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Research report

Could the Food Neophobia Scale be adapted to pregnant women? A confirmatory factor analysis in a Portuguese sample ☆

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ABSTRACT

Background: The Food Neophobia Scale (FNS) is widely used in different countries, however appropriate psychometric analyses are required to allow cross-cultural comparisons. To our knowledge, most studies have been conducted among children and adult populations, with no reference to pregnant women. The objective of this study was to translate and test the psychometric properties of a Portuguese version of the FNS, and to identify clusters of food neophobia during pregnancy. *Methods:* The FNS was translated into Portuguese by three health researchers, and back-translated into English by an independent native English speaker and professional translator. The scale was self-administered in a sample of 219 women from the baseline evaluation of the Taste intervention study (HabEat project: http://www.habeat.eu/), who attended medical visits in two hospitals from Porto, Portugal, reporting food neophobia during the last trimester of pregnancy. The FNS consists of 10 items with a 7-point rating scale. An exploratory analysis was performed to evaluate the scale's dimensionality, followed by a confirmatory factor analysis to test the fit of the previous model by using different indexes. Cronbach's alpha coefficient was calculated to evaluate the internal reliability of the scale. The construct validity was assessed by comparing the FNS scores by categories of education, age and fruit and vegetables intake by ANOVA. A Model-based clustering was used to identify patterns of food neophobia; the number of latent classes was defined according to the Bayesian information criterion. *Results:* A two-factor model solution was obtained (after excluding item 8 with a factor loading <0.4), explaining 51% of the total variance. Cronbach's alpha was 0.75 for factor 1 (5 items) and 0.71 for factor 2 (4 items). Items 1, 4, 6, 9 and 10 loaded into the first factor (i.e. more willingness to try new foods; less neophobic traits) and items 2, 3, 5 and 7 loaded into a second factor (i.e. more neophobic traits). A good global of fitness of the model was confirmed by fit indexes: TLI = 0.876, CFI = 0.911, RMSEA = 0.088 and SRMR = 0.051. The higher the education, age, and fruit and vegetables intake the lower the neophobic tendency, measured by the Portuguese FNS. Three patterns (i.e. clusters) of food neophobia, characterizing neophobia traits of pregnant women were identified: Moderate Neophilic, Moderate Neophobic, and Extreme Neophilic (cut-off points were provided). *Conclusion:* The Portuguese version of the FNS has the basic requirements of a valid and reliable measure of food neophobia and permits the identification of clusters of neophobic traits during pregnancy.

Introduction

Food neophobia, defined as reluctance to eat unfamiliar foods, is an individual trait that influences food choices and consequently food acceptance and consumption (Pliner & Hobden, 1992). Food neophobia has been associated with the "Omnivore's Dilemma", in which humans must decide whether or not to consume novel foods; that is, they must weigh up the possible benefit of consumption (receiving valuable nutrition) against the possibility of harm (ingesting poisons or toxins) (Dovey, Staples, Gibson, & Halford,

Abbreviations: BIC, Bayesian information criterion; CFA, confirmatory factor analysis; CFI, comparative fit index; EFA, exploratory factor analysis; FNS, Food Neophobia Scale; P-FNS, Portuguese version of the Food Neophobia Scale; R, reversed scores; RMSEA, route mean square error of approximation; SRMR, standardized root mean square residual; SD, standard deviation; TLI, Tucker–Lewis Index.

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2008; Pliner & Hobden, 1992). In the broadly safe food environment of the 21st century, the protective function of neophobia is less salient than in the distant past. Rejection of new foods nowadays may have an adverse effect on food choices, compromising quality and variety of diet, particularly the consumption of fruit and vegetables, since in the modern environment food safety is mostly guaranteed (Cooke, Carnell, & Wardle, 2006; Cooke, Haworth, & Wardle, 2007; Pliner & Melo, 1997). According to previous literature, food neophobia, in general, tends to decline with age (Pliner & Melo, 1997), being minimal during the infancy, peaking around the age of 4, and gradually decreasing during adult life (Birch, 1999; Dovey et al., 2008). Food neophobia scores seem also to decrease with education. A higher education level probably enhances the access, experience and exposure to novel foods, and it could help to decrease the neophobic response (Tuorila, Lähteenmäki, Pohjalainen, & Lotti, 2001).

