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RESEARCH ARTICLE

Evaluation of the implementation and acceptability of the new intercultural guidelines in Chile's National School Feeding Program at a rural school: A pilot quali-quantitative research

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KEYWORDS

Access to Healthy Foods;

Dietary Patterns;

Nutritional Policy.

➤ **Evaluation of the implementation and acceptability of the new intercultural guidelines in Chile's National School Feeding Program at a rural school: A pilot quali-quantitative research**

ABSTRACT

Introduction: Chile's School Feeding Program (PAE) is undergoing modifications in menu planning due to the country's epidemiological and sociocultural reality. The introduction of the native seaweed 'cochayuyo', increased legume consumption, and the elimination of refined flours and ultra-processed foods are some of the changes in the PAE under initiatives called 'Cocina del Mundo' and 'Cocina con Raíces' (World Cuisine and Roots Cuisine). These efforts are based on promoting healthy and intercultural eating habits from early ages. However, the implementation and acceptability of these modifications may face obstacles due to the limited familiarity of these preparations among Chilean children and food handlers. Therefore, the aim of this study was to evaluate the implementation and acceptability of the new intercultural modifications of the PAE.

Methodology: A cross-sectional qualitative-quantitative study was conducted. To measure acceptability, the sample was defined by trays served over three days of lunch at a rural establishment in southern Chile. Visual methods were used to determine the percentage of salad, main course, and dessert consumed. Regarding implementation, lunch service was considered holistically, following the official program guidelines. Additionally, semi-structured interviews were conducted with six key stakeholders to complement quantitative measures.

Results: Adequate implementation of the new guidelines (88%) was reported, with no significant differences between the days considered ($p=0.857$; $p=0.923$; and $p=0.934$). About acceptability ($n=141$), it was also adequate for dessert (100%), salads (79%), and main courses (65%). From the interviews, the perception of the initiative is positive but demands greater technical and cultural preparation for proper implementation among children and adolescents.

Conclusions: According to the technical parameters established by the PAE, its new guidelines are implemented correctly in the evaluated establishment.

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PALABRAS CLAVE

Acceso a Alimentos Saludables;

Patrones Dietéticos;

Política Nutricional.

➤ **Evaluación de la implementación y aceptabilidad de las nuevas directrices de interculturalidad en el Programa Nacional de Alimentación Escolar de Chile en una escuela rural: Una investigación piloto cualicuantitativa**

RESUMEN

Introducción: El Programa de Alimentación Escolar (PAE) de Chile se encuentra realizando modificaciones en la planificación de sus menús debido a la realidad epidemiológica y sociocultural que enfrenta el país. La introducción del alga nativa "cochayuyo", el aumento de legumbres, y la eliminación de harinas refinadas y ultra procesados, constituyen algunos de los cambios del PAE bajo las iniciativas denominadas "Cocina del Mundo" y "Cocina con Raíces". Estos esfuerzos se fundamentan en la promoción de una alimentación saludable e intercultural a partir de edades tempranas, sin embargo, la implementación y aceptabilidad de estas modificaciones puede enfrentar obstáculos debido a la poca familiaridad de estas preparaciones entre los infantes chilenos y manipuladores de alimentos. Frente a esto, el objetivo del presente trabajo fue evaluar la implementación y aceptabilidad de las nuevas modificaciones interculturales del PAE.

Metodología: Se realizó estudio cuali-cuantitativo transversal. Para medir aceptabilidad, muestra fue definida por las bandejas entregadas en tres días del almuerzo en un establecimiento rural al sur de Chile. Por método visual se definió el porcentaje consumido en ración de ensalada, plato principal y postre. Respecto a la implementación, se consideró al servicio de almuerzo de forma global, y se ocuparon las pautas oficiales del programa. Además, se realizaron entrevistas semiestructuradas con seis actores críticos para complementar medidas cuantitativas.

