

- chronic illness, edited by N. Hobbs and J.M. Perrin. Jossey-Bass Publishers, San Francisco, 1985, pp. 827-863.
2. Newacheck, P. W., and McManus, M. A.: Financing health care for disabled children. *Pediatrics* 81: 385-394, (1988); (a) p. 391.
 3. Salkever, D. S.: Parental opportunity costs and other economic costs of children's disabling conditions. *In* Issues in the care of children with chronic illness, edited by N. Hobbs and J. M. Perrin. Jossey-Bass Publishers, San Francisco, 1985, pp. 864-879.
 4. Hodgson, A., and Meiners, M. R.: Cost-of-illness methodology: a guide to current practices and procedures. *Milbank Memorial Fund Q* 60: 429-462 (1982).
 5. Technology dependent children: hospitals vs. home care. Publication OTA-TM-H-38. U.S. Congress, Office of Technology Assessment, U.S. Government Printing Office, Washington, DC, 1987; (a) p. 13.
 6. Thorsheim, M. J.: Final report: study of factors that promote home care of older persons. HCFA Cooperative Agreement No. 18-C-98385/5-03. Abbott Northwestern Hospital, Minneapolis, MN, 1987.
 7. Juster, J. F.: Conceptual and methodological issues involved in the measurement of time use. *In* Time, goods, and well-being, edited by J. T. Juster and F. P. Stafford. Survey Research Center, University of Michigan, Ann Arbor, 1985.
 8. Perrin, J. M.: Introduction. *In* Issues in the care of children with chronic illness, edited by N. Hobbs and J. M. Perrin. Jossey-Bass Publishers, San Francisco, 1985, pp. 1-10.
 9. Leonard, B. J., Brust, J. D., and Choi, T.: Providing access to home care for disabled children: Minnesota's Medicaid Model Waiver Program. *Public Health Rep* 104: 465-472, September-October 1989.
 10. Healthy children: investing in the future. Publication OTA-H-345. U.S. Congress, Office of Technology Assessment, U.S. Government Printing Office, Washington, DC, 1987.
 11. Newacheck, P. W., and Halfon, N.: The financial burden of medical care expenses for children. *Med Care* 24: 1110-1117 (1986).
 12. U.S. General Accounting Office: Home care experiences of families with chronically ill children. Publication No. GAO/HRD-89-73, Washington, DC, 1989.
 13. Cabin, B.: Cost effectiveness of pediatric home care. *Caring* 4: 48-53 (1985).
 14. Jacobs, P., and McDermott, S.: Family caregiving costs of chronically ill and handicapped children: method and literature review. *Public Health Rep* 104: 158-163, March-April 1989.

The Nutritional Status and Dietary Adequacy of Single Homeless Women and Their Children in Shelters

MARY ANNE DRAKE, PhD, RD

Dr. Drake is Associate Professor of Human Environmental Sciences at Central Missouri State University.

Tearsheet requests to Mary Anne Drake, PhD; Central Missouri State University, Department of Human Environmental Sciences, Grinstead 247, Warrensburg, MO 64093; tel. (816) 543-4217.

Synopsis

Data were collected on the nutrient intake and nutritional status of 96 single mothers and their 192 dependent children who had been displaced from their homes. The objective of the study was to provide information on the dietary adequacy of a newly identified subgroup of homeless persons, single women and their dependent children.

Once situated in temporary housing, those participating in the study indicated that they believed

that they were receiving sufficient food. However, a nutrient analysis found that the study subjects in all age groups were consuming less than 50 percent of the 1989 Recommended Dietary Allowances (RDA) for iron, magnesium, zinc, and folic acid. Adults were consuming less than 50 percent of the RDA for calcium. The type and amounts of fats consumed were in higher than desirable quantities for a significant number of subjects of all ages. The health risk factors of iron deficiency anemia, obesity, and hypercholesterolemia were prevalent.

