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Comparison of children's diets as reported by the child via the Youth/Adolescent Questionnaire and the parent via the Willett food-frequency questionnaire

Molly M Lamb, Colleen A Ross, Heather L Brady and Jill M Norris*
University of Colorado at Denver and Health Sciences Center, 4200 East 9th Avenue, Denver, CO 80262, USA

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Abstract

Objective: A comparison of a parent-completed Willett food-frequency questionnaire (FFQ) and a self-completed Youth/Adolescent Questionnaire (YAQ) has not yet been conducted.

Setting: In the Diabetes Autoimmunity Study in the Young (DAISY), parents report their child's diet on the FFQ annually from birth until age 10 years, when the child begins to report their own diet using the YAQ.

Subjects: To determine the comparability of these collection methods, 89 children aged 10–17 years and their parents completed the YAQ and FFQ, respectively, for the child's previous year's diet.

Design: We compared reported intakes for energy, the macronutrients and a variety of micronutrients of interest to the DAISY study.

Results: Bland–Altman plots of energy-adjusted differences between questionnaire responses against their means suggested that the two collection methods gave similar results. The average Spearman correlation coefficient of all energy-adjusted nutrient intakes was 0.50, and did not differ significantly by gender (males, $r = 0.48$; females, $r = 0.46$) or age (10–11 years, $r = 0.49$; 12–17 years, $r = 0.51$). While correlated, the nutrient values from the FFQ were higher than the nutrient values from the YAQ.

Conclusions: While reported nutrient intakes are correlated, an indicator variable defining which survey method a nutrient was collected with should be included in any longitudinal data analyses examining nutrient intakes collected with the YAQ and the FFQ as independent predictors of a disease outcome.

Keywords
Youth diet questionnaire
Comparison

Longitudinal research studies that collect diet information often follow subjects through childhood and adolescence. The semi-quantitative Willett food-frequency questionnaire (FFQ) (Nutrition Questionnaire Service Center, Boston, MA), is used to collect diet information in young populations via parental report. This method has been validated against the 24-hour dietary recall in Caucasian and Hispanic pre-school populations[1,2]. However, the potentially reduced ability of a parent to report the diet of their child as the child becomes more independent necessitates a change in diet collection tools and methods that take advantage of the maturation of the child's cognitive abilities.

Rockett and colleagues described the development of the Youth/Adolescent Questionnaire (YAQ) (Channing Laboratory, Boston, MA), a youth-friendly questionnaire based on the FFQ that allows adolescents 9–19 years old to report their own diet[3,4]. The YAQ has been shown to be reproducible[3], and has been validated against the 24-hour dietary recall in a primarily Caucasian population[5].

The Diabetes Autoimmunity Study in the Young (DAISY) study has been following a cohort of children from birth through adolescence for the development of diabetes-related autoimmunity. DAISY used a parent-completed FFQ to collect diet information annually on all children between 2 and 10 years old. This FFQ had been altered for measurement of children's diets[2]. In recognition of the increasing age of the children in the DAISY cohort and issues related to nutrient intake, DAISY began collecting self-completed YAQs annually for all subjects aged 10 years or older. In order to determine whether data from the FFQ and the YAQ were comparable, we collected data using both instruments in a sample of DAISY children.

Our goal was to determine if these two diet collection tools and reporting methods could be used to collect similar and correlated diet information throughout childhood and adolescence in a young population participating in a longitudinal research study. A reference instrument was not used for this analysis because our purpose was not to validate either the YAQ or the FFQ in our

*Corresponding author: Email Jill.Norris@uchsc.edu

population. Instead, we aimed to identify a mechanism that would allow us to use data from the FFQs and the YAQs in the same analyses and maintain the dietary trends throughout childhood and adolescence.

Methods

Between 1994 and 2004, DAISY has enrolled >1700 children in the Denver, CO area at increased risk for type 1 diabetes (T1DM), as defined by either having a high-risk human leukocyte antigen (HLA) genotype or a first-degree relative with T1DM. Children with high-risk HLA genotype were identified and enrolled at birth, while children with a first-degree relative with T1DM were enrolled up to the age of 8. The Colorado Multiple Institutional Review Board approved all study protocols, and informed consent was obtained from the parents/legal guardians of all subjects.

