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# Reporting children's food consumption: a comparison of reliability between a 2-day food record and a 7-day food diary

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## Abstract

**Background:** Monitoring eating behavior of children is critical to understanding risks for developing nutrition-related diseases in later life. While accurately assessing children's food intake is important, collecting reliable data about children's food intake remains challenging. Limited validated tools exist, and issues of dietary intake assessment such as recall accurateness, portion size estimation, and participant burden persist. In a previous study conducted in Switzerland, a 7-day food diary assessing eating behavior of school-aged children was developed and tested for reliability, showing high levels of agreement between parents and children. In this study, a shorter, 2-day food consumption record was developed and tested. The objective of this study was to compare the reliability of the two instruments, measuring the level of agreement between children and their parents when reporting a child's food consumption.

**Methods:** A cross-sectional study was conducted in Switzerland (April–June 2014) among 589 children and one of their parents, where 299 completed a 7-day diary and 290 completed a 2-day tick box record. Children and parents independently reported what the child ate at six eating occasions. To assess agreement, Cohen's Kappa, Kendall's tau-b and Spearman's non-parametric correlations were used. Lin's concordance correlation coefficient and corresponding 95% confidence interval was also computed.

**Results:** With the 2-day food record, Kendall's tau-b correlations ranged from 0.66 (whole grains) to 0.85 (proteins). Kappa values showed moderate to substantial agreement for all food categories, ranging from 0.47 for dairy products to 0.75 for fat meat and fast food. Agreement between child's and parent's reporting was similar for both genders. Large Kendall's tau-b and Spearman's correlations were found for almost all foods in all school grades.

**Conclusions:** The 2-day tick box food record showed a higher level of agreement between parents and children of all ages (7–14) and for both genders as compared to the 7-day food diary. Moreover, the 2-day food record tool simplifies data collection and data entry procedures, while providing reliable data about children's food intake. Thus, this instrument could be used to reliably collect food intake directly from children without parental involvement.

**Keywords:** Dietary records, Food diaries, Children, Eating behavior, Food consumption, Parent-child agreement

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## Background

Poor nutrition is a risk factor for overweight and obesity, cardiovascular disease, type 2 diabetes, some cancers and is associated with low productivity. In Switzerland, children do not adhere to the national nutrition guidelines of the Swiss Society for Nutrition [1–3]. As monitoring the eating behavior of children is critical to understand the risks for developing nutrition-related diseases in later life, accurately assessing children's food intake is both important and challenging. Limited validated instruments exist [4–6], and issues such as recall accuracy, portion size estimation, costs, and participant burden [4–7] impede measurement that is reliable and feasible.

In previous studies conducted in the Italian-speaking Canton of Switzerland, a 7-day food diary that assessed the eating behavior of school-aged children was developed [8] and tested for reliability [9]. This instrument required parents and children to each report everything the child ate for three main meals and three snack moments over the course of 7 days. As children in this population consume most meals at home in the presence of at least one parent [10], it was expected that parents would know what their child ate at most meals. The study showed that children were as reliable as their parents in reporting food consumption [9], but it also required considerable time for participants to complete [8]. Further, the manual coding of the food and the data entry process represented an enormous burden on the research team in terms of time and human resources.

In an effort to overcome the burden on participants and researchers while also improving reliability, a shorter 2-day food consumption record was developed and tested. As with the first instrument, the focus was food-based consumption and not portions or nutrients. It was different in that it required participants to tick boxes of foods consumed rather than manually writing items they ate. The new instrument was tested, and the reliability was compared to the reliability of the previous one. Agreement values for the 2-day food record and the 7-day food diary [9] were compared and are reported in this paper.

## Methods

### Study setting and sampling

This study was conducted according to the guidelines of the Declaration of Helsinki and was exempt from full ethics review by the Ethics Committee of Canton Ticino, in accordance with Swiss Human Subjects Law. Written informed consent was obtained from all the parents and children prior to data collection.

