

# Assessment of Food and Cooking Skills: Validation of a Portuguese Version of a Tool and Characterisation of Food and Cooking Skills in Young Adults

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## Keywords

Food skills · Cooking skills · Questionnaire validation · Young adults · Eating habits

## Abstract

**Introduction:** Food and cooking skills (FCSks) are defined as a complex, interrelated, and person-centred set of skills, necessary to provide and prepare safe, nutritious, and culturally acceptable meals for all members of the household. Recent studies have associated higher FCSk with healthier eating habits and better health. This study aimed to validate a Portuguese version of a tool to assess and describe FCSk in young adults. **Methods:** A cross-sectional study used an online anonymous questionnaire that was disseminated to students from three Portuguese Higher Education Institutes. The questionnaire validation included Cronbach alpha and confirmatory factor analysis (CFA). The Mann-Whitney test was used for evaluating sample differences and Pearson correlation for association among variables. **Results:** Internal consistency reliability was 0.89 for cooking skills (CSks) and 0.87 for food skills (FSks). A moderate positive correlation was found between CSks and FSks confidence ( $r = 0.658, p < 0.01$ ). CFA presented a good adjustment model for most of the fit

indices, indicating the adequacy of the questionnaire. The CSks score was  $74.1 \pm 21.2$  (moderate) and the food Skills was  $94.2 \pm 20.8$  (high). Cook pulses, steaming food, and planning meals ahead scored the lowest value, while boiling or simmering food, chopping, peeling vegetables, and reading the best-before date scored the highest value. No difference was found among sex ( $p_{CSk} = 0.576; p_{FSk} = 0.158$ ), age ( $p_{CSk} = 0.566; p_{FSk} = 0.130$ ), body mass index classes ( $p_{CSk} = 0.903; p_{FSk} = 0.320$ ), or course ( $p_{CSk} = 0.169; p_{FSk} = 0.126$ ). The greatest interest in gastronomy and frequency of meal preparation is associated with higher FCSk ( $p < 0.05$ ). **Conclusion:** This research validated a Portuguese version of a tool to assess FCSk among young adults. Internal consistency reliability was adequate. Confirmatory factor analysis returned good psychometric properties for the questionnaire. Authors identified lower FCSk competencies in cooking pulses and vegetables, which are healthy and sustainable foods. This may compromise the adoption of healthy eating behaviours, so promoting FCSk in young adults may pose a strategy for nutrition and public health in reducing diet-related diseases. This tool may be used to identify opportunities for intervention in public health nutrition.

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## Avaliação de competências culinárias e alimentares: validação da versão portuguesa de uma ferramenta e caracterização de competências culinárias e alimentares em adultos jovens

### Palavras Chave

Competências alimentares · Competências culinárias · Validação de questionário · Jovens adultos · Hábitos alimentares

### Resumo

**Introdução:** O conceito de competências culinárias e alimentares (FCSk) está associado à existência de um conjunto complexo de competências, inter-relacionadas e centradas na pessoa quando capaz de fornecer e preparar para todos os membros do agregado familiar refeições seguras, nutritivas e culturalmente aceitáveis. Estudos recentes associaram as FCSk mais elevadas a hábitos alimentares mais saudáveis e melhor saúde. Este estudo visou validar uma versão portuguesa de uma ferramenta para avaliar e descrever as FCSk em adultos jovens. **Métodos:** Foi feito um estudo transversal que utilizou um questionário anónimo online, que foi divulgado a estudantes de três institutos de Ensino Superior portugueses. A validação do questionário incluiu Cronbach alfa e o Confirmatory Factor Analysis (CFA). O teste Mann-Whitney foi utilizado para avaliar as diferenças da amostra e a correlação de Pearson para associação entre variáveis. **Resultados:** A fiabilidade da consistência interna foi de 0,89 para CSk e 0,87 para FSk. Foi encontrada uma correlação positiva moderada entre a cozedura e a confiança nos conhecimentos alimentares ( $r = 0.658, p < 0.01$ ). CFA apresentou um bom modelo de ajuste para a maioria dos índices de ajuste, indicando a adequação do questionário. A pontuação de competências culinárias foi de  $74.1 \pm 21.2$  (moderada) e as competências alimentares de  $94.2 \pm 20.8$  (elevada). Cozinhar legumes, cozer alimentos a vapor e planear refeições com antecedência obteve o valor mais baixo, enquanto ferver ou ferver alimentos, picar e descascar vegetais, e ler a melhor data antes da data obteve o valor mais alto. Não foi encontrada diferença entre sexo ( $p_{CSk} = 0.576; p_{FSk} = 0.158$ ), idade ( $p_{CSk} = 0.566; p_{FSk} = 0.130$ ), classes do Índice de Massa Corporal ( $p_{CSk} = 0.903; p_{FSk} = 0.320$ ) ou curso ( $p_{CSk} = 0.169; p_{FSk} = 0.126$ ). O maior interesse em gastronomia e frequência de preparação de refeições está associado a uma FCSk mais elevada ( $p < 0.05$ ). **Conclusão:** Esta investigação validou uma versão portuguesa de uma ferramenta para avaliar a FCSk entre os jovens adultos. A fiabilidade da consistência interna era adequada.

A Confirmatory Factor Analysis devolveu boas propriedades psicométricas para o questionário. Os autores identificaram competências inferiores das FCSk em legumes e legumes de cozinha, que são alimentos saudáveis e sustentáveis. Isto pode comprometer a adoção de comportamentos alimentares saudáveis, pelo que a promoção das FCSk em adultos jovens pode constituir uma estratégia para a nutrição e saúde pública na redução de doenças relacionadas com a dieta. Esta ferramenta pode ser utilizada para identificar oportunidades de intervenção na nutrição da saúde pública.

