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Original article

# CoCu: A new short questionnaire to evaluate diet composition and culture of eating in children and adolescents

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SUMMARY

*Background & aims:* The aim of this project was to develop and validate a short questionnaire (titled CoCu – Composition and Culture of Eating) for assessing the composition of the diets of children and adolescents, and their culture of eating. We also investigated whether what and how children eat is associated with their age, gender, and social background.
*Methods:* The "diet composition" part of the developed questionnaire contains 14 questions about the number of portions of different food products the subject child eats per week or per day. The selection of food products was based on food groups assessed in a Food Frequency Questionnaire (FFQ). The "culture of eating" part asks five questions about how children eat (e.g., number of meals, frequency of shared dinners). A total of 1604 questionnaires were completed within the framework of the LIFE Child study in Leipzig, Germany, with 741 questionnaires regarding a child aged between 10 and 19 (self reporting) and 863 regarding a child aged between 2 and 9 (parent reporting). In a subsample (n = 212 for the parent-report group and 188 for the self-report group), retest reliability was assessed by correlating answers given at two consecutive study visits (one year apart). In another subsample of the self-report group (n = 105), the validity of the questionnaire was assessed by comparing answers in CoCu with answers in the FFQ. Multiple regression analysis was used to assess whether aspects of diet composition and the culture of eating were associated with child age, gender, and social background.
*Results:* The analyses revealed significant positive correlations between responses given at two consecutive study visits as well as significant positive correlations between the CoCu data and the FFQ. Furthermore, both the composition of the children's diets and their eating culture were found to vary significantly depending on child age, gender, and social background.
*Conclusions:* The proposed short nutrition questionnaire represents a useful, inexpensive, and time-efficient tool for surveying the diets of children and adolescents.


## 1. Introduction

A healthy diet (e.g., balanced nutrition, moderate consumption of sugary and fatty foods, high consumption of fruits and vegetables) is one of the prerequisites for healthy development and has been related to higher quality of life and improved mental health in children and adolescents [1,2]. An unhealthy diet, in contrast, increases the risk of developing diseases, e.g., adiposity, cardiovascular diseases, or diabetes [3–8].

As has been shown in several studies, the nutrition of children is linked to socio–demographic parameters such as age, gender, and socio-economic background [9–13]. Younger children have been reported as having a healthier diet than older children [9–11] and girls have been found to have a healthier diet than boys [10,11]. With respect to social background, previous studies have suggested associations between a higher socio-economic status (SES) and a

*Abbreviations:* SES, Socio-economic status; FFQ, Food Frequency Questionnaire.
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healthier diet [10–13]. Another feature that is related to what children eat is how they eat (i.e., eating culture). For example, the composition of children's diets has been shown to be affected by a tendency to watch television while eating [14–16], by skipping meals [17], and by the frequency of shared family dinners [16,18,19]. In addition, the way children eat, i.e., their eating culture, has been related to more general health outcomes, especially weight [15,20,21].

Because of the importance of nutrition, many large (epidemiological) studies on the development of children and adolescents include an evaluation of what children eat. In most of these studies, diet is examined via questionnaires assessing how often and in which portion sizes children consume specific food products (so called food frequency questionnaires (FFQ)). These questionnaires are suitable for ranking subjects according to their general and specific calorie consumption and their intake of nutrients (carbohydrates, protein, fat) [22]. However, they do not enable an adequate estimation of actual intake [22]. Furthermore, they usually contain no items on eating culture. Additionally, the completion of FFQs is time-consuming, and the analysis is challenging. Therefore, short questionnaires or screening instruments may represent a good alternative to FFQs, especially if the aim of a survey is to gain an overview on children's nutrition and/or if temporal resources are limited.

The aim of the present project was to establish a short questionnaire on nutrition among children that could serve as a screening instrument in large (epidemiological) studies as well as in clinical practice, and provide an estimation of the general healthiness and balance of children's diets. We were also interested in developing a questionnaire that would not only include questions about what children eat (diet composition), but also questions about how they eat (culture of eating). The instrument created, which we have titled CoCu (Composition and Culture of Eating) is presented in this paper. Having validated the retest reliability and concurrent validity of the questionnaire, we analyzed the data for possible associations between healthiness of diet or aspects of eating culture and various socio–demographic parameters.

