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Trabajo Original

Pediatría

Early consumption of liquids different to breast milk in Mexican infants under 1 year: results of the probabilistic National Health and Nutrition Survey 2012

Consumo temprano de líquidos diferentes a leche materna en niños mexicanos menores de 1 año: resultados de la Encuesta Nacional de Salud y Nutrición 2012

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Abstract

Introduction: Studies on infant dietary intake do not generally focus on the types of liquids consumed.

Objective: To document by age and breastfeeding status, the types of liquids present in the diet of Mexican children under 1 year of age (< 1 y) who participated in the National Health and Nutrition Survey 2012 (ENSANUT-2012).

Methods: Analysis of the infant < 1 y feeding practices from the ENSANUT-2012 survey in non-breastfed (non-BF) and breastfed (BF) infants by status quo for the consumption of liquids grouped in: water, formula, fortified LICONSA milk, nutritive liquids (NL; thin cereal-based gruel with water or milk and coffee with milk) and non-nutritive liquids (non-NL) as sugared water, water-based drinks, tea, beans or chicken broth, *aguamiel* and coffee.

In this infants < 1 y we analyzed the not grouped consumption of liquids in the first three days of life (newborns) from the mother's recall. Percentage and confidence intervals (95% CI) were calculated adjusting for survey design. Statistical differences were analyzed by Z test.

Results: We observed a high consumption of human milk followed by formula (56.7%) and water (51.1%) in infants under 6 months of age (< 6 mo). The proportion of non-BF infants consuming non-NL was higher than for BF infants ($p < 0.05$). More than 60% of older infants (6 mo and < 1 y) consumed formula and were non-BF. In newborns formula consumption was predominant, followed by tea or infusion and water.

Conclusions: Non-breast milk liquids are present undesirably in Mexican infants' diet and non-NL are consumed earlier than NL, revealing inadequate early dietary practices.

Key words:

Infant feeding.
Liquid consumption.
Nutrition. Survey.
Mexico.

Resumen

Introducción: los estudios en consumo dietético infantil no se enfocan generalmente al tipo de líquidos consumidos.

Objetivo: documentar los líquidos presentes en la dieta de infantes mexicanos < 1 año, participantes en la Encuesta Nacional de Salud y Nutrición 2012 (ENSANUT-2012) de acuerdo a su edad y lactancia.

Métodos: se analizaron las prácticas de alimentación de infantes < 1 año de la ENSANUT-2012 en niños no amamantados (no-A) y amamantados (A) determinado por status quo para el consumo de líquidos agrupados en: agua, fórmula, leche fortificada LICONSA, líquidos nutritivos (LN; atole con agua o leche y café con leche) y líquidos no-nutritivos (Lno-N): agua endulzada, bebidas a base de agua, tes, caldos de frijol o pollo, aguamiel y café con agua.

A partir del recuerdo de la madre en los tres primeros días de nacidos (recién nacidos) de los infantes < 1 año, analizamos el consumo de líquidos sin agrupar. Calculamos porcentajes e intervalos de confianza (IC 95%) ajustados por diseño de encuesta. Las diferencias estadísticas se analizaron a través de la prueba Z con un valor $p < 0,05$.

Resultados: en infantes < 6 meses se observó un alto consumo de leche materna seguido por fórmula (56,7%) y agua (51,1%). Fue más alta la proporción del consumo Lno-N en infantes no-A que en amamantados ($p < 0,05$). Más del 60% de infantes entre 6 meses y 1 año consumieron fórmula y no eran amamantados. En recién nacidos predominó el consumo de fórmula seguido por té o infusión.

Conclusiones: los líquidos diferentes a la leche materna se encuentran indeseablemente en la alimentación de infantes mexicanos y los líquidos no nutritivos son consumidos antes que los nutritivos, resaltando negativas prácticas dietéticas tempranamente.

Palabras clave:

Alimentación infantil.
Consumo de líquidos.
Nutrición. Encuesta.
México.

