Vitamin–Mineral Supplement Use Among Preschool Children in the United States

Stella M. Yu, ScD, MPH*; Michael D. Kogan, PhD, MA‡; and Peter Gergen, MD§

ABSTRACT. *Objective.* **To estimate the prevalence of recent supplement use in a national sample of preschool children and to examine the relationship of maternal and child characteristics, past maternal supplement use practices, familial, health services, and child health factors associated with supplement use.**

Methods. **We used data on 8285 preschool children whose mothers were interviewed for the 1991 Longitudinal Follow-up to the 1988 National Maternal and Infant Health Survey. Data collection was conducted either by telephone or personal interview. The sample is representative of the estimated 3.8 million US born children in 1988 and alive in 1991. The outcome measures are whether the child was given any vitamin and mineral supplements at least 3 days a week in the 30 days before the interview and the type of supplement received. Statistical techniques included bivariate and weighted multiple logistic regression analysis.**

Results. **More than half of all US 3-year-olds (54.4%) were given some vitamin and mineral supplement. The most common supplements consumed were multivitamin–mineral with iron (59% of supplement users) and multivitamin–mineral without iron (26.4%). Children who received any supplements tended to have mothers who are non-Hispanic White, older, more educated, married, insured, receiving care from a private health care provider, have greater household income, and took supplements during pregnancy. Child health characteristics associated with supplement use included first birth order and having eating problems or poor appetites.**

Conclusions. **More than half of US preschool children used vitamin and mineral supplements. The sociodemographic and health predictors identified for supplement use suggest that groups at risk for nonuse are likely the same groups whose circumstances may predispose a need for supplementation.** *Pediatrics* **1997;100(5). URL: http://www.pediatrics.org/cgi/content/full/100/5/e4;** ***vitamin–mineral supplements, preschool child, socioeconomic factors, National Maternal and Infant Health Survey.***

ABBREVIATIONS. RDA, Recommended Dietary Allowance; MVI, multivitamin–mineral supplement; Longitudinal Follow-up (LF); NMIHS, National Maternal and Infant Health Survey; HMO, health maintenance organization; OR, odds ratio.

From the *Health Resources and Services Administration, Maternal and Child Health Bureau, Rockville, Maryland; ‡Centers for Disease Control and Prevention, National Center for Health Statistics, Hyattsville, Maryland; and §Agency for Health Care Policy and Research, Rockville, Maryland.

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Reprint requests to (S.M.Y.) Maternal and Child Health Bureau, Health Resources and Services Administration, 5600 Fishers Lane, 18A-55, Rockville, MD 20857.

Vitamin and mineral supplements have been prescribed or recommended by physicians for a variety of reasons. Both iron and vitamin C supplements have been found to alleviate iron deficiency anemia and its sequelae.[1,2] Less clear is the role of supplementation in improving children's nutrition status.[3,4] Multivitamin treatments have been used to enhance the performance and behavior of children with Down syndrome, although results have been equivocal.[5,6] Other work has found that vitamin and mineral supplements did not enhance the intelligence of children in the general population.[7] Additionally, supplements have been used for prevention of the common cold, improvement of children's appetite, enhancement of cognitive performance, and augmentation of growth. Given the fact that children are often difficult and erratic eaters at the preschool age, supplements are often used to improve their diets.[8]

With the exception of children at nutritional risk, such as those from deprived families; those who suffer from neglect and abuse, anorexia, eating disorders, fad diets, and chronic diseases (such as cystic fibrosis and inflammatory bowel disease); obese children on a weight-loss regimen; and children on vegetarian diets, the American Academy of Pediatrics[9] does not advise supplement use for the general pediatric population. The 1993 guidelines have essentially remained unchanged since 1980.[10] In addition, the 1989 Recommended Dietary Allowances (RDAs)[11] recommends that RDAs for nutrients be met as part of a normal diet rather than by supplementation or fortification, so that diets will also likely be adequate for other nutrients for which RDAs cannot be currently established. Vitamin and mineral preparations currently available in the United States for infants and children <4 years of age are regulated by the Food and Drug Administration.[12,13] However, in 1993, close to 10 000 cases of overdose exposure to vitamin–mineral supplements have been reported for the <6-year-old population by Poison Control Centers[14] (which captures less than half of the US population).