The findings indicate a need to examine and remedy nutrient intake deficiencies among single women who are heads of household and their dependent children in temporary housing situations. Diet-related conditions found included low nutrient intakes that may affect child growth and development, risk factors associated with chronic disease, and lack of appropriate foods and knowledge of food preparation methods in shelter situations. Applicable, understandable nutrition education should be offered mothers in shelter situations to help them make food choices at the shelter and when they become self-sufficient. Assistance programs such as the Special Supplemental Food Program for Women, Infants, and Children, and food stamps, should be available to this group.

THE GROWING HOMELESS POPULATION IS CHANGING in composition from the characteristics described in the late 1980s (1).

One expanding segment of the homeless population is single women who are heads of household and their children younger than 13 years (1). They often find themselves suddenly without such basic necessities as shelter, food, and clothing owing to conditions and situations that include the mother's marital breakup, her unemployment without public assistance, and the mother's and the children's poor health (2).

Limited studies have focused on the nutritional status or dietary adequacy of homeless persons (3-6). Homeless persons in general have such chronic health problems as coronary artery disease, hypertension, and diabetes mellitus (6). Studies show them to be at risk for protein calorie malnutrition and chronic malnutrition (4-6). Despite the particular health risks of homeless women and children, information on their nutritional status is lacking.

This study was designed to obtain data on the nutritional status and nutrient intake of single women who are the heads of the household and their children who are living in marginal housing owing to being displaced from their homes. Marginal housing was defined as housing for those without legal rights to their housing facilities. The data analysis provides background information useful to public health officials in assessing the health and nutrition needs of this special population subgroup.

Methods

Residents of two temporary housing shelters in Kansas City, MO, were surveyed during the 12 months from January 1989 to January 1990. The same nonprofit organization operated both shelters, providing up to 6 months of long-term living accommodations for homeless single women who are heads of household with dependent children. The goal of the supporting organization is to enable residents to become self-supporting and to return to the community as soon as possible. The average length of stay at the shelter was 3.4 months. Private sleeping and bathing areas were available for 12 families at each shelter.

With the help of two licensed social workers, who each worked on a full-time basis at the two locations during the study, mothers were identified with sufficient capability to participate. About 2

Typical Pattern for Menus at Temporary Housing for Homeless Single Mothers and Their Children in Two Shelters in Kansas City, MO, 1989

Breakfast

Eggs with bacon or sausage
Cereal with whole milk
Toast with margarine or jelly doughnuts
Coffee or milk

Noon meal

Sandwich, white enriched bread with bologna, cheese, and mayonnaise
Cookies, ice cream, cake dessert, or combination
Milk or fruit drink or coffee

Afternoon

Ice cream or cake dessert

Dinner

Fried meat
Starch with gravy or macaroni and cheese
Vegetable with margarine (corn or green beans)
Bread and margarine
Fried pie or canned fruit
Coffee or fruit drink or whole milk

weeks after a family began residing in the shelter, the author visited potential subjects to explain in detail the purpose and methods of the study. Of 126 women interviewed, 96 agreed to participate. Signed consent forms were obtained from all participants. In order to maintain confidentiality, each subject was assigned a random identifying number. Interviews and examinations were conducted and data were obtained concerning dietary intake, biochemical indexes of nutritional status, and anthropometric measurements.

Teams of shelter residents took turns on a weekly basis in planning meals, purchasing food, and preparing the meals served at the shelter. A typical menu pattern is shown in the accompanying box. Residents ate in a large common dining room. Other food was obtained by the residents themselves. School-aged children and children in day care centers ate food provided at those facilities. Women who worked outside the shelter most often ate sack lunches they prepared for themselves at the shelter. Food money was obtained from the shelter's limited budget and donations. Residents who were able to obtain food stamps used them to purchase food items.

