Measuring fruit and vegetable intake in primary school children: validation of the CADET Diary in children aged 8-11 years

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Abstract

The Child And Diet Evaluation Tool (CADET) diary designed by the Nutritional Epidemiology Group at the University of Leeds is a 24-hour food diary that measures the nutrition intake of children aged 3-7 years old, with a focus on fruit and vegetable consumption. CADET has never been used to measure nutrient intake of children aged 8 to 11 years old. To ensure that these portion sizes reflect actual dietary intake, participants were asked to complete the CADET diary (i.e. the School and Home Food Diary) concurrently with a one day weighed record diary. Total fruit and vegetable intake in grams and other nutrients were extracted to compare the mean intakes from the CADET diary and Weighed Food Dairy using t-tests and Pearson's r correlations. Bland-Altman analysis was also conducted to assess the agreement between these two methods. A total of 67 children with a mean age of 9.3 years old (SD: +/- 1.4, 51% girls) participated in the study. Correlations comparing the CADET diary to the weight food diary were high for fruit, vegetables and combined fruit and vegetables (r=0.7). The results from the Bland Altman plots revealed a mean difference of only 54 grams (-88, 152) for combined fruit and vegetables intake. These results suggest the CADET diary is a valuable nutritional epidemiological tool for measuring children's diets from age 3 to 11 years. It is easy to implement in large studies, and only requires a basic level of literacy to complete.

Introduction

Dietary assessment attempts to accurately estimate habitual intake for a group of individuals of interest. However, measuring food intake is difficult due to the wide variation that can occur daily, weekly, or even seasonally[1]. The importance of accurately measuring food intake in children is a concern, as dietary habits formed in early life can have a serious impact on long term health status[2]. Measuring food and nutrient intake in children is more challenging than in adults. Until children are eight years or older, they are not aware of the food they are consuming or do not have the cognitive abilities to identify their own food intake[3]. This means parents play a vital role in reporting their child's food intake. Epidemiological research involving primary school aged children tends to rely on parents or field workers to report children's food intake. Evidence suggests that parents can be reliable reporters of their child's food intake using either dietary recalls or 24-hour food diaries in the home environment[4]. This reliability is strengthened when both parents are involved in the reporting process[3]. Food eaten outside the home is less reliable, and often a major source for possible bias. When children are absent from their parent's care for four or more hours of the day, their parents ability to accurately recall their child's dietary intake dramatically decreases[4]. Therefore using field workers to complete the children's recall at school reduces this risk of bias. Another area of measurement error is portion sizes in both adult and child studies. There are mixed views as to whether children can estimate the quantities of food they have consumed. Some studies state children aged 8-15 years can estimate within ten percent the food they actually consumed when measures such as household items are used to help aid quantification[5]. It is accepted that there is no perfect way of measuring habitual intake in children[6]. For large population studies it is essential that the dietary assessment method is easy to complete.

When validating a dietary assessment method it is important to look at the daily energy intake between the two methods; it is also necessary to explore differences in nutrient intake; e.g protein, carbohydrates, total saturated fat, monounsaturated fat, polyunsaturated fat, fibre, calcium, iron, carotene, folate and vitamin C. Generally speaking variability in nutrient intake is low for those nutrients regularly found ubiquitously in the diet e.g. protein, carbohydrates, and higher for nutrients concentrated in a small range of foods such as carotene, retinol, folic acid, and unsaturated fatty acids[3].

For children, the validity of a 24-hour recall compared to a more complex food diary has been shown to accurately reflect energy intake of the sample population, however, they are generally not precise enough to accurately measure individual intake[7]. The most likely cause of overestimation or underestimation of energy intake is associated with the portion sizes assigned to different foods. Misreporting in dietary questionnaires is a major problem in adult studies let alone in paediatric populations that rely on information from parents and children. It is vital that all studies built in validation methods to critically examine evidence of measurement error in the reporting.

Whilst the CADET diary has been previously validated in children aged 3-7 years, this study involves children aged 8-11 years[8]. Using the age specific portion sizes based on research from the children's NDNS[9], the CADET diary was up-dated for children aged 8-11. This study aims to evaluate whether a modified version of CADET has the potential to measure the diet of children aged 8-11 years by validating it against a reference method. A sample of primary school children were asked to complete the CADET diary whilst at the same time completing a weighed food diary[10, 11].

Method

Subjects

Eight schools surrounding the Leeds and the West Yorkshire area were asked to participate in the study. Five schools were recruited, and a total of 67 children from years 3-6 (aged 8-11 years old) agreed to take part in the study.

