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Children's perceived cooking competencies in Mediterranean Countries: translation and psychometric properties of the CooC11 questionnaire

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Abstract

Background

Cooking skills are important determinants of diet quality, overall health, and adherence to the Mediterranean Diet. However, no culturally adapted and validated versions of the CooC11 questionnaire were previously available for Mediterranean populations. This research objective was to translate, culturally adapt, and evaluate the psychometric properties of the CooC11 questionnaire assessing perceived cooking competence among children and adolescents in five Mediterranean countries (Croatia, Italy, Portugal, Spain, and Turkey).

Methods

A multicentre cross-sectional validation study was conducted across five Mediterranean countries following translation and cross-cultural adaptation procedures. The adapted questionnaire was assessed for factorial validity and reliability. Participants were recruited from public schools and third-sector associations in Croatia, Italy, Portugal, Spain, and Turkey. A total of 1416 children and adolescents aged 8–14 years completed the questionnaire (mean age = 11.04 ± 2.18 years; 53% female). Factorial structure, internal consistency, and perceived cooking competence assessed using culturally adapted versions of the CooC11 questionnaire. Confirmatory factor analysis (CFA) tested the original two-factor structure. Internal consistency was evaluated using inter-item correlations, corrected item-total correlations, Cronbach's alfa, and Raykov's rho. Non-parametric descriptive, correlation, and group-comparison analyses were conducted at a significance level of 5%.

Results

Confirmatory factor analysis generally supported the original two-factor structure across countries, with most factor loadings exceeding the predefined threshold of 0.30. Internal consistency was acceptable to good across countries (Cronbach's $\alpha = 0.76–0.84$), although lower factor loadings were observed for the measuring (0.285) and weighing (0.263) items in the Turkish version. Perceived cooking competence was moderate overall and significantly higher among females and older participants ($P < 0.001$).

Conclusions

The adapted CooC11 questionnaire demonstrated satisfactory psychometric properties and provides a culturally appropriate tool for assessing perceived cooking competence among children and adolescents in Mediterranean countries. The availability of harmonised versions in five Mediterranean languages facilitates international research on children's cooking competence and supports the evaluation of nutrition education and cooking-based interventions.

Background

Cooking skills have gained attention in recent years as an important factor influencing diet quality and overall health. Evidence indicates that cooking competencies and proficiency are associated with improvements in dietary patterns and healthier food choices across the population, including children[1].

Within this context, the Mediterranean Diet (MedDiet) is widely recognised as a model of a healthy lifestyle, not only for its nutritional profile but also by its emphasis on culinary practices, particularly cooking, as integral to promoting health and fostering lifelong healthy eating habits[2,3]. Despite this, adherence to the MedDiet has declined in recent decades, even in countries that hold UNESCO Intangible Cultural Heritage of Humanity designations, namely Portugal, Spain, Croatia, and Italy[4,5]. More recent evidence indicates that this shift is also evident among children and adolescents, who have shown low compliance with this dietary pattern[6,7]. It is important to note that although cooking skills are a key component of the MedDiet, there are still very few studies examining young people's cooking skills in these countries[8–10].

Cooking skills are typically acquired in life, traditionally being transmitted across generations within families or, in some contexts, taught through formal education systems. However, there has been a notable decline in opportunities to develop these skills in both settings in recent decades. This trend has raised concerns that younger generations may lack essential life skills required for making informed food choices, potentially impacting their health and well-being[11,12].

The importance of early acquisition of cooking skills is supported by evidence showing that childhood and early adolescence represent critical periods for skill development. Lanacsek et al. demonstrated that learning during these stages leads to greater competence in adulthood across domains such as sports, musical instruments, and second languages[13]. Emerging evidence suggests that this principle may also apply to cooking skills[14,15]. Early engagement in food preparation, especially during childhood and adolescence, correlates with a wider range of cooking skills, increased time spent cooking, greater enjoyment of cooking, and less food waste in adulthood. Furthermore, it is linked to improved dietary behaviours, including higher consumption of fruits and vegetables, lower intake of takeout and fast food, and more regular meal patterns[15,16].

In response to these findings, an increasing number of nutrition intervention programmes focus on developing cooking skills, particularly through hands-on activities such as preparing food and cooking[1,12,17–19]. These interventions have demonstrated short-term improvements in dietary behaviour, such as increased fruit intake and reduced reliance on convenience and takeaway food[17–19]. Additional benefits observed among children and adolescents include improved food preferences, greater willingness to try new foods, increased cooking knowledge and confidence, higher self-efficacy, enhanced food literacy, and positive social and emotional outcomes[12]. However, despite these promising results, interventions vary widely in the outcomes they measure and the tools they use. Many

cases involve significant methodological limitations, as non-validated tools are sometimes used, thereby affecting the reliability and comparability of the findings[1,17,19,20].

