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Original Article

Comparison of a short food-frequency questionnaire and derived indices with a seven-day diet record in Belgian and Italian children

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Summary

Objectives: To compare food group intakes and dietary indices estimated from a 14-item food frequency questionnaire (FFQ) with a seven day diet record.

Methods: 112 Belgian and 114 Italian children (11–12 years) completed the FFQ followed by a seven-day diary (FD) and a retest one week later. Dietary indices were calculated from the FFQ and the FD.

Results: Spearman's correlations between the FFQ items and the diary varied between –0.13 and 0.67. When comparing the FFQ with the FD an overestimation was found for most items. The Excess Index was significantly correlated with energy intake (respectively 0.35 and 0.25 for Belgian and Italian children); the Variety Index with fiber intake (0.26 for both) and Calcium intake (respectively 0.32 and 0.41); the Fiber Index with fiber intake (respectively 0.30 and 0.37) and the Calcium Index with Calcium intake (respectively 0.47 and 0.50).

Conclusion: When the FFQ is used for estimating consumption frequencies, overestimation must be considered. The ability to rank individuals varies considerably between food items. The Calcium index can be useful in situations requiring brief dietary instruments. The value of the other indices is lower although still associations in the expected directions were found.

Key words: Adolescents – Reliability – Validity – Dietary index – Food-frequency questionnaire.

The Health Behaviour in School-aged Children (HBSC) study is an international WHO collaborative survey on lifestyle factors, and health behaviour in young people[1] done in 41 countries and regions in 2005/2006 (www.hbsc.org). One of the topics of the HBSC-questionnaire is eating behaviour. A short study specific food frequency questionnaire (FFQ), focusing on the intake of a few indicators of the adolescents' diet, has been developed.[2, 3] The indicators that were identified for the 2001–2002 survey were important sources of dietary fibre and calcium and items typically of the youth food culture (e.g. soft drinks).[2, 3]

Human eating behaviour is, however, complex and focusing on single foods or nutrients does not provide a complete picture of the total diet. Hence several investigators developed global indices of food and nutrient intake that express several related aspects of dietary intake concurrently.[4] Important aspects of the total diet include variety and moderation.[5]

No single food contains all of the necessary nutrients and in order to have a balanced diet, variety (or diversity) of foods is recommended. Lack of dietary variety is a problem frequently investigated in developing countries but is also crucial in the evaluation of the diet of industrialized countries. Even though the importance of dietary diversity is well recognized[6–8], there are clear differences throughout the scientific literature in what dietary diversity is and how it should be measured. Usually dietary diversity is assessed by summing the number of foods across or within food groups. However, a variety of food and food group classification systems, different numbers of foods and food groups, and varying reference period lengths have been used.[9] Since there are no international rec-

ommendations on dietary diversity and the number and types of food groups suggested for different age groups, these decisions remain arbitrary.[9]

Moderation refers to the avoidance of excess, especially of those food components (e.g., fats, added sugars, alcohol, sodium) believed to be related to suboptimal health outcomes.[5] Excess may be due to several factors related to the Western lifestyle, for example the great availability of energy dense food items, the palatability and media promotion of these items, the supersized portions and increased sedentary behaviour.

Of all the indices available in the literature, none is appropriate for use with the HBSC data, as the number of food items in the HBSC FFQ is limited: four are mandatory for all countries participating in the study, 10 items are optional items, (countries can decide to add this package or not). Therefore several investigators, analyzing HBSC data of different countries, have developed their own general eating indices.[10–12] Nonetheless, no study has documented the value of these indices.

Several studies in the literature document the validity of food and food group consumption based on food frequency questions in adolescents[13–19]; most of these studies focused on fruit and vegetables. The validity of the HBSC FFQ has previously been investigated in Belgian-Flemish adolescents[2], however the HBSC-study is an international study and a test measure validated in one country may perform quite differently in other countries.[20]

The purpose of the present study was therefore to investigate the test-retest reliability and relative validity of this 14-item FFQ in Belgian and Italian school children as well as to examine how indices derived from this short FFQ compare to nutrient values obtained from a seven-day food diary (FD).

Methods

Subjects

A convenience sample of primary schools in the neighbourhood of the researchers' university were contacted to participate in the study. All pupils of the 6th grade were asked to participate. One hundred and twelve Belgian Flemish pupils (52 % boys; mean age 11.7 (SD = 0.6)) from 4 primary schools (6 classes) and 114 Italian pupils (36 % boys; mean age 11.6 (SD = 0.3)) from 3 primary schools (6 classes) were involved in the study.