Past studies on multivitamin–mineral supplement (MVI) use have focused primarily on US adult populations.[15–20] Supplement use in children at the national level has only been reported to a limited extent.[21–23]

Yet, despite recommendations from the medical community and the lack of sufficient evidence indicating beneficial effects for most children, limited

national data have generally indicated a high prevalence of supplement use among children. Data from the 1981 Child Health Supplement to the National Health Interview Survey found that approximately half of children, ages birth to six, were given a vitamin or mineral supplement in the previous 2 weeks.[21] Similar levels of use for children 2 to 6 years old were found in the 1986 Health Interview Survey; 43% were reported to have been given vitamin or mineral supplements within 2 weeks of the survey.[22] A 1985 study estimated supplement use by low-income families participating in the Aid to Families with Dependent Children program in Mississippi to be ~11%.[24]

Although previous studies have examined prevalence, the factors that may influence the use of supplements in preschool children have never been explored. The objectives of this study are 1) to estimate the prevalence of recent supplement use in a national sample of preschool children, 2) to examine their use in relation to maternal and child characteristics, and 3) to examine past maternal supplement use practices, familial, health services, and child health factors associated with their use, using data from a representative sample of US children from the 1991 Longitudinal Follow-up (LF) to the 1988 National Maternal and Infant Health Survey (NMIHS), conducted by the National Center for Health Statistics.

METHODS

The LF is a nationally representative sample of 8285 children whose mothers were interviewed when the children were ~3 years old.[25] The baseline for the 1991 LF was the 1988 NMIHS. A more complete description of the NMIHS design has been published elsewhere.[26]

The National Center for Health Statistics contacted all the respondents from the 1988 live birth cohort in 1991 where the child was known to be alive at the time of the NMIHS interview (N = 9440) and asked them to participate in the LF.[25] Data collection was conducted either by telephone or personal interview. The children sampled ranged from 27 months to 48 months of age, with 80% of the sample within 6 months of 3 years of age. Cases in which either the mother or the child was reported to be deceased were excluded; the response rate for the LF live birth cohort was 89% (N = 8285). The data were reweighted and adjusted for loss to follow-up to be representative of the estimated 3.8 million US-born children in 1988 and alive in 1991.

This investigation is limited to the mothers of the children from the 1988 live birth cohort who were alive at the time of the interview and who had lived with the respondent in the month before the interview. After these exclusions, 8145 (86%) women who had a live birth in 1988 were available for analysis.

The outcome measures used in this investigation are whether the child was given any vitamin and mineral supplements at least 3 days a week in the 30 days before the interview and the type of supplement the child received. The choices of supplements provided to respondents were multivitamins–minerals with iron, multivitamins–minerals without iron, iron, vitamin C, and fluoride drops or tablets. Respondents could also provide information on any other types of supplements not included in these categories. There were 283 such responses. They were either recoded into one of the categories, when appropriate, or included in the "other" category.

The sociodemographic variables maternal education, marital status, maternal age, and household income were drawn from the mothers' response to the LF questionnaire. Maternal race and mothers' vitamin and mineral supplement use before and during pregnancy were based on the mothers' self-report provided on the NMIHS questionnaire. The characteristics of the child, including gender, eating behavior, allergy problems, and health status, were also drawn from the mothers' responses on the LF questionnaire.

TABLE 1. Population Characteristics

	Unweighted (N)	Weighted Percent
Maternal race		
White	3423	67.5
Black	3922	16.3
Asian	181	3.3
American Indian	62	0.8
Hispanic	697	12.1
Maternal age		
17 to 20	511	4.4
21 to 34	6007	75.0
35+	1627	20.5
Maternal education		
<High school	1609	17.1
High school	3089	37.2
>High school	3258	45.7
Marital status		
Married	4613	73.0
Not married	3300	27.0
Medical care source		
Private/HMO	4854	68.9
Health center	1955	21.3
Hospital clinic	990	9.4
Other	39	0.4
Insurance		
Insurance/Medicaid	6614	80.2
Neither	1671	19.8
Income		
<10 000	2433	18.0
10 000–19 999	1656	18.9
20 000–29 999	1169	15.9
30 000+	2887	47.2
Gender		
Male	4226	52.5
Female	4033	47.5
Birth order		
First	3352	42.0
Second+	4903	58.0
Health status		
Excellent	3958	53.2
Very good	2457	29.9
Good	1280	13.2
Fair	354	3.4
Poor	44	0.3

