

Nutritional quality of foods and beverages on child-care centre menus in Mexico

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Abstract

Objective: The purpose of the present study was to assess the nutritional quality of foods and beverages listed on menus serving children in government-sponsored child-care centres throughout Mexico.

Design: For this cross-sectional menu assessment, we compared (i) food groups and portion sizes of foods and beverages on the menus with MyPlate recommendations and (ii) macronutrients, sugar and fibre with Daily Reference Intake standards.

Setting: Menus reflected foods and beverages served to children attending one of 142 government-sponsored child-care centres throughout Mexico.

Subjects: There were fifty-four distinct menus for children aged 4–6 months, 7–9 months, 10–12 months, 13–23 months, 24–47 months and 48–72 months.

Results: Menus included a variety of foods meeting minimum MyPlate recommendations for each food category except whole grains for children aged 48–72 months. Menus listed excessive amounts of high-energy beverages, including full-fat milk, fruit juice and sugar-sweetened beverages for children of all ages. The mean daily energy content of menu items yielded an average of 2.76 MJ for infants, 4.77 MJ for children aged 13–23 months, 5.36 MJ for children aged 24–47 months and 5.87 MJ for children aged 48–72 months. Foods and beverages on menus provided sufficient grams of carbohydrate and fat, but excessive protein.

Conclusions: Menus provided a variety of foods but excessive energy. Whole grains were limited, and high-energy beverages were prevalent. Both may be appropriate targets for nutrition intervention. Future studies should move beyond menus and assess what children actually consume in child care.

Keywords
Child care
Mexico
Nutrition
Obesity

Mexico is in the midst of a nutrition transition^(1,2). Wasting and stunting among children <5 years of age have declined in recent years^(3–7), while rates of obesity have risen steadily^(3,7–12). Data from a recent national study in Mexico showed that 20% of children aged 2–12 years were overweight or obese⁽⁸⁾. For children of pre-school age, rates of obesity were highest in northern Mexico, in urban areas such as Mexico City and among children from higher-resource families^(8,13,14). Childhood obesity is associated with a number of adverse health outcomes that can include type 2 diabetes mellitus^(15,16), hypertension and hyperlipidaemia^(15,17,18), asthma and sleep apnoea^(19–21), early maturation^(22,23) and psychosocial stress^(24–26).

Dietary determinants of childhood obesity include excessive intake of sugar-sweetened beverages⁽²⁷⁾, fruit

juice^(28,29) and high-energy foods of low nutritional value, such as chips and cookies^(30–32). A handful of previous studies have assessed dietary intake in young children in Mexico. In one study of public-school children in Mexico City, researchers found that children consumed insufficient fibre (<25 g/d) and excessive dietary fat (>35% of daily energy)⁽¹⁸⁾. A second study of children 10–19 years of age in Mexico City found that foods provided by schools were of lower nutritional quality than those brought from home⁽³³⁾. A study of children aged 1–4 years showed that those living in Mexico City consumed more dietary fat, carbohydrate and total energy than children in any other region in Mexico⁽³⁴⁾. In a national study of beverage consumption, researchers noted a substantial increase in caloric beverage intake over the past decade

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among pre-school and school-aged children⁽³⁵⁾. The authors cited full-fat milk and sugar-sweetened fruit juice as the two primary beverages consumed by young children. However, little is known about dietary intake and the nutritional quality of foods and beverages provided to children outside the family home. The purpose of the present study was to assess the nutritional quality of foods and beverages listed on menus serving children in government-sponsored child-care centres throughout Mexico.

Methods

We reviewed and analysed a sample of fifty-four daily menus (including breakfast, lunch and afternoon snack) reflecting foods and beverages served to children attending 142 government-sponsored child-care centres in Mexico, all of whom follow the same menus. The 142 child-care centres provide care to almost 30 000 children from 6 weeks to 6 years of age. We collected menus in the spring of 2009. Menus were still in use in early 2012, but are scheduled to be re-evaluated later that year. Menus were developed by a nutritionist and were used by all government-sponsored child-care centres throughout the country. Menus varied by age, with separate menus for children aged 4–6 months, 7–9 months, 10–12 months, 13–23 months, 24–47 months and 48–72 months. A 1 d sample menu is provided in Fig. 1. We translated menus from Spanish to English prior to nutrient analysis. Since this research was limited to a menu review and did not involve human subjects, we were granted an exemption from the Institutional Review Boards at both Harvard Pilgrim Health Care and Duke University Medical Center.

