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## Abstract

**Introduction and Objectives:** To assess the impact of implementing a community intervention project on the food offered at lunch in Portuguese daycare centers. **Methods:** A study was conducted in a nonprobabilistic, convenience sample of 18 Portuguese daycare centers that welcome children from six to 36 months old. The characterization of the institutions was developed using a self-administered online questionnaire. To evaluate the menu, a qualitative analysis tool was created. After an initial assessment of 12 weeks of menus in each institution, the intervention lasted for nine months. This entailed the preparation of individualized technical reports and the close monitoring of the daycare centers. A further application of the menu analysis tool was subsequently conducted for the final 12 weeks of the project. The impact of the intervention was estimated by the difference between the results obtained before and after the intervention. **Results:** Following the intervention, there was an improvement in the description of meal components and the overall quality of the menus, which was improved by 16%. Throughout the study, the number of facilities with a lunch menu for the six to eight months age group increased from 13 to 16, while the number of times cooked fruit was offered decreased by a median of 100% in the institutions. In the nine to 11 months age group, there was a median of 100% of institutions beginning to offer only one type of pureed fruit. In the 12 to 36 months age group, the number of times that oily fish was offered, as well as vegetables, in addition to the carbohydrate source increased in a median of 8.3% of the institutions. **Discussion:** Despite the simplicity and duration of this intervention, there was an improvement with compliance with recommendations, including a decrease in the number of times cooked fruit was offered in the six to eight months age group and an increase in the number of times oily fish was offered in the 12 to 36 months age group.

**Keywords:** Food offer. Daycare. Lunch. Menu. Intervention. Children.

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## Impacto da intervenção do projeto “Creche com Sabor e Saúde” (C2S) na oferta alimentar de creches portuguesas

### Resumo

**Introdução e Objetivo:** Avaliar o impacto da implementação de um projeto de intervenção comunitária na oferta alimentar de creches portuguesas. **Métodos:** Estudo realizado numa amostra de seleção não probabilística e de conveniência em 18 creches portuguesas com crianças dos 6 aos 36 meses. Para caracterização das instituições, desenvolveu-se um questionário online de autoaplicação. Para avaliação das ementas, desenvolveu-se uma ferramenta de análise qualitativa. Após uma avaliação inicial de 12 semanas de ementas a cada instituição, a intervenção teve a duração de 9 meses e consistiu na redação de relatórios técnicos individualizados e num acompanhamento próximo das creches. O impacto foi estimado pela diferença entre os resultados obtidos na pré-intervenção e numa nova aplicação da ferramenta de análise de ementas nas últimas 12 semanas do projeto. **Resultados:** Após a intervenção, verificou-se uma melhoria na descrição dos componentes das refeições e na qualidade global das ementas, que melhorou 16%. Ao longo do estudo, o número de estabelecimentos com ementa de almoço entre os seis e os oito meses aumentou de 13 para 16, e o número de vezes que foi oferecida fruta cozinhada diminuiu numa mediana de 100% nas instituições. Dos nove aos 11 meses, houve uma mediana de 100% de instituições que passaram a oferecer apenas um tipo de puré de fruta. Dos 12 aos 36 meses, a oferta de peixe gordo e de hortícolas adicionais à fonte de hidratos de carbono aumentou numa mediana de 8,3% das instituições. **Discussão:** Apesar da simplicidade e da duração desta intervenção, registou-se uma melhoria na adesão às recomendações, incluindo uma diminuição do número de vezes que foi oferecida fruta cozinhada dos seis aos oito meses e um aumento do número de vezes que foi oferecido peixe gordo dos 12 aos 36 meses.

**Palavras-chave:** Oferta alimentar. Creches. Almoço. Ementas. Intervenção. Crianças.

#### Keypoints

##### What is known?

- Adequate nutrition is essential for optimal growth and development in children.
- Daycare centers are valuable environments for fostering healthy eating behaviors.