TABLE 2. Prevalence by Type of Supplement Use

Type of Medication	% Supplement Users	% Total Population
	Total N = 3953	Total N = 8145
Any supplement use	100.0	54.4
Multivitamin–mineral with iron	59.0	31.8
Multivitamin–mineral without iron	26.4	14.2
Iron supplement	2.0	1.1
Vitamin C	10.5	5.7
Fluoride drops or tablets	12.7	6.9
Other	7.5	4.0

Percentages weighted to represent all US live births in 1988.

The birth order, birth weight, and gestational length of the child were derived from the birth certificate.

Respondents to the LF were asked for the usual source of the child's medical care. They were given a choice of doctor's office; neighborhood, family, or community health center or clinic; free-standing health maintenance organization (HMO); hospital clinic, emergency room or other outpatient services at the hospital; or other. For this analysis, doctor's office and HMO were combined into a single variable because of the small numbers who used HMOs. The combined variable denoted privately funded sites of care.

Insurance status was examined by mothers' response to

whether the child had health insurance coverage through an insurance company or an HMO or whether the child received medical care through a governmental program such as Medicaid.

Medical factors were examined by creating a variable for childhood chronic conditions by combining children with any reported chronic conditions and those reported to have had tubes inserted in ears because of ear infections. Reports on whether the mother received nutrition information from a provider were drawn from the LF questionnaire.

Analysis

All analyses were weighted and adjusted for nonresponse, to be representative of the US national distribution for live births. All analyses were performed using normalized (scaled) weights. The scaling factor was the reciprocal of the mean weight; the sum of all the scaled weights is the same as the actual number of observations.

The logistic regression analysis for factors associated with supplement use examined maternal race/ethnicity; age; marital status; education; household income; employment; the child's birth order, gender, and reported health status; availability of health insurance or government assistance; nutrition advice; chronic conditions; eating behavior; and site of pediatric care. In addition, interaction terms were examined in the multivariate model. The logistic regression analysis was conducted using the Survey Data Analysis software program.[27]

RESULTS

Table 1 details characteristics of the study population that weights up to children born in 1988 who were alive in 1991. Overall, this study indicates that more than half of all 3-year-olds (54.4%) in the United States were given some vitamin and mineral supplement in the past 30 days (Table 2). The total percentages for supplement use exceed 100%, indicating the fact that some children were given more than one supplement in the past 30 days. A total of 15.7% of the vitamin–mineral users consumed two types of supplements, whereas 1.3% were given three or more types of supplements (data not shown). Among supplement users, the most common supplements consumed were multivitamin–mineral with iron (59.0% of supplement users) and multivitamin–mineral without iron (26.4% of supplement users). A total of 10.5% reported use of vitamin C, and 12.7% reported use of fluoride drops/tablet. Only 2.0% reported use of iron supplements, whereas 7.5% indicated taking other vitamin and mineral supplements.

A number of maternal characteristics were associated with any supplement use (Table 3). Although supplement use was relatively common in most groups, children who received supplements were more likely to have mothers who were non-Hispanic White or Hispanic, 21 years or older, married, in-

TABLE 3. Supplement Use by Selected Maternal Characteristics and Health Services Variables