A major challenge in this field is therefore the lack of reliable, standardised, and universally applicable tools to measure cooking skills. Van der Horst et al., in their systematic review, highlighted a clear need for valid and reliable measurement instruments to ensure robust outcomes and enable cross-study comparison[1].

This challenge is further compounded by the absence of a universally agreed-upon definition of cooking skills. Hartmann et al. clearly defined cooking skills as the ability to prepare a variety of food, while other authors emphasise that these skills encompass both practical and cognitive components. More specifically, cooking skills can involve a combination of mechanical tasks (e.g. chopping, mixing, and heating), along with perceptual and conceptual abilities[21], such as recognising sensory changes in food during cooking (e.g. taste, colour, and texture)[22,23].

This multidimensional definition aligns with children's cognitive abilities and highlights the complexity of assessing cooking competence in younger populations[14].

To address these measurement challenges, Dean et al. developed the Perceived Cooking Competence (CooC11) measure, an interactive, simple, and age-appropriate tool designed to assess perceived cooking competence in children aged 8 to 12 years[24]. The questionnaire includes eleven essential cooking skills- such as chopping, washing vegetables, grating, and mixing ingredients- selected to reflect the skills appropriate to the development of this age group[24]. While the CooC11 offers a promising approach to standardised assessment, no validated versions currently exist in other languages, limiting its applicability in diverse cultural and linguistic contexts.

Given the lack of validated tools to assess cooking skills among children and adolescents, particularly in Mediterranean populations the present study aimed to translate, culturally adapt, and evaluate the psychometric properties of the CooC11 questionnaire in five Mediterranean languages (Croatian, Italian, Portuguese, Spanish, and Turkish). Additionally, the study sought to characterise perceived cooking competencies among children and adolescents aged 8–14 years in these communities, thereby enabling a more accurate assessment of cooking competencies in this population.

Methods

This multicentre cross-sectional study aimed to translate, culturally adapt, and validate the CooC11 questionnaire developed by Dean et al.[24] for use among children and adolescents in five Mediterranean countries (Croatia, Italy, Portugal, Spain, and Turkey). The study followed established recommendations for the cross-cultural adaptation of self-report measures and included psychometric evaluation of the adapted versions. This approach allows assessment of whether the instrument maintains its conceptual structure and measurement properties across cultural settings, supporting valid cross-cultural

comparisons and the use of a standardized measure of perceived cooking competence in international research.

Study design

This study was conducted within the context of the Tool4MEDLife project-From tradition to innovation: new foods and educational toolkits for a healthy and sustainable Mediterranean lifestyle- across five Mediterranean countries: Croatia, Italy, Portugal, Spain, and Turkey[25].

Study setting and participants

Participants were recruited from community settings and partner institutions, including public schools and third-sector associations. A convenience sample of 200 participants for each age group (children and adolescents) was defined in each country through a priori power analysis using G*Power software, assuming an effect size of 0.5, a statistical power (1–β) of 0.95, and a dropout rate of 20%[26].

Participants were eligible if they lived in the assessment country, completed the questionnaire in their native language, were enrolled in participating institutions, and provided guardian consent and participant assent. Children under 8 years of age were excluded due to limited autonomy, comprehension, and difficulty reliably completing the questionnaire.

Data Collection procedure

Data collection occurred between April 2024 and January 2025 using a self-administered Qualtrics® questionnaire (online platform compliant with the European Union General Data Protection Regulation). Data collection took place during supervised school-based group sessions conducted by researchers or teachers. For children aged 8 to 10 years old, sociodemographic data were provided by legal guardians. In Spain, challenges with school-based online data collection and parental sociodemographic data led to some questionnaires being completed on paper (n = 76). Sociodemographic data were not collected for this subgroup.

Ethics

All participants and legal guardians received prior information about the study, including its aims and confidentiality procedures. Participation was voluntary and unpaid. Minors were included with institutional approval, guardian consent, and participant assent. The study received ethical approval from the relevant ethics committees in each participating country.

Measures

The CooC11 questionnaire, originally developed by Dean et al. to assess perceived cooking competence among children, was used as the basis for the cross-cultural adaptation process. The instrument was designed to evaluate developmentally appropriate cooking skills based on age-specific recommendations for children and adolescents [14,24]. The item “using a can opener” was removed from the original questionnaire due to limited cultural relevance across the five participating countries. The final translated version included ten cooking skills: washing, mixing, mashing, measuring liquids, weighing ingredients, cutting, grating, peeling, and using the oven and stove. Item selection was reviewed by an expert panel to ensure developmental relevance and cultural neutrality, consistent with the original instrument.