An FFQ was sent to the child's parents 1 month before each birthday, starting with the second birthday, or starting at enrolment if the child was older than 2 years at entry into the study. Parents were instructed to complete the questionnaire for the child's diet over the previous year. The FFQ was has been altered for use in children[2], and has been validated in the DAISY population[1]. When children turned age 10 years and older, DAISY began sending a YAQ, so that these older children could report their own diets.

The 152-question YAQ is based on the 145-question FFQ. There are a few notable differences between the two questionnaires, because the YAQ was specifically designed to reflect the eating habits of adolescents. Reference portion sizes, when given, were the same on the FFQ and the YAQ. Reference sizes were given on approximately 65% of the FFQ questions, and 50% of the YAQ questions. Some foods included on the FFQ do not appear on the YAQ, such as sour cream, bacon, cranberry sauce and brussel sprouts. Some foods, such as lasagne, salsa, cheeseburger and potato salad, appear on the YAQ but are not listed in a specific category on the FFQ. Also some foods that are separate on the FFQ are combined on the YAQ, such as brown and white rice, and dark and white fish[5]. Also, the FFQ lists nine consumption frequency options, ranging from 'never, or less than once per month' to '6+ per day' for all foods, while the YAQ offers only 4–5 consumption frequency options, and these options differ by food.

Research has suggested that an FFQ can be a reliable and accurate method for collecting diet information in adults[6], and that children age 10 and older have a thinking process similar to adults[7]. Furthermore, the YAQ was designed to be user-friendly for adolescents, and has been both validated against 24-hour diet recalls and shown to be reproducible in this age group.

Comparison study population

To determine the comparability of reported nutrient intake on the parent-completed FFQ and the self-completed YAQ, an FFQ and a YAQ were sent to 129 DAISY families with children turning 10–17 years of age whose birthdays fell between November 2003 and April 2004. A sample size of at least 100 is recommended for diet survey comparison and calibration studies[8]. Based on prior FFQ return rates for the DAISY study, we expected to receive approximately 100 completed FFQ/YAQ sets from these subjects. Eligible families were telephoned prior to the mailing of the diet surveys and the purpose of the double survey was explained to them. Parents were instructed to fill out the FFQ just as they always had in the past (i.e. completing the questionnaire alone, asking their child what they ate, talking to other caregivers about the child's diet, etc.), and the child was instructed to fill out the YAQ all by themselves. If a family could not be reached by telephone, a note was sent with the FFQ/YAQ mailing with the same explanation and instructions. Eighty-nine completed FFQ/YAQ pairs were received either in the mail or at the child's next clinic visit, a 69% response rate. Responders were 56% male, 84% non-Hispanic white, and had an average age of 11.9 years.

Comparison study statistical analysis

All YAQs were sent to Channing Laboratory (Boston, MA), and FFQs were sent to the Nutrition Questionnaire Service Center (Boston, MA) for nutrient analysis. The aetiological questions that we are investigating in DAISY with regard to predictors of islet autoimmunity primarily involve micronutrients such as vitamins and carotenoids; and polyunsaturated fatty acids, particularly those found in fish oil, and arachidonic acid. Therefore, the following nutrients or nutrient combinations were chosen for analysis because of their relevance to our research questions regarding predictors of islet autoimmunity, and for their ability to describe the overall diet: energy, total fat, total protein, total carbohydrate, fish oils (eicosapentaenoic acid + docosahexaenoic acid), arachidonic acid, calcium, α- and β-carotene, β-cryptoxanthin, lutein, lycopene, retinol, vitamins A, C and D, and α-tocopherol.

Because DAISY intends to use nutrient intake including supplements in future analysis of these dietary factors for association with islet autoimmunity, we conducted our comparison study on micronutrient values that included intake from supplements. The micronutrient variables that include supplements are: calcium, retinol, β-carotene, vitamin A, C and D, and α-tocopherol. Nutrient values were calculated from reported food intake using the US Department of Agriculture Nutrient Database for Standard Reference, Release 14 for both the YAQ and the FFQ.

Nutrient values were energy adjusted using the residual method prior to analyses[8]. Mean caloric intakes used to adjust the nutrient values were 2086.02 for the FFQ and 1910.35 for the YAQ. Using Spearman rank correlation coefficients, we tested the strength of the relationship of reported energy-adjusted nutrient intakes on the FFQ and the YAQ. Spearman rank correlation coefficients were calculated because the data were not normally distributed. Significance was determined using a test for the equality of two correlations[9]. Bland–Altman plots of the energy-adjusted difference between FFQ and YAQ responses plotted against their mean were drawn to determine the presence or absence of systematic bias in the new measurement technique (self-completed YAQ) when compared with the old technique (parent-completed FFQ). If the differences are symmetric around zero, then there is no systematic bias. There is no formal statistical test that can be applied to a Bland–Altman plot to determine if the two methods give 'similar' results or 'non-similar' results. Instead, one should look for a mean difference near zero and good clustering of data points. If one is satisfied with the mean difference, the clustering and the standard deviation of the data[10], then one can assume similarity of the two diet collection methods.