Child-parent dyads were recruited through a sample of 14 representative elementary and middle schools, selected by the governing body of schools. Each school was

randomly assigned one of the two food consumption records. Between April and June 2014, teachers invited a total of 1195 child-parent dyads from the selected schools to participate in the study. Of those, 299 completed a 7-day food diary and 290 completed a 2-day food record. The objective of this study was to compare the reliability of the two instruments, measuring the level of agreement between children and their parents when reporting the child's food consumption.

### Instruments and data collected

Parents completed a one-page survey where they reported the age and sex of themselves and their child and the child's grade at school, weight, and height. Each parent and child were asked to complete the child food consumption instrument independently of each other. The 2-day food record consisted of a list of 11 common food groups and six food consumption occasions (breakfast, morning snack, lunch, afternoon snack, dinner, after dinner snack). The 7-day food log required participants to write out what they ate (for example, lasagna, pizza, fruit, water) and is reported elsewhere [9]. The food groups were based on the Swiss food pyramid [3]. They included water, fruit, vegetables, starchy food, whole grains, dairy products, protein-rich foods, plant proteins, sweets and junk food, fat meat and fast food, and soft drinks. Examples of mixed foods and explanations of the food groups were presented (see Additional file 1: Figure S1 and Additional file 2: Figure S2).

The 2-day instrument required participants to indicate whether the child consumed a certain food or drink by ticking "YES" or "NO" at each food consumption occasion on two random days in a week that the family chose. Hence, some dyads completed it on consecutive days, other on nonconsecutive days, including weekdays and weekends. As the aim was not to assess quality of diet, the self-selection of reporting days did not affect the study aim. Parents were asked to only assist their children in understanding how to complete the food record and not in recalling what they ate. If participants did not remember or did not know what food was consumed, they were asked to write "I do not know".

### Statistical analysis

After excluding cases for incomplete data, the sample consisted of 264 child-parent pairs that completed the 7-day food diary [9] and of 267 child-parent pairs that completed the 2-day food record. Data were entered in an excel database and coded as dichotomous variables for each day and meal (0 = food not consumed and 1 = food consumed). Given the low number of "I do not know" responses (maximum of 14 parents for lunchtime on day 2), these were treated as missing. The total count and percentage of "I do not know" answers are shown in

Additional file 3: Table S1. The frequency of consumption was calculated by dividing the total count for each food category (max 2 days  $\times$  6 meals = 12) by the number of days the log was completed (max 2 days). As only logs with 2 days completed were analyzed, all total counts were divided by 2 (see Additional file 4: Table S2). Statistical analyses were conducted using IBM SPSS Statistics version 23.0 (IBM Inc., Armonk, USA).

As with the reliability study of the 7-day food log, associations between children's and parents' results were assessed using Kendall's tau-b and Spearman's non-parametric correlations [9]. Values between 0.10 and 0.29 indicated a small correlation, between 0.30 and 0.49 a medium correlation and between 0.50 and 1.00 a large correlation [11]. Cohen's Kappa values were assessed and the lower bound of the 95% confidence interval (CI) of Kappa was used to categorize agreement. The same categorization as in previous studies was applied: values below 0.20 indicate low agreement, between 0.21 and 0.45 indicate moderate agreement, between 0.46 and 0.75 show substantial agreement, and values above 0.75 indicate very good agreement [9, 12, 13]. Lin's concordance correlation coefficient and corresponding 95% CI was computed to assess agreement. This procedure was repeated after stratifying for the sex and school grade of the child. Finally, Kappa values and their corresponding 95% CI of the 2-day record were compared to those from the 7-day food diary [9].

## Results

Just over half of the children who completed the 2-day food record were female (54.3%) between 7 and 14 years of age (mean age = 10.2, SD = 2.1 years). Most of the children attended elementary school (66.8%). Parents were mainly women (84.5%) aged between 27 and 66 years (mean = 41.9, SD = 5.7 years).

Food consumption is shown in Additional file 4: Table S2. Kappa values and their corresponding 95% confidence interval for the 2-day food record and those for the 7-day food record for water, fruit, vegetables, starchy foods, whole grains, dairy products, legumes, tofu and quorn, and soft drinks are shown in Table 1.