To assess food neophobia, Pliner and Hobden (1992) developed the Food Neophobia Scale (FNS), a validated psychometric instrument specifically designed to assess this reluctance to consume new foods (Pliner & Hobden, 1992). This scale is a self-administrated ten-item questionnaire, where a lower score represents more willingness to try or choose new foods (food neophilia) and a higher score represents those less willing to try new foods; more neophobic. The FNS is the most common measure used for assessing food neophobia and it has been widely used, but since the scale was originally developed using a sample of Canadian students (Pliner & Hobden, 1992), care must be taken in interpreting results from different populations. In order to allow for cross-cultural comparison, its psychometric properties need to be tested in different countries.

Several validation studies have been conducted to explore the properties of the FNS (Fernández-Ruiz, 2012; Ritchey, Frank, Hursti, & Tuorila, 2003; Schickenberg, Van Assema, Brug, & de Vries, 2008; Tuorila et al., 2001) and the results from these different studies suggest that the FNS is a valid tool for assessing food neophobia in different populations. The scale has been used to identify individuals with more neophobic traits, who might require proper intervention and medical advice, supporting its usefulness and importance.

To our knowledge, this scale has not been used in the Portuguese population, and most studies have been conducted among children (with a different FNS version) (Cooke, Carnell, & Wardle, 2006; Cooke, Haworth, & Wardle, 2007; Cooke, Wardle, & Gibson, 2003; Dovey et al., 2008; Falciglia, Couch, Gribble, Pabst, & Frank, 2000; Flight, Leppard, & Cox, 2003; Galloway, Lee, & Birch, 2003; Koivisto & Sjödén, 1996, 1997; Monneuse et al., 2008; Mustonen, Oerlemans, & Tuorila, 2012) and adult populations (Arvola, Lahteenmaki, & Tuorila, 1999; Edwards, Hartwell, & Brown, 2010; Knaapila et al., 2011, 2007; Nordin, Broman, Garvill, & Nyroos, 2004; Pliner, Eng, & Krishnan, 1995; Pliner & Melo, 1997) with no reference to pregnant women. During pregnancy, significant physiological, psychological and social changes occur (Abduljalil, Furness, Johnson, Rostami-Hodjegan, & Soltani, 2012) that require adaption of pregnant woman. Food choices are influenced by environmental factors such as cultural food practices and beliefs, internal factors such as food cravings and food aversions, and some digestive disorders such as reflux, nausea and vomiting that together may influence the intake of certain foods (Forestell & Mennella, 2008; Kramer, Bowen, Stewart, & Muhajarine, 2013). During this period, maternal dietary intake is particularly important to meet with increased nutritional needs and metabolic demands of mother and fetus (Picciano, 2003), and can greatly impact health status and life expectancy of both (Abu-Saad & Fraser, 2010; Le Clair, Abbi, Sandhu, & Tappia, 2009; Roseboom, de Rooij, & Painter, 2006). At the same time, pregnant women should be cautious, avoiding potentially toxic and hazardous food. Thus, physiological and psychosocial changes occurring during pregnancy can predispose the more neophobic women to express a higher neophobic response during this stage. Although pregnancy can be a sensitive period for more neophobic responses, the existing information is still very scarce, and to our knowledge no study has evaluated neophobia in pregnant women. Since neophobia might affect both the quality and variety of diet (Falciglia et al., 2000), it seems relevant to explore food neophobia in pregnant woman.

This study aims to translate, culturally adapt and test the psychometric properties of the FNS in a sample of Portuguese women who reported food neophobia during the last trimester of pregnancy. We also aim to identify clusters of food neophobia among pregnant women.

Methods

Participants

Participants were pregnant women who were in their final trimester of pregnancy (mean weeks of gestation was 36.62 (S.D. = 3.36) and mothers of newborns in the first week of life (n = 219). Pregnant women were consecutively approached between April–July 2011, before their attendance to medical visits in two hospitals from Porto (main public hospital and private antenatal clinic), and they were invited to take part in the baseline evaluation of the Taste intervention, included in the HabEat project that aims to determine factors and critical periods in food habit formation and breaking in early childhood in several European countries (more detailed information could be find at http://www.habeat.eu/). All participants signed an informed consent form to participate in the study. The research protocol was approved by the local ethical committee (Ethical committee of São João Hospital/University of Porto Medical School) and the study procedures complied with the Helsinki Declaration. Participants did not receive any financial support.