Results

The average Spearman correlation coefficient (r) of energy-adjusted nutrient intakes was 0.50 (range 0.34–0.76). Correlations were similar by gender (males, $r = 0.48$, range 0.24–0.82; females, $r = 0.46$, range 0.18–0.83) and by age group (10–11 years, $r = 0.49$, range 0.23–0.84; 12–17 years, $r = 0.51$, range, 0.26–0.86). The carotenoids, such as β-carotene, β-cryptoxanthin and lutein, consistently had the highest correlations. The macronutrients examined (total fat, total protein and total carbohydrates) had relatively low correlations in all groups (Table 1).

Bland–Altman plots of responses for each nutrient generally showed clustering and mean differences near (but usually above) zero. This suggests that the two diet collection methods gave similar nutrient intakes, and that the parents consistently reported higher intakes than the children (data shown in Appendix). Table 2 presents the mean reported nutrient intakes from the FFQ and the YAQ. Nutrient values from the FFQ were higher for every nutrient except lycopene and retinol when compared with the YAQ, suggesting that any transition from the parent-reported FFQ to the child-reported YAQ would result in an apparent drop in intake. Agreement varied by nutrient. For example, the percentage difference between the two diet reports for vitamin D is very low, at 0.2%, whereas the percentage difference for calcium was very high, at 78%.

Discussion

Despite the fact that the two different diet collection methods examined in this analysis differed on both reporter and instrument, this analysis shows that a self-completed YAQ gives nutrient intakes that are similar to a parent-completed FFQ. The correlations between the FFQ and the YAQ nutrients that we found for each gender and each age group were in the range of those found in the YAQ validation study[5]. While the nutrient values of these two instruments are correlated, there is a systematic difference whereby the YAQ nutrient values are lower than the FFQ values. In addition to this systematic difference, the variability in the quality of the Bland–Altman plots also suggests that nutrient data collected with these two different instruments cannot be used in the same analyses without somehow accounting for the survey type.

The nutrient values were higher on the FFQ than the YAQ for most nutrients examined. There are several

Table 1 Energy-adjusted Spearman correlation coefficients (r, with 95% confidence interval in parentheses) of nutrients estimated by the Willett food-frequency questionnaire and the Youth/Adolescent Questionnaire

