sustainability

MDPI

Article

Impact of a Food Education Session on Vegetables Plate Waste in a Portuguese School Canteen

Cátia Marques [1], João P. M. Lima [1,2,3,*], Sónia Fialho [4], Ezequiel Pinto [5] and Ana Lúcia Baltazar [1,6]

[1] Scientific-Pedagogical Unit of Dietetics and Nutrition, Coimbra Health School, Polytechnic Institute of Coimbra, 3046-854 Coimbra, Portugal
[2] ciTechCare—Center for Innovative Care and Health Technology, R. de Santo André 2410, 2410-541 Leiria, Portugal
[3] GreenUPorto—Sustainable Agrifood Production Research Centre, Campus de Vairão Edifício de Ciências Agrárias (FCV2) Rua da Agrária, 747, 4485-646 Vairão, Portugal
[4] CISAS: Center for Research and Development in Agri-Food Systems and Sustainability, Polytechnic Institute of Viana do Castelo, University of Algarve, 8005-139 Faro, Portugal
[5] School of Health Sciences, University of Algarve (ESSUAlg), 8005-139 Faro, Portugal
[6] The Health Sciences Research Unit: Nursing (UICISA), 3000-232 Coimbra, Portugal
* Correspondence: joao.lima@estesc.ipc.pt

Abstract: Several authors have shown that vegetables a re the most commonly wasted component in school lunches and enhance the importance of food education on topics such as food waste and vegetable consumption. The present research evaluated the efficacy of a single session of food education on vegetables waste and consumption. The data collection was focused on primary school students from a school located in Guarda district (Portugal). A vegetable selective aggregate weighing from the lunch plate was required in two distinct phases: before and after a single 30 min nutritionist's intervention. The variables collected were the quantities of vegetables produced, leftovers and plate waste. Through these weighings, it was possible to measure the variables: distributed vegetables, consumed vegetables, vegetables waste, leftovers index, plate waste index. The use of materials such as a scale, suitable containers, gown, disposable gloves, cap and office supplies were necessary. In total during the two phases, 870 meals were evaluated. Measures of central tendency and statistical analysis tests were used. At the end of the present research, it was possible to verify significant results in the reduction of the vegetables leftovers index and in the increase in vegetable consumption per capita, through the nutritionist's intervention. There were significant differences in the reduction of the index of vegetable leftovers and in the increase in the consumption of vegetables per capita and no significant differences in total vegetable waste. Potential causes and strategies for future research were also discussed. This study demonstrates how a nutritionist's intervention, in a school context, could translate into behavioral change in nutrition and sustainability terms.

Keywords: food education; nutritionist; school meals; vegetables; food waste

Citation: Marques, C.; Lima, J.P.M.; Fialho, S.; Pinto, E.; Baltazar, A.L. Impact of a Food Education Session on Vegetables Plate Waste in a Portuguese School Canteen. *Sustainability* **2022**, *14*, 16674. https://doi.org/10.3390/su142416674

Academic Editor: Alessandra Durazzo

Received: 22 September 2022
Accepted: 7 December 2022
Published: 13 December 2022

1. Introduction

Food is the most important factor for human health [1]. However, during childhood and adolescence, a high nutritional quality diet becomes particularly crucial, as they are globally recognized as critical periods of development [2].

In Portugal, there was a decrease, from 37.9% in 2008 to 29.6% in 2019 in the prevalence of overweight in children [3]. However, it is still necessary to work on equally important aspects, since IAN-AF data show a prevalence of inadequate daily consumption of fruit and vegetables daily of around 72% (below 400 g, according to the WHO) [4,5].

Vegetables are essential for a complete, balanced and varied diet, with health benefits due to their composition, rich in fiber, minerals, vitamins and other compounds. Adequate

vegetable intake is associated with the prevention of chronic non-communicable diseases, which makes it fundamental to promote their consumption in different contexts [6].

Along with promoting health through food, food sustainability is another subject of deep debate.

Studies indicate that, annually in Europe, about 89 million tons of food are wasted, and therefore food waste (FW) is recognized as a significant social problem with nutritional, environmental, and economic impacts. Improving food quality and reducing environmental impact is now a global concern [1,7,8].

Currently, there is no single standardized definition of FW in the European Union, resulting in the use of definitions from three different entities. One of them is from FAO, which defines FW as the amount of food lost or wasted along the food chain, which includes all food that was initially intended for human consumption, but which has deviated from the human food chain [7].

