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Nutrient Composition Covariance and Cognitive Health

A Factor Analytic Approach

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STA-3013 001: Applied Multivariate Analysis

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INTRODUCTION:

Dietary composition consists of many interrelated nutrients that tend to coincide in patterns rather than in isolation. Understanding how nutrients cluster together can provide insight into broader dietary behaviors that may have implications for health and cognition. The goal of this project was to examine how nutrients relate to one another, identify latent dietary factors through factor analysis, and interpret these factors as meaningful dietary patterns. As an extension of this work, we explored whether these extracted dietary patterns showed any association with cognitive performance in adults from the 2013–2014 National Health and Nutrition Examination Survey (NHANES).

DATA SELECTION:

Nutrient Composition Data

Out of 168 dietary variables present in the data set, we selected 26 variables which consisted of macronutrients, vitamins, minerals, cholesterol, and caffeine. Nutrient components were selected based on their relevance to public nutrition guidelines, and clear interpretability. In doing so, the factor interpretations and conclusions found can be utilized by observers. Additionally, several nutrients that were excluded from the study were variables with high

correlation to other variables, including alpha and beta-carotene. These micronutrients are precursors to vitamin a, so excluding them minimized redundancy and excessive multicollinearity.

Cognitive Function Data

From the cognitive function data, six standardized tests measured memory, processing speed, and verbal fluency. After standardizing each test, we created a cognitive composite score by averaging their standardized test scores.

The variables for both data sets are listed below:

Dietary data (26 variables):

DR1TKCAL - Calorie Count
DR1TPROT - Protein
DR1TCARB - Carbohydrate
DR1TSUGR - Sugar
DR1TFIBE - Fiber
DR1TTFAT - Total Fat
DR1TSFAT - Saturated Fat
DR1TMFAT - Monosaturated Fat
DR1TPFAT - Polyunsaturated Fat
DR1TCHOL - Total Cholesterol
DR1TATOC - Vitamin E
DR1TVARA - Vitamin A
DR1TVB6 - Vitamin B6
DR1TFOLA - Total folate
DR1TCHL - Total choline
DR1TVB12 - Vitamin B12
DR1TVC - Vitamin C
DR1TVD - Vitamin D
DR1TVK - Vitamin K
DR1TCALC - Calcium
DR1TMAGN - Magnesium
DR1TIRON - Iron
DR1TZINC - Zinc
DR1TSODI - Sodium
DR1TPOTA - Potassium
DR1TCAFF - Caffeine

Cognitive function data:

CFDCST1 - Score Trial 1 Recall
CFDCST2 - Score Trial 2 Recall
CFDCST3 - Score Trial 3 Recall
CFDCSR - Score Delayed Recall
CFDAST - Animal Fluency: Score Total
CFDDS - Digit Symbol: Score

METHODS:

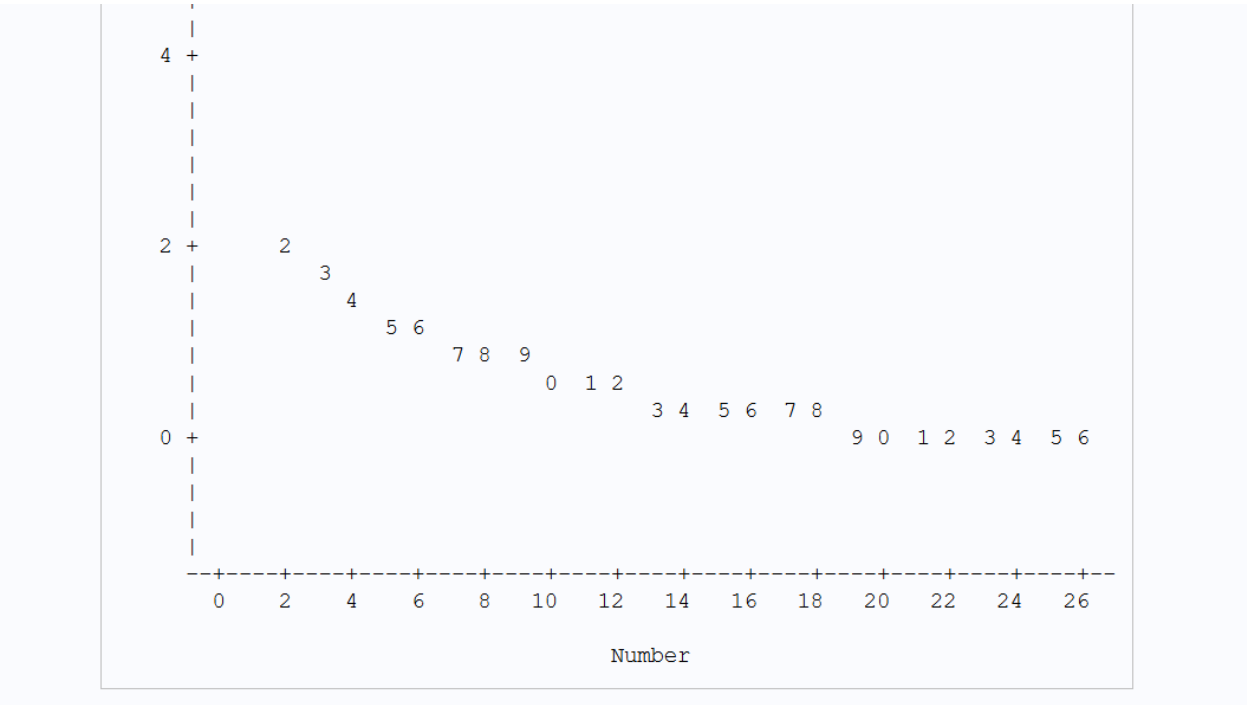
Factor Analysis of Nutrient Composition

The central analytical method of this project was factor analysis, used to uncover underlying patterns in nutrient intake. The extraction method used was Principal Factor and varimax rotation was used to improve interpretability of the factors.

<u>Factor selection</u>

Determining the number of factors (latent variables) that should be used can be done by observing the scree plot, the eigenvalues, and the residuals (error values). We determined that 6 factors were appropriate to reduce dimensionality, increase interpretability of factors, and to keep residuals low.

Scree plot:



The numbers listed on the plot correspond to the eigenvalues of the variables (Eigenvalue 1 excluded for fitting reasons). The number of factors that should be used can be determined by selecting which eigenvalue the “elbow” is, (the point where the slope is steep to the left but at the same time not very steep to the right). You then subtract the number of substantial eigenvalues by 1, giving you the number of factors that should be used. Here, the argument can be made that the eigenvalue is at 7, so 7 -1 = 6 factors. On the contrary, arguments can be made that the “elbow” is at eigenvalues 10 or 13 or even 19. So, we move on to examining the eigenvalues.

