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Construct validity of Brazilian cooking skills and healthy eating questionnaire by the known-groups method

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Construct validity of Brazilian Cooking Skills and Healthy Eating Questionnaire by the known-groups method

Abstract

Purpose - This paper aims to describe the results of the construct validity by the known-groups method of a Brazilian cooking skills and healthy eating questionnaire.

Design/methodology/approach – Responses obtained from university students (n=767) to Brazilian Portuguese cooking skills and health eating questionnaire, surveyed online, were submitted to construct validity comparing two known-groups. The t-test was used to compare differences between gender (male and female) and level of cooking knowledge (high or low) in each measure of the questionnaire. Internal consistency was evaluated by obtaining Cronbach's coefficient.

Findings – Women showed significantly higher means than men in all scale measures, except in the Self-Efficacy for Using Basic Cooking Techniques (SECT), where no differences were found. Students classified as having high cooking knowledge had higher score means in all scales compared to students with low levels. Internal consistency was adequate for all scales ($\alpha > 0.70$), except for Cooking Attitude (CA) ($\alpha=0.33$) and Cooking Behavior (CB) scales ($\alpha=0.59$).

Research limitations/implications – SECT likely depends on cooking knowledge, independent of gender, suggesting further examination. Items and structure of CA and CB constructs need also to be examined more deeply.

Practical implications – A validated cooking skills and health-eating questionnaire demonstrated its ability to detect differences between groups, being useful to provide data for further interventions.

Originality/value – No available cooking skills questionnaires were found that have been validated by the known-groups method regarding differences between gender and individuals' level of cooking knowledge, as conducted in this study.

Keywords – Psychometric propriety, Scale measure, Reliability, Cooking knowledge, Cooking techniques

Paper type Research paper

Introduction

In the context of healthy eating practices, cooking skills have been the subject of research in many countries (Caraher *et al.*, 1999; Begley and Gallegos, 2010; Hartmann *et al.*, 2013; Reicks *et al.*, 2014). The concept of cooking skills remains widely debated, mainly regarding its relationship to healthy eating (Caraher *et al.*, 1999; Short, 2003; Begley and Gallegos, 2010; Hartmann *et al.*,

2013; Reicks *et al.*, 2014; Raber *et al.*, 2016). These skills include the confidence to employ mechanical techniques in practical tasks, perceptual and conceptual skills and knowledge of planning and preparing food from scratch (fresh or raw), using convenience food, or both (Caraher *et al.*, 1999; Short, 2003; Byrd-Bredbenner, 2004; Begley and Gallegos, 2010; Hartmann *et al.*, 2013).

Studies have strongly suggested that cooking skills have been in decline among young adults in past decades, mainly in university students (Larson *et al.*, 2006; De Backer, 2013; Jones *et al.*, 2014). One of the factors is related to decreasing cooking knowledge transmission among generations (Byrd-Bredbenner, 2004; Caraher *et al.*, 1999; De Backer, 2013), which may lead these individuals to have poor diets (Jones *et al.*, 2014; Reicks *et al.*, 2014). In the first year of university, most students have just begun to live away from their parents and acquire autonomy and responsibility for their eating practices. Therefore, they confront some barriers when it comes to cooking their own food, causing them to increase their consumption of convenience foods and reduce their consumption of fruits and vegetables. Many times, this was related to the lack of cooking skills (Begley and Gallegos, 2010; Warmin *et al.*, 2012; Jones *et al.*, 2014; Reicks *et al.*, 2014).

Although high cooking knowledge among youth should hypothetically increase home cooking confidence and attitudes, improvements in cooking and healthy eating behaviors were not effectively proved among them (Byrd-Bredbenner, 2005; Winkler and Turrel, 2009; Begley and Gallegos, 2010; Warmin *et al.*, 2012; Reicks *et al.*, 2014). Moreover, it has been clearly shown that women are more willing and confident in their performance of cooking skills compared to men (Caraher *et al.*, 1999; Byrd-Bredbenner, 2005; Winkler and Turrel, 2009; Begley and Gallegos, 2010; Smith *et al.*, 2010; Hartmann *et al.*, 2013; De Backer, 2013), with the exception of low income women (Caraher *et al.*, 1999; Mc Laughling, 2003; Winkler and Turrel, 2009; Lyon *et al.*, 2011). Studies suggest that women seem to be more likely to cook every day, feel more confident than men to cook with different ingredients, and use different cooking techniques (Caraher *et al.*, 1999; Winkler and Turrel, 2009; Hartmann *et al.*, 2013).