Design

Data collection was carried out between November 2010 and June 2012. The children received a consent letter to take home to their parents a week before the day of data collection. All parents who gave consent attended an information session at the end of the school day.

Dietary Assessment Method: CADET

For this trial, diet was assessed using a modified version of the validated Child And Diet Evaluation Tool (CADET) questionnaire[8]. The CADET uses age and gender specific food portion sizes to calculate food and nutrient intake for children aged 3 to 11 years old. The

CADET diary comprises a list of 115 separate food and drink types, divided into 15 categories. The categories of foods are cereals (5 items); sandwich/bread/cake/biscuit (10 items); spreads/sauces/soup (7 items); cheese/egg (6 items); chicken/turkey (3 items); meat other (9 items); fish (5 items); vegetarian (3 items); pizza/pasta/rice (8 items); desserts/puddings (3 items); sweets/crisps (4 items); vegetables and beans (18 items); potato (2 items); fruit (13 items); and drinks (9 items). The CADET diary for this study was split into a School Food Diary and a Home Food Diary. Both diaries included the same food items, with different meal time options. The School Food Diary had the meal time options of morning break, lunch time, afternoon break, whereas the Home Food Diary had the following options: after school/before tea, evening meal/tea, after tea/during night, and breakfast/before school. To complete the School and Home Food diary participants tick each item consumed, under the appropriate meal time heading within the 24-hour period.

The School Food Diary was completed by a trained fieldworker at school for all school time meals, whilst the children were given the Home Food Diary to take home for their home food, their evening snacks and meals, as well as breakfast the next day. The following day the fieldworker would go back to the school to collect the Home Food Diary, and check that it had been completed accurately. If a child forgot to return their Home Food Diary the fieldworker did a retrospective recall for the after school dietary intake, including snacks, evening meals and breakfast that morning.

Comparison Method: Weighed Food Diary

The method used for comparison with the School and Home Food Diaries was a semi-weighed food diary. This diary is again a prospective food diary, administrated on the same day as the School and Home Food Diaries. Similar to the School and Home Food Diaries it involves two sections, one to be completed by field workers at school, the other to be taken home to be completed by the parents.

Researchers asked the parents to weigh all food their child ate using standard kitchen scales. Children who brought a packed lunch to school had their food weighed in the morning, and then their left-overs were collected at the end of lunchtime, weighed and recorded again. For children who received a school meal, the administrator recorded on a tick list what the children consumed from the food provided, then used the standardised portion sizes provided by the school kitchen to weigh and record the food consumed.

Parents were asked to weigh and record all food consumed after school as well as the left-overs from each meal. They were also required to weigh and record the breakfast that the child consumed the next day. Scales were provided if the parents required them. The diaries and scales were then returned to the fieldworker the following day, and checked for completeness.

Data Coding

The dietary information from the School and Home Food Diaries was converted to an MS Access spreadsheet using the established in-house software, based on the composition of foods[12] and using standard predefined algorithms to convert weights of composite foods into total daily nutrient values for each child. The weighed food diary data was entered using MS Access spreadsheet based on the DANTE software.

Ethical Approval

Ethical approval was obtained through the Leeds Institute of Health Sciences and Leeds Institute of Genetics, Health and Therapeutic Joint Ethics Committee (Reference number: 09/012).

Statistical Analysis

All statistical analysis was performed using Stata IC version 12[13]. The results from the two methods were compared using Bland-Altman plots, Pearson's correlation coefficients, and paired t-test or Wilcoxon signed rank test for non-parametric data to identify any significant differences between the two methods[8]. Correlation coefficients (r) determine any significant correlations between the CADET tick list and weighed food diary. Correlation coefficients measure the strength of the relationship between the two dietary methods(14). Paired t-tests were used to assess significant differences between the two methods of assessment.

To examine the agreement between the school and home diary and the weighed food dairy Bland-Altman plots were reviewed. For this the mean values of nutrients from the two diaries are plotted against the differences between the diaries. The differences between the methods were also checked for normality of distribution before attempting the Bland-Altman plots.

A sub-analysis exploring the mean differences between fruit and vegetables was conducted to explore whether a particular fruit or vegetable was affecting the overall accuracy of the CADET diary. Paired t-tests were used to determine whether there was a significant difference between individual fruit and vegetables.

Results

The total sample consisted of 67 children who completed the questionnaires, with a mean age of 9.3 years old (SD: +/- 1.4) and of whom 51% were girls. Table 1 shows the number of children from each year group.