In Portugal, studies show that FW is around 131 kg per capita and the consumer plays a decisive role in this measured value. At the school level, data show a FW of between 11–31% [7].

The FW assessment has been an indirect measure used in a school context to assess both satisfaction with school meals and their context. This assessment helps to direct the necessary changes towards greater credibility and acceptance of meals, conciliating essential aspects of food supply and for optimization of food service management processes [7].

FW comprises two components: leftovers (prepared food not distributed) and plate waste (food distributed and not consumed). Although leftovers are more related to service, which may reflect processing errors, plate waste allows the evaluation of integration with regards to the consumer and therefore is more difficult to control and often unavoidable [2].

In the literature, different factors are pointed out as possible causes for meal rejection, leading to plate waste: appetite variation and/or energy needs, food preferences, mealtimes and time available to complete eating, availability of food from other sources, distraction with other activities at the same time as the meal, the school canteen environment, presence of assistants to encourage meal intake, the absence of consumer awareness, among others [2,7].

In addition to the direct loss of food and the resulting costs, plate waste can mean a reduction in the nutritional benefit that children receive from the meal, especially if it comes from foods such as fruit and vegetables. Therefore, it is of great importance to perceive and evaluate the acceptance, adherence, and rejection of food, and its causes [2,7].

Food waste is an important indicator of sustainability [7]. Improving diet quality while simultaneously reducing environmental impact and achieving sustainable development outcomes is a critical focus globally. Despite this shared international interest, progress in improving diet quality and achieve sustainable development goals related to planetary health are exceptionally challenging to achieve [9].

Furthermore, international recommendations identified a need for additional investigation of the relationship between consumer behaviors, waste disposal and the sustainability of individual food groups in order to improve long-term food security. This is an important research gap that precludes a more comprehensive accounting of the multiple factors relating public health nutrition to environmental sustainability [7].

Empowering the younger population to make healthy decisions when choosing and consuming food may not be enough [9]. As the school is a place where children spend a considerable number of hours and, consequently, have a large part of their daily food, the quality and quantity of food ingested at school has a strong impact on their health and well-being [2].

The school, as an educational space and health promoter, is an ideal place to design programs that value healthy eating, through food education [9].

The age group from 0–12 years old has revealed to be indicated as important when working on these themes since studies claim that targeted local actions, aimed at children of these ages, are effective in modifying long-term behaviors [10].

Food education can be defined as learning experiences designed to facilitate the adoption of behaviors related to food consumption and nutrition, promoting health and well-being [11]. Several authors have already reported the importance of this strategy, both for increasing the acceptance of foods that are often rejected in school meals and for improving the quality of food for school-age children, as well as for reducing food waste in school canteens [12–17].

Food waste has a negative impact on human health, especially through deficient consumption of balanced meals, and encourages the consumption of nutritionally poorer foods in subsequent meals.

Through the analysis of this intervention, strategies could be developed generally in schools to reduce the food waste occurring. Despite that several studies were conducted to access food waste in schools, among children, new studies need to be developed to analyze the impact of different strategies.

Therefore, the aim of this study was to evaluate the impact of a food education session on vegetable food waste, namely leftovers and plate waste; and to analyze differences between components.

2. Materials and Methods

A quasi-experimental study was carried out in a Portuguese school, located in Guarda district. Data were collected at two different times during January and February in the school year of 2021/2022, and included only primary school students. Between these two moments of data collection, a single nutritionist intervention was carried out.

In the first phase of data collection (P1), prior to the intervention, the prepared vegetables for distribution and vegetable waste from the lunch plate of primary school students who used the food service were weighed for 5 consecutive working days. In total during P1, 383 meals were evaluated.

The intervention phase took place on the first day of the second data collection phase, during the morning, two weeks after P1. A total of five food education sessions were carried out for 109 primary school students. All food education sessions were held in a classroom context, with a slide presentation about the health benefits of vegetables consumption and, at the end, a practical activity took place using wooden vegetable models, to demonstrate their importance in the context of health promotion.

In the second phase of data collection (P2), there was a new weighing of the prepared vegetables for distribution and vegetable waste from the lunch plate during 5 consecutive working days for comparison. In total of P2, 489 meals were evaluated.

The procedure related to food waste assessment was the same as that reported by Ferreira J [2].

All data collection was performed by the principal researcher, who weighed the leftovers from the production, the plate waste and the containers used. It should be noted that the staff assigned to the kitchen served each student's plate and the bowls with the vegetable component of the meal.