Thus, there is no consensus among studies regarding how to evaluate cooking skills related to healthy eating in young adults (Larson *et al.*, 2006; Winkler and Turrel, 2009; Begley and Gallegos, 2010; Reicks *et al.*, 2014; Raber *et al.*, 2016), particularly considering the differences between individuals' cooking knowledge and gender (Caraher *et al.*, 1999; Byrd-Bredbenner, 2005; Larson *et al.*, 2006; Winkler and Turrel, 2009; Begley and Gallegos, 2010; De Backer, 2013; Hartmann *et al.*, 2013).

When known variables are expected to be different in a specific outcome or construct of a questionnaire in a target population, the construct validity of this questionnaire can be supported if these differences are shown. In the construct validity by using known-groups method, also called extreme groups, the questionnaire is administered to two or more groups that are expected to have

different levels of the construct to demonstrate whether these differences reflect the scores of these groups (Di Lorio, 2005; Streiner and Normam, 2008; Davidson, 2014; Koh et al., 2016). Hence, cooking skills are thought to be higher among females and people with high levels of cooking knowledge compared to males and people with low levels of cooking knowledge, respectively (Caraher *et al.*, 1999; Byrd-Bredbenner, 2005; Larson *et al.*, 2006; Winkler and Turrel, 2009; Begley and Gallegos, 2010; De Backer, 2013; Hartmann *et al.*, 2013).

Few articles addressing this method in the area of nutrition were found (Guyonnet *et al.* 2008; Söderhamn *et al.*, 2012; Vanderwegen and Van Nuffelen, 2012; Weller *et al.*, 2014; Klie-mann *et al.*, 2016; Koh et al., 2016). In the available scientific literature, none were found combin-ing it with cooking skills. Based on a systematic search of questionnaires that evaluate cooking skills, few validated questionnaires were found (Barton *et al.*, 2011; Condrasky *et al.*, 2011; Costa, 2013). One of them seemed more appropriate for evaluating cooking skills related to healthy eating. This questionnaire was developed to evaluate the cooking intervention program Cooking with Chefs by researchers from Clemson University in South Carolina, United States of America (Michaud, 2007) and applied in different groups of subjects (Warmin *et al.*, 2012; Condrasky *et al.*, 2013).

Considering that questionnaires evaluating the cooking skills and healthy eating habits of university students were not found in Brazil, the Cooking with Chefs' questionnaire has been cross-culturally adapted for university students in this country. However, it is unknown if it can detect differences between levels of cooking knowledge' and gender. Therefore, the Brazilian cooking skills and healthy eating questionnaire needs to be validated, using the construct validity by known-groups method.

Thus, the present study aims to provide the construct validity by the known-groups method of a cooking skills and healthy eating evaluation questionnaire for Brazil.

Methods

Participants and procedures

Based on the 4,112 applicants for enrollment at the Federal University of Santa Catarina (UFSC), Brazil, in 2015, freshmen enrolled in undergraduate courses in this university were recruit-ed. The recommendation of 10 people for each item (10:1) of the questionnaire was followed for the validation process (Streiner and Normam, 2008). Moreover, a representative sample of this population was considered. Thus, a minimum of 770 participants, considering 10% loss, 2.0 effect, and 5% of random error was stipulated in this study.

The inclusion criteria were students 16 years or over and enrolled in undergraduate programs at UFSC, as freshmen in the year 2015. Those enrolled in graduate or online undergraduate courses were excluded.

The university students were recruited at an event which occurred on the first day class of the second semester of 2015. Students who had started their undergraduate program at UFSC in 2015 were selected based on convenience. They voluntarily accessed the online questionnaire until the established sample size was achieved. Folders were distributed in the classrooms and in the line at the university restaurant. The questionnaire was also promoted on websites during the period of the online survey (August to November, 2015). The folders contained a quick response code (*QRcode*) for participants to easily access the online questionnaire on their smartphones, if they chose to do so.

The study received ethical approval from the UFSC Ethics Committee and informed consent was obtained from all participants.