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### Background

Food skills are an essential set of skills for life [1] and they are defined as a complex, interrelated, and person-centred set of skills that are necessary to provide and prepare safe, nutritious, and culturally acceptable meals for all members of one's household [1, 2]. Food skills are a component of food literacy, which is defined as the set of skills and knowledge that facilitates informed choices regarding eating habits, considering the impact that these choices have on health and economic, social, and environmental sustainability [1, 3–5].

Among the diversity of skills included in food skills, we can identify the following: the ability to access and interpret the nutritional information on food labels; the ability to plan meals and manage the budget; the ability to conceptualize food, including adjusting recipes and using leftovers; ability to use mechanical techniques, including chopping, mixing, and following recipes; and ability to safely store and prepare food [1, 6, 7]. According to the current literature, higher food skills (FSks) are associated with healthier eating habits [4], including a higher intake of vegetables and fruits and a lower intake of fats, sugars, and ultra-processed foods [2, 4, 8–10]. Also, higher FSks seem to be associated with better health, mainly by preventing the development of excessive weight [11, 12].

Cooking skills are defined as the organization and transformation of ingredients to produce a meal, involving a variety of skills and competencies related to the technical act of preparing food and the ability to plan, cook, and deliver food within the food environment, time, and budget constraints. Cooking skills include some of the competencies from FSks that allow individuals to decide, prepare, and produce meals [13].

In general, university students have low FSks, which is one of the identified barriers to compliance with healthier

eating habits [14, 15]. University admission is characterized by an increase in unhealthy eating habits, like the low consumption of fruits, vegetables, pulses, whole grains, and fish, a high intake of snacks, red meat, and sugars, and the habit of skipping breakfast [16]. By promoting the development of FSks among university students, we may counteract the presented tendency and promote healthier eating habits among this population [2, 17, 18].

Many intervention programs, targeting FSks, have been developed [4]; however, methodological limitations have been identified, such as the use of non-validated assessment tools [4, 11, 19]. Two of the main barriers to the development of measuring tools are the lack of standard references [4, 20] and the non-recognition of FSks as an autonomous set of skills, leading to the non-inclusion of important elements [21, 22]. Some other limitations found in previous tools include the reference to specific foods, the targeting of specific intervention groups, and the absence of short definitions of the measured skills [21–23]. Besides the limitations identified during the development of the measuring tools, other issues have also been found in their validation, including the use of small, highly educated, and mainly female samples, the use of test-retest biased samples, and the existence of self-selection bias [22–24].

According to our research, only one study assessed the cooking skills (CSks) of Portuguese students, using a 6-item questionnaire [25]. No study has been found regarding the development and validation of an assessment tool for the evaluation of FCSks, or their promotion among young Portuguese adults.

In response to the need for the evaluation and promotion of food and cooking skills (FCSks) in young Portuguese adults, the present study intends to validate for this population, the FCSks questionnaire of Lavelle et al. [22], which considered all the barriers previously addressed. Also, we intend to characterize the FCSk as being of the same population.

## Objective

The purpose of this research was to validate the questionnaire to assess the FCSk for the young Portuguese adult population through the assessment of psychometric properties. Several goals were pursued: (a) questionnaire validation and (b) characterize the FCSk in the evaluated sample and identify possible differences among different groups using sociodemographic variables.

## Methodology

This research was a cross-sectional study among university students from Portuguese Higher Education Institutes.

### *Questionnaire Development*

The development of the questionnaire started with a review of the scientific literature regarding the FCSk among young adults and its impact on food choices and health status. The availability of tools for assessing FCSk was also analysed. Researchers found a study from Brazil [26] and another from the USA [22] that developed and validated different questionnaires to evaluate individuals' FCSk. After careful analysis of both tools, researchers decided to develop a Portuguese version of the questionnaire from Lavelle et al. [22] since it included more broad questions about FCSk and because it clearly separated food skills from cooking skills. To proceed with this adaptation, authorization was obtained from the authors.

The original questionnaire evaluates FCSk as separate dimensions: the CSks block, with 14 questions, and the FSks block, with 19 questions. Each question is rated on a scale from 1 to 7, where 1 means “not confident” and 7 means “highly confident.” An option for “never/rarely do it” is also included in the scale (scored as 0). The total confidence score results in the sum of the points given to each question. This process is applied separately for the CSks block and FSks block, resulting in two independent scores [22]. The questionnaire was initially designed to evaluate these skills separately, but researchers may use these two scores to calculate a global score for FCSk.

Two researchers (C1 English level) translated the questionnaire. After completing the Portuguese translation, respective retro-translation was carried out by another two researchers (C1 English level) and reviewed by an English proficiency professional. This version was sent to be validated by the original authors. Along this process, researchers added two more questions in the CSks block, one for “cooking soup” and another for “cooking pulses,” two culinary practices that are very popular and traditional in Portugal [27]. The third block regarding sociodemographic factors (e.g., gender, age, height, weight, degree, cooking frequency, and type of food pattern) was added for correlation purposes.

The final questionnaire was composed of 3 blocks: (1) CSks (16 questions); (2) FSks (19 questions); and (3) sociodemographic data (15 questions). Researchers used the same 1–7 scale as the original article, resulting in a total confidence score range of 16–112 points for the CSks and 19–133 for the FSks. Additionally, by calculating the theoretical quartiles of scores, a classification was established for the confidence level of CSks ( $\leq 32$  low, 32–64 moderate, 64–96 high, and  $>96$  very high) and FSks ( $\leq 38$  low, 38–76 moderate, 76–114 high, and  $>114$  very high). The Portuguese version of the questionnaire is presented as online supplementary Material (for all online suppl. material, see <https://doi.org/10.1159/000530672>).