Resultados: Se reportó una implementación adecuada de las nuevas directrices (88%), sin diferencias significativas entre los días considerados ($p=0,857$; $p=0,923$; y $p=0,934$). En cuanto a la aceptabilidad ($n=141$), también fueron adecuadas para postre (100%), ensaladas (79%), y platos principales (65%). De las entrevistas, la percepción de la iniciativa es positiva, pero exige una mayor preparación técnica y cultural para implementarse adecuadamente en infantes y adolescentes.

Conclusiones: Según los parámetros técnicos establecidos por el PAE, sus nuevas pautas se implementan correctamente en el establecimiento evaluado.

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KEY MESSAGES

1. Chile's School Feeding Program adapts menus to combat childhood overnutrition, incorporating native foods and intercultural cuisine to improve nutritional quality.
2. Implementation of new guidelines shows promising compliance but challenges remain in the acceptability of intercultural dishes.
3. Introducing diverse, nutritious foods in school meals aims to address Chile's pressing public health concerns.
4. Strategies are needed to enhance children's acceptance of intercultural meals, ensuring successful integration into Chile's School Feeding Program.

CITATION

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INTRODUCTION

Overnutrition constitutes a serious public health issue on a global scale, causing health, social, and economic consequences in most countries around the world¹⁻². In Chile, 54% of school-aged and preschool-aged children experience overnutrition. This includes 31% obesity and nearly 11% severe obesity³. Unfortunately, these results are more critical in the early educational levels, highlighting the urgent need to modify the obesogenic food environments to which this age group is exposed⁴.

Given this situation, the School Feeding Program (PAE, for its acronym in Spanish)⁵ which provides daily lunches to more than 1,800,000 children and adolescents in the country has decided to renew its guidelines by incorporating changes to its meal plans (Table 1). Notably, this includes adding a greater quantity of healthy seafood products and increasing the frequency of legume consumption to at least six times a month in the form of burgers, stews, salads, etc. Additionally, the program reduces the provision of refined preparations, replaces powdered milk with its liquid version, and incorporates quinoa and polenta to increase the frequency of whole grains and boosts the intake of high

biological value protein⁶. In this regard, the modifications aim not only to enhance the nutritional quality of the integrated service but also to adapt to the public health context of overnutrition faced by Chilean schoolchildren.

The program educates students on healthy eating habits by promoting a structured approach to meals and encouraging the consumption of natural, nutritious, and diverse foods through a balanced diet. On the other hand, considering the significant demographic changes in the country over the past fifteen years due to substantial migration from Colombian, Venezuelan, and Haitian populations⁷, the PAE has also decided to implement the 'Cocina del Mundo'. This initiative is based on including foreign children who have entered the Chilean educational system in recent years⁸. Furthermore, the new tender also proposed, including traditional preparations. This initiative, called 'Cocina con Raices', aims to enhance the existing meal options. Additionally, for the first time, the menus will be differentiated according to the season and vary based on geographical location, incorporating regionally relevant dishes and promoting local ingredients⁹.

It also adopts an intercultural approach based on reports indicating that mothers who feel culturally separated from their social context are more likely to restrict the quality of their

Table 1. Preparations incorporated in the program.

Type of recipes	Preparations	
a) Main courses	<ul style="list-style-type: none"> • Tuna Sauce • Beef Stew • Poultry Carbonade • Lentil Stew • Baked Fish 	<ul style="list-style-type: none"> • Pasta with Mussels • Chicken Fricassee • Baked Salmon • Baked Fried Egg
b) Side dishes	<ul style="list-style-type: none"> • Chaufa Rice • Rice with Black Beans • Creamy Brown Rice • Lentil Salad • Rustic Potatoes 	<ul style="list-style-type: none"> • Cochayuyo Charquicán • Quinoa Salad • Creamy Quinoa Salad • Quinoa Tabbouleh
c) 'Cocina del Mundo'	<ul style="list-style-type: none"> • Chilli Hen - Peru • Creole Hall - Venezuela • Tomatoes Chicken - Haiti • Pique Macho - Bolivia 	<ul style="list-style-type: none"> • Chicken Stew - Ecuador • Yapingacho - Ecuador • Atollado Rice - Colombia • Potatoes with Cheese and Tomato Sauce - Colombia
d) 'Cocina con Raices'	<ul style="list-style-type: none"> • Kalapurca – Aymara • Spicy Chicken with Llaite – Aymara • Milloquin with Pepper – Mapuche • Catutos with Pepper – Mapuche 	<ul style="list-style-type: none"> • Pisku – Mapuche • Koru Achawal – Mapuche • Baked Tuna with Mashed Sweet Potato – Rapa Nui • Po'e of banana – Rapa Nui