Measurement

The cooking skills and health eating evaluation questionnaire developed to evaluate the Cooking with Chef (CWC) intervention program was primarily validated with 51 items (Michaud, 2007). Three scales of this questionnaire were changed and validated (Condrasky *et al.*, 2011). Moreover, its online format was tested with university students (Warmin *et al.*, 2012), and further adapted by Condrasky *et al.* (2013). Then, the final questionnaire consisted of six scales, one knowledge evaluation section, and a short index, with a total of 64 items. The questionnaire presented predictive and construct validity, showed different correlations between their scales among people classified as low and high cooking knowledge (Michaud, 2007). Except for the Cooking Behavior measure, all remaining scales had adequate consistency (Michaud, 2007; Condrasky *et al.*, 2011).

The questionnaire items were distributed in 8 measures. The Availability and Accessibility of Fruits and Vegetables (AAFV) index measured the availability of fruits and vegetable over the past week. Items from the original index (Block *et al.*, 2000; Dave *et al.*, 2012) were excluded and internal consistency was adequate. There was a total of 7 items with yes/no questions, scored as 1 or 2, respectively (Michaud, 2007). The Cooking Attitude (CA) measured how respondents felt about cooking. It was composed of 7 items with 5-point Likert responses (from “strongly disagree” to “strongly agree”), where 4 items had statements with reverse wording that had reversed scores (Michaud, 2007; Condrasky *et al.*, 2011; Warmin *et al.*, 2012). The CA was originated from an 18-items scale based on the What’s Cooking survey (Byrd-Bredbrenner, 2005), Physical Activity En-

joyment Scale (PACES) (Kendzierki and DeCarlo, 1991), and Body and Soul Peer Counselor Handbook (National Institute of Health, 2006).

The Cooking Behavior (CB) measured the frequency of common cooking activities based on the Food and Cooking Skills Questionnaire (Wrieden *et al.*, 2007). Here there was a 3-items scale with low internal consistency (Michaud, 2007) adapted to 11-items, but not yet validated (Kerrison, 2014). CB measured responses were “not at all”, “1 to 2 times a month”, “once a week”, “several times a week”, and “about every day”.

Four self-efficacy scales (Produce Consumption Self-Efficacy - SEPC, Cooking Self-Efficacy - SEC, Using Basic Cooking Techniques - SETC, Self-Efficacy for Using Fruits, Vegetables, and Seasonings - SEFVS) were developed to evaluate cooking and nutrition related self-efficacy. Responses options were based on the 5-point Likert scale (from “not at all confident” to “extremely confident”). They measured the degree of confidence in meeting the government’s three recommendations for the consumption of fruits and vegetables (SEPC) (Bere and Klep 2005), performing 6 basic cooking activities (SEC) (Caraher *et al.*, 1999; Byrd-Bredbrenner, 2005), 12 specific cooking techniques (SECT) (Byrd-Bredbrenner, 2005), and using fruits and vegetables when cooking (9 items) (Caraher *et al.*, 1999; Wrieden *et al.*, 2007).

The last measure evaluated the level of cooking knowledge by the Knowledge of Cooking Terms and Techniques (CTT), based on a 46-item instrument (Byrd-Bredbrenner, 2004; Byrd-Bredbrenner, 2005), selecting 8 items with multiple choice answers, where the correct answer is given 1 point. The higher the value of the measures, the higher the cooking skills.

This questionnaire was originally applied in written form to parents, caregivers (Condrasky *et al.*, 2011), and cooks (Condrasky *et al.*, 2013). An online form was also given to university students (Warmin *et al.*, 2012). It was cross-culturally adapted to Brazil, according to the following procedures: 1) Translation (two independent translations), 2) Synthesis of Translations (discussion among two translators and one researcher), 3) Back-translations (two independent translations compared with the original questionnaire, followed by a discussion among dietitians), 4) Expert Committee (consensus workshop with experts and university students), 5) Synthesis of the final Brazilian Portuguese version, 6) Pre-test (self-administered online questionnaire by 48 university students) (Guillemin *et al.*, 1993; Beaton *et al.*, 2000). The original and translated questionnaires were compared for conceptual, item, semantic (idiomatic and experiential), and operational equivalences (Reichenheim and Moraes, 2007).

Data related to age, gender, children, self-reported cooking knowledge, source of cooking learning, and lunch or dinner location was also collected to characterize the population of the study.

Data analysis

Mean and standard deviations for age, as well as the relative frequency of gender, children, self-reported cooking knowledge, source of cooking learning, and lunch or dinner location data were calculated. Cronbach's alpha coefficient was obtained to verify the scale's internal consistency, which was 0.70, a satisfactory value.