Nutrient	Overall ($n = 89$)	Males ($n = 50$)	Females ($n = 39$)	Age 10–11 years ($n = 44$)	Age 12–17 years ($n = 45$)
Energy	0.47 (0.30, 0.72)*	0.60 (0.41, 0.98)*	0.18 (−0.14, 0.51)	0.50 (0.24, 0.86)*	0.42 (0.15, 0.75)*
Total fat	0.43 (0.25, 0.67)*	0.35 (0.08, 0.66)*	0.51 (0.23, 0.89)*	0.54 (0.30, 0.91)*	0.35 (0.07, 0.67)*
Total protein	0.39 (0.21, 0.63)*	0.34 (0.07, 0.64)*	0.41 (0.11, 0.76)*	0.46 (0.19, 0.80)*	0.36 (0.07, 0.67)*
Total carbohydrate	0.28 (0.08, 0.50)*	0.21 (−0.07, 0.50)	0.30 (−0.02, 0.64)	0.33 (0.4, 0.65)*	0.20 (−0.10, 0.51)
Calcium	0.44 (0.26, 0.68)*	0.37 (0.10, 0.67)*	0.54 (0.28, 0.93)*	0.33 (0.03, 0.64)*	0.53 (0.29, 0.89)*
Fish oils	0.61 (0.50, 0.92)*	0.48 (0.24, 0.81)*	0.69 (0.52, 1.00)*	0.66 (0.49, 1.00)*	0.54 (0.30, 0.90)*
Arachidonic acid	0.43 (0.24, 0.67)*	0.45 (0.19, 0.77)*	0.36 (0.05, 0.70)*	0.43 (0.15, 0.76)*	0.44 (0.17, 0.78)*
α-Carotene	0.52 (0.36, 0.79)*	0.55 (0.33, 0.90)*	0.47 (0.19, 0.84)*	0.51 (0.26, 0.87)*	0.56 (0.34, 0.94)*
β-Carotene	0.63 (0.54, 0.96)*	0.71 (0.60, 1.00)*	0.45 (0.16, 0.81)*	0.62 (0.41, 1.00)*	0.67 (0.51, 1.00)*
β-Cryptoxanthin	0.62 (0.51, 0.93)*	0.61 (0.42, 0.99)*	0.61 (0.38, 1.00)*	0.54 (0.29, 0.90)*	0.67 (0.50, 1.00)*
Lutein	0.64 (0.54, 0.96)*	0.66 (0.51, 1.0)*	0.50 (0.22, 0.87)*	0.65 (0.47, 1.0)*	0.59 (0.38, 0.99)*
Lycopene	0.48 (0.31, 0.73)*	0.48 (0.24, 0.81)*	0.52 (0.24, 0.90)*	0.44 (0.16, 0.78)*	0.46 (0.19, 0.79)*
Retinol	0.51 (0.35, 0.78)*	0.34 (0.06, 0.64)*	0.66 (0.47, 1.00)*	0.36 (0.07, 0.68)*	0.68 (0.52, 1.00)*
Vitamin A	0.63 (0.53, 0.95)*	0.65 (0.49, 1.00)*	0.54 (0.28, 0.94)*	0.60 (0.38, 0.99)*	0.71 (0.58, 1.00)*
Vitamin C	0.49 (0.33, 0.75)*	0.61 (0.42, 0.99)*	0.33 (0.02, 0.67)*	0.59 (0.37, 0.99)*	0.40 (0.12, 0.72)*
Vitamin D	0.47 (0.30, 0.72)*	0.42 (0.16, 0.73)*	0.48 (0.20, 0.85)*	0.36 (0.07, 0.68)*	0.55 (0.32, 0.92)*
α-Tocopherol	0.43 (0.24, 0.67)*	0.41 (0.15, 0.73)*	0.35 (0.04, 0.70)*	0.41 (0.13, 0.74)*	0.51 (0.26, 0.86)*
Mean r (range)	0.50 (0.34, 0.76)*	0.48 (0.24, 0.82)*	0.46 (0.18, 0.83)*	0.49 (0.23, 0.84)*	0.51 (0.26, 0.86)*

*Statistically significant at the $P < 0.05$ level.

Table 2 Willett food-frequency questionnaire (FFQ) and Youth/Adolescent Questionnaire (YAQ) nutrient means*, mean differences, percentage difference and standard deviations in 89 children, aged 10–17 years

Nutrient	Mean FFQ value	Mean YAQ value	Mean difference (FFQ, YAQ)	% Difference	2 SD from mean difference
Total calories (kcal)	2086.02	1910.35	175.67	8	−1244.00, 1595.34
Total fat (g)	77.85	67.75	10.10	13	−12.56, 32.76
Total protein (g)	86.45	75.14	11.31	13	−18.62, 41.22
Total carbohydrate (g)	267.34	256.64	10.70	4	−58.65, 80.04
Calcium (mg)	1185.12	264.57	920.55	78	99.31, 1741.49
Fish oils (g)	0.15	0.06	0.09	60	−0.17, 0.35
Arachidonic acid (g)	0.13	0.09	0.04	4	−0.0625, 0.14
α-Carotene (μg)	924.72	573.31	351.41	38	−1555.51, 2258.33
β-Carotene (μg)	3467.61	2386.42	1081.19	31	−4350.53, 6512.91
β-Cryptoxanthin (μg)	131.02	113.89	17.13	13	−163.95, 198.21
Lutein (μg)	2000.36	1989.07	11.28	0.5	−4984.52, 5007.08
Lycopene (μg)	6155.00	6397.08	−242.08	4	−8375.08, 7890.92
Retinol (IU)	3005.30	3376.25	−370.95	12	−4716.39, 3974.49
Vitamin A (IU)	10 863.28	8818.66	2044.62	19	−11 318.60, 15 407.84
Vitamin C (mg)	203.28	124.01	79.27	39	−264.58, 423.10
Vitamin D (IU)	307.90	307.14	0.76	0.2	−326.28, 327.80
α-Tocopherol (mg)	14.91	7.16	7.75	52	−57.17, 72.67

* Residual-adjusted for total energy intake.

possible explanations for these differences. While the underlying database for both instruments is common, the combination of some foods on the YAQ that were listed as single foods on the FFQ (such as brown and white rice) could have some impact on reporting. In addition, a child reporting what they actually ate rather than a parent reporting what was sent to school may also impact reporting. These factors may reduce the correlations between the results of the two questionnaires.