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INTRODUCTION

Mexico is experiencing nutritional changes in terms of consumption of foods and liquids (1). Early introduction of liquids other than breast milk, nutritive or not, has been documented in Mexican infants < 2 years of age (2). Recently, Özen et al. (3) conducted a systematic review on the consumption of fluid intake from representative populations of all age groups in more than 20 countries. Out of more than 1,200 studies reviewed, 65 were included in their analysis and only two of them collected information for infants < 1 y. These two studies revealed a high level of consumption of what could be called non-nutritive liquids such as tea, coffee, fruit or vegetable juice or soft drinks, as well as consumption of nutritive liquids including whole, skimmed or flavored milk.

The World Health Organization (4) recommends exclusive breastfeeding for the first 6 months of life and continued breastfeeding for 24 months or more if mother and child so desire, accompanied by an adequate introduction of nutritive semisolids and solids foods from 6 months (5,6). There is no evidence of a benefit to the BF infants by introducing water or glucose water before 6 months. Conversely, there is an increased risk of early cessation of breast feeding (7). In developing countries, early introduction of complementary foods is of public health concern because of the risk of a greater incidence of infections and diarrheal disease due to potential contamination (8,9), as well as to their potential to displace breast milk consumption. The guiding principle for complementary feeding as far as liquids are concerned is to emphasize avoidance of sugar-sweetened beverages (SSBs), tea, coffee and other non-nutritive liquids, due to the adverse effects on the infant's health or appetite (4). Early introduction of complementary foods and displacement of breast milk are associated with overall dietary nutrient inadequacy and suboptimal childhood growth, underweight, and developmental delay (8-10). Furthermore, a higher body mass index (BMI) has been observed in preschool age children who were formula fed compared to exclusively breastfed (11). A poor diet based in non-nutritive liquids is a common cause of iron and zinc deficiency in this age group (12,13).

When infants consume non-nutritive liquids they are exposed to sweet (or savory) foods or formulas during early life which predisposes them to preferences for similarly flavored foods later in life (14,15).

There is evidence that Mexican preschool and school-aged children have increased their consumption of milk (and milk products) (16) and SSBs (17). Consumption of other non-nutritive liquids such as coffee and broths (chicken of bean), sweetened water or teas by Mexican infants is very common (18). However, nationally representative data on liquid consumption by the general population or for specific age groups is scarce. The objective of the study is to document, by age and breastfeeding status, the types of liquids consumed by Mexican infants < 1 year of age who participated in the National Health and Nutrition Survey (ENSANUT-2012 by its Spanish acronym).

METHODS

STUDY DESIGN

We determined the types of liquids consumed by infants < 1 y using data from the ENSANUT-2012 survey. The objective of the survey was to characterize the nutritional status and food and nutrient patterns of the Mexican population. A detailed description of the sampling procedures and survey methodology has been published elsewhere (19). Data were derived from a multi-stage, stratified random sample, representative of the country as a whole, for 4 regions (North, Central, Mexico City and metropolitan area, and South) and also representative of all 32 states. The survey had sampling power to disaggregate into urban (population ≥ 2,500 inhabitants) and rural (population < 2,500 inhabitants) areas. Data of infant and young child feeding practices (IYCFP) represented women of reproductive age (12 to 49 years) and their living under 3-year-old children. From this sample, we analyzed a total of 1,965 infants who represent Mexicans < 1 y. Interviews were carried out in selected households and were responses made by the child's mother or caretaker's recall. Information on IYCFP was collected in a computerized questionnaire by personnel trained by the researchers.

DIETARY DATA

Questions on IYCFP referred to the day and night prior to the interview (status quo method) (20). We included information on whether the infant had ever been breastfed, if he/she was still breast-feeding at the time of the survey, or the age at weaning. For the purpose of this study, the consumption of human milk was defined by infants receiving colostrum or breast milk the day before the interview (regardless of the quantity).

We classified every food item consumed by incorporating each into a corresponding food group. The questionnaire has no information on portion size or amounts, so we could not calculate energy or nutrient consumption. What we report here pertains exclusively to the types of liquids consumed by the infants and it is not presenting data on solid or semi-solid food consumption. Thus, infants who are classified in any given group may or may not consume solid or semi-solid food along with the liquids described.

CLASSIFICATION OF LIQUIDS CONSUMED BY INFANTS UNDER 1 YEAR

Liquids were classified according to their caloric density or quality into 7 groups: a) human milk (colostrum or breast milk); b) plain water; c) non-nutritive liquids: sweetened water, water-based drinks: teas, beans broth, chicken or beef broth, coffee, soft drinks and fruit juices; d) nutritive liquids (*atole:* Thin cereal-based beverage with water or milk); and other cereal-based gruels with water or milk, coffee with milk; e) formula and other non-human

milks; f) LICONSA milk only; and g) human milk only (no liquids other than human milk).

