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Validity of the factorial structure of the Brazilian version scale of the Food Choice Questionnaire

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Abstract *This study examines the dimensional structure and reliability of the 36-item Food Choice Questionnaire (FCQ) in a Brazilian Portuguese version, an instrument used to measure the importance of motives behind food choices. The sample includes 502 adults. Confirmatory factorial analysis (CFA) were used to evaluate the configural (dimensionality) and metric (magnitude of factorial loadings, residual correlations and factorial discriminatory validity) structures of the instrument. Internal consistency evaluation used the Omega coefficient (Ω); temporal reproducibility used the Kappa coefficient with quadratic weighting (κ) in a separate sample of 41 subjects. The final CFA corroborates the 9-factor original structure and shows high factorial loadings ($\lambda_i > 0.80$ in 34 items); two residual correlations (r(i2-i3) = 0.773 and r(i16 i17) = 0.853); and factorial correlations indicating factor discriminant validity ($\varphi < 0.80$). Regarding reliability, there is adequate internal consistency (Ω = 0.877 to 0.968), and good test-retest reproducibility indicating temporal stability (κ = 0.768 to 0.917). It can be concluded that the FCQ version has good configural and metric properties, and may be recommended for use in Brazil in its present form.*

Key words *Validation studies, Cross-cultural comparison, Questionnaires, Food preferences, Feeding Behavior*

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Introduction

Food choices are based on many factors, such as economic, sociocultural, ideological, psychological and biological factors[1,2]. The possible relationship between these choices and their health effects, whether unfavorable or protective, directs public policies in the area of food and nutrition[3,4]. In order to reduce the risk of non-communicable chronic diseases, the guidelines of these policies have the restriction of the intake of ultra-processed foods of high energy density as central proposals[3,4]. Nevertheless, the consumption of these types of food remains high in Brazil[5]. To create public policies in the area of food and nutrition only based on the thought that food choices are motivated by health concerns seems limited[6], and other needs may underlie these options[2,7,8]. For example, being a vegetarian for ethical or political values[9], reducing the consumption of meat and prioritizing seasonal fruits and vegetables to minimize the environmental impact[8], and choosing food that is easily accessible and at a reduced price may influence food choices[7].

Thus, identifying the influences becomes relevant to guide the development and implementation of actions in food and nutritional education. Moreover, with the global market, understanding the differences that governthe motives behind food choices is important for the production of food products and their trade in different cultures and countries[10].

Unlike other measurement tools that aim to quantify or capture individuals' regular food consumption, such as food frequency questionnaires (FFQ)[11-14], or the Food Choice Questionnaire (FCQ) is unique in investigating the motives that guide food choices. Created by Steptoe et al.[6] in English, the FCQ was initially proposed with 68 items. A preliminary exploratory factor analysis identified that several items were not exclusive to the corresponding postulated factors, causing the authors to exclude them subsequently. The final version was reduced to 36 items, involving nine dimensions covering issues related to health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity, and ethical concern[6]. Each item contains a *Likert* scale ranging from 1 to 4 points according to the importance perceived by the participants (not important; a little important; moderately important; and very important)[15]. This version had acceptable internal consistency (Cronbach's α ranging from 0.70 to 0.87) and test/retest reliability (Pearson's correlation coefficient ranging from 0.714 to 0.830).

Since its launch, several additional studies have analyzed the reliability and dimensional structure of the FCQ in different countries[10,16-20]. For many reasons, alternative versions were suggested in the process, either by eliminating, including or modifying items and/or factors[17,18,20]. Clearly, there is lack of consensus.

In 2015, Heitor et al.[21] started the process of cross-cultural adaptation of the FCQ. Guided by the methodology proposed by Herdman et al.[22], the authors followed the steps of theoretical, semantic and operational equivalence, presenting a Portuguese version (*according to*, Chart 1 in Heitor et al.[21]) aiming at future tests. Continuing the process, this study examines the configural and metric structure of this Brazilian version of the FCQ in the adaptation process, as well as its reliability through internal consistency and temporal stability (test-retest).