FFQs are prone to a variety of errors, including poor recall, different interpretation of questions, different perceptions of serving sizes and lack of reporting of foods not listed on the questionnaire. In addition, FFQs are culture-specific, and results derived from the analyses of their data may only be generalised to populations similar in cultural composition to that in the study[8]. This analysis was not meant to determine the source of the errors in the diet surveys. Rather, its aim was to examine the differences between the two surveys and identify a method for dealing with the differences.

We have chosen to examine those nutrients that were directly applicable to our research questions regarding the nutritional aetiology of T1DM autoimmunity. It is unlikely that we would see different results with respect to the comparability of the YAQ and FFQ if different nutrients had been examined, as we analysed a wide variety of micro- and macronutrients.

The strengths of our analysis include the wide variety of nutrients we were able to examine for comparability and our ability to examine the entire age range for which we will gather YAQ information in the future. Our comparison analysis is limited by relatively small sample size ($n = 89$), which limits our statistical power. Also, while our population did include more than one race/ethnicity, the vast majority of the participants were non-Hispanic white, limiting the generalisability of our findings.

In conclusion, this analysis suggests that nutrient data from the FFQ and the YAQ are similar and correlated. However, the systematic decrease in nutrient values, in addition to other differences in errors, between the FFQ and YAQ suggest the need to mark the change in data collection instrument. We recommend that researchers who switch from the FFQ to the YAQ as their study subjects reach adolescence include an indicator variable in their analyses defining which survey method the nutrients were gathered with at each time point. This analysis method would allow researchers to collect dietary data in children longitudinally while accounting for the age-related change in who is most qualified to report the child's diet.