Eigenvalues:

Eigenvalues of the Correlation Matrix: Total = 26 Average = 1				
	Eigenvalue	Difference	Proportion	Cumulative
1	12.6884261	10.6827279	0.4880	0.4880
2	2.0056983	0.3570499	0.0771	0.5652
3	1.6486484	0.2798241	0.0634	0.6286
4	1.3688242	0.2544662	0.0526	0.6812
5	1.1143581	0.0399413	0.0429	0.7241
6	1.0744168	0.1723590	0.0413	0.7654
7	0.9020577	0.1167888	0.0347	0.8001
8	0.7852689	0.0496277	0.0302	0.8303
9	0.7356412	0.1714534	0.0283	0.8586
10	0.5641878	0.0469245	0.0217	0.8803
11	0.5172633	0.0575812	0.0199	0.9002
12	0.4596821	0.0757668	0.0177	0.9179
13	0.3839152	0.0949408	0.0148	0.9326
14	0.2889745	0.0095014	0.0111	0.9437

Eigenvalues greater than 1 are appropriate for factor number selection, and here we can see the first six eigen values (highlighted in yellow) are greater than 1. Additionally, the first 6 eigenvalues capture 76.54% of the variance of the original data, which is also sufficient.

Residuals:

When running the Proc Factor procedure in SAS, you may select the number of factors you want to use and may include the residuals using the “res” command. A successful factor model will reproduce the correlation matrix of your original variables as closely as possible, while only using the extracted factors. The RMS off-diagonal residuals tell you how well the factor model reproduces the correlation matrix of the variables. In other words, it measures the “leftover

correlation" not explained by the factors. An RMS value of less than 0.05 is often deemed appropriate.

Using 6 factors in the proc factor procedure, the output is:

Root Mean Square Off-Diagonal Residuals: Overall = 0.04827641

However, using 5 factors, the output is:

Root Mean Square Off-Diagonal Residuals: Overall = 0.05530477

This suggests 6 factors are appropriate, as the RMS value is under .05 and selecting 5 factors isn't appropriate since the RMS value is over .05. By selecting 6 factors we reduce the dimensionality as much as possible while keeping low error.

FACTOR INTERPRETATIONS:

Using the rotated factor pattern, we identified food groups that represent each factor. Each nutrient component contains a correlation with each factor, indicating how highly it loads on each factor. Values highlighted in yellow represent variables with high loadings on each factor, more specifically loadings greater than .65. Additionally, loadings highlighted in gray represent variables with moderate loadings on a given factor. These correlations are in the 0.45-0.65 range and are important as they further support factor interpretations.

Rotated Factor Pattern						
	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
Energy (kcal)	0.74238	0.38859	0.12374	0.46147	0.11283	0.13382
Protein (gm)	0.72035	0.36314	0.34153	-0.01239	0.13103	0.24064
Carbohydrate (gm)	0.44293	0.40449	0.06672	0.71413	0.13214	0.13580
Total sugars (gm)	0.24531	0.09698	0.16186	0.85484	0.10723	0.18508
Dietary fiber (gm)	0.31912	0.65881	-0.08345	0.15202	0.43665	0.01822
Total fat (gm)	0.88207	0.28061	0.06220	0.29365	0.06632	-0.02696
Total saturated fatty acids (gm)	0.78038	0.22183	0.19628	0.36540	-0.05725	-0.09942
Total monounsaturated fatty acids (gm)	0.86376	0.28699	0.03187	0.22787	0.07813	0.00461
Total polyunsaturated fatty acids (gm)	0.77500	0.25644	-0.10853	0.19402	0.19858	0.00222
Cholesterol (mg)	0.75763	-0.05848	0.38957	-0.14191	0.08659	0.23747
Vitamin E as alpha-tocopherol (mg)	0.45218	0.48680	0.01240	0.06779	0.33339	-0.00765
Vitamin A, RAE (mcg)	0.11749	0.28114	0.53916	0.09142	0.40897	-0.10729
Vitamin B6 (mg)	0.20521	0.53300	0.35610	0.02782	0.13525	0.46376
Total folate (mcg)	0.21812	0.79854	0.17120	0.15003	0.18570	0.01296
Total choline (mg)	0.72025	0.13969	0.42697	-0.09920	0.23099	0.30588
Vitamin B12 (mcg)	0.17819	0.40739	0.65923	0.06950	-0.08623	0.25640
Vitamin C (mg)	-0.04925	0.10457	0.19433	0.29731	0.69485	0.01562
Vitamin D (D2 + D3) (mcg)	0.09237	0.04206	0.79484	0.10626	0.08836	-0.11192
Vitamin K (mcg)	0.17919	0.12321	-0.01606	-0.10467	0.73430	0.00193
Calcium (mg)	0.36261	0.37462	0.49459	0.35129	0.07369	-0.21122
Magnesium (mg)	0.48520	0.57408	0.14297	0.14198	0.41182	0.18215
Iron (mg)	0.24781	0.77551	0.26535	0.19324	0.03169	-0.02570
Zinc (mg)	0.45278	0.63332	0.36815	0.05553	0.01546	0.10919
Sodium (mg)	0.71810	0.35842	0.15919	0.15752	0.09585	0.15693
Potassium (mg)	0.49763	0.42087	0.28837	0.22537	0.46984	0.24362
Caffeine (mg)	0.11583	0.02154	-0.11161	0.17432	-0.01184	0.76565

Factor 1: Dense, Processed Foods & Animal Protein

This factor captures a pattern high in energy-dense, fat-rich, animal-based foods. It is defined by very strong correlations with multiple forms of dietary fat and associated nutrients:

- Total fat (0.88207)
- Monounsaturated fat (0.86376)
- Polyunsaturated fat (0.77500)
- Saturated fat (0.78038)
- Cholesterol (0.75763)
- Energy (0.74238)
- Protein (0.72035)
- Choline (0.72025)
- Sodium (0.71810)

These nutrients commonly appear together in animal products and processed foods. A supportive loading from potassium (0.49763) aligns with foods such as meats and prepared meals that include potassium-containing additives.

Factor 2: Fiber-Rich Grains and Legumes

This factor reflects plant-based, whole-grain, and legume-rich dietary patterns. It is driven by strong correlations with:

- Folate (0.79854)
- Iron (0.77551)
- Dietary fiber (0.65881)

Supportive nutrients include zinc (0.63332), magnesium (0.57408), vitamin B6 (0.53300), and vitamin E (0.48680), which often co-occur in fortified grains, legumes, nuts, and seeds. This profile represents nutrient-dense plant sources.

Factor 3: Dairy

This factor aligns with a classic dairy nutrient signature:

- Vitamin D (0.79484)
- Vitamin B12 (0.65923)

Both nutrients are concentrated in milk, yogurt, and fortified dairy products. Supportive loadings on calcium (0.49459) and vitamin A (0.53961) further reinforce this interpretation, as these nutrients also commonly originate from dairy.

Factor 4: Simple Carbohydrates & Sugars

This factor isolates refined carbohydrate intake:

- Sugars (0.85484)
- Carbohydrates (0.71413)

The very strong sugar loading indicates that this factor reflects sweetened foods, desserts, refined grains, and other rapidly absorbed carbohydrates.