To facilitate participants' understanding and engagement, particularly for those unfamiliar with certain cooking skills, the tool includes drawings of children performing each assessed motor competency. These visual cues provide clarity and support comprehension of the tasks. Additionally, to address a limitation of the original measure regarding the lack of diversity, the authors included illustrations representing a variety of genders and ethnicities, as provided by the original authors. These alterations ensure greater inclusivity and relevance for a broader range of participants[24].

Participants first indicated whether they usually performed each task (yes = 1; no = 0), and frequency scores were obtained by summing the ten items (range 0–10). For the validated CooC11 perceived cooking competence score, participants who answered “no” received an automatic score of 0 for that item, whereas those who answered “yes” were shown two illustrations (competent vs. poor performance) and rated their perceived competence on a five-point Likert scale (1 = “identify with the child who performs poorly”; 5 = “identify with the child who performs well”). To ensure consistent interpretation, items indicating “really good” performance were reverse-coded, and those indicating “not that good” were coded in ascending order, so that higher values always reflected greater perceived competence. The 10-item scores were then summed to obtain the total CooC11 score (range 0–50)[24].

Back-Translation and Cross-cultural adaptation

The cross-cultural adaptation process followed internationally accepted recommendations for the translation and adaptation of self-report measures. Permission to adapt the questionnaire into Croatian, Italian, Portuguese, Spanish, and Turkish was obtained from the original author. For translation and cultural adaptation of the index, each research team systematically followed the following steps: translation, synthesis of translations, back-translation, and review by the research team[27,28].

1. **1. Translation**: First, two members of the research team, each with a C1 level in English, independently translated the questionnaire from English into their respective native languages — Croatian, Italian, Portuguese, Spanish, and Turkish — producing versions T1 and T2. Both translators were thoroughly familiar with the index, its content, and the population for which the instrument was intended, thereby facilitating an informed, contextually relevant translation.
2. **2. Synthesis of Translations and Cultural Adaptation**: Next, translators and research team members synthesised both versions into a consensus version (T3), with cultural adaptations where needed.
3. **3. Back-translation**: Back-translations of T3 were then completed by one or two independent professional translators blinded to the original questionnaire and study aims. These translators, who were not familiar with the original English questionnaire or experts in the instrument's subject area, were kept blind to prevent bias. In cases where two translators were involved, they worked independently and did not communicate during the translation process, ensuring objective back-translations.
4. **4. Review by the research team**: Finally, research team members compared the back-translated and original versions to assess linguistic equivalence and interpretative consistency, resolving discrepancies by consensus to produce the final harmonised versions.

Statistical analysis

Statistical analysis was conducted using R (version 4.3.2), with significance set at 5%. Confirmatory Factor Analysis (CFA) using maximum-likelihood estimation with robust standard errors (MLR) was conducted to examine whether the original two-factor structure of the CooC11 questionnaire was retained across the adapted language versions. Model fit was evaluated using the following thresholds for good fit: a non-significant chi-square test (χ^2, $P > 0.05$), a standardized root mean square residual (SRMR) ≤ 0.08, a comparative fit index (CFI) ≥ 0.95, and a Tucker-Lewis index (TLI) ≥ 0.95[27–30]. Factor loadings were examined to assess the strength of the association between observed items and their respective latent constructs, with a minimum interpretive threshold of 0.3. Additionally, Raykov's rho was calculated to assess the reliability of the latent variables, with values above 0.70 indicating acceptable internal consistency[31,32]. The reliability of the questionnaire was assessed using three techniques: inter-item correlation (mean of the inter-item correlations), corrected item-total correlations, and Cronbach's α. The mean of the inter-item correlation should be between 0.15 and 0.5 (moderate correlation) to indicate adequate internal consistency[31,32]. The corrected item-total correlation should ideally range from 0.3 to 0.7 to ensure an acceptable level of internal consistency. Cronbach's α was used for this evaluation, with values exceeding 0.75 considered indicative of high reliability and consistency[32,33].

Descriptive statistics for quantitative variables (age, number of household members, and cooking skills score) were presented as mean and standard deviation (SD), whereas categorical variables (gender, parental education, and parental employment status) were summarised as absolute (n) and relative (%) frequencies. For quantitative variables, parametric tests were applied based on the Central Limit Theorem, given the large sample size. Pearson's correlation coefficient was used to assess associations

between quantitative variables, and group differences were examined using the independent samples t-test and one-way analysis of variance (ANOVA), as appropriate. When the ANOVA test was significant, Bonferroni-adjusted post-hoc pairwise comparisons were conducted. Differences in proportions between categorical variables were assessed using the chi-squared test.