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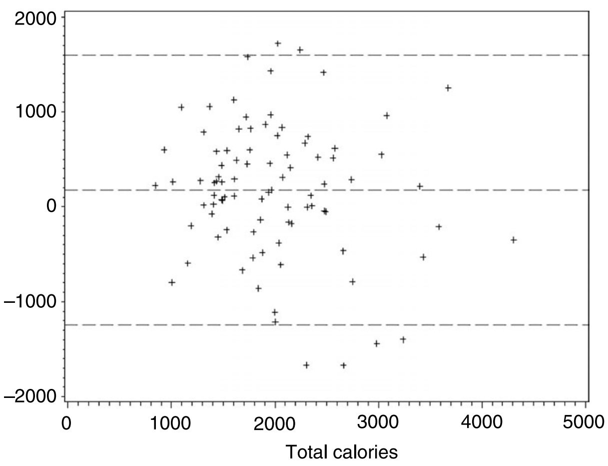
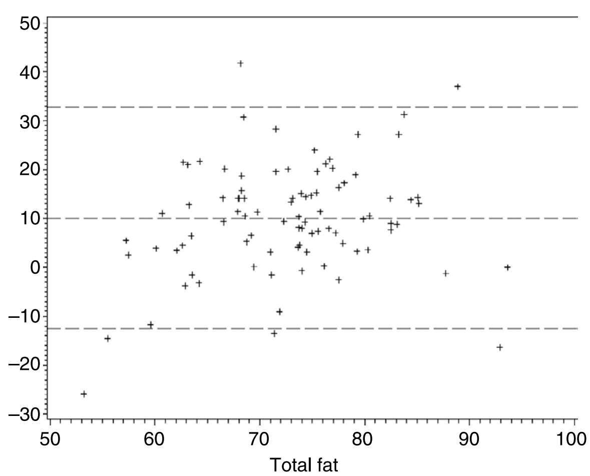
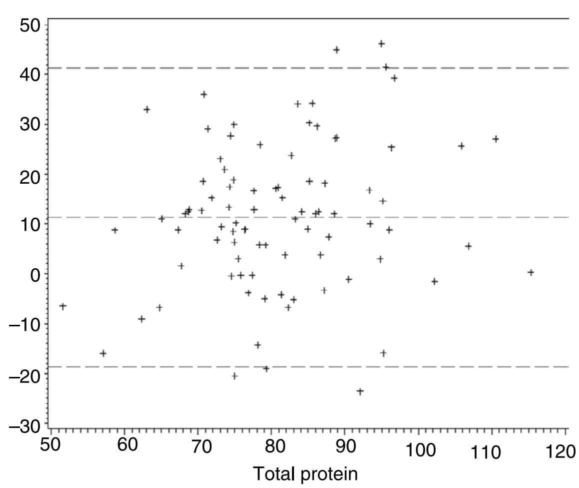
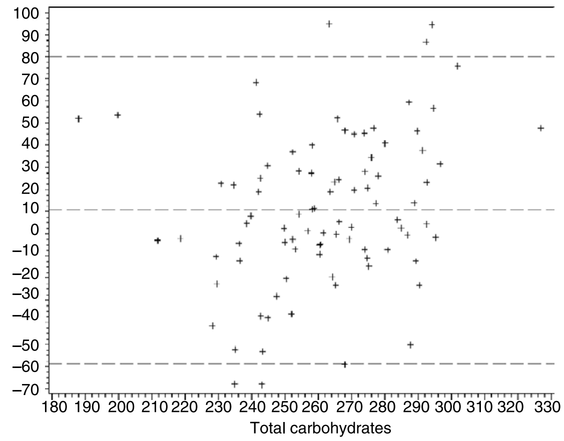
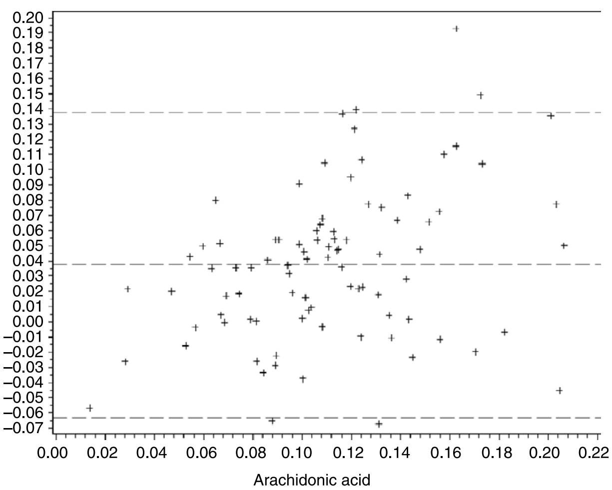
Appendix – Bland–Altman plots of energy-adjusted difference between nutrient means estimated from the Willett food-frequency questionnaire (FFQ) and the youth/Adolescent Questionnaire (YAQ) (*y*-axes) plotted against energy-adjusted average of FFQ and YAQ values (*x*-axes) see Table 2 for nutrient units

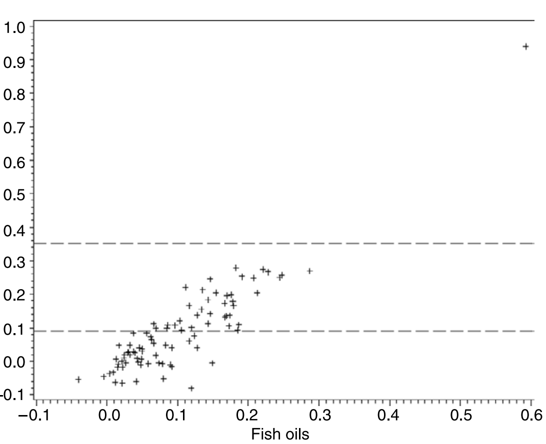












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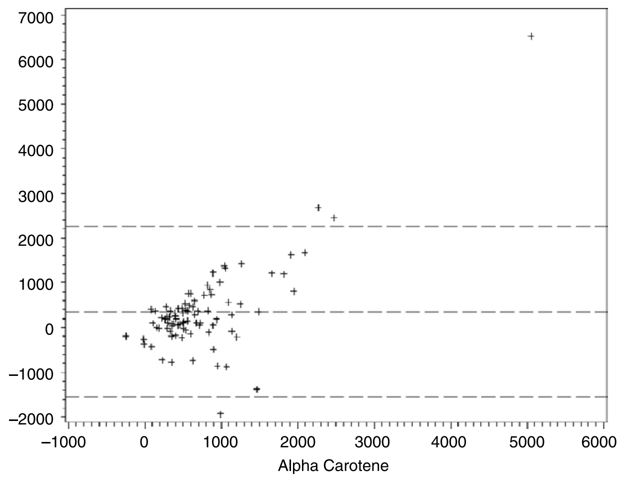