Data from the FD's from 18 Belgian Flemish pupils were excluded for analyses because the pupils did not complete the diaries accurately (n = 6) or followed the Ramadan (n = 12) (food pattern and food consumption during Ramadan deviates substantially from usual food pattern/consumption).

Dietary assessment instruments

The pupils were asked to complete the 14-item HBSC FFQ twice and to fill out an estimated seven-day FD during seven consecutive days.

The FFQ asked about the consumption frequency of important sources of dietary fibre (fruit, vegetables, breakfast cereals (for example cornflakes, choco pops, muesli…), white bread, brown bread) and calcium ((semi-)skimmed milk, whole fat milk, cheese, other milk products (for example yogurt, quark, chocolate milk, pudding…)) and items typically of the youth food culture (crisps, chips, sweets or chocolates, carbonated sugared soft drinks and diet soft drinks). The response categories for each food item were: "never", "less than once a week", "once a week", "2–4 days/week", "5–6 days/week", "once a day, every day" and "every day, more than once".

For each day of the FD three pages were provided divided into six "eating occasions" (breakfast, midmorning snacks, lunch, afternoon snacks, dinner and evening snacks). Each eating occasion was further subdivided into food groups (e.g. for lunch: beverages, bread, sandwich filling, soup/starter, potatoes, vegetables, meat/fish/eggs, dessert and other) in which information on the type (including brand) and amount of food consumed was collected in two separate columns.

Procedure

After completion of the first FFQ, a dietician gave oral and written instructions on how to fill in the diary forms. The estimation of portion sizes in terms of household measures, pack sizes and units was given special attention. Children were encouraged to ask their parents for assistance in describing recipes of home cooked meals. For the first day, pupils were asked to recall all the foods and beverages they already had consumed that day, while the dietician went round the classroom, responding to requests for help in completing the FD.

The pupils' collaboration in completing the FD for the following six days was encouraged by a daily visit (with the exception of the weekend) of the dietician and a researcher in the classroom. At the same time, the FD's were checked for accuracy and completeness.

Data for the retest was collected seven days after the data collection of the first FFQ.

Data collection took place in 2004–2005.

Coding of dietary intake

In Belgium, a dietician coded the FD's by means of the software package developed by the Unilever Company in the Netherlands[21] and a standard manual on food portions and household measures.[22] In Italy a similar protocol was followed by a dietician who derived the food raw weights and

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codes from the Scotti-Bassani Institute Manual for Standardized quantification of Food Items.[23] The dietary intake (total energy, fat, carbohydrates, proteins, fiber, calcium, and vitamin C intake) was analyzed using the Belgian[24] and the Dutch Food Composition Tables[25] for the Flemish population. For the Italian population, dietary intake was computed using the food tables of the Italian National Institute of Nutrition[26] and the food tables of the European Oncologic Institute of Milan[27].

Food items were recoded into the food groups of the FFQ by day of the week and eating occasion. Composite dishes were disaggregated into their major food groups. Consumption frequencies (days/week) of the different food groups were calculated.

To further enable comparison of the FFQ with the FD, the FFQ response categories were recoded as follows: "never" = 0, "less than once a week" = 0.25 (reflecting a consumption frequency of once every four weeks), "once a week" = 1, "2–4 days a week" = 3 (midpoint of the interval), "5–6 days a week" = 5.5 (midpoint of the interval) and "once a day, every day" and "more than once a day, every day" = 7, representing the average weekly consumption frequency.

Construction of indices

A series of composite scores were computed from the FFQ as well as the FD. For this, the FFQ items were scored as above with the exception of "more than once a day, every day" which was recoded into 14, to keep the maximum of information from the original response options.

For the first score, the "fruit and vegetables (FV) index", the FFQ consumption frequencies of fruit and vegetables were summed. The second index, labeled hereafter as "Fiber Index", cumulated the consumption frequency of fruit, vegetables and brown bread. For the third index, the "Calcium-Index" (Ca-Index), we cumulated the FFQ consumption frequencies of whole fat milk, semi-skimmed milk, cheese and other milk products. In order to have a balanced diet, diversity or variety of items from different food groups is advocated. Hence also a "variety index" was composed by summing the consumption frequencies of fruits, vegetables, brown bread, whole fat milk, semi-skimmed milk, cheese and other milk products. The FFQ consumption frequency of carbonated sugared soft drinks, sweets, chips and crisps, 4 popular food items of low nutritional value were cumulated to form an "Excess Index". As crisps and chips are not part of the mandatory HBSC FFQ, also a "Short Excess Index", including only soft drinks and sweets, was computed.

