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## Food and nutrition education as a strategy to reduce food wastage in public elementary schools

### *A educação alimentar e nutricional como estratégia para redução do desperdício de alimentos em escolas públicas de ensino fundamental*

#### Abstract

**Introduction:** Food and nutrition education (FNE) activities in the context of school meals have been highlighted for contributing, among other possibilities, to the reduction in food wastage. **Objective:** To assess the impact of FNE activities aimed at reducing wastage in school meals. **Methods:** The study began with a diagnosis food wastage in two public elementary schools in Santa Bárbara do Oeste-SP and Limeira-SP, through monitoring of leftovers and food waste, for 12 non-consecutive days, at different times, between August and December 2019. After the diagnosis, the FNE activities were planned, prepared, and executed, with subsequent analysis of the results. The activities were carried out with elementary school classes (n=152 schoolchildren), allocated to "control" (n=77) and "intervention" (n=75) groups, to enable evaluation of the effectiveness of the FNE in reducing food wastage at the end of the study (control vs. intervention). **Results:** In both schools, the consumption of rice, beans, and the protein dish stood out, compared to the other preparations. Waste reduction was observed in both schools, in the intervention and control groups, when comparing the data before and during the intervention ( $p<0.05$ ). The reductions in wastage in the intervention group were 62.0% in the SBO school and 43.1% in the Limeira school. **Conclusion:** FNE activities were effective, but long-term follow-up is recommended to assess their effectiveness.

**Keywords:** Food waste. Food and nutrition education. School food.

#### Resumo

**Introdução:** Atividades de educação alimentar e nutricional (EAN) no contexto da alimentação escolar vêm se destacando por contribuir, dentre outras possibilidades, para a redução do desperdício de alimentos. **Objetivo:** Avaliar o impacto de atividades de EAN direcionadas à redução do desperdício na alimentação escolar. **Métodos:** O estudo teve início com um diagnóstico de duas escolas públicas de ensino fundamental em Santa Bárbara do Oeste-SP e Limeira-SP, por meio do monitoramento das sobras e resto-ingestão, por 12 dias não consecutivos, em momentos distintos, entre agosto e dezembro de 2019. Após o diagnóstico, as atividades de EAN foram planejadas, elaboradas e executadas, com posterior análise dos resultados. As atividades foram realizadas com turmas do ensino fundamental (n=152 escolares), que foram alocadas em grupos "controle" (n=77) e "intervenção" (n=75), para possibilitar a avaliação da eficácia da EAN na redução do desperdício de alimentos ao final do estudo (controle vs. intervenção). **Resultados:** Em ambas as

escolas, destacava-se o consumo de arroz, feijão e prato proteico, comparado às demais preparações. Observou-se redução do desperdício nas duas escolas, nos grupos intervenção e controle, quando comparados os dados antes e durante a intervenção ( $p < 0,05$ ). As reduções foram de 62,0% do desperdício no grupo intervenção da escola de SBO e de 43,1% da escola de Limeira. **Conclusão:** As atividades de EAN foram eficazes, porém é recomendável o acompanhamento em longo prazo para que seja avaliada sua efetividade.

**Palavras-chave:** Desperdício de alimentos. Educação alimentar e nutricional. Alimentação escolar

## INTRODUCTION

According to Resolution No. 06, of May 8, 2020,<sup>1</sup> one of the objectives of school feeding is to promote “[...] the formation of healthy eating practices of students, through food and nutrition education activities and the provision of meals that cover their nutritional needs during the school term”. The National School Feeding Program (PNAE), on the premise of health promotion, encourages and contributes to the development of skills and eating practices that can be permanently implemented.<sup>1</sup>

In this context, there are several strategies of Food and Nutrition Education (FNE), with activities aimed at the reflexive construction of knowledge, as well as the promotion of healthy eating in institutional environments.<sup>1</sup> The FNE Reference Framework for Public Policies is a prominent reference to support the planning of interventions that encourage significant changes in the context of health promotion and Food and Nutrition Security (FNS).<sup>2</sup>

According to Silva et al.,<sup>3</sup> school feeding takes on a pedagogical character, which favors and stimulates, in a transversal way, the union of themes related to food and nutrition in the school curriculum. FNE is, therefore, a contemporary transversal strategy<sup>4</sup> that should encompass the curriculum in order to contemplate transdisciplinarity. In this sense, its activities can make use of different knowledge and topics related to food, such as social, environmental, and economic sustainability and an approach to the food system in its entirety.<sup>1</sup>