Data collection

Mothers self-completed questionnaires (including the FNS and other characteristics) on their convenience: during the visit or at home, reporting the questionnaire in the next visit or sending it by post (in a prepaid envelope).

The original FNS consists of 10 items with a 7-point rating scale ranging from (1) strongly disagree' to (7) strongly agree', with (4) corresponding to the neutral position 'neither agree nor disagree'.

The FNS, originally written in English, was translated into Portuguese by three health researchers, and the result was the Portuguese Food Neophobia Scale (P-FNS). This Portuguese version was back-translated into English by an independent native English speaker and professional translator (who was blinded to the original version) and it was compared with the original version of FNS to ensure equivalence between the two versions. Discrepancies were decided by unanimous agreement. Therefore, the instrument was piloted in a convenience sample (n = 10) to evaluate its cultural adaptation.

The P-FNS was self-administered and had as reference period the third trimester of gestation. The 10 items of the P-FNS appear in the same order as in the original version (see Appendix A.). Before analysis, the scores of 5 items marked with (R) were reversed to obtain ratings in the same direction (Pliner & Hobden, 1992). The total score could range from 10 to 70, as the original one.

The questionnaire administered during the recruitment process also provided socio-demographic information and maternal fruit and vegetable intake, obtained by a food frequency questionnaire (FFQ). The FFQ reported in this paper included one global item for fruits and one for vegetables, and 8 categories of frequency, ranging from less than 1 per week to 4 or more times per day. Educational levels were categorized into mandatory education (1–9

schooling years), high school education (10–12 schooling years) and university education (>12 schooling years). Three age categories were formed (⩽25, 26–34, ⩾35 years). Fruit and vegetables intake were dichotomized according to the World Health Organization recommendations (<5 vs. ⩾5 servings/day).

Statistical analysis

An exploratory factor analysis (EFA) was performed to understand the underlying structure of the P-FNS version. The exploratory factor analysis was performed using the maximum likelihood estimation method together with the Geomin rotation (considering that we expected a correlation between factors). Factors were selected if their eigenvalue was higher than one. The items with absolute factor loading of 0.4 or higher were interpreted as having meaningful part on the whole domain.

This analysis was followed by confirmatory factor analysis (CFA) to test the fit of the model obtained from the EFA. The fit of the scale was assessed using different indexes: (i) the Tucker–Lewis Index (TLI) (Tucker & Lewis, 1973), (ii) the Comparative fit index (CFI) (Bentler, 1990), (iii) the Route mean square error of approximation (RMSEA) (Steiger, 1990), and (iv) the Standardized root mean square residual (SRMR) (Hu & Bentler, 1999). The CFI and TLI indexes range from 0 to 1, with higher values indicating a better model fit. The RMSEA and SRMR indexes range from 0 to 1, with lower values indicating a better model fit. A good model fit is indicated by a CFI and TLI values of 0.90 or higher (Hu & Bentler, 1999) and values of RMSEA and SRMR close to 0 (Browne & Cudeck, 1993).

The internal reliability of the scale was tested using the Cronbach's alpha coefficient.

To test the construct validity of the FNS, the mean values of each subscale were compared according to age, education and fruit and vegetables intake categories (previous theoretical hypotheses) by using ANOVA.

A model-based clustering (Fraley & Raftery, 2002) was used to identify clusters of food neophobia. According to this method, data was assumed to be generated with multivariate normal distribution items. The multivariate normal distributions were parameterized by their means and covariances that determine their geometric features. Characteristics (orientation, volume and shape) of distributions were estimated from data, and can be allowed to vary between clusters, or constrained to be the same for all clusters. In this study, the number of latent classes (patterns of food neophobia) was defined according to the Bayesian information criterion (BIC). Starting from one single class and increasing one class at each step, the best solution was identified when the increase in the number of classes did not lead to a decrease in BIC. The interpretation of the clusters was obtained by a classification tree that identified the cut-offs to predict the clusters membership using the factors extracted from previous CFA (Lemon, Roy, Clark, Friedmann, & Rakowski, 2003).