Method

Target population, sample selection and inclusion criteria

This study was conducted in the township of Frutal, Minas Gerais, between January and July 2016. Participants were selected from 2,875 adults (≥ 18 years old) included in the database of the Primary Care Information System (SIAB), composed of the population assigned to the Family Health Team (ESF) of the township. Selection was made through random drawing, with both sexes and different levels of education. Only one individual was selected through household sampling.

The sample size calculation was guided by suggestions found in the related literature[23,24]. Considering a proportion of 15 cases for each of the 36 FCQ items, 540 individuals were expected, plus 10% due to possible losses or refusals. With that in mind, 598 people were effectively approached; 32 refused to participate, 21 were not found after three attempts, 38 had changed addresses, two were excluded because they were deaf/mute/illiterate, and three had died. Thus, 502 were included and analyzed. It is worth mentioning that this projected sample size proved to be appropriate subsequently. Based on the estimates obtained in the Confirmatory Factorial Analysis (CFA) of the original nine-dimensional model proposed by Steptoe et al.[6], a *post hoc* study using Monte Carlo simulation with 10,000 replications showed statistical power above 0.99 for all estimated loading[25].

A new sample of 41 individuals was selected, aiming at evaluating the reproducibility of the instrument. The second approach was made 15 to 20 days later, the same time interval used by Steptoe et al.[6] in their initial analyses. The instrument was used both times in the same place and at approximate times.

Instruments for measuring and collecting data

As presented in the Introduction, the Brazilian Portuguese version of the FCQ tested in this study relates to the proposal of Heitor et al.[21]. To characterize the socio-demographic and economic profile, part of the Brazilian Multidimensional Functional Assessment Questionnaire (BOMFAQ) was used[26].

The questionnaire was presented to the participants in their own residences to be self-reported, after explanations on how to fill the questionnaire by trained field supervisors. It was necessary to apply it face-to-face to 17 interviewees due to old age or low education. After a thorough evaluation on how they were filled, the questionnaires were submitted to double typing and their consistency was checked in both databases.

Analyses

The process was initiated by assessing the multidimensional structure proposed by Steptoe et al.[6]. The first step consisted of evaluating the nine-factor solution. For this purpose, a confirmatory factorial analysis (CFA)[24,27] was made. Following recommendations for modeling ordinal categorical items[28], the estimator *Weighted Least Squares Mean and Variance Adjusted* (WLSMV) was used in Mplus 7.4[29].

Three indexes were used to evaluate the model fit: *Comparative Fit Index* (CFI), *Tucker-Lewis Index* (TLI) and the *Root Mean Square Error of Approximation* (RMSEA). CFI and TLI compare the proposed model with a null model. Both range from 0 to 1 and values above 0.95 indicate adequate fit. RMSEA compensates for the effect of model complexity by estimating the fit regarding the number of parameters involved (degrees of freedom). Values < 0.06 suggest a good fitting, and values >0.10 indicate poor fitting and the removal of the model[27]. The upper confidence limits (UCL) of 90% are also shown.

The residual correlations were evaluated, since conditional dependencies can indicate semantic redundancy of the items[27]. Modification Indexes (MI) provided by the analysis *software* (Mplus) were used, which project the effect in the fitting to the inclusion of parameters not considered in the proposed model. MIs reflect how much the χ^2 of the model would reduce (fit better) if a certain parameter were freely estimated. Complementing the MIs, expected parameter changes (EPC) values were also explored, anticipating the direction and intensity of the estimates with the freely implemented modifications in the following steps of the analysis[27]. The sustainability of discriminant factor validity (DFV) was also examined. Factor correlations of 0.80 demarcated the decision. For parsimony, it was opted for violation if $\varphi_{(f)} > 0.80$[23,27].

Internal consistency was calculated using the McDonald's Omega (Ω) coefficient. Values from 0.70 to 0.95 were considered acceptable[30]. Temporal reproducibility (test/retest)was evaluated using the *Kappa* coefficient with quadratic weighting estimated in the *kapci* program of *software* Stata 14.2[31,32]. 95% confidence intervals were calculated using the *bootstrap* method with 1,000 replications. The classification used the limits proposed by Shrout[33]: $\kappa < 0.10$: absent; $\kappa =$ 0.11-0.40: poor; $\kappa = 0.41$-0.60: discrete; $\kappa = 0.61$-0.80: moderate and $\kappa = 0.80$-1.0: substantial.