Nutrients consumed. Each woman was interviewed about 2 weeks after agreeing to participate in the

Table 1. Nutrient intake of 96 single mothers and their 192 dependent children in temporary housing in two shelters in Kansas City, MO, 1989, as mean percentages 1 of 1989 Recommended Dietary Allowances for mothers and children, by age group

Nutrient	Children				Mothers	
	0.5-1 years	1-3 years	4-6 years	7-10 years	19-24 years	25-49 years
Energy	93 ± 32	91 ± 30	89 ± 38	98 ± 33	92 ± 35	94 ± 28
Protein	96 ± 39	89 ± 34	93 ± 31	94 ± 32	90 ± 34	91 ± 32
Calcium	101 ± 39	99 ± 38	91 ± 33	89 ± 34	49 ± 24	48 ± 29
Magnesium	51 ± 24	52 ± 24	47 ± 29	49 ± 31	48 ± 29	44 ± 37
Zinc	52 ± 29	49 ± 28	51 ± 26	48 ± 27	43 ± 36	48 ± 31
Iron	56 ± 26	48 ± 29	54 ± 35	55 ± 39	50 ± 38	49 ± 39
Vitamin A	67 ± 39	63 ± 31	59 ± 39	61 ± 36	71 ± 34	77 ± 26
Ascorbic acid	89 ± 29	84 ± 32	81 ± 26	79 ± 34	83 ± 32	81 ± 39
thiamin	98 ± 35	91 ± 29	93 ± 29	99 ± 29	92 ± 31	89 ± 24
Riboflavin	89 ± 39	81 ± 27	88 ± 40	92 ± 34	76 ± 32	84 ± 39
Niacin	94 ± 29	96 ± 31	89 ± 35	91 ± 29	88 ± 42	91 ± 28
Folic acid	47 ± 39	49 ± 33	49 ± 39	52 ± 31	41 ± 39	45 ± 27
Vitamin B-6	89 ± 22	86 ± 37	85 ± 38	89 ± 33	81 ± 29	89 ± 29
Vitamin B-12	101 ± 31	98 ± 36	89 ± 41	97 ± 31	99 ± 41	102 ± 37

¹ Mean plus or minus standard deviation.

project, and was asked about her and her children's food preparation and consumption practices since entering the shelter. They were given directions about recording food and beverage consumption in a food diary. Before being accepted in the study, mothers were asked to demonstrate their ability to measure and record food consumption. Standard measuring implements and models of food portions were used to determine quantities eaten during a 48-hour period. Children's food consumption away from the shelter at school or at a day care center was observed.

Diet records for each day were analyzed and averaged for macro and micro nutrients using the Nutritionist III computer software program (A). Results were expressed as age- and sex-specific percentage comparisons of the 1989 Recommended Dietary Allowances (RDAs) (7). Results were compared with data from the Health and Nutrition Examination Survey (NHANES I) (8).

Anthropometric measurements. Anthropometric measurement procedures were standard techniques (9, 10) that included height, weight, and triceps skin fold thickness. A beam balance was used for weights, which were obtained with the subjects attired in light clothing, without shoes. Infants and small children not able to stand alone were weighed on infant scales. A fixed stadiometer with digital display to 0.1 centimeters (cm) was used for height determinations. The height of subjects younger than 2 years was taken in the recumbent position with the use of a fixed headboard and movable foot board measuring device. Triceps skin fold thickness measurements, taken on the left arm, were obtained with Lange skin fold calipers. All

anthropometric measurements were taken by the author. Group mean results were compared to established standards (11, 12).

Body mass index (BMI) was determined for all adult subjects. BMI is a weight-to-height index (weight in kilograms [kg] divided by height in meters squared [m²]) that has a higher correlation with body fat than body weight (13).

Biochemical indexes. Venous blood samples were used to determine hemoglobin concentration, hematocrit percent, transferrin saturation, albumin, and cholesterol. All fasting samples were drawn by the same technician on the second morning after subjects began recording food consumption. All laboratory values were determined by a private facility following established biochemical methods of assay (14). Results for iron biochemical indices were compared to data from NHANES II (15).

Statistical analysis. Pearson product-moment correlation procedures, chi-square tests, and Student's t-tests were used to analyze the data. The statistical level was set at *P* less than 0.05 for all tests. The SAS statistical program (B) was used to perform the calculations.