To perform EFA and CFA, Mplus, version 5.2 was used. Data analysis for model-based clustering was conducted with the software R 2.14.1, using the package mclust (Fraley, Raftery, Murphy, & Scrucca, 2012). To obtain the classification tree, rpart was used (Therneau, Atkinson, & Ripley, 2011). *Retrieve from* http://cran.rproject.org/web/packages/rpart/rpart.pdf.)

The significance level was set at 5%. The missing values were treated as missing at random.

Results

Exploratory factor analysis

An initial EFA was performed to explore if the Portuguese version of the FNS in this population supports a single dimension, as did the original version of the FNS (Pliner & Hobden, 1992). In this analysis, it was identified one-factor solution model that explained 36.1% of the total variance (Table 1). Since item 8 "I am very particular about the foods I will eat" had a low factor loading (less than 0.4), it was decided to eliminate this item, and a second EFA was performed. This factor analysis revealed a two-factor model solution, explaining approximately 51% of the total variance, with factor 1 and factor 2 explaining 26.3% and 24.5% of the total variance, respectively. The respective scree plot supported this solution, indicating that a two-factor solution was the most appropriate model. The internal reliability coefficients from the two subscales were calculated. Cronbach's alpha was 0.75 for subscale factor 1 (5 items) and 0.71 for subscale factor 2 (4 items), indicating that the P-FNS has good reliability.

In a sensitivity analysis, we explored the internal consistency of the scale only among pregnant women. A similar structure was found, with 2-factors solution, with very similar Cronbach alphas (0.75 for factor 1 and 0.75 for factor 2), supporting that the scale's performance does not change by including also women reporting food neophobia during pregnancy retrospectively.

Confirmatory factor analysis

In accordance with results from the EFA (Table 1), in the CFA it was assumed that items 1, 4, 6, 9 and 10 belong to factor 1 and items 2, 3, 5 and 7 belong to factor 2, and they were correlated with each other. Figure 1 shows the factor loadings supporting these relations. The global of fitness of the model was tested and it was confirmed by the following fit indexes: TLI = 0.876, CFI = 0.911, RMSEA = 0.088 and SRMR = 0.051. These values suggest a good global of fitness of the P-FNS. The two factors were moderately correlated ($r = -0.64$), and items 1, 4, 6, 9 and 10 loaded into the first factor and items 2, 3, 5 and 7 loaded into a second factor. The first factor corresponds to the five reversed ordering items (i.e. more willingness to try new foods; less neophobic traits) and the second factor corresponds to the four positively ordering items (i.e. less willingness to try new foods: more neophobic traits).

Construct validity

Construct validity was assessed considering three theoretical hypotheses, based on previously described literature: as the higher the education (Schickenberg et al., 2008; Tuorila et al., 2001), age (Dovey et al., 2008; Tuorila et al., 2001) and fruit and vegetables intake (Cooke et al., 2004), the lower the neophobia. To test these hypotheses, the mean values of each subscale according to these variables were compared (Table 2).

Educational level was positively related to factor 1 and negatively related to factor 2: more educated pregnant women scored significantly higher on factor 1 (representing more neophilic traits) and significantly lower on factor 2 (representing more neophobic traits). Although differences of FN scores with age were not statistically significant, they suggest that there is an inverse association between age and factor 2 (⩽25, 26–34, ⩾35 years: 3.84, 3.63, 3.38 $p = 0.225$) and a direct association between age and factor 1 (⩽25, 26–34, ⩾35 years: 4.42, 4.46, 4.69 $p = 0.483$). Pregnant women consuming at least 5 portions/day scored significantly higher on factor 1 (4.89 vs. 4.38, $p = 0.012$) and lower on factor 2 compared with those consuming less servings, although the results were not significant (3.31 vs. 3.71, $p = 0.064$). These associations are consistent with the theoretical hypothesis, supporting the construct validity of the P-FNS.

Table 1
Items of the Portuguese version of the Food Neophobia Scale, in pregnancy: mean values, factor loadings and explained variance obtained from the exploratory factor analysis.