Ethical aspects

This study was approved by the Research Ethics Committee of the Federal University of Triangulo Mineiro (UFTM). Participants were informed about the research procedures and their risks before signing the Free and Informed Consent, ensuring voluntary participation.

Results

The participants' ages ranged from 18 to 96 year old (mean 46.4; SD 19.3), with a predominance of women who were married/with partners, had at least 10 years of education, with some insertion in the labor market, per capita family income between one and three minimum wages and were catholic or evangelical (Table 1).

Consistently, item distribution showed that all four response options in the scale were used to represent food choices (Table 2). Focusing on the extremes, the options most elected as *very important* occurred in items 19 and 21, whereas those marked as *not important* appeared in items 34 and 35.

Table 1. Socio-demographic and economic characteristics of the interviewees. Frutal, MG, Brazil, 2016. (n = 502).

Variables		N = 502	%
Gender	Male	142	28.2
	Female	360	71.8
Age group (in years old)	18 ┤ 19	30	6.0
	20 ┤ 29	104	20.8
	30 ┤ 39	79	15.7
	40 ┤ 49	77	15.3
	50 ┤ 59	79	15.7
	≥ 60	133	26.5
Marital status	Single	144	28.7
	Married/living with partner	260	51.8
	Separated/divorced	48	9.6
	Widower	50	10.0
Schooling (in years of study)	No schooling	4	0.8
	Elementary and Middle School (1 ┤ 9)	151	30.0
	High School (10 ┤ 13)	182	36.3
	Higher education (14 and below)	165	32.9
Professional activity	Employee with or without a work card	125	24.9
	Employee as a public servant	87	17.3
	Employer	26	5.2
	Self-employed	64	12.7
	Unpaid	32	6.4
	Unemployed	58	11.6
	Retired/pensioner	110	21.9
Household per capita income (minimum wages-MW)[a]	< 1	96	19.1
	1	23	4.6
	1 ┤ 3	156	31.0
	3 ┤ 5	26	5.2
	>5	23	4.6
	Refused to declare income	18	3.6
	Unknown	160	31.9
Religion	Catholic	275	54.8
	Evangelical	121	24.1
	Spiritualist	69	13.7
	Umbanda/Candomblé/other religions	4	0.8
	Without religion or atheist/did not declare	33	6.6

[a] Between January and July 2016, the MW corresponded to R$880.00.

Similar to the model shown in Table 3, most loadings in the CFA based on the original model by Steptoe et al.[6] was above 0.80. In only two items (i27 and i33) there were loadings below this level, although remaining above 0.60. The CFI and RMSEA fit indexes were 0.971 and 0.065, respectively (90%UCL: 0.068).

Diagnosis through MI indicated two residual correlations, one between items i16↔i17(EPC: 0.774)and other between items i2↔i3 (EPC: 0.344). As shown in Table 3, the subsequent free estimation of the first improved the fit (RMSEA = .053; UCL90%: 0.057) and, in general, the loadings remained at the same levels.

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Table 2. Frequency distribution of responses (%) of the items from the *Food Choice Questionnaire* scale (n = 502).