Findings

The group of subjects was 44 percent white, 41 percent black, 11 percent Hispanic, and 4 percent of oriental descent. Adult subjects were 19- to 45-years old, with a mean age of 24.2 years, only 2 of whom were 35 to 45 years old. Adult subjects were 33 percent of the study group, 59 percent were children ranging in age from 1 to 10 years,

and 8 percent were infants younger than 1 year. Among the 96 adults, 59 percent were smokers, who had an average consumption of 1.5 packs of cigarettes a day; 42 percent reported some use of alcohol; and 8 percent reported occasional use of street drugs. Among the adults, 41 percent had a chronic health condition, and 49 percent were receiving prescription medications, including 9 who indicated they were taking oral contraceptives. Six women said they had diabetes mellitus, four reported a history of hypertension, six subjects had a history of mental illness, and three had a history of heart disease.

Of the 96 women, 17 (18 percent) said that they had been told in the past to follow a modified diet, but only 1 said that she was following the recommended diet modification. Four of the women were pregnant. Only one of the women reported a significant change in weight. She had deliberately lost more than 10 pounds following a physician's recommendation. All participants lacked financial resources and were in the process of obtaining guidance from various social agencies on receiving appropriate financial, housing, education, and employment opportunities. The average period of homelessness before entering the shelter was 6 days. Many had been housed with friends or at a drop-in shelter prior to residing at the long-term shelter.

Nutrients consumed. The mean percentage of the RDA for each nutrient analyzed for the women and children is shown in table 1. Subjects were classified by age, conforming to the categories of the 1989 RDAs. Information does not reflect the use of nutrient supplements, since only three subjects reported they consistently consumed supplements.

The intake of kilocalories, protein, thiamin, niacin, and cobalamin provided 90 percent or more of the RDA for all age groups. The calcium intake for children was found to be close to 90 percent of the RDA, while that for adults was close to 50 percent. All subjects consumed less than 50 percent of their RDA for iron, magnesium, zinc, and folic acid. Statistical analysis found no significant differences in nutrient intakes by race.

Data from NHANES I (8) detailing nutrients consumed is shown in table 2. Nutrients were calculated and reported as a percentage of the most recent RDAs (7). Table 3 gives the type and amount of fat consumed by the subjects.

Anthropometric measurements. Subjects' body measurements were compared to national data ob-

Table 2. Mean percentages of nutrient intake, NHANES I 1, calculated to reflect data for both sexes and for age groups for 1989 Recommended Dietary Allowances

Nutrient	Children			Mothers	
	1-3 years	4-6 years	7-10 years	19-24 years	25-49 years
Energy	92	88	91	96	86
Protein	86	84	89	88	89
Calcium	105	95	79	42	39
Iron	59	48	54	49	41
Vitamin A	68	62	59	67	71
Ascorbic acid	67	71	76	69	82
Thiamin	95	89	96	88	97
Riboflavin	97	91	86	69	74
Niacin	117	94	98	89	93

¹ Reference (8).

tained from NHANES I (11, 12). Data indicating the percentage distribution of the subjects' anthropometric measurements by percentile distribution is shown in table 4.

Obesity was prevalent among the women, with 29 percent of those 19-24 years of age and 36 percent of those 25-49 having body mass indexes above 27.3, a level indicative of obesity (16). By the other indicator of body fat, triceps skin fold measurement (17), 29 percent of the mothers measured higher than the 95th percentile.

Biochemical indexes. Mean laboratory values for the subjects and the percentage of subjects with blood values considered to be beyond the normal range (18) are shown in table 5. All age groups showed significant ($P < 0.05$) indicators of iron status lower than normal range. Serum cholesterol levels for adult subjects were higher than the desirable level of 5.20 milliliters per liter (L) (200 mg per deciliter) (18) for at least 20 percent of the population.

Discussion

The study participants represent a small segment of a growing population of the homeless, but are not typical of the homeless population because they are attempting to become self-sufficient and are motivated to improve themselves.