### *Participants*

University students from Portuguese Higher Institutes in Portugal, ages above 17 years old, could fulfil the questionnaire and be part of the sample. Researchers obtained a convenience sample through the dissemination of an online link to the questionnaire among all the university students from three different universities in the cities of Lisbon and Coimbra. No exclusion criteria were applied.

The questionnaire was filled out anonymously and autonomously by the students. Before filling out the questionnaire, participants signed written informed consent. This study was

approved by the Ethical Committee of Escola Superior de Tecnologia da Saúde de Lisboa (CE-ESTeSL No. 11-2022). Data collection occurred from January to May 2021.

### Statistical Analysis

Statistical analysis was performed with the Statistical software R version 4.0.3. The results were considered significant at the 5% significance level.

### Questionnaire Validation

Questionnaire validation included several steps: (1) internal consistency reliability of the questionnaire measures; (2) exploratory analysis to assess if described measures of CSks and FSks were related but distinct (two different factors); and (3) confirmatory factor analysis (CFA) to test the model that resulted from the second step. For the first step (internal consistency and reliability), Cronbach's alpha was used, considering a value above 0.75 as highly reliable and consistent [28]. For step two, principal component analysis (PCA) was used to verify that items under each dimension of FCSks matched the ones from the original questionnaire. An oblimin rotation was performed. The overall Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were examined and returned a value of 0.89, which is good for the analysis [29].

Finally, CFA was performed. A structural equation model, using the variables and loadings from PCA was analysed, considering an overall model fit using fit indexes ( $\chi^2$  [ $p > 0.05$ ], standardized root mean square [ $\leq 0.08$ ], comparative fit index [ $\geq 0.95$ ], and Tucker-Lewis index [ $\geq 0.95$ ]) [30, 31]. Raykov's rho was used to evaluate the reliability of the CFA, considering a value above 0.7 as reliable [32].

Researchers perform all the statistical analyses for the original measures and the final version of the questionnaire [22]. No differences were found in the psychometric properties, so only results relating to the final version of the questionnaire are presented.

### Characterisation of FCKs

For the characterisation of the sample, frequency analysis was used ( $n$ , %), for qualitative data and for quantitative data, mean  $\pm$  standard deviation was used. Due to the absence of a normal distribution of the data, as well as the presence of ordinal and scale variables, non-parametric analysis was deemed as the best choice, and Spearman's correlation and the Mann-Whitney U test for comparisons among two different groups [28].

## Results

The questionnaire was answered by 275 university students from three Portuguese public institutions. Table 1 presents the sociodemographic characteristics of the sample. Most of the respondents were female (67.5%), and the average age was  $21 \pm 4.2$  years old. Most of the sample (88.9%) presented a normal body mass index (BMI) and prepares meals daily. The mother is referred to as the major contributor to the development of FCSk.

### Questionnaire Validation

The internal consistency reliability was 0.89 for cooking skills and 0.87 for food skills (Table 2). The inter-item

correlation mean was 0.91 for cooking skills and 0.90 for food skills. A moderate positive correlation [33] was found between FCSk confidence ( $r = 0.658$ ,  $p < 0.01$ ), indicating that the two measures are related.

Regarding PCA, Bartlett's test of sphericity and KMO returned an overall MSA = 0.89. PCA resulted in two factors, both with eigenvalues over 1 (Table 3). The first component accounts for 29.5% of the variability and the other for 7.5%. The loadings for each variable indicate that most of the CSks and FSks fall into their original component, with some exceptions. One CSks item (*c8. Microwave food*) had a higher loading for FSks (factor CSk =  $-0.176$ , factor FSk =  $0.336$ ), and three FSks (*f14. Use leftovers to create another meal; f15. Keep basic items in your cupboard for putting meals together; and f18. Read the nutrition information on food labels*) had higher loading for CSks (F14. factor CSk =  $0.366$ , factor FSk =  $0.339$ ; F15. factor CSk =  $0.447$ , factor FSk =  $0.290$ ; F18. factor CSk =  $0.302$ , factor FSk =  $0.296$ ).

A model based on the PCA was used for the confirmatory analysis. Results are presented in Tables 4 and 5, showing a good adjustment model for most of the fit indices. The factor correlation between the two confidence measures is  $r = 0.689$ ,  $p < 0.01$ .

### FCSks in University Students

Table 6 presents the mean scores for FCSk confidence measures. The overall score is 74.1 (moderate) for CSks and 94.2 (high) for FSks. Cook pulses using pressure cooking ( $\bar{x}_{FS} = 2.48 \pm 2.52$ ), steaming food ( $\bar{x}_{FS} = 2.58 \pm 2.63$ ), and making sauces from scratch ( $\bar{x}_{FS} = 3.50 \pm 2.62$ ) are the CSks with the lowest score, while boil or simmer food ( $\bar{x}_{FS} = 6.12 \pm 1.35$ ), chop and peel vegetables ( $\bar{x}_{FS} = 5.77 \pm 1.54$ ), chop, mix and stir food ( $\bar{x}_{FS} = 5.65 \pm 1.68$ ) are the ones with the highest score.