During the research, there was no change in school practices regarding school lunch, namely in terms of lunchtime and staff accompanying the meal, in order to avoid interference with food consumption. The P1 menu was replicated as much as possible in P2, in order to reduce factors that might possibly influence the results (Table 1). Table 1 describes the menu. As shown, the soup and the main course was the same in P1 and P2. The changes in menus related to the order of vegetables distribution were unavoidable, due to internal operational issues.

In general, the menus in Portuguese schools are composed of soup, main course, dessert (fruit and sweet dessert, with an established frequency) and water, which is the only allowed drink.

The vegetable component from the lunch plate was always distributed as salad, according to a common practice in this school. The waste of the following vegetables was evaluated: lettuce, carrot, red cabbage, cucumber and tomato.

Table 1. First (P1) and second (P2) phase of data collection school menu.

Days	Soup	Main Course	P1 Vegetable Options	P2 Vegetable Options	Dessert
1	Green bean	Tuna Pasta	Lettuce, tomato	Lettuce, cucumber	Apple, banana, tangerine
2	Chicken Soup	Roast Veal with Pea's Rice	Lettuce, red cabbage	Lettuce, tomato	Apple, pear tangerine
3	Chickpeas and cabbage	Cod "à Brás"	Lettuce, cucumber	Lettuce, carrot	Apple, banana, tangerine
4	Leek cream	Roasted Chicken Legs with Rice	Lettuce, tomato	Lettuce, red cabbage	Apple, pear, tangerine
5	Turnip greens	Pork meat "à Alentejana"	Lettuce, carrot	Lettuce, tomato	Apple, banana, pear

The seasoning consisted of olive oil, salt and onion (used as an ornament), always counted in the final weighing. The container's weight was eliminated from the final weight by subtracting it from the overall weight.

The selective aggregate weighing method was performed for the prepared vegetables for distribution and vegetable waste from the lunch plate. The following data were collected: prepared vegetable weight for distribution (PW), leftover weight (LW) that corresponded to the undistributed vegetables at the end of the meal, plate waste weight (PWW) that corresponds to the distributed vegetables not consumed, and the total number of daily meals [2].

The following material was used to ensure compliance with good hygiene and food safety practices: gown, cap and disposable gloves. Office supplies, plastic containers, garbage bags and scale (brand: Jata; model 724—digital scale with a maximum capacity of 3 kg and division of 1 g) were also used.

The calculated variables were distributed vegetables weight (DVW), Consumed vegetables weight (CVW), Consumed vegetables weight per capita (division of CVW by the number of served meals), VW (sum of LW and PWW), VW percentage, leftover index (LI) (division of LW by PVW), plate waste index (PWI) (PWW division by DVW).

For statistical analysis, the Statistical Package for Social Sciences (IBM SPSS® Statistics, version 27, Chicago, IL, USA) and Microsoft Excel® were used to make graphs and tables.

Descriptive analysis of variables was performed by determining the mean, median, standard deviation, frequency, maximum and minimum.

For the association of variables, the *t*-Student test was used to compare means of two independent samples. The considered level of significance was 5% ($p < 0.05$). Previously, normality was tested using the Shapiro-Wilk test.

3. Results

In the five days of P1 the waste of vegetables in 383 primary school meals was evaluated. In this phase, a total of 6.9 kg of vegetables were produced, giving an average of 1.4 kg per day. Of these, an average of 30.4% was consumed resulting in a vegetable waste of 69.6%. The LI in this phase reached 59.9%, while the PWI was around 24.5%. In terms of average CVW per capita in P1, this was around 5.3 g (Table 2).

When analyzing P1 in more detail (Table 2), the highest PWI (28.5%) is noted on day 1, with tuna pasta as the main course and a vegetable component of lettuce and tomato salads. It proved to be the day with the highest percentage of VW, at around 77.6%. Consequently, it had the lowest percentage of CV (22.4%) and CVW per capita (4.7 g).

It is possible to see in Table 2, that day 2, whose menu was roasted veal with peas and rice accompanied by lettuce and red cabbage salads, was the day with the most meals, at 87 meals. This day also proved to have the lowest PWI and percentage of VW (15.3% and 61.7%, respectively). The highest percentage of CV (38.3%), CVW per capita (5.8 g) and DVW (595 g) were attained on this day.

Table 2. Results from the first phase of data collection.

