Maternal Nutrition Knowledge and Children's Nutrient Intakes

We have shown that maternal knowledge has a significant influence on preschoolers' HEI, and now we explore which nutrients mother's knowledge affects the most. Table 2 lists the explanatory variables used in this analysis. Because the nutrients study and the HEI study were conducted in two phases, the specifications used are slightly different, with the HEI specification being more general. We grouped the explanatory variables into four broad categories: child's characteristics, household characteristics, mother's characteristics, and survey-related controls. Among the notable differences from the HEI study, controls for mothers' employment status were included to account for possible time allocation effects on knowledge and food preparation (Horton and Campbell, 1991) while maternal height and weight were not included.

Empirical Model

For the seven food components/nutrients (total fat, saturated fat, cholesterol, fiber, sodium, calcium, and iron), we jointly estimated a system of latent variable equations similar to the HEI study of the form:

(9) $$C_j = \alpha_{j0} + \sum_{p=1}^{P} \alpha_{jp} X_p + \beta_j K + u_j, \; j = 1,...,7,$$

(10) $$K = \gamma_0 + \sum_{q=1}^{Q} \gamma_q Z_q + v$$

(11) $$NCK = \lambda_{10} + \lambda_{11} K + e_1$$
$$DHA = \lambda_{20} + \lambda_{21} K + e_2$$

where K is a latent variable representing the mother's health and nutrition knowledge, C_j is the amount of jth nutrient, X_p and Z_q represent explanatory variables, α, β, and γ are the parameters to be estimated, and u and v are stochastic error terms distributed independently and identically across individuals but may be correlated across the equations for a given child-mother pair due to unobserved family heterogeneity. The estimation was carried out by the same maximum likelihood procedure used in the HEI study.

Estimates of the Nutrient Intakes and Knowledge Equations

As with the HEI equations system, the scale of the latent variable (K) is identified by normalizing the coefficient of K in the NCK measurement equation in equation λ_{11} to one (i.e., $\lambda_{11} = 1$) so that NCK and K have the same scale; a unit change in K causes a unit change in NCK. The coefficient for DHA, λ_{21}, is free. All variables are expressed as deviations from their means, so the intercept coefficients in equations 9-11 are zero.

Table 8 reports the estimates of the mother's latent knowledge equations for the two age groups (that is, equation 10). The most striking result is the positive and highly significant effect of a mother's education level on her health and nutrition knowledge for both groups. Because the scale of the latent variable is set by normalizing the coefficient for the NCK equation to one, any explanatory variable that affects K has an equivalent effect on NCK. This suggests that an additional year of education increases the NCK score of the mother of a 2- to 5-year-old child by 0.184 point. In elasticity terms, this implies that a 1-percent increase in education level leads to a 0.14-percent higher NCK score. Thus, our results provide direct evidence supporting the knowledge- and

Table 8—Estimates for mother's nutrition knowledge equation in the children's nutrient intakes study

Explanatory variable	Ages 2-5	Ages 6-17
Mother's characteristics:		
Education	0.184*	0.239*
	(.043)	(.032)
Age	.058*	.003
	(.015)	(.010)
Part-time employed	.763*	.326
	(.307)	(.211)
Not employed	.508*	.170
	(.261)	(.179)
Smoker	-.350*	-.354*
	(.180)	(.142)
Disease	-.084	.452*
	(.396)	(.217)
Diet advice	.499	-.053
	(.373)	(.271)
Household characteristics:		
Income (x 10^{-3})	1.680*	.758*
	(.687)	(.432)
Black	-.911*	-1.290*
	(.329)	(.236)
Other race	-.980	-.721
	(.608)	(.548)
Hispanic	-1.330*	-1.559*
	(.346)	(.267)
Female head	-.012	-.180
	(.280)	(.192)
Food stamp participant	-.553*	-.385*
	(.285)	(.230)
WIC participant	-.481*	-.276
	(.264)	(.304)
Vegetarian diet	.356	.234
	(.256)	(.260)
R^2	.544	.418

Note: Asymptotic standard errors are given in parentheses below the estimates. An asterisk indicates significance of the estimate at the 10-percent or lower level. Each equation also includes 8 dummy variables representing region and urbanization of the household and the survey year; see table 2.