Factor 5: Fruits & Vegetables

This factor represents a nutrient profile found in fresh produce:

- Vitamin K (0.73430)
- Vitamin C (0.69485)

A supportive loading for potassium (0.46984) is consistent with fruits and vegetables such as leafy greens, citrus, and bananas, which are major potassium sources.

Factor 6: Caffeinated Beverages

This factor is dominated by:

- Caffeine (0.76565)

A supportive loading from vitamin B6 (00.46376) suggests co-consumption patterns such as fortified teas, energy drinks, or breakfast products that pair caffeine with B-vitamins. Overall, this reflects intake of coffee, tea, sodas, and energy beverages.

ASSOCIATIONS WITH COGNITIVE FUNCTION

Parameter Estimates					
Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.01024	0.02130	0.48	0.6309
Dense/Processed Foods & Animal Protein	1	0.09778	0.02093	4.67	<.0001
Fiber-Rich Grains & Legumes	1	0.06649	0.02100	3.17	0.0016
Dairy	1	-0.04340	0.01950	-2.23	0.0262
Simple Carbs & Sugars	1	0.02830	0.02318	1.22	0.2223
Fruits & Vegetables	1	0.08227	0.01977	4.16	<.0001
Caffeinated Foods/Beverages	1	0.03664	0.02221	1.65	0.0992

The regression model explained 3.41% of the variance in cognitive performance ($R^2 = 0.0341$). Several dietary patterns displayed statistically significant associations:

- Factor 1 (Processed/Animal Protein): Positive
- Factor 2 (Fiber-Rich Grains & Legumes): Positive
- Factor 5 (Fruits & Vegetables): Positive
- Factor 3 (Dairy): Slight negative association

Patterns based primarily on sugars and caffeine were not significantly associated with cognition. These associations are modest but illustrate how the extracted factors can be applied to health-related outcomes.

Works Cited:

"2013-2014 Dietary Data - Continuous NHANES." *Cdc.gov*, 2025, wwwn.cdc.gov/nchs/nhanes/search/datapage.aspx?Component=Dietary&Cycle=2013-2014. Accessed 25 Nov. 2025.

"2013-2014 Questionnaire Data - Continuous NHANES." *Cdc.gov*, 2025, wwwn.cdc.gov/nchs/nhanes/search/datapage.aspx?Component=Questionnaire&CycleBeginYear=2013. Accessed 25 Nov. 2025.

```
/*-------------------------------*/
/* 1. Load Nutrient Intake Data  */
/*-------------------------------*/
libname myxpt xport "/home/u63546026/sasuser.v94/STA_3013/DR1TOT_H.xpt";

proc copy in=myxpt out=work;
run;

/*-------------------------------*/
/* 2. Load Cognitive Function Data */
/*-------------------------------*/
libname myxpt xport "/home/u63546026/sasuser.v94/STA_3013/CFQ_H.xpt";

proc copy in=myxpt out=work;
run;

/*-------------------------------*/
/* 3. Factor Analysis on Nutrients */
/*-------------------------------*/
options ls=75 ps=65 nodate nonumber;

proc factor data=work.dr1tot_h method=prin res nfact=6 scree rotate=varimax
        out=factor_scores;
    var DR1TKCAL DR1TPROT DR1TCARB DR1TSUGR DR1TFIBE DR1TTFAT DR1TSFAT DR1TMFAT
        DR1TPFAT DR1TCHOL DR1TATOC DR1TVARA DR1TVB6 DR1TFOLA DR1TCHL DR1TVB12
        DR1TVC DR1TVD DR1TVK DR1TCALC DR1TMAGN DR1TIRON DR1TZINC DR1TSODI
        DR1TPOTA DR1TCAFF;
run;

/*-------------------------------*/
/* 4. Standardize Cognitive Scores and Create Composite */
/*-------------------------------*/
proc standard data=work.cfq_h mean=0 std=1 out=cfq_std;
    var CFDCST1 CFDCST2 CFDCST3 CFDCSR CFDAST CFDDS;
run;

data cfq_std;
    set cfq_std;
    /* Create composite using mean(), automatically ignores missing tests */
    Cognitive_Composite = mean(of CFDCST1 CFDCST2 CFDCST3 CFDCSR CFDAST CFDDS);
run;

/*-------------------------------*/
/* 5. Merge Cognitive Scores with Factor Scores */
/*-------------------------------*/
proc sort data=factor_scores; by SEQN; run;
proc sort data=cfq_std; by SEQN; run;

data merged;
    merge cfq_std factor_scores;
    by SEQN;
run;

/*-------------------------------*/
/* 6. Keep only rows with non-missing composite and factor scores */
data merged_complete;
```

```
    set merged;
    if nmiss(Cognitive_Composite, Factor1, Factor2, Factor3, Factor4, Factor5, Factor6)=0;
run;

/*--------------------------------*/
/* 7. Label factors for descriptive regression output */
data merged_labeled;
    set merged_complete;
    label
        Factor1 = "Dense/Processed Foods & Animal Protein"
        Factor2 = "Fiber-Rich Grains & Legumes"
        Factor3 = "Dairy"
        Factor4 = "Simple Carbs & Sugars"
        Factor5 = "Fruits & Vegetables"
        Factor6 = "Caffeinated Foods/Beverages";
run;

/*--------------------------------*/
/* 8. Run regression using labeled factors */
proc reg data=merged_labeled;
    model Cognitive_Composite = Factor1 Factor2 Factor3 Factor4 Factor5 Factor6;
run;
quit;
```

The FACTOR Procedure

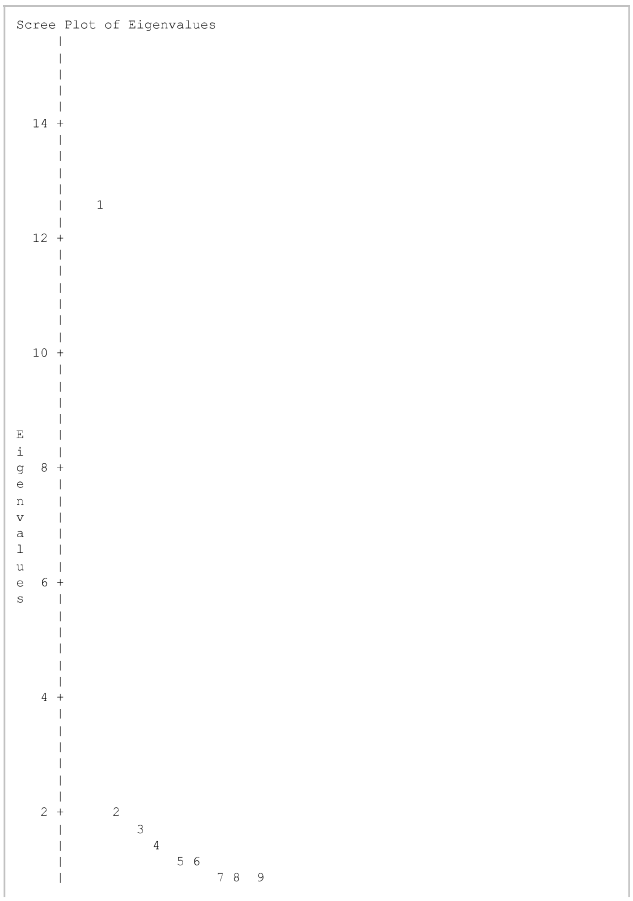
Input Data Type	Raw Data
Number of Records Read	9813
Number of Records Used	8531
N for Significance Tests	8531