We collected information on names and types of infant formula, as well as other types of powdered or liquid milk consumed by the infant. We gathered information on the consumption of the micronutrient-fortified LICONSA milk, distributed by the social program of the same name (21).

With regard to newborns, we collected information on the types of liquids consumed within the first three days of life. This information was obtained from the recall of mothers whose infants were under 1 year at the time of the survey and who had ever breastfed. The proportion of ever-breastfed infants was 94.0%; thus, we do not have information on the small proportion (6%) of infants who were never put to breast. Mothers provided information about the liquids that, to their knowledge, their newborns consumed at any time during the first three days after birth, given either by them or by the health-care staff. The questionnaire on which we collected information for newborns was different than the one used for the rest of the survey and it included the following items: plain water, water sweetened with sugar (refined or raw) or honey, oral rehydration solution (either homemade or purchased), tea or other infusions, honey (as an item by itself), non-human milk, formula, fruit juices, or *atoles*.

SOCIODEMOGRAPHIC VARIABLES

The sociodemographic variables of mothers were: Education, considered as completed years of school; paid employment, reports holding a job or having some economic activity from which she received remuneration the week prior to the interview; formal employment, mothers were receiving a fixed salary during the same period; informal employed, mothers who reported not having a fixed salary prior to the interview; indigenous, at least one woman between 12 and 49 years of age speaks an indigenous language in the household, otherwise non-indigenous.

The protocol was reviewed and approved by the Research, Ethics and Biosecurity Committees of the National Institute of Public Health (INSP, by its Spanish acronym). Written informed consent was obtained from the child's mother or guardian after explaining the objective, the procedures involved and their potential risks, ethical considerations, as well as the right to decide to not participate without coercion. The Ethics approval number was CI-1033.

DATA ANALYSES

Information on the consumption of liquids by all infants < 1 year was analyzed in two broad age groups: < 6 mo and > 6 mo to < 1 y. Breastfeeding status was categorized as follows: breastfed (BF) if the infant received breast milk the day before the interview, otherwise, non-breastfed. Thus, there are four groups: < 6 mo (BF or non-breastfed) and > 6 mo to < 1 year (BF or non-breastfed). We calculated the proportion and 95% confidence intervals (95% CI), after adjusting for sample design, of infants who consumed each liquid group. Statistical differences for each of the 7 liquid groups between BF and non-breastfed infants were analyzed by Z test (22) and p-values < 0.05 were considered statistically significant. We also estimated the proportion and 95% CI for each type of liquid consumed at three days of age. Data were analyzed with the SVY module to account for the complex sampling design using STATA (version 13.0, 2013. College Station, TX: Stata Corp LP.).

RESULTS

We analyzed data from 1,965 infants who represent a population of 2.0 million. Less than 10% of the infants had mothers not living in the household studied. For this reason sample sizes for some sociodemographic characteristics vary (Table I). More than two-thirds of study infants lived in urban areas. The proportion of infants from indigenous mothers was less than 10%. In general, more than 95% of infants consumed formula and the rest consumed other types of non-formula milk.

TYPES OF LIQUIDS CONSUMED BY INFANTS < 6 MO

The predominant liquid group consumed by infants < 6 mo was human milk, followed by formula and water (Table II). A quarter of

Table I. Characteristics of mothers with an infant < 1 y[a], ENSANUT-2012. Mexico

Survey	ENSANUT-2012	
	n	
Area[b] *(%, CI)*	1,965	
Urban		72.2* (69.4-74.9)
Maternal education (y) (mean ± SE)	1,932	9.5 ± 0.14
Paid employment[c] (%)	1,932	
Formal		15.2 (12.9-17.5)
Informal		8.0* (6.1-10.0)
Ethnicity[d] (household, % yes)	1,965	8.2 (6.5-9.9)