#### Keypoints

##### What is added?

- This pioneering study in Portuguese daycare centers aims to enhance lunchtime food quality.
- There was a 16% improvement in the results of the qualitative assessment of the lunch menus at the end of the project.
- These results highlight the urgent need to develop intervention projects in the food environment of daycare centers.

### Introduction

According to recent literature, Portuguese children have inadequate dietary habits. The 2012 Study on Dietary Patterns and Child Growth (EPACI) showed that children aged 12 to 36 months consumed insufficient quantities of vegetables and an excess of dairy products, soft drinks, sweets, and snacks<sup>1</sup>. According to the National Survey on Nutrition and Physical Activity (IAN-AF 2015/16), children aged three to nine years have a lower intake of fruits and vegetables and an excessive consumption of soft drinks and red and processed meats compared to the World Health Organization (WHO) recommendations<sup>2</sup>. Based on these findings, there is an urgent need to improve the dietary habits of Portuguese children.

There is strong scientific evidence that exposure to environmental factors during critical periods of growth

and development has lasting effects on an individual's health<sup>3–6</sup>, in particular the early postnatal period, when nutrition plays a very important role regarding the risk of developing noncommunicable diseases, such as obesity, type 2 diabetes, and cardiovascular disease through metabolic programming effects<sup>7,8</sup>.

Daycare centers are among the key factors that must be taken into account in shaping dietary preferences during childhood. Daycare is understood as a social response aimed at accommodating children between the ages of three and 36 months during the daytime period corresponding to their parents' working hours<sup>9</sup>. In recent decades, there has been an increase in the number of children enrolled in these facilities due to the greater participation of women in the workforce<sup>10</sup>, making the nutritional quality of the menus offered in these settings a key factor in promoting healthy eating during

childhood<sup>11</sup>. The WHO highlights daycare centers as a unique setting for implementing health-promoting interventions<sup>12</sup>.

Daycare centers have become increasingly important as excellent settings for intervening to promote child health, with a particular focus on encouraging healthy dietary habits, in countries such as Poland, Brazil, Australia, and China<sup>13–16</sup>. The “Healthy Start” intervention project, conducted in the United States in 2002, successfully reduced the total and saturated fat content consumed by children aged two to five by modifying the food provision in these settings<sup>17,18</sup>. In Australia, the “Romp & Chomp” project in 2010 achieved a reduction in the prevalence of obesity in children aged eight to five by increasing the consumption of fruits and vegetables and decreasing the intake of energy-dense, nutrient-poor foods and beverages<sup>19</sup>.

In Portugal, the “Creche com Sabor e Saúde – C2S” project (2022 – 2023) involved 18 Portuguese daycare centers, with more than 800 children aged six to 36 months<sup>20</sup>. This project made it possible to characterize lunch offerings in this country for the first time, which revealed inadequacies. Notable findings from this analysis include an excessive provision of prepared fruit for the six to eight months age group, the simultaneous serving of a protein-based dish and soup for the 9–11 months age group, and the absence of oily fish and eggs for children aged 12–36 months. Therefore, aiming to enhance the nutritional quality of the food supply in these educational settings, where many children embark on and undergo dietary diversification, establishing their preferences and eating habits, we proposed researching the impact of a nine-month intervention strategy for children aged six to 36 months in the daycare social response stemming from the C2S project.

## Materials and methods

This study was conducted using a nonprobabilistic, convenience sample consisting of 18 social institutions with daycare services, located in the northern and central regions of Portugal. These institutions were part of the C2S project. All the institutions attend children aged 12 to 36 months, but only 17 (out of 18) had children aged six to 11 months. The study took place between February 2022 and February 2023.

### *1st phase (initial phase) – data collection*

An initial, self-administered online questionnaire was developed for the purpose of gathering information on

the characteristics of the social institutions. This included the type of food service unit (preparation or collection), the type of management (direct or concession), the number of children enrolled in daycare, the number of education professionals (teachers and educational assistants) and food handlers, collaboration with a nutritionist in the institution, and the existence of food donations.