INSERT TABLE 1

Accuracy of the CADET Diaries compared to the Weighed Food Diary

Table 2 shows the mean and standard deviation of the daily intake of fruit (g), vegetables (g) fruit and vegetables combined (g) and key nutrient intakes as recorded by the CADET Food Diaries and the Weighed Food Diary. As the outcome for this data was found to be normally distributed, paired t-tests were conducted, which showed no statistically significant differences for protein, carbohydrates, fibre, and sodium. However, there was a statistically significant difference between the CADET Diaries and the Weighed Food Diaries for combined fruit and vegetable intake, vegetable intake, fat calcium vitamin C and sugar. The CADET Diaries recorded higher fruit and vegetable intake and macronutrient intake values than the Weighed Food Diary. The CADET diary correlates well with the Weighed Food Diary for fruit, vegetables and combined fruit and vegetable intake. However, for the micronutrient intake it there was a poor correlation between the CADET Diary and the Weighed Food Diary.

INSERT TABLE 2

Agreement between the two methods

Figure 1 to 6 shows the Bland-Altman plot for the agreement between the CADET Diary and the Weighed Food Diary (WFD) for fruit intake, vegetable intake, total fruit and vegetable intake combined, total fat intake, energy intake (in kcal) and vitamin C. The shaded area on each figure represents the 95% limits of agreement. This area increases in size when the mean

difference between the methods increases. The large cluster on the scatter plots for fruit and vegetable intake represent the number of children who had no fruit or no vegetable intake. From the sample of 67 children 5 did not consume any vegetables and 14 did not consume any fruit.

INSERT FIGURES 1-6

The results of the Bland-Altman analyses for figures 4 to 9 are summarised in Table 3. The difference between the CADET Diary and Weighed Food Diary is relatively small for fruit (22g) and vegetable (32g) intake measured separately. However, when combined it does increase the mean difference between the two methods to 54g which is over half a portion. There is a mean difference of 191 kcal in the two methods for energy intake. The mean differences for fat intake and vitamin C were relatively small. The 95% limits of agreement were moderately wide for fruit and vegetable intake. The 95% limits of agreement for fat intake were much smaller at -63 g to 99 g. However, there was more variation in the 95% limits of agreement for energy intake from -1497 to 1881 kcal, and vitamin C intake -233 to 264 mg.

INSERT TABLE 3

Sub-analysis of fruit and vegetables – reviewing age/gender portion sizes

There were significant differences in the mean intake of fruit and vegetables between recordings taken with CADET and those with the Weighed Food Diary; to explore the possible causes for these results a sub-analysis assessing the mean differences for individual fruit and vegetable was conducted. From conducting this analysis it was evident that compared to the weighed food diary more fruit and vegetables were ticked on the CADET diaries. There were only 90 individual fruit and vegetable items listed in the food weighed diaries, whereas 215 items were ticked in the CADET diaries. This is a substantial difference. One of the primary reasons for this difference was parents listing combinations of fruit or vegetables in one weighed portion and ticking each item on the CADET diary, rather than selecting fruit salad, or mixed vegetables. From the 90 foods recorded in the weighed food diary these items were broken down into the list of fruit and vegetables (see Table 4). Paired t-tests were conducted to explore which particular fruit and vegetables were contributing to the significant differences between the two dietary measurements.

The results revealed small non-significant differences for apples (mean difference 9 g, 95%CI: -24, 6); bananas (mean difference -22 g, 95%CI: -30, 75); strawberries (mean difference 1 g, 95%CI: -76, 77); oranges and satsuma (mean difference 7 g, 95%CI: -60, 75); peaches, plums, nectarines and apricot (mean difference -3 g, 95%CI: -31, 24). Whilst for grapes the paired t-tests revealed there was no significant differences in portion sizes (mean difference 47 g, 95%CI: -24, 6). Melon and watermelon on the other hand did have a significant difference in the mean weight between the weighed food diary and the CADET diaries with a mean difference of 104 g (95%CI: 33, 175) - suggesting that the portion sizes for melon and watermelon might be reducing the accuracy of the CADET diary to measure fruit intake. For vegetables there was no significant differences between mean intake for carrots (mean difference 3 g, 95%CI: -26, 33), cucumber (mean difference -4 g 95%CI: -16, 8). However, there were significant differences between peas and sweetcorn (mean difference 23 g, 95%CI 10, 36) and broccoli, brussels sprouts and cabbage (mean difference 25 g, 95%CI: 18,33). Again the differences in these vegetable items might be reducing the accuracy of the CADET diary to measure vegetable intake.