The same indices were calculated for the FD, by summing the number of times the food items from the respective groups were consumed.

Analyses

To investigate the test-retest stability of the FFQ and of the composite scores, Spearman's correlation coefficients were computed between test and retest. To assess the agreement between the FFQ and the FD, Spearman's correlations and the Wilcoxon signed rank test were used. The ratio FFQ/FD was calculated for each of the food items to give an indication of the over- and underestimation of the FFQ in comparison with the FD.

To evaluate the performance of the composite scores, Spearman's correlation with energy and several nutrient intakes (% energy form Carbohydrates, Fat, and Proteins and Fiber, Vitamin C and Calcium intake) were computed.

Results

The average energy intake of the Belgian adolescents was 7653 (SD = 2238) kJ; the average energy intake of the Italian adolescents was 7220 (SD = 1777) kJ.

Test-retest stability correlations of the food items range from 0.38 to 0.79 for the Belgian sample and from 0.40 to 0.83 for the Italian sample, with an overall mean correlation of 0.65 for both samples (Table 1).

Table 2 presents the results of the comparison of the FFQ with the FD. Spearman's correlations between the FFQ and the FD vary between 0.16 for diet soft drinks and 0.69 for white bread for the Belgian adolescents and between –0.13 for diet soft drinks and 0.63 for breakfast cereals among Italian adolescents, with an overall mean correlation of respectively 0.43 and 0.33. Comparing the mean consumption frequency (days/

Table 1. Reproducibility of the food-frequency questionnaire among Belgian and Italian children: spearman's correlations between test and retest, 2004–2005.

	Belgium	Italy
Fruit	0.69	0.76
Vegetables	0.54	0.83
Sweets	0.79	0.70
Soft drink	0.75	0.54
Diet soft drink	0.79	0.53
(Semi-)Skimmed milk	0.68	0.65
Whole fat milk	0.59	0.67
Cheese	0.71	0.71
Other milk products	0.38	0.59
Breakfast cereals	0.70	0.73
White bread	0.49	0.40
Brown bread	0.70	0.72
Crisps	0.63	0.63
Chips	0.60	0.66

All correlations were significant at $p < 0.00$

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Table 2. Comparison of the food frequency questionnaire with a 7-day dietary record among Belgian and Italian children, 2004–2005.

	Belgium							Italy						
	FFQ Median	P25–P75	FD Median	P25–P75	rho	p^a	FFQ/FD	FFQ Median	P25-P75	FD Median	P25-P75	rho	p^a	FFQ/FD
Fruit	5.5	(3–7)	2	(1–4)	0.42***	***	1.8	5.5	(3–7)	4	(1–5)	0.42***	***	1.3
Vegetables[b]	7	(5.5–7)	5	(3–6)	0.16	***	1.1	3	(1–7)	3	(1–4)	0.49***	***	1.4
Sweets	3	(1–5.5)	1	(0–2)	0.35***	***	2.6	3	(1–5.5)	0	(0–1)	0.25**	***	4.2
Soft drink	3	(1–7)	3	(1–5.25)	0.52***		1.1	1	(0.25–3)	3	(1–5)	0.21*	***	0.7
Diet soft drink	0	(0.25–3)	0	(0–0)	0.16	***	5.0	0.25	(0–1)	0	(0–0)	–0.13	***	
(Semi-)Skimmed milk	5.5	(0.25–7)	2	(0–5)	0.58***	***	1.6	3	(0–7)	1	(0–5)	0.59***	***	1.5
Whole fat milk	0.25	(0–3)	0	(0–1)	0.40***	*	1.5	0	(0–5.5)	2	(0–5)	0.51***	**	0.8
Cheese	3	(1–5.5)	2.5	(1–4)	0.58***		1.0	3	(0.25–5.5)	1	(0–2)	0.41***	***	2.1
Other milk products	3	(3–5.5)	3.5	(1–5)	0.34***		1.1	1	(0.25–3)	0	(0–1)	0.33***	***	2.5
Breakfast cereals	3	(1–7)	1	(0–4)	0.59***	***	1.7	1	(0–5.5)	0	(0–2)	0.63***	***	2.0
White bread	3	(0.25–7)	2	(0–5)	0.69***	**	1.3	7	(3–7)	5	(3–6)	0.12	*	1.1
Brown bread	3	(1–7)	2	(0–4)	0.61***	***	1.5	0	(0–0.25)	0	(0–0)	0.21*	***	6.9
Crisps	1	(0.25–3)	0	(0–1)	0.27**	***	2.7	0.25	(0.25–1)	0	(0–0)	0.21*	***	5.2
Chips	1	(0.25–1)	1	(1–2)	0.31**	***	0.7	1	(0.25–3)	0	(0–1)	0.34***	***	2.3