In the initial phase, lunch menus from the 12 weeks prior to the start of the project were collected. A qualitative evaluation tool, developed within the context of the C2S project, was applied based on recommendations from the Directorate-General of Health (DGS), the European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN), and the WHO<sup>21–23</sup>. The tool is designed to assess compliance with specific parameters for three distinct age groups (six to eight months, nine to 11 months, and 12 to 36 months), investigating a total of 23, 47, and 48 items, respectively. Compliance is established as “Compliant,” “NonCompliant,” and “Not Applicable/Not Auditable.” The percentage (%) of compliance over the 12 weeks was calculated for each item. Finally, the mean value of the menu quality for each institution was calculated by averaging the total percentage of compliance across all evaluated parameters<sup>20</sup>.

### *2nd phase – intervention strategy*

Following the evaluation of lunch menus provided in daycare centers (phase 1), the research team drafted individualized technical reports for each institution. These reports detailed which evaluated items complied the most with the recommendations and, conversely, which items did not adequately comply with the recommendations and therefore should be prioritized. Each report included suggestions for improvement for the items that were not properly addressed so as to enhance the quality of the menus offered. These reports were presented and discussed individually in a meeting with the daycare nutritionist at each institution or, in the absence of a nutritionist, with the person in charge of the institution. Additionally, the research team provided ongoing support to the institutions throughout the 12-month project period for the purpose of clarifying any doubts related to the suggested improvements.

### *3rd phase (final phase) – evaluation of the intervention strategy*

In the final phase, the lunch menu plans from the previous 12 weeks of the project were collected and

evaluated using the same tool employed in the initial phase<sup>20</sup>. In addition to calculating the percentage of compliance for each parameter and the average menu quality percentage, the percentage of variation in compliance and the percentage of improvement were determined.

The variation percentage represents the difference between the average menu quality values in the initial and final periods. The improvement percentage corresponds to the proportion of positive change, calculated as  $[100 - (\text{final \%} \times 100 / \text{initial \%})]$ .

The data were analyzed using the Software Package for Social Sciences (SPSS®) for Windows V.27.0 and results were considered statistically significant when  $p < 0.05$ . The descriptive analysis of the variables was conducted by presenting measures of central tendency and dispersion. Specifically, relative and absolute frequencies were employed for nominal variables, while mean ( $\pm$  standard deviation) or median (25<sup>th</sup> – 75<sup>th</sup> percentile) were utilized for continuous variables. This approach was based on the normality of the variable, which was assessed by the Shapiro-Wilk test. The Wilcoxon signed-rank test was employed to ascertain whether there were discernible discrepancies in the quality of the menus in question prior to and subsequent to the intervention, as well as for each item under consideration in this study. The association between institutional characteristics and the enhancement in menu quality (in general and for each item) was evaluated utilizing the Pearson correlation coefficient and the t-student test for independent samples.

This study was approved by the Ethics Committee of the Faculty of Nutrition and Food Sciences at the University of Porto (report No. 77/2022/CEFCNAUP/2022).

## Results

Twelve weekly menu plans from 18 private social solidarity institutions were analyzed at two assessment periods (the 1<sup>st</sup> and 3<sup>rd</sup> phases), totaling 432 weeks of menu plans (216 in each phase) and 5,040 meals analyzed (1<sup>st</sup> phase: 780 from the six to eight months age bracket, 780 from the nine to 11 months age bracket and 1,080 from the 12 to 36 months age bracket; 3<sup>rd</sup> phase: 960 from the six to eight months age bracket, 960 from the nine to 11 months age bracket and 1,080 from the 12 to 36 months age bracket).