Results

Of the 1445 questionnaires initially collected, 1416 valid responses were included in the analysis, as 29 were not completed. Table 1 summarises the sample's sociodemographic characteristics. Most participants were female (53%), with the highest proportion in Turkey (60%). Ages ranged from 7 to 14, with a mean age of 11.04 years (SD = 2.18). The lowest mean ages were observed in Turkey (9.93 years) and Portugal (10.21 years). About one-third of parents had a tertiary education, the highest in Spain (63–65%) and Portugal (63–74%). Most parents were employed (70–78%), with the highest rates in Portugal (□ 85%; □ 84%).

Table 1
Sociodemographic Characteristics of the Studied Sample (n = 1416)

Gender	**All countries n = 1416**	**Croatia n = 351**	**Italy n = 205**	**Portugal n = 395**	**Spain n = 234**	**Turkey n = 231**	**P-value[1]**
							< 0.001
Female	744 (53%)	167 (48%)	105 (51%)	203 (51%)	131 (56%)	138 (60%)	
Male	644 (45%)	172 (49%)	97 (47%)	189 (48%)	95 (41%)	91 (39%)	
Other	11 (0.8%)	1 (0.3%)	3 (1.5%)	2 (0.5%)	5 (2.1%)	0 (0%)	
Prefer not to answer	17 (1.2%)	11 (3.1%)	0 (0%)	1 (0.3%)	3 (1.3%)	2 (0.9%)	
Age (years)	11.04 ± 2.18	11.83 ± 2.05	11.71 ± 2.40	10.21 ± 1.88	11.77 ± 2.01	9.93 ± 1.80	< 0.001
Mother's Education Level							< 0.001
Primary Education or less	103 (9.3%)	26 (10%)	2 (1.0%)	0 (0%)	8 (8.1%)	67 (29%)	
Lower Secondary Education	126 (11%)	58 (22%)	16 (8.3%)	13 (3.9%)	6 (6.1%)	33 (14%)	
Upper Secondary Education and Post-secondary but Non-tertiary Education	394 (35%)	120 (46%)	105 (54%)	72 (22%)	23 (23%)	74 (32%)	
Tertiary Education	488 (44%)	56 (22%)	70 (36%)	245 (74%)	62 (63%)	55 (24%)	
Father's Education Level							< 0.001
Primary Education or less	75 (6.9%)	23 (8.9%)	3 (1.6%)	5 (1.6%)	9 (9.6%)	35 (15%)	
Lower Secondary Education	127 (12%)	34 (13%)	33 (18%)	23 (7.2%)	4 (4.3%)	33 (14%)	
Upper Secondary Education and Post-secondary	415 (38%)	122 (47%)	99 (53%)	89 (28%)	20 (21%)	85 (37%)	

[1] Pearson's Chi-squared test for categorical variables; One-way analysis of variance (ANOVA)

Gender	All countries n = 1416	Croatia n = 351	Italy n = 205	Portugal n = 395	Spain n = 234	Turkey n = 231	P-value[1]
							< 0.001
but Non-tertiary Education							
Tertiary Education	470 (43%)	79 (31%)	51 (27%)	203 (63%)	61 (65%)	76 (33%)	
Mother's Work Status							< 0.001
Employed	930 (75%)	244 (81%)	157 (83%)	330 (88%)	112 (77%)	87 (38%)	
Other situation	309 (25%)	56 (19%)	33 (17%)	44 (12%)	33 (23%)	143 (62%)	
Father's Work Status							0.009
Employed	1031 (86%)	263 (89%)	152 (84%)	319 (90%)	111 (81%)	186 (81%)	
Other situation	169 (14%)	34 (11%)	28 (16%)	37 (10%)	26 (19%)	44 (19%)	
Number of Household Members	4.25 ± 1.14	4.52 ± 1.20	4.07 ± 0.88	4.01 ± 1.00	4.00 ± 0.91	4.67 ± 1.42	< 0.001

[1] Pearson's Chi-squared test for categorical variables; One-way analysis of variance (ANOVA)

Confirmatory factor analysis

CFA tested the original two-factor structure (Motor Skills and Additional Development Skills) (Table 2). Model fit indices by country are shown in Table 3. Fit varied across countries: Italy showed a good fit, while Portugal, Spain, and Turkey demonstrated an acceptable-to-good fit, supporting the model's adequacy. In contrast, the model fit for Croatia was suboptimal, suggesting issues with the measurement model.