Nutrient intake. During initial interviews we determined that accurate information on the subjects' prior eating patterns would be impossible to obtain. Confounding factors were their lack of income to buy food on a consistent basis, an unstable living environment, inconsistent eating habits and sources of food, and general lack of willing-

Table 3. Type and amount of fat intake of 96 single mothers and their 192 dependent children in temporary housing in two shelters in Kansas City, MO, 1989, as mean percentages 1 of 1989 Recommended Dietary Allowances for mothers and children, by age group

Type of fat	Children				Mothers	
	0.5-1 years	1-3 years	4-6 years	7-10 years	19-24 years	25-49 years
Total fat (in grams)	29 ± 10	49 ± 12	64 ± 19	81 ± 27	103 ± 42	99 ± 53
Saturated fat (in grams)	9 ± 4	12 ± 9	19 ± 29	34 ± 18	43 ± 11	39 ± 14
Cholesterol (in milligrams)	347 ± 29	418 ± 91	422 ± 81	446 ± 78	495 ± 91	408 ± 82
Percent kilocalories from fat	47 ± 13	49 ± 17	52 ± 28	51 ± 19	48 ± 23	53 ± 21

¹ Mean plus or minus standard deviation.

Table 4. Percent distribution ¹ of anthropometric measurements of 96 single mothers and their 192 dependent children in temporary housing in two shelters in Kansas City, MO, 1989, compared to percentile distribution of U.S. population data from NHANES I, by age groups

Anthropometric measurement	0.5-1 years	1-3 years	4-6 years	7-10 years	19-24 years	25-49 years
Height:²						
Less than 5th percentile	6	9	13	12	...	...
5th-25th percentile	26	21	15	13	...	...
26th-75th percentile	52	52	59	60	...	...
75th-95th percentile	5	12	8	10	...	...
More than 95th percentile	11	16	5	5	...	...
Weight:						
Less than 5th percentile	13	9	15	15	16	19
5th-25th percentile	19	13	19	11	12	11
26th-75th percentile	32	36	25	31	30	27
75th-95th percentile	31	28	8	17	15	24
More than 95th percentile	5	14	33	26	27	19
Triceps skin fold:						
Less than 5th percentile	11	9	4	11	11	8
5th-25th percentile	21	11	17	19	21	16
26th-75th percentile	31	32	31	23	18	18
75th-95th percentile	11	23	20	20	21	29
More than 95th percentile	26	25	28	27	29	29

¹ Percentile distribution of U.S. population derived from NHANES I, references 11 and 12.

² Not calculated for adult subjects.

Table 5. Mean values of biochemical assay of blood samples and percent with values outside normal range ¹, 96 single mothers and their 192 dependent children in temporary housing in two shelters in Kansas City, MO, 1989, by age group

Component	0.5-1 years	1-3 years	4-6 years	7-10 years	19-24 years	25-49 years
Albumin mean value ²	39	42	41	38	37	41
Percent below normal	0	2	3	2	0	3
Hemoglobin mean value ³	123	109	112	115	109	111
Percent below normal	26	32	28	27	27	25
Hematocrit mean value ¹	0.36	0.35	0.36	0.36	0.35	0.34
Percent below normal ⁴	26	29	26	25	24	28
Transferrin saturation mean value ²	1.78	1.82	1.79	1.89	1.82	1.88
Percent below normal ⁵	24	26	27	25	26	28
Cholesterol mean value ⁶	3.76	4.10	4.15	4.72	5.93	6.11
Percent above desirable level	0	9	16	19	31	34

¹ Normal blood values were derived from age-specific standards, reference 15.

² Grams per liter. Normal level is 35 grams per liter.

³ Grams per liter. Normal level is 115 grams per liter.

⁴ Normal level is 0.33.

⁵ Normal level is 1.70 grams per liter.

⁶ Millimoles per liter. Desirable level is 5.20 millimoles per liter. Based on recommendations of the National Cholesterol Education Program, reference 18.

ness or ability to recall this information. Frequently the subjects indicated they felt lucky to have any food available, and they had minimal concerns for the nutritional value of the foods they consumed when their prime objective was simply to feed their hungry children and themselves.

Foods consumed were typically convenience and prepackaged foods that were often high in saturated fat and low in nutrient density. The main method of food preparation was frying. Most subjects indicated that since they were now in a more secure environment they believed that they and their children were seldom hungry and that they were consuming foods that were well balanced. Nearly a fourth of the children 4 years of age and older were found to be hoarding food. Mothers indicated they felt that meals consumed by the children at school or day care were nourishing and more than adequate in quantity.