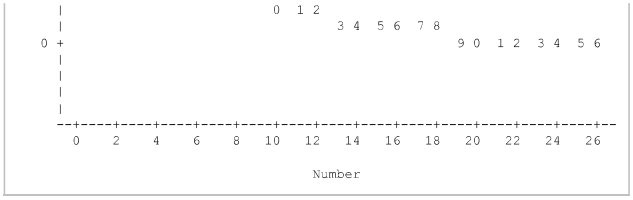
The FACTOR Procedure
Initial Factor Method: Principal Components

Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 26 Average = 1				
	Eigenvalue	Difference	Proportion	Cumulative
1	12.6884261	10.6827279	0.4880	0.4880
2	2.0056983	0.3570499	0.0771	0.5652
3	1.6486484	0.2798241	0.0634	0.6286
4	1.3688242	0.2544662	0.0526	0.6812
5	1.1143581	0.0399413	0.0429	0.7241
6	1.0744168	0.1723590	0.0413	0.7654
7	0.9020577	0.1167888	0.0347	0.8001
8	0.7852689	0.0496277	0.0302	0.8303
9	0.7356412	0.1714534	0.0283	0.8586
10	0.5641878	0.0469245	0.0217	0.8803
11	0.5172633	0.0575812	0.0199	0.9002
12	0.4596821	0.0757668	0.0177	0.9179
13	0.3839152	0.0949408	0.0148	0.9326
14	0.2889745	0.0095014	0.0111	0.9437
15	0.2794731	0.0273562	0.0107	0.9545
16	0.2521169	0.0523008	0.0097	0.9642
17	0.1998161	0.0080202	0.0077	0.9719
18	0.1917959	0.0503812	0.0074	0.9793
19	0.1414146	0.0388086	0.0054	0.9847
20	0.1026060	0.0069865	0.0039	0.9886
21	0.0956195	0.0186366	0.0037	0.9923
22	0.0769830	0.0120879	0.0030	0.9953
23	0.0648950	0.0188374	0.0025	0.9978
24	0.0460577	0.0355435	0.0018	0.9995
25	0.0105142	0.0091688	0.0004	0.9999
26	0.0013454		0.0001	1.0000

6 factors will be retained by the NFACTOR criterion.





Factor Pattern

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
DR1TKCAL	Energy (kcal)	0.92848	-0.24749	-0.10949	-0.15426	0.01139	0.04232
DR1TPROT	Protein (gm)	0.85383	-0.09259	0.25999	0.17690	0.07204	-0.03132
DR1TCARB	Carbohydrate (gm)	0.78750	-0.09600	-0.32546	-0.38497	0.08015	0.14215
DR1TSUGR	Total sugars (gm)	0.56038	-0.08112	-0.25613	-0.54212	0.07304	0.43225
DR1TFIBE	Dietary fiber (gm)	0.69051	0.19517	-0.42309	0.17882	0.02388	-0.17461
DR1TTFAT	Total fat (gm)	0.86967	-0.40403	-0.02813	-0.03081	-0.16528	-0.05820
DR1TSFAT	Total saturated fatty acids (gm)	0.78872	-0.34789	0.07803	-0.21423	-0.21581	-0.04178
DR1TMFAT	Total monounsaturated fatty acids (gm)	0.84008	-0.39656	-0.02770	0.03314	-0.12866	-0.07810
DR1TPFAT	Total polyunsaturated fatty acids (gm)	0.74030	-0.37320	-0.17347	0.13968	-0.12757	-0.04520
DR1TCHOL	Cholesterol (mg)	0.62839	-0.27745	0.48581	0.27078	-0.04410	0.17344
DR1TATOC	Vitamin E as alpha-tocopherol (mg)	0.66995	0.05468	-0.20830	0.19724	-0.06030	-0.14018
DR1TVARA	Vitamin A, RAE (mcg)	0.50382	0.47675	0.11061	0.02436	-0.23859	0.14067
DR1TVB6	Vitamin B6 (mg)	0.63295	0.29408	0.14174	0.06347	0.41912	-0.01608
DR1TFOLA	Total folate (mcg)	0.70659	0.34766	-0.18788	-0.04725	0.09930	-0.32279
DR1TCHL	Total choline (mg)	0.77401	-0.10239	0.38312	0.30190	0.03363	0.16939
DR1TVB12	Vitamin B12 (mcg)	0.56894	0.33309	0.43848	-0.19310	0.21288	-0.02818
DR1TVC	Vitamin C (mg)	0.33780	0.41895	-0.31638	0.10201	-0.16032	0.44356
DR1TVD	Vitamin D (D2 + D3) (mcg)	0.36405	0.39118	0.48149	-0.21460	-0.26094	0.20534
DR1TVK	Vitamin K (mcg)	0.33738	0.23062	-0.27678	0.51942	-0.18487	0.22388
DR1TCALC	Calcium (mg)	0.68256	0.19120	0.11504	-0.31666	-0.26968	-0.03481
DR1TMAGN	Magnesium (mg)	0.84461	0.14711	-0.17302	0.18901	0.08304	-0.02824
DR1TIRON	Iron (mg)	0.71211	0.30436	-0.06692	-0.18520	0.07560	-0.35778
DR1TZINC	Zinc (mg)	0.78821	0.16243	0.16395	-0.03928	0.10546	-0.26400
DR1TSODI	Sodium (mg)	0.82111	-0.20794	0.06073	0.05714	0.03239	-0.05130
DR1TPOTA	Potassium (mg)	0.86457	0.15763	-0.07894	0.14715	0.05543	0.18854
DR1TCAFF	Caffeine (mg)	0.21009	-0.19521	-0.04169	0.04107	0.68334	0.30077

Variance Explained by Each Factor

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
12.688426	2.005698	1.648648	1.368824	1.114358	1.074417

Final Communality Estimates: Total = 19.900372

DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR1TCHL	DR1TVB12	DR
0.96102782	0.84265904	0.91012598	0.87227477	0.75693748	0.95201815	0.84341208	0.88751649	0.75524466	0.81321810	0.55740515	0.57066542	0.68714287	0.77171770	0.87732582	0.71030990	0.622