Table 2
Confirmatory Factor Analysis (With 2 Factors) Of The Croatian, Italian, Portuguese, Spanish And Turkish-Language Measure (N = 1416) And The Original Measure

Dimensions	Cooking skill	Croatia	Italy	Portugal	Spain	Turkey	Original[1]
Factor 1 - Motor Skills	Washing	0.791	0.648	0.478	0.655	0.342	0.54
	Mashing	0.525	0.513	0.563	0.623	0.649	0.50
	Chopping	0.54	0.72	0.56	0.575	0.647	0.73
	Grating	0.686	0.468	0.495	0.596	0.587	0.41
	Peeling	0.529	0.504	0.551	0.624	0.604	0.6
Raykov's rho - Factor 1		0.719	0.706	0.661	0.749	0.713	-
	Stirring	0.593	0.632	0.496	0.585	0.567	0.63
Factor 2 - Additional development skills	Measuring	0.614	0.487	0.534	0.488	0.285	0.46
	Weighing	0.532	0.738	0.508	0.512	0.263	0.58
	Oven use	0.652	0.666	0.581	0.541	0.522	0.40
	Stove use	0.368	0.679	0.53	0.655	0.609	0.49
Raykov's rho - Factor 2		0.681	0.778	0.656	0.691	0.538	-
Factor loading cut-off ≥ 0.30; [1] Dean et al. 2021							

Factor loadings were examined to assess the strength of the relationships between the observed variables and their corresponding latent constructs, as defined in the original scale developed by Dean et al. All cooking skills loaded significantly across all countries, except in Turkey, where the measuring and weighing showed factor loadings below the acceptable threshold, indicating weak associations with their designated constructs.

Table 3
Fit Indices of Models (n = 1416)

Indices	Croatia	Italy	Portugal	Spain	Turkey	Reference
χ^2	69.883	54.193	108.905	71.614	80.256	
p value	0.000	0.015	0.000	0.000	0.000	> 0.05
X^2/df	2.055	1.594	3.203	2.106	2.360	$2 < \chi^2/g.l. < 3$
SRMR	0.097	0.047	0.057	0.054	0.064	< 0.08
RMSEA	0.129	0.058	0.078	0.074	0.080	0.05 < RMSEA ≤ 0.08
90% CI	0.085–0.172	0.026–0.086	0.062–0.095	0.050–0.098	0.057–0.103	< 0.08
CFI	0.780	0.958	0.871	0.926	0.877	≥ 0.95
TLI	0.708	0.945	0.830	0.902	0.837	≥ 0.95

Abbreviations: SRMR (Standardized Root Mean Square Residual); RMSEA (Root Mean Square Error of Approximation); CI (Confidence Interval); CFI (Comparative Fit Index); TLI (Tucker-Lewis's index)

Internal consistency

Table 4 summarises the internal consistency of the CooC11 across countries. While Cronbach's α values varied between countries and were slightly lower than reported by Dean et al. (2021)[24], all Inter-item correlations were in an adequate range across all countries. Regarding item-total correlations, all countries fell within the acceptable range, except Italy, which exhibited a slightly broader range that marginally exceeded the defined threshold.

Table 4
Internal Consistency Of The Croatian, Italian, Portuguese, Spanish And Turkish-Language Measure (N = 1416) And The Original Measure

Country	Min; Max	Mean score ± SD	n	IIC	ITC	Cronbach α	Cronbach α (original measure)[1]
Croatia	0–50	28.57 ± 12.21	351	0.43	0.56–0.69	0.81	0.85
Italy	0–50	24.40 ± 13.45	205	0.42	0.52–0.72	0.84	
Portugal	0–50	20.47 ± 11.63	395	0.33	0.51–0.6	0.76	
Spain	0–50	24.63 ± 13.12	234	0.41	0.58–0.68	0.84	
Turkey	0–48	20.22 ± 11.73	231	0.33	0.36–0.7	0.76	

Abbreviations: IIC (Inter-item correlation); ITC (Item-total correlation); Cut-offs: IIC 0.15–0.5; ITC 0.3–0.7; Cronbach α ≥ 0.75

[1] Cronbach α (Original) refers to Dean et al. (2021) CooC11 version.

Perceived Cooking Competence Assessment

Item-level scores for perceived cooking competence by country are presented in the supplementary material. In the overall sample, the mean perceived cooking competence score was 23.69 ± 12.74, indicating a moderate level of perceived competence, a pattern observed across countries. Statistically significant differences were observed between countries ($p < 0.001$). Croatia reported the highest mean perceived competence score (28.57 ± 12.21), followed by Spain (24.63 ± 13.12) and Italy (24.40 ± 13.45), while Portugal and Turkey exhibited the lowest mean scores (20.47 ± 11.63 and 20.22 ± 11.73, respectively).