It was noted that melon and watermelon, peas and sweetcorn, broccoli, brussels sprouts and cabbage were all consumed both at home and at school. To explore how these items were affecting the mean differences they were removed from the analysis and paired t-tests were conducted again on combined fruit and vegetable intake. These results revealed that after removing the above mentioned items the mean difference between combined fruit and vegetable intake was only 4 g (95%CI: -5, 14).

INSERT TABLE 4

Discussion

The CADET is one of the few 24-hour measurement tools that can provide a reliable and valid nutrient analysis on children's diets. The simple tick box style of CADET is considered an appropriate tool for people with low literacy that struggle to record or weigh what they eat. CADET is aimed at capturing mean intake of a population as the instrument is not sensitive enough to identify individual differences in dietary patterns[15]. The primary aim of the CADET tool has been to measure fruit and vegetable intake in children, and this analysis has

demonstrated that for children aged 3-11 years old CADET is an effective method of capturing fruit and vegetable intake.

Fruit and vegetables intake combined

From the sample of 67 children 5 did not consume any vegetables and 14 did not consume any fruit. The mean daily intake in the CADET Diary was 253 g and in the Weighed Food Diary 119 g, with the CADET measuring similar intakes to the NDNS (2008/9 – 2010/11) of 2.8 portions for boys and 3 portions for girls[16]. The CADET Diary generally reported higher values than the Weighed Food Diary for mean fruit, vegetables and total fruit and vegetables consumption. The Bland-Altman plot showed that the mean difference for combined fruit intake was 53 g. Overall the Bland-Altman plots had fairly wide 95% limits of agreement. The mean difference in fruit and vegetable intake was larger for the age group 8-11 years than in the previous validation study which reported a difference of 42 g[8]. This indicates that the CADET diary overestimates intakes compared to the Weighed Food Diary, a common problem with tick list food frequency questionnaires. The correlation coefficients were strong for fruit and vegetable intake, all equalling 0.7 and were statistically significant. Compared to the previous validation of CADET[8], overall the results from this study have slightly higher r correlations for combined fruit and vegetable intake, and vegetables and fruit intake measured separately. As the tool is often used in trials that have a primary outcome of fruit and vegetable intake, these results indicate that it is a valid method for measuring fruit and vegetable intake, one of the fundamental aims of the questionnaire. This suggests that the CADET tool is suitable to measure children's fruit and vegetable intake.

Sub-analysis exploring portions sizes for fruit and vegetables

The additional analysis exploring individual fruit and vegetables revealed that the portion sizes for peas and sweetcorn, broccoli and other green vegetables, and in particular melon and watermelon showed significantly differences between the two methods. None of the children actually consumed watermelon, which might be affecting the portion size of other melon intake such as honeydew melon. Whilst there was a significant difference in peas, sweetcorn and broccoli intake, children's portions sizes do vary for these types of vegetables, more so than consuming a piece of fruit such as an apple. These differences in consumption patterns reduce the chances of accurately measuring intake in these items. Nevertheless unlike melon which was found to have a mean difference in intake of 104 grams between the dietary methods, the difference in vegetable intake (peas sweetcorn and broccoli) was only 23 to 25

grams, which is a considerably smaller difference. Further work should be conducted to reduce the error in this reporting method by modifying the CADET portions slightly for these commonly consumed fruits and vegetables. Of course a limitation of this analysis is it is only using small frequency of consumption per fruit or vegetables, however, these numbers are similar to those used in the NDNS data.

Nutrients

The comparison between the CADET Diary and the Weighed Food Diary for nutrient intakes shows a similar trend. The CADET diary had higher mean intakes for every nutrient (kcal, protein, carbohydrate, fat fibre, calcium total sugar and sodium) compared to the weighed intake, apart from vitamin C intake, with correlation results of 0.2 to 0.6, equivalent to other food frequency recall questionnaires[1, 8]. There were however three nutrients that did have statistically significant results for the correlations; these were kcal, protein and fibre. The Bland-Altman plots showed that the mean difference for kcal, vitamin C and total fat were small with reasonably small 95% limits of agreement, demonstrating that the CADET diary can provide valid nutrient data for the whole diet.

