

# Temperature of Foods Sent by Parents of Preschool-Aged Children

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child care, foodborne illness, temperature, daycare, food safety

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**WHAT'S KNOWN ON THIS SUBJECT:** Many preschool-aged children carry a sack lunch to child care centers that is packed by their parent.



**WHAT THIS STUDY ADDS:** These results provide initial data on how frequently sack lunches sent by parents of preschool-aged children are kept at unsafe temperatures.

## abstract



**OBJECTIVE:** To measure the temperatures of foods in sack lunches of preschool-aged children before consumption at child care centers.

**METHODS:** All parents of 3- to 5-year-old children in full-time child care at 9 central Texas centers were invited to participate in the study. Foods packed by the parents for lunch were individually removed from the sack and immediately measured with noncontact temperature guns 1.5 hours before food was served to the children. Type of food and number of ice packs in the lunch sack were also recorded. Descriptive analyses were conducted by using SPSS 13.0 for Windows.

**RESULTS:** Lunches, with at least 1 perishable item in each, were assessed from 235 parent-child dyads. Approximately 39% ( $n = 276$ ) of the 705 lunches analyzed had no ice packs, 45.1% ( $n = 318$ ) had 1 ice pack, and 88.2% ( $n = 622$ ) of lunches were at ambient temperatures. Only 1.6% ( $n = 22$ ) of perishable items ( $n = 1361$ ) were in the safe temperature zone. Even with multiple ice packs, the majority of lunch items (>90%) were at unsafe temperatures.

**CONCLUSIONS:** These results provide initial data on how frequently sack lunches sent by parents of preschool-aged children are kept at unsafe temperatures. Education of parents and the public must be focused on methods of packing lunches that allow the food to remain in the safe temperature zone to prevent foodborne illness. *Pediatrics* 2011;128:519–523

The burden of foodborne illness remains a major public health threat in the United States that results in significant impact on the well-being of young children. Studies conducted by the Centers for Disease Control and Prevention in 2009 confirm that children younger than 4 years have 4.5 times the number of bacterial infection incidents transmitted through food compared with adults aged 20 to 49 years.<sup>1</sup> Symptoms of foodborne illness are unpleasant and debilitating. Severe cases, especially in young children whose immune systems are not fully developed, can lead to serious medical issues such as kidney problems, malnutrition, and even death.<sup>2</sup> Another way of contracting bacterial infections in children is through improper hand-washing.<sup>3</sup> In addition to affecting the child's physical well-being, foodborne illness has a financial cost that results from medical expenses and work absenteeism.<sup>4</sup>

Biological hazards, especially bacteria, are found everywhere, including most foods, and multiply rapidly when exposed to warm moist conditions. Control of the temperature of food is an important way to prevent bacteria from growing and possibly causing foodborne illness. Bacteria are preserved in a state of suspended animation when refrigerated or frozen and most are killed when food is heated to an internal temperature  $>74^{\circ}\text{C}$  ( $165.2^{\circ}\text{F}$ ). Keeping foods  $>60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ) or  $<4^{\circ}\text{C}$  ( $39.2^{\circ}\text{F}$ ) is critical in the prevention of foodborne illness.<sup>5</sup> Foods left in the temperature zone of  $4^{\circ}\text{C}$  ( $39.2^{\circ}\text{F}$ ) to  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ) for  $>2$  hours are unsafe to consume and must be discarded because of the production of heat-resistant toxins by bacteria that can cause foodborne illness. Of the 20 million children younger than 5 years in the United States,  $\sim 63\%$  are in regular child care arrangements and many are required to carry their

lunch.<sup>6</sup> Although no definite numbers exist,  $\sim 50\%$  of day care centers require parents to pack lunches, and this number is expected to increase. In this article, a sack lunch is defined as a meal that is brought from home in a container to be consumed at the center. A study in the United Kingdom concluded that on a week-by-week basis, 52% to 78% of children took a sack lunch.<sup>7</sup> In a US survey of National School Lunch Program participation, 44% of children aged 5 to 18 years reported not participating in the program every day and therefore possibly packing a sack lunch.<sup>8</sup> Lunches prepared at home can create an environment for bacteria to replicate unless steps are taken to maintain a safe food temperature.<sup>5</sup>