Across the overall sample, participants more frequently reported regular engagement in tasks classified as ‘motor skills’, except for mashing, compared with tasks categorised as additional development skills. However, when specific task scores were examined, weighing ingredients and stove top use, both classified as additional development skills, showed the highest median competence scores.

In the overall sample, females evidenced significantly higher perceived cooking competence scores than males ($p < 0.001$). A weak but statistically significant positive correlation was observed with age ($r_s = 0.326$; $p < 0.001$), indicating higher perceived competence among older participants. Differences in perceived cooking competence were observed across maternal education-level categories ($p < 0.05$); however, no statistically significant pairwise differences were observed after Bonferroni adjustment. No

significant associations were found with fathers' education level, parental employment status, or household size (all $p > 0.05$). Detailed results are presented in Supplementary Table S1.

Discussion

This study contributes to the cross-cultural validation of the CooC11 questionnaire, developed by Dean et al., across five Mediterranean countries (Croatia, Italy, Portugal, Spain, and Turkey), thereby supporting its use for assessing perceived cooking competence in children and adolescents. To the best of our knowledge, this is the first study to achieve this level of cross-cultural adaptation, and in some of these countries, it is also the first validated instrument for assessing perceived cooking competence in children aged 8–14 years[24]. Establishing measurement equivalence across contexts is therefore essential, given the current lack of standardized and culturally adapted tools in this field, as such instruments are needed to generate comparable evidence and inform educational and public health strategies aimed at improving culinary skills during childhood and adolescence. The CFA largely supported the original two-factor structure proposed by the authors[24]. However, variation in model fit across countries suggests that social and cultural factors may influence how the constructs and corresponding items are interpreted and operationalised.

In the Italian sample, the model demonstrated a good fit to the data, whereas in Portugal, Spain, and Turkey, the fit indices were acceptable, falling within or close to the recommended thresholds, supporting the general applicability of the two-factor structure across these cultural contexts. In contrast, Croatia showed a suboptimal fit, suggesting potential cultural differences in the construct's factorial structure. To further explore the structure in the Croatian context, an exploratory factor analysis (EFA) was conducted, which yielded a three-factor solution: *(1) Chopping, Oven Use, Stirring, Measuring; (2) Mashing, Grating, Washing, Peeling; and (3) Weighing, Stove Use*. However, following Hair et al. methodological recommendations requiring at least three items per factor, the three-factor solution was not retained[31]. Instead, the original two-factor model was retained, as it demonstrated a similar fit to the data compared with the EFA-derived structure. Further research is warranted to examine the scale's factorial validity in the Croatian context, confirm its structural stability, and enhance its psychometric robustness.

The questionnaire's factor structure was largely consistent across countries, reaffirming the robustness of the original model by Dean et al.[24]. However, a notable deviation emerged in the Turkish sample, where the measuring and weighing items did not meet the minimum factor-loading requirement. This discrepancy may reflect cultural or contextual influences on how these tasks are perceived or practised, as they involve more complex, numeracy-based activities within the range of culinary behaviour assessed and were evaluated in a sample that was both predominantly female and had the lowest educational level. Nonetheless, given that only these two items showed inadequate loadings and the overall factor structure remained stable, it was deemed appropriate to retain them in the original factor without modifying the model.

Considering the two-factor structure proposed by the original authors, internal consistency reliability, as measured by Cronbach's α, fell within the acceptable range, although it was slightly lower than the values reported in the original validation study[24]. These findings suggest that the translated versions of the measure exhibit adequate reliability and consistency across each cultural context.

The overall perceived cooking competence score in this sample fell within the moderate range, indicating lower perceived competence compared with participants in the pre-intervention phase of the Cook Like a Boss Online study (mean = 31.58 ± 11.96) and similar levels to those observed in the pre-intervention phase of the school-based intervention PhunkyFoods (mean = 25.8)[35,36]. Both studies used the same measurement instrument, including the tin-opener item, which was excluded from the present analysis. Notably, the Croatian mean score was closely aligned with that reported in the Cook Like a Boss pre-intervention group, whereas Spain and Italy presented values more comparable to those observed in the PhunkyFoods pre-intervention. These findings are relevant given evidence that the early development of cooking skills is associated with healthier dietary behaviour later in life, including reduced intake of takeaways and fast food, higher intake of fruits and vegetables, greater meal regularity, particularly breakfast and lunch, and more frequent home-cooking practices[15,37]. Notably, Lavelle et al. found that adults who developed their cooking skills during childhood and adolescence were more likely to use fresh ingredients and rely less on pre-packaged or convenience foods in adulthood than those who learned to cook later in life.