To assess the nutritional value of foods and beverages listed on the menus, we analysed menus using the Nutrition Data System for Research (NDS-R) software version 2005 (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA). The NDS-R software generated serving sizes based on the 1992 US Department of Agriculture (USDA) Food Guide Pyramid, a national nutrition guideline system in the USA. Menus specified amounts of foods (e.g. 50 g beans) and beverages (e.g. 120 ml fruit juice) for children in each age group. The menus also included detailed ingredients for mixed dishes, which we used in the nutrient analysis. We translated serving sizes into cups and ounces for comparison with national recommendations. Generally, information about the amounts and types of foods was included on the menus. In some cases, the method of preparation, the recipe and the list of ingredients were also included. A small number of traditional Mexican foods were listed on the menus but not included in the NDS-R database. In those cases, we used the closest available substitute based on expert review by one author (e.g. Garibaldi biscuit was substituted with vanilla sponge cake). The NDS-R software does not categorize food into various groups (e.g. fruits);

we therefore manually combined data into food group categories. Because NDS-R classified sweetened beverages (e.g. fruit drinks, flavoured waters, sweetened milks) and 100% fruit juices by their ingredient components, we created a separate category for servings of juice and sugar-sweetened beverages.

We reviewed menu data to determine the amount and type of foods and beverages served to children by age group, averaged over one full day of care. These menus, however, do not reflect foods and beverages served to children at home or outside child care. First, we compared food group values with current USDA MyPlate⁽³⁶⁾ recommendations by age group. We used MyPlate recommendations because, at the time of the study, Mexico did not have national food group standards for children, with the exception of La Piramide De La Salud, which did not include specific recommendations to allow for comparisons. MyPlate recommendations represent the 2010 Dietary Guidelines for Americans food group serving sizes that replaced the USDA Food Guide Pyramid in 2011. We compared portion sizes of foods and beverages on the menus with daily MyPlate recommendations for each food group (grains, vegetables, fruits, meats and dairy). Next, we computed mean total energy, macronutrients (fat, carbohydrate and protein), fibre and sugar for each menu by age group, and compared these values with the Daily Reference Intake (DRI)⁽³⁷⁾ standards. Since MyPlate and DRI recommendations begin at age 2 years, with a few exceptions noted, we were not able to make many comparisons for dietary data from infant menus.

Results

Based on a total of fifty-four menus among children aged 24–72 months, for whom MyPlate food group recommendations exist, children in child-care centres were provided with sufficient servings of grains, vegetables, fruits, meats and meat alternatives, and dairy (Table 1). Foods listed contained some wholegrain items, but amounts were below recommendations for children aged 48–72 months. Children received more than the recommended amounts of dark (orange, red, yellow) vegetables, and these vegetables represented ~50% of the total vegetables listed on the menus. Moreover, fried vegetables such as French fries and fried potatoes were not listed on any of the 54 d of menus. Nearly half of the meats and meat alternatives on the menus were high-fat or fried, with high-fat beef and eggs being the most common meat items. Fewer than 4% of total dairy items were reduced-fat and none were 1% or fat-free. High-sugar and high-salt snack foods were not often listed on the menus.

In terms of beverages, menus included some fruit juice for all age groups. Infants were provided a mean of

MENÚ DESARROLLADO 14

Ración de alimentos a servi para niños de 10 a 23 meses

DESAYUNO	RACIONES 1	COMIDA	RACIONES 1	MERIENDA	RACIONES 1
Fruit De Temporada	150 g	Sopa De Codito		Fruta De Temporado	150 g
		Pasta de codito	15 g		
Molletes Con Salsa Mexicana		Margarina sin sal	3 g	Pollo a La Mantequilla	
Pan blanco bolillo	35 g	Apio	5 g	Pechuga de pollo	60 g
Frijol	15 g	Calabacita	15 g	Ajo	0.0002 g
Queso manchego	30 g	Papa	10 g	Cebolla	1 g
Cebolla	2 g	Tocino	3 g	Margarina sin sal	5 g
Sal de mesa	1 g	Jitomate	30 g	Sal de mesa	1 g
Jitomate	30 g	Consumé de pollo	0.0003 g		
Aceite de cártamo	5 ml	Aceite de cártamo	1 ml	Ensalada De Betabel	
Margarina sin sal	1 g	Sal de mesa	1 g	Betabel	60 g
		Cebolla	1 g	Naranja	50 g
Leche Con Cajeta		Ajo	0.0001 g	Azúcar	10 g
Leche entera polvo	18 g	Hierbas de olor tomillo	0.0001 g		
Cajeta	15 g			Leche	
Agua	150 ml	Loma a La Naranja		Leche entera polvo	18 g
		Lomo de cerdo	80 g	Agua	150 ml
Jugo De Piña*		Naranja para jugo	50 g	Azúcar	10 g
Concentrado de piña	15 ml	Perejil	2 g		
Agua	60 ml	Pimienta negra polvo	0.0001 g	Tortilla De Harina	25 g
		Hierbas de olor	0.0001 g		
		Naranja	20 g	Agua De Jamaica	
		Cebolla	1 g	Flor De Jamaica	3 g
		Sal de mesa	1 g	Azúcar	10 g
		Aceite de cártamo	3 ml	Agua	150 ml
		Ensalada Tricolor		Jugo De Piña*	
		Zanahoria	20 g	Concentrado de piña	15 ml
		Pepino	35 g	Agua	60 ml
		Pimiento morrón rojo	10 g		
		Limón	5 g		
		Sal de mesa	1 g		
		Malvisco Cereal			
		Cereal	30 g		
		Malvisco	15 g		
		Margarina sin sal	8 g		
		Extracto de vainilla	2 ml		
		Pan De Caja Integral	25 g		
		Agua De Mandarina			
		Concentrado de mandarina	10 ml		
		Azúcar	10 g		
		Agua	150 ml		

*Calcular sólo para niños de 10 a 12 meses.