Sustaining a safe temperature in a sack lunch can be difficult. A case study assessing the general internal temperatures of sack lunches from 239 children in junior high school showed that, with the exception of the first hour of the day, the presence of an ice pack in the sack lunch did not always guarantee lower temperatures and, in all cases, temperatures increased throughout the day to reach temperatures in excess of  $17^{\circ}\text{C}$  ( $62.6^{\circ}\text{F}$ ).<sup>9</sup>

To our knowledge, no study has documented the temperature of individual items in packed lunches at child care centers. The objective of this study was to measure the temperature of the foods in preschool-aged children's sack lunches shortly before consumption at child care centers. By examining the temperatures of foods in the children's sack lunches, this study contributes to the sparse knowledge base regarding prevention of foodborne illness in young children.

## METHODS

The contents of sack lunches parents packed for their 3- to 5-year-old chil-

dren were analyzed at 6 central Texas child care centers in the fall of 2008 and 3 additional centers in the fall of 2009. Two were smaller centers (7–10 children enrolled), whereas the other 7 had 25 to 35 children enrolled. All parents of 3- to 5-year-old children at the 9 private centers were invited to participate in the study. A total of 235 parents completed consent forms for the study, which was approved by the University of Texas at Austin institutional review board.

Sack lunches sent by parents were assessed on 3 random, nonconsecutive days between 9:30 AM and 11:00 AM on-site at the child care centers.<sup>10,11</sup> Research staff ( $n = 6$ ) were trained by a researcher with a master's degree in clinical nutrition using a standardized protocol to visually estimate the amount and type of foods and beverages, and record temperatures.<sup>12</sup>

Food items were individually removed from the sack lunch and temperatures were recorded with a Raytek ST20 PRO temperature gun (Raytek Corporation, Santa Cruz, CA)  $\sim 1.5$  hours before lunches were served to children. The noncontact Raytek device has a sensitivity of  $0.2^{\circ}\text{C}$  ( $0.36^{\circ}\text{F}$ ), and the infrared technology prevents cross-contamination between the instrument and the foods.<sup>13</sup> Device accuracy was checked daily by measuring the temperature of a designated item with all guns within a 10-second time frame. Interrater reliability was 100% in all cases. Wrappers were partially removed from all items before taking a temperature reading except items that were prepackaged by manufacturers (eg, Lunchables [Kraft Foods, Glenview, IL]). Medical-grade gloves were used to ensure that observers had no direct contact with food. Thermoses were opened to measure the temperature of their fluid contents.

The number and kind of ice packs in each sack lunch were recorded. Foods

were recorded “in acceptable temperature range” if the temperature was  $<4^{\circ}\text{C}$  ( $39.2^{\circ}\text{F}$ ) or  $>60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ). Foods were recorded “in unacceptable temperature range” if the temperature was between  $4^{\circ}\text{C}$  ( $39.2^{\circ}\text{F}$ ) and  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ).<sup>5</sup> Emphasis was placed on meats, dairy, and vegetables because of their higher protein content and the higher probability of causing food-borne illness once a food was in unacceptable temperature range.<sup>14,15</sup>

Descriptive analyses were conducted by using SPSS 13.0 for Windows (SPSS Inc, Chicago, IL).

## RESULTS

Participants included white Euro-American (69.4%), Asian (12.3%), Hispanic/Latino (9.3%), and black (2.6%) parents. More than half (60.4%) were aged 30 to 39 years. Approximately 90.2% of the subjects were married, and 72.3% were in households with  $\geq 2$  children. Nearly all (89.3%) had at least some postsecondary education, including 39.1% with a graduate or a professional degree. Two-thirds (71.1%) were employed, and 72.3% had a household income above \$80 000 (Table 1).

A total of 705 lunches were assessed. Some lunches (83 [11.8%]) were stored in refrigerators whereas the rest (622 [88.2%]) were stored at ambient classroom temperature in a storage cube with little air circulation (Table 2). Classrooms were air conditioned, with indoor temperatures ranging from  $22^{\circ}\text{C}$  ( $71.6^{\circ}\text{F}$ ) to  $24^{\circ}\text{C}$  ( $75.2^{\circ}\text{F}$ ), and an average outdoor temperature of  $27.5^{\circ}\text{C}$  ( $81.5^{\circ}\text{F}$ ). Overall,  $\sim 91\%$  of lunches were packed in thermally insulated plastic bags. Three child care centers used refrigerators (1 household size and 2 industrial) for lunch storage on regular bases. The internal temperatures of the refrigerators ranged between  $2^{\circ}\text{C}$  ( $35.6^{\circ}\text{F}$ ) and  $10^{\circ}\text{C}$  ( $50^{\circ}\text{F}$ ). Teachers often failed to use