In the context of sustainability, schools become important spaces for the design and application of FNE activities, in order to contemplate, for example, goal 12 of the UN 2030 Agenda for Sustainable Development.<sup>5</sup> Although there are no specific data on food wastage from school meals, it is known that, in Brazil, approximately 35% of the production available for consumption (whether in the production, post-harvest, storage, or transport phases) is wasted each year, leading the country to occupy the 10th place in the ranking of the countries that waste the most food in the world.<sup>5</sup>

In general, studies that relate FNE to food wastage use acceptance and adherence rates<sup>1</sup> as a way of measuring wastage in a school environment.<sup>6-8</sup> Although studies on this topic are scarce, according to Abrantes et al.,<sup>9</sup> FNE activities reduced food wastage by 50%, reaching up to 100% in some classes at a philanthropic institution with children aged 3-12 years. Araújo and Rocha<sup>10</sup> observed a reduction in food wastage in schoolchildren aged 3-10 years, who were made aware of the wastage through FNE activities.

So, the aim of the present study was to evaluate the impact of FNE activities aimed at reducing wastage in school meals in two public schools located in the interior of São Paulo, Brazil.

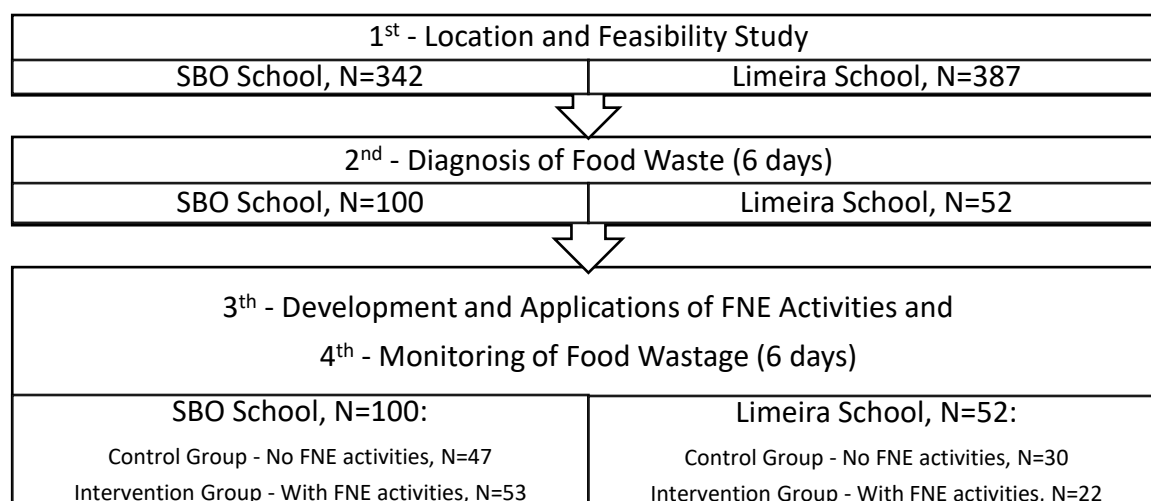
## METHODS

The study was carried out in two municipal public schools, located in Santa Bárbara d'Oeste (SBO) and Limeira, São Paulo, Brazil. Schools were chosen for convenience. Initially, a diagnosis was carried out by measuring food waste, with monitoring of leftovers and food waste. Next, FNE activities aimed at reducing wastage were planned, prepared, and executed. The project began after approval by the Ethics and Research Committee of UNICAMP (# 3.455.193).

After the selection and acceptance of the schools studied, the study was divided into five stages: 1a) study of the location and the feasibility of carrying out the intervention; 2a) diagnosis of food waste in schools before FNE activities; 3a) implementation of FNE activities with children; 4a) monitoring of food waste in

schools during the execution of FNE activities; 5a) analysis of results and impact assessment. The first four stages are described in figure 1.

**Figure 1.** Phases of the study of Food and Nutrition Education (FNE) in schools in the municipalities of Santa Bárbara d'Oeste (SBO), SP and Limeira, SP. 2021



Source: Prepared by the authors (2021).