Factor	Items	Importance (perceived)			
		Not important	A little important	Moderately important	Very important
(1) Health	1. Contains a lot of vitamins and minerals	22.9	17.6	18.5	41.0
	2. Keeps me healthy	6.6	13.3	23.5	56.6
	3. Is nutritious	8.8	13.9	24.5	52.8
	4. Is hight in protein	8.5	19.5	22.5	29.5
	5. Is good for my skin/teeth/hair/nails	36.9	13.1	14.3	35.7
	6. Is rich in fiber and roughage	26.9	15.3	19.2	38.6
(2) Mood	7. Helps me cope with stress	36.3	18.9	12.5	32.3
	8. Helps me to cope with life	31.5	18.5	15.7	34.3
	9. Helps me relax	33.1	16.5	20.5	29.9
	10. Keeps me awake/alert	44.8	20.2	14.7	20.3
	11. Cheers me up	35.7	15.3	16.7	32.3
	12. Makes me feel good	22.7	12.4	17.5	47.4
(3) Convenience	13. Is easy to prepare	20.5	15.9	18.9	44.7
	14. Can be cooked very simply	20.1	16.5	20.2	43.2
	15. Takes no time to prepare	19.9	16.7	22.1	39.3
	16. Found in shops close to where I live or work*	18.7	19.7	17.1	44.5
	17. Is easily available in shops and supermarkets	11.4	17.7	18.5	52.4
(4) Sensory appeal	18. Smells nice	2.8	5.0	12.5	79.7
	19. Looksnice	1.8	5.2	12.7	80.3
	20. Has a pleasant texture	2.4	4.8	17.7	75.1
	21. Tastes good	1.4	3.3	11.6	83.7
(5) Natural content	22. Contains no additives	27.9	18.7	23.3	30.1
	23. Contains natural ingredients	23.1	15.7	20.8	40.4
	24. Contains no artificial ingredients	28.5	22.5	18.9	30.1
(6) Price	25. Is notexpensive	12.0	16.1	23.3	48.6
	26. Is cheap	12.5	20.1	23.5	43.9
	27. Is good value for money	4.4	7.0	17.1	71.5
(7) Weight control	28. Is low in calories	35.9	19.5	15.9	28.7
	29. Helps me control my weight	31.5	16.5	17.3	34.7
	30. Is low in fat	25.9	17.1	16.2	40.8
(8) Familiarity	31. Is what I usually eat	13.9	23.3	25.7	37.1
	32. Is familiar	14.1	22.1	26.3	37.5
	33. Is like the food I ate when I was a child	38.2	25.2	18.5	18.1
(9) Ethical concern	34. Comes from countries I approve of politically	60.5	12.0	12.4	15.0
	35. Has the country of origin clearly marked	58.0	12.2	10.3	19.5
	36. Packaged in an environmentally friendly way*	44.0	12.5	11.6	31.9

* The complete semantics of the items can be found in Heitor et al.[21], Chart 1.

The exception concerned the loadings of items involving the residual correlation itself, which decreased from 0.867 to 0.505 in i16 and from 0.919 to 0.564 in i17. The residual correlation itself increased in relation to the value previously suggested by the MI, increasing to 0.853 (95%CI: 0.820-0.887). Free estimation of the other recommended residual correlation (i2↔i3) further improved the fit indexes, but factor loadings remained at the same levels as before. When freely estimated simultaneously, both residual correlations of interest were i2↔i3 = 0.773 and

Table 3. Analysis of the dimensional structure of the *Food Choice Questionnaire* according to a confirmatory factorial analysis and reliability estimates.

Factor	Item	λ_i [a]	δ_i [b]	Ω [c] (95%CI)
(1) Health	1. Contains a lot of vitamins and minerals	0.868*	0.246	0.913 (0.898 - 0.928)
	2. Keeps me healthy	0.788*	0.379	
	3. Is nutritious	0.747*	0.443	
	4. Is hight in protein	0.834*	0.304	
	5. Is good for my skin/teeth/hair/nails	0.899*	0.192	
	6. Is high in fibre and roughage	0.891*	0.206	
(2) Mood	7. Helps me cope with stress	0.906*	0.180	0.968 (0.962 - 0.975)
	8. Helps me to cope with life	0.941*	0.114	
	9. Helps me relax	0.930*	0.134	
	10. Keeps me awake/alert	0.804*	0.353	
	11. Cheers me up	0.933*	0.129	
	12. Makes me feel good	0.925*	0.144	
(3) Convenience	13. Is easy to prepare	0.928*	0.139	0.877) (0.857 - 0.896)
	14. Can be cooked very simply	0.951*	0.096	
	15. Takes no time to prepare	0.929*	0.137	
	16. Found in shops close to where I live	0.505*	0.745	
	17. Is easily available in shops and markets	0.564*	0.682	
(4) Sensory appeal	18. Smells nice	0.943*	0.110	0.949 (0.934 - 0.963)
	19. Looksnice	0.961*	0.076	
	20. Has a pleasant texture	0.897*	0.196	
	21. Tastes good	0.813*	0.340	
(5) Natural content	22. Contains no additives	0.918*	0.158	0.959 (0.946 - 0.971)
	23. Contains natural ingredients	0.958*	0.083	
	24. Contains no artificial ingredients	0.940*	0.117	
(6) Price	25. Is not expensive	0.983*	0.034	0.927 (0.909 - 0.945)
	26. Is cheap	0.923*	0.147	
	27. Is good value for money	0.764*	0.416	
(7) Weight control	28. Is low in calories	0.929*	0.137	0.947 (0.933 - 0.962)
	29. Helps me control my weight	0.929*	0.137	
	30. Is low in fat	0.925*	0.145	
(8) Familiarity	31. Is what I usually eat	0.918*	0.157	0.898 (0.875 - 0.920)
	32. Is familiar	0.958*	0.082	
	33. Is like the food I ate when I was a child	0.637*	0.594	
(9) Ethical concern	34. From countries I approve of politically	0.916*	0.162	0.952 (0.938 - 0.966)
	35. Has the country of origin clearly marked	0.955*	0.089	
	36. Environmentally-friendly packaging	0.925*	0.144	
$r_{(i2\text{-}i3)}$ [d]	0.773			
$r_{(i16\text{-}i17)}$ [d]	0.853			
RMSEA [e]	0.047 (0.043-0.051)			
CFI [f]	0,985			
TLI [g]	0.983			