## 2. Material & methods

### 2.1. Study participants and design

The data analyzed in the present project were collected between May 2016 and August 2017 as part of the LIFE Child study, a longitudinal study aimed at investigating normal child development and the development of civilization diseases [23,24]. The LIFE Child study was designed in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Leipzig (Reg. No. 264-10-19042010). Informed written consent was obtained from all parents prior to the inclusion of their children in the study. For participants aged 12 and upwards, written consent was also obtained from the child itself.

The parent-report version of CoCu was completed by parents of 863 children (52% boys, mean age = 5.56 years, range = 2.00–9.99). The self-report version was completed by 741 children (53% boys, mean age = 13.79 years, range = 10.00–19.93). Table 1 displays the distribution of age and gender in the different samples.

For the assessment of SES, parents of the study participants provided information on their education, their occupational position, and their family net income. Based on this information, a SES composite score (the so-called Winkler index) was derived [25,26]. This score ranged between 3 and 21, with a higher score indicating higher SES. As proposed by the developers of the Winkler index, scores between 3 and 8.4 indicated a low SES, scores between 8.5 and 15.4 a middle SES, and scores between 15.5 and 21 a high SES [26]. In a representative sample, 60% of participants would be expected to have a middle SES, 20% a lower SES, and another 20% a higher SES [26]. In the parent-report sample, 7% of children were assigned to the lower SES group, 56% to the middle SES group, and 37% to the higher SES group. In the self-report sample, 10% of participants were categorized as having a low SES, 60% as having a middle SES, and 30% as having a high SES.

**Table 1**
Characteristics of the study population.

| | N | Mean age (range) | Gender |
|---|---|---|---|
| **Parent-report questionnaire** | | | |
| Total | 863 | 5.56 (2.00–9.99) | 452 male, 411 female |
| 2–3 years | 262 | 2.93 (2.00–3.99) | 139 male, 123 female |
| 4–6 years | 341 | 5.46 (4.00–6.99) | 175 male, 166 female |
| 7–9 years | 260 | 8.34 (7.01–9.99) | 138 male, 122 female |
| **Self-report questionnaire** | | | |
| Total | 741 | 13.79 (10.00–19.93) | 390 male, 351 female |
| 10–12 years | 321 | 11.51 (10.00–12.99) | 179 male, 142 female |
| 13–15 years | 267 | 14.50 (13.00–15.99) | 137 male, 130 female |
| 16–19 years | 153 | 17.35 (16.03–19.93) | 74 male, 79 female |

For the assessment of retest reliability, only children and parents who had completed the questionnaire at baseline (first study visit) and follow-up (second study visit) were included. This sample consisted of 212 children in the parent-report group (52% boys, mean age at baseline = 5.81 years, range = 2.00–8.97) and of 188 children in the self-report group (52% boys, mean age at baseline = 13.55 years, range = 10.08–19.03). The average time between baseline and follow-up was 11.85 months (range = 8.97–14.16) for the parent-report group and 11.82 (range 8.97–13.50) for the self-report group. These figures are consistent with the usual time interval between study visits in the LIFE Child study. An advantage of this time interval is that both visits take place in the same season. Therefore, seasonal differences in diet can effectively be ruled out. A drawback of this large interval, however, is that a child's diet might change over the course of the intervening year, which may then affect the reliability results.

We assessed the validity of our short questionnaire in a subsample of 105 children aged 13 and above (49% male, mean age = 15.81, range 13.62–19.72) who completed an additional FFQ [22].

### 2.2. Measures

#### 2.2.1. CoCu: composition and culture of eating

CoCu is a screening instrument that assesses the composition of the diets of children and adolescents and their culture of eating. The self-report version of the questionnaire is designed to be used with subjects aged 10 and upwards and is completed by children themselves. The answers, therefore, reflect the child's subjective perspective. In contrast, the parent-report version used for children aged 2 to 9 is completed by the child's parents. The responses, therefore, reflect parents' understanding of what and how their children eat.

The questionnaire consists of two parts. Part 1 (diet composition) contains 14 questions on *what* children eat (see Table 2). The respondent is asked to judge how many portions of different food products the child consumes per day (for fruits/vegetables, unsweetened milk products, sweetened milk products, sweetened beverages, wholegrain bread, white bread) or per week (for meat, fish, ready-made meals, fried potatoes, potatoes, rice/noodles, cakes, sweet or savory snacks). Answers are given on a 6-point scale (1 = “never”; 2 = “max. 1”; 3 = “2–3”; 4 = “4–5”; 5 = “6–7”; and 6 = “>7 portions”). Reference portions are described in the text (e.g., “a fistful”) or illustrated using photographs.