Calcium consumption for adults was found to be close to 50 percent of the RDA, while the intake for their children was close to the recommended levels. Similar results have been reported for NHANES I (8). Most adults drank coffee, iced tea, and carbonated beverages, rather than milk. Many mothers indicated that milk was an appropriate beverage for infants and young children, but not for adults.

Their intake of iron was found to be about 50 percent of the RDA for all age groups. Similar findings have been reported previously in all age and socioeconomic groups (8, 19). Rather than use the iron-fortified formula that was available for infants, most mothers of children younger than 1 year typically fed their children homogenized whole milk from a bottle. The low iron consumption is reflected in the mean biochemical indexes of iron status (hemoglobin concentration, hematocrit percent, and transferrin saturation) that fall at the low level of recommended normal limits for 25 percent in all age groups (19). The concern is that the growth and development of infants and children may be adversely affected (20), as well as the mental and physical performance of all subjects (20, 21). Women of child bearing age who have iron deficiency anemia could affect adversely their own health and that of children from subsequent pregnancies.

Low iron intake and low biochemical iron status levels could be corrected through education concerning the adverse health effects of poor iron status, nutrition education concerning preferred food sources for iron, means of increasing iron absorption, and the appropriate use of iron supple-

'People of all ages, particularly children, need readily understandable nutrition education about food choices, keeping in mind their life-style limitations.'

ments. Government nutrition education and assistance programs, such as the Special Supplemental Food Program for Women, Infants, and Children (WIC), should be used whenever possible.

Analysis of diet records found that the subjects' consumption of total fat, saturated fat, and cholesterol, as well as their percentage of kilocalories obtained from fat, were in excess of recommended levels (18) for all age groups. Data from NHANES I found lower levels of total fat and cholesterol consumed by all age groups, along with lower percentages of kilocalories obtained from fat (22). However, a recent survey of homeless men and women (6) found values similar to those obtained in this study. The high level of total fat and type of fat consumed in the present study was reflected in the mean serum cholesterol levels for adults. They were found to be significantly ($P < 0.01$) above the desirable level of 5.20 mm per L (200 mg per dL) for both adult age groups (18), with more than 30 percent of the adult population having serum cholesterol levels above the desirable limit. As subjects increased in age (from 1 to 3 years to adulthood) both the mean serum cholesterol level and the percentage of subjects with serum cholesterol above the desirable level increased in number. Other recent research of the nutritional status of adult homeless found serum cholesterol levels above the desirable level of 200 mg per dL in slightly more than 50 percent of the subjects (5, 6).

Nutritional risk factors. Although the number of subjects in this sample is small, the relatively high incidence of hypercholesterolemia is of concern. Hypercholesterolemia among adults is a major risk factor in the prevalence and severity of coronary heart disease (18, 23). Lowering the serum cholesterol concentration in hypercholesterolemic adult persons who consume high intakes of saturated fat and cholesterol has been found to lower the risk of developing symptoms of cardiovascular disease (18). Appropriate food choices can help in reducing this risk factor. Intervention with the assistance of understandable nutrition education and the avail-

ability of appropriate food choices could be used by public health and private social organizations to reduce this health risk factor.

As the body mass index increases, incidence and relative risk of complications of chronic diseases, including hypertension and coronary heart disease, increases (24). Obesity and high fat consumption are associated with cancer of the breast, prostate, and bowel (24-26). At least 35 percent of the adult subjects were classified as obese. Triceps skin fold measurement was above the 95th percentile for at least 25 percent of all subjects. Similar results with a high incidence of excess body fat, obesity, and hypercholesterolemia in an adult, homeless population has been reported (5, 6).

A high prevalence of nutritional risk factors, identified by nutrient consumption, biochemical indexes, and anthropometric measurements, is apparent in the group studied. Iron deficiency anemia, overweight and obesity, and hypercholesterolemia were found to be present at much higher than expected levels.