Fig. 1 Sample of a 1 d menu for children aged 10–23 months attending child-care centres in Mexico, spring 2009

1.6 (SD 0.2) oz (4–6 months), 4.9 (SD 0.3) oz (7–9 months) and 1.0 (SD 0.0) oz (10–12 months) of 100% juice daily. Older children received <1 oz/d, on average. Other sugar-sweetened beverages, such as water or milk with added sugar, were more common, with menus listing 6.9 (SD 0.0) oz/d for infants aged 10–12 months and 13.3 (SD 0.1) oz/d for children aged 13–72 months of age. Full-fat milk, including both sweetened and unsweetened, was the most common type of milk served to children of all ages. For children 13–72 months of age, menus listed an average of 1.2 cups of full-fat milk/d, with small amounts of reduced-fat milk. Of all milk served as a

beverage (not in recipes), 37% had added sugars. Children <1 year of age were also served whole cow's milk.

Menus yielded a mean daily energy content of 2.10 (SD 0.09) MJ for infants aged 4–6 months, 3.03 (SD 0.13) MJ for infants aged 7–9 months and 3.14 (SD 0.48) MJ for infants aged 10–12 months. For older children, menus provided 4.77 (SD 0.68) MJ/d for children aged 13–23 months, 5.36 (SD 0.73) MJ/d for children aged 24–47 months and 5.87 (SD 0.70) MJ/d for children aged 48–72 months (Table 2). Menus provided a mean daily fat amount of 20.7 (SD 1.2) g for infants aged 4–6 months, 28.6 (SD 1.6) g for infants aged 7–9 months and 33.3 (SD 7.8) g for infants

Table 1 Foods and beverages from fifty-four Mexican child-care centre menus compared with MyPlate recommendations by age*

Food category	Age (months)	Amount provided		MyPlate recommendation	Percentage of MyPlate
		Mean	SD		
Grains, total (oz)	4-6	0.2	0.1	No MyPlate recommendation	
	7-9	1.4	0.3		
	10-12	1.7	0.8		
	13-23	2.4	0.7		
	24-47	2.9	0.9		
	48-72	3.2	0.9		
All or some whole grains (oz)	4-6	0.0	0.0	No MyPlate recommendation	
	7-9	0.7	0.5		
	10-12	0.5	0.5		
	13-23	0.8	0.5		
	24-47	1.1	0.8		
	48-72	1.2	0.8		
Vegetables, total (cups)	4-6	0.4	0.2	No MyPlate recommendation	
	7-9	0.8	0.3		
	10-12	0.8	0.4		
	13-23	0.9	0.4		
	24-47	1.0	0.5		
	48-72	1.1	0.5		
Vegetables, dark (cups)†	4-6	0.1	0.1	No MyPlate recommendation	
	7-9	0.3	0.3		
	10-12	0.4	0.3		
	13-23	0.5	0.4		
	24-47	0.6	0.4		
	48-72	0.6	0.4		
Vegetables, starchy (not fried) (cups)	4-6	0.1	0.2	No MyPlate recommendation	
	7-9	0.1	0.2		
	10-12	0.1	0.1		
	13-23	0.2	0.1		
	24-47	0.2	0.2		
	48-72	0.2	0.2		
Vegetables, other (cups)	4-6	0.2	0.3	No MyPlate recommendation	
	7-9	0.4	0.3		
	10-12	0.2	0.2		
	13-23	0.3	0.2		
	24-47	0.3	0.2		
	48-72	0.3	0.2		
Vegetables, fried (cups)	4-6	0.0	0.0	No MyPlate recommendation	
	7-9	0.0	0.0		
	10-12	0.0	0.0		
	13-23	0.0	0.0		
	24-47	0.0	0.0		
	48-72	0.0	0.0		
Fruit (excluding 100% juice) (cups)	4-6	0.6	0.1	No MyPlate recommendation	
	7-9	0.8	0.2		
	10-12	0.7	0.2		
	13-23	0.7	0.2		
	24-47	0.9	0.3		
	48-72	1.0	0.3		
Meats/alternatives, total (oz)	4-6	0.0	0.0	No MyPlate recommendation	
	7-9	1.3	0.1		
	10-12	2.8	0.8		
	13-23	3.5	1.2		
	24-47	4.0	1.2		
	48-72	4.4	1.3		
Meat, high-fat/fried (oz)	4-6	0.0	0.0	No MyPlate recommendation	
	7-9	0.0	0.1		
	10-12	1.3	0.8		
	13-23	1.7	1.2		
	24-47	1.9	1.2		
	48-72	2.0	1.4		
Meat, low-fat (oz)	4-6	0.0	0.0	No MyPlate recommendation	
	7-9	0.7	0.0		
	10-12	0.7	0.7		
	13-23	0.8	0.8		
	24-47	0.9	1.0		
	48-72	1.1	1.1		
Meat alternatives (oz)	4-6	0.0	0.0	No MyPlate recommendation	
	7-9	0.6	0.0		
	10-12	0.9	0.9		
	13-23	1.0	1.1		
	24-47	1.2	0.6		
	48-72	1.3	0.7		