Details all the new preparations incorporated into the program, divided into (a) Main Dishes, where the inclusion of a greater quantity of fish and seafood preparations stand out, (b) Side dishes, which for the first time includes Quinoa, Brown Rice, and Cochayuyo in the pre-school diet, (c) Preparations from countries with a high level of migration in the country, and (d) Preparations from three indigenous peoples from the north, centre and south of the country.

children's diets¹⁰. On the contrary, when there exists a traditional corpus of beliefs regarding nutrition and childcare within an intercultural context, the idea of maintaining a balanced diet and harmonious coexistence with the natural environment is established¹¹.

Implementing this approach may be difficult due to unfamiliarity with the foods and the lack of parental supervision during meals, which could hinder acceptance. Familiarity, curiosity, and food categorization are crucial for successfully introducing new foods to children's diets^{12,13}. Furthermore, it is essential to mention that not all establishments nationwide are prepared to integrate these new recipes, which require the executive chef of the central organization to provide technical sheets¹⁴ and pilot the program in only a few regions of the country. Understanding the obstacles mentioned, the present study aims to evaluate the implementation and acceptability of the modifications in the new guidelines of the PAE qualitatively and quantitatively.

METHODOLOGY

A mixed-methods pilot study was conducted with an exploratory and cross-sectional scope to evaluate the implementation and acceptability of the new bidding guidelines for Chile's School Feeding Program in one educational establishment in Paillaco, a locality within one of the country's 16 regions where the latest program modifications began piloting in 2022. Geographically, Paillaco is in the Los Ríos Region, approximately 870.9 kilometers south of the capital Santiago de Chile, with a population close to 20,000 inhabitants, featuring a high percentage of rural population (48%)¹⁵. The establishment is one of the 30 educational centers in the municipality, and its enrollment represents 10% of all students in Paillaco, according to data from the Ministry of Education's Center for Studies in Chile.

To assess acceptability, the lunch service was attended on the same three non-consecutive days used to evaluate implementation. During this period, trays returned after consumption by students from grades one to eight who participated in the establishment's School Feeding Program were examined. It is important to note that a sample size of 140 trays was targeted, calculated based on the total beneficiary population of the establishment's program ($n=220$), with a 95% confidence level and a maximum error of 5%, using SurveyMonkey® software.

From the amount consumed in each dish on the tray (salad, main course, and dessert), the intake fraction was visually assessed for each serving delivered on the tray, averaged daily. Three researchers in the field conducted this evaluation, each

providing their interpretation of the consumed portion, with the result being the average of the three observations. The evaluation used was selected based on the hedonistic principles of nutrition and previous national publications that advocated its use by the local reality of the educational institutions offering the program¹⁶. One week before the fieldwork, criteria were standardized among the researchers regarding the measures they would use as references (quarter portion, half portion, three-quarters portion, and full portion). This process was carried out by providing different trays with the same amount of food to the field researchers separately, where they were asked to quantify the portion consumed individually. The exercise was repeated with each tray until they achieved 100% accuracy thrice. In cases where differences were found according to the measurements taken by each field researcher, an average of the reports was calculated. Trays that did not have all the dishes initially provided at the start of the service were not included in the evaluation.