Source: Calculated by the Economic Research Service, USDA, using data from 1989-91 CSFII-DHKS.

information-enhancing role of education, that is, the allocative efficiency effect stressed in previous studies (Grossman and Kaestner, 1995).

Other determinants that have consistent effects on mothers' nutrition knowledge include race, ethnicity, whether the mother is a smoker, household income, and whether a member of the household participates in the Food Stamp Program. The finding of lower knowledge levels for mothers who are Black or Hispanic compared with White and non-Hispanic mothers is similar to earlier results for all household meal planners (Carlson and Gould, 1994; Gould and Lin, 1994). Household income and smoking have the anticipated positive and negative effects, respectively. Age and employment status affect nutrition knowledge positively, but only for mothers of preschoolers.

Tables 9 and 10 present the estimates of the nutrient density equations for the two age groups (that is, equation 9). The R^2 is generally low because densities are computed from only 3 days of intake and, thus, have a sizable random component. A mother's health and nutrition knowledge has a beneficial effect on her child's diet if the

Table 9—Intake equation estimates for children, ages 2-5

Explanatory variable	Total fat	Saturated fat	Cholesterol	Fiber	Sodium	Calcium	Iron
K	-0.965*	-0.620*	-0.016*	0.275*	-0.052*	0.010	-0.190
	(.482)	(.262)	(.006)	(.164)	(.028)	(.014)	(.221)
Child's age	-.036	-.240*	-.002	.197*	.013	-.018*	.013
	(.253)	(.134)	(.003)	(.087)	(.015)	(.008)	(.119)
Female child	-.023	.187	.006	.310	.027	.006	-.203
	(.552)	(.292)	(.006)	(.191)	(.033)	(.017)	(.259)
Mother not employed	-.478	-.132	.010	-.168	-.008	.017	-.048
	(.809)	(.439)	(.009)	(.276)	(.048)	(.024)	(.371)
Mother part-time employed	.268	.198	.010	.005	.025	.033	.396
	(.992)	(.538)	(.011)	(.339)	(.058)	(.029)	(.455)
Income (x 10^{-3})	.609	-.395	.026	-.057	-.023	-.078	1.014
	(2.377)	(1.290)	(.027)	(.812)	(.140)	(.070)	(1.090)
Black	1.153	.074	.006	-.002	-.010	-.075*	-.780*
	(1.027)	(.558)	(.012)	(.351)	(.060)	(.030)	(.471)
Other race	-3.490*	-1.644	-.007	.944	.150	.033	2.591*
	(1.863)	(1.011)	(.022)	(.636)	(.110)	(.055)	(.854)
Hispanic	-1.343	-.636	.017	1.074*	-.088	.028	-.320
	(1.231)	(.668)	(.014)	(.420)	(.072)	(.036)	(.564)
Female head	-.130	-.044	.005	-.283	.011	-.021	.224
	(.836)	(.453)	(.010)	(.285)	(.049)	(.025)	(.383)
Food stamp participant	-.956	-.865*	-.006	.133	-.026	-.027	.452
	(.927)	(.503)	(.011)	(.317)	(.054)	(.027)	(.425)
WIC participant	-.432	-.515	-.006	.389	.024	-.019	.358
	(.846)	(.459)	(.010)	(.289)	(.050)	(.025)	(.388)
Vegetarian diet	.278	-.226	-.006	1.292*	-.011	-.059*	-.332
	(.785)	(.426)	(.009)	(.268)	(.046)	(.023)	(.360)
Low-fat/low-calorie diet	-1.214	-0.569	-0.012	0.205	-0.134*	-0.054	0.618
	(1.276)	(.679)	(.014)	(.440)	(.075)	(.039)	(.596)
Midwest	1.259	.009	.007	.348	.110*	.003	-.157
	(.885)	(.480)	(.010)	(.302)	(.052)	(.026)	(.406)
South	1.070	-.353	.009	.321	.071	-.066*	-.224
	(.866)	(.470)	(.010)	(.296)	(.051)	(.026)	(.397)
West	.589	-.249	.017	.880*	.129*	-.026	.435
	(1.130)	(.613)	(.013)	(.386)	(.066)	(.033)	(.518)
Suburb	-.066	.342	-.009	-.406*	-.026	.022	-.141
	(.706)	(.383)	(.008)	(.241)	(.041)	(.021)	(.324)
Nonmetro	.217	.635	-.003	-.467	-.050	-.027	-.086
	(.834)	(.453)	(.010)	(.285)	(.049)	(.025)	(.382)
R^2	.085	.097	.174	.202	.088	.170	.097