Table 1 Continued

Food category	Age (months)	Amount provided		MyPlate recommendation	Percentage of MyPlate
		Mean	SD		
Dairy, total (excluding infant formula) (cups)‡	4–6	0.1	0.1	No MyPlate recommendation	
	7–9	0.3	0.1		
	10–12	0.5	0.4		
	13–23	1.7	0.5		
	24–47	1.8	0.6		
Milk, whole (cups)	48–72	1.9	0.7	2.5 cups	72
	4–6	0.1	0.1	No MyPlate recommendation	
	7–9	0.3	0.1		
	10–12	1.0	0.2		
	13–23	1.2	0.2		
24–47	1.2	0.2			
Milk, reduced-fat (cups)	48–72	1.2	0.2	No MyPlate recommendation	
	4–6	0.0	0.0		
	7–9	0.0	0.0		
	10–12	0.1	0.1		
	13–23	0.1	0.1		
Milk, 1% or non-fat (cups)	24–47	0.1	0.1	No MyPlate recommendation	
	48–72	0.1	0.1		
	4–6	0.0	0.0		
	7–9	0.0	0.0		
	10–12	0.0	0.0		
Infant formula (oz)	13–23	0.0	0.0	No MyPlate recommendation	
	4–6	17.7	1.2		
	7–9	12.2	0.0		
	10–12	0.0	0.0		
	13–23	0.0	0.0		
100% fruit juice (oz)§	4–6	1.6	0.2	0 oz	
	7–9	4.9	0.3	≤6 oz	
	10–12	1.0	0.0	≤6 oz	16
	13–23	0.6	0.0	≤6 oz	11
	24–47	0.6	0.0	≤6 oz	11
Sugar-sweetened beverages (oz)‡	48–72	0.6	0.0	≤6 oz	11
	4–6	0.0	0.0	No MyPlate recommendation	
	7–9	0.0	0.0		
	10–12	6.9	0.0		
	13–23	13.3	0.1		
24–47	13.3	0.1			
Sugar snacks (FDA serving size)	48–72	13.3	0.1	No MyPlate recommendation	
	4–6	0.1	0.2		
	7–9	0.0	0.0		
	10–12	0.2	0.3		
	13–23	0.2	0.4		
Salty snacks (FDA serving size)	24–47	0.3	0.5	No MyPlate recommendation	
	48–72	0.3	0.6		
	4–6	0.0	0.0		
	7–9	0.0	0.0		
	10–12	0.0	0.0		
Added fats (FDA serving size)	13–23	0.0	0.0	No MyPlate recommendation	
	24–47	0.0	0.0		
	48–72	0.0	0.0		
	4–6	0.0	0.0		
	7–9	0.7	0.2		
	10–12	3.0	1.0		
	13–23	3.6	1.2		
	24–48	4.1	1.3		
	45–72	4.4	1.4		

FDA, Food and Drug Administration.

*MyPlate recommendations start at age 24 months. Age 24–47 months is based on a 5.02 MJ (1200 kcal) diet as recommended by MyPlate (2010 Dietary Guidelines for Americans) for a 3-year-old girl, active 30–60 min/d. Age 48–72 months is based on a 5.86 MJ (1400 kcal) diet as recommended by MyPlate (2010 Dietary Guidelines for Americans) for a 5-year-old girl, active 30–60 min/d.

†Based on amounts recommended weekly by MyPlate (2010 Dietary Guidelines for Americans). Dark vegetable recommendation combines green vegetables and orange vegetables.

‡Sweetened milk is categorized under both the dairy and sweetened beverage categories. Of sweetened beverages, sweetened milk accounts for 27% (3.6 oz) of the total for age 13–72 months and 0% for age 10–12 months.

§100% fruit juice served as a beverage only, not as added in a recipe.