To the implementation evaluation, institutional forms and indicators from the School Feeding Program's new tender 85-41-LR21 for 2022-2025 were utilized¹⁷. These addressed aspects related to recipe modifications, advice from the executive chef, use of raw materials, and critical points in the production process ([Supplementary material - Figure 1](#)). The application was conducted by field researchers with advanced knowledge in dietetics and using checklist-based supervision instruments for lunch services in a randomly chosen week of November 2022. Results were tabulated based on the degree of compliance and expressed as a percentage for each day of service, with compliance interpreted if it exceeded 75% of the items, following the program's official evaluation criteria guidelines.

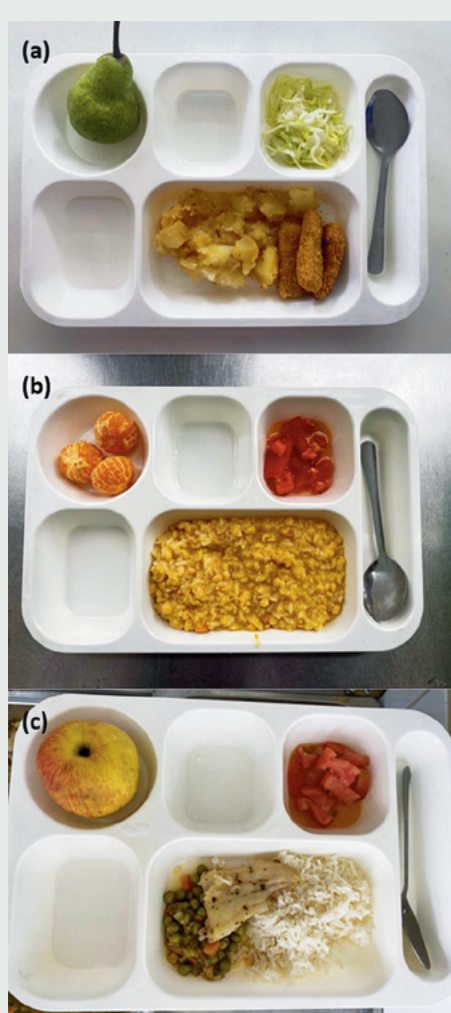
Finally, for a better interpretation of the results, various establishment levels were consulted regarding their perceptions of the implementation process and the students' acceptability towards the program modifications through semi-structured interviews ([Supplementary material - Figure 2](#)). Representatives from each level were individuals associated with the educational establishment and had some connection with the students (teachers, staff members, program coordinators, etc.). For the interviews, responses were collected anonymously in a quiet space within the establishment to ensure audio recording of each response. These responses were transcribed in triplicate and analyzed by the principal investigator, identifying the most relevant answers to deepen the understanding of the phenomenon reported in evaluating the implementation and acceptability of the program modifications. Descriptive analysis was used to analyze each study objective, comparing each day for implementation and acceptability. Mann-Whitney U tests were also conducted to evaluate dietary differences across days. Data obtained from interviews were analyzed using MAXQDA

Analytics Pro v22.5.0[®]. Recurrent themes and patterns were identified within the text, along with code matrices for each key stakeholder interview.

RESULTS

The evaluated meal preparations (Figure 1) and their acceptability (Figure 2) were assessed by recruiting the full calculated sample size on each fieldwork day (n=141). Results

Figure 1. Evaluated preparations.



The preparations consisted of (a) Cabbage with lemon, Breaded Hake with Lyonnaise Potatoes and Pear for day 1 (D1), (b) Tomato Salad, Stewed Chickpeas and Tangerines for day 2 (D2), and (c) Tomato Salad, Fish Fillet with Pearl Rice and Apple for day 3 (D3).