Validity of tick list questionnaires to assessment of children's dietary intake

The use of portion size data provided by the NDNS[16] enabled the CADET diary algorithms to be adjusted so it was suitable for older children in this study. NDNS portions sizes are based on a representative sample from the UK. However, with such a vast amount of nutrient data from the different foods in the CADET it meant using portion sizes based on relatively small samples for each food. CADET does, however, provide good estimation for combined fruit and vegetable intake, the primary outcome of these two RHS trials. This is due to assigning age and gender portion sizes for all foods and drinks. Another limitation is using a one day tick list to measure intake which is unlikely to reflect true long term intake. Since the sample size for this study was small with only 67 children, and likely to be underpowered for certain comparisons, as according to best-practice recommendations, a sample size of 100 is sufficient to assess the validity of a dietary assessment method[17]. Undertaking a one day weighed diary alongside the CADET diary can be time consuming, and this may have reduced our potential sample size and the generalisability of these validation study results. Furthermore, this study was done as an addition to evaluating the two RHS trials, impacting on time and funding dedicated to this analysis.

Nevertheless, the CADET diary does avoid the issues with child self-reported food intake, and is less of a burden on the participants than the most commonly used alternative, a weighed 4 day food diary[18]. Also, academic research suggests that a one day food frequency questionnaire can be as useful as a multiple day food diary[19]. Furthermore, the CADET has been used in large intervention trials where measuring food intake is a difficult task in terms of time, funding and resources[20]. The sub-analysis which explores individual items on the CADET also revealed that parents ticked more items on the CADET diary than they entered in the weighed food diary. This could be partly due to combining mixed vegetables or fruit salad being recorded as one item in the weighed food dairy, but as separate items in the CADET diary. It also supports the contention that completing a food frequency questionnaire is easier therefore more items are recorded. With the additional development of the DVD to help explain how to complete the CADET to parents, CADET is one of the few diary assessment tools that can be quickly implemented by non-professionals.

Conclusion

The results from this validation study concluded that the CADET diary is a valuable nutritional epidemiological tool for measuring children's diets from age 3 to 11 years. It is easy to implement in large studies, and only requires a basic level of literacy to complete. Whilst it does tend to overestimate children's intake, this is a limitation of all tick list food based questionnaires. The modest differences between the two methods indicate it is possible to use the CADET diary for any primary school children up to 11 years old.

Trial registration

ISRCTN11396528

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Department of Health disclaimer

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Ethics Approval

Ethical approval was obtained through the Leeds Institute of Health Sciences and Leeds Institute of Genetics, Health and Therapeutic joint ethics committee (Reference number: 09/012).

Contributors

MSC managed the project, the statistical analysis the data and wrote the initial draft of the manuscript. JEC secured funding and was guarantor of the project. Both JEC and CELE supervised the project, the interpretation of the data and the preparation of the manuscript. CN was the research assistant for the project. NH was the database manager for the project. All authors contributed to the final version of the paper.

Trial Steering Committee

The chairperson was Dr Cindy Cooper (Director, Sheffield Clinical Trials Research Unit Senior Research Fellow University of Sheffield). Graeme Slate (Learning Mentor – Forster Park Primary School, London) and Deirdre Walton (RHS Regions Manager) were the independent members of the steering committee. The Trial Steering Committee also acted as the data monitoring committee.

Competing interests

None to declare.

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References

1. Cade J, Thompson, R. Development, validation and utilisation of food-frequency questionnaires-a review. Public Health Nutr. 2002;5:567-87.

2. Maynard M, Gunnell D, Emmett P, Frankel S, Davey Smith G, Maynard M, et al. Fruit, vegetables, and antioxidants in childhood and risk of adult cancer: the Boyd Orr cohort.[erratum appears in J Epidemiol Community Health. 2007 Mar;61(3):271]. J Epidemiol Community Health. 2003;57(3):218-25.

3. Livingstone M, Robson, PJ. Measurement of dietary intake in chidlren. . Proceedings of the Nutrition Society. 2000;59:279-93.

4. Baranowski T S-MB. Dietary and physical activity assessment in school-aged children: Measurement issues. Journal of School Health. 1991;61:195-7.

5. Murray DM, Phillips, G. A., Bimbaum, A. S., Lytle, L. A. Intraclass correlation for measures from a middle school nutrition intervention study: estimates, correlates, and applications. Health Education & Behavior, 28, 666-79. 2001.

6. Frobisher, Maxwell. The estimation of food portions sizes: a comparison between using descriptions of portion sizes and a photographic food atlas by children and adults. Journal of Human Nutrition Diet. 2003;16:181-8.

7. Johnson B, Hackett, A. F. Trends in fruit, vegetable and salad intakes in 9-10-year-old schoolchildren living in Liverpool. Public Health Nutr. 2006;10(3):252-5.