Table 2 Nutrients from fifty-four Mexican child-care centre menus compared with Dietary Reference Intake (DRI) standards by age*

Nutrient	Age (months)	Amount provided		DRI standard	Percentage of DRI		
		Mean	SD				
Energy (MJ)*	4-6	2.1	0.1	No DRI standard			
	7-9	3.0	0.1				
	10-12	3.1	0.5				
	13-23	4.8	0.7			4.18-5.86 MJ	81-114
	24-47	5.4	0.7			4.18-5.86 MJ	91-128
Fat (g)*	48-72	5.9	0.7	5.86-6.69 MJ	88-100		
	4-6	20.7	1.2	31 g	67		
	7-9	28.6	1.6	30 g	95		
	10-12	33.3	7.8	30 g	111		
	13-23	50.1	9.4	No DRI standard			
Percentage of energy from fatt	24-47	55.8	10.7				
	48-72	60.5	10.8				
	4-6	37.3	-	No DRI standard			
	7-9	35.5	-				
	10-12	39.6	-				
Saturated fat (g)	13-23	39.5	-	30-40 %‡	-		
	24-47	39.0	-	30-40 %‡	-		
	48-72	38.7	-	25-35 %‡	-		
	4-6	7.2	0.4	No DRI standard			
	7-9	9.2	0.3				
Percentage of energy from saturated fatt	10-12	9.1	3.1				
	13-23	16.2	3.4				
	24-47	17.9	4.3				
	48-72	19.2	4.4				
	4-6	12.9	-	No DRI standard			
Carbohydrate (g)*	7-9	11.5	-				
	10-12	10.8	-				
	13-23	12.8	-				
	24-47	12.6	-				
	48-72	12.3	-				
Percentage of energy from carbohydratet	4-6	70.3	5.9	60 g	171		
	7-9	100.4	8.1	95 g	106		
	10-12	84.1	14.0	95 g	89		
	13-23	128.0	23.1	130 g	99		
	24-47	145.0	23.4	130 g	116		
Protein (g)*	48-72	160.4	25.4	130 g	123		
	4-6	56.1	-	No DRI standard			
	7-9	55.3	-				
	10-12	45.1	-				
	13-23	45.0	-	45-65 %‡	-		
Percentage of energy from proteint	24-47	45.4	-	45-65 %‡	-		
	48-72	45.8	-	45-65 %‡	-		
	4-6	9.9	0.5	9.1 g	109		
	7-9	19.8	0.4	11 g	180		
	10-12	32.3	7.0	11 g	294		
Added sugars (g)*	13-23	48.8	8.8	13 g	375		
	24-47	54.8	9.9	13 g	422		
	48-72	59.9	10.0	19 g	315		
	4-6	7.9	-	No DRI standard			
	7-9	10.9	-				
Fibre (g)*	10-12	17.2	-				
	13-23	17.2	-	5-20 %‡	-		
	24-47	17.2	-	5-20 %‡	-		
	48-72	17.1	-	10-30 %‡	-		
	4-6	29.5	4.3	No more than 25 % of total energy	24		
Fibre (g)*	7-9	19.9	0.1		11		
	10-12	17.6	7.3		10		
	13-23	31.4	16.5		11		
	24-47	34.5	17.1		11		
	48-72	37.3	18.0		10		
Fibre (g)*	4-6	4.0	0.4	No DRI standard			
	7-9	8.2	0.7				
	10-12	8.3	1.8				
	13-23	10.5	2.2	19 g	55		
	24-47	12.3	2.6	19 g	65		
	48-72	13.8	3.1	25 g	55		

*Recommended Dietary Intake/Adequate Intake (kcal converted to MJ).

†Averaged by day, not total.

‡Acceptable Micronutrient Distribution Range.

aged 10–12 months, compared with the DRI of ~ 30 g. There is no DRI for grams of fat for toddlers and pre-school children. For children aged 4–6, 7–9, 10–12, 13–23, 24–47 and 48–72 months, menus yielded 70.3 (SD 5.9), 100.4 (SD 8.1), 84.1 (SD 14.0), 128 (SD 23.1), 145 (SD 23.4) and 160.4 (SD 25.4) g carbohydrate/d and 9.9 (SD 0.5), 19.8 (SD 0.4), 32.3 (SD 7.0), 48.8 (SD 8.8), 54.8 (SD 9.9) and 59.9 (SD 10.0) g protein/d, respectively. Generally, the percentage of energy from fat, carbohydrate and protein was in line with DRI standards. However, the percentage of energy from fat was 38.7% for children 48–72 months, which is slightly above the DRI recommendation of 25–35%. According to menus, children were provided a mean daily fibre amount of 10.5 (SD 2.2) g (13–23 months), 12.3 (SD 2.6) g (24–47 months) and 13.8 (SD 3.1) g (48–72 months), which approached the DRI recommendation of 19, 19 and 25 g, respectively. Nevertheless, wholegrain foods were low for all age groups. Foods listed on the menu did not include high levels of sugar, except for sugar-sweetened milk and water. In fact, the sugar content of total daily foods was below the recommended level of 25% for all children.