Residual Correlations With Uniqueness on the Diagonal

		DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR
DR1TKCAL	Energy (kcal)	0.03897	0.02001	0.03491	-0.00117	-0.00859	-0.01273	-0.01299	-0.01729	-0.00901	-0.00501	-0.03164	-0.00510	0.01884	0.01155	0
DR1TPROT	Protein (gm)	0.02001	0.15734	0.02277	0.01278	0.01403	-0.04048	-0.02496	-0.04285	-0.06274	-0.02155	-0.07347	-0.06869	-0.00729	-0.01690	0
DR1TCARB	Carbohydrate (gm)	0.03491	0.02277	0.08987	0.03002	0.02445	-0.04152	-0.05103	-0.04677	-0.01929	0.04978	-0.04783	-0.00258	0.00769	0.02144	0
DR1TSUGR	Total sugars (gm)	-0.00117	0.01278	0.03002	0.12773	-0.02065	-0.02760	-0.05430	-0.01633	-0.00326	0.05551	0.04346	-0.00287	0.02768	-0.00342	0
DR1TFIBE	Dietary fiber (gm)	-0.00859	0.01403	0.02445	-0.02065	0.24306	-0.02461	0.00135	-0.02766	-0.05421	0.02741	-0.09925	-0.01952	-0.04825	-0.04589	0
DR1TTFAT	Total fat (gm)	-0.01273	-0.04048	-0.04152	-0.02760	-0.02461	0.04798	0.04318	0.04881	0.04278	-0.04035	0.02339	0.03216	0.03355	-0.01188	-0
DR1TSFAT	Total saturated fatty acids (gm)	-0.01299	-0.02496	-0.05103	-0.05430	0.00135	0.04318	0.15659	0.01263	-0.07264	-0.02254	-0.04756	0.05250	0.01184	0.00999	-0
DR1TMFAT	Total monounsaturated fatty acids (gm)	-0.01729	-0.04285	-0.04677	-0.01633	-0.02766	0.04881	0.01263	0.11248	0.00821	-0.04474	0.05373	0.01839	0.02874	-0.02944	-0
DR1TPFAT	Total polyunsaturated fatty acids (gm)	-0.00901	-0.06274	-0.01929	-0.00326	-0.05421	0.04278	-0.07264	0.00821	0.24476	-0.05042	0.07690	0.02539	0.05857	-0.00869	-0
DR1TCHOL	Cholesterol (mg)	-0.00501	-0.02155	0.04978	0.05551	0.02741	-0.04035	-0.02254	-0.04474	-0.05042	0.18678	-0.02707	0.00967	-0.02265	0.07672	0
DR1TATOC	Vitamin E as alpha-tocopherol (mg)	-0.03164	-0.07347	-0.04783	0.04346	-0.09925	0.02339	-0.04756	0.05373	0.07690	-0.02707	0.44259	0.00133	0.02777	-0.08144	-0
DR1TVARA	Vitamin A, RAE (mcg)	-0.00510	-0.06869	-0.00258	-0.00287	-0.01952	0.03216	0.05250	0.01839	0.02539	0.00967	0.00133	0.42933	-0.02903	-0.00827	-0
DR1TVB6	Vitamin B6 (mg)	0.01884	-0.00729	0.00769	0.02768	-0.04825	0.03355	0.01184	0.02874	0.05857	-0.02265	0.02777	-0.02903	0.31286	-0.06518	-0
DR1TFOLA	Total folate (mcg)	0.01155	-0.01690	0.02144	-0.00342	-0.04589	-0.01188	0.00999	-0.02944	-0.00869	0.07672	-0.08144	-0.00827	-0.06518	0.22828	0
DR1TCHL	Total choline (mg)	0.01881	0.00018	0.04610	0.04142	0.03715	-0.04620	-0.05153	-0.03873	-0.03480	0.07127	-0.02861	-0.04574	-0.04836	0.04661	0
DR1TVB12	Vitamin B12 (mcg)	0.00351	-0.05566	-0.00890	0.00912	-0.01741	0.05033	0.00497	0.04960	0.10144	-0.05854	0.07327	0.01651	0.04306	-0.05962	-0
DR1TVC	Vitamin C (mg)	-0.01071	0.03423	-0.04472	-0.06220	-0.04401	0.01356	0.01351	0.03108	-0.01679	0.05513	0.00483	-0.15165	0.03272	0.00459	0
DR1TVD	Vitamin D (D2 + D3) (mcg)	-0.01038	-0.02826	-0.01956	-0.04042	0.04099	0.01857	-0.04182	0.02839	0.08353	-0.09581	0.08864	-0.13576	-0.04765	0.01503	-0
DR1TVK	Vitamin K (mcg)	0.01303	-0.03050	0.02256	0.05283	-0.09745	0.02222	0.06324	-0.01004	0.00466	-0.04747	-0.08493	0.03743	0.00905	0.04118	-0
DR1TCALC	Calcium (mg)	-0.02696	0.01982	-0.05268	-0.08177	0.03089	-0.01206	0.04721	-0.03488	-0.05091	-0.03508	-0.04713	-0.02860	-0.04314	-0.00903	-0

Residual Correlations With Uniqueness on the Diagonal

		DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR
DR1TMAGN	Magnesium (mg)	0.00364	0.02889	-0.01409	-0.01936	0.05237	-0.01583	-0.01934	0.00343	-0.03128	-0.05141	0.00371	-0.05279	-0.03361	-0.04988	0
DR1TIRON	Iron (mg)	-0.00941	-0.02907	0.00736	0.02174	-0.06541	-0.00201	-0.01082	-0.00196	0.01376	0.08087	-0.02211	0.02099	-0.06035	0.01626	0
DR1TZINC	Zinc (mg)	-0.01617	0.03121	-0.02163	0.04483	-0.03613	-0.01282	0.00997	0.00196	-0.06624	0.01098	-0.01157	-0.03684	-0.07051	-0.04229	0
DR1TSODI	Sodium (mg)	0.01318	0.05252	0.04170	-0.03562	0.00327	-0.04002	-0.01606	-0.06086	-0.04687	-0.01828	-0.11132	-0.00170	-0.00847	0.01585	-0
DR1TPOTA	Potassium (mg)	-0.00467	0.04175	-0.01750	-0.03584	0.05772	-0.01515	-0.00709	-0.00296	-0.03999	-0.04893	-0.04641	-0.06572	-0.03551	-0.03445	0
DR1TCAFF	Caffeine (mg)	-0.04944	-0.08068	-0.09436	-0.11061	-0.01252	0.05279	0.09455	0.03716	0.02085	-0.06447	0.04519	0.13455	-0.17629	0.03935	-0

Root Mean Square Off-Diagonal Residuals: Overall = 0.04827641

DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR1TCHL	DR1TVB12	DR
0.01836843	0.04014304	0.03739352	0.04273685	0.04409025	0.03244523	0.04004575	0.03289056	0.04828228	0.04943704	0.05688639	0.05794596	0.05180382	0.03810292	0.04112211	0.05129452	0.067