For FSks, the ability to buy cheaper cuts of meat to save money ( $\bar{x}_{FS} = 2.98 \pm 2.55$ ) and plan meals ahead ( $\bar{x}_{FS} = 3.84 \pm 2.46$ ) score the lowest value, while reading the best-before date on food ( $\bar{x}_{FS} = 6.15 \pm 1.26$ ) and reading the storage and use by information on food packets ( $\bar{x}_{FS} = 5.83 \pm 1.58$ ) score the highest value. Upon analysing the FCSk level by variable, no difference was found among sex ( $p_{CSk} = 0.576$ ;  $p_{FSk} = 0.158$ ), age ( $p_{CSk} = 0.566$ ;  $p_{FSk} = 0.130$ ), class of BMI ( $p_{CSk} = 0.903$ ;  $p_{FSk} = 0.320$ ), or course ( $p_{CSk} = 0.169$ ;  $p_{FSk} = 0.126$ ). Significant differences were found for interest in gastronomy and frequency of meal preparation ( $p < 0.05$ ).

## Discussion

The main purpose of this study was to validate a Portuguese version of the tool to assess FCSks, developed by Lavelle et al. [22]. Internal consistency reliability

**Table 1.** Sociodemographic characteristics of the studied sample ( $n = 275$ )

Characteristic	$n$ (%)	Min-max	Mean±SD
Age		18–46	21±4
Sex			
Female	160 (67.5)		
Male	77 (32.5)		
BMI		15.4–59.0	22.1±3.8
Underweight ( $\leq 18.49$ kg/m <sup>2</sup> )	17 (8.2)		
Normal (18.5–24.99 kg/m <sup>2</sup> )	185 (88.9)		
Overweight ( $\geq 30$ kg/m <sup>2</sup> )	6 (2.9)		
Year of college			
1st	103 (43.8)		
2nd	64 (27.2)		
3rd	67 (28.5)		
4th	1 (0.4)		
Course			
Nurse	70 (29.8)		
Nutrition	54 (23.0)		
Medicine	111 (47.2)		
Frequency of meal preparation			
Daily	118 (50.2)		
Weekly (4–6 times)	48 (20.4)		
Weekly (1–4 times)	28 (11.9)		
Occasionally	37 (15.7)		
Rarely	3 (1.3)		
Never	1 (0.4)		
Main contributor to the development of FCSks			
Mother	153 (65.4)		
Father	22 (9.4)		
Grandfather	0 (0.0)		
Grandmother	28 (12.0)		
Siblings	10 (4.3)		
Others	21 (9.0)		

Min, minimum; max, maximum; SD, standard deviation.

**Table 2.** Internal consistency reliability of the CSks and FSks confidence measures: number of items, range, mean, and standard deviation (SD), inter-item correlation mean, Cronbach’s alpha

Measure	No. of items	Range	Mean score±SD	$n$	Inter-item correlation	Alpha	Alpha (original questionnaire)
CSks	16	0–112	74.1±21.1	270	0.91	0.89	0.93
FSks	19	21–133	91.2±20.8	242	0.90	0.87	0.94

returned a Cronbach’s alpha within the desirable values, although slightly lower than the ones obtained by the original authors [22].

As for the PCA performed, the significance of Bartlett’s test of sphericity and the excellent KMO index confirmed the executability of this procedure and the adequacy of the factor structure. Most of the items presented a factor loading that fell within the expected category. An exception was found for *c8. Microwave food* presented a

higher loading for food skills instead for cooking skills. In the original validation, item *c8. Microwave food* also fell out of the CSks component into a third factor [22]. This may be because microwaving may be considered not a real culinary competence, as mentioned by other authors [22].

Three items from FSks presented higher loadings in the Cooking Skills category and three items from the Food Skills – *f14. Use leftovers to create another meal; f15.*

**Table 3.** Summary of PCA for CSks and FSks measures using oblimin rotation

Item	Factor loadings		Communalities
	factor 1: CSks	factor 2: FSks	
1. Chop mix and stir foods	0.826		0.614
2. Blend food to make them smooth	0.742		0.531
3. Steam food	0.404		0.289
4. Boil or simmer food	0.708		0.462
5. Stew food	0.708		0.476
6. Roast food in the oven	0.741		0.543
7. Fry/stir-fry food in a frying pan/wok with oil or fat	0.511		0.315
8. Microwave food		0.336	0.091
9. Bake goods	0.478		0.278
10. Peel and chop vegetables	0.749		0.537
11. Prepare and cook raw meat/poultry	0.585		0.380
12. Prepare and cook raw fish	0.668		0.470
13. Make sauces and gravy from scratch	0.572		0.402
14. Use herbs and spices	0.654		0.516
15. Cook soup	0.747		0.538
16. Cook pulses using a pressure cooker	0.403		0.242
1. Plan meals ahead?		0.708	0.454
2. . .prepare meals in advance?		0.785	0.563
3. . .follow recipes when cooking?		0.247	0.124
4. . .shop with a grocery list?		0.590	0.294
5. . .shop with specific meals in mind?		0.475	0.315
6. . .plan how much food to buy?		0.638	0.487
7. . .compare prices before you buy food?		0.422	0.240
8. . .know what budget you have to spend on food?		0.571	0.344
9. . .buy food in season to save money?		0.386	0.300
10. . .buy cheaper cuts of meat to save money?		0.399	0.166
11. . .cook more or double recipes which can be used for another meal?		0.661	0.406
12. . .prepare or cook a healthy meal with only few ingredients on hand?		0.513	0.530
13. . .prepare or cook a meal with limited time?		0.432	0.350
14. . .use leftovers to create another meal?	0.366		0.358
15. . .keep basic items in your cupboard for putting meals together?	0.447		0.398
16. . .read the best-before date on food?		0.394	0.139
17. . .read the storage and use-by information on food packets?		0.360	0.160
18. . .read the nutrition information on food labels?	0.302		0.258
19. . .balance meals based on nutrition advice on what is healthy?		0.410	0.409
Eigenvalues	10.34	2.64	
% variance	29.5	7.54	

Keep basic items in your cupboard for putting meals together; and f18. Read the nutrition information on food labels. The first two also presented this behaviour in the original questionnaire validation. The authors argue that these skills have been identified as FSks in the previous literature, supporting the choice of leaving them in the Food Skills component [22].