Note: Asymptotic standard errors are given in parentheses below the estimates. An asterisk indicates significance of the estimate at the 10-percent or lower level. Each equation also includes nine dummy variables representing survey year, survey season, and whether any of the 3-day intake was on a weekend; see table 2. The R^2s are the squared correlation between observed and predicted intake values.

Source: Calculated by the Economic Research Service, USDA, using data from 1989-91 CSFII-DHKS.

Table 10—Intake equation estimates for children, ages 6-17

Explanatory variable	Total fat	Saturated fat	Cholesterol	Fiber	Sodium	Calcium	Iron
K	-0.350	-0.194	-0.013*	0.187*	-0.016	0.015	0.077
	(.321)	(.158)	(.004)	(.117)	(.019)	(.009)	(.154)
Child's age	.070	-.032	0	-.025	.005	-.009*	-.022
	(.054)	(.027)	(.001)	(.020)	(.003)	(.002)	(.026)
Child female	.792*	.206	0	.053	.016	.006	-.039
	(.381)	(.187)	(.004)	(.140)	(.023)	(.011)	(.185)
Mother not employed	-.751	-.408*	.002	.138	-.024	-.017	.294
	(.470)	(.231)	(.005)	(.171)	(.028)	(.013)	(.226)
Mother part-time employed	-1.018*	-.910*	-.006	.207	-.032	-.023	.335
	(.560)	(.275)	(.006)	(.204)	(.033)	(.016)	(.269)
Income (x 10^{-3})	-.507	-.239	.021	-.051	.044	-.043	.339
	(1.223)	(.600)	(.013)	(.446)	(.072)	(.034)	(.587)
Black	.231	-.112	.006	-.349	.109*	-.042*	-.246
	(.748)	(.367)	(.008)	(.273)	(.044)	(.021)	(.359)
Other race	-1.749	-1.498*	.003	.310	.070	-.034	1.362*
	(1.465)	(.719)	(.016)	(.534)	(.087)	(.041)	(.703)
Hispanic	-1.634*	-.633	.006	.518	-.017	.005	.324
	(.908)	(.446)	(.010)	(.331)	(.054)	(.026)	(.436)
Female head	-.549	-.234	-.009	-.054	-.018	.002	.441*
	(.501)	(.246)	(.005)	(.183)	(.030)	(.014)	(.240)
Food stamp participant	.221	.106	-.006	.422*	.012	-.003	-.367
	(.622)	(.305)	(.007)	(.227)	(.037)	(.017)	(.298)
WIC participant	1.790*	.431	.015*	.142	.052	-.003	.553
	(.796)	(.391)	(.009)	(.290)	(.047)	(.022)	(.382)
Vegetarian diet	-1.938*	-.801*	-.013*	1.507*	-.022	.008	.386
	(.688)	(.338)	(.008)	(.251)	(.041)	(.019)	(.330)
Low-fat/low-calorie diet	-.849	-.085	-.002	.464*	.068	.016	.280
	(.709)	(.348)	(.007)	(.261)	(.042)	(.020)	(.344)
Midwest	1.225*	.452	.005	-.087	-.018	.003	-.593*
	(.603)	(.296)	(.007)	(.220)	(.036)	(.017)	(.290)
South	.886	-.156	.002	-.127	-.072*	-.041*	-.457
	(.603)	(.296)	(.007)	(.220)	(.036)	(.017)	(.290)
West	.037	-.121	.022*	.541*	-.055	-.003	-.377
	(.658)	(.323)	(.007)	(.240)	(.039)	(.019)	(.316)
Suburb	-.008	.423*	.003	-.277	-.020	.024*	-.142
	(.490)	(.240)	(.005)	(.178)	(.029)	(.014)	(.235)
Nonmetro	-.174	.193	.002	.055	.010	-.007	-.457*
	(.543)	(.267)	(.006)	(.198)	(.032)	(.015)	(.261)
R^2	.073	.061	.117	.120	.053	.153	.047