*Prevalence and (95% CI) or Mean ± SE are presented, [a]: Adjusted by sampling design and sampling power; [b]: Area: Urban (pop. ≥ 2,500 inhabitants); SE: Standard error; [c]: Paid employment, reports holding a job or having some economic activity for which she received remuneration in exchange the week prior to the interview, formal employment, mothers were receiving a fixed salary the week prior to the interview, informal employment, mothers who reported not having a fixed salary prior to the interview; [d]: Indigenous: At least one woman 12-49 years of age speaks an indigenous language in the household; *Statistically significant difference between groups, p < 0.05.*

Table II. Consumption of liquid groups[£*] in infants < 1 y, by age and breastfeeding status. ENSANUT-2012. Mexico

	Infants < 6 mo[β]			Infants ≥ 6 mo and < 1 y[β]		
	All	Breastfeed	Non-breastfeed	All	Breastfeed	Non-breastfeed
n	1,015	743	272	950	492	458
n thousands[&]	1,069	770	299	953	460	492
	% (95% CI)			% (95% CI)		
Human milk	72.0 (68.3-75.4)	100.0		48.3 (43.4-53.3)	100.0	
Water	51.1 (47.0-55.2)	50.3 (45.3-55.2)	53.3 (45.8-60.5)	80.8 (77.3-83.9)	82.1 (77.6-85.9)	79.6 (74.0-84.2)
Non-nutritive liquids	25.7 (22.3-29.5)	21.3 (17.5-25.6)	37.2[‡] (30.0-45.0)	69.9 (65.4-74.0)	68.7 (62.3-74.4)	71.0 (64.2-76.9)
Nutritive liquids	7.2 (5.2- 9.9)	4.9 (3.1-7.8)	13.1[‡] (8.6-19.6)	22.4 (19.1-26.1)	16.5 (13.1-20.7)	27.9[‡] (22.8-33.8)
Formula	56.7 (52.6-60.7)	41.0 (36.2-45.9)	97.0[‡] (93.4-98.7)	66.0 (61.7-70.0)	38.4 (31.7-45,4)	91.9[‡] (88.3-94.4)
LICONSA[¥]	1.4 (0.5- 3.7)	1.1 (0.2-5.1)	2.2 (0.9-5.2)	7.0 (4.9-9.9)	4.5 (2.6-7.6)	9.4[‡] (6.2-14.2)
Only human milk	16.9 (14.1-20.2)	23.5 (19.6-27.8)		2.3 (1.4-3.8)	4.7 (2.8-7.9)	

*[£]: Adjusted by sampling design and sampling power and collected by status quo method; *Liquid groups: Water. Formula includes: infant formula (95%) and other than human milk (5%). Non-nutritive liquids include: Sweetened water, tea, coffee, soda, bean broth, chicken or beef broth, fruit juice. Nutritive liquids include: Atole, other cereal, coffee with milk; [β]: Percentage, 95% confidence intervals (95%CI) and estimated population size are presented; [¥]: Enriched milk from the Federal LICONSA Program; [‡]: Indicates statistical significance difference between breastfeeding groups, p < 0.05.*

the non-breastfed infants < 6 mo consumed non-nutritive liquids at significantly higher rates than BF infants ($p < 0.05$). Although LICONSA milk is present in the diet of both BF and non-breastfed infants, its consumption is infrequent.

Over 40% of the BF also consumed formula and less than a fourth of them consumed human milk as their only liquid.

We observed that more than half of non-breastfed infants consumed plain water and more than a third consumed non-nutritive liquids. The proportion of non-breastfed infants consuming non-nutritive liquids and nutritive liquids was higher than for BF infants (15 pp and 8 pp, respectively $p < 0.05$).

TYPES OF LIQUIDS CONSUMED BY INFANTS ≥ 6 MO AND < 1 YEAR

A high proportion (48%) of older infants (n = 950) were not breastfed and more than 60% consumed formula. Over two-thirds of both BF and non-breastfed infants consumed non-nutritive liquids. Over a quarter of infants ≥ 6 mo consumed nutritive liquids and the proportion that consumed the federal program LICONSA milk is higher in non-breastfed infants than BF ($p < 0.05$).

For BF infants we observed that more than a third consumed formula and there was still a small percentage that consumed human milk as the only liquid. Furthermore, in BF the consumption of nutritive liquids is significantly lower ($p < 0.05$) than in non-breastfed infants. Eight percent of non-breastfed infants did not consume breast milk or formula.