Days	Number of Meals	PVW (g)	DVW (g)	PWW (g)	PWI (%)	LW (g)	LI (%)	VW (g)	VW (%)	CVW (g)	CV (%)	CVW *per Capita* (g)
1	78	1637	512	146	28.52	1125	68.72	1271	77.64	366	22.358	4.692
2	87	1316	595	91	15.29	721	54.79	812	61.70	504	38.298	5.793
3	77	1656	514	133	25.88	1142	68.96	1275	76.99	381	23.007	4.948
4	76	1386	573	143	24.96	813	58.66	956	68.98	430	31.025	5.658
5	65	939	486	136	27.98	453	48.24	589	62.73	350	37.274	5.385
TOTAL	383	6934	2680	649	——	4254	——	4903	——	2031	——	——

PVW: Produced vegetables weight. DVW: Distributed vegetables weight. PWW: Plate waste weight. PWI: Plate waste index. LW: Leftovers weight. LI: Leftovers index. VW: Vegetables waste. CVW: Consumed vegetables weight. CV: Consumed vegetables.

On day 3, with cod "*à Brás*" (cod with french fries, egg, onion and seasoning) accompanied by lettuce and cucumber salads, there was the highest LI during P1 (69%) and this was also the day with the highest PVW (1.7 kg) (Table 2).

On the last day, with pork meat "à Alentejana" (pork meat with cubed french fries and clams) accompanied by lettuce and carrot salads, the lowest number of meals during this phase was recorded, with 65 meals. The smallest DVW (486 g) and the smallest LI were also verified on this day (48.2%) (Table 2).

Regarding P2, the vegetables waste in 489 primary school meals was evaluated. In this phase, a total of 9.1 kg of vegetables were produced, giving an average of 1.8 kg per day. An average of 42.1% was consumed resulting in a VW of 57.9%. The LI in this phase reached 41.8%, while the PWI was around 28.5%. Regarding CVW per capita in P2, on average, this was around 7.7 g (Table 3).

Table 3. Results from the second phase of data collection.

Days	Number of Meals	PVW (g)	DVW (g)	PWW (g)	PWI (%)	LW (g)	LI (%)	VW (g)	VW (%)	CVW (g)	CV (%)	CVW *per Capita* (g)
1	99	1679	1201	399	33.222	478	28.469	877	52.233	802	47.767	8.101
2	99	2196	906	360	39.735	1290	58.743	1650	75.137	546	24.863	5.515
3	99	1877	1064	268	25.188	813	43.314	1081	57.592	796	42.408	8.040
4	97	1630	852	249	29.225	778	47.730	1027	63.006	603	36.994	6.216
5	95	1714	1188	182	15.320	526	30.688	708	41.307	1006	58.693	10.589
TOTAL	489	9096	5211	1458	——	3885	——	5343	——	3753	——	——

PVW: Produced vegetables weight. DVW: Distributed vegetables weight. PWW: Plate waste weight. PWI: Plate waste index. LW: Leftovers weight. LI: Leftovers index. VW: Vegetables waste. CVW: Consumed vegetables weight. CV: Consumed vegetables.

It was found that day 1, with tuna pasta and accompanied by lettuce and cucumber salads as vegetable component, was the day that recorded the lowest LI (28.5%) and the highest DVW (1.2 kg) (Table 3).

On day 2, with roasted veal, peas and rice, and lettuce and tomato salads as vegetable component, there was the highest PVW (2.2 kg), the highest LI and PWI (58.7% and 39.7% respectively), resulting in the highest percentage VW in P2 (75.1%). The percentage of consumption (24.9%) and CVW per capita (5.5 g) were the lowest in this phase (Table 3).

On day five, the day on which the lowest number of meals was recorded and whose options for the vegetable component of the dish were lettuce and tomato salads accompanying the pork meat "à Alentejana", the PWI and the percentage of VW were the lowest in P2, 15.3% and 41.3% respectively. The highest CV percentage (58.7%) and CVW per capita (10.6 g) were also observed on this day (Table 3).

It should be noted that, in both phases, the PWI was higher when the vegetable options were lettuce and tomato (Day 1 in P1 and Day 2 in P2). Additionally, on day 5 of P2, the lowest PWI and the highest CV values of P2 were registered, precisely the days when lettuce and tomato were served (Tables 2 and 3).

Table 4 makes reference to the comparison of the average values of the two project phases, spaced by 3 weeks and with the nutritionist's 30-min intervention in the morning of the first day of P2. It was verified that there were no significant differences in the percentage of VW and PWI ($\rho = 0.111$ and $\rho = 0.425$, respectively). However, a significant decrease in LI ($\rho = 0.030$) and a significant increase in CVW per capita ($\rho = 0.031$) were observed from P1 to P2.

Table 4. P1 and P2 average values comparison.