First, participant observation was carried out in the location, focusing on school meals in both schools. This stage began with the collection of data and information about the menu offered (type of preparations and ingredients used), understanding the flow of preparation times, and monitoring of the consumption of preparations during lunch and throughout the study, as well as analysis of the amount of food wasted and its relationship with the types of menu preparations. This stage was essential to understand the feasibility of carrying out the study in the school environment.

After verifying that there was food wastage in both schools, at a second moment, data were collected on food waste (foods prepared, but not served) and leftovers (foods that remained on the plate and were thrown into the garbage after finishing the meal) during the lunch period. To account for food waste (clean) and leftovers, as well as total food wastage, two scales were used (Balmak, model LBC-50 with a capacity of 50 kg; Líder Balanças, model B-160 with a capacity of 60 kg), accurate to two decimal places. The prepared and wasted foods were weighed based on the method proposed by Boschini et al.,<sup>11</sup> and calculations of percentage of leftovers and food waste, as well as per capita consumption per meal and the average amount of school food wastage per child, were carried out according to Vaz<sup>12</sup> cited by Augustini et al.<sup>13</sup> Wastage monitoring was carried out on 12 days; the first six days before the FNE activities, and the other six during the execution of the FNE activities (Figure 1). All culinary preparations were weighed before being served and after the lunch period, and the difference was used to calculate the food wastage (clean and dirty). Simultaneously, participant observation was carried out during the meals, which allowed greater nearness to reality and dialogue with the students, aiming to understand the reasons for the low acceptability of certain preparations and high consumption of others, for example.<sup>14</sup>

The adherence index (AI) was used to verify the general adherence to the meals served at the school, as well as the adherence to each preparation (rice, beans, protein dish, salad, and garnish) individually.<sup>15</sup> This

index was calculated from the values found for food waste and leftovers, that is, there was no reference to the hedonic scale test. For the calculation, the following equation was used: adherence index (%) = (number of students who consumed the meal/number of students present at school on the day of collection)\*100.<sup>15</sup> For this AI calculation (%), second helpings were excluded, when taken by the children, to avoid duplicity. This index made it possible to establish food preferences and understand how each culinary preparation was adhered to in each school.<sup>15</sup>

At the end of the initial weighing of leftovers and food waste, the FNE activities were prepared and executed, and the final weighing of the leftovers and food waste was carried out concomitantly with the FNE activities, following the same methodology described above. The FNE activities were applied to four elementary school groups (n=152 students in total) of the same age group, with two groups of students allocated as a "control" group and two groups as an "intervention" group, aiming to compare the effectiveness of the FNE activities on food waste. The plan for the implementation of FNE activities was developed by the researchers themselves, according to the diagnosis obtained in the previous stage. The activities were designed to promote the reflective construction of knowledge in the children, with emphasis on the perception of impacts related to waste. Therefore, the FNE activities were divided into three parts, with one activity per day with the "intervention" groups (Chart 1), over six consecutive days. Each activity lasted approximately one hour.

**Chart 1.** Plan of Food and Nutrition Education (FNE) activities carried out in elementary schools in Santa Bárbara do Oeste (SBO), SP, and Limeira, SP. 2021

Title / Purpose	Description of the FNE action performed	Outcome
<p><b>Title:</b> Discovering the size of your hunger.</p> <p><b>Objective:</b> To promote reflection on the size of hunger, that is, how much food they would need to consume to feel satiated.</p>	<p>For this first activity, the children were required to look at four dolls illustrated in images (2 girls, one large and one small, and 2 boys, one large and one small) drawn in a similar size to the schoolchildren by the researchers themselves. After viewing the images, the children were required to measure how hungry the dolls were and imagine that they would be serving the dolls for lunch. For this, the students had printed portions of three different sizes and of the five classes of food normally served (rice, beans, protein dish, salad, and garnish) to assemble the plate of the puppet in which assigned to them. At the end of the activity, the ideal portion was revealed to the students, that is, the balanced dish should contain 50% vegetables, 25% of foods which are main sources of carbohydrates, and 25% of foods which are main sources of protein (meat and legumes) (US, 2010). All excesses were placed on the same plate, and thus it was possible to measure the possible waste of those meals.</p> <p>The dynamics ended with a reflection on the importance of knowing the amount really needed to satisfy hunger and at the same time not to waste food, and with an explanation of the “food path”, that is, the food process until it reaches the dish for consumption (production in the field, transport, industry, packaging, supermarkets, and consumer). Beans were chosen to exemplify the process, the children also received cotton, cups, and beans to plant and take home.</p>	<p>With this activity, we sought to increase the children's awareness of how hungry they felt and the amount of food needed to satisfy this hunger, in addition to showing the impact on the entire production chain that this waste provides, such as loss of input, loss of workers' time, high cost for the treatment of these foods, and environmental impacts, for example.</p>

**Chart 1.** Plan of Food and Nutrition Education (FNE) activities carried out in elementary schools in Santa Bárbara do Oeste (SBO), SP, and Limeira, SP. 2021(Continues).