Discussion

Based on dietary data from 54 d of menus used by 142 government-sponsored child-care centres throughout Mexico, children were provided with a high number of megajoules coming from a variety of food groups while in child care. Given that children spend part, but not all of their waking hours in child care, menus listed excessive amounts of most foods, including vegetables, fruits, meats and dairy, compared with MyPlate recommendations. Average total energy and macronutrient levels were quite high for all age groups in which DRI have been established. In particular, menus included excessive grams of protein for nearly all children. Fruit juice, sugar-sweetened beverages and full-fat milk also contributed to excessive total energy.

Several explanations may exist for the excessive amount of energy listed on the menus. Since children spend 8–10 h in full-day care, child-care centres may wish to provide enough energy to meet children's energy needs for an entire day, given that some children may not receive sufficient amounts of foods and beverages at home. Additionally, foods listed on the menu may provide more than the recommended amounts of energy and nutrients because child-care centres may assume that children will not eat all foods and beverages served; children may elect to consume a portion of what is offered.

Despite the excess of sugar-sweetened beverages, the total amount of added sugars to foods was just over 10% of total energy intake for all age groups except infants 4–6 months of age. While this falls well below the liberal DRI recommendation of <25%, it is just over the

WHO recommendation of <10% of daily energy and is more than double the American Heart Association recommendation of <16 g/d for a 5.86 MJ (1400 kcal) diet^(38–40). This finding was true despite pervasive amounts of sugar-sweetened beverages listed on the menus. Low levels of added sugars may be due to the infrequency of processed foods; nearly all foods listed on the menu were prepared at the child-care centres from scratch, with limited reliance on pre-packaged or processed foods. Nevertheless, grains provided to children aged 48–72 months were slightly inadequate. Interestingly, fibre levels were within recommended amounts, even though wholegrain items were not. This apparent discrepancy may be due to the relatively high levels of fruits and vegetables served. Although beans are a contributor to overall fibre intake and were also listed on the menu, they did not appear frequently.

While menus suggested that the recommended average levels of dairy were served, the majority were full-fat items (for children over the age of 2 years). This finding is similar to results from Ball *et al.*⁽⁴¹⁾, who showed that most milk served to pre-school children in US-based child care was full-fat milk. In our sample, beverages were problematic in general, with high quantities of sugar-sweetened beverages served daily. Moreover, 100% fruit juice was provided to infants <6 months of age, and an average of 5 oz of 100% fruit juice was served daily to infants aged 7–9 months. Additionally, menus listed cow's milk for infants <12 months of age, which goes against current recommendations to wait until children turn 1 year of age⁽⁴²⁾.

A handful of studies have assessed the diet quality of foods and beverages served to children in child care in the USA and found that children consumed inadequate amounts of fruits and vegetables, insufficient Fe and fibre, and excessive quantities of full-fat milk^(41,43–47). Menu data from the present study suggest that the diet quality of foods served to children in child care in Mexico may be higher than in the USA, with greater amounts of fruits and vegetables served, and lower added sugars and processed foods. However, juice and cow's milk were introduced to infants too early, and children were served excessive amounts of full-fat milk, fruit juice and sugar-sweetened beverages. Beverages may be of lower nutritional quality due to the high prevalence of sugar-sweetened beverages. Because beverages contribute to children's overall energy intake, they may be an appropriate target for intervention in this setting.

The few published studies on overall dietary intake suggest that children consume inadequate fibre and excessive amounts of fat in the more urban areas of Mexico⁽¹⁸⁾. Children also consume a high percentage of energy from beverages, including full-fat milk and fruit juice⁽³⁵⁾. Our findings are consistent with this previous research, in that we found menus to provide excessive total energy, insufficient whole grains and a high prevalence of full-fat milk and fruit juice. Menus were also a source of

excessive grams of protein, and the contribution from protein made up a large percentage of overall total energy.

The present study has several limitations. First, menus were obtained from government-sponsored child-care centres and may not be representative of other types of child-care programmes in Mexico. While the study population does not represent all children in Mexico, the government-sponsored centres represent roughly one-third of all child-care centres in Mexico. Children who attend organized child care in Mexico come from smaller families with higher household incomes and are more likely to have mothers with higher educational attainment than children cared for at home⁽⁴⁸⁾. Additionally, we analysed the nutrient composition of foods and beverages listed on the menu, not what was actually served to children. Previous data suggest that menus are a reasonably accurate source of information on categories of food (e.g. fruits and vegetables) actually served in child care^(49,50). Moreover, we did not assess actual dietary intake in children, but our previous study in the USA suggests that children consume 50–100% of what they are offered in child-care centres⁽⁴¹⁾. We also compared foods, beverages and portion sizes with US-based recommendations, given the absence of specific national standards in Mexico. We did not assess foods and beverages consumed at home or away from child care, which may provide a more complete and accurate picture of dietary consumption in children <5 years of age.