	PVW (g)	LW (g)	PWW (g)	LI (%)	PWI (%)	VW (g)	CVW (g)	DV (g)	CVW *per Capita* (g)	VW (%)	CV (%)
P1	1386.8	850.8	129.8	59.875	24.525	980.6	406.2	536	5.295	69.61	30.390
P2	1819.2	777	291.6	41.789	28.538	1068.6	750.6	1042.2	7.693	57.86	42.140
				$\rho = 0.030$	$\rho = 0.425$				**$\rho = 0.031$**	$\rho = 0.111$	

PVW: Produced vegetables weight. DVW: Distributed vegetables weight. PWW: Plate waste weight. PWI: Plate waste index. LW: Leftovers weight. LI: Leftovers index. VW: Vegetables waste. CVW: Consumed vegetables weight. CV: Consumed vegetables.

4. Discussion

Food waste is a current problem in school canteens and its evaluation has been used to measure the effect of food education programs in a school context [18,19].

Vegetables were the food group chosen for this study, as several works refer to it as the group that has the highest levels of food waste in school canteens [15,20–26].

In fact, the vegetables waste found in this study was high, even compared with other author's results. This information proved to be worrying since this food group provides essential nutrients for children's growth and, at the same time, are of low acceptance by this age group [22,23,26]. However, there are a large number of factors that could influence such differences, as mentioned earlier.

In England, Haroun et al. observed that the fruit and vegetable waste at lunch in primary schools was approximately 30–40% lower than that found in the present study [15].

Regarding the LI, it decreased significantly from P1 to P2, 59.9% and 41.8% respectively. Values lower than these were reported by Silva et al. [19] and by Salomé [27].

Another study, carried out in Portugal by Araújo and Rocha [28], also noticed lower LI values, 28.7% observed in the first phase and 27.5% in the second phase. These differences could be related to the proper management of food service, previously described in the literature as a determinant of LI (2).

According to Vaz [29], leftovers index (LI) values greater than 3% are unacceptable and supposed indicators of poor management of the school food services (SFS). These may indicate an excess of production, either due to inefficiency in the management of the production of meals, or due to inadequacy in food recommendations, the capitation defined in the national guidelines and the amount consumed by students for reasons such as meal characteristics, appetite, environment, among others [19,30].

However, this kind of conclusion should not be drawn because, according to Muller [31], the use of reference values as categorizers of these units may not be adequate, since each SFS has its own food preferences and processes, error margin calculated in planning and oscillation in the number of meals.

It is important to note that, in the school used in the present study, it is usual to serve leftovers resulting from primary school students' lunches later to other students (middle and high school), promoting less control of this parameter and a possible explanation for the values obtained.

Thus, the leftovers evaluation in each SFS is essential for the unit's continuous improvement process and must be worked on individually. This approach will help to determine an acceptable amount of leftover food according to the SFS characteristics and the stakeholders involved in the school canteens [32,33].

Regarding PWI, they increased by 4% from P1 to P2 (24.5% and 28.5%, respectively), but this was not statistically significant ($\rho = 0.425$). These values were higher than those found in some studies, such as Salomé [27], who reported a PWI value of 6.8%. The Silva et al. [19] study, carried out in two schools, obtained an average PWI of 13.5% for the dish vegetable component.

Another work carried out with children aged 3 to 5 years found, in a pre-intervention phase, an average PWI of 41.1%, which was much higher compared to the present study. However, in the post-intervention phase, the average PWI was 27.6%, slightly lower than that reported in the present study [34]. It is important to emphasize that in the work of Silva [34], several interventions were performed.

According to Teixeira [35], PWI values greater than 10% are not acceptable and the lowest possible value should be recommended. In both phases of the present study, the PWI values were much higher.

The value suggested by Teixeira [35] is normally applied in groups of healthy adults, which is not the case for this study and, specifically in a Portuguese school context, there are no reference values [36]. Therefore, it would be precipitate to indicate a value from which the PWI is not acceptable under these circumstances [7]. Moreira [7], after collecting data referring to 33 days of food waste, states that the values of the rest should be compared within each SFS over time.

The literature directly relates the PWI to several factors such as the lack of awareness of students regarding FW, the degree of student satisfaction and/or a possible discrepancy between actual consumption and the required capitation [19].

It is important to note that, at both phases of the present research, the PWI was lower than the LI, which can be justified by the hypothesis mentioned above, as the leftovers are later served to the remaining school students who use the food service, together with the fact that the capitations used are small, below those recommended [30].