Weighing ingredients and using the stovetop, both classified as additional development skills, were the tasks in which participants reported the highest levels of perceived competence. Despite high confidence scores for these items, only about half of the participants reported regularly performing them. Overall, children reported more frequent engagement in basic motor skills, such as washing, chopping, and peeling, than in additional development skills, except for stirring. Although stirring is categorised as an additional development skill due to its typical performance over heat, it was among the most frequently practised tasks. These findings align with those reported in the cross-sectional study by de Carvalho e Silva da Rosa et al. (2022) among Brazilian adolescents, which identified high engagement in washing, peeling, chopping, and measuring ingredients as the most commonly performed cooking tasks[39]. Together, these results suggest a possible discrepancy between task frequency and perceived competence; more complex tasks, although less commonly performed, may elicit higher confidence, whereas frequently practised basic skills may be perceived as less demanding and therefore associated with lower perceived competence.

Analysis of sociodemographic differences revealed that only age and gender were significantly associated with perceived cooking competence ($p < 0.001$). Higher perceived competence was reported by older participants and by females, although the strength of this association was weak. These findings reinforce the relevance of sociodemographic factors, particularly age and gender, in shaping children's perceived cooking competence. Although the association with age was modest, older children exhibited slightly higher levels of perceived cooking competence, in line with developmental expectations and prior research suggesting that older children are generally capable of performing more complex cooking tasks

than younger children[14,39,40]. Hollywood et al. demonstrated that age significantly predicted post-intervention perceived cooking competence in their virtual cooking intervention "Cook Like A Boss Online", which also resulted in substantial gains in cooking skills ($p < 0.001$)[35]. Despite the modest association observed with age, literature emphasises the importance of developing cooking skills from an early age, as learning during childhood and adolescence is associated with greater continuity of food preparation behaviours and healthier dietary patterns into early adulthood, including lower consumption of ultra-processed foods and fast food, higher fruit intake, and more regular meal patterns[37,38]. Specifically, individuals who acquire cooking skills at younger ages are more likely to consume less ultra-processed and fast food, have higher fruit intake, and follow regular meal patterns, including consistent breakfast consumption[38].

Gender differences were more pronounced, with girls reporting significantly higher perceived competence than boys ($p < 0.001$). These trends are consistent with previous studies using the CooC11 measure[9,10,41]. Vaughan et al., in their evaluation of the PhunkyFoods programme, identified a fixed effect of sex, with girls scoring 2.8 points higher than boys on the CooC11 measure (95% CI: 0.88–4.82, $p < 0.01$), regardless of intervention group[42]. These findings are further supported by studies using alternative measures of cooking skills. Similar findings have been reported in studies assessing self-perceived cooking skills among adolescents from Spain, Italy, Portugal, and Brazil, in which females consistently demonstrated higher cooking skill levels than males[9,10,41]. Collectively, these findings highlight gender as a stable and influential factor in the development of cooking skills.

Taken together, the results suggest that both developmental stage and gender-related socialisation processes influence children's perceived cooking competence. Accordingly, future interventions may benefit from tailoring strategies to better engage younger children and boys, who may perceive themselves as less competent at cooking.

Cooking and food preparation are central components of the MedDiet, supporting not only the promotion of healthy eating habits but also children's socialisation within families, peer groups, and school communities[3]. Children's cooking interventions have increasingly been recognised as essential components of school-based nutrition education programs. The World Health Organisation recommends the inclusion of practical food and cooking skills into school nutrition initiatives as part of its strategy to address the rising prevalence of childhood obesity and promote healthier eating behaviours[43]. A growing body of evidence supports the role of experiential cooking programs in improving children's dietary patterns[12,19,44,45]. These programmes also appear to enhance nutrition knowledge, food literacy, and cooking confidence and competence, which are critical mediators of sustained healthy eating habits[1,12,19,44,45]. Collectively, this evidence highlights the potential of culinary education as a promising and scalable strategy to support the development of healthier dietary behaviours in school-aged children.

Despite this, many existing interventions present methodological limitations, particularly the absence of standardized evaluation tools, which hinders comparability across studies and weakens the overall evidence base[1,12,17–20,45]. The present study addresses this gap by contributing a valuable tool for the standardised evaluation of such interventions across five Mediterranean countries. The use of validated measures is essential for accurately assessing children's cooking skills, evaluating intervention effectiveness, and examining their associations with healthier dietary behaviours, thereby supporting both research advancement and evidence-informed public health policy development.