TYPES OF LIQUIDS CONSUMED BY NEWBORNS

In relation to non-breast milk, we observed that formula was the most frequently consumed liquid, followed by tea or infusion and water. More than 44% of the studied newborns consumed non-nutritive liquids or nutritive liquids since birth (Table III). Other beverages consumed only by a very small fraction of newborns included sweetened water, oral rehydration liquids, fruit juices, *atoles* and honey.

DISCUSSION

We present information from the ENSANUT-2012 survey relative to the types of liquids consumed by Mexican infants < 1 year, by age and breastfeeding status. Our results document a high proportion of infants who consume formula and water and a low proportion of those who consumed breast milk during both semesters of the first year of life. These findings reveal that the consumption of liquids other than breast milk, be they nutritive or not, is highly prevalent in the first semester of life, when thirty-percent of newborns consumed formula. In the first semester 40% of breastfed infants consumed formula, severely interfering with exclusive breastfeeding. In general, breastfed infants complied with the WHO feeding recommendations better than the non-breastfed infants, not because they were breastfed but also because a lower proportion of infants < 6 mo consumed other liquids.

We also analyzed information on liquid consumption during the first three days of life from national data; evidence that had not been available until now. We documented the high prevalence of newborns that consumed liquids other than breast milk. Close to 10% consumed water, teas or other infusions and just over half of newborns in Mexico received breast milk as the only food (liquid or solid). Formula is consumed by around a third of newborns.

Our results are relevant because consumption of liquids other than breast milk during the first year of life have short and long-term consequences both in terms of nutrition and infection.

This high consumption of liquids by Mexican infants is similar to other infant populations around the world. Tea, coffee, fruit or vegetable juice, soft drinks or whole, skimmed or flavored milk are the most consumed beverage sources at this age (3,9,23). In fact, the trend is towards greater consumption of formula over breast milk in infants < 6 mo (24).

Newborns who are not exclusively breastfed are at a greater risk for mortality than those who do not consume anything other than breast milk (25). Consumption of liquids during the first year of life, nutritive or otherwise, should not be liberally offered to the infant because liquids displace breast milk, diluting the beneficial effects of breastfeeding and because they take valuable space in the small infant's stomach size (12), displacing breast milk and replacing nutritive complementary feeding after 6 months of life (26).

Some liquids studied represent a high nutritional risk as coffee and tea compromising the availability and absorption of iron and zinc (27,28). Furthermore, zinc and iron supplementation in infants using ferrous sulfate could have the most potent inhibitory effect on Zn absorption. Because of the above, coffee and tea consumed by Mexican infants < 6 mo is detrimental to their nutritional status.

A relatively small proportion of young infants under 1 year of age consumes LICONSA milk. LICONSA milk is a reduced-priced product fortified with those micronutrients usually deficient in the Mexican population (29). According to the corresponding Mexican Regulation LICONSA is distributed by the Federation to families who live below the poverty line. It is intended to be consumed by vulnerable groups, i.e. children (≥ 6 mo to < 12 years) and other groups. This targeting, which includes 6-month-old infants, is unfortunate given that the WHO recommends that infants < 1 year consume milk only from their mother (or another suitable human donor). Recommending consumption of other non-breast milks clearly interferes with breastfeeding, which in Mexico is at its lowest ever (2), and the federal program promoting its consumption sends the wrong message. Also, infants < 1 year are not physiologically prepared to consume cow's milk, skimmed or not, for its consumption increases the risk of allergies (30) and this milk is low in iron, vitamin E and essential fatty acids and increase the risk of dehydration (due to diarrhea or gastrointestinal problems (31).

Another concern relative to early consumption of liquids other that breast milk has the potential to expose infants to pathogens. Feeding infants other foods, liquids or solids, expose them to pathogens which increase the incidence of infection diseases (6,9,13) such as diarrhea.

There are scarce data on the diets of children < 1 year in Mexico. The consumption of SSBs is particularly important in this country. In 2006 children between 1-4 years consumed more than a fourth of their energy consumption (27.8%) from caloric beverages, mainly whole milk, fruit juice and SSBs (carbonated or not) (17) . It has been shown that consumption of SSBs as young as 2 y of age contributes to the risk of obesity (11).