**TABLE 1** Demographic Characteristics of Parents of Preschool-aged Children ( $N = 235$ )

Demographic	<i>n</i>	%
Persons/households		
2–3	67	28.5
4–5	159	67.7
$\geq 6$	8	3.4
Total No. of children in the household		
1	65	27.7
2	146	62.1
3	19	8.1
$\geq 4$	5	2.2
Relationship to the child		
Mother	198	83.9
Father	34	14.5
Other	3	1.6
Parent's gender		
Female	201	85.5
Male	34	14.5
Parent's age, y		
20–29	10	4.3
30–39	142	60.4
40–49	76	32.3
50–59	6	2.6
$\geq 60$	1	0.4
Parent marital status		
Single, never married	4	1.7
Married	212	90.2
Separated	3	1.3
Divorced	11	4.7
Living with partner	4	1.7
Other	1	0.4
School completed		
Some high school/not completed	1	0.4
Completed high school	3	1.3
Post high school	7	3.0
Some university/not completed	15	6.4
University/college	76	32.3
Some graduate/professional/not completed	20	8.5
Graduate/professional	92	39.1
Other	21	9.0
Family income		
\$20 000–\$40 000	13	5.5
\$40 000–\$60 000	17	7.2
\$60 000–\$80 000	31	13.2
\$80 000–\$100 000	37	15.7
$\geq \$100 000$	133	56.6
Racial/ethnicity		
Asian/Asian American	29	12.3
Black/African American	6	2.5
Hispanic/Latino	22	9.3
Middle Eastern/Middle Eastern American	2	0.9
Pacific Islander	2	0.9
White/European American	163	69.4
Other	8	3.5
Employment status		
Unemployed	6	2.6
Part-time	38	16.2
Full-time	128	54.5
Homemaker	53	22.5
Part-time student	1	0.4
Self-employed	1	0.4
Other	8	3.4

Not all demographic questions were answered by the parents.

the available refrigerators and left lunches at room temperature for an average of 2 hours before refrigeration.

Only 22 (1.6%) of the 1361 perishable food items (total of 3708) in the 705 sack lunches registered in a safe temperature range (Table 3). Overall, 97.4% of meats ( $n = 385$ ), 99.0% of dairy ( $n = 582$ ), and 98.5% of vegetables ( $n = 394$ ) were not in an acceptable temperature range when measured shortly before children consumed the lunches (Table 4). Only 4 (0.9%) of the 458 items in the 83 sack lunches located in the refrigerators used by teachers were in an acceptable temperature range. The mean ( $\pm$ SD) temperature of the perishable food items in the sack lunches was  $17.6 \pm 5.0^{\circ}\text{C}$  ( $63.7 \pm 9^{\circ}\text{F}$ ) and median was  $18.1^{\circ}\text{C}$  ( $64.6^{\circ}\text{F}$ ).

Parents put 1 ice pack in 45.1% of the 705 sack lunches and 39.1% of the sack lunches had no ice packs (Table 2). Of the 618 perishable items in lunches with 1 ice pack, only 14 food items were in an acceptable temperature range (Table 3). Only 5 (8.2%) of the 61 perishable food items packed with multiple ice packs (2–4) were in a safe temperature range. One lunch contained 1 large ice pack ( $15 \times 7.5$  cm), and 2 contained 2 medium ice packs ( $10 \times 7.5$  cm) each. Ice packs in the remainder of lunches had varying sizes and shapes. In 15 lunches, items such as frozen teething rings and drink boxes were used as “ice packs.”