[a] significance of the Wilcoxon signed rank test
[b] vegetables = excluding soup in the Flemish sample; excluding legumes and composite dishes in the Italian sample
* $p<0.05$; ** $p<0.01$; *** $p<0.001$

week) between FFQ and FD shows an overestimation in the food frequency questionnaire for all but four items among Belgian adolescents: the consumption of chips is underestimated, and no significant difference is found for soft drinks, cheese and other milk products. Among Italian adolescents, a significant underestimation is found in the food frequency questionnaire for soft drinks and whole fat milk and an overestimation for all other items.

Test-retest correlations of the different dietary scores vary between 0.52 and 0.85 for the Belgian children and between 0.62 and 0.81 for the Italian children (Tab. 3). Low correlations between the indices computed from the FFQ and the FD are found for the Fruit and vegetable score in the Belgian sample (0.28) and for the excess scores in the Italian sample (respectively 0.33 and 0.27 for the excess and short excess scores).

Worth mentioning are the significant positive correlations found in both samples between the Fiber Index and fiber intake (g and g/kJ), the Ca-Index and calcium intake (mg and mg/kJ), the Variety Index and fiber intake (g) as well as Ca intake (mg and mg/kJ) and between the Excess Indices and energy intake. In addition, a negative association is found between the excess indices and all the nutrients/kJ in the Belgian sample while only half of these correlations were significant in the Italian sample.

Discussion

In lifestyle surveys such as the HBSC study, in which the number of dietary questions needs to be limited due to space, time and budget limitations, only a brief dietary questionnaire assessing specific dietary behaviour is possible. Nonetheless, inclusion of dietary questions in a broad lifestyle survey is important as it offers the possibility to examine these behaviours in a broader context and to move beyond examining isolated risk behaviours.

In the present paper the reliability and relative validity of the 14-item HBSC FFQ is investigated among Belgian and Italian children. Additionally we investigated to what extent these single items could be combined into more global dietary quality indices.

Spearman's correlations measuring test-retest reliability of the FFQ items and the indices fell in or above the common range of correlation coefficients (0.5–0.7) reported between two administrations of an FFQ in the literature[28]; comparable results in adolescents have been found.[13, 29] Others have reported lower correlations in adolescent studies,[30–32] however test-retest intervals were longer in these studies.

In both samples the correlations measuring agreement in ranking subjects according to the FFQ and the FD's could be accepted as fair for fruit, milk ((semi-)skimmed, whole fat) cheese and breakfast cereals (>0.35) and rather low for chips, crisps, sweets and other milk products (0.21–0.34).

A non significant association was found for diet soft drinks in both samples and considerable differences between both countries were found for vegetables, soft drinks and bread. The correlations of bread were high in the Belgian sample (>0.60), whereas low correlations were found in the Italian sample (0.12 and 0.21 for respectively brown and white bread). However the consumption pattern of these items is also very different in both populations: the Italian population consumes mostly white bread, while in Belgium brown bread is as popular as white bread with some people eating usually brown bread, others preferring white and still others consuming half of the time white and half of the time brown bread.

The correlation for vegetables was much higher in Italy than in Belgium (0.49 versus 0.16). The low correlation for vegetables in Belgium was however unexpected as in the previous validation study in another Belgian sample[2]–of which the results are in general in line with current findings- a much higher correlation was found (0.48).

A possible explanation for the low correlation for soft drinks in the Italian sample, might be that they forgot to mention whether the soft drinks they drank were sugared or diet which could also explain the underestimation of sugared soft drinks in the FFQ in comparison with the FD and the lack of the consumption of diet soft drinks in the FD's.

In general, comparable correlations have been found by others investigating the validity of the consumption frequency of food items among children and adolescents.[14, 16–19]

Comparison of our FFQ with the FD shows in general an overestimation for both healthy and less healthy items. Overestimation has also been observed in other studies assessing intake of fruit and vegetables in children and adolescents.[13, 14, 19, 30, 33] In a study of Field et al.[18] FFQs underestimated the consumption of fruit and vegetable among high school students. In the study of Frank et al.[34] among 15–17 year old females, the FFQ reflected in general a less frequent consumption of many types of food relative to 24-hour recalls. In the study of Cavadini et al.[15] no general pattern of over or underestimation was found for the 19 different food groups.