	Mean	SD	Loadings of one-factor solution	Loadings of two-factors solution	
			F1	F1	F2
1. I am constantly sampling new and different foods. (R)	3.89	1.762	0.400	**0.781**	0.281
2. I don't trust new foods	2.76	1.530	−0.526	–	**0.719**
3. If I don't know what's in a food, I won't try it	4.38	2.113	−0.532	0.131	**0.756**
4. I like foods from different countries. (R)	4.54	2.039	0.685	**0.641**	−0.214
5. Foreign food looks too weird to eat	3.43	1.903	0.734	−0.231	**0.672**
6. At dinner parties, I will try a new food. (R)	4.74	1.810	0.653	**0.740**	–
7. I am afraid to eat things I have never had before	3.78	2.100	−0.711	−0.199	**0.660**
8. I am very particular about the foods I will eat[a]	5.25	1.681	−0.334	–	–
9. I will eat almost anything. (R)	5.05	1.916	0.556	**0.532**	−0.143
10. I like to try new ethnic restaurants. (R)	4.38	2.130	0.730	**0.632**	−0.287
% Explained variance			36.1	26.3	24.5
				Total: 50.8	

Higher loadings are in bold type.
(R): reversed items.
SD: standard deviation.
[a] Item 8 was excluded from the two-factor solution model.

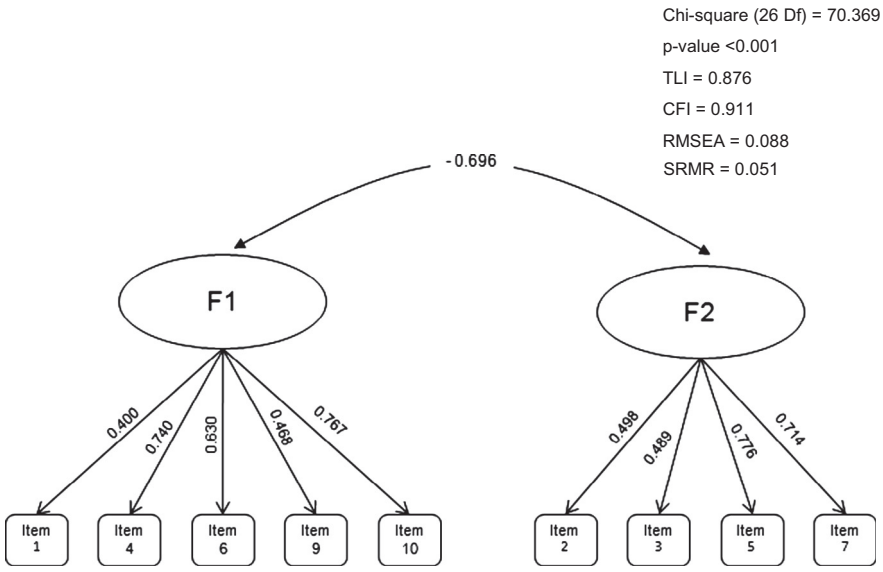

Fig. 1. Confirmatory factor analysis for the two-factor model of the Portuguese version of the Food neophobia Scale (P-FNS). *Factor 1 (F1) represents the more neophilic trait and factor 2 (F2) represents the more neophobic trait. The factor loadings are the values of the correlation coefficient between the items and factors.*

Identification of clusters of food neophobia

Clusters of food neophobia were identified based on the mean score on each factor (factor 1 representing more neophilic traits and factor 2 representing more neophobic traits). The number of clusters of food neophobia was defined according to the BIC, and the best solution was set at 3 clusters for characterizing neophobia traits of pregnant women (representing 3 mutually-exclusive groups of women sharing the same pattern). Figure 2 shows the mean scores of each pattern in the two factors, previously defined. Cluster 1 was characterized by moderate scores in all items (answers could range from 1 to 7), with a slightly higher score in factor 1 (mean 5.02 ± 0.84) than in factor 2 (mean 3.06 ± 0.78). Cluster 2 had also a moderate score in all items, but with a slightly higher score in factor 2 (mean 4.76 ± 1.05) than in factor 1 (mean 3.50 ± 1.17). In turn, cluster 3 had the highest score in factor 1 (mean 6.22 ± 0.44) and the lowest score in factor 2 (mean 1.59 ± 0.43) (Fig. 3).

The interpretation of the clusters could be easily represented by a classification tree (Fig. 3) that predicts the clusters membership using the factors extracted from previous CFA. The classification tree shows the cut-off points in the two subscales (factor 1 and factor 2) that discriminate each cluster identified.