## DISCUSSION

Results from this study indicate parents were not successful in keeping perishable items such as meat, dairy, and vegetables in the sack lunches of preschool-aged children in a safe temperature zone before consumption. Of the 1631 perishable food items, only 22 were found to be in an acceptable temperature range. Only 14 of 618 perish-

**TABLE 2** Description of Methods Used by Parents of Preschool-aged Children for Keeping Lunches at a Safe Temperature

Total No. (%) of Lunches	No. (%) of Lunches With No Ice Pack	No. (%) of Lunches With 1 Ice Pack	No. (%) of Lunches With 2 Ice Packs	No. (%) of Lunches With 3 Ice Packs	No. (%) of Lunches With 4 Ice Packs	No. (%) of Lunches in the Refrigerator
705 (100)	276 (39.1)	318 (45.1)	23 (3.3)	4 (0.6)	1 (0.1)	83 (11.8)

**TABLE 3** Number of Perishable Food Items in Acceptable Temperature Ranges According to Methods Used to Keep Foods at a Safe Temperature

Items (N = 22)	Total No. of Items	No. of Items With No Ice Pack	No. of Items With 1 Ice Pack	No. of Items With 2 Ice Packs	No. of Items With 3 Ice Packs	No. of Items With 4 Ice Packs	No. of Items in the Refrigerator
Meats	10	0	7	0	2	0	1
Dairy	6	0	4	1	0	0	1
Vegetables	6	1	3	2	0	0	0

Acceptable temperature range: <4°C or >60°C.

**TABLE 4** Perishable Food Items in Acceptable and Unacceptable Temperature Range

Food Type	Total No. (%) of Items	No. (%) of Items in Acceptable Temperature Range	No. (%) of Items in Unacceptable Temperature Range
Meats	385 (100.0)	10 (2.6)	375 (97.4)
Dairy	582 (100.0)	6 (1.0)	576 (99.0)
Vegetables	394 (100.0)	6 (1.5)	388 (98.5)

Unacceptable temperature range: 4°C–60°C. Acceptable temperature range: <4°C or >60°C.

able items in lunches that had 1 ice pack were in the safe temperature zone. Although a larger percentage of perishable items were found at safe temperatures in sacks with multiple ice packs, only 5 of 61 perishable items with multiple ice packs were at a safe temperature. The majority of perishable food items in lunches even stored in refrigerators were in the unsafe temperature zone, a result perhaps of the nature of the lunch sacks, the internal temperature of the refrigerator, and/or amount of time at ambient temperature before refrigeration. These results indicate an urgent need for parents and child care personnel to be educated in safe food practices.

Few reports are available regarding the temperatures of foods in lunches packed by parents for their preschool-aged children in child care centers. This research provides new data where little to no previous studies exist for comparison. Temperatures of packed lunches, regardless of age of

the consumer, have not been a focus in public health or food science. However, a study assessing knowledge of food safety in ~4000 young adults showed that participants were only able to answer 60% of the questionnaire correctly and had trouble designating foods with higher food safety concerns.<sup>16</sup> Although our study did not measure knowledge of food storage practices, only 50% of parents attempted to provide cold storage with ice packs for their preschool-aged children's sack lunches. Safe practices and relationships between food handling and personal health need to be taught and reinforced.

Time, energy, and lack of knowledge are all possible reasons for food-handling practices that result in poorly packed and stored sack lunches. Parents of preschool-aged children in child care centers are usually working and may be managing other activities as well. Safe food

practices for packing and storage of lunches extend beyond children in child care to school-aged children as well as adults who carry lunch to work.

The child care setting imposes some natural limitations seen in this study. The temperature of food was taken ~1.5 hours before consumption, largely because many of the children could start consuming snack foods in their lunches as early as 1 hour before lunchtime. To avoid losing the temperature reading of any food item, the research team elected to record temperature earlier. Because the temperature readings were conducted 1.5 hours before consumption, this method is a more conservative approach because it is likely that the temperature remained in the unsafe zone for at least 1.5 hours before the child consumed the food.

Another limitation was that temperatures of food items were surface and not core temperatures to avoid cross-contamination between different food items. Conversely, a major strength to this study is that it assessed the temperature of each item in the sack lunch as opposed to collective temperature of all items. The research also offered a rare look at safety of foods offered to a population at a critical developmental age. This topic merits a more extensive

epidemiologic study that more closely examines the number of foodborne illness cases in preschool-aged children who bring lunch from home compared with others who eat school-prepared lunch.

## CONCLUSIONS

Results of this study provide evidence that how parents pack their

preschool-aged child's lunch has potential effects on the temperature of the food packed and may result in foodborne illness when left uncorrected. Education of parents and the public must focus on proper methods of packing lunches that allow the food to remain in the food safety zone. Our results also highlight the need for additional research and ac-

tion on the development of ice packs, lunch bags, and other tools to maintain food in sack lunches in the safe temperature zone.

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