Out of the institutions surveyed, 15 (83.3%) were preparation units while three (16.7%) were collection units. Additionally, 17 (94.4%) institutions had an in-house management service while one institution

**Table 1.** Characterization of institutions involved in the “creche com sabor e saúde (C2S)” project

	N = 18
Type of food service unit, n (%)	
Preparation	15 (83.3)
Collection	3 (16.7)
Type of management, n (%)	
Direct	17 (94.4)
Concession	1 (5.6)
Total number of children, mean (SD)	45 (18)
Total number of education professionals, mean (SD)	10 (3)
Total number of food handlers, mean (SD)	5 (3)
Total number of employees, mean (SD)	14 (4)
Collaboration of a nutritionist in the institution, n (%)	
Yes	12 (66.7)
No	6 (33.3)
Receipt of food donations, n (%)	
Yes	11 (61.1)
No	7 (38.9)

SD: standard deviation.

(5.6%) had a leased management service. Approximately 60% (n = 11) of the establishments received food donations and only 10 (55.6%) had a nutritionist working daily in these spaces. The average number of enrolled children in the institutions was 45, with a min of 25 and a max of 90, and the number of human resources dedicated to meal preparation and cooking varied between two and 11 individuals (Table 1).

In terms of the qualitative assessment of menus, a comparison of the postintervention evaluation with the preintervention evaluation revealed that all institutions exhibited an improvement in the quality of their lunch menus. Indeed, the difference observed in the quality of the menus before and after the intervention was statistically significant ( $p < 0.001$ ; result shown only in the text). The median value of improvement in the percentage of compliance with menu plan evaluations was 16%, with the median percentage of compliance in the final evaluation being 80.7% and in the initial evaluation being 70.3%. Specifically, an improvement of greater

**Table 2.** Evaluation of the effect of the intervention strategy on the lunch menu plans under the “creche com sabor e saúde (C2S)” project

	Average % of compliance (initial phase)	Average % of compliance (final phase)	% compliance variation*	% of improvement†
Daycare center A	71.9	93.0	+21.1	29.3
Daycare center B	61.7	66.4	+4.7	7.7
Daycare center C	72.3	75.8	+3.5	4.8
Daycare center D	73.8	79.5	+5.7	7.7
Daycare center E	63.7	91.6	+27.9	43.7
Daycare center F	78.6	97.4	+18.8	23.9
Daycare center G	66.8	81.8	+15.0	22.5
Daycare center H	71.4	87.7	+16.3	22.9
Daycare center I	81.3	87.9	+6.6	8.2
Daycare center J	74.0	83.5	+9.5	12.9
Daycare center K	66.9	77.5	+10.6	15.9
Daycare center L	66.9	77.5	+10.6	15.9
Daycare center M	66.9	77.5	+10.6	15.9
Daycare center N	66.9	77.5	+10.6	15.9
Daycare center O	71.1	76.0	+4.9	6.8
Daycare center P	69.7	76.2	+6.6	9.4
Daycare center Q	66.2	89.5	+23.2	35.1
Daycare center R	70.8	87.1	+16.2	22.9
Total	70.3	80.7	+10.6	16

\*Compliance % variation = final phase % - initial phase %.

†Improvement % =  $100 - (\text{final phase \%} \times 100 / \text{initial phase \%})$ .

than 30% was observed in two institutions, between 15.0 and 30.0% in nine institutions, and between 0.0 and 15.0% in nine institutions (Table 2).

In the initial phase of the study, 18 institutions were taken into consideration for the 12–36 months age group and 13 (73%) for the 6–11 months age group. Four of the latter, despite providing meals, did not have a defined menu plan. In the final phase, there was a notable increase in the number of institutions with menu plans for the 6–11 months age group, from 13 (76.5%) to 16 (94.1%), along with an increase in the number of assessable items. In these cases, the qualitative assessment of menus was more comprehensive, as a more detailed description of soup and dessert components was observed. A notable increase was observed in the number of institutions specifying the drink (water) on their lunch menus. This increase was particularly evident in the six to eight months age

group, with a 27% increase, followed by the 9–11 months age group, with a 34.6% increase, and finally the 12–36 months age group, with a 22.2% increase (results shown only in the text).