Construct validity was determined by the known-groups method, that is usually done when a test can discriminate between a group of individuals known to have a particular trait and a group that does not have this trait. The known-groups method is applied by comparing these groups that are expected to differ in their main construct (Di Lorio, 2005; Streininger and Normam, 2008; Davidson, 2014; Koh et al., 2016).

The known groups were gender (males and females) and level of cooking knowledge (high and low) of participants. Cooking skills were then the main construct, which was thought to differ between these established groups; females and people with high levels of cooking knowledge have higher cooking skills scores. The t-test for independent samples was performed by assessing the means differences between groups according to each scale of the cooking skills questionnaire, considering p-value <0.05. If the differences are proven, the questionnaire is considered able to detect these differences, thus being validated.

The level of cooking knowledge was calculated based on responses to the Knowledge of Cooking Terms and Techniques (CTT) measure of the questionnaire. Five questions were about basic cooking techniques related to fruits and vegetables, 2 about correctly measuring food, and 1 about planning meal preparation. If they answered correctly $\geq 75\%$ of the items (≥ 6 items), they were classified as having high level of knowledge and those who answered $\leq 60\%$ (≤ 5 items), were classified as having low level of knowledge (Michaud, 2007). The calculations were made using the Statistical Package for the Social Sciences SPSS® version 18.0 (IBM Corporation, Armonk, NY, 2011).

Results

Based on the 850 students who responded to the online Brazilian cooking skills and healthy eating questionnaire, 767 were eligible for the present study. Individuals had an average age of 20.7 (± 5.59) years old. The profile of the students is presented in Table I.

Gender distribution and differences in cooking skills are described in Table II.

Female participants had significantly higher mean scores than males for all measures (AAFV, CA, CB, SEPC, SEC, SEFVS) except for SECT, where there was no difference.

The distribution and the differences between high and low levels of cooking knowledge in students' cooking skills is presented in Table III. The internal consistency values of the scales are also presented.

Most students (74.3%) were classified as having low level of cooking knowledge. There were significant differences in all measures according to cooking knowledge level of participants. However, the difference found in the CB scale was close to the established limit of significance (0.048). Overall, students with higher level of knowledge had higher mean scores than those with lower levels of knowledge in all scales. Alpha values were all adequate, except for CA (0.33) and CB (0.59) scales, indicating they have low internal consistency.

Discussion

The validity of the present questionnaire revealed the differences examined between groups by the known-groups method. As Streiner and Norman (2008) have discussed, it is appropriate to clearly distinguish these known-groups so that it is possible to plan focused interventions according to these groups or conduct new reliable and deeper diagnoses. Thus, males and students with low levels of cooking knowledge had lower mean scores than females and students with high levels of cooking knowledge in mostly scales. These results demonstrated that the questionnaire was validated in Brazil in terms of differences between gender and cooking knowledge.

Construct validity by known-groups method

The questionnaire used in the present study was applied to a larger and representative sample, which may support the validity's results in the specific population. Barton *et al.* (2011) have validated the content of their short cooking skills questionnaire consisting of 19 items with 160 experts and 26 professionals. Face validity was carried out in a small sample (n=20), which was limited to the evaluation of the ability of participants to fill out and basic comprehension.

Barton *et al.*'s (2011) questionnaire presented very few items and scales. Some items were similarly to the idea of questionnaire in the present study. These items were related to frequency of preparing food, confidence in following a simple recipe, cooking with basic ingredients, and preparing new foods and recipes. However, most of the items were related to nutritional knowledge (about food portions) and none were about cooking knowledge, differently from the Brazilian questionnaire. Construct validity was not assessed in this questionnaire.

Costa (2013) developed a 40-item cooking skills questionnaire, including measures about daily meal preparation submitted to construct, convergent, and discriminant validity. After using factor analysis, a seven-factor solution was satisfactorily recovered and each of the items tested loaded higher than 0.70 on their corresponding measure. Correlations among items and measures were also evaluated for testing discriminant and convergent validity of the instrument (Clark and Watson, 1995). However, there was no item added to evaluate healthy eating related to cooking skills, nor were there items about cooking behavior, confidence, or knowledge. In the present study,

the evaluation of correlations has not been carried out, because the original questionnaire had already applied the exploratory factorial analysis (Michaud, 2007; Condrasky *et al.*, 2011).