Conclusions

The present study provides insight into the quantity and nutritional quality of foods and beverages served to young children in child-care centres in Mexico, a country with rapidly rising rates of childhood obesity. Future studies should explore dietary intake to assess what children actually consume in child care and at home throughout Mexico.

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References

- Romieu I, Hernandez-Avila M, Rivera J *et al.* (1997) Dietary studies in countries experiencing a health transition: Mexico and Central America. *Am J Clin Nutr* **65**, 4 Suppl., 1159S–1165S.
- Rivera JA, Barquera S, González-Cossío T *et al.* (2004) Nutrition transition in Mexico and in other Latin American countries. *Nutr Rev* **62**, 7 Pt 2, S149–S157.
- Fernald LC & Neufeld LM (2006) Overweight with concurrent stunting in very young children from rural Mexico: prevalence and associated factors. *Eur J Clin Nutr* **61**, 623–632.
- Rivera JA, Monterrubio EA, Gonzalez-Cossio T *et al.* (2003) Nutritional status of indigenous children younger than five years of age in Mexico: results of a national probabilistic survey. *Salud Publica Mex* **45**, Suppl. 4, S466–S476.
- Rivera JA & Sepulveda Amor J (2003) Conclusions from the Mexican National Nutrition Survey 1999: translating results into nutrition policy. *Salud Publica Mex* **45**, Suppl. 4, S565–S575.
- Jaime S, Flavia B, Roberto T *et al.* (2006) Improvement of child survival in Mexico: the diagonal approach. *Lancet* **368**, 2017–2027.
- Rivera JA, Barquera S, Campirano F *et al.* (2002) Epidemiological and nutritional transition in Mexico: rapid increase of non-communicable chronic diseases and obesity. *Public Health Nutr* **5**, 113–122.
- Bonvecchio A, Safdie M, Monterrubio EA *et al.* (2009) Overweight and obesity trends in Mexican children 2 to 18 years of age from 1988 to 2006. *Salud Publica Mex* **51**, Suppl. 4, S586–S594.
- del Rio-Navarro BE, Velazquez-Monroy O, Sanchez-Castillo CP *et al.* (2004) The high prevalence of overweight and obesity in Mexican children. *Obes Res* **12**, 215–223.
- Fernald LC, Gutierrez JP, Neufeld LM *et al.* (2004) High prevalence of obesity among the poor in Mexico. *JAMA* **291**, 2544–2545.
- Filozof C, Gonzalez C, Sereday M *et al.* (2001) Obesity prevalence and trends in Latin-American countries. *Obes Rev* **2**, 99–106.
- Sanchez-Castillo CP, Lara JJ, Villa AR *et al.* (2001) Unusually high prevalence rates of obesity in four Mexican rural communities. *Eur J Clin Nutr* **55**, 833–840.
- Bacardi-Gascón M, Jiménez-Cruz A, Jones E *et al.* (2009) Trends of overweight and obesity among children in Tijuana, Mexico. *Ecol Food Nutr* **48**, 226–236.
- Villa-Caballero L, Caballero-Solano V, Chavarría-Gamboa M *et al.* (2006) Obesity and socioeconomic status in children of Tijuana. *Am J Prev Med* **30**, 197–203.