Discussion

In the present study, we aimed to describe the adaptation and validation process of the P-FNS to address the lack of available instruments to assess and explore food neophobia in Portuguese pregnant women.

Factor analysis revealed a two-factor model solution, explaining 51% of the total variance; factor 1 (with moderate-to-strong correlations with items 1, 4, 6, 9 and 10, representing more willingness to try new foods; less neophobic traits) and factor 2 (with moderate-to-strong correlations with items 2, 3, 5 and 7, representing less willingness to try new foods; more neophobic traits). Although the original scale was one-dimensional, as previously reported by Pliner and Hobden (1992), in the present study the factor analysis revealed a two-factor model solution. In a sensitivity analysis, we forced the EFA to one factor, as the original scale. The model only showed good fit if we add correlations between items (which

Table 2
Mean scores of the two factors according to education, age and servings of fruit and vegetables intake of pregnant women.

	n (%) 219	Factor 1[a] Mean (SD)	Factor 2[b] Mean (SD)
Education (schooling years)			
1–9	45 (20.5)	4.00 (1.28)	4.09 (1.07)
10–12	58 (26.5)	4.65 (1.31)	3.72 (1.59)
>12	112 (51.1)	4.68 (1.38)	3.36 (1.39)
	4 (1.8)		
p-Value		**0.013**	**0.002**
Age (years)			
<25	48 (21.9)	4.42 (1.40)	3.84 (1.27)
26–34	106 (48.4)	4.46 (1.30)	3.63 (1.56)
⩾35	65 (29.7)	4.69 (1.45)	3.38 (1.28)
	0		
p-Value		0.483	0.225
Servings of fruit and vegetables in the last 3 months			
<5 portions/day	128 (58.4)	4.37 (1.30)	3.66 (1.43)
⩾5 portions/day	85 (38.8)	4.78 (1.44)	3.48 (1.42)
	6 (2.7)		
p-Value		**0.031**	0.362

SD: standard deviation.
[a] Factor 1 represents more neophilic traits.
[b] Factor 2 represents more neophobic traits.

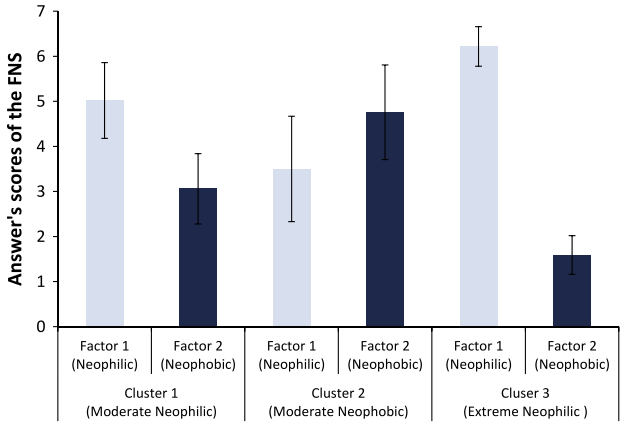

Fig. 2. Mean scores in the Portuguese version of the Food Neophobia Scale (FNS) in each cluster by factor 1 and factor 2. Bars represent means and lines the respective standard deviation.

enable the rapid and easy use of the scale by other researchers). In our data, we found correlations between the positively and negatively worded items, and thus assuming a two-factor solution (with no correlations between the items), would simplify the calculation of the scores for each factor. Additionally, when we compared both models, by using the BIC, the model with 2 factors showed a lower BIC (7678.082 vs. 7678.329), confirming that this is the best model. Previous studies in adults have suggested the possibility of existing two factors (Fernández-Ruiz, Claret, & Chaya, 2013; Tuorila et al., 2001).

In our sample, this two-factor model was supported based upon values of the fit indexes from the confirmatory factor analyses, indicating that the P-FNS has a good global fitness. Based on Cronbach's alpha coefficients, with values higher than 0.7 for each subscale, our results also suggest a good internal reliability of the P-FNS.

In contrast, other studies have also tested the psychometric properties of an adapted Dutch version of the FNS, and showed adequate internal consistency and test–retest reliability of the FNS version used, but with a one-factor structure of the scale (Schickenberg et al., 2008). A French version of the FNS was successfully translated and its validity was confirmed, in this study a factor analysis also revealed a one-dimensional structure of the adapted questionnaire (Rubio, Rigal, Boireau-Ducept, Mallet, & Meyer, 2008).