Once reliable food sources are established for all homeless persons, steps may be taken to help reduce the possibility of malnutrition, particularly among children and pregnant women. Enrollment in food assistance programs, including food stamps, WIC, Child Care Food programs, and school lunch programs, should be made available. The quality of foods consumed could be enhanced by modifying menus served at shelters, changing the methods of food preparation, fat content, and food selections to make available a wider variety. An increase in food costs, however, could be remedied by deleting some inappropriate food choices and by getting eligible shelter residents to use food stamps more and to involve themselves more in assistance programs.

People of all ages, particularly children, need readily understandable nutrition education about food choices, keeping in mind their life-style limitations. This alone would greatly improve the quality of the diets of shelter inhabitants.

References.....

1. Committee on Banking and Urban Affairs, Subcommittee on Housing and Community Development: Homelessness in America. House of Representatives, 100th Congress, second session. U.S. Government Printing Office, Washington, DC, 1983.
2. Rossi, P. H., Wright, J. D., Fisher, G. A., and Willis, G.: The urban homeless: estimating composition and size. *Science* 235: 1336-1341, Mar. 13, 1987.
3. Physician Task Force on Hunger in America: Hunger in

America: the growing epidemic. Harvard University, School of Public Health, Boston, MA, 1985.

4. Laven, G. T., and Brown, K. C.: Nutritional status of men attending a soup kitchen: a pilot study. *Am J Public Health* 75: 875-878 (1985).
5. Luder, E., Boey, E., Buchalter, B., and Martinez-Weber, C.: Assessment of the nutritional status of urban homeless adults. *Public Health Rep* 104: 451-457, September-October 1989.
6. Luder, E., Ceysens-Okada, E., Koren-Roth, A., and Martinez-Weber, C.: Health and nutrition survey in a group of urban homeless adults. *J Am Diet Assoc* 90: 1387-1392 (1990).
7. Food and Nutrition Board: Recommended dietary allowances. Tenth revision. National Academy of Sciences, Washington, DC, 1989.
8. Dietary intake source data, United States, 1971-74. DHEW Publication No. (PHS) 79-1221. National Center for Health Statistics, Hyattsville, MD, 1979.
9. Fomon, S. J.: Nutritional disorders of children. Prevention, screening, and follow-up. DHEW Publication No. (HSA) 76-5612, Hyattsville, MD, 1977.
10. Frisancho, A. R.: Anthropometric standards for evaluation of growth and nutritional status of children and adults. Healthy Products, Ann Arbor, MI, 1986.
11. National Center for Health Statistics: Basic data on anthropometric measurements and angular measurements of the hip and knee joints, for selected age groups 1-74 years of age, United States, 1971-75. Data from Health and Nutrition Survey I. *Vital Health Stat* [11] No. 219 (1975). DHHS Publication No. (PHS) 81-1669. Hyattsville, MD 1981.
12. Hamil, P. V., et al.: Physical growth: National Center for Health Statistics percentiles. *Am J Clin Nutr* 32: 607-629 (1979).
13. Prevalence of overweight in selected states—behavioral risk factor surveillance, 1986. *MMWR CDC Surveillance Summary* 37: 9-20 (1988).
14. Sauberlich, H. E., Skala, H. N., and Dowdy, R. P.: Laboratory tests for the assessment of nutritional status. CPC Press, Cleveland, OH, 1974.
15. Yip, R., Johnson, C., and Dallman, B.: Age-related changes in laboratory values used in the diagnosis of anemia and iron deficiency. *Am J Clin Nutr* 39: 427-436 (1984).
16. Bray, G. A.: Complications of obesity. *Ann Intern Med* 103: 1052-1062 (1985).
17. Crook, C. E., and Roche, A. F.: Race and sex-specific reference data for triceps and subscapular skinfolds and weight stature. *Am J Clin Nutr* 35: 347-354 (1982).
18. Report of the National Cholesterol Education Program Expert Panel on detection, evaluation, and treatment of high blood cholesterol levels in adults: *Arch Int Med* 148: 36-42 (1982).
19. Dierks, E. C., and Morse, L. M.: Food habits and nutrient intakes of preschool children. *J Am Diet Assoc* 47: 292-294 (1965).
20. Deinard, A., Gilbert, A., Dodds, M., and Egeland, B.: Iron deficiency and behavioral deficits. *Pediatrics* 68: 828-834 (1981).
21. Pollih, E., Haas, J., and Levitsky, D. A., editors: International conference on iron deficiency and behavioral development. *Am J Clin Nutr* 50: 565-587, March (supp.) 1989.
22. Abraham, S., and Carroll, M. D.: Fats, cholesterol, and sodium intake in the diet of persons 1-74 years, United