* p<0.001; [a] Factor loadings; [b] Residual variances; [c] McDonald's Omega coefficients; [d] Residual correlations; [e] Root mean square error of approximation (RMSEA); 90% confidence interval in parentheses; [f]Comparative Fit Index (CFI); [g] Tucker-Lewis Index (TLI)

i16↔17 = 0.853. Table 3 also shows the McDonald's Omega coefficients, which ranged from 0.877 to 0.968.

Focusing on the evaluation of discriminant factor validity, Table 4 shows that no correlation between the nine factors was above the limit of 0.80. Values ranged from $\phi_{(f4\text{-}f9)}$ = -0.104 between the factors *Sensory appeal* and *Ethical concern*, and $\phi_{(f1\text{-}f7)}$ = 0.711 between *Health* and *Weight control.*

With respect to estimating reproducibility, all *kappa* were above 0.80, except the *kappa* related to F4 (*Sensory appeal*). The means were close in the test and in the retest (Table 5).

Discussion

FCQ is a tool that evaluates the importance attached by individuals to food choices and has been widely used in epidemiological researches. However, studies related to its dimensional structure still indicated some controversy[17,18,20,34]. In order to clarify some divergences, this study evaluated the psychometric properties of the FCQ, examining its reliability and validity in the configural and metric scope.

The model submitted to the initial CFA fitted reasonably well, evidencing high factor loadings and, thus, indicating reliable and discriminant items.[35] These results were similar to the study by Januszewska et al.[19], showing a well fitted model (RMSEA = 0.061, CFI = 0.950) and with acceptable factor loadings, ranging from 0.43 to 0.84. In light of even a better fit – RMSEA of 0.037 and CFI of 0.963 – Markovina et al.[10] also found factor loadings at these levels (between 0.541 and 0.923). The convergence of these findings is important because it expresses the ability of the instrument to adapt to different population domains, being able to satisfactorily capture the construct in several situations, in addition to the original context used in development and validation.

Nevertheless, this study identified two pairs of items with residual correlations, a violation of local independence that suggests some semantic redundancy between items. The strongest residual correlation of 0.853 occurred between items 16↔17 (importance of the food 'bought where the interviewee lives or works' and 'easily found/

Table 4. Correlations (ϕ) between the factors of the Brazilian Portuguese FCQ version.

Factors	F1	F2	F3	F4	F5	F6	F7	F8	F9
F1	---								
F2	0.678	---							
F3	0.063	0.249	---						
F4	–0.066	–0.019	0.203	---					
F5	0.667	0.514	–0.001	–0.073	---				
F6	0.102	0.095	0.376	0.336	0.079	---			
F7	0.711	0.652	0.161	–0.083	0.591	0.081	---		
F8	0.087	0.196	0.355	0.284	0.125	0.247	0.145	---	
F9	0.623	0.568	0.097	–0.104	0.690	0.052	0.595	0.309	---

Legend (factors): F1: Health; F2: Mood; F3: Convenience; F4: Sensory appeal; F5: Natural content; F6: Price; F7: Weight control; F8: Familiarity; F9: Ethical concern.