The parameters of the qualitative menu evaluation tool are detailed in table 3, demonstrating the greatest variation in the compliance percentage between the initial and final phases across the different age groups. Notably, in the six to eight months age group, there was an increase in compliance by offering soup with a min of three different vegetables (+ 100%,  $p = 0.007$ ) and providing prepared fruit a max of twice a week (+ 100%,  $p = 0.014$ ). In the 9–11 months age group, there was a 100% increase in compliance concerning offering pureed fruit of only one variety, although this was not statistically significant ( $p = 0.317$ ). There was also a 100% increase in the inclusion of at least three different vegetables in each soup ( $p = 0.007$ ). Among the 12–36 months age

**Table 3.** Effect of the intervention strategy on the degree of compliance with the parameters of the menu evaluation tool within the scope of the “creche com sabor e saúde (C2S)” project

	Average % of compliance (initial phase)		Average % of compliance (final phase)		p-value*	Compliance % variation†
	N	Median (p25, p75)	N	Median (p25, p75)		Median (p25, p75)
Parameters						
6 – 8 months						
A minimum of three different vegetables in the soup, daily	11	0 (0, 95.8)	14	100 (100,100)	0.007	+100 (31.3,100)
Fish in soup two to three times a week	12	91.7 (0.0, 93.8)	16	100.0 (87.5, 100.0)	0.010	+8.3 (0.0, 79.2)
Provision of prepared fruit, with no added sugar, no more than twice a week	10	0.0 (0.0, 0.0)	15	100.0 (50.0,100.0)	0.014	+100.0 (0.0, 100.0)
9 – 11 months						
Wide range of cooking techniques	8	33.3 (33.3, 50.0)	13	83.3 (33.3, 83.3)	0.180	+50.0 (0.0, 83.3)
Absence of repeated dishes in a month	8	0.0 (0.0, 0.0)	13	66.7 (33.3, 100.0)	0.024	+41.7 (33.3, 66.7)
A minimum of three different vegetables in the soup, daily	11	0.0 (0.0, 95.8)	13	100.0 (100.0, 100.0)	0.007	+100.0 (31.3, 100.0)
Fish as the main source of protein two to three times a week	11	100.0 (95.8, 100.0)	16	100.0 (91.7, 100.0)	0.102	+4.2 (0.0, 85.4)
Max presence of the same CH supplied twice a week	8	70.8 (50.0, 100.0)	13	91.7 (83.3, 100.0)	0.034	+33.3 (8.3, 83.3)
Provision of prepared fruit, with no added sugar, no more than once a week	4	0.0 (0.0, 25.0)	15	100.0 (50.0,100.0)	0.317	+100.0 (0.0, 100.0)
Fruit puree of only one variety of fruit	2	--	15	100.0 (100.0, 100.0)	0.317	+100.0 (100.0, 100.0)
12 – 36 months						
Absence of prefried and deep-fried foods	18	70.8 (52.1, 81.3)	18	83.3 (66.7, 83.3)	0.043	+4.2 (0.0, 9.6)
Absence of animal protein food (meat/fish/egg) in soup	18	91.7 (72.9, 100.0)	18	100.0 (100.0, 100.0)	0.006	+4.2 (0.0, 8.3)
Meat as the main source of protein two to three times a week	18	100.0 (91.7, 100.0)	18	91.7 (83.3, 100.0)	0.007	–8.3 (–8.3, 0)
Oily fish at least once a week	18	16.7 (0, 31.3)	18	41.7 (20.8, 56.3)	0.025	+8,3 (0.0, 45.8)
Max provision of the same CH supplied twice a week	18	83.3 (41.7, 89.6)	18	83.3 (83.3, 100.0)	0.022	+8.3 (0.0, 41.7)
Adding vegetables to CH supplied twice a week	18	45.8 (25.0, 66.7)	18	50.0 (43.8, 72.9)	0.093	+8.3 (0.0, 16.7)
Provision of legumes on the plate once a week	18	70.8 (50.0, 83.3)	18	83.3 (58.3, 97.9)	0.046	+4.2 (0.0, 14.6)