The high percentage of infants who consume non-nutritive liquids such as sweetened water or teas, fruit juices, soft drinks, coffee or tea in Mexico points to the strong cultural preference for water or teas at this age. Similar findings from other countries have been documented (9,24,25).

Table III. Liquids consumption by breastfed infants in the first three days of life[£∞]. ENSANUT 2012. Mexico

Liquids	n thousands	n	% (95% CI)
	1,898[&]	1,849[β]	
Human milk only		1,035	56.1 (52.9-59.3)
Water		72	3.6 (2.4-5.3)
Sweetened water (sugar, honey, *piloncillo*[1])		-	-
Oral rehydration solution[2]		4	0.2 (0.1-0.7)
Tea or infusion		131	6.6 (5.2-8.3)
Honey		-	-
Non-human milk[3]		18	1.0 (0.5-2.0)
Formula		601	32.7 (29.7-35.8)
Fruit juices		7	0.5 (0.22-1.23)
Atole[4]		-	
Mother[ç] responded "yes but did not remember specific liquid or food		5	0.1 (0.05-0.29)

[£]: Adjusted by sampling design; [∞]: Data from the group of infants < 1 y according to recall in the first three days of life who consumed breast milk (94.0%). We do not have data for those who never consumed breast milk; n: Infants < 1 y that met two conditions: were breastfed and have answered the question about consumption of liquids in newborns; n: Breastfed newborns and consumers of other liquids; [β]: Percentage and 95% confidence intervals (95%CI) and estimated population size are presented; [α]: Since infants could have consumed more than one type of liquid the sum is above 100%; [1]: Solid unrefined cane sugar; [2]: Homemade water prepared with salt and sugar or purchased; [3]: Milk does not include formula; [4]: Thin cereal-based beverage with water or milk; -: Sample size = 1 or 2, insufficient to perform estimations; [ç]: Less than 10% of mother's did not answer the interview because they did not live in the household.

Diet during infancy and early childhood is one such area where parental or family food choices and preferences may have significant long-term effects on a child's weight status. The fact that infants consume SSBs early in life, in the form of sweetened teas, fruit based drinks or carbonated beverages, means they are unnecessarily exposed early in life to sweetened flavors predisposing them to preferences for sweet foods later in life (14,15).

Consumption of sugared beverages is also related to oral health due to the erosive potential of fruit juices and other SSBs (32).

Regarding comparability with other populations, the data from this study was derived using an instrument developed according to the WHO recommendations for collecting these types of data (33).

In the sample analyzed in our study, we observed 3% of young infants (< 6 mo) who were not fed with breast milk nor did they consume formula, which may be explained by the consumer report from the federal micronutrient-fortified LICONSA milk.

This study presents two strengths. First, data were derived from a national representative survey, which has a robust design and represents the Mexican population < 1 year of age. Second, data were collected in the field using status quo, a valid methodology that captures information from the day before the interview, avoiding recall bias (20).

We acknowledge some limitations to the study. In order to reduce the time of the interview (compared to applying a 24 hour recall), we designed the instrument to record consumption without quantities or portion sizes. This fact did not allow us to analyze their contribution in terms of energy or nutritional quality. Sample sizes are small for some of the subgroups under analysis, i.e. nutritive liquids, fortified milk LICONSA and only human milk. Thus, the estimations for these subgroups may be unstables.

Our results show that the challenge for Mexico is enormous due to the higher overall consumption of liquids in infants < 6 mo and non-nutritive liquids in infants ≥ 6 mo. Nutrition Global Targets number 5 for improving maternal, infant and young child nutrition of the WHO (34) recommends an increment in the rate of exclusive breastfeeding in the first 6 months from the 2012 baseline of 38% to at least 50% in 2025. It is of public health concern that consumption of liquids partially explains the decreasing rates of exclusive breastfeeding seen in infants <6 mo in Mexico. The goal is to avoid offering infants beverages with low nutrient value, such as tea and coffee, and sugary drinks such as soda.

Exist recommendations to protect, promote and support exclusive breastfeeding in infants < 6 mo (35) and in older infants to continue feeding with breast milk until the child and their mother desire.

CONCLUSIONS

The adequate Mexican infant feeding according to age requires involving a large group of actors and the population in a joint effort. Future research needs to understand the contribution of liquids to the infant diet in terms of energy and nutrients.

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