8. Cade JE, Frear L, Greenwood DC. Assessment of diet in young children with an emphasis on fruit and vegetable intake: using CADET--Child and Diet Evaluation Tool. Public Health Nutr. 2006;9(4):501-8.

9. Wenlock R, Farron M. Report of the Diet and Nutrition Survey vol. 1, National Diet and Nutrition Survey: Young People Aged 4 to 18 Years. The London Stationery Office, 2000.

10. Nelson M, et al. Low income diet and nutrition survey. 2007.

11. Molag ML, et al. Design characteristics of food frequency questionnaires in relation to their validity. Am J Epidemiol. 2007;166(12):1468-78.

12. Holland B, Welch, A., et al. . McCance and Widdowson's The composition of foods. Cambridge, Royal Society of Chemistry.2002.

13. StataCorp. Statistical software 11 ed. College Station: Stata Corporation; 2005.

14. Bland J, Altman, DG Statistical methods for assessing agreement between two methods of clinical measurement. The Lancet 1986;8:1(8476):307-10.

15. Christian MS EC, Ransley, JK, Greenwood DC, Thomas, JD, Cade, JE Process evaluation of a cluster randomised controlled trial of a school-based fruit and vegetable intervention: Project Tomato. Public Health Nutr. 2011;15(03):459-65.
16. Health Do. National Diet and Nutrition Survey: Headline results from Years 1 and 2 (combined) of the rolling programme 2008/9 - 2009/10. London: 2011.
17. Serra-Majem L. Evaluating the quality of dietary intake validation studies. Br J Nutr. 2009:102 S3-9.
18. Hackett A, Gibbon, M., Sratton, G. and Hamill, L. . Dietary intake of 9-10-year-old and 11-12-year-old children in Liverpool. Public Health Nutr. 2002;5:449-56.
19. Rockett HR BM, Frazier AL, Witschi J, Wolf AM, Field AE, et al. . Validation of a youth/adolescent food frequency questionnaire. Prev Med. 1997;26:808-16.
20. Evans CE, Christian MS, Cleghorn CL, Greenwood DC, Cade JE. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. The American Journal of Clinical Nutrition. 2012;96(4):889-901.

Table 1 The number of children from each year group

Year	Number of children (%)
3 (age 8)	18 (27)
4 (age 9)	15 (22)
5 (age 10)	22 (33)
6 (age 11)	12 (18)

Table 2 CADET Diary vs. weighted food diary (n=56)

	School & Home Food Diaries		Weighed Food Diary		Difference CADET –Weighed Food Diary			Difference (P-value)	Correlation coefficient between CADET and weighed food diary		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**95% CI**		**R**	**95% CI**	**P-value**
Fruit (g)	**169**	166.9	**148**	145.1	**21**	116.9	-10, 54	0.6	**0.7**	0.5, 0.8	<0.001
Vegetables (g)	**83**	85.8	**51**	61.7	**32**	61.3	15, 49	0.001	**0.7**	0.5, 0.8	<0.001
Fruit & Vegetables (g)	**253**	202.5	**119**	161.9	**53**	19.5	14, 93	0.008	**0.7**	0.5, 0.8	<0.001
Energy (kcal)	**2001**	651.1	**1773**	809.7	**228**	914.4	-6, 462	0.06	**0.2**	-0.2, 0.4	0.07
Protein (g)	**6**	29.3	**62**	28.6	**5**	35.7	-3, 14	0.2	**0.2**	-0.1, 0.4	0.06
Carbohydrate (g)	**267**	79.6	**240**	134.4	**27**	134.7	-7, 61	0.1	**0.3**	0.1, 0.5	0.02
Fat (g)	**80**	37.0	**63**	31.8	**17**	41.1	6, 27	0.001	**0.3**	0.1, 0.5	0.02
Fibre, Englyst (g)	**12**	4.9	**11**	9.7	**1**	10.2	-1, 4	0.3	**0.3**	-0.1, 0.4	0.2
Calcium (mg)	**890**	374.6	**704**	376.6	**185**	331.7	100, 270	0.001	**0.6**	0.4, 0.8	<0.001
Total sugar (g)	**136**	52.7	**108**	80.4	**28**	79.7	8, 49	0.006	**0.3**	0.1, 0.5	0.007
Sodium (µg)	**2632**	1173.9	**2480**	1340.2	**151**	1546.6	-244, 548	0.4	**0.2**	-0.0, 0.5	0.05
Vitamin C (mg)*	**97**	91	**65**	89	**-27**	375.5	-123, 69	0.003	**0.4**	0.2, 0.6	<0.001

*Median and Interquartile range presented. Differences tested using the Wilcoxon signed rank

Table 3 Results of the Bland Altman analyses comparing the agreement between CADET and the Weighed Food Diary.