(Continues)



**Table 3.** Effect of the intervention strategy on the degree of compliance with the parameters of the menu evaluation tool within the scope of the “Creche com Sabor e Saúde (C2S)” project (*continued*)

	Average % of compliance (initial phase)		Average % of compliance (final phase)		p-value*	Compliance % variation†
	N	Median (p25, p75)	N	Median (p25, p75)		Median (p25, p75)
Varied offer between raw and cooked vegetables	18	70.8 (43.8, 91.7)	18	91.7 (77.1, 91.7)	0.008	+4.2 (0.0, 39.6)
Absence of dishes with all components of a similar texture	18	100.0 (100.0, 100.0)	18	95.8 (77.1, 100.0)	0.007	−4.2 (−23.0, 0.0)
Absence of sweet desserts	18	91.7 (60.4, 97.9)	18	100.0 (100.0, 100.0)	0.087	+4.2 (0.0, 8.3)

CH: Carbohydrates; P25 – 25<sup>th</sup> percentile; P75 – 75<sup>th</sup> percentile.

\*Wilcoxon signed-rank test.

†Compliance % variation = final phase % - initial phase %.

group, for instance, there was a higher provision of oily fish (8.3%,  $p = 0.025$ ) and a decrease in animal protein in soup (4.2%,  $p = 0.006$ ). In this age group, two parameters exhibited a negative variation: the offering of meat as the main protein source two to three times a week (−8.3%,  $p = 0.007$ ) and the absence of dishes with components of a similar texture (−4.2%,  $p = 0.007$ ).

In examining the relationship between menu quality improvement and institutional management characteristics, no statistically significant differences were observed. This indicates that there is no association between the percentage of improvement and the total number of children ( $p = 0.493$ ), education professionals ( $p = 0.801$ ), food handlers ( $p = 0.563$ ), and collaborators ( $p = 0.492$ ). Furthermore, there was no correlation between menu quality improvement and the receipt of food donations (mean with donations = 16.9%, mean without donations = 19.4%,  $p = 0.551$ ) or collaboration with a nutritionist in the institution (mean with nutritionists = 20.2%, mean without nutritionists = 13.1%,  $p = 0.590$ ).

The absence of animal protein sources (meat, fish, and eggs) in the soup was found to be statistically significantly different according to the total number of education professionals (correlation coefficient = 0.487,  $p = 0.040$ ). Similarly, oily fish consumption at least once a week was also found to be statistically significantly different according to the total number of food handlers (correlation coefficient = 0.484,  $p = 0.042$ ).

## Discussion

The main results of this study are an increase in the availability of meal plans for the 6–11 months age group, a more detailed description of the ingredients in the meals, and a 16% improvement in the qualitative

rating of these meal plans. Although there was no statistically significant association between the improvement in the quality of the menus and the collaboration of a nutritionist in the institution, it is important to note that the average quality of the menus was higher in the institutions with nutritionists than in those without (20.2% and 13.1%, respectively). Moreover, it was evident that the technical and scientific support provided by the project's nutritionists in the evaluation of the menu plans and the writing of the reports had a positive impact on the final result.

In the 12 month follow-up period of this study, there was a notable improvement in the quality of menus across all participating institutions, with an average increase of 10.6% and a max of 43.7%. This is a significant finding, particularly considering the fact that children spend a substantial portion of their day in a childcare setting, where they consume a considerable number of meals that can have a profound impact on their early eating habits<sup>24</sup>. In this study, two of these institutions showed an improvement of more than 30% in the quality of their lunch menus. However, it was not possible to identify a plausible justification for this significant improvement concerning the other institutions, nor for such a large disparity in the improvement percentage found (4.8% to 43.7%). It was not possible to ascertain whether this improvement was associated with any of the covariates analyzed, such as the presence or absence of a nutritionist or the receipt or non-receipt of food donations. The small sample size may reduce the power of this analysis, so further studies are needed to understand the factors related to the improvement in menu quality.