Regarding the 2-day food record, Kendall's tau-b correlation coefficients ranged from 0.66 for whole grains to 0.85 for proteins (meat, fish, and eggs). Spearman's rank correlation coefficients ranged from 0.72 for whole grains to 0.90 for proteins, showing large correlations for all food categories. Lin's correlation coefficients ranged from 0.65 for whole grains to 0.90 for both water and proteins. Kappa values showed moderate to substantial agreement for all food categories, ranging from 0.47 for dairy products to 0.75 for fat meat and fast food. Water, vegetables, starchy foods, whole grains, dairy products, and sweets and junk food showed moderate

**Table 1** Agreement between children and parents using a 2-day food record and a 7-day food diary

Food item	2-day food record Kappa (95% CI)	7-day food diary [9] Kappa (95% CI)
Water	0.50 (0.42–0.58)	0.20 (0.15–0.25)
Fruits	0.60 (0.52–0.69)	0.19 (0.14–0.25)
Vegetables	0.51 (0.42–0.60)	0.25 (0.19–0.31)
Starchy foods	0.47 (0.39–0.55)	0.18 (0.13–0.23)
Whole grains	0.47 (0.38–0.56)	0.37 (0.20–0.54)
Dairy products	0.50 (0.42–0.58)	0.16 (0.11–0.21)
Legumes, tofu, quorn	0.60 (0.50–0.70)	0.59 (0.50–0.68)
Soft drinks	0.57 (0.49–0.65)	0.32 (0.26–0.38)

agreement. Fruits, proteins, legumes, tofu and quorn, fat meat and fast food, and soft drinks showed substantial agreement (see Table 2).

Agreement between child's and parent's reporting was similar for both genders. For boys, Kendall's tau-b coefficients ranged from 0.61 for starchy foods to 0.87 for proteins, showing high correlations for all food items. For girls, Kendall's tau-b correlations ranged from 0.65 for whole grain to 0.84 for fat meat and fast food, also showing high correlations for all food items. Kendall's tau-b correlations by grade at school ranged from 0.49 for whole grain (children in the first grade of elementary school) to 1.00 for fast food and fatty meat (children in the fourth grade of elementary school). Large correlations were found for almost all foods in all grades. The sole exception was whole grains among children in the first grade, which showed a medium correlation (Kendall's tau-b = 0.49).

## Discussion

The aim of this study was to compare the reliability of the 2-day food record that required ticking items consumed with the reliability of the 7-day log that required writing down foods consumed. As most meals, including lunches, were consumed at home in the presence of at least one parent [10], it was possible to analyze the level of agreement for all meals. This differs from other studies, where children ate mostly outside the home and parents were often unaware of the food consumed by their children [6, 7, 14, 15].

Results showed significant and high levels of agreement of the 2-day tick box instrument, compared to the 7-day food log used in this population and to other similar studies [9, 12, 16]. For instance, Kappa values for fruit were 0.60 in this study, versus 0.19, 0.27, and 0.12 in the test of the 7-day log [9], Thiagarajah et al. [12] and van de Gaar et al. [16] For soft drinks, the values were 0.57 for this study and 0.32, 0.38, and 0.19 for the other studies, respectively [9, 12, 16].

**Table 2** Association between food items recorded by children and by parents on 2 days

Food item	Kendall's tau-b	Spearman's coefficient	Kappa (95% CI)	Lin's coefficient (95% CI)
Water	0.78	0.89	0.50 (0.42–0.58)	0.90 (0.87–0.93)
Fruits	0.77	0.85	0.60 (0.52–0.68)	0.85 (0.81–0.89)
Vegetables	0.74	0.81	0.51 (0.42–0.60)	0.79 (0.73–0.84)
Starchy foods	0.69	0.77	0.47 (0.39–0.55)	0.77 (0.72–0.83)
Whole grains	0.66	0.72	0.47 (0.38–0.56)	0.65 (0.56–0.73)
Dairy products	0.76	0.85	0.50 (0.42–0.58)	0.85 (0.81–0.88)
Proteins (meat, fish, eggs)	0.85	0.90	0.68 (0.60–0.76)	0.90 (0.87–0.93)
Legumes, tofu, quorn	0.75	0.78	0.60 (0.50–0.70)	0.74 (0.68–0.81)
Sweets and junk food	0.71	0.80	0.47 (0.39–0.55)	0.82 (0.77–0.87)
Fat meat and fast food	0.78	0.79	0.75 (0.66–0.84)	0.88 (0.85–0.91)
Soft drinks	0.79	0.86	0.57 (0.49–0.65)	0.88 (0.85–0.91)