**Table 2**
Items of the "diet composition" part of CoCu.

| Nr. | Questions |
|---|---|
| **How may … do you eat PER DAY?** | |
| 1 | Portions of fruit/vegetables (1 portion = 1 apple, 1 pear, 1 kohlrabi)[a] |
| 2 | Portions of unsweetened milk products (1 portion = 1 glass of milk, 150 g quark, 150 g natural yoghurt, 1 slice of cheese) |
| 3 | Portions of sweetened milk products (1 portion = 150 g pudding, 150 g fruit yoghurt, 1 cup of cocoa) |
| 4 | Glasses of sweetened beverages (e.g., lemonade, sweetened tea, flavored water) |
| 5 | Portions of wholegrain bread/roll (1 portion = 1 slice of bread, 1 roll) |
| 6 | Portions of white bread/brown bread/toast/white roll (1 portion = 1 slice of bread, 1 roll) |
| **How may … do you eat PER WEEK?** | |
| 7 | Portions of meat/sausage (1 portion = 3 slices of sausage)[a] |
| 8 | Portions of fish (1 portion = 1 canned fish, 3 fish fingers)[a] |
| 9 | Portions of ready-made meals (e.g., frozen pizza, frozen lasagne, instant noodles, microwave meals)[a] |
| 10 | Portions of boiled potatoes/potatoes cooked in skins[a] |
| 11 | Portions of fried potatoes (e.g., fries, croquettes, roast potatoes)[a] |
| 12 | Portions of rice/noodles[a] |
| 13 | Portions of cakes/cookies/pastries (1 portion = 1 piece of cake, 3–4 cookies) |
| 14 | Portions of sweet or savory snacks (1 portion = 1 chocolate bar)[a] |

Response categories = never; max. 1; 2–3; 4–5; 6–7; and >7 portions.
[a] Photographs of reference portions are provided as an additional guide. The entire questionnaire (including photographs) is available on request.

The selection of food items was largely based on a FFQ [22]. Most of the different food categories used in the FFQ (e.g., meat, fish, caloric drinks) were represented by one item in CoCu. However, some of the food groups presented in the FFQ were not included in CoCu, as they were judged to be consumed too infrequently (e.g., oil, nuts), to reveal little about the healthiness of the subject's diet (e.g., eggs, tea, water), or to be inappropriate for children (e.g., alcohol).

In the data presented here, the answers for part 1 were analyzed in two phases. First, the consumption of each food product was described in terms of portions/week. Second, the level of consumption of each food product was categorized as either healthy ("green" or "10 points"), moderately healthy ("yellow" or "0 points"), or unhealthy ("red" or "−10 points"). The "green", "yellow", and "red" categories were based on the German dietary guidelines for children and adolescents [27], with specific parameters set for each food product (see Supplement 1). For example, for meat, an answer of "4–5" portions/week was categorized as "green", answers of "never", "max. 1", "2–3", and "6–7" portions/week were categorized as "yellow", and an answer of ">7" portions/week was categorized as "red". For the purposes of categorization, three of the original food items (sweetened milk products, cakes, and sweet or savory snacks) were aggregated into one item called "treats". By summing the categorizations/points of all food items, a "Nutritional Health Score" was derived, which could range from −120 (for children who scored "red", i.e., "−10 points" for each item) to +120 (for children who scored "green", i.e., "+10 points" for each item).

The second part of CoCu (eating culture) comprises questions on *how* children eat and on the value placed on mealtimes. Specifically, the children are asked how many and which meals they eat each day (first breakfast, second breakfast, lunch, afternoon snack, dinner), whether they usually have dinner with their family, use media while eating, eat unhealthy snacks between meals, and/or help their parents to prepare meals. Most of these items were binary, i.e., the answer is either "yes" or "no".

A copy of the CoCu questionnaire can be obtained, for free, by contacting the corresponding author.

#### 2.2.2. Food frequency questionnaire (FFQ)

The FFQ applied in the LIFE Child study offers a detailed overview of a child or adolescent's diet [22]. The respondent is asked to judge the frequency of consumption (choosing from 9 possible frequency levels ranging from "never" to "more frequently than 4 times per day") as well as the portion size (3–5 different answer categories) of different food products. The 82 different questions assess 18 food groups (41 subgroups). In the LIFE Child study, the FFQ is completed by children aged between 13 and 19.