	Any Supplement		MVI With Iron		MVI Without Iron		Iron		Vitamin C		Fluoride	
	%	χ^2	%	χ^2	%	χ^2	%	χ^2	%	χ^2	%	χ^2
Maternal race		<0.001		0.003		<0.001		<0.001		<0.001		<0.001
White	59.2		32.7		17.5		0.7		6.0		8.4	
Black	38.8		28.1		4.6		2.1		3.4		2.4	
Hispanic	48.6		33.4		8.2		1.6		6.8		4.5	
Maternal age		0.138		<0.001		<0.001				0.168		0.353
17 to 20	49.3		39.5		4.8		1.5	0.296	4.0		6.7	
21 to 34	54.7		32.8		14.2		1.1		6.0		6.7	
35+	54.5		27.6		16.9		0.7		5.1		7.8	
Maternal education		<0.001		<0.001		<0.001		0.014		0.478		<0.001
<High school	40.3		29.9		5.1		1.6		5.1		3.5	
High school	51.9		30.7		12.9		1.3		5.7		5.5	
>High school	61.9		34.3		19.1		0.7		6.0		9.5	
Marital status		<0.001		0.631		<0.001		0.153		0.003		<0.001
Married	58.3		32.3		16.8		1.0		6.2		8.3	
Not married	44.4		31.7		8.0		1.4		4.5		3.6	
Medical care source		<0.001		0.176		<0.001		0.899		0.884		0.005
Private/HMO	57.2		32.8		15.9		1.0		5.6		7.7	
Health center	48.5		30.4		11.9		1.2		5.9		5.5	
Hospital clinic	48.4		31.5		9.8		0.9		6.1		5.2	
Other	32.1		22.0		10.0		0.8		3.0		6.2	
Insurance		0.016		0.244		<0.001		0.209		0.002		0.001
Insurance/Medicaid	55.0		32.1		14.9		1.1		5.3		7.3	
Neither	51.6		30.6		11.5		0.8		7.2		5.0	
Income		<0.001		0.003		<0.001		<0.001		<0.001		<0.001
<10 000	40.4		29.0		6.9		0.9		3.2		3.0	
10 000–19 999	50.7		30.4		11.8		2.0		7.3		4.9	
20 000–29 999	51.6		31.4		13.2		1.4		6.6		6.3	
30 000+	62.5		34.0		18.8		0.6		5.8		9.6	
Took MVI before pregnancy		<0.001		<0.001		<0.001		0.125		<0.001		<0.001
Yes	66.7		39.5		18.2		1.4		7.9		9.14	
No	50.1		29.1		12.8		1.0		4.9		6.07	
Took MVI during pregnancy		<0.001		0.005		<0.001		0.185		0.026		<0.001
Yes	56.5		32.5		15.5		1.0		5.9		7.7	
No	45.4		28.9		8.9		1.4		4.5		3.5	
Provider nutrition advice		<0.001		<0.001		0.164		0.089		0.546		<0.001
Yes	57.0		33.9		14.7		1.0		5.6		8.0	
No	47.0		27.2		13.4		1.4		6.0		4.6	

MVI indicates multivitamin–mineral supplement.

sured, received care from a private health care provider, reported receiving nutrition advice from the child's medical care provider, more educated, had greater household income, and tended to have taken vitamin–mineral supplements before and/or during pregnancy. When the supplements were examined individually, only iron supplementation did not follow this pattern. Mothers of children who received only iron supplements were more likely to be Black, less educated, and have lower household income.

As for child characteristics, more first-born children received supplements than those of second and higher birth order across all supplement types (Table 4). Mothers who reported children as having eating problems or poor appetites, as well as those who reported food allergy problems, were more likely to give supplements. Physical characteristics such as child gender, birth weight, and gestational length were not significantly associated with supplement use. When individual supplements were examined, iron use was again different. Iron use increased with reported poorer health status as compared with the other supplements for which use increased with better reported health status.

Results of the weighted logistic regression analyses on factors associated with supplement use are shown in Table 5. Compared with the referent categories listed in Table 5, the following characteristics were significantly more likely to be associated with any supplement use: non-Hispanic White (odds ratio [OR] = 1.63); Hispanic (OR = 1.44); high school education (OR = 1.25); some college education and above (OR = 1.23); married (OR = 1.19); $10 000 to $19 999 household income (OR = 1.32); $30 000+ household income (OR = 1.50); took multivitamin–mineral supplements before pregnancy (OR = 1.76); first births (OR = 1.62); occasional eating problems (OR = 1.17); and poor appetite most of the time (OR = 1.42). Receipt of nutrition advice (OR = 1.27) and presence of chronic conditions (OR = 1.16) were also significant predictors of use. Both medical care source and child's perceived health status were not significant predictors of any supplement use.