The results from the CFA showed that the measures that indicated a good fit is within or close to the ranges, suggesting an acceptable fit of the model to the data with good psychometric properties. Therefore, researchers decided to keep the structure of the

questionnaire, following the methodology used by the original authors [22].

The student sample showed a high level of Cooking Skills ( $\bar{x}_{CSk} = 74.1$  SD  $\pm 22.2$ ). Different results were found among the student sample of the Lavelle et al. [22] study ( $\bar{x}_{CS} = 58.83$ , SD  $\pm 16.45$ ), which indicates that Portuguese students have better skills. The CSks with the highest score (*c4. Boiling and simmering food; c10. Chopping and peeling vegetables, along with c1. Chopping, mixing, and stirring food*) were the same as the ones identified in the Lavelle et al. [22] study. Nevertheless, contrary to our sample, Lavelle et al. [22] also scored high

**Table 4.** Fit indices of models

Indices	Result	Reference
$\chi^2$ (465)	3,611.989	
<i>p</i> value	0.000	>0.05
$\chi^2/df$	7.765	$2 < \chi^2/g.l. < 3$
SRMR	0–077	<0.08
RMSEA	0.080	$0.05 < RMSEA \leq 0.08$
90% CI	(0.073, 0.087)	<0.08
CFI	0.779	$\geq 0.95$
TLI	0.763	$\geq 0.95$
AIC	29,311	
BIC	29,530	

SRMR, standardized root mean square; CFI, comparative fit index; TLI, Tucker-Lewis index.

values for microwaving, frying/stir-frying, and using herbs and spices, which might indicate that our sample may have lower consumption of fried food and pre-prepared meals or that meals are not eaten at home. The Cooking Skills with the lowest scores were the following: *c16. Cook pulses using a pressure cooker*, *c5. Steam food*, and *c13. Make sauces and gravy from scratch*. These skills also had the highest variability, which may indicate that the ones who do not feel competent with these CSks do not feel competent at all, and the ones who do are completely comfortable. This also highlights the importance of developing CSks not only from an early age but also mostly during this period of life, in which many young people leave home and become more independent, developing lifelong skills.

**Table 5.** Factor loadings and reliability model

Items	Factor loading	Raykov's rho
<b>CSks</b>		
C1. Chop, mix, and stir foods	0.745	0.907
C10. Peel and chop vegetables	0.691	
C15. Cook soup	0.699	
C2. Blend food to make them smooth	0.682	
C6. Roast food in the oven	0.715	
C4. Boil or simmer food	0.634	
C5. Stew food	0.644	
C12. Prepare and cook raw fish	0.650	
C14. Use herbs and spices	0.710	
C11. Prepare and cook raw meat/poultry	0.599	
C13. Make sauces and gravy from scratch	0.590	
C7. Fry/stir-fry food in a frying pan/wok with oil or fat	0.503	
C9. Bake goods	0.514	
F15. . .keep basic items in your cupboard for putting meals together?	0.629	
C3. Steam food	0.504	
C16. Cook pulses using a pressure cooker	0.460	
F14. . .use leftovers to create another meal?	0.553	
F18. . .read the nutrition information on food labels?	0.431	
<b>FSks</b>		
F2. . .prepare meals in advance?	0.645	0.854
F1. Plan meals ahead?	0.543	
F11. . .cook more or double recipes which can be used for another meal?	0.574	
F6. . .plan how much food to buy?	0.670	
F4. . .shop with a grocery list?	0.389	
F8. . .know what budget you have to spend on food?	0.555	
F12. . .prepare or cook a healthy meal with only few ingredients on hand?	0.757	
F5. . .shop with specific meals in mind?	0.514	
F13. . .prepare or cook a meal with limited time?	0.587	
F7. . .compare prices before you buy food?	0.503	
F19. . .balance meals based on nutrition advice on what is healthy?	0.616	
F10. . .buy cheaper cuts of meat to save money?	0.396	
F9. . .buy food in season to save money?	0.553	
Factor correlation: CSks ↔ FSks, $r = 0.698$		