A validation study (n = 101 children participating in the German Infant Nutritional Intervention Study (GINI PLUS)) provided some, although weak, evidence for associations between diet as assessed by the FFQ and diet as assessed by a 24 h dietary recall [22]. Even if the FFQ overestimated the intake of several food groups, the authors concluded that, overall, the FFQ offered a satisfactory measure of dietary intake [22].

### 2.3. Statistical analysis

The retest reliability of CoCu was assessed by comparing answers given at a first study visit (baseline) with those given at a second study visit (follow-up). Multiple linear regression analyses were applied, with the selected answer ranges (1–6) for each food item at baseline as independent variables and the selected answer categories at follow-up as dependent variables. All associations were adjusted for age, gender, and SES (Winkler index). Changes between the mean responses at baseline and follow-up were assessed by paired *t*-tests.

The concurrent validity of CoCu was investigated by comparing responses in CoCu with responses in the FFQ, with all items expressed as portions/week or weight/week (where it was not possible to identify a portions/week value). Each item of CoCu was associated with the appropriate item(s) of the FFQ. If an item of CoCu was represented by more than one item in the FFQ, the relative items of the FFQ were aggregated. Multiple linear regression analyses were applied, with the answers in the FFQ as independent variables and the answers in CoCu as dependent variables. All associations were controlled for age, gender, and SES.

Associations between the healthiness of children's diet and eating culture, on the one hand, and socio–demographic parameters, on the other, were assessed by using multiple linear or logistic regression analyses, with age, gender, and SES as independent variables and the Nutritional Health Score or the single eating culture items as dependent variables.

Possible relationships between the healthiness of diet and eating culture were investigated by using a multiple linear regression analysis, with the different eating culture items as independent variables and the Nutritional Health Score as dependent variable. Age, gender, and SES were included as control variables.

The parent-report and self-report versions of CoCu contained the same questions. However, due to possible differences in the self-reporting and parent-reporting processes (e.g., differing perceptions of portion sizes or different tendencies to give social desirable responses), we avoided analyses that spanned the whole age range from 2 to 18, i.e., any analysis that incorporated both parent-report and self-report data. Instead, all analyses were performed separately for parent-report vs. self-report.

## 3. Results

### 3.1. Diet composition and eating culture in the present sample

The average intake of the single food products (in portions/week) and the average responses given on the eating culture items of CoCu are displayed in Supplements 2 (for the parent-report version) and 3 (for the self-report version). The most frequently consumed food products were fruits and vegetables. The least frequently consumed food products were fish, fried potatoes, and ready-made meals. The average Nutritional Health Score was 43.73 (95% CI 41.91–45.55) in the parent-report cases and 24.28 (95% CI 22.32–26.24) in the self-report cases.

In the parent-report questionnaires, children were reported as having between 4 and 5 meals per day. In the self-report versions, children reported between 3 and 4 meals per day. Across both versions of the questionnaire, most children (>50%) were reported as having dinner together with their families, as habitually eating unhealthy snacks between meals, as not using any form of media while eating, and as rarely helping their parents to prepare meals.

### 3.2. Retest reliability

Retest reliability of CoCu was assessed in a subsample of study participants who had completed the questionnaire at two different time points 12 months apart (n = 212 in the parent-report group and 188 in the self-report group). Table 3 displays the associations as well as the mean differences between answers given at both study visits. As can be seen, all associations between responses at first and second visit were positive and significant (with $\beta$ ranging from .26 to .55 in the parent-report group and from .25 to .54 in the self-report group). The mean differences between answers given at first and second visit were small and, with a few exceptions, not significant. In the parent-report group, only the average consumption of unsweetened milk products ($\Delta_M$ = .12 (95% CI .02 – .22), $p$ = .015), ready-made meals ($\Delta_M$ = −0.12 (95% CI −.21 to −.04), $p$ = .004), and fried potatoes ($\Delta_M$ = −0.08 (95% CI −.16 to −.01), $p$ = .031) differed significantly between both visits. In the self-report group, only the consumption of sweetened beverages ($\Delta_M$ = .15 (95% CI .01 – .31), $p$ = .037) and fish ($\Delta_M$ = 0.14 (95% CI .04 – .24), $p$ = .004) differed significantly between both visits. It is also worth noting that the Nutritional Health Score was significantly higher at second study visit than at first study visit ($\Delta_M$ = −4.68 (95% CI −8.46 to −.90), $p$ = .015).