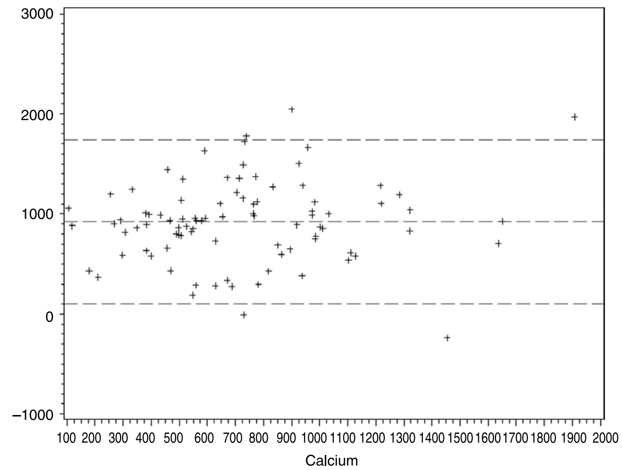

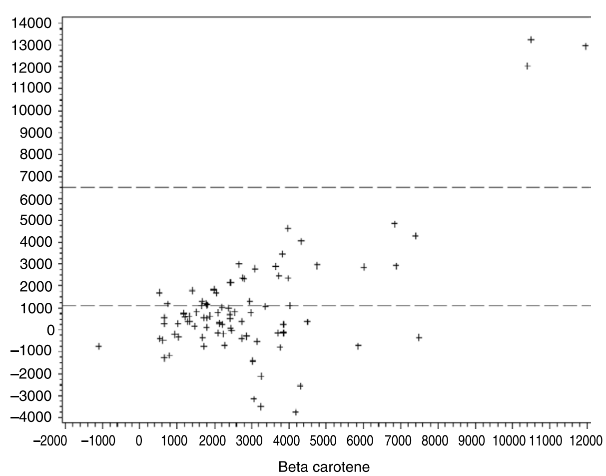

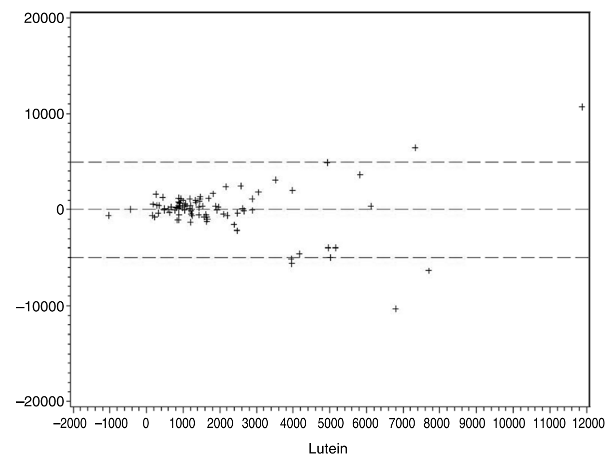

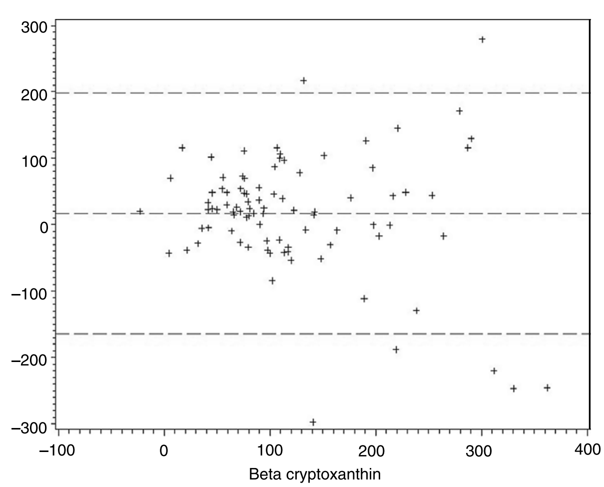