All values are significant at  $p < 0.01$

Consistent with the previous study in this Canton, no substantial differences were found between boys and girls [9]. When using the 2-day food record, no differences were found between school grades, contrary to the 7-day food diary where older children had higher agreement with their parents than younger children did [9]. This suggests that the 2-day food record is a reliable instrument to use with children in both elementary and middle school and that data may not need to be reported by or confirmed with parents. An added advantage is the reduced burden on respondents.

The high levels of agreement using the 2-day food record compared to the 7-day food diary can likely be explained by its simplified data collection. Children were asked to select from a list the foods they ate and on only 2 days, instead of writing down all foods consumed for seven consecutive days. Further, providing children with a visual cue (the list of food categories) might have increased recall accuracy.

Further, both food consumption assessment instruments could be easily adapted to other food cultures and countries by modifying the food categories to common foods or with the dietary guidelines in that country. However, the 2-day food record presents an advantage in terms of reduced burden on researchers for data coding and entry. Finally, for studies aiming to assess what foods children consume and that do not need information about nutrients or portion sizes, this 2-day food record could be used if reliability test showed similar results.

### Limitations

The direct comparison with the 7-day food diary is limited by the fact that the instruments differ both in length and in completing procedures. However, since the aim of both studies was to assess child-parent

agreement and that the two samples were selected from the same population and completed it during the same week, the comparison of agreement values is a valid approach to understand which instrument is more reliable and feasible for food-based reporting in real world settings.

A limitation, common to both studies, is that while all parents were asked to not assist their children in recalling or reporting what they ate, it is possible that parents helped their children complete the log. Further, Kappa values were used to compare studies. Using a different threshold could have resulted in slightly different values. However, as the lower bound of the CI were used, overestimation of results was likely avoided. Finally, as there is a lack of validated food consumption instruments in Switzerland, the 7-day food diary and the 2-day food record were also non-validated instruments.

### Conclusion

The 2-day food record showed higher agreement in the reporting of children's food intake compared to the 7-day food diary, suggesting that it could be used to collect reliable food intake information directly from children, for studies where nutrients and portions are not imperative. Both instruments could be used to record children's food consumption, but using the 2-day record resulted in higher agreement between parents and children and regardless of their gender and grade at school. Finally, the 2-day food record tool simplifies data collection and data entry procedures, while providing reliable data about children's food intake. Thus, the 2-day food record is recommended for monitoring children's food consumption, yet a further study with objective reporting (such as direct observation) is warranted.

## Additional files

**Additional file 1: Figure S1.** Example of the 2-day food record—front page (JPG 779 kb)

**Additional file 2: Figure S2.** Example of the 2-day food record—back page (JPG 742 kb)

**Additional file 3: Table S1.** Total count and percentage of “I do not know” answers by children and their parents (PDF 141 kb)

**Additional file 4: Table S2.** Consumption of foods stated by children and their parents (PDF 13 kb)

## Abbreviations

CI: Confidence interval; SD: Standard deviation

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## Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

## Authors' contributions

NR and SS formulated the research question and designed the study. NR carried out the study and analyzed the data. PMV helped in the data analysis. All authors wrote the article and approved the final manuscript.

## Ethics approval and consent to participate

This study was conducted according to the guidelines of the Declaration of Helsinki and was exempt from full ethics review by the Ethics Committee of Canton Ticino, in accordance with Swiss Human Subjects Law. Written informed consent was obtained from all the parents and children prior to data collection.

## Consent for publication

Not applicable.

## Competing interests

The authors declare that they have no competing interests.

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