### 3.3. Concurrent validity

Associations between the answers given in CoCu and those given in the FFQ were investigated in a subsample of children aged 13 or older (n = 105). The results are summarized in Table 4. With the exception of sweetened milk products ($\beta$ = .06 (95% CI −.18–.30), $p$ = .931), white bread ($\beta$ = .18 (95% CI −.03–.39),

**Table 4**
Concurrent validity: Associations between the answers given in CoCu and those given in the FFQ.

| Food item | Self-report group (N = 105) |
|---|---|
| | $\beta$ (95% CI) |
| Fruits/vegetables | .49 (.31 – .67)*** |
| Milk unsweetened | .37 (.17 – .57)*** |
| Milk sweetened | .06 (−.18 – .30) |
| Beverage sweetened | .27 (.07 – .47)* |
| Wholegrain bread | .27 (.07 – .46)* |
| White bread | .18 (−.03 – .39) |
| Meat | .50 (.30 – .70)*** |
| Fish | .34 (.14 – .55)** |
| Fried potatoes | .21 (−.00 – .41) |
| Rice/noodles | .52 (.33 – .70)*** |
| Potatoes | .46 (.28 – .65)*** |
| Cakes | .54 (.36 – .72)*** |
| Sweet/savory snacks | .42 (.23 – .61)*** |

All associations are controlled for age, gender, and SES.
*$p$ < .05, **$p$ < .01, ***$p$ < .001.

**Table 3**
Retest reliability: Associations and mean differences between answers given at first and second visit, separated for parent-report and self-report groups.

| Food item | Parent-report group (N = 212) | | Self-report group (N = 188) | |
|---|---|---|---|---|
| | Association T1 - T2 | Mean difference (T1-T2) | Association T1 - T2 | Mean difference (T1-T2) |
| | $\beta$ (95% CI) | | $\beta$ (95% CI) | |
| Fruits/vegetables | .45 (.33 – .58)*** | .01 (−.07 – .09) | .43 (.30 – .56)*** | 0.01 (−.11 – .13) |
| Milk unsweetened | .33 (.20 – .46)*** | .12 (.02 – .22)* | .37 (.23 – .51)*** | −.05 (−.18 – .07) |
| Milk sweetened | .26 (.12 – .39)*** | −0.05 (−.14 – .04) | .25 (.11 – .40)*** | 0.01 (−.11 – .12) |
| Beverage sweetened | .55 (.43 – .66)*** | 0.01 (−.10 – .13) | .47 (.34 – .60)*** | 0.15 (.01 – .31)* |
| Wholegrain bread | .39 (.27 – .52)*** | 0.10 (−.01 – .21) | .42 (.29 – .56)*** | −0.04 (−.18 – .09) |
| White bread | .36 (.24 – .49)*** | −0.00 (−.10 – .09) | .33 (.19 – .47)*** | 0.12 (−.01 – .24) |
| Meat | .53 (.41 – .64)*** | 0.14 (−.00 – .28) | .41 (.27 – .55)*** | 0.00 (−.18 – .18) |
| Fish | .44 (.32 – .56)*** | 0.03 (−.05 – .11) | .54 (.41 – .66)*** | 0.14 (.04 – .24)** |
| Ready-made meals | .48 (.36 – .60)*** | −0.12 (−.21 to −.04)** | .42 (.29 – .55)*** | 0.08 (−.05 – .21) |
| Fried potatoes | .43 (.30 – .55)*** | −0.08 (−.16 to −.01)* | .31 (.17 – .45)*** | 0.02 (−.09 – .13) |
| Rice/noodles | .30 (.17 – .43)*** | 0.01 (−.09 – .11) | .41 (.28 – .55)*** | −0.01 (−.13 – .12) |
| Potatoes | .34 (.21 – .47)*** | 0.07 (−.03 – .18) | .40 (.27 – .54)*** | 0.07 (−.05 – .19) |
| Cakes | .51 (.39 – .63)*** | 0.06 (−.07 – .19) | .42 (.28 – .55)*** | 0.06 (−.08 – .20) |
| Sweet/savory snacks | .42 (.30 – .55)*** | 0.13 (−.02 – .27) | .39 (.25 – .53)*** | 0.00 (−.16 – .16) |
| Nutritional Health Score | .52 (.40 – .63)*** | 2.17 (−1.40 – 5.74) | .52 (.39 – .65)*** | −4.68 (−8.46 to −.90)* |

All associations are controlled for age, gender, and SES.
*$p$ < .05, **$p$ < .01, ***$p$ < .001.