According to Baranowski and Domel[35], overestimation in young children is likely a retrieval problem; that is, in reconstructing their food intake children infer that they ate commonly consumed foods more often than they did.

Another explanation for some of the overestimation might well be an underreporting in the diaries: the average energy intake (Belgian: 7653 kJ; Italian: 7220 kJ) was considerably below the reference for this age group (boys: 9211 kJ; girls:

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Table 3. Reproducibility of the indices and comparison with indices and nutrient values obtained from the reference method, 2004–2005.

	Belgium						Italy					
	FV-Index	Fiber Index	Ca-Index	Variety Index	Excess Index	Short Excess Index	FV-Index	Fiber Index	Ca-Index	Variety Index	Excess Index	Short Excess Index
Index calculated from FFQ												
Median	11.0	14.3	10.0	26.3	7.8	6.0	10.0	11.5	10.3	21.3	7.5	4.0
P25-P75	(7.3–14.4)	(9.5–21.8)	(7.3–17)	(17.5–38)	(2.5–14.4)	(1.3–10)	(6–17)	(6–20)	(7.3–16.2)	(15.8–32.5)	(5.3–13)	(1.3–7.3)
Min-Max	(0.5–28)	(0.8–42)	(0.5–56)	(2–98)	(0.3–36)	(0–28)	(0–28)	(0–33.5)	(0–45)	(3.8–76)	(1.3–43)	(0–28)
Test retest correlations FFQ index												
	0.52* **	**0.68*** **	**0.66*** **	**0.71*** **	**0.85*** **	**0.82*** **	**0.80*** **	**0.81*** **	**0.62*** **	**0.72*** **	**0.71*** **	**0.69*** **
Index calculated from FD												
Median	8.0	12.0	12.0	24.0	7.0	5.0	7.0	7.0	7.0	16.0	13.0	12.0
P25-P75	(6–11.3)	(8–16)	(8–15.3)	(17.8–30)	(4–12)	(2–9.3)	(5–12)	(5–12)	(5–10)	(10–20)	(9–17)	(8–17)
Min-Max	(0–21)	(0–27)	(0–27)	(6–53)	(0–33)	(0–31)	(0–24)	(0–25)	(0–19)	(0–36)	(1–39)	(1–35)
Correlations between FFQ and FD indices												
	0.28**	**0.43*** **	**0.48*** **	**0.43*** **	**0.56*** **	**0.53*** **	**0.52*** **	**0.48*** **	**0.53*** **	**0.48*** **	**0.33****	**0.27****
Correlations FFQ indices with nutrient intake of FD												
KJ	0.07	0.06	**0.24***	0.15	**0.35*** **	**0.35*** **	0.22*	0.23*	**0.39*** **	0.34***	**0.25****	**0.19***
%E from Carbohydrates	0.01	–0.06	0.09	0.02	0.15	0.16	0.03	0.03	–0.19	–0.11	–0.15	–0.17
%E from Lipids	–0.01	0.01	–0.02	–0.03	0.06	0.02	–0.04	–0.04	0.21*	0.12	0.22*	0.21*
%E from Proteins	–0.05	0.04	–0.14	–0.03	–0.45***	–0.40***	–0.06	–0.10	0.11	0.01	–0.14	–0.08
Fiber	0.16	**0.31****	0.20	**0.26***	–0.03	–0.04	0.37***	**0.37*** **	0.14	**0.26****	–0.03	–0.06
Fiber/kJ	0.14	**0.31****	0.01	0.20	**–0.38*** **	**–0.37*** **	0.23*	**0.19***	–0.18	–0.01	**–0.26****	**–0.24***
Vitamine C	0.06	0.09	–0.09	–0.01	–0.16	–0.13	0.34***	0.31***	0.06	0.25**	–0.16	–0.10
Vitamine C/kJ	0.05	0.08	–0.22*	–0.07	**–0.35*** **	–0.32**	0.26**	0.23*	–0.05	0.14	**–0.26****	–0.17
Calcium	0.10	0.12	**0.47*** **	**0.32****	0.06	0.06	0.19*	0.20*	**0.50*** **	**0.41*** **	0.05	0.11
Calcium/kJ	0.12	0.11	**0.35*** **	**0.28****	–0.23*	–0.23*	0.07	0.07	**0.33*** **	**0.25****	–0.09	0.02

* $p<0.05$; ** $p<0.01$; *** $p<0.001$
In **bold** correlations that are significant in both samples

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8164 kJ).[36] Major strengths of the food dietary method are that they do not rely on memory and an unlimited level of specificity regarding the description of foods and amounts is possible.[37] However, at the daily visit of the dietician she often noticed a lack of adequate description, and some had even still to complete their diary since her last visit. In addition to simplify the food record subjects can eat less frequently and reduce the number of foods.