Note: Asymptotic standard errors are given in parentheses below the estimates. An asterisk indicates significance of the estimate at the 10-percent or lower level. Each equation also includes nine dummy variables representing survey year, survey season, and whether any of the 3-day intake was on a weekend; see table 2. The R^2s are the squared correlation between observed and predicted intake values.

Source: Calculated by the Economic Research Service, USDA, using data from 1989-91 CSFII-DHKS.

coefficient for K is negative in the total fat, saturated fat, cholesterol, and sodium intake equations and positive in the fiber, calcium, and iron equations. This is because K and NCK have the same scale, and a higher NCK and, hence, a higher K, implies a higher knowledge level. A higher knowledge level, in turn, translates to a better diet by reducing (increasing) the intake of nutrients whose over-consumption (under-consumption) may cause health problems.

The coefficient estimates for K suggest that a mother's knowledge of health and nutrition have substantial beneficial effects on the diets of her preschool children. A higher level of maternal knowledge translates into significantly lower intakes of total fat, saturated fat, cholesterol, and sodium, and a significantly higher intake of fiber by 2- to 5-year-old children. In terms of magnitude, an increase in nutrition knowledge sufficient to answer one more NCK question correctly would cause a decline of about 1 percentage point in energy intake from all fat, a 0.6-percentage-point decline in energy intake from saturated fat, a decline of 16 milligrams of cholesterol intake per 1,000 calories, a decline of sodium intake by 52 milligrams per 1,000 calories, and an increase of fiber intake by 0.3 gram per 1,000 calories. Given such sizable effects for these nutrients, the lack of significant influence on calcium and iron intake of preschoolers is somewhat surprising. There may be several explanations for this finding. First, mothers may not perceive the underconsumption of calcium or iron as a serious problem and, secondly, these nutrients have not received the press attention of other dietary problems (for example, dietary fat and cholesterol). Another reason may be that calcium and iron can come from mineral supplements that are not reflected in the CSFII data.

The effect of mothers' knowledge on intakes wanes for children ages 6 and above. For this age group, an increase in mothers' nutrition knowledge is accompanied by a statistically significant reduction in children's intake of cholesterol and an increase in children's intake of dietary fiber. Fat and sodium intakes are not significantly affected by mother's knowledge. The knowledge effect on fiber is less for the 6-17 age group than for 2-5 year-olds while the effect on cholesterol is of similar magnitude.

Our empirical results strongly suggest that maternal nutrition knowledge has a positive effect on the diets of children, particularly for preschoolers. The effect of a mother's nutrition knowledge on the diets of her older children is less for several reasons. First, older children likely make more dietary decisions independently of their mother, and secondly, they tend to eat away from home more often and also receive a higher percentage of their total caloric intake from away-from-home food sources (Lin, Guthrie, and Blaylock, 1996). These results lead to the important conclusion that health and nutrition education may be more effective if targeted toward mothers with preschool children but directly toward school-age children.