$p = .117$), and fried potatoes ($\beta = .21$ (95% CI −.00 − .41), $p = .102$), the answers given in CoCu showed significant positive associations with answers given in the FFQ (with $\beta$ ranging from between .27 and .54).

### 3.4. Associations between diet composition/eating culture and age/gender/SES

#### 3.4.1. Diet composition

The analysis revealed a significant negative association between the Nutritional Health Score and child age in the parent-report group ($\beta = -.21$ (95% CI −.03 to −.14), $p < .001$), but a significant positive association in the self-report group ($\beta = .13$ (95% CI .06 − .21), $p < .001$). In the parent-report data, the Nutritional Health Score did not differ between boys and girls ($\beta = .05$ (95% CI −.02−.11), $p = .17$). However, in the self-report data, girls were reported as having a significantly healthier diet than boys ($\beta = .11$ (95% CI .03 − .18), $p < .01$). In both the parent-report and self-report groups, a higher SES was significantly associated with a higher Nutritional Health Score ($\beta = .14$ (95% CI .08 − .21), $p < .001$ for parent-report and $\beta = .14$ (95% CI .07 − .21), $p < .001$ for self-report).

#### 3.4.2. Eating culture

The associations between eating culture and age, gender, and SES are summarized in Table 5. In the parent-report group, higher age was associated with a reduced likelihood of helping with the preparation of meals. In the self-report group, the likelihood of eating together with the family was higher for younger children than it was for older children, whereas the number of daily meals, the likelihood of using media while eating, of eating unhealthy snacks between meals, and of helping to prepare meals was higher for older children than it was for younger children. In both the parent-report and the self-report groups, girls were more likely to help parents to prepare meals than boys. No other gender differences were found.

With respect to SES, children from families with a higher SES were reported as having more meals per day and as being less likely to use media while eating than children from families with a lower SES. These associations were significant in both the parent-report as well as the self-report groups. In the parent-report data, the likelihood that the child would habitually eat unhealthy snacks between meals also decreased as the SES increased. In the self-report group, meanwhile, a higher SES was additionally associated with a higher likelihood of having dinner with the family and of helping parents to prepare meals.

### 3.5. Relations between Nutritional Health Score and eating culture

In the parent-report group, a higher Nutritional Health Score was significantly associated with having more meals ($\beta = .12$ (95% CI .06 − .18), $p < .001$), refraining from using media during meals ($\beta = -.07$ (95% CI −.13 to −.01), $p = .027$), refraining from eating unhealthy snacks between meals ($\beta = -.31$ (95% CI −.37 to −.25), $p < .001$), and helping to prepare meals on a regular basis ($\beta = .17$ (95% CI .10 − .23), $p < .001$).

In the self-report group, a higher Nutritional Health Score was significantly associated with eating together ($\beta = .08$ (95% CI .00−.15), $p = .038$), refraining from eating unhealthy snacks between meals ($\beta = -.26$ (95% CI −.33 to −.19), $p < .001$), and helping to prepare meals on a regular basis ($\beta = .13$ (95% CI .06−.20), $p < .001$).

## 4. Discussion

We have developed a short nutrition questionnaire for assessing diet composition and eating culture among children and adolescents, with a parent-report version for children aged 2 to 9 and a self-report version for children aged 10 to 19.

### 4.1. Retest reliability

We investigated the retest reliability of CoCu by comparing the responses given at a first study visit with those given at a second study visit a year later. The associations between the data acquired at the two visits were not very strong, but they were highly statistically significant. Additionally, with a few exceptions, the average responses did not change between both study visits. In the parent-report group, only unsweetened milk products, ready-made meals, and fried potatoes differed significantly between study visits. In the self-report group, differences were observed for sweetened beverages, fish, and the Nutritional Health Score. Given the long period between the first and second study visits – a whole year –, it may be that these differences represent changes due to age rather than limited retest reliability. Taken as a whole, the reliability analysis presented here is promising and suggests a good