Table 5. Distribution of the test-retest reliability analyses of the FCQ, according to the factors.

Factors	Test		Retest		Kappa (95%CI) [b]	
	$\bar{x}$ (DP) [a]		$\bar{x}$ (DP) [a]			
Health	12.09	(5.61)	12.58	(5.69)	0.902	(0.825 - 0.966)
Mood	10.19	(5.80)	10.04	(5.51)	0.912	(0.831 - 0.960)
Convenience	8.41	(4.69)	8.63	(4.65)	0.900	(0.798 - 0.965)
Sensory appeal	10.75	(1.69)	10.85	(1.82)	0.768	(0.498 - 0.931)
Natural content	5.73	(3.14)	5.31	(3.21)	0.871	(0.696 - 0.964)
Price	6.58	(2.35)	6.80	(2.36)	0.865	(0.702 - 0.954)
Weight control	5.17	(3.15)	4.85	(3.40)	0.874	(0.763 - 0.955)
Familiarity	4.12	(3.00)	3.85	(3.00)	0.894	(0.804 - 0.952)
Ethical concern	3.80	(3.23)	3.34	(3.18)	0.917	(0.783 - 0.978)

Average gross scores. Standard deviations in parentheses. [b]Weighted Kappa coefficient (quadratic weighting). In parentheses, 95% confidence intervals obtained by the bootstrap method with 1,000 replications.

reachable in grocery stores and supermarkets'). The other of 0.773 occurred between items 2↔3 (importance of the food 'being able to keep the interviewee healthy' and 'being nutritious'). As expected, the model fit improved after the residual correlations were freely estimated, especially for RMSEA, which estimates were no longer as limiting as before[35].

Also recognizing anomalies in items i16 and i17, Pula et al.[20] proposed the exclusion of both and thus, reduced the number of components of the *Convenience* factor from five to three items. However, if a factor is composed of few items, the other components may not be able to compensate the desired dimensional mapping. In the limit situation of the proposed dimension, the easiest option would be to remove only one of the elements of the pair[35]. Supported by the similarity of the relevant contents and the significant residual correlation, the candidate for exclusion would be item 16 for having the smaller of the two loadings. Also indicated for removal by Ares and Gámbaro[36], its exclusion would probably not entail much loss of information. In addition to the remaining item 17, being able to grasp the importance of food being near and easily accessed as a sign of convenience to food choice, there would be four other items quite appropriate to complete the mapping of the targeted dimensional content. Another feasible option would be to add the semantic contents of both items to a single question aiming at explicitly expressing both ideas underlying the original items. Yet another strategy would be to look for a new item to replace the proposed content coverage of both of them. Clearly, all of these alternatives would require psychometric scrutiny in a new study[35]. In fact, the same would apply to a possible redundancy pointed out by the residual correlation identified between items 2 and 3, which from the substantive point of view implies the perception that there is a superposition of content when a food is recognized as healthy or nutritious.

Another point discussed in the literature is the appropriate number of response options per item. Although Steptoe et al.[6] suggested four options, more recent studies with the FCQ have used seven alternatives, using the perceptions in a rank of "extremely unimportant" to "extremely important"[17,19,20,34]. Fotopoulos et al.[17] justify that the addition of other response options increases the transmitted information, improving the quality of the scale. They also defend that the presence of a neutral option makes the interviewee more comfortable when expressing their opinion. On the other hand, Milošević et al.[2] adopted a five-point scale in order to adjust FCQ options to the other scales included in the background search.

Conflicting results may arise from this lack of consensus among the number of response options on a scale. Adding points to a scale by adding response options does not necessarily result in the intended discrimination between options if the interviewees are not able to position themselves incrementally across the intensity spectrum of the proposed object. In addition to larger scales requiring more mental processing by the participants, it also predisposes the individual to have the same response option throughout the instrument. Therefore, items with many levels of response are often of little metric relevance or even deleterious by introducing unwanted noises. Choosing fewer options can help limiting process errors[15]. Back to the discussion, these analyses tend to corroborate the proposal of four categories offered by Steptoe et al.[6] two decades ago. The use of items at four levels seems pertinent and deserves to be recommended at least for use in Brazil.