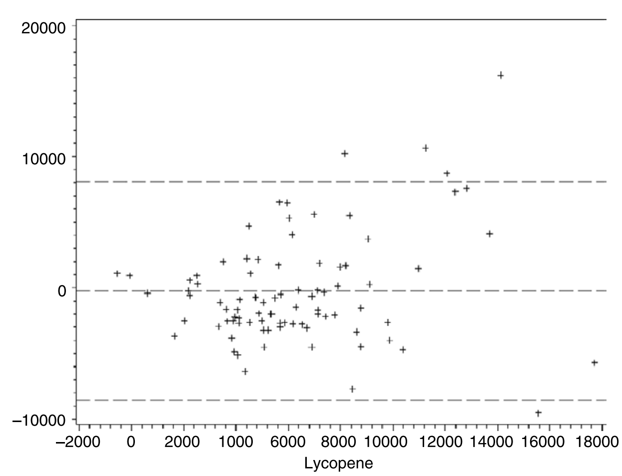

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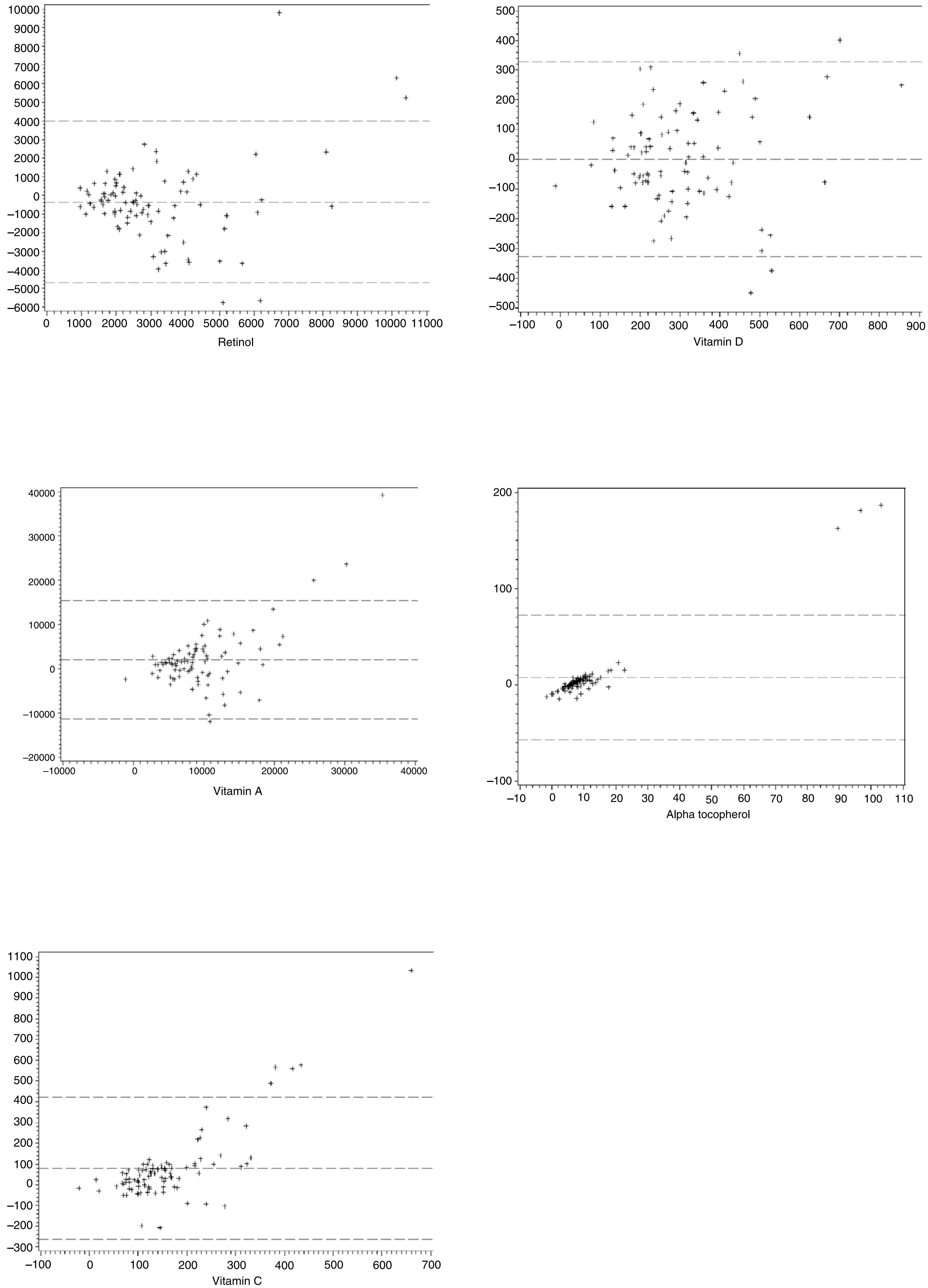

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