A multidisciplinary intervention conducted in Australia was efficacious in enhancing the food provision and

nutritional practices of the 50 daycare centers included in the study<sup>25</sup>. In the same country and in the context of childcare, a randomized clinical trial lasting six months intervened in a group with on-the-job training for staff, the provision of checklists for planning menus, recipes, and budget fact sheets. The results indicated an increase in compliance with national dietary guidelines for children aged two to five years<sup>26</sup>. In this same group, it was found that improving the quality of the food offered led to an increase in the intake of healthier foods<sup>26</sup>. Although this study did not directly assess the food intake of children in the institutions, it is anticipated that the findings had a positive impact on their dietary consumption, due to the increased ease of influencing behaviors in these age groups<sup>27</sup>.

The provision of prepared fruit up to twice a week from the six to 11 months age group, as well as the provision of a fruit puree with only one variety of fruit, were identified as one of the criteria that exhibited the greatest improvement among the institutions. These items are extremely important as the first years of life are a window of opportunity for training in different tastes and textures<sup>23</sup>. These months are essential for the child's sensory development and from the sixth month onwards, neuromotor control and physiological and metabolic maturity allow for a progressive increase in textures<sup>23</sup>. A notable increase in the addition of vegetables to the carbohydrate provision was observed between the ages of 12 and 36 months. This finding suggests that a more consistent and frequent provision of these foods may be achieved by following this approach. Compliance with this item becomes even more relevant in the knowledge that the repeated offer of a particular vegetable to a child is one of the main determinants for an increase in its consumption<sup>28</sup>.

All of the items mentioned above and those discussed support the need to increase food literacy in this context with a view to changing behaviors<sup>29</sup>. This is the inaugural study to assess the efficacy of a brief, simple intervention in the food provision of 18 daycare centers. In this study, the intervention strategy was based on close monitoring of these institutions for a year by a team of nutritionists, who provided early-stage recommendations for enhancing the lunch menus. Additionally, the team provided personalized monitoring with each institution to assist in overcoming the primary challenges encountered as they attempted to improve the menus. Nevertheless, the significance of these initiatives and the necessity of robust and sustainable public health policies at the national level to enhance the nutritional quality of food served in daycare centers

and to enhance the training of professionals working in these institutions were readily apparent.

No statistically significant associations were observed between the general improvement of menus and the total number of children and staff. Notwithstanding these considerations, the results of this study indicate that the presence of meat, fish, or eggs in the soup (even when a dish was already provided) and the offer of oily fish at least twice a week were positively correlated with the number of professionals dealing with children and the number of food handlers, respectively. When analyzing this data, it is important to consider the influence of chance, as compliance with these items is largely due to the level of food literacy in this age group and is not directly related to the number of employees.

Despite the observed improvement in numerous parameters of the qualitative assessment tool, it was not possible to achieve 100% compliance in all the parameters considered. These data are consistent with the difficulties reported in the literature regarding the improvement of the food provision in institutions. Some studies have identified the difficulty in verifying the nutritional adequacy of the menus as the main barrier to improvement. This difficulty is inherent to the lack of knowledge, training, and resources for their drafting, which prevents institutions from complying with national and international guidelines. Additionally, the lack of support from families to promote the necessary changes at home, monitoring the eating habits of the institution, further complicates the situation<sup>30,31</sup>. Another study considers obstacles to improving the food provision, including the perceived increase in costs related to healthy eating, the lack of time to prepare healthy meals, the limited storage space, and the perception that children will not adhere as well to a diet that better meets the recommendations in force, resulting in increased food waste<sup>32</sup>.