Title / Purpose	Description of the FNE action performed	Outcome
<p><b>Title:</b> Food and its health benefits.</p> <p><b>Objective:</b> To provide knowledge about the benefits and functions of food, as well as to assess children's knowledge of this topic.</p>	<p>Different types and classes of food were used, but with a focus on the preparations most rejected by schoolchildren (in this study being the foods normally served as garnish and salad) and the benefit they could bring to our body. A paper with the name of a different food was distributed to each student, as well as two plates (one written “yes” and the other, “no”) to facilitate the dynamics and to establish how much the class knew about the benefits of these foods in our body. In addition, an image of the illustrated human body, highlighting the eye, lung, muscle, intestine, bone, and skin was placed in the frame, to make the activity more dynamic. After distributing the images and plates, the student, voluntarily, spoke about the food drawn and indicated which part of the body (according to the drawing on the board) this food would benefit. Then, the other students raised the sign “Yes”, if they agreed or “No”, if they did not agree. The answer was then revealed and the student went to the board to paste his food close to the part of the body that was benefited. For example, if the food was papaya, the student mentioned which part of the body this food contributed to the most and the other students said whether they agreed or not, using the signs. Then, the image of the food was pasted close to the body part and the activity continued successively with all the students in the room.</p>	<p>Obtain greater awareness of the benefits of food for our body and thus encourage the consumption of the most rejected foods in school meals.</p>

**Chart 1.** Plan of Food and Nutrition Education (FNE) activities carried out in elementary schools in Santa Bárbara do Oeste (SBO), SP,

and Limeira, SP. 2021(Continues).

Title / Purpose	Description of the FNE action performed	Outcome
<p><b>Title:</b> Reducing hunger with health.</p> <p><b>Objective:</b> Associate the two previous activities, encouraging the reduction in portions and the consumption of the most rejected foods, encouraging health promotion.</p>	<p>For this action, the same dynamics were used as on the first activity, however, now the children were required to think about the quality of the food selected to put on the plates, in addition to the ideal quantity for each of the dolls. The idea was to reinforce the importance of having a balanced dish, in addition to emphasizing that portion control would be with each of the schoolchildren, that is, they could request smaller portions from the lunch servers, thus avoiding food waste. For this activity, the same illustrated dolls were used and the portions were now served on coloring paper. In addition to coloring the drawings, the schoolchildren could use scissors to cut the portion size they deemed necessary to feed the dolls.</p>	<p>The expected result of this activity was to stimulate the consumption of previously rejected food, as well as to show the students that the amount of wasted food was in their control (hence the use of scissors, to show that they had the power to “cut” the amount of food consumed).</p> <p>The same activities were carried out in both cities, SBO and Limeira, and on the day of the activity, weighing was carried out, as well as the control of what each child consumed. From the general data, it was possible to measure per capita consumption and also the leftovers before and after the activities.</p>

Source: Prepared by the authors (2021).



To analyze the difference between food wastage before and during FNE activities, the paired Student t-test was applied. To compare the results between the two schools, the means were compared using two-way ANOVA, in which the two quantitative variables were compared, before and during the FNE activities (interaction vs. group). Wastage reduction percentages were also calculated according to schools and groups (intervention vs control). All data were analyzed for normality distribution using the Shapiro-Wilk test and for homoscedasticity using the Levene test. The analyses were performed using BioEstat 5.0 software, considering 5% significance.

## RESULTS

The two selected schools, one from each municipality, presented physical and management similarities, to facilitate the comparison of results. Both contain classes from 1<sup>st</sup> to 5<sup>th</sup> year, with similar numbers of classes (12 from the SBO school and 15 from the Limeira school) and students (342 in SBO and 387 in Limeira). The FNE activities were carried out with 152 schoolchildren aged between 8-9 years.