The allocative efficiency hypothesis implies that education promotes better nutrition outcomes through the acquisition and use of information related to the health effects of nutrients (Grossman and Kaestner, 1995). In the nutrients intake study, we imposed this hypothesis by excluding a mother's education level from the children's intake equations so that education influenced intake only indirectly through the knowledge equation. This restriction can be tested by a likelihood ratio test. Such a test showed that the restriction could not be rejected at the 10-percent level for preschoolers (χ^2=4.92, df=7). While the restriction was rejected for the 6-17 age group, mothers' education did not have a statistically significant coefficient in any of the children's intake equations. These results, therefore, support the view that maternal education affects children's diets wholly through its positive effect on maternal knowledge of health and nutrition. Previous evidence in support of the allocative efficiency hypothesis has been mainly from nutrition and health studies of children in developing countries (Strauss and Thomas, 1996). Our results suggest that the relationship persists when the dietary problem is one of overconsumption rather than malnutrition. Further, our results are robust to fixed family effects since our models include several variables, including the mother's employment status, to control for such effects (Behrman, 1995; Behrman and Wolfe, 1987).

Turning to other factors influencing children's nutrient intakes, school-age girls had significantly higher energy intakes from fat than boys. Gender had no influence on any preschooler's nutrient intake densities. To the extent that children’s diets are under parental control, dietary differences between boys and girls are not expected. Therefore, the result for the 2-5 age group is not surprising. The higher fat energy for school-age girls may be related to their dietary patterns such as a greater tendency to skip relatively low-fat breakfasts and eating a higher proportion of meals and snacks outside the home (Lin, Guthrie, and Blaylock, 1996).

The effect of a mother’s employment status on both her nutrition knowledge and on her children’s intakes differs between the age groups and has some interesting implications. For preschoolers, the effect of mother’s employment status occurs mainly through nutrition knowledge while for school-age children, the effect occurs through time available for food preparation at home. School-age children with mothers employed part-time have significantly lower intakes of fat and saturated fat than those whose mothers are employed full-time. Mothers who work less may be able to exert more influence on the diets of their school-age children.

One variable with a systematic effect on nutrient intake densities for both age groups is whether any household member is on a vegetarian diet. This variable has a positive and significant effect on the fiber intake of all children with a stronger effect for those 6-17 years old. If a household member is vegetarian, the fiber intake of 6- to 17 year-olds increases by 1.5 grams per 1,000 calories. Concomitantly, the calories from fat and saturated fat of school-age children fall by 2 percentage points and 0.8 percentage point, respectively, and their cholesterol intake declines by 13 milligrams per 1,000 calories.

Older children in both age groups, but more so for preschoolers than school-age children, had lower calcium intake densities than the younger children in the group, possibly because older children drink less milk. Older preschoolers also tend to have lower saturated fat and higher fiber intake densities.

Significant racial differences exist in calcium intake densities. Black preschoolers were found to have 75 mg less calcium intake per 1,000 calories than White preschoolers, while Black school-age children had 42 mg less calcium intake per 1,000 calories than White children. Black school-age children also have significantly higher sodium intakes than White school-age children. Fat intake by Hispanic children was significantly lower than that by non-Hispanic children in the 6-17 age group, while fiber intake by Hispanic children ages 2-5 was significantly higher than that by 2- to 5-year-old non-Hispanic children. Overall, after accounting for other factors, including mothers’ nutrition knowledge, racial and ethnic effects on children’s diets were somewhat limited. This result is contrary to the findings for adults where strong racial and ethnic effects have been detected (Carlson and Gould, 1994; Gould and Lin, 1994).

Food Stamp Program participation by a household has beneficial effects on children’s diets. FSP participation is related to a lower saturated fat intake by 2- to 5-year-olds and a higher fiber intake by 6- to 17-year olds. The fat and cholesterol intakes of school-age children from households participating in the WIC program were significantly higher than those of children of the same age group from nonparticipating households, perhaps because WIC subsidizes egg consumption.