DISCUSSION

This study documents generally high levels of supplement use for preschool children in the United States. Our analysis estimated that more than half (54.4%) of US preschool children had received a vitamin/mineral supplement in the last 30 days, exceeding levels (22.8% in the National Health and Nutrition Examination Survey [NHANES] I[15] and 34.9% in NHANES II)[16] reported in US adult populations and those reported in children (49% in the 1981 National Health Interview Survey [NHIS][21] and 43% in the 1986 NHIS[22]). This suggests that there may be moderate increased intake over the past 2 decades.

Results of this study also identified social and demographic characteristics that are associated with supplement use. Independent of income, education, and a host of other factors, Black mothers are less likely than White or Hispanic mothers to give supplements, except for iron. Women of higher socioeconomic status are consistently more likely to give different types of supplements. Mothers' own supplement use behavior before pregnancy is also

TABLE 4. Supplement Use By Selected Child Health Characteristics

	Any Supplement		MVI With Iron		MVI Without Iron		Iron		Vitamin C		Fluoride	
	%	χ^2	%	χ^2	%	χ^2	%	χ^2	%	χ^2	%	χ^2
Gender		0.106		0.634		0.525		0.521		0.253		0.444
Male	55.3		32.0		14.5		1.1		5.4		6.7	
Female	53.5		31.5		14.0		1.0		6.0		7.1	
Birth order		<0.001		<0.001		0.002		0.108				<0.001
First	61.3		37.0		15.6		1.3		5.1	0.068	8.1	
Second+	49.4		28.0		13.2		0.9		6.1		5.9	
Health status		0.058		0.672		0.013		<0.001		0.55		0.073
Excellent	54.3		31.5		14.9		0.8		5.5		7.4	
Very good	56.3		33.2		15.1		1.0		5.9		7.1	
Good	51.4		31.7		11.5		1.8		6.4		5.4	
Fair	51.3		32.9		10.5		2.4		5.8		5.2	
Poor	46.2		33.6		11.7		8.2		0.0		0.0	
Birthweight		0.331		0.346		0.039		0.381		0.058		0.278
<2500 g	52.4		33.6		11.3		1.4		3.9		5.7	
≥2500 g	54.5		31.6		14.4		1.0		5.8		6.9	
Eating behavior		<0.001		<0.001		<0.001		0.319		0.214		0.043
No eating problems	50.3		29.7		12.2		1.0		5.9		6.4	
Occasional eating problems	59.5		34.8		17.1		1.1		5.8		7.8	
Poor appetite most of the time	58.9		36.2		15.8		1.7		4.1		6.3	
Food allergy problem		<0.001				<0.001		0.168		0.189		0.367
Yes	63.0		33.2	0.585	21.2		0.4		7.1		7.9	
No	53.8		32.0		13.9		1.1		5.6		6.8	
Eating or swallowing problem		0.216		0.91		0.705		0.43		0.723		0.314
Yes	46.3		31.4		12.6		0.0		4.6		3.6	
No	54.5		32.1		14.4		1.1		5.7		7.0	
Chronic health problems		0.005		0.001		0.713		0.13		0.066		0.328
Yes	56.4		33.9		14.4		1.3		6.3		6.5	
No	53.2		30.5		14.1		0.9		5.3		7.1	

MVI indicates multivitamin–mineral supplement.

TABLE 5. Adjusted OR and Confidence Interval Values for Factors Associated With Supplement Use