**Table 5**
Associations between eating culture and age, gender, and SES.

| Dependent variable | Parent-report group (N = 863) | | | Self-report group (N = 741) | | |
|---|---|---|---|---|---|---|
| | Independent variable | | | Independent variable | | |
| | age | gender[f] | SES | age | gender[f] | SES |
| | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) | β (95% CI) |
| Meals/day[a] | −.07 (−.13 − .00) | −.01 (−.07 − .06) | .12 (.05 − .19) *** | .09 (.02 − .17)* | −.05 (−.12 − .03) | .18 (.10 − .25)*** |
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Dinner with family[b] | 1.04 (0.76−1.41) | 0.57 (0.14−2.42) | 1.16 (0.94−1.42) | 0.78 (0.69−0.85) *** | 1.09 (0.68−1.76) | 1.17 (1.09−1.26) *** |
| Media while eating[c] | 1.06 (0.97−1.16) | 0.94 (0.62−1.41) | 0.81 (0.76−0.87) *** | 1.11 (1.03−1.19) ** | 0.95 (0.67−1.33) | 0.84 (0.80−0.89) *** |
| Unhealthy snacks between meals[d] | 1.06 (0.99−1.13) | 1.11 (0.84−1.46) | 0.87 (0.84−0.92) *** | 1.08 (1.01−1.16) * | 1.16 (0.85−1.59) | 0.98 (0.94−1.03) |
| Preparing meals[e] | 0.92 (0.87−0.99) * | 1.42 (1.06−1.90) * | 1.02 (0.97−1.07) | 1.10 (1.03−1.18) ** | 1.59 (1.17−2.17) ** | 1.06 (1.01−1.11) ** |

All associations are adjusted for the other independent variables.
*$p < .05$, **$p < .01$, ***$p < .001$.
[a] Linear regression.
[b] Logistic regression, reference = having no dinner with family.
[c] Logistic regression, reference = no media while having dinner.
[d] Logistic regression, reference = no unhealthy snacks between meals.
[e] Logistic regression, reference = never or rarely helping to prepare meals.
[f] Reference = male.

level of reliability for the CoCu questionnaire, although it may be desirable to carry out further tests using a shorter time interval.

### 4.2. Validity: comparison with FFQ

In a subsample of children aged 13 years or older, a comparison between answers given in CoCu and a more detailed FFQ showed positive, though weak, associations between both questionnaires. For sweetened milk products, white bread, and fried potatoes, however, the associations between CoCu and FFQ did not reach significance. This might be explained by the difficulty of estimating usual consumption of these food products, and by methodological differences between the questionnaires (e.g., fruit yoghurt was categorized as an unsweetened milk product in the FFQ, but as a sweetened milk product in CoCu). Overall, the present analysis shows a satisfactory concordance between CoCu and FFQ, indicating CoCu's overall efficacy in assessing children's diet.

It is worth noting that the validity of the FFQ itself is contestable. The associations between food intake as assessed by the FFQ and a 24 h dietary recall were not very strong [22]. It might, therefore, be advisable to re-evaluate the validity of the CoCu using other methods, e.g., comparison with a food diary or photographs of meals. The questionnaire could also be validated using a sample of children under the age of 13.

### 4.3. Healthiness of diet reported in the present sample

The high average Nutritional Health Scores reported in this study suggest that the present study sample, overall, has a relatively healthy diet. The finding that the Nutritional Health Score was higher in the parent-report group than in the self-report group may indicate that younger children (2–9 years) tend to have a healthier diet than older children and adolescents (10–19). However, these differences might also reflect differences in the response behavior of children and parents. For example, parents might show a higher tendency than children to respond in a socially desirable manner.

### 4.4. Associations between diet composition/eating culture and age/gender/SES

Another aim of the present study was to assess whether aspects of the diets and eating culture of young people today are associated with parameters of age, gender, and socio-economic status. In the parent-report group (i.e., for children aged 2 to 9), the healthiness of nutrition decreased as child age increased, suggesting a reduction in parental control or an increasing flexibility with respect to what the child is allowed to eat. This result is in line with another German study that reported a decrease in the healthiness of nutrition, although in that case the decrease was not only evident up to the age of 9 (as in the present data) but continued to the age of 17 [10,11]. In the self-report group (i.e., for children aged 10 to 19), the healthiness of nutrition increased as the child's age increased. This finding is at variance with a Brazilian study on nutrition among adolescents in which the diet healthiness decreased between the ages of 12 and 18 [9]. We consider that this increase in healthiness might be due to a growing awareness of the importance of healthy food.