Food & Nutrients	Mean difference	Lower limit	Upper limit
Fruit intake (g)	22	-207	250
Vegetable intake (g)	32	-88	152
Total fruit and vegetable intake (g)	54	-226	333
Energy intake (kcal)	191	-1497	1881
Fat intake (g)	18	-63	99
Exponential of log Vitamin C intake(mg)	15	-233	264

Table 4 CADET Diary vs. Weighed food diary by fruit and vegetables

		School & Home Food Diaries		Weighed Food Diary		CADET –Weighed Food Diary			
	Frequency of consumption	Mean	SD	Mean	SD	Mean	SD	95% CI	Diff (P_{value})
Apples	11	**116**	10	**107**	17	**9**	22	-24, 6	0.2
Banana	7	**127**	44	**150**	29	**-22**	57	-30, 75	0.3
Grapes	4	**109**	47	**62**	49	**47**	49	-17, 141	0.2
Strawberries	4	**107**	15	**106**	50	**1**	48	-76, 77	0.9
Melon, watermelon	4	**193**	30	**88**	44	**104**	44	33, 175	0.01
Oranges, satsuma	6	**127**	17	**120**	73	**7**	64	-60, 75	0.8
Peaches, Plums, nectarines, apricot	8	**81**	9	**84**	31	**-3**	33	-31, 24	0.8
Carrots	5	**50**	8	**47**	18	**3**	24	-26, 33	0.8
Peas, sweetcorn	4	**54**	11	**30**	12	**23**	8	10, 36	0.001
Broccoli, brussels sprouts, cabbage	11	**57**	6	**31**	10	**25**	11	18, 33	<0.001
Cucumber	10	**28**	5	**32**	13	**-4**	17	-16, 8	0.5
Refined fruit & vegetables combined	66	**86**	42	**81**	51	**4**	39	-5, 14	0.4

Figure 1 Differences between CADET Diary and Weighed Food Diary mean fruit intake (g). Shaded area represents 95% limits of agreement

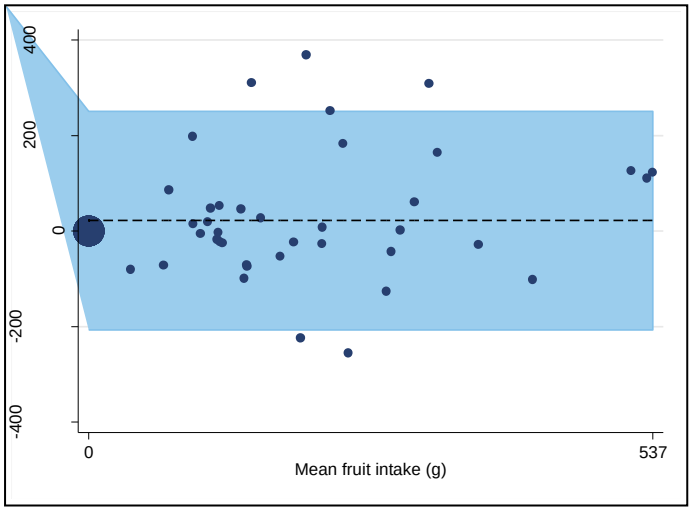

Figure 2 Differences between CADET Diary and Weighed Food Diary mean vegetable intake (g). Shaded area represents 95% limits of agreement

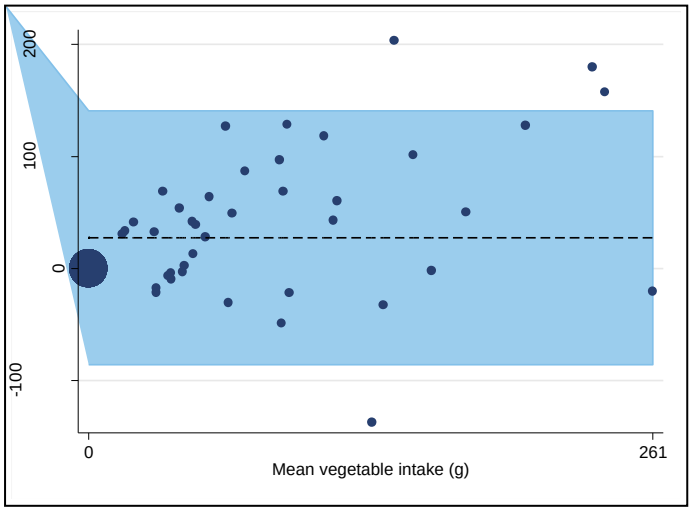

Figure 3 Differences between CADET Diary and Weighed Food Diary mean total fruit and vegetable intake (g). Shaded area represents 95% limits of agreement