	AOR	95% CI
Maternal race/ethnicity		
White, non-Hispanic	1.63	1.52, 1.76
Black	1.00	
Hispanic	1.44	1.29, 1.62
Maternal age		
17–20	1.12	0.95, 1.32
21–34	1.00	
35+	0.92	0.85, 1.01
Maternal education		
<High school	1.00	
High school	1.23	1.11, 1.36
>High school	1.50	1.35, 1.67
Marital status		
Married	1.19	1.09, 1.30
Not married	1.00	
Medical care source		
Private office/HMO	1.06	0.98, 1.15
Hospital clinic/ER	0.99	0.88, 1.12
Public health center	1.00	
Insurance		
Insurance/Medicaid	1.00	
Neither	0.92	0.84, 1.00
Income		
<10 000	1.00	
10 000–19 999	1.32	1.19, 1.47
20 000–29 999	1.09	0.96, 1.23
30 000+	1.50	1.34, 1.68
Took MVI before pregnancy		
Yes	1.76	1.63, 1.91
No	1.00	
Took MVI during pregnancy		
Yes	1.09	1.00, 1.18
No	1.00	
Birth order		
First	1.62	1.51, 1.74
Second+	1.00	
Health status		
Excellent/very good/good	1.00	
Fair/poor	1.12	0.94, 1.34
Eating behavior		
No eating problems	1.00	
Occasional eating problems	1.17	1.09, 1.26
Poor appetite most of the time	1.42	1.25, 1.62
Food allergy problem		
Yes	1.08	0.93, 1.25
No		
Received nutrition advice		
Yes	1.27	1.18, 1.37
No	1.00	
Chronic condition		
Yes	1.16	1.08, 1.24
No	1.00	

MVI indicates multivitamin–mineral supplement.

strongly related to children's supplement use. Those who took supplements only during pregnancy are likely transient users and perhaps did not continue the practice after childbirth and exert an influence on the child's intake throughout the preschool years. The fact that first-born children are 60% more likely to receive any supplement than children of higher birth order is very interesting. This is perhaps a reflection of more experienced parents or less attention being paid to the latter-born children. Supplement use also appears to be strongly influenced by mother's perception of the child's eating behavior, to the extent of exhibiting a dose–response type of relationship. Those receiving nutrition advice from health care providers, as well as children who have a chronic condition, were more likely to be given supplements.

Some of the sociodemographic predictors of supplement use are similar to those identified through bivariate analysis in previous studies based on both adult and younger populations.[15–20] Mothers who are White, older, married, economically affluent, and better educated tend to provide supplements for their children. Our findings support the relationship between financial resources and pediatric supplement use, as documented previously by the low prevalence (11%) of supplement use among children participating in an Aid to Families with Dependent Children program.[24] Interestingly, the source of the health care provider was not related to giving of supplements, suggesting that few differences exist in the advice on supplement use by private or public health care providers. However, mothers receiving nutrition advice for the children from providers do tend to give supplements regardless of the health care setting. Alternatively, children's use of supplements may be more of a parent-initiated health practice that is more influenced by sources other than pediatric health care providers. The perceived health status of the child was also not a significant predictor of supplement use, the influence of which may be overshadowed by the mother's perception of the child's eating problems.

The pattern for iron supplement use departs from that for other supplements and is probably related to the higher prevalence of anemia and lower hemoglobin and hematocrit among Blacks.

The self-report nature of the mothers' questionnaire data poses certain limitations. Mothers' ability to differentiate accurately among various vitamin and mineral supplements to conform with instructions on the questionnaire remains undetermined. For example, when iron supplement use is reported, how well a respondent can identify iron supplement use over and above the iron contained in multivitamin–mineral tablets cannot be determined. Ideally, child growth status would also be a potential predictor of vitamin and mineral use. Although such data were collected from medical providers, the differential response rate of the medical provider data (74%) and the mothers' questionnaire (89%) precludes meaningful analysis of the effects of child growth. In addition, we could not estimate vitamin use among children who were born in 1988 outside of the United States but immigrated to the United States by 1991.

Although recent American Academy of Pediatrics[9] and RDA[11] guidelines do not recommend multivitamin–mineral supplementation for children except for a few high-risk groups, our findings reveal that nearly 55% of US preschool children receive a supplement. Our data indicate that the groups at risk for nonuse are likely the same groups whose home environments and dietary practices may predispose a necessity for supplementation. Given the data on reported toxicity exposure,[14] their common use should alert the medical community to consider issues of toxicity.

The findings of this study should serve as a baseline for future studies, as well as provide insight into

the vitamin and mineral supplement use behavior for medical and nutrition providers that care for young children. These data are also useful to scientific groups that compile dietary data and develop dietary guidance for this population.

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