Partial Correlations Controlling Factors

		DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR
DR1TKCAL	Energy (kcal)	1.00000	0.25552	0.58991	-0.01665	-0.08823	-0.29427	-0.16632	-0.26121	-0.09229	-0.05869	-0.24094	-0.03944	0.17063	0.12245	0
DR1TPROT	Protein (gm)	0.25552	1.00000	0.19152	0.09017	0.07175	-0.46588	-0.15904	-0.32207	-0.31971	-0.12573	-0.27839	-0.26428	-0.03286	-0.08917	0
DR1TCARB	Carbohydrate (gm)	0.58991	0.19152	1.00000	0.28019	0.16545	-0.63225	-0.43017	-0.46517	-0.13008	0.38422	-0.23980	-0.01314	0.04587	0.14968	0
DR1TSUGR	Total sugars (gm)	-0.01665	0.09017	0.28019	1.00000	-0.11721	-0.35251	-0.38398	-0.13622	-0.01843	0.35940	0.18278	-0.01224	0.13846	-0.02004	0
DR1TFIBE	Dietary fiber (gm)	-0.08823	0.07175	0.16545	-0.11721	1.00000	-0.22785	0.00690	-0.16726	-0.22225	0.12864	-0.30259	-0.06041	-0.17498	-0.19483	0
DR1TTFAT	Total fat (gm)	-0.29427	-0.46588	-0.63225	-0.35251	-0.22785	1.00000	0.49816	0.66446	0.39472	-0.42622	0.16050	0.22408	0.27384	-0.11354	-0
DR1TSFAT	Total saturated fatty acids (gm)	-0.16632	-0.15904	-0.43017	-0.38398	0.00690	0.49816	1.00000	0.09513	-0.37105	-0.13181	-0.18065	0.20250	0.05348	0.05281	-0
DR1TMFAT	Total monounsaturated fatty acids (gm)	-0.26121	-0.32207	-0.46517	-0.13622	-0.16726	0.66446	0.09513	1.00000	0.04949	-0.30865	0.24079	0.08367	0.15322	-0.18371	-0
DR1TPFAT	Total polyunsaturated fatty acids (gm)	-0.09229	-0.31971	-0.13008	-0.01843	-0.22225	0.39472	-0.37105	0.04949	1.00000	-0.23581	0.23364	0.07832	0.21166	-0.03676	-0
DR1TCHOL	Cholesterol (mg)	-0.05869	-0.12573	0.38422	0.35940	0.12864	-0.42622	-0.13181	-0.30865	-0.23581	1.00000	-0.09415	0.03415	-0.09370	0.37156	0
DR1TATOC	Vitamin E as alpha-tocopherol (mg)	-0.24094	-0.27839	-0.23980	0.18278	-0.30259	0.16050	-0.18065	0.24079	0.23364	-0.09415	1.00000	0.00306	0.07464	-0.25622	-0
DR1TVARA	Vitamin A, RAE (mcg)	-0.03944	-0.26428	-0.01314	-0.01224	-0.06041	0.22408	0.20250	0.08367	0.07832	0.03415	0.00306	1.00000	-0.07922	-0.02642	-0
DR1TVB6	Vitamin B6 (mg)	0.17063	-0.03286	0.04587	0.13846	-0.17498	0.27384	0.05348	0.15322	0.21166	-0.09370	0.07464	-0.07922	1.00000	-0.24390	-0
DR1TFOLA	Total folate (mcg)	0.12245	-0.08917	0.14968	-0.02004	-0.19483	-0.11354	0.05281	-0.18371	-0.03676	0.37156	-0.25622	-0.02642	-0.24390	1.00000	0
DR1TCHL	Total choline (mg)	0.27205	0.00133	0.43906	0.33091	0.21512	-0.60212	-0.37181	-0.32971	-0.20085	0.47080	-0.12278	-0.19932	-0.24684	0.27853	1
DR1TVB12	Vitamin B12 (mcg)	0.03303	-0.26072	-0.05514	0.04740	-0.06562	0.42691	0.02334	0.27476	0.38096	-0.25167	0.20463	0.04681	0.14302	-0.23186	-0
DR1TVC	Vitamin C (mg)	-0.08834	0.14046	-0.24282	-0.28330	-0.14530	0.10075	0.05556	0.15086	-0.05525	0.20763	0.01182	-0.37673	0.09523	0.01563	0
DR1TVD	Vitamin D (D2 + D3) (mcg)	-0.09204	-0.12473	-0.11419	-0.19801	0.14554	0.14844	-0.18501	0.14817	0.29557	-0.38808	0.23325	-0.36271	-0.14912	0.05508	-0
DR1TVK	Vitamin K (mcg)	0.10403	-0.12123	0.11867	0.23307	-0.31164	0.15997	0.25198	-0.04719	0.01486	-0.17316	-0.20128	0.09006	0.02550	0.13590	-0
DR1TCALC	Calcium (mg)	-0.24525	0.08973	-0.31557	-0.41087	0.11253	-0.09886	0.21422	-0.18677	-0.18479	-0.14575	-0.12723	-0.07839	-0.13849	-0.03394	-0
DR1TMAGN	Magnesium (mg)	0.04208	0.16636	-0.10735	-0.12374	0.24265	-0.16506	-0.11164	0.02338	-0.14442	-0.27170	0.01275	-0.18404	-0.13725	-0.23847	0
DR1TIRON	Iron (mg)	-0.09989	-0.15356	0.05142	0.12749	-0.27800	-0.01918	-0.05730	-0.01227	0.05829	0.39207	-0.06965	0.06713	-0.22608	0.07132	0
DR1TZINC	Zinc (mg)	-0.16610	0.15958	-0.14633	0.25438	-0.14862	-0.11874	0.05111	0.01184	-0.27156	0.05151	-0.03528	-0.11403	-0.25568	-0.17952	0
DR1TSODI	Sodium (mg)	0.12803	0.25390	0.26676	-0.19116	0.01271	-0.35039	-0.07781	-0.34798	-0.18168	-0.08111	-0.32090	-0.00496	-0.02905	0.06363	-0
DR1TPOTA	Potassium (mg)	-0.05895	0.26217	-0.14538	-0.24978	0.29162	-0.17230	-0.04465	-0.02200	-0.20134	-0.28199	-0.17377	-0.24984	-0.15813	-0.17961	0
DR1TCAFF	Caffeine (mg)	-0.41923	-0.34045	-0.52686	-0.51806	-0.04250	0.40337	0.39993	0.18546	0.07055	-0.24969	0.11371	0.34372	-0.52756	0.13785	-0

Root Mean Square Off-Diagonal Partials: Overall = 0.22363613

DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR1TCHL	DR1TVB12	DR
0.21135929	0.21794889	0.30498563	0.24425360	0.18018178	0.34869962	0.23228315	0.24723964	0.21190336	0.26290214	0.18864225	0.17314764	0.18765270	0.16758401	0.27631072	0.21236686	0.199