Strengths and limitations

To our knowledge, this study represents the first translation and cultural adaptation of the CooC11 measure, thus providing a standardised instrument for researchers and research teams across these five countries to assess perceived cooking competence in children and young adolescents. This constitutes a relevant contribution to the field, given the growing interest in evaluating cooking skills within nutrition education and public health research. Several limitations should nevertheless be acknowledged. First, the use of convenience sampling may limit the generalizability of the findings and restrict the extent to which the adapted questionnaires fully capture the heterogeneity of children and adolescents within this age group. Second, logistical challenges in data collection led some countries to administer paper-based questionnaires rather than the originally planned digital format. This was particularly evident in Spain, where difficulties were reported regarding children's comprehension and accurate completion of the paper questionnaires. Differences between paper and digital administration may have influenced participants' engagement and ease of responding, potentially affecting data quality. Measurement invariance across countries and age groups was not formally assessed. Therefore, cross-country comparisons should be interpreted cautiously, as potential cultural differences in item interpretation may exist.

Additionally, the Croatian version demonstrated a suboptimal model fit, suggesting that some items may not have been fully aligned with the local cultural context. This finding highlights the need for further refinement and validation of the Croatian adaptation in future studies, rather than undermining the instrument's overall validity.

Despite these limitations, the present study has several important strengths. The cooking skills included were selected based on evidence-based, age-appropriate recommendations derived from international public health guidelines. This original questionnaire was validated for children aged 8–12 years, and an additional strength of the present study is its extension of applicability to adolescents up to 14 years of age across five languages. All five translations exhibited positive internal consistency and reliability, with results closely aligned with those of the original measure.

Finally, the inclusion of relatable, representative illustrations of diverse ethnicities and genders enhances the tool's engagement and accessibility, making it more suitable for younger populations. Taken together,

these strengths position the CooC11 as a valuable and scalable instrument for both research and intervention evaluation in multicultural and multilingual settings.

Conclusion

This study represents the first translation and cultural adaptation of the CooC11 measure, providing a validated tool for assessing perceived cooking competence among children and young adolescents aged 8–14 years across five Mediterranean countries. The adapted versions offer a robust and practical instrument for establishing baseline levels of cooking competence and for evaluating the effectiveness of cooking and nutrition interventions in diverse cultural contexts.

Overall, moderate levels of self-perceived cooking competence were observed, with higher scores reported by older participants and girls. These findings indicate that developmental stage and gender are important factors shaping children's perceptions of their cooking abilities and should be considered when designing and tailoring future cooking skill interventions. The availability of a standardised, age-appropriate, and culturally adapted measure may support more consistent evaluation of intervention outcomes and contribute to the development of evidence-based strategies to promote healthy food practices from an early age.

Abbreviations

CFA- Confirmatory factor analysis

MedDiet- Mediterranean Diet

CooC11- Perceived Cooking Competence measure

MLR - Maximum-likelihood estimation with robust standard errors

SRMR- Standardised root mean square residual

CFI- comparative fit index

TLI- Tucker-Lewis index

SD- standard deviation

ANOVA- one-way analysis of variance

Declarations

Ethics approval and consent to participate

All participants and legal guardians received detailed information about the study, including its aims, procedures, and confidentiality procedures. Participation was voluntary and unpaid. Written informed consent was obtained from all legal guardians prior to participation, and assent was obtained from all participating children.

Minors were included with institutional approval, guardian consent, and participant assent. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and all relevant national and institutional guidelines and regulations.

The study received ethical approval from the relevant ethics committees in each participating country: Croatia – Institute for Adriatic Crops and Karst Reclamation (KLASA: 007-05/24-02/001; URBroj: 2181-103-01-24-12); Italy – Comitato Etico Territoriale delle Marche (Prot. 2024 118); Portugal – Escola Superior de Tecnologia da Saúde de Lisboa (CE-ESTeSL-No 73-2023); Spain – Ramon Llull University (CER URL_2023_2024_014); Turkey – Adana Alparslan Türkeş Science and Technology University (E-76907350-050.01.04-89469; Decision number 04/5).

Consent for publication

Not applicable

Data availability

The datasets used and/or analysed in this study are available from the corresponding author upon receipt of a justified request. Each questionnaire is freely available and can be obtained by contacting the corresponding author.

Competing interests

The authors consent to the publication of the paper. The authors declare no competing interests.

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Author contributions

VC, CV, IMC and RB were responsible for conception and design and original questionnaire adaptation. Portugal (VC, IMC, RB), Spain (ECA, BCF, AOR, BSR, EGV, MC, MRM), Croatia (MZ, MJS EV), Turkey (TEAZ; ZE), and Italy (SR, GV, SP, VP, SV) were involved in recruitment and data collection. IMC and CV performed most of the statistical analysis. IMC and VC wrote the initial draft manuscript. All members from

Portugal, Spain, Croatia, Turkey, and Italy revised the manuscript. VC and IMC made the final revision. The authors read and approved the final manuscript.

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