When we look at the average CVW per capita consumption, the difference between phases becomes significant ($\rho = 0.031$), with a 5.3 g CVW in P1 and 7.7 g in P2 (after the nutritionist's intervention). Regardless of this significant difference, it was possible to verify the low CVW per capita of the lunch dish vegetable component in our study, which was far from that recommended [30]. Similarly, national and international has shown that in these age groups low consumption of vegetables is prevalent [37–41].

According to a national guidance document [42], the capitations referring to the lunch dish vegetable component, aimed at children between 3 and 6 years old and between 6 and 10 years old, should correspond to 0.55 (99 g raw or 77 g cooked) and 0.70 servings (126 g raw or 98 g cooked), respectively.

Furthermore, the guidelines regarding the variety of vegetables served are not complied with, due to only two options to choose instead of three (raw or cooked) as recommended in the guidance issued by the Portuguese Education General Directorate [30].

Even dividing the PVW by the number of daily meals, referring to primary school students, the guidelines are still not complied with. These results raise the possibility that children ingest less nutrients than recommended.

It is also verified that in this school, as observed when the portion of vegetables is served on the plate, the employees tend to include a reduced portion, suggesting that, in this way, they reduce food waste.

It is necessary to reconsider the portion served at school lunch, as this may be one of the factors that is conditioning the consumption of vegetables. In fact, Miller et al. [43], has shown that increasing the serving size of vegetables served could be a strategy to increase their consumption by children.

Several other determinants of food waste are conditioned by the environment under study [36]. In general, school canteens are considered unwelcoming places [36,44]. Several authors have demonstrated a link between the canteen environment, the acceptance of the meal and consequent waste. Issues such as light, sound or temperature and number of people present are reported [45–47].

Regarding the vegetable options, in the school for the present study there were only two daily options (ranging across five vegetables), in which one was always lettuce. The fact that the lunch dish vegetable option is always raw, especially during this season of the year, can also contribute to low adherence.

The sensory characteristics of the food served, such as taste, temperature, color and texture, are crucial to meal acceptance [36].

It is important to mention that, according to the Portuguese Education General Directorate guidance document, in addition to raw vegetables, prepared vegetables should whenever possible, be part of the accompaniment to the dishes [30].

Food monotony, without variations in the food type and preparations, is also one of the factors that can reduce the child's appetite and interest in food, according to Silva [34].

Spigarolo et al. [48] also published a study, with students from 6 to 13 years old, on the food service of 40 Italian schools, concluding that one of the parameters that was least satisfying was the lack of variety in the menus.

A self-service study found that greater variety in the type of food was associated with a reduction in food waste in vegetables and fruit [20].

Self-service is mentioned as a possible method to reduce food waste and increase consumption of fruit and vegetables, which are often rejected [36]. Authors defend this as encouraging children's autonomy to choose and serve food and, consequently, deciding the amount they want to eat and the respective seasonings can generate a more conscious choice and a more adequate and varied food intake [49,50].

This type of measure can bring benefits in terms of food waste, but it can also compromise some crucial aspects, such as meeting the nutritional needs of children [36]. Reducing the portion size of the vegetable component can reduce the intake of essential nutrients, so it is important not to analyze food waste reduction in an isolated way [36].

Authors also refer to children's food preferences as an influencing factor in food waste at school lunch, suggesting the development and implementation of strategies that can improve the acceptance of the most frequently rejected foods, as well as raising students' awareness of the consequences of food waste [36,51].

Another aspect pointed out by several authors as a possible cause of food waste in these age groups is the lack of food waste problem awareness and the absence of food education in schools aimed at reducing food waste [17,52–54].

Food education programs are recognized as important strategies to increase the acceptance of foods that are often rejected in school meals and to improve the quality of children's diets [12–16].

In the present study, a unique 30-min intervention was carried out for a total of 109 primary school students, in a classroom context, about vegetable's nutritional characteristics and the introduction to the topic of food waste with its simplified definition and some of its consequences. No information was obtained by the researchers as to whether this topic was or would be approached in the curricular plan.

After this single intervention, which took place during the morning of the first day of the P2 data collection, CVW per capita increased and the LI decreased, both significantly ($\rho = 0.031$ and $\rho = 0.030$, respectively).

The intervention of this study was short-term, which may have contributed to these VW results. Some studies state that the time and intensity of intervention are factors that influence the success of food education programs, with longer interventions being more effective [55,56].