Using a Greek version of FCQ composed of 24 items distributed in eight factors, Fotopoulos et al.[17] found two pairs of factors presenting correlations above 0.80 suggesting discriminatory factor validity violation concerning the factors *Health* and *Natural content* (0.95) and *Health* and *Sensory appeal* (0.88). As a result, the authors pointed to the possible grouping of the factors *Health* and *Natural content* on a higher order factor, which they entitled "Concern about health and safety". Considering a much smaller demarcation of $r > 0.60$ to define DFV violation, Markovina et al.[10] ended up suggesting three correlations as disturbing, namely, between the factors *Health* and *Mood* (0.797), *Health* and *Natural content* (0.668) and *Natural content* and *Ethical concern* (0.649). Although they did not openly address the issue of DFV violation, the authors of the original article also found a factor correlation above 0.60 between *Health* and *Natural content* (0.69). They conceive that the correlation occurs because health-conscious people prefer not to ingest products rich in additives and artificial ingredients, often incorporated into food as a way of preserving them[6].

Returning to a more conservative and widely supported demarcation in the related literature, in this study no correlation between the nine factors indicated values above the 0.80 limit. Although three of them showed values around 0.70

— *Health* and *Weight control* (0.711), *Natural content* and *Ethical concern* (0.690) and *Health* and *Natural content* (0.667), as a whole, the FCQ translated into Brazilian Portuguese seems to present a reasonable discrimination between the specified factors. Thus, in this adopted perspective, a proposal such as that of Fotopoulos et al.[17] to adjust a model with a higher order factor would not be sustained and therefore was not pursued.

The estimates of the *Kappa* coefficients (> 0.80) indicated that there was a substantial agreement between the answers in the repeated process to evaluate them, except for *Sensory appeal*, for which agreement was moderate ($k = 0.768$), following Shrout's classification[33]. Steptoe et al.[6] also found moderate or substantial reliabilities in all dimensions in the retest (r ranging from 0.714 to 0.830). This consistency of findings endorses the quality of the FCQ, since an instrument that is repeatedly reliable in the measurement process, by extension, also shows its operational potential for use in population studies[37].

The argument of Eertmans et al.[16] and Pula et al.[20] that the items used to prepare the FCQ have evolved since the scale was developed should be considered. Three issues seem eminent. One is the inclusion of items that reflect the religious characteristics of the interviewees. The second relates to concerns for animal welfare[18,20]. Another issue would be to add items encompassing the influence of the media on food choices, since *marketing* on food can be attractive, persuasive and long-lasting[38]. It is known that television successfully manipulates children's minds through commercial attractions, an influence that tends to persist into adulthood[39].

These evaluations of new groups of items (dimensions), as well as possible modifications in the pairs of items i16↔i17 and i2↔i3, already point to an immediate new study to improve the FCQ. It would be useful to add to this study the evaluations of the scale structure of the tool, as well as, subsequently, the very needed studies of external validity[40].

Adding knowledge to the previous literature about the FCQ, this study attests the adequacy of the configural and metric properties of the Brazilian Portuguese version of the *Food Choice Questionnaire*. The instrument seems to be a good tool for evaluation, fulfilling well what it proposes. It encompasses important factors that permeate the individuals' food choices, is brief, easy to apply and understand, and is apparently a reproducible and valid instrument in the Brazilian context. Although there still pending evidence from the many steps still to be followed in the process to purify and refine the instrument, the FCQ can already be recommended for use in Brazil in its present form.

Collaborations

SFD Heitor – Project design, data collection and analysis, writing and article discussion. ME Reichenheim – Data analysis and interpretation, critical review of the article and final approval of the version to be published. JES Ferreira – Designer and academic co-advisor of the project, writing of the article. SS Castro – Drafting and academic advisor of the project, data analysis and interpretation, critical review of the article and final approval of the version to be published.

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