The FACTOR Procedure
Rotation Method: Varimax

Orthogonal Transformation Matrix

	1	2	3	4	5	6
1	0.69247	0.51764	0.30483	0.27878	0.24966	0.13989
2	-0.63064	0.42675	0.50110	-0.09119	0.39450	-0.07165
3	0.17962	-0.26143	0.72067	-0.43143	-0.42295	0.12247
4	0.21362	-0.05850	-0.22885	-0.75146	0.55249	0.16924
5	-0.20824	0.26329	-0.16213	-0.01546	-0.25321	0.89257
6	-0.03903	-0.63941	0.24073	0.40361	0.48353	0.36740

Rotated Factor Pattern

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
DR1TKCAL	Energy (kcal)	0.74238	0.38859	0.12374	0.46147	0.11283	0.13382
DR1TPROT	Protein (gm)	0.72035	0.36314	0.34153	-0.01239	0.13103	0.24064
DR1TCARB	Carbohydrate (gm)	0.44293	0.40449	0.06672	0.71413	0.13214	0.13580
DR1TSUGR	Total sugars (gm)	0.24531	0.09698	0.16186	0.85484	0.10723	0.18508
DR1TFIBE	Dietary fiber (gm)	0.31912	0.65881	-0.08345	0.15202	0.43665	0.01822
DR1TTFAT	Total fat (gm)	0.88207	0.28061	0.06220	0.29365	0.06632	-0.02696
DR1TSFAT	Total saturated fatty acids (gm)	0.78038	0.22183	0.19628	0.36540	-0.05725	-0.09942
DR1TMFAT	Total monounsaturated fatty acids (gm)	0.86376	0.28699	0.03187	0.22787	0.07813	0.00461

Rotated Factor Pattern

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
DR1TPFAT	Total polyunsaturated fatty acids (gm)	0.77500	0.25644	-0.10853	0.19402	0.19858	0.00222
DR1TCHOL	Cholesterol (mg)	0.75763	-0.05848	0.38957	-0.14191	0.08659	0.23747
DR1TATOC	Vitamin E as alpha-tocopherol (mg)	0.45218	0.48680	0.01240	0.06779	0.33339	-0.00765
DR1TVARA	Vitamin A, RAE (mcg)	0.11749	0.28114	0.53916	0.09142	0.40897	-0.10729
DR1TVB6	Vitamin B6 (mg)	0.20521	0.53300	0.35610	0.02782	0.13525	0.46376
DR1TFOLA	Total folate (mcg)	0.21812	0.79854	0.17120	0.15003	0.18570	0.01296
DR1TCHL	Total choline (mg)	0.72025	0.13969	0.42697	-0.09920	0.23099	0.30588
DR1TVB12	Vitamin B12 (mcg)	0.17819	0.40739	0.65923	0.06950	-0.08623	0.25640
DR1TVC	Vitamin C (mg)	-0.04925	0.10457	0.19433	0.29731	0.69485	0.01562
DR1TVD	Vitamin D (D2 + D3) (mcg)	0.09237	0.04206	0.79484	0.10626	0.08836	-0.11192
DR1TVK	Vitamin K (mcg)	0.17919	0.12321	-0.01606	-0.10467	0.73430	0.00193
DR1TCALC	Calcium (mg)	0.36261	0.37462	0.49459	0.35129	0.07369	-0.21122
DR1TMAGN	Magnesium (mg)	0.48520	0.57408	0.14297	0.14198	0.41182	0.18215
DR1TIRON	Iron (mg)	0.24781	0.77551	0.26535	0.19324	0.03169	-0.02570
DR1TZINC	Zinc (mg)	0.45278	0.63332	0.36815	0.05553	0.01546	0.10919
DR1TSODI	Sodium (mg)	0.71810	0.35842	0.15919	0.15752	0.09585	0.15693
DR1TPOTA	Potassium (mg)	0.49763	0.42087	0.28837	0.22537	0.46984	0.24362
DR1TCAFF	Caffeine (mg)	0.11583	0.02154	-0.11161	0.17432	-0.01184	0.76565

Variance Explained by Each Factor

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
7.0475882	4.3990262	2.7021269	2.2579225	2.1383822	1.3553256

Final Communality Estimates: Total = 19.900372

DR1TKCAL	DR1TPROT	DR1TCARB	DR1TSUGR	DR1TFIBE	DR1TTFAT	DR1TSFAT	DR1TMFAT	DR1TPFAT	DR1TCHOL	DR1TATOC	DR1TVARA	DR1TVB6	DR1TFOLA	DR1TCHL	DR1TVB12	DR
0.96102782	0.84265904	0.91012598	0.87227477	0.75693748	0.95201815	0.84341208	0.88751649	0.75524466	0.81321810	0.55740515	0.57066542	0.68714287	0.77171770	0.87732582	0.71030990	0.622

The FACTOR Procedure
Rotation Method: Varimax

Scoring Coefficients Estimated by Regression

Squared Multiple Correlations of the Variables with Each Factor

Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000

Standardized Scoring Coefficients

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
DR1TKCAL	Energy (kcal)	0.08882	-0.01332	-0.05377	0.16072	-0.04813	0.01547
DR1TPROT	Protein (gm)	0.11932	0.00201	0.06395	-0.15495	-0.02717	0.10090
DR1TCARB	Carbohydrate (gm)	-0.04252	0.01410	-0.06278	0.37046	-0.02951	0.05315
DR1TSUGR	Total sugars (gm)	-0.08577	-0.17060	0.05809	0.54201	0.01990	0.12933
DR1TFIBE	Dietary fiber (gm)	-0.03999	0.23870	-0.19209	-0.04707	0.14868	-0.04926
DR1TTFAT	Total fat (gm)	0.19962	-0.04913	-0.07619	0.04218	-0.05621	-0.13416
DR1TSFAT	Total saturated fatty acids (gm)	0.16934	-0.07119	0.02399	0.11764	-0.12916	-0.18671
DR1TMFAT	Total monounsaturated fatty acids (gm)	0.19957	-0.03105	-0.09532	-0.00201	-0.04690	-0.10429
DR1TPFAT	Total polyunsaturated fatty acids (gm)	0.18612	-0.03091	-0.16620	-0.01326	0.05069	-0.09176
DR1TCHOL	Cholesterol (mg)	0.21866	-0.23564	0.15815	-0.18360	0.03053	0.11039
DR1TATOC	Vitamin E as alpha-tocopherol (mg)	0.04381	0.13274	-0.11691	-0.09336	0.10760	-0.08188
DR1TVARA	Vitamin A, RAE (mcg)	-0.06708	-0.03668	0.24173	0.00323	0.20266	-0.14325
DR1TVB6	Vitamin B6 (mg)	-0.11031	0.17180	0.07544	-0.08325	-0.04292	0.34505
DR1TFOLA	Total folate (mcg)	-0.10543	0.35017	-0.05717	-0.04781	-0.05642	-0.05527
DR1TCHL	Total choline (mg)	0.15085	-0.15673	0.14308	-0.18117	0.08724	0.16284
DR1TVB12	Vitamin B12 (mcg)	-0.09480	0.09987	0.28356	-0.02492	-0.17477	0.16395
DR1TVC	Vitamin C (mg)	-0.11800	-0.15312	0.08014	0.18402	0.44744	0.00113
DR1TVD	Vitamin D (D2 + D3) (mcg)	-0.04286	-0.15296	0.43680	0.06278	0.02567	-0.13952
DR1TVK	Vitamin K (mcg)	0.02322	-0.09239	-0.06505	-0.12913	0.47541	-0.03238
DR1TCALC	Calcium (mg)	-0.00809	0.02082	0.19883	0.14070	-0.06067	-0.25782
DR1TMAGN	Magnesium (mg)	-0.00401	0.12154	-0.06859	-0.05838	0.13465	0.07143
DR1TIRON	Iron (mg)	-0.09416	0.34312	0.00370	-0.01446	-0.16190	-0.09268
DR1TZINC	Zinc (mg)	-0.00644	0.22442	0.06326	-0.11204	-0.15323	0.00440
DR1TSODI	Sodium (mg)	0.12154	0.01537	-0.03144	-0.03949	-0.04770	0.03646
DR1TPOTA	Potassium (mg)	-0.00522	-0.02407	0.03522	0.02176	0.19992	0.12510
DR1TCAFF	Caffeine (mg)	-0.06391	-0.04565	-0.10084	0.10536	-0.02691	0.66145