For the practical activity carried out in the food education sessions of the present study, wooden models of vegetables commonly served at school lunch were used. Even though

there was no significant reduction in VW percentage, the use of this method may have helped to increase vegetables per capita consumption and decrease the LI, as other authors report that food education programs seem to be more effective in reducing waste, in a school context, when they focus on foods that are usually provided in this context [14,17].

The lack of a nutrition professional in this school can also be seen as a negative factor. Some studies relate that the absence of nutritionists in schools to coordinate and implement food education projects adequately was identified as an obstacle to the success of these type of projects [57,58]. The presence of a nutritionist in these contexts was associated with participation in food education programs related to increased consumption of fruit and vegetables at school lunch [59].

Despite the still limited presence of n nutritionists in Portuguese schools as internal elements in the educational process, they have proven to be essential in creating a better food environment and good behavioral examples [60].

The evaluation of vegetable waste occurred immediately after the food education intervention (during the 5 days of that week), so its effectiveness may not be verified in the medium/long term. Martins et al. [61] showed that a food education intervention focused on children was effective in reducing food waste in the short term, but in the medium term an intervention directed at teachers was more effective.

Future studies should include more schools in the region and a longer follow-up period to understand the effects on food waste and consumption in the long term, between regions. It would be relevant to assess individual waste and associate it with a survey that includes other determinants, directed to students, parents, teaching and non-teaching staff, providing greater robustness to the work [62].

5. Conclusions

The leftover index and the remain index of the dish vegetable component, in both phases, was well above the waste values recommended by the literature (3% for LI and 10% for RI), justifying the need for intervention. However, greater conclusions should not be drawn due to the fact that these values are dependent on intrinsic factors related to each SFS and there are no Portuguese references for these parameters in school-age population.

When we focus on per capita consumption values, the need for intervention increases. There are different influencing factors and strategies related with FW, ranging from modelling the environment in which the meal is held, the meal itself and other factors such as food education programs

The present study evaluated the impact of a single 30-min intervention. It was possible to verify the significant reduction of LI and a significant increase in CVW per capita, allowing a highlighting of the role of awareness and food education.

The absence of food education programs in schools, guided by nutrition professionals, specifically aimed at reducing food waste and promoting knowledge about food and its benefits, makes interventions in this context essential.

It is crucial to find innovative ways to access the causes for food waste, in order to reduce it, without compromising student satisfaction and nutritional intake.

Limitations of this study were the methodology of data collection of food waste, the difference observed in the vegetables between the first and the second evaluation; and the limited number of nutrition sessions performed.

The advantages were the good results for just one session and the number of meals evaluated.

For future practice, this study points to the benefit of practical sessions with single a 30-min intervention for the reduction of food waste in schools.