States. Advance Data from Vital and Health Statistics, No. 54. National Center for Health Statistics, Hyattsville, MD, 1981.

23. National Academy of Sciences report on diet and health. *Nut Rev* 47: 142-149 (1989).

24. Burton, S. T., Foster, W. R., Hirsh, J., and Van Italie, T. B.: Health implications of obesity: an NIH Consensus Development Conference. *Int J Obes* 9: 155-169 (1985).

25. Garfinkel, L.: Overweight and cancer. *Ann Int Med* 103: 1034-1036 (1985).

26. National Research Council executive summary: diet, nutrition and cancer. *Nut Today* 17: 20-24 (1987).

Equipment

A. Nutritionist III, v. 6.0, analytic computer software. N-Squared Computing, 3040 Commercial St. SE, Salem, OR 97302; tel. (503) 364-9118.

B. SAS Institute, Inc., Cary, NC; tel. (919) 677-8000.

A Seasonal Association Between SIDS Deaths and Kindergarten Absences

WARREN G. GUNTHEROTH, MD
RÜDIGER LOHMANN, MD
PHILIP S. SPIERS, PhD

Two of the authors are at the University of Washington, School of Medicine. Dr. Guntheroth is Professor of Pediatrics (Cardiology) and Dr. Spiers is Research Associate Professor (Epidemiology). Dr. Lohmann is a resident physician at Berlin University and participated in this research while a senior student at Hannover Medical School, Federal Republic of Germany.

Tearsheet requests to Warren G. Guntheroth, MD; University of Washington, Department of Pediatrics, RD-20; Seattle, WA 98195; tel. (206) 543-3186.

Synopsis

Data from linked birth and death certificates from the State of Oregon were used to determine

the monthly distribution of deaths from sudden infant death syndrome (SIDS) for the years 1976 through 1984. The monthly number of SIDS deaths increased in winter and decreased in summer, when schools usually are not in session. Absences from kindergarten were determined from school records for the period 1979-84. School absences, previously shown to reflect incidence of predominantly infectious diseases, were found to be positively correlated with occurrences of SIDS.

The role of ordinarily nonlethal infections in occurrences of SIDS has been established by history, histology, and viral isolation. The authors concluded that the seasonality of SIDS is related to the seasonality of respiratory infections and that the seasonality is influenced by respiratory infections being spread from school children to infants during periods when schools are in session.

SINCE 1892, when Templeman reported an increase during winter months in what was then called overlaying (1), sudden infant death syndrome (SIDS), sometimes known as crib death, has been reported to have a greater incidence during winter than summer.

Templeman attributed the increased rate in Edinburgh to cold weather and the huddling of a family in a single bed, often of burlap sacks. As late as 1944, Abramson attributed SIDS to accidental suffocation by bedclothes, with an increase of both owing to cold weather (2). Beal argued that cold weather was directly involved in SIDS (3). The same seasonality for SIDS, however, has been

observed for Hawaii, which has no truly cold weather, as for other parts of the country (4).

Beginning in 1945, some investigators attributed the seasonality of SIDS to the seasonality of respiratory infections (5-7). Many reports have similar conclusions, including Beal, based on data from Australia where winter months are June through August (8). Beal showed that the rate of SIDS paralleled the rate of respiratory infections for the preceding 2 weeks in the general population.

We analyzed data from the State of Oregon and determined a seasonality for SIDS and examined the relation of that seasonality to school schedules