During the validation process, item 8 "I'm very particular about the foods I'll eat" had a low factor loading (<0.4) and it was excluded from analysis. Other studies also detected some problems related to item 8. Tuorila et al. (2001), reported that this item may be related to a concern caused by dietary restrictions rather to neophobia or neophilia. Also, Koivisto and Sjödén (1996) reported that item 8 may not clearly reflect the trait of neophobia, suggesting that it has been changed during the translation process. Nevertheless, we cannot rule out a translation problem (one potential solution is to replace the word "particular", in Portuguese "exigente" by selective, in Portuguese "seletivo"). In this study, the theoretical hypotheses were confirmed: as the higher the education, age and fruit and vegetables intake the lower the neophobia, measured by the P-FNS.

Education seems to improve the access and exposure to various stimuli, events and cultural knowledge, which may influence and reduce neophobia levels (Flight et al., 2003). Although the evidence about food neophobia levels among different age groups is not as consistent as with education, some studies support that food neophobia is inversely correlated with age in adutls (Dovey et al., 2008; Roseboom et al., 2006; Tuorila et al., 2001). Cooke et al. (2003), reported that food neophobia appears to be minimal in infancy, raising rapidly at age two and gradually tailing off thereafter. In our study, although it seems that FN decreases with age, we were restricted to a very narrow age range (reproductive age); thus, the low variability of age could help to explain the lack of a significant association. Cooke et al. (2006) also suggested that neophobia impacts differentially the consumption of different food types and that could be observed in our investigation; pregnant women consuming at least 5 portions/day of fruit and vegetables scored significantly more in factor 1 (more neophilic traits) and lower in factor 2 (more neophobic traits) compared with those consuming less servings.

In the present study, the mean score of the FNS was 4.53 (SD = 1.36) for factor 1 and 3.56 (SD = 1.42) for factor 2. Given the different structure of the FNS, the different number of items, the different factors and factor loadings, cross-national comparisons of FN scores with other scores from other studies are not advisable (Ritchey et al., 2003). However, in a general way, it is interesting to note that our data suggest that our study participants had highest mean scores of food neophobia compared with other studies (Fernández-Ruiz et al., 2013; Olabia, Najma, Baghdadia, & Morton, 2009; Pliner & Hobden, 1992; Rubio et al., 2008; Schickenberg et al., 2008). These different scores could be related with the different cultural and socio-demographic backgrounds, which could influence food neophobia level. In the particular case of pregnant women, given the food restrictions and precautions recommended during pregnancy, mothers could see the experience of trying a new food as potential dangerous, supporting that FN scores would be greater than in adult non-pregnant participants. In this sense, it would be interesting to extend the study to other population groups, to observe whether this is a general characteristic of the Portuguese population, or if these scores are due to the specific target group under study.

Most studies analyze food neophobia scores based on the factor loadings of the two factors identified (or one factor, when appropriate). According to this, each individual is represented in both factors, but with higher scores in one of them. The clustering approach used in this study allowed the identification of three distinct groups of women, each group with similar food neophobia scores: moderate neophilic, moderate neophobic, and extreme neophilic. Thus, in the context of health measurement, the view that dominates is the categorical one, because it meets clinical needs and allows reporting for health-care planners, while with