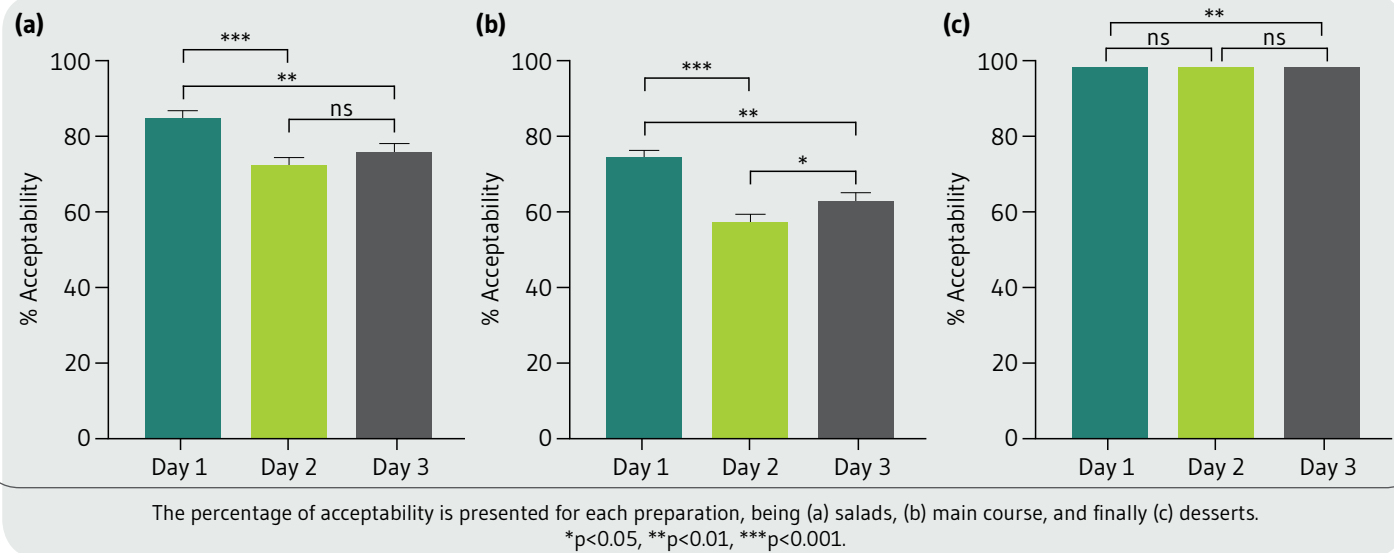
showed the highest average acceptability over the three days for desserts (100%), followed by salads (79%), and main dishes (65%). When comparing specific preparations across days, the dishes with the highest average acceptability were Cabbage Salad (88%) and Breaded Hake with Lyonnaise Potatoes (73%) among the main dishes. For Cabbage Salad, 79% of diners consumed the entire portion, compared to only half of the students who consumed Tomato Salads. As for the main dishes, 41% of students consumed the entire Breaded Hake with Lyonnaise Potatoes, 26% the Fish Fillet with Pea Rice, and only 22% the stewed Chickpeas. Differences were observed in salad acceptability between the first, second, and third days ($p=0.000$ and $p=0.002$, respectively). For main dishes, significant differences were reported between Breaded Hake with Lyonnaise Potatoes and stewed Chickpeas ($p=0.000$), Breaded Hake and Fish Fillet with Pea Rice ($p=0.023$), and between the latter and stewed Chickpeas ($p=0.007$). There were no significant or descriptive differences in dessert acceptability.

On the other hand, focusing on one of the principal axes of the new modifications, it was reported that none of the lunches included main dishes from the '*Cocina del Mundo*', and only Lyonnaise Potatoes from the '*Cocina con Raices*' guidelines were considered during these three days of evaluation. Concerning the principles associated with improving the nutritional quality of lunch, a proper protein option was observed on all three days, reflecting an increase in the inclusion of legumes and fish. Natural lemon was added to salads, and fruits were provided as dessert. The percentage results based on the program implementation checklist (Figure 3) showed that Day 1 achieved 95% compliance, Day 2 achieved 80%, and Day 3 achieved 90%. This indicates a correct implementation of the program according to the 24 points considered in its evaluation, with no significant differences observed between each day (Day 1 vs. Day 2, $p=0.857$; Day 1 vs. Day 3, $p=0.923$; and Day 2 vs. Day 3, $p=0.934$). Specifically, the recurring points not met on all three evaluation occasions relate to the use of 'pouch' format foods. Additionally, Day 2 and Day 3 did not incorporate intercultural preparations, and Day 2 did not adhere to the planned raw materials.