Construct validity by known-groups method has been used in other studies about validation of food or nutrition questionnaires (Guyonnet *et al.* 2008; Söderhamn *et al.*, 2012; Vanderwegen and Van Nuffelen, 2012; Martins *et al.*, 2013; Weller *et al.*, 2014; Kliemann *et al.*, 2016). Söderhamn *et al.* (2012), Vanderwegen and Van Nuffelen (2012), Martins *et al.* (2013) and Kliemann *et al.* (2016) measured the construct validity of their respective questionnaires using two known-groups for comparison and using the t-test, like the present study.

Other ways of validity using known-groups are shown in some studies which compared three or more groups using ANOVA test (Guyonnet *et al.*, 2008; Vanderwegen and Van Nuffelen 2012; Weller *et al.*, 2014).

The present study showed construct validity using the known-groups method regarding gender differences. It was clear based on the evaluation of the present questionnaire that men and women are different regarding cooking attitudes, behaviors, self-efficacy, and knowledge. Differences were found between men and women in their confidence to cook particular foods, mainly related to fruits and vegetables. However, differences between gender in the use of cooking terms and techniques were not found, thus being similar to the present study (Caraher *et al.*, 1999; Larson *et al.*, 2006; Winkler and Turrell, 2009; Hartmann *et al.*, 2013).

Only the Self-Efficacy in Cooking Terms and Techniques (SECT) scale showed no differences between genders. Gender would have little influence on one's confidence in using these cooking elements as seen in the other studies (Caraher *et al.*, 1999; Winkler and Turrell, 2009). It is possible that students' knowledge seems to more closely influence the evaluation of self-efficacy in specific cooking terms and techniques (Byrd-Bredbenner, 2005), rather than gender.

Regarding cooking knowledge, the students with high levels of cooking knowledge had significantly higher mean scores for all scales, compared to those with low levels of cooking knowledge, as hypothesized (Byrd-Bredbenner, 2005; Winkler and Turrell, 2009; Begleys and Gallegos, 2010; Caraher *et al.*, 2010; Warmin *et al.*, 2012; De Backer, 2013; Jones *et al.*, 2014). Although, most students (74.8%) from the present study claimed they knew how to cook, few students were classified as having a high level of cooking knowledge (25.2%), similar to what Byrd-Bredbenner (2005) found in her study with university students.

Cooking knowledge has been studied according to knowledge of specific cooking terms and techniques (Caraher *et al.*, 1999; Byrd-Bredbenner, 2005; Michaud, 2007; Warmin *et al.*, 2012; Condrasky *et al.*, 2013; Kerrison, 2014), considered as practical tasks and mechanical skills (Short, 2003). Byrd-Bredbenner (2005) verified that the university students mentioned considerable experience and confidence in microwaving, reheating leftovers, boiling, baking, and grilling. However,

the author found that their confidence in poaching, stewing, and sautéing was low. She suggested that cooking terms need to be described, with examples and substitutions, instead of only cited in recipes to encourage people to cook.

On the other hand, cooking skills are usually evaluated by cooking from scratch, without specifying cooking techniques or terms (Caraher *et al.*, 1999; Short, 2003; Michaud, 2007; Begleys and Gallegos, 2010; Raber *et al.*, 2016). Little is mentioned about other fields of knowledge that could be part of cooking knowledge such as academic knowledge, which could involve nutrition and food portions (Short, 2003; Byrd-Bredbrenner, 2005; Wrieden *et al.*, 2007; Barton *et al.*, 2011).

Furthermore, it is important to note the relationship between cooking knowledge and cooking behaviors. Differences between high and low cooking knowledge levels found for the CB scale were close to the limit of significance. This suggests that students with high levels of cooking knowledge may present slightly higher mean scores for their cooking behaviors compared to students with low levels, considering that cooking knowledge is not necessarily related to actual cooking practices (Murray *et al.*, 2016).

Reliability using an internal consistency analysis

All of the studies that validated a cooking skills questionnaire evaluated the reliability using an internal consistency analysis (Michaud, 2007; Barton *et al.*, 2011; Condrasky *et al.*, 2011; Condrasky *et al.*, 2013; Costa, 2013), such as the present study. Michaud (2007) showed adequate Cronbach's alpha coefficients for all the measures, except for Cooking Behavior. This could be explained by the low number of items (3 items) which composed this specific measure. In addition, Cronbach's alpha coefficients were satisfactory for internal consistency for the questions related to cooking confidence (0.86) and knowledge (0.84) of Barton *et al.*'s (2011) questionnaire. According to the authors, the other sections of their questionnaire were not tested because the domains within each section were assessing different constructs. Costa (2013) showed satisfactory internal reliability of all the measures extracted.