The initial stage of the project made it possible to observe that several foods were rejected by the students, such as carrots, chayote, pumpkin, and zucchini, and that there was food wastage, especially in relation to leftovers. These data made it possible to verify the need to work on the importance of all foods for a balanced and healthy diet, as well as to promote understanding of the true size of the children's appetites, in order to avoid wastage.

During the first FNE activity, it was observed that although some students expressed understanding of the consequences of food wastage, when “assembling the plate”, during the second stage of the activity, there was disproportion between the amount of rice and other foods, with the rice portion being too large, for example.

In addition, during the second FNE activity, the students showed little knowledge about the health benefits of food. However, during the dynamics, when relating foods of the same color and with similar benefits, there was greater understanding expressed in the comments and manifestations of the students.

In the third and final FNE activity, we sought to encourage the consumption of preparations with low adherence and to reduce food wastage. As after completion of the activities, the results described in table 1 showed a reduction in food wastage. The reduction was observed in both schools, in the intervention and control groups, when comparing the data before and during the activities ( $p < 0.05$ ). In absolute quantity, the reduction was greater in the intervention groups in both schools. In the SBO school, the wastage reduction in the control group was 20.7%, and in the intervention group, 62.0%. In the Limeira school, the reduction was 31.4% in the control group and 43.1% in the intervention group.

**Table 1.** Mean food waste, in kg, by the control (n=77) and intervention (n=75) groups in the schools of Santa Bárbara d'Oeste (SBO), SP (n=100 students) and Limeira, SP (n=52 schoolchildren). Limeira, SP, 2021.

	Control - Before (kg)	Control - During (kg)	Intervention - Before (kg)	Intervention - During (kg)
SBO	0.715a	0.567b	0.907c	0.345d
Limeira	1.403a	0.963b	0.585c	0.333d

<sup>a,b</sup> and <sup>c,d</sup> indicate differences ( $p < 0.05$ ) between wastage results before and during the intervention in each school.  
Source: Prepared by the authors (2021).

The calculation of the average AI of the meals, as a percentage, as well as of each preparation offered in the two schools (Table 2), showed that adherence was higher in the SBO school than in the Limeira school. This can be explained by the fact that the school in Limeira allowed students to take snacks from home, which did not occur at the SBO school. Among the foods that were taken as a snack, the most widely consumed in the lunch period were ready-to-eat snacks, iced biscuits, snacks made with wheat flour, and sandwiches (bread with ham and cheese), for example.

**Table 2.** Adherence Index (AI), expressed in percentage (%), of meals and of each preparation offered in schools in Santa Bárbara d'Oeste (SBO), SP, and Limeira, SP (n=12 days). Limeira, SP, 2021.

	SBO (%)	Limeira (%)
IA	87.60	47.73
IA Arroz/Macarrão	98.19	97.81
IA Feijão	76.03	72.43
IA Prato Proteico	69.21	63.10
IA Salada	39.81	26.70
IA Guarnição	25.75	26.70

Source: Prepared by the authors (2021).

The overall food wastage results are described in table 3. The total amount of food wasted over the data collection period (12 days) would be enough to feed 1,947 children for lunch. Considering that the schools attend approximately 729 students, it would be possible to feed all the children for more than two days.

**Table 3.** Average amount of food produced, leftovers, and food waste in the schools of Santa Bárbara d'Oeste (SBO), SP, and Limeira, SP (n=12 days). Limeira, SP, 2021.

	Meals Served (No.)	Quantity Produced (kg)	Distributed Quantity (kg)	Food waste (kg)	Food waste (%)	Per capita consumption (kg/person)	Leftovers (kg)	Leftovers (%)
SBO	400.50	103.26	91.64	11.62	11.33	0.36	5.71	6.37
Limeira	193.08	47.31	36.47	10.83	22.48	0.30	5.51	15.12

Source: Prepared by the authors (2021)

## DISCUSSION

The results of the AI, together with the data from the participant observation, made it possible to identify the possible causes of the low acceptance of some preparations, in particular the vegetables offered as garnish. The foods served in this category of the menu - zucchini, squash, and carrots - were prepared, in general, sautéed. Zucchini is a food that has a subtle flavor and, in general, is often rejected, as described by Camargo et al.<sup>16</sup> However, if incorporated into other culinary preparations,<sup>17</sup> it may present better acceptance. This same suggestion could also be used for other vegetables served in the garnish and/or in the salad.