About the qualitative results, interviews were conducted with key stakeholders from the establishment, representing different sectors related to the school lunch service (n=6). From these interviews, 105 unique open codes were collected and categorized into four main domains (Table 2) to investigate the factors influencing the implementation and acceptability of the new school feeding program guidelines.

In the first category, "Personal perception of the modifications", stakeholders agree that the new guidelines improve student nutrition and promote cultural diversity. However, students' unfamiliarity with the new foods causes significant waste, leading to deviations from the guidelines. Despite these challenges,

Figure 2. Acceptability by day.



stakeholders support maintaining the program with strategies to boost acceptance.

In the second category, "Acceptability among students", the new meals are largely rejected due to their unfamiliar appearance. Students prefer familiar, Westernized dishes, and acceptance improves when new ingredients are subtly incorporated. Salt content is also a key factor in their preferences. In the third category, "Factors that enhance rejection", parents play a major role in students' acceptance. Many provide ultra-processed snacks when they believe their children won't like the school meals, and their lack of encouragement hinders students' willingness to try new dishes. In the fourth category, "Proposals to improve acceptability and implementation," nutritional education is seen as essential. Early education and training for stakeholders are suggested to better support students in accepting new foods.

DISCUSSION

Previously, studies of the same program have been conducted, but with different orientations focusing on evaluating dietary modifications related to the number of calories and sodium provided^{18,19}. As for the evaluation of acceptability measured by intake, our results can only be contrasted with a 2021 initiative on the program in the country's northern region. A cross-sectional study²⁰ reported results from over 500 students enrolled in the PAE, indicating an average of 77% for the main

Figure 3. Percentage of checklist implementation.

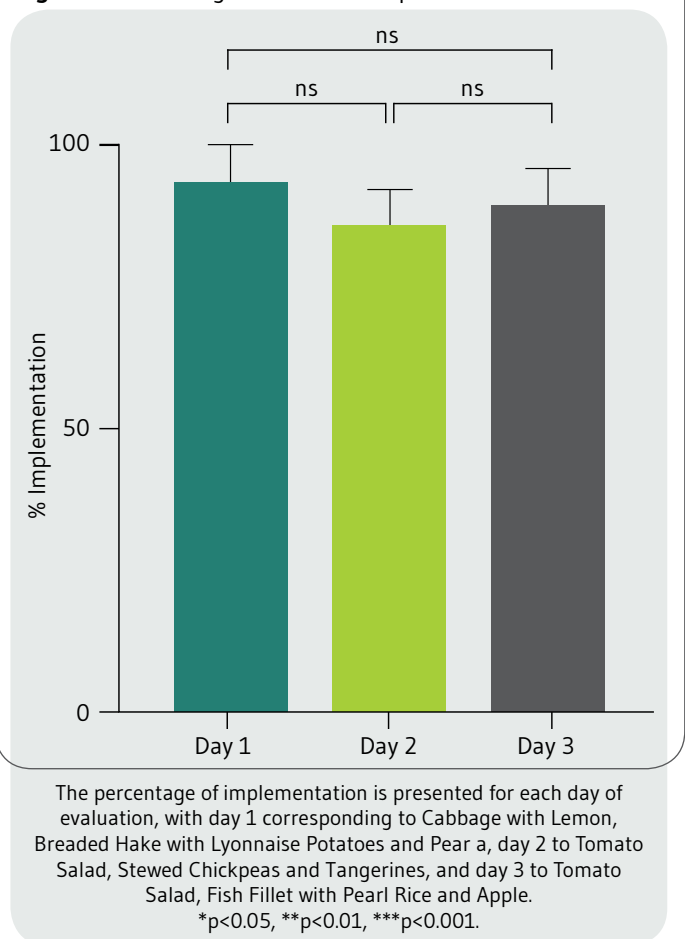


Table 2. Summary of the significant themes and quotes of participants.