The four-item Ca-Index performs well in ranking subjects according to calcium intake in both study populations in comparison to other larger questionnaires that were designed specifically to measure calcium intake in adolescents. Barr[38] reported a Spearman's correlation of 0.59 between their 23-item FFQ and a one-day record among Canadian High school students; in the study of Jensen et al[39] Spearman's correlations between an 80-item FFQ and two 24-hour recalls of 10–18 years old were as follows: for Asian 0.53, Hispanic 0.21 and White 0.43; in the study of Harnack et al[40] a correlation between a ten-item FFQ and three recalls was 0.43.

The correlations of the other indices with the nutrient intake were less strong, but still significant correlations in the expected directions were found. In both samples, a higher Fiber Index was associated with a higher fiber intake; a higher Excess Index was associated with a higher caloric intake. Other associations were however only significant in one sample, worth mentioning are for example the negative associations of the excess scores in the Belgian sample with Fiber/kJ, Ca/kJand Vitamin C/kJ, indicating a lower nutrient density in this population, while this was much less pronounced in the Italian sample. The Fruit and vegetables score on the other hand, seems to be only of value in the Italian sample.

Several limitations of the study should be noted. Generally we could have expected low correlation coefficients with the energy and nutrient intake as the questionnaire was not designed to assess energy or nutrient intake. Only a limited number of food items were available in the questionnaire and only for calcium the main sources were covered. Additionally we did not ask about quantity consumed, whereas for example all foods (even small amounts of sugared soft drinks and sweets) can fit into a healthy diet as long as they are consumed in moderation.

A seven day diet record was chosen as reference method based on the assumption that this is a valid measure of habitual food intake. However, because of day-to-day variability in an individual's intake, a 7 day diet record does not seem to assess the usual intake with the accuracy commonly assumed.[41] Especially in children and adolescents the ratio of within-between subject variances seems to be larger requiring more days to rank subjects correctly. The latter does however not say that it has no value.[41, 42]

For logistical and practical reasons, seven consecutive days were chosen. Non-consecutive days of dietary record might be more independent and cause less respondent fatigue,[37, 42] but might result more in forgetfulness and drop out.

The seven day diet record (the validation standard) followed the questionnaire, whereas congruence typically enhances the level of agreement. However completing a seven day diet record first, may draw the children's attention too much to their food intake and consequently influence how the questionnaire would be completed.[28]

For practical reasons, the retest was done after completing the seven days of dietary record. For the above mentioned reason, it would have been methodologically more correct to collect the retest data before the validation standard.

In validation studies, the errors associated with the test method and reference method should be independent.[28] Both methods were however from self report data of the children, and thus might suffer from errors inherent to self reports (e.g. social desirability). In addition the FFQ is a recall method and hence depends on memory. The FD is not supposed to depend on memory. However, many children did not fill in the dietary records on an hour to hour basis and in this regard the FD also act more as a recall method.

The food records were often not filled in with the accuracy required. The latter calls into question the feasibility of using intrusive and burdensome methods such as dietary records. Therefore for future studies in this age group precoded record instruments might be more adequate: in this way the data is directly at the requested level of detail (for amounts and food items) and at a similar level of detail for all respondents. Accuracy and standardization can even be improved by the use of computer technology. Moreover the latter will make it more attractive for – and enhance the motivation and compliance of – children and adolescents who are brought up with multimedia. Finally, this study included only two countries while currently more than 40 countries are involved in the HBSC study.

The results in both samples are in general in line with each other. The HBSC FFQ and the derived indices have an acceptable reliability. When the FFQ is used for estimating consumption frequencies, overestimation must be considered. The ability to rank individuals on the FFQ items in comparison with a FD varies considerably between food items. The indices and especially the Ca-Index may be useful in situations requiring brief dietary instruments for ranking adolescents. The value of the Variety, Fiber and Excess Indices seem to be low but still significant. The Fruit and vegetable index seems to perform well in the Italian sample but not in the Flemish sample. The excess index performs better in the Belgian sample.

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