The REG Procedure
Model: MODEL1
Dependent Variable: Cognitive_Composite

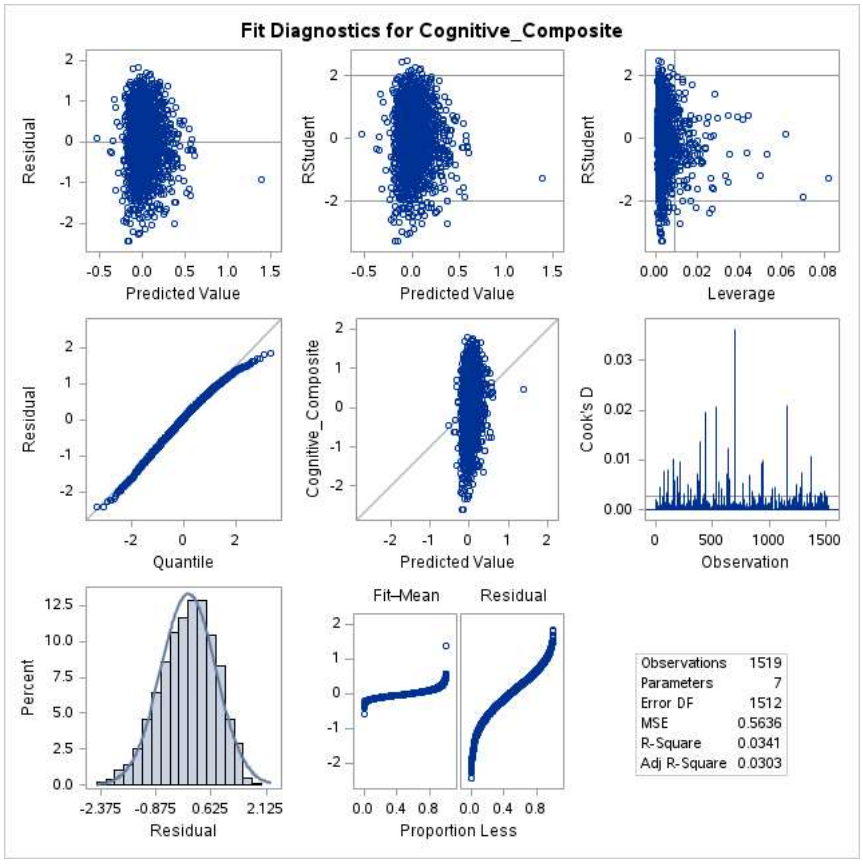
Number of Observations Read	1519
Number of Observations Used	1519

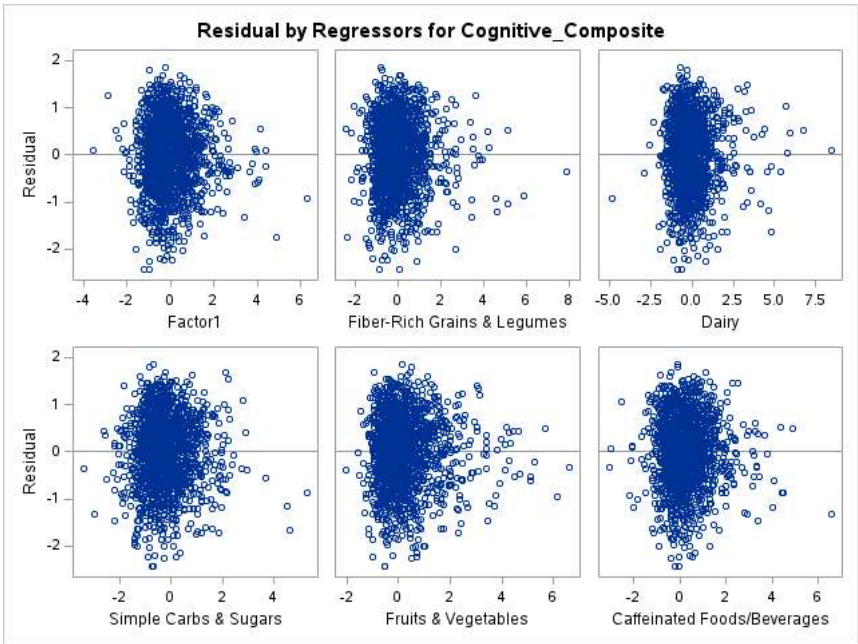
Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	30.11274	5.01879	8.90	<.0001
Error	1512	852.19802	0.56362		
Corrected Total	1518	882.31075			

Root MSE	0.75075	R-Square	0.0341
Dependent Mean	0.02942	Adj R-Sq	0.0303
Coeff Var	2551.63706		

Parameter Estimates						
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	0.01024	0.02130	0.48	0.6309
Factor1	Dense/Processed Foods & Animal Protein	1	0.09778	0.02093	4.67	<.0001
Factor2	Fiber-Rich Grains & Legumes	1	0.06649	0.02100	3.17	0.0016
Factor3	Dairy	1	-0.04340	0.01950	-2.23	0.0262
Factor4	Simple Carbs & Sugars	1	0.02830	0.02318	1.22	0.2223
Factor5	Fruits & Vegetables	1	0.08227	0.01977	4.16	<.0001
Factor6	Caffeinated Foods/Beverages	1	0.03664	0.02221	1.65	0.0992

The REG Procedure
Model: MODEL1
Dependent Variable: Cognitive_Composite




Residual by Regressors for Cognitive_Composite
Residual
Factor1
Fiber-Rich Grains & Legumes
Dairy
Simple Carbs & Sugars
Fruits & Vegetables
Caffeinated Foods/Beverages