Main Themes	Quotes
<p>Personal perception of modifications</p>	<p><i>"The changes were made with more natural products; for example, there is a dish called Mar y Tierra, a Charquicán de Cochayuyo with meat."</i></p> <p><i>"So far, I have only seen traditional preparations; I have not seen Venezuelan or Colombian dishes, for example."</i></p> <p><i>"Good because it is more varied, so they eat different things, not as repetitive as in the previous minutes. Now there is more fish and chicken, prepared differently"</i></p> <p><i>"I think the change in the menus has been very positive, but unfortunately, we still do not have a culture in Chile that allows us to value what we do."</i></p>
<p>Acceptability of schoolchildren</p>	<p><i>"When the children tasted some Caribbean dishes, they perceived them to be very sweet, bad, and strange."</i></p> <p><i>"The children have been getting used to it, although they have brought out some dishes they do not eat."</i></p> <p><i>"There is a rejection of vegetables, but I think it is because they are not encouraged to eat them at home either."</i></p> <p><i>"But the children generally do not find them bad; they just look at them and say that food is weird."</i></p> <p><i>"Yes, they usually leave much food behind when there is something they do not like."</i></p>
<p>Factors that enhance rejection</p>	<p><i>"They eat less elaborate preparations because their mothers work and only prepare fast food."</i></p> <p><i>"Generally, the mothers make what they like because I ask if they prepare casseroles at home, and they do not. They indicate that the food is prepared differently, so they compare it with what they usually eat"</i></p> <p><i>"They do not have a culture of consuming these foods because generally nowadays married couples both work and prepare dishes quickly."</i></p> <p><i>"They still bring their biscuits, chocolates, juices, or sugary drinks, which they consume when they do not feel like it. Unfortunately, it comes from their home culture"</i></p>
<p>Proposals to improve acceptability and implementation</p>	<p><i>"We blended the pumpkin so that it was like cream because if we did it the way indicated, there was more rejection."</i></p> <p><i>"Here, we make sure that the onion is finely chopped so that the child can accept the food, and they learn to put vegetables to one side."</i></p> <p><i>"The habit is in the children; they have to start eating this type of food from a very young age so that when they reach higher levels, they know what food it is, but to change it, just as they had arrived, no, it is complicated."</i></p> <p><i>"We make peasant lentils with potatoes because these things are made at home, and if it is closer to the tradition of the house, it is received in a better way."</i></p>

meal provided, ranging between 68-86% depending on the evaluated preparation (which includes dishes such as stews, fish, and legumes). In contrast to our findings, we report notably lower figures, with the meal receiving the highest intake at 73%, and the overall average intake across all preparations was only 65%. Regarding salads or desserts, comparisons cannot be made as the compared study only focused on main courses. The possible reasons for these differences are that we must note that the previous study included high school students from urban areas, and all evaluated preparations consisted of more traditional Chilean diet dishes. Similarly, when comparing the intake of main dishes from school feeding programs with other studies in the Latin American population, our intake results remain lower²¹. The high intake of salads and desserts may be

due to bulk fruit being offered, allowing students to snack on it later, which could skew the results. Thus, alternative evaluation methods are needed to capture more accurate data on this behavior.

To implement the new guidelines, the establishment meets over 75% of the program's central requirements. It has improved nutritional quality by adding fish, seaweed, and fresh lemon to salads and daily fruit as dessert. Unmet aspects related to supply management could be resolved with better planning and communication between central authorities and local managers. While menus should consider seasonal and regional products, factors like high costs in remote areas and food handlers' unfamiliarity can affect meal delivery. Evidence

shows that practice trials increase familiarity with new cooking methods, which leads to better program implementation²². In this regard, the guidance provided to each of those responsible for implementing these changes on the ground is crucial. Relying solely on a manual that may not adequately address the needs and realities of each region, especially in countries as heterogeneous as Chile, is impractical. Another unmet aspect concerns that none of the evaluated lunches adhered to the '*Cocina del Mundo*' guidelines. This is concerning as it was one of the key elements this initiative aimed to develop. This could be attributed to the low acceptability of the new preparations, leading to adjustments in the monthly planning to prevent losses. Unfortunately, this outcome is not reflected in the overall compliance level of the program's guidelines, as the technical standards do not stipulate a minimum frequency, and the checklist item addressing this represents less than 5% of the evaluation tool. This could result in inaccurate metrics regarding the implementation status without capturing the situation's complexity.

