acculturated Hispanics were less likely to provide cow's milk than Black ($P < 0.001$), more acculturated Hispanic ($P < 0.001$), and Asian ($P < 0.001$) caregivers. The addition of the marketing variable in Model 2 changed many of the relationships between toddler caregiver race/ethnicity and milk type provision. For toddler milk, differences between Black non-Hispanic and Asian compared to White non-Hispanic were no longer significant ($P = 0.22$ and 0.20, respectively) when the agreement with the marketing claim was included in this model. Conversely, the difference between and Hispanic less acculturated and more acculturated caregivers became significant ($P = 0.047$). For commercially prepared infant formula, the difference between Black non-Hispanic and Hispanic less acculturated caregivers became marginally significant ($P = 0.08$) with the addition of the marketing claim variable.

DISCUSSION

Although the majority of caregivers in this sample reported providing recommended milk types to their child, common provision of non-recommended milk types and racial, ethnic, and cultural differences raise concerns.[1,2] Furthermore, wide variation in the age that children transitioned from breastmilk and/or commercially prepared infant formula to cow's milk, including frequent transition after 12 months, suggests the need for additional guidance on best practices for this transition.

Infants Aged 6−11 Months

The incidence of providing non-recommended milk to infants raises serious concerns that these products may displace consumption of commercially prepared infant formula and/or breastmilk. Although the risk lowers with every additional month of age, caregivers who served cow's milk to their infant (aged 6−11-months) could place their child at risk for dehydration and iron-deficiency anemia because of potential blood loss and inhibition of nonheme iron from the higher concentration of calcium and casein in cow's milk or by displacing iron-fortified commercially prepared infant formula.[24] As the majority of caregivers who provided cow's milk did so daily, and provision of commercially prepared infant formula and cow's milk were positively related, it appears that caregivers may be supplementing commercially prepared infant formula with cow's milk before their child is developmentally ready. Although toddler milk and plant milk did not appear to displace commercially prepared infant formula in this sample (provision was not related), providing these products to infants raises additional concerns, especially if caregivers are serving them as a replacement for healthy foods.

The findings that caregivers in lower- and middle-income households and those who identified as Asian and Black non-Hispanic were more likely to provide commercially prepared infant formula are consistent with previous research and support the need for additional breastfeeding support for these populations.[27] In this sample, Asian and Black non-Hispanic infant caregivers were also more likely to provide cow's milk, and Black non-Hispanic caregivers were most likely to provide toddler milk.

Toddlers Aged 13−36 Months

Although experts recommend cow's milk as the only type of milk that young children need, few caregivers provided only cow's milk to their toddlers. Rather, the majority provided non-recommended types of milk, in addition to or instead of cow's milk. Serving cow's milk was negatively associated with providing commercially prepared infant formula or toddler milk, which suggests that caregivers view these commercial products as substitutes for plain cow's milk, despite expert concerns about the added sugar and additional cost of toddler milk.[1,5,14] Experts agree that infants who receive commercially prepared infant formula can switch to pasteurized whole cow's milk by 12 months of age, whereas breastfed infants may continue breastfeeding until they are 2 years old, as breastmilk's composition naturally changes over time to meet the child's needs.[24,26,27] Two expert guidelines recommend against providing commercially prepared infant formula for children after 12 months of age.[28,29] The 2019 consensus statement includes 12-month-old children in both infant and toddler age categories, which likely reflects the need for flexibility in the transition from commercially prepared infant formula to cow's milk.[1] However, findings suggest that many caregivers may find it difficult to transition from commercially prepared infant formula to cow's milk

and/or have concerns about their child receiving adequate nutrition from cow's milk and healthy food.

Agreement with marketing claims appears to partially explain some relationships between demographic variables and the provision of different milk types. Although most changes in significance were small, these findings highlight the need to examine how marketing claims may differentially affect diverse populations. Consumers may believe that all the marketed properties of commercially prepared products have been tested and scientifically proven before appearing on labels.[30] However, scientific evidence does not support the advertised properties of some commercially prepared products (eg, sensitive varieties).[5,30] For example, caregivers often believe that infants' excessive crying is caused by a digestive problem, even though only 5% to 10% of infants who cry excessively have any identifiable problems with their digestive tract.[31]

This study is not without limitations. As with all self-report surveys, participant responses may reflect inaccurate recollection or self-presentation bias. Although diverse, this sample is not nationally representative. However, online survey panels and quota sampling provide geographical heterogeneity and adequate representation of harder-to-recruit demographic groups. *Post hoc* power analysis showed that plant milk comparisons by race were underpowered; therefore, caution when interpreting these findings is warranted. In addition, the survey assessed the incidence and not the amount of milk served, although this method provides insights about the frequency of provision unavailable through 24-hour dietary recalls.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The results of this study indicate an opportunity for public health education campaigns, community outreach, and additional guidance from health care providers, especially regarding potential nutrient deficiencies, dehydration, and undernutrition when providing cow's milk or plant milk to infants and replacing breastmilk (or commercially prepared infant formula). Furthermore, health care and public health guidance could provide caregivers with strategies for weaning their 12-month-old child from commercially prepared infant formula and transition to accepting the taste of plain cow's milk. Research could explore if caregivers believe that these commercial products are necessary or beneficial for young children's nutrition and/or that cow's milk is not recommended or appropriate.

Findings from this study suggest possible false assumptions or interpretations regarding product marketing messages that might be helpful for health professionals to address when working with caregivers of infants and toddlers. In addition, media literacy may aid in diminishing consumer desires for subjective and unnecessary product qualities as a way to discourage purchases of non-recommended products. This study also supports the need for additional research on differences in milk provision patterns by race/ethnicity, especially to understand why Black and Hispanic caregivers were more likely to provide commercially prepared infant formula and/or toddler milk to toddlers, how diverse populations interpret product claims, and the potential role of marketing in perpetuating health disparities.[32,33] This study demonstrates that most caregivers are offering appropriate milk-based products to their infants and toddlers while also providing non-recommended milk types. More research is needed to identify effective methods to discourage diverse consumers from providing non-recommended milk-based products for infants and toddlers.

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SUPPLEMENTARY DATA

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