According to data from the WHO, in 2019, approximately 38.2 million children under the age of five years had preobesity and obesity<sup>33</sup>. In adulthood, this pathology is ranked as the fifth leading cause of death globally, accounting for the development of 44% of diabetes mellitus cases, 23% of cardiovascular diseases, and 7–41% of some types of cancer<sup>33,34</sup>. Although intervention projects with an impact on the early age of life (up to 36 months) are still scarce, it has been demonstrated that changing the degree of exposure to risk factors at this stage can lead to a reduction in the risk of developing diseases such as obesity and other non-communicable diseases later in life<sup>7</sup>. Intervention projects in this age group have demonstrated that the qualitative improvement in the food supply of daycare



centers is associated with a decrease in body mass index (BMI) and a general improvement in children's eating habits. This is in line with the findings presented by Natale et al.<sup>35</sup>.

The main limitations of this study are the small sample size ( $n = 18$ ), which may have reduced the power to find statistically significant associations as well as the fact that this was a convenience sample and that it is therefore imperative to exercise caution when extrapolating these results, as the sample is not representative of the Portuguese population. In addition, the results of this study may have been biased due to the possible inaccuracy of the data provided by the self-administered questionnaires. Also, it is crucial to acknowledge the simplicity and brief duration of the intervention strategy, despite its efficacy in yielding promising outcomes. Regarding the lunch menus, it is important to take into consideration that the menus may differ in terms of details and description between institutions, which may have under- or over-estimated the results. Besides, the analysis of the quality of the lunch menus was carried out by three different individuals, although previously trained for this purpose, in order to reduce this possible bias. Finally, although the study assessed the quality of the lunch menus, it did not directly assess children's food consumption, which is a crucial measure to understand the real impact on child nutrition.

This study, despite the aforementioned limitations, reinforces the role and importance of a nutritionist in the context of daycare centers and the need to provide guidelines aimed at improving the quality of the food provision. The intervention strategy used stands out as a practical and an effective approach. Notably, this strategy could be replicated across the country. Furthermore, it is notable that the analysis encompassed 12 week menu plans at each stage of the study, which afforded the research team results that were more closely aligned with the realities of each location and a more precise identification of the changes implemented and sustained over time.

The findings of this study revealed an average improvement of 16% (with a min of 4.8% and a max of 43.7%) in the qualitative assessment of menu plans in the institutions involved. It is noteworthy that there was a notable improvement in the menus drawn up for children aged 6–11 months and that a more precise description of meal components was provided. These findings underscore the pressing need to develop community intervention projects in the dietary environment of daycare centers. Furthermore, they highlight the untapped potential of these strategic settings to establish and positively influence children's eating habits.

## Author contributions

M. do Céu Monteiro, M.C. Teixeira Santos, S.S.P. Rodrigues, A. Rocha, C. Afonso: Conception and design of the study, report, review or other type of work or paper; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. A. Gonçalves, I. Dias, M. Conceição: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Agreement to be accountable for the accuracy or integrity of the work. B. Teixeira: Conception and design of the study, report, review or other type of work or paper; Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. O. Pita: Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Critical review of the article for important intellectual content; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. L. Nova: Acquisition of data either from patients, research studies, or literature; Analysis or interpretation of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work. B. Cidade Coelho: Acquisition of data either from patients, research studies, or literature; Drafting the article; Final approval of the version to be published; Agreement to be accountable for the accuracy or integrity of the work.

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## Conflict of interest

None.

## Ethical considerations

**Protection of human and animal subjects.** The authors declare that no human subjects and/or animal experiments were performed in the course of this research.

**Data confidentiality.** The authors declare that no patient data appear in this article. In addition, the authors have acknowledged and followed the recommendations of the SAGER guidelines, as appropriate to the type and nature of the study.

**Right to privacy and informed consent.** The authors declare that no patient data appear in this article.

**Use of artificial intelligence to generate text.** The authors declare that they did not use any type of generative artificial intelligence in the writing of this manuscript or in the creation of the figures, graphs, tables, and/or their respective legends.

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