Author Contributions: Conceptualization, C.M. and J.P.M.L.; methodology, C.M.; formal analysis, C.M. and E.P.; investigation, C.M.; res writing—original draft preparation, C.M.; writing—review and editing, S.F. and A.L.B.; supervision, J.P.M.L.; funding acquisition, A.L.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research received funding from the Polytechnical Institute of Coimbra—Coimbra Health School, UIDB/05748/2020 and UIDP/05748/2020.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: Authors would like to thank to the food unit of the school involved in data collection of food waste.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lages, S. Relação entre a Aceitação das Refeições Escolares e a Perceção dos pais sobre o Comportamento Alimentar dos Filhos. Master's Dissertation, Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Porto, Portugal, 2013. Available online: https://sigarra.up.pt/fep/en/pub_geral.show_file?pi_doc_id=4143 (accessed on 15 May 2022).
2. Ferreira, J. *Desperdício Alimentar em duas Escolas Básicas do Município de Penafiel—Estudo Piloto*; Graduation's Investigation Work; Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto: Porto, Portugal, 2012. Available online: https://repositorio-aberto.up.pt/bitstream/10216/68603/2/39780.pdf#:~{}:text=%C3%89%20consensual%20que%20na%20inf%C3%A2ncia%20e%20adolesc%C3%AAncia%2C%20sendo,essencial%20para%20garantir%20um%20crescimento%20e%20desenvolvimento%20saud%C3%A1veis (accessed on 15 May 2022).
3. Instituto Ricardo Jorge. Childhood Obesity Surveillance Initiative—COSI PORTUGAL 2019. Available online: http://www.insa.min-saude.pt/cosi-portugal-2019-excesso-de-peso-e-obesidade-infantil-continuam-em-tendencia-decrescente/ (accessed on 17 May 2022).
4. Lopes, C.; Torres, D.; Oliveira, A.; Severo, M.; Alarcão, V.; Guiomar, S.; Mota, J.; Teixeira, P.; Rodrigues, S.; Lobato, L.; et al. Inquérito Alimentar Nacional e de Atividade Física, IAN-AF 2015–2016: Relatório de Resultados. 2017. Available online: https://ian-af.up.pt/sites/default/files/IAN-AF%20Relat%C3%B3rio%20Resultados_0.pdf (accessed on 15 May 2022).
5. WHO; FAO. *Diet, Nutrition and the Prevention of Chronic Diseases*; WHO: Geneva, Switzerland, 2003. Available online: https://books.google.pt/books?hl=pt-PT&lr=&id=S6YsDwAAQBAJ&oi=fnd&pg=PA4&ots=t9YQmlUGG8&sig=hXRLFfO2WJLULFDiaV54ogqmFGQ&redir_esc=y#v=onepage&q&f=false (accessed on 15 May 2022).
6. APN. Ano Internacional das Frutas e Hortícolas. 2021. Available online: https://www.apn.org.pt/v0D0O0C/ano-internacional-das-frutas-e-horticolas (accessed on 17 May 2022).
7. Moreira, P.; Ávila, H.; Correia, M.J. *Quantificação do Desperdício Alimentar em Refeitórios Escolares: Impacto de Uma Campanha de Sensibilização*; Acta Portuguesa de Nutrição: Porto, Portugal, 2021; pp. 38–45. [CrossRef]
8. Santos, D. A Alimentação Escolar Como Estratégia de Educação Alimentar e Nutricional: Uma Revisão da Literatura. Graduation's Investigation Work. Universidade Federal de Pernambuco. 2017. Available online: https://repositorio.ufpe.br/bitstream/123456789/23871/1/SANTOS%2C%20Deborah%20Maria%20dos.pdf (accessed on 17 May 2022).
9. Direção Geral da Saúde—Programa Nacional de Promoção da Alimentação Saudável. Alimentação em meio Escolar. 2014. Available online: https://nutrimento.pt/alimentacao-escolar/alimentacao-em-meio-escolar/ (accessed on 17 May 2022).
10. Commission of the European Communities. White Papel on a Strategy for Europe on Nutrition, Overweight and Obesity Related Health Issues. 2007. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52007DC0279&from=PT (accessed on 17 May 2022).
11. Contento, I.R. *Nutrition Education-Linking Research, Theory and Practice*; Jones & Bartlett, Learning, LLC: Burlington, MA, USA, 2016.
12. Arcan, C.; Hannan, P.; Himes, J.; Fulkerson, J.; Rock, B.; Smyth, M.; Story, M. Intervention effects on kindergarten and first-grade teachers' classroom food practices and food-related beliefs in american Indian reservation schools. *J. Acad. Nutr. Diet.* **2013**, *113*, 1076–1083. [CrossRef] [PubMed]
13. Cunningham-Sabo, L.; Lohse, B. Cooking with kids positively affects fourth graders' vegetable preferences and attitudes and self-efficacy for food and cooking. *Child Obes.* **2013**, *9*, 549–556. [CrossRef] [PubMed]
14. Guthrie, J.; Buzby, J.C. Several strategies may lower plate waste in school feeding programs. *Food Rev. Econ. Res. Serv.* **2002**, *25*, 36–42. Available online: https://www.researchgate.net/publication/285237458_Several_strategies_may_lower_plate_waste_in_school_feeding_programs (accessed on 17 May 2022).
15. Haroun, D.; Harper, C.; Wood, L.; Nelson, M. The impact of the food-based and nutrient-based standards on lunchtime food and drink provision and consumption in primary schools in England. *Public Health Nutr.* **2011**, *14*, 209–218. [CrossRef] [PubMed]
16. Heim, S.; Stang, J.; Ireland, M. A garden pilot project enhances fruit and vegetable consumption among children. *J. Am. Diet. Assoc.* **2009**, *109*, 1220–1226. [CrossRef]
17. Kim, M.; Jeon, E.; Hwang, K.; Jung, L. Perception and attitudes to leftover food at school food service—The elementary school students in Gwangju area. *J. Korean Soc. Food Sci. Nutr.* **2011**, *40*, 137–147. [CrossRef]
18. Shanks, C.B.; Banna, J.; Serrano, E.L. Food waste in the National School Lunch Program 1978–2015: A systematic review. *J. Acad. Nutr. Diet.* **2017**, *117*, 1792–1807. [CrossRef]

19. Silva, B.F.; Teixeira, B.; Ávila, H.; Afonso