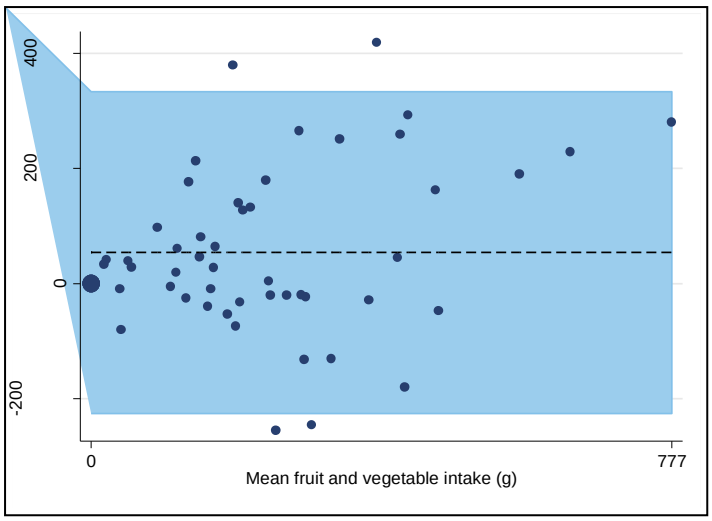

Figure 4 Differences between CADET Diary and Weighed Food Diary mean energy intake (kcal). Shaded area represents 95% limits of agreement

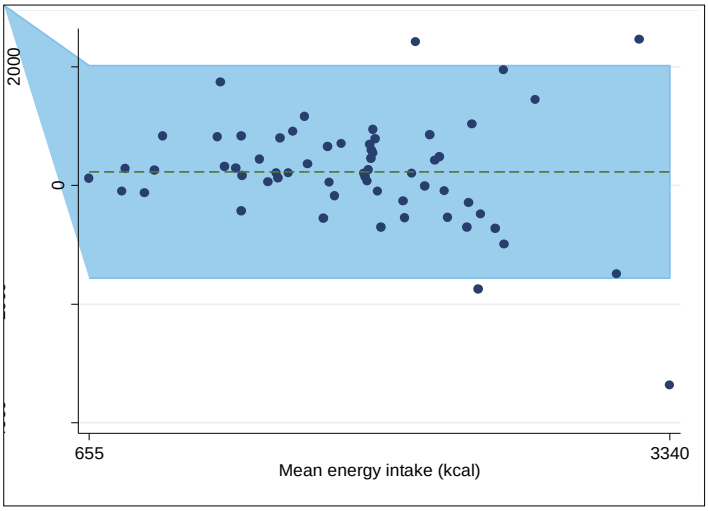

Figure 5 Differences between CADET Diary and Weighed Food Diary mean fat intake (g). Shaded area represents 95% limits of agreement

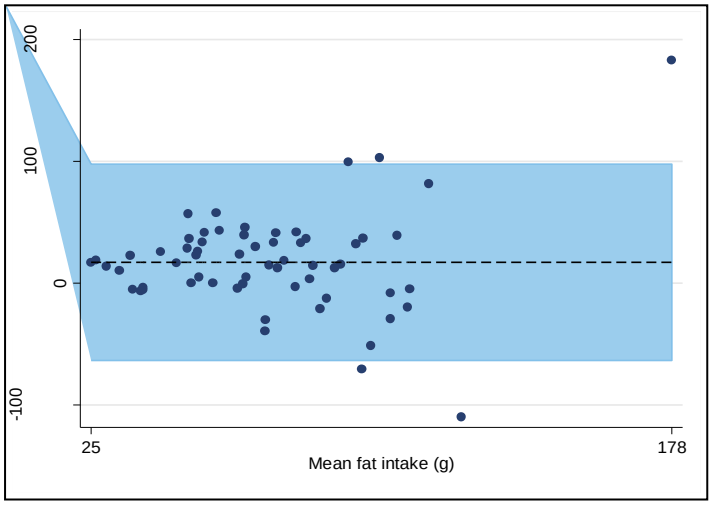

Figure 6 Differences between CADET Diary and Weighed Food Diary exponential of the log of vitamin C intake (mg). Shade area represents 95% limits of agreement