In the present study, the internal consistency was evaluated for all sections of questionnaire with a larger sample. All scales had high internal consistency, except Cooking Attitude (CA) and Cooking Behaviour (CB) scale. CA measure presents reversed items (Michaud, 2007; Condrasky *et al.*, 2011). At first, the 7-item CA scale showed good internal consistency and the items were evaluated as positive and negative attitudes separately (Michaud, 2007). The negative items evaluated

also showed adequate internal consistency in different subjects, but the positive items were not evaluated (Condrasky *et al.*, 2011).

In the present study, problems in the process of cross-cultural adaptation of the questionnaire into Brazilian Portuguese probably occurred, mainly referred to reversed items, such as “*I don't like to cook because it takes too much time*”. Reversed worded items do not always prevent response bias and it is suggested that scores may be contaminated by respondents due to their lack of attention or confusion (van Sonderen *et al.*, 2013). However, these kinds of items have to be rethought and adjusted to be more appropriate to the Brazilian Portuguese language, based on the results above.

The CB scale of original cooking skills questionnaire was not assessed in the format it was applied in the present study. Michaud (2007) first developed a 3-item Cooking Behavior scale. The internal consistency was low since its development and validation. Warmin *et al.* (2012) maintained a 3-item Cooking Behavior scale and applied the entire questionnaire with university students. The internal consistency of actual 11-item CB scale may have not been previously evaluated even when it was used in Kerison's (2014) study.

Internal consistency shows the extent to which items in a scale are inter-correlated and thus measuring the same construct (Terwee *et al.*, 2007; Strauss *et al.*, 2016). Considering that the internal consistency of the CA and CB scales was below the accepted value (0.70), items from these scales, or part of these items, were not sufficiently inter-correlated. Thus, it is suggested that either these items might not represent the constructs in question or each construct shows diverse characteristics as well as these scales might measure multiple traits. The number of items in the scale directly influences the Cronbach's alpha values. The greater the number of items, the higher the alpha value that can be produced (Di Lorio, 2005; Streiner and Norman, 2008; Panayides, 2013).

In the present study, CB scale has 11 items. In this case, higher values of alpha could reflect redundant items as well as a narrow coverage of the construct, decreasing its precision (Panayides, 2013). However, it is not problem when it is used for comparing mean scores between different groups, keeping in mind that means and correlations based on individuals lose their psychological meaning (Sijtsma, 2009). In this sense, it can be suggested that CB measures traits that are better analyzed individually than in groups, even the construct validity shows significant differences between the compared groups. Moreover, this scale can represent a specific construct, considering each item as specific trait, such as the questions about eating out present in this scale.

Considering that the CA scale has less items (7) than CB, additional information is needed to know what alpha stands for, because alpha itself cannot be interpreted as a measure of internal consistency. Cronbach's alpha value may be low due to the reduced number of items (Di Lorio, 2005; Streiner and Norman, 2008; Panayides, 2013). Additionally, statistical results based on a sin-

gle test administration convey little if any information about individuals' measurement accuracy reflected by their propensity distributions (Sijtsma, 2009). It is valid to note that the Cronbach's alpha can support the scale structure (item correlations and number) and not necessarily its complete reliability. Parallel tests would be needed to test reliability (Sijtsma, 2009; Panayides, 2013).

Furthermore, construct validity using differences between gender and between cooking knowledge was achieved in both the CA and CB measures. Therefore, these scales achieved accurate measures for detecting these differences (Di Lorio, 2005; Streinner and Norman, 2008).

However, the present study does not eliminate the possibility of inadequate cross-adaptation of this specific scale to the Brazilian Portuguese version. Hence, each item from the CA and CB scales must be reviewed to better represent them in the evaluation of cooking skills of Brazilian university students and not necessarily exclude these scales or items. Some additions are needed to increase the internal consistency of these scales. It is therefore suggested to explore the present questionnaire, verifying its dimensionality with factor analyses or new exploratory principal component analysis (Terwee *et al.*, 2007; Strauss *et al.*, 2016) in CA and CB scales.

Limitations and strengths

This study was conducted in a single Brazilian university, and while it receives students from all over the country, this research suggested that this questionnaire could be applied to the various culinary contexts of other Brazilian regions. Furthermore, the description of the construct validity by using the known-group method in the context of Brazilian university students allowed some specific cooking skills constructs to emerge, mainly related to cooking attitudes and behaviors.

Regarding the lack of differences found between gender in the SECT scale, it is suggested that self-efficacy in cooking terms and techniques might depend on the dimension of cooking knowledge. If most of the subjects do not know the cooking terms and techniques from this scale, self-efficacy for using them could be underrepresented, independently of gender. Thus, specific terms and techniques that are considered parameters of the range of cooking knowledge must be established, such as the examination of culinary techniques for cooking from scratch, for example.

Special attention must be paid to cooking attitude and behavior scales, given their low internal consistency that could influence the results of this validation process. The CA scale can structure positive and negative items separately. The CB scale explores other components such as eating away from home. Items related to using leftovers from another meal or away from home ($n=2$) as well as eating out of home ($n=3$) were mixed in this scale, may become confusing for respondents. Changes in the questionnaire can be made for further analysis and adaptation for Brazil, considering cooking behaviors related to the home cooking and eating away from home separately.

It is worth mentioning that in the present study half of participants usually had lunch or dinner away from home. This finding could be analyzed regarding the barriers to home cooking behaviors found by people who eat away from home, as seen in studies (Larson et al., 2006; Smith et al., 2013; Jones et al., 2014). Youth who frequent fast-food settings less are more likely to cook at home (Larson et al., 2006). The time spent cooking at home is considered a barrier, leading university students to prefer eating in cafeteria settings (Jones et al., 2014). Although eating away from home has increased from the 1960's to 2000's, it is difficult to affirm that this can contribute to the decline of home food preparation by people. However, people may be preparing meals at home by using leftovers from ready meals or convenience foods as well as eating takeout (Smith et al., 2013).

Moreover, data from the CB scale is still unclear about detecting differences between cooking knowledge levels. It can strengthen the premise that knowledge is not related to the behavior, specifically for food or nutrition (Murray *et al.*, 2016).

On the other hand, the present study also had many strong points. Although there was low consistency for CA and CB scales, they were able to detect differences between genders and between cooking knowledge levels, according to the expectations in the literature (Caraher *et al.*, 1999; Byrd-Bredbenner, 2005; Larson *et al.*, 2006; Winkler and Turrel, 2009; Begleys and Gallegos, 2010; Caraher *et al.*, 2010; Warmin *et al.*, 2012; De Backer, 2013; Hartmann *et al.*, 2013; Jones *et al.*, 2014). Therefore, the validity analysis of the cooking skills and healthy eating questionnaire demonstrated its ability to detect differences between groups using the known-groups method, showing that their scales measured what they proposed to measure.

This highlights that the questionnaire can be used to clearly distinguish between these known-groups, making it possible to plan focused interventions according to these groups or conduct new reliable and deeper diagnoses regarding cooking skills and healthy eating. Hence, it is important to consider that males and students with low levels of cooking knowledge may require special attention related to their cooking skills and healthy eating habits, mainly in the university environment.

Conclusions

The present study showed the construct validity using the known-groups method regarding gender and cooking knowledge differences. It appears to be the first validation study of a Brazilian Portuguese cooking skills and healthy eating questionnaire able to detect these differences. This study could contribute to reducing the lack of validated and reliable cooking skills questionnaires.

The availability of this valid questionnaire may support the reliable and accurate cooking skills' data collection in Brazilian university student populations. The questionnaire's potential for detecting the sited differences in the cooking skills of university students can also contribute to

identifying vulnerable groups that may likely need healthy eating and cooking interventions. The use of this valid instrument and consequently accurate diagnosis can support public health policies regarding the cooking skills of university students in Brazil. Therefore, this study may be useful to guide others in performing questionnaire validation by using the known-groups method.

Since no differences between genders have been found only in SECT scale, further deeper examinations of SECT measures are suggested. On the other hand, it does suggest that knowledge about specific cooking terms and techniques might influence individuals' self-efficacy, independently of gender. CA and CB scales also need to be further examined regarding modifications in their structures.

Moreover, variables such as living with others, meal preparation responsibility, lack of time, source of cooking learning, and eating out of home can be explored since they presented differences in cooking skills across studies. Additionally, it is important to propose further evaluations in adults, the elderly, and children, where gender and knowledge differences may be less prominent.

The evaluation of other psychometric proprieties represents the next step, aiming to better comprehend the Brazilian cooking skills and healthy eating questionnaire.

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Table I. Demographic, eating and cooking characteristics of the students from a Brazilian university (n=767).

Questions	Responses	N	%
Do you have children < 16 years old?	Yes	24	3.1
	No	743	96.9
Do you believe that you know how to cook?	Yes	549	71.6
	No	218	28.4
Indicate who you learned to cook with.	Mother/Father/Grandparents/family member exclusively	113	14.7
	Cooking class/School exclusively	1	0.1
	Recipe book exclusively	0	0.0
	Internet exclusively	8	1.0
	Friends exclusively	1	0.1
	TV program exclusively	1	0.1
	2 or more of the previous options	670	87.4
	Alone	20	2.6
	Others	9	1.2
	Did not answer	219	28.6
Indicate the location where you usually make your main meal (lunch or dinner).	Home	376	49.0
	Away from home	391	51.0

Table II. Differences between the means of men and women's cooking skills, according to the measures of a Brazilian cooking skills questionnaire (n=767).

Measures	Gender	N (%)	Mean (SD)	<i>P</i> -value ¹
Availability and Accessibility of Fruits and Vegetables Index	Female	457 (59.6)	0.69 (2.74)	0.016*
	Male	310 (40.4)	0.64 (2.65)	
Cooking Attitude	Female	457 (59.6)	3.49 (3.29)	0.033*
	Male	310 (40.4)	3.40 (3.11)	
Cooking Behavior	Female	457 (59.6)	2.74 (0.49)	0.011*
	Male	310 (40.4)	2.65 (0.52)	
Produce Consumption Self-Efficacy	Female	457 (59.6)	3.29 (1.15)	0.024*
	Male	310 (40.4)	3.11(1.07)	
Cooking Self-Efficacy	Female	457 (59.6)	3.84 (0.81)	0.000*
	Male	310 (40.4)	3.56 (0.86)	
Self-Efficacy for Using Basic Cooking Techniques	Female	457 (59.6)	3.42 (0.80)	0.096
	Male	310 (40.4)	3.32 (0.77)	
Self-Efficacy for Using Fruits, Vegetables, and Seasonings	Female	457 (59.6)	3.59 (0.89)	0.000*
	Male	310 (40.4)	3.31 (0.92)	
Knowledge of Cooking Terms and Technique Evaluation	Female	457 (59.6)	4.63 (1.58)	0.000*
	Male	310 (40.4)	3.95 (1.79)	

Notes: ¹T-test for independent samples.

* $p < 0.05$ for significance

Table III. Differences between high and low levels of cooking knowledge in Brazilian university students' cooking skills and internal consistency of cooking skills scales (n=767).

Measure	Cooking knowledge level ¹	N (%)	Mean (SD)	<i>P</i> -value ²	Cronbach's alpha coefficient
Availability and Accessibility of Fruits and Vegetables Index	Low	570 (74.3)	0.65 (0.30)	0.000*	0.80**
	High	193 (25.7)	0.75 (0.23)		
Cooking Attitude	Low	570 (74.3)	3.38 (0.54)	0.000*	0.33
	High	193 (25.7)	3.66 (0.48)		
Cooking Behavior	Low	570 (74.3)	2.69 (0.52)	0.048*	0.59
	High	193 (25.7)	2.76 (0.44)		
Produce Consumption Self-Efficacy	Low	570 (74.3)	3.13 (1.12)	0.000*	0.81**
	High	193 (25.7)	3.50 (1.07)		
Cooking Self-Efficacy	Low	570 (74.3)	3.60 (0.83)	0.000*	0.84**
	High	193 (25.7)	4.11 (0.74)		
Self-Efficacy for Using Basic Cooking Techniques	Low	570 (74.3)	3.25 (0.77)	0.000*	0.87**
	High	193 (25.7)	3.76 (0.71)		
Self-Efficacy for Using Fruits, Vegetables, and Seasonings	Low	570 (74.3)	3.33 (0.91)	0.000*	0.89**
	High	193 (26.7)	3.93 (0.78)		

Notes: ¹Low= Low level of cooking knowledge; High=High level of cooking knowledge. ²T-test for independent samples.

* $p < 0.05$ for significance

** $\alpha > 0.70$ for acceptable consistency/descriptive scale correlation

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