With respect to the culture of eating, the analysis of the parent-report data showed a decrease in the frequency of helping in the preparation of meals as a function of child age. One reason for this finding might be that younger children are more inclined to spend time with their parents, i.e., including during meal preparation. Older children, in contrast, might be less interested in cooking, and their parents may make less of an effort to involve them in the preparation of meals. In the self-report group, the centrality of set "mealtimes" in the young person's culture of eating decreased with growing child age, as indicated by an increased use of media while eating, increased consumption of unhealthy snacks between meals, and a reduced frequency of family dinners. These findings might be explained by a rising desire for, and increased parental authorization of, greater independence as children grow older. The increased use of media while eating might partly be explained by a general increase in media usage during adolescence, i.e., independently of mealtime behavior [28,29].

Regarding diet composition, gender differences were only found in older children (self-report), with girls reporting healthier diets than boys. This finding is in line with previous studies [10,11] and indicates a better awareness of healthy food or a higher motivation to eat healthy food in girls than in boys. For younger children (parent-report), in contrast, no gender differences were found. This result suggests that the behavior of parents – who are mainly responsible for what children eat at these young ages – does not depend on the sex of the child. With respect to the culture of eating, we observed a higher likelihood of helping to prepare meals in girls vs. boys. This association might be explained by a higher interest in preparing meals in girls vs. boys, but also by early gender-specific parental behavior (e.g., asking girls, but not boys, to help with the preparation of meals).

With respect to the socio-economic status of children, our findings suggest that children who belong to families with higher SES tend to have healthier diets and place greater value on mealtimes with family. This is in line with previous studies [10–13] and may be explained by different lifestyles in families from different social backgrounds.

Another possible explanation for the observed associations between aspects of diet composition and culture of eating and parameters of age, gender, and SES is that certain groups of study participants (e.g. girls, children from families with a higher SES) have a greater tendency to give socially desirable answers (e.g., to report an especially healthy diet) than other groups of participants.

### 4.5. Associations between diet composition and eating culture

Our analyses revealed that the answers of parents or children who reported a healthier diet also indicated a greater concern with the value of mealtimes. Importantly, these associations were significant even after controlling for families' social background. They indicate that children and parents who pay attention to what they eat also care about how they eat. This suggestion is in line with previous studies reporting healthier nutrition in children who do not use media while eating [14–16], who eat with family more frequently [16,18–21], and who are taught how to prepare food [30].

### 4.6. Implications

The CoCu short nutrition questionnaire represents a useful and time-efficient tool for assessing eating habits in children and adolescents. It might, therefore, be used not only as a screening instrument in large epidemiological or cohort studies, but also in clinical practice. Information about the healthiness of children's diets and their eating culture might, for instance, be helpful in the context of preventing or treating digestive disorders and/or underweight or overweight.

### 4.7. Limitations

We acknowledge that the time interval for investigating the retest reliability of the instrument was particularly long (12

months). Other studies have applied shorter time intervals (e.g., 2–4 weeks [31,32]), thereby limiting the risk of confounding due to age-related changes. Another limitation is that all the measures reflect the subjective perspectives of children or parents. Participants with unfavorable eating habits might be particularly prone to over-estimating the healthiness of their diets. Furthermore, the questionnaire does not assess all the possible foods children and adolescents might eat. Finally, the representativeness of the present study sample was limited, especially with regard to the participants' SES. As in many cohort studies, the participating families tended to be of a higher SES than a representative sample of the population. It is possible, therefore, that in children with lower SES the quantities consumed for each food product may differ from those presented here.

## 5. Conclusion

The developed short nutrition questionnaire – titled "CoCu" – represents an economic and efficient tool for surveying the diets of children and adolescents. The questionnaire provided satisfactory retest reliability and concurrent validity. In addition to information on the weekly or daily consumption of specific foods, the questionnaire provides for an estimation of the healthiness of the child's diet and provides insights into children's and adolescents' eating culture.

## Submission declaration

The work described has not been published previously and is not under consideration for publication elsewhere. The publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out. If accepted, the work will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

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## Statement of authorship

TP and US created the questionnaire, were responsible for conception and design of the study, analyzed and interpreted the data, and were major contributors in the writing of the manuscript; MV contributed to the analysis of data; AK and WK supervised conception and design of the study, data acquisition, analysis and interpretation, and contributed to the writing of the manuscript. All authors drafted the article and gave final approval to the version to be submitted.

## Conflict of interest

The authors declare that they have no conflicts of interest to declare. The funding sources were not involved in study design, in data collection, analysis, and interpretation, in writing of the report, or in the decision to submit the article for publication.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnu.2018.12.020.

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