The semi-structured interview helped understand that the main reasons for children's rejection are a lack of familiarity and cultural barriers to preparations with structures and ingredients different from the typical dishes that Chilean children consume. Alarming, the intake of ultra-processed foods reported at a national level in this population constitutes a strategy that parents use to mitigate students' dissatisfaction with the preparations offered by the program, becoming a phenomenon that occurs at increasingly younger ages. In such situations, a publication²³ reported that interventions focused on complementary feeding methods for parents to promote greater child autonomy and reduce their children's supply and consumption of ultra-processed foods. This could be an interesting topic to consider in planning new public policies to establish new dietary habits in the child population, as requested by key stakeholders in this study regarding parental involvement. It is understood that parents play a vital role in the inseparable relationship between child rearing and child nutrition. Based on this understanding and considering that the program involves parents in establishing habits in their children, it would be interesting to develop strategies that more prominently integrate the stakeholders. Currently, the program educates parents through the website about the menus offered at each establishment and engages in civic dialogues. It would be beneficial in the future to evaluate how these tools influence the execution, implementation, and improvements of the current program. Furthermore, it is essential to reinforce that studies indicate economic and cultural barriers play a crucial role in resistance to dietary modifications of this kind. However, with consistency and commitment, healthy habits can be established in rural schoolchildren through interventions in their school feeding programs²⁴.

On limitations, the three days that were evaluated do not fully reflect the implementation of the guideline, as they lacked non-Chilean dishes. A quantitative method to standardize portions is needed, possibly by weighing trays. Despite limitations, results align with qualitative data from key stakeholders. It is also essential to consider that northern and central regions have a higher foreign population. (in border areas, it can reach up to 10%, and in metropolitan areas, even close to 20% compared to regional population)²⁵. Therefore, the acceptability and implementation of the assessed guidelines could yield different results, with a more significant consolidation of the preparations and ingredients among the evaluated schoolchildren.

It is essential to clarify that this initiative constitutes a pilot study that evaluated the implementation of new guidelines of this nature. Hence, the results should be interpreted with caution. However, this does not diminish the importance of gathering data as in the present study, as it is essential to disseminate institutional school feeding initiatives to social, health, and academic communities that aim to address interculturality issues²⁶. The evidence strongly indicates that it is a sound strategy but requires evaluation and monitoring to achieve the expected results²⁴. The inputs reported in this work will likely help generate future studies evaluating intercultural dietary initiatives in Chile (across more regions and educational establishments) and Latin America.

Based on our findings, we recommend (a) Establish a system to evaluate new meal preparations, set approval thresholds, and reformulate recipes to prevent food waste and reduce the substitution of ultra-processed foods. (b) Implement a standardized system for frequent menu changes to avoid disruptions like low integration of new dishes and meal repetition. (c) Link the program to migrant-focused initiatives to provide cultural insights and engage students with new foods.

Lastly, we suggest adjusting menus to resemble familiar meals while adhering to the new guidelines. Exploring culinary techniques for ingredients like seaweed or legumes could also improve acceptance, positively impacting the program.

CONCLUSIONS

The new guidelines of Chile's School Feeding Program are correctly implemented at the evaluated rural establishment. However, concerns arise that student acceptability is not fully reflected in the program's evaluation criteria. Defining better parameters to ensure successful implementation of the '*Cocina con Raíces*' and '*Cocina del Mundo*' initiatives is crucial.

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AUTHORS' CONTRIBUTIONS

V.B., V.C., and C.V. designed the study and collected and processed the data. N.R., S.M., and C.R. analyzed the data, reviewed the writing, and contributed to the discussion of technical issues. M.L. wrote the publication and supervised all research processes.

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DATA AVAILABILITY STATEMENT

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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