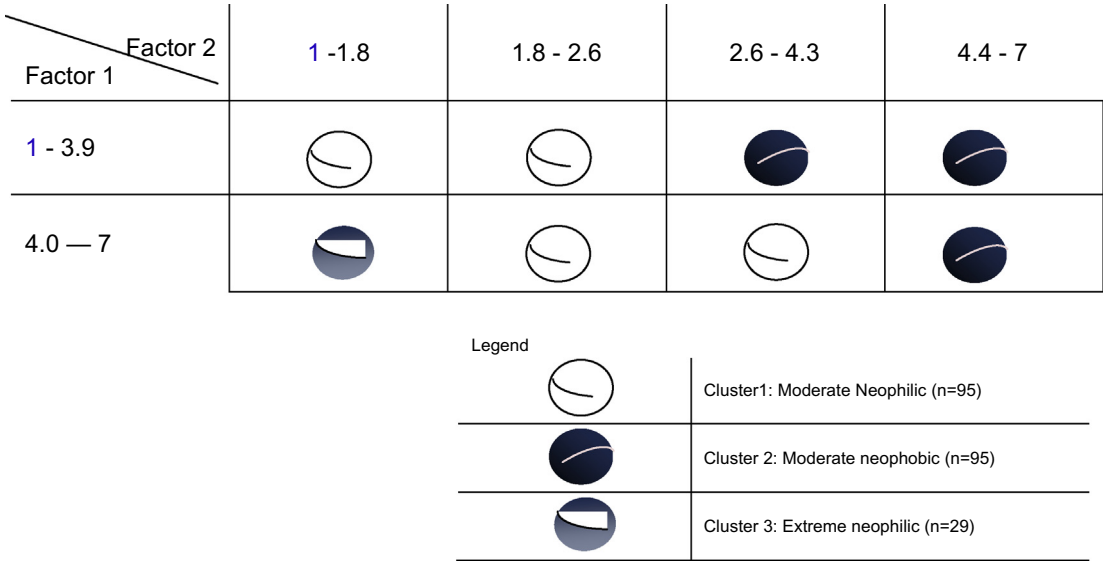

Fig. 3. Classification tree showing the cut-off points in the two subscales (factor 1 and factor 2) that discriminate each cluster identified.

factor analysis it is difficult to find natural cut points or thresholds for the traits, reducing its usefulness to provide a classification.

The identification of groups with homogeneous characteristics regarding to food neophobia might be useful in future research given that it will help to better understand the characteristics of each group, their determinants and consequences. Further, the use of the classification tree permits the use of a very visual schema that allowing a rapid identification of groups with similar characteristic. The classification tree shows the cut-off points in the two subscales (factor 1 and factor 2) that discriminate each cluster identified, and could thus be reproduced by other investigators who want to use the P-FNS among pregnant women.

Some limitations of the present study deserve discussion. It was not possible to measure test–retest reliability of the P-FNS. Women were reporting during the last trimester of their pregnancy, meaning that we were unable to administer another test at a later stage of pregnancy. Moreover, we were not able to clarify if food neophobia in these women are specific to pregnancy, because we do not have food neophobia assessed before pregnancy. Although the P-FNS data were self-reported usually leading to a lower social desirability bias, women's reports may be affected by their own believes in what pregnant women should ideally eat to provide better nutrition to their baby; thus we cannot exclude social desirability. Also, food neophobia could be trimester-specific, and so it would be interesting to administer the P-FNS in each trimester. Finally, our results are focused on food neophobia during pregnancy, so the generalization of results for other populations should be made with caution.

Conclusions

The findings of this study support the use of the P-FNS as a valid and reliable measure is able to identify clusters of food neophobia during pregnancy. This validation study provides sufficient evidence that the P-FNS could be a very useful instrument in health research and clinical interventions in pregnant women.

Future studies could use the P-FNS to assess the impact of maternal food neophobia on child's behaviors and growth.

Appendix A.

Description of correspondence between the original items of the Food Neophobia Scale (Pliner & Hobden, 1992) and the Portuguese version of the Food Neophobia Scale (P-FNS).

Items of the original FNS	Items of the P-FNS
1. I am constantly sampling new and different foods. (R)	1. Estou constantemente a experimentar alimentos novos e diferentes. (R)
2. I don't trust new foods.	2. Não confio em alimentos novos.
3. If I don't know what's in a food, I won't try it.	3. Se não souber o que está num alimento/comida, eu não experimento.
4. I like foods from different countries. (R)	4. Gosto de alimentos/comidas de diferentes países. (R)
5. Foreign food looks too weird to eat.	5. Os alimentos/comidas de outros países parecem muitos estranhos para se comer.
6. At dinner parties, I will try a new food. (R)	6. Em jantares de festa, eu costumo experimentar novos alimentos/comidas. (R)
7. I am afraid to eat things I have never had before.	7. Receio experimentar coisas que nunca comi antes.
8. I am very particular about the foods I will eat.	8. Sou muito exigente com os alimentos/comidas que vou comer.
9. I will eat almost anything. (R)	9. Eu como quase de tudo. (R)
10. I like to try new ethnic restaurants. (R)	10. Eu gosto de experimentar novos restaurantes étnicos (cozinha internacional. (R)

R – Reversed item.

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