15. Freedman DS, Serdula MK, Srinivasan SR *et al.* (1999) Relation of circumferences and skinfold thicknesses to lipid and insulin concentrations in children and adolescents: the Bogalusa Heart Study. *Am J Clin Nutr* **69**, 308–317.
16. Pinhas-Hamiel O, Dolan LM, Daniels SR *et al.* (1996) Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *J Pediatr* **128**, 608–615.
17. Morrison JA, Sprecher DL, Barton BA *et al.* (1999) Overweight, fat patterning, and cardiovascular disease risk factors in black and white girls: The National Heart, Lung, and Blood Institute Growth and Health Study. *J Pediatr* **135**, 458–464.
18. Colín-Ramírez E, Castillo-Martínez L, Orea-Tejeda A *et al.* (2009) Waist circumference and fat intake are associated with high blood pressure in Mexican children aged 8 to 10 years. *J Am Diet Assoc* **109**, 996–1003.
19. Leung TF, Li CY, Lam CW *et al.* (2004) The relation between obesity and asthmatic airway inflammation. *Pediatr Allergy Immunol* **15**, 344–350.
20. Perez-Padilla R, Rojas R, Torres V *et al.* (2006) Obesity among children residing in Mexico City and its impact on lung function: a comparison with Mexican-Americans. *Arch Med Res* **37**, 165–171.
21. Taveras EM, Rifas-Shiman SL, Camargo CA *et al.* (2008) Higher adiposity in infancy associated with recurrent wheeze in a prospective cohort of children. *J Allergy Clin Immunol* **121**, 1161–1166. e1163.
22. Vignolo M, Naselli A, Di Battista E *et al.* (1988) Growth and development in simple obesity. *Eur J Pediatr* **147**, 242–244.
23. Lee JM, Appugliese D, Kaciroti N *et al.* (2007) Weight status in young girls and the onset of puberty. *Pediatrics* **119**, e624–630.
24. French SA, Story M & Perry CL (1995) Self-esteem and obesity in children and adolescents: a literature review. *Obes Res* **3**, 479–490.
25. Puhl RM & Latner JD (2007) Stigma, obesity, and the health of the nation's children. *Psychol Bull* **133**, 557–580.
26. Puhl RM, Moss-Racusin CA & Schwartz MB (2007) Internalization of weight bias: implications for binge eating and emotional well-being. *Obesity (Silver Spring)* **15**, 19–23.
27. Malik VS, Schulze MB & Hu FB (2006) Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr* **84**, 274–288.
28. Dennison BA, Rockwell HL & Baker SL (1997) Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity. *Pediatrics* **99**, 15–22.
29. Faith MS, Dennison BA, Edmunds LS *et al.* (2006) Fruit juice intake predicts increased adiposity gain in children from low-income families: weight status-by-environment interaction. *Pediatrics* **118**, 2066–2075.
30. Taveras EM, Berkey CS, Rifas-Shiman SL *et al.* (2005) Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. *Pediatrics* **116**, e518–524.
31. Bowman SA, Gortmaker SL, Ebbeling CB *et al.* (2004) Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Pediatrics* **113**, 112–118.
32. Brownell KD (2004) Fast food and obesity in children. *Pediatrics* **113**, 132.
33. Lozada M, Sánchez-Castillo CP, Cabrera GA *et al.* (2008) School food in Mexican children. *Public Health Nutr* **11**, 924–933.
34. Mundo-Rosas V, Rodríguez-Ramírez S & Shamah-Levy T (2009) Energy and nutrient intake in Mexican children 1 to 4 years old. Results from the Mexican National Health and Nutrition Survey 2006. *Salud Publica Mex* **51**, Suppl. 4, S530–S539.
35. Barquera S CF, Bonvecchio A, Hernandez-Barrera L *et al.* (2010) Caloric beverage consumption patterns in Mexican children. *Nutr J* **9**, 1475–2891.
36. US Department of Agriculture (2009) Daily Food Plan for Preschoolers. <http://www.choosemyplate.gov/preschoolers/daily-food-plans.html> (accessed March 2012).
37. Office of Dietary Supplements, National Institutes of Health (2009) Nutrient Recommendations: Dietary Reference Intakes (DRI) http://ods.od.nih.gov/health_information/Dietary_Reference_Intakes.aspx (accessed September 2012).
38. Nishida C, Uauy R, Kumanyika S *et al.* (2004) The joint WHO/FAO expert consultation on diet, nutrition and the prevention of chronic diseases: process, product and policy implications. *Public Health Nutr* **7**, 245–250.
39. National Research Council (2005) *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients)*. Washington, DC: The National Academies Press.
40. Johnson RK, Appel LJ, Brands M *et al.* (2009) Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation* **120**, 1011–1020.
41. Ball SC, Benjamin SE & Ward DS (2008) Dietary intakes in North Carolina child-care centers: are children meeting current recommendations? *J Am Diet Assoc* **108**, 718–721.
42. American Academy of Pediatrics (2003) Prevention of pediatric overweight and obesity. *Pediatrics* **112**, 424–430.
43. Briley ME, Buller AC, Roberts-Gray CR *et al.* (1989) What is on the menu at the child care center? *J Am Diet Assoc* **89**, 771–774.
44. Padgett A & Briley ME (2005) Dietary intakes at child-care centers in central Texas fail to meet Food Guide Pyramid recommendations. *J Am Diet Assoc* **105**, 790–793.
45. Oakley CB, Bomba AK, Knight KB *et al.* (1995) Evaluation of menus planned in Mississippi child-care centers participating in the Child and Adult Care Food Program. *J Am Diet Assoc* **95**, 765–768.
46. Erinoshio T, Dixon LB, Young C *et al.* (2011) Nutrition practices and children's dietary intakes at 40 child-care centers in New York city. *J Am Diet Assoc* **111**, 1391–1397.
47. Sigman-Grant M, Christiansen E, Branen L *et al.* (2008) About feeding children: mealtimes in child-care centers in four western states. *J Am Diet Assoc* **108**, 340–346.
48. Flores Hernández S, Reyes Morales H, Pérez Cuevas R *et al.* (1999) The day care center as a risk factor for acute respiratory infections. *Arch Med Res* **30**, 216–223.
49. Benjamin Neelon SE, Copeland KA, Ball SC *et al.* (2010) Comparison of menus to actual foods and beverages served in North Carolina child-care centers. *J Am Diet Assoc* **110**, 1890–1895.
50. Fleischhacker S, Cason KL & Achterberg C (2006) 'You had peas today?': a pilot study comparing a Head Start child-care center's menu with the actual food served. *J Am Diet Assoc* **106**, 277–280.