The low consumption of salad in both schools could also be attributed to the way the foods are prepared, such as boiled beetroot and cooked carrot, as observed by other authors.<sup>17,18</sup> One of the alternatives to increase adherence to salads would be to use raw grated beetroot, and/or add it to other preparations.<sup>18</sup> It is important to mention that other factors, such as meal distribution conditions, types of utensils used, self-service or not, the variety on the menu, as well as the learning environment may be related to a low AI in school feeding.<sup>19</sup> However, many of these factors were not evaluated in the present study.

The AI is a very important parameter that can help to improve the quality of the food offered to students.<sup>8</sup> According to Oliveira and Vassimon,<sup>7</sup> from this evaluation it is possible to remove foods that are not accepted by students and increase the use of preferred foods, thus improving the nutritional value of the preparations served. According to the National Fund for the Development of Education (FNDE),<sup>1</sup> acceptability above 90% is considered satisfactory when considering leftovers. However, values lower than 90% require investigation, with a probable change in food or preparations, before performing a new analysis.

When analyzing the variability in the percentage of food waste during data collection, similarity with other studies was observed, that is, average food waste values varying between 14.9% and 28.4%.<sup>20,21</sup> According to Abreu and Spinelli,<sup>22</sup> there is no percentage limit for food waste and each location must establish its own indicators. As described by Abreu et al.,<sup>23</sup> this number may vary according to the frequency of people who eat daily at the place, the food preferences, and even according to the amount of food served on the plates. However, Vaz<sup>12</sup> cited that the acceptable value for food waste would be up to 3%.

The reduction in the percentage of leftovers and the reduction in food wastage during FNE activities ( $p < 0.05$ ) showed that FNE activities had a positive impact on reducing food wastage. The same trend was observed by Abrantes et al.,<sup>9</sup> on the effectiveness of FNE activities to reduce food wastage, with a reduction of 50%, reaching up to 100% in some classes. Araújo and Rocha<sup>10</sup> also showed a reduction in food wastage, including an increase of from 18.1% to 21.4% in schools that were not sensitized by FNE activities. FNE activities are, therefore, important strategies for bringing significant results, especially when they engage with the real demands of the location and/or the target audience.

An observation to be highlighted is that, during the period of the study, many teachers were motivated to stimulate the students in relation to wastage, with a competition between the rooms in order to waste less. This engagement of teachers and students may have conditioned the changes observed in the control group, as the children, despite not being exposed to FNE activities, showed significant reductions in waste. The process of weighing leftovers and food waste may also have directed the students' attention to wastage, even without exposure to FNE activities in the classroom.

In this sense, despite the bias, it was observed that the insertion of the teacher as a mediating agent in the educational process related to food, as well as their presence during the lunch period, encouraged the

consumption of certain preparations and, consequently, seemed to be a factor related to awareness of the reduction in food wastage in the school environment.<sup>24</sup>

Although the results of the FNE activities were satisfactory in reducing wastage, there were some limitations. That is, it was not possible to carry out a long-term follow-up to assess the need for continuity and frequency of FNE activities. According to Martins,<sup>24</sup> the results of FNE activities were more effective in the short term (one week after the application of FNE activities) in relation to the medium term (three months after the application of FNE activities). In this way, long-term follow-up could be even more interesting to monitor the effectiveness of FNE activities, through adaptations and integration in pedagogical practices, so that FNE takes place in a procedural and continuous way.

The results found in this study are in line with the objectives of promoting reflection in the context of FNE practice in the school environment, as described in the FNE Reference Framework.<sup>2</sup> Likewise, it was possible to observe that strategies associated with FNE, such as the promotion of children's autonomy when measuring the quantity and quality of food consumed and the reduction in food waste, were also in line with the guidelines of the FNE Reference Framework.<sup>2</sup> It is important to emphasize the importance of including FNE activities in schools, based on different themes, aimed at promoting health and sustainability.<sup>25,26</sup>

## CONCLUSION

The monitoring of food wastage in schools in the present study allowed us to identify significant amounts of leftovers and food waste. The initial diagnosis was essential for the FNE activities to be designed according to the local reality and carried out in a playful way, thus allowing the results to be favorable, with a significant reduction in food wastage. However, the need to develop strategies so that FNE activities are carried out continuously and permanently should be emphasized, so that these habits are consolidated in the school environment and in the daily lives of students

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### Contributors

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