**Table 6.** CSks and FSks measure: mean and standard deviations (SD)

CSks	N	Confidence (rated 1–7)
		mean score±SD
1. Chop, mix, and stir foods	274	5.65±1.68
2. Blend food to make them smooth	274	5.42±2.11
3. Steam food	273	2.58±2.63
4. Boil or simmer food	274	6.12±1.35
5. Stew food	274	3.55±2.51
6. Roast food in the oven	273	5.14±2.04
7. Fry/stir-fry food in a frying pan/wok with oil or fat	274	5.24±2.03
8. Microwave food	274	5.16±2.47
9. Bake goods	274	4.70±2.22
10. Peel and chop vegetables	274	5.77±1.54
11. Prepare and cook raw meat/poultry	274	4.55±2.21
12. Prepare and cook raw fish	273	4.00±2.31
13. Make sauces and gravy from scratch	274	3.50±2.62
14. Use herbs and spices	274	5.50±1.76
15. Cook soup	274	4.73±2.43
16. Cook pulses using a pressure cooker	274	2.48±2.52
Overall CSks scores		74.1±22.2
FSks	N	Confidence (rated 1–7)
		mean score±SD
1. Plan meals ahead?	248	3.84±2.46
2. . .prepare meals in advance?	248	4.14±2.37
3. . .follow recipes when cooking?	247	5.17±2.04
4. . .shop with a grocery list?	248	5.66±1.85
5. . .shop with specific meals in mind?	248	5.29±1.97
6. . .plan how much food to buy?	248	4.82±2.06
7. . .compare prices before you buy food?	248	5.29±1.96
8. . .know what budget you have to spend on food?	248	4.71±2.21
9. . .buy food in season to save money?	248	4.39±2.18
10. . .buy cheaper cuts of meat to save money?	247	2.98±2.55
11. . .cook more or double recipes which can be used for another meal?	248	5.20±2.05
12. . .prepare or cook a healthy meal with only few ingredients on hand?	248	4.94±1.84
13. . .prepare or cook a meal with limited time?	248	4.95±1.83
14. . .use leftovers to create another meal?	248	5.04±1.97
15. . .keep basic items in your cupboard for putting meals together?	248	5.85±1.45
16. . .read the best-before date on food?	247	6.15±1.29
17. . .read the storage and use-by information on food packets?	247	5.83±1.58
18. . .read the nutrition information on food labels?	246	4.72±2.27
19. . .balance meals based on nutrition advice on what is healthy?	246	5.11±1.73
Overall FSks scores		94.2±20.8

Regarding Food Skills, our population showed a high level of skills ( $\bar{x}_{FS} = 94.2$ ,  $SD \pm 20.8$ ). Like Cooking Skills, we also found higher results when compared to the Lavelle et al. study [22]. The Food Skills with the highest scores were the following: *c16. Read the best-before date on food* and *c17. Read the storage and use-by information on food packets*. When compared to the results of Lavelle et al. [22], only reading the best-before date also had a high score, along with following a recipe, keeping basics

in the cupboard and planning meals ahead [22]. Interestingly, in our study, “*planning meals ahead*” had the second-lowest score, which may be consistent with the cultural difference between the two countries.

The FCSk with the highest and lowest scores reflect the eating habits of our sample. According to the literature, regarding the eating habits of children, adolescents, and Portuguese adults, there is a low consumption of pulses [34, 35], the food group which our



sample found harder to cook. Due to their nutritional composition (fiber, complex B vitamins, iron, zinc, magnesium, phosphorus, and antioxidants), pulses consumption is associated with better health status [36, 37].

When comparing the ability to cook and prepare meat and fish, our sample had more difficulty cooking fish. This difference also seems to reflect the eating habits of Portuguese young adults, where meat consumption is higher than fish consumption [34]. This fact may reflect in health status since fish consumption is associated with health benefits, like the prevention of cardiovascular diseases [38], while high meat consumption is associated with the development of chronic diseases, namely, cancer [39, 40], which states the importance of FCSk interventions to promote good eating habits and health. Moreover, reducing meat consumption is widely recognized as an important factor towards sustainability, which along with increased consumption of pulses and nuts is quite relevant towards plant-based food patterns. Investing in the ability to cook pulses could help this necessary change and approach young people to the Mediterranean diet.

Similarly, to Lavelle et al. [22], the FCSk with the highest score reflected a preference for quick and easy meals, characteristic of the university student's diet. Developing the FCSk that will allow young people to create healthy and sustainable meals that are tasty and quick to prepare may lead to better food habits and better health.

Our data showed that individuals with a liking for cooking and having a higher frequency of meal preparation had higher levels of FCSk. Similar outcomes have been found in other studies [2, 41, 42]. These results come as no surprise since the more we practice a certain skill the more we develop and enjoy the skill. In addition, the more we like to do a certain activity, the more we practice it. Future FCSk interventions should focus on creating positive experiences and integrating these skills into the daily routine.

Unlike some studies [2, 41], where a higher FCSk level was found among women, our study showed no differences among different sex. Traditionally, women have been responsible for attending to household tasks, including preparing and cooking meals [43]. However, in recent years, while women have been dedicating less time to house chores and meal preparation, men have been spending more time on these activities [2, 43]. Our data reflect this evolution of "gender roles."

No differences were found between age and the student's degree, which also contradicts the findings of most studies, where older individuals and individuals with a nutrition

degree tend to have higher FCSk levels [41]. These results may be so because our sample is very close in age and most students are taking a nutrition or health-related course.

Finally, no differences were found in the BMI classification among the FCSk level. A recent study also found similar results [44]. Weight gain is influenced by multiple factors, being one of them the level of FCSk [45]. Nevertheless, there is a diversity of factors involved in weight gain, which may explain why no difference was found among the BMI classification.

#### *Limitations and Strengths*

The present study had some limitations, namely: (1) the use of a self-field questionnaire which may lead to the overestimation of the participants' FCSk level; (2) the self-assessment of height and weight, leading to a possible underestimation of BMI; (3) the evaluation of the FCSk on university students from health degrees, which could explain the high level of FCSks found. Also, researchers are aware that this is not representative of Portuguese university students since it included only health degrees and two Portugal regions. However, some strengths can also be identified as follows: (1) the proximity between the results of these studies and the Lavelle et al. [22] study, showing positive reliability on the developed questionnaire; (2) the characterisation of the level of FCSk among Portuguese adults, being one of few studies presenting these analyses.

#### **Conclusions**

This research successfully validated a Portuguese version of the questionnaire to measure the FCSks of the young adult population. Although the validation was performed among a group of young adults, researchers consider that it can be applicable to older adults and teenagers over 15 years old, in future research relating FCSk and eating habits. The questionnaire identified lower competencies on FCSk associated with healthy foods and cooking procedures, such as cooking pulses and vegetables. This may compromise the adoption of healthy eating behaviours, so promoting FCSk in young adults may pose a strategy for nutrition and public health in reducing diet-related diseases. More studies are needed, involving a larger and more diverse sample, for a better characterization of FCSk and studying their relation to eating patterns.

#### **Acknowledgments**

The authors acknowledge Fiona Lavelle and all authors from the original questionnaire for authorizing the Portuguese translation. Authors thank Joana Sousa from Faculdade de Medicina da

Universidade de Lisboa for the support in this research. Authors would also like to thank Maria José Pires from Escola Superior de Hotelaria e Turismo do Estoril for the English and grammar review.

### Statement of Ethics

This study protocol was reviewed and approved by Escola Superior de Tecnologia da Saúde de Lisboa, with the approval number CE-ESTeSL-No. 11-2022. Informed consent was obtained from participants to participate in the study.

### Conflict of Interest Statement

The authors have no conflicts of interest to declare.

### References

- 1 Health Canada. [Canada's dietary guidelines 2018](#). Ottawa, ON: Health Canada; 2019.
- 2 Hartmann C, Dohle S, Siegrist M. Importance of cooking skills for balanced food choices. [Appetite](#). 2013;65:125–31.
- 3 Truman E, Elliott C. Barriers to food literacy: a conceptual model to explore factors inhibiting proficiency. [J Nutr Educ Behav](#). 2019; 51(1):107–11.
- 4 Kennedy LG, Kichler EJ, Seabrook JA, Matthews JJ, Dworatzek PDN. Validity and reliability of a food skills questionnaire. [J Nutr Educ Behav](#). 2019;51(7):857–64.
- 5 Krause C, Sommerhalder K, Beer-Borst S, Abel T. Just a subtle difference? Findings from a systematic review on definitions of nutrition literacy and food literacy. [Health Promot Int](#). 2018;33(3):378–89.
- 6 Bertrand J, Crerar A, Randall Simpson J. A Canadian University “Understanding Foods” Course improves confidence in food skills and food safety knowledge. [Can J Diet Pract Res](#). 2018;79(4):170–5.
- 7 Canada. Region of Waterloo Public Health. [Food skills of waterloo region adults \(2008-2014\)](#). Waterloo (ON): Region of Waterloo Public Health; 2015.
- 8 Murray DW, Mahadevan M, Gatto K, O'Connor K, Fissinger A, Bailey D, et al. Culinary efficacy: an exploratory study of skills, confidence, and healthy cooking competencies among university students. [Perspect Public Heal](#). 2016;136(3):143–51.
- 9 Thorpe MG, Kestin M, Riddell LJ, Keast RS, McNaughton SA. Diet quality in young adults and its association with food-related behaviours. [Public Health Nutr](#). 2014;17(8): 1767–75.
- 10 Utter J, Larson N, Laska MN, Winkler M, Neumark-Sztainer D. Self-perceived cooking skills in emerging adulthood predict better dietary behaviors and intake 10 years later: a longitudinal study. [J Nutr Educ Behav](#). 2018; 50(5):494–500.
- 11 Reicks M, Trofholz AC, Stang JS, Laska MN. Impact of cooking and home food preparation interventions among adults: outcomes and implications for future programs. [J Nutr Educ Behav](#). 2014;46(4):259–76.
- 12 Wolfson JA, Bleich SN. Is cooking at home associated with better diet quality or weight-loss intention? [Public Health Nutr](#). 2015; 18(8):1397–406.
- 13 Wolfson JA, Lahne J, Raj M, Insolera N, Lavelle F, Dean M. Food Agency in the United States: associations with cooking behavior and dietary intake. [Nutrients](#). 2020; 12(3):877.
- 14 Sprake EF, Russell JM, Cecil JE, Cooper RJ, Grabowski P, Pourshahidi LK, et al. Dietary patterns of university students in the UK: a cross-sectional study. [Nutr J](#). 2018;17(1): 90–17.
- 15 Bernardo GL, Jomori MM, Fernandes AC, Proença RPC. Food intake of university students. [Rev Nutr](#). 2017;30(6):847–65.
- 16 Truninger M, Borrego R, Silva PA, Ferreira VS, Lavado E, Rowland J. [Consumos e estilos de vida no ensino superior: o caso dos estudantes da ULisboa-2012](#). Lisboa: Serviço de Intervenção nos Comportamentos Aditivos e nas Dependências (SICAD); 2008.
- 17 Vélez-Toral M, Rodríguez-Reinado C, Ramallo-Espinosa A, Andrés-Villas M. It's important but, on what level?: healthy cooking meanings and barriers to healthy eating among university students. [Nutrients](#). 2020; 12(8):2309.
- 18 Kim MJ, Hwang ES, Kim KJ, Maeng S, Heo HJ, Park JH, et al. Young chefs in the classroom: promoting scientific process skills and healthy eating habits through an inquiry-based cooking project. [Antioxidants](#). 2021; 11:1–10.
- 19 Kelly NR, Mazzeo SE, Bean MK. Systematic review of dietary interventions with college students: directions for future research and practice. [J Nutr Educ Behav](#). 2013;45(4): 304–13.
- 20 Short F. Domestic cooking skills: what are they? [J HEIA](#). 2003;10(3):13–22.
- 21 Barton KL, Wrieden WL, Anderson AS. Validity and reliability of a short questionnaire for assessing the impact of cooking skills interventions. [J Hum Nutr Diet](#). 2011;24(6): 588–95.
- 22 Lavelle F, McGowan L, Hollywood L, Surgeon D, McCloat A, Mooney E, et al. The development and validation of measures to assess cooking skills and food skills. [Int J Behav Nutr Phy](#). 2017;14(1):118.
- 23 Condrasky MD, Williams JE, Catalano PM, Griffin SF. Development of psychosocial scales for evaluating the impact of a culinary nutrition education program on cooking and healthful eating. [J Nutr Educ Behav](#). 2011; 43(6):511–6.
- 24 Morin P, Demers K, Turcotte S, Mongeau L. Association between perceived self-efficacy related to meal management and food coping strategies among working parents with preschool children. [Appetite](#). 2013;65:43–50.
- 25 Kowalkowska J, Póinhos R, Rodrigues S. Cooking skills and socio-demographics among Portuguese university students. [Br Food J](#). 2018;120(3):563–77.
- 26 Martins CA, Baraldi LG, Scagliusi FB, Villar BS, Monteiro CA. Cooking Skills Index: development and reliability assessment. [Rev Nutr](#). 2019;32(1):1–16.

### Funding Sources

This research was supported by FCT/MCTES (UIDB/05608/2020 and UIDP/05608/2020).

### Author Contributions

Vânia Costa, Rute Borrego, Cátia Mateus, and Cláudia Viegas prepared the questionnaire. Cátia Mateus, Elisabete Carolino, and Cláudia Viegas analyse the data. Cátia Mateus and Cláudia Viegas wrote the first draft with contributions from Elisabete Carolino. All authors reviewed and contributed to the subsequent drafts of the manuscript.

### Data Availability Statement

The data supporting this study's findings are available on request from Cláudia Viegas.

- 27 Modesto ML. *Cozinha tradicional portuguesa*. Lisboa: Verbo; 2005.
- 28 Maroco J. *Análise estatística com o SPSS*. Pêro Pinheiro: ReportNumber; 2014.
- 29 Dodge Y. *The concise encyclopedia of statistics*. Berlin: Springer; 2010.
- 30 Brown TA. *Confirmatory factor analysis for applied research*. New York (NY): Guilford Press; 2015.
- 31 Schreiber JB, Nora A, Stage FK, Barlow EA, King J. Reporting structural equation modeling and confirmatory factor analysis results: a review. *J Educ Res*. 2006;99(6):323–38.
- 32 Hair JF, Babin BJ, Black WC, Anderson RE. *Multivariate data analysis*. New Jersey, NJ: Pearson; 2010.
- 33 Mukaka MM. Statistics corner: a guide to appropriate use of correlation coefficient in medical research. *Malawi Med J*. 2012;24(3):69–71.
- 34 Lopes C, Torres D, Oliveira A, Severo M, Alarcão V, Guiomar S, et al. *Inquérito Alimentar Nacional e de Atividade Física: IAN-AF 2015-2016: relatório de resultados 2017*. Porto: Universidade do Porto; 2017.
- 35 Gregório MJ, Sousa SM, Chkoniya V, Graça P. *Estudo de adesão ao padrão alimentar mediterrânico*. Lisboa: Direção-Geral da Saúde; 2020.
- 36 Clemente A, Olias R. Beneficial effects of legumes in gut health. *Curr Opin Food Sci*. 2017;14:32–6.
- 37 Çakir Ö, Uçarlı C, Tarhan Ç, Pekmez M, Turgut-Kara N. Nutritional and health benefits of legumes and their distinctive genomic properties. *Food Sci Technol*. 2019;39(1):1–12.
- 38 Zhang Y, Ding J, Guo H, Liang J, Li Y. Associations of fish and omega-3 fatty acids consumption with the risk of venous thromboembolism: a meta-analysis of prospective cohort studies. *Front Nutr*. 2020;7:614784.
- 39 Vajdi M, Farhangi MA. A systematic review of the association between dietary patterns and health-related quality of life. *Health Qual Life Out*. 2020;18(1):337.
- 40 Vipperla K, O’Keefe SJ. Diet, microbiota, and dysbiosis: a “recipe” for colorectal cancer. *Food Funct*. 2016;7(4):1731–40.
- 41 Wilson CK, Matthews JI, Seabrook JA, Dworatzek PDN. Self-reported food skills of university students. *Appetite*. 2017;108:270–6.
- 42 Lavelle F, McGowan L, Spence M, Caraher M, Raats MM, Hollywood L, et al. Barriers and facilitators to cooking from “scratch” using basic or raw ingredients: a qualitative interview study. *Appetite*. 2016;107:383–91.
- 43 Sayer LC. Gender, time and inequality: trends in women’s and men’s paid work, unpaid work and free time. *Soc Forces*. 2005;84(1):285–303.
- 44 Rivera Medina C, Briones Urbano M, de Jesús Espinosa A, Toledo López Á. Eating habits associated with nutrition-related knowledge among university students enrolled in academic programs related to nutrition and culinary arts in Puerto Rico. *Nutrients*. 2020;12(5):1408.
- 45 Bernardo GL, Jomori MM, Fernandes AC, Colussi CF, Condrasky MD, Proença RPC. Nutrition and culinary in the kitchen program a randomized controlled intervention to promote cooking skills and healthy eating in university students study protocol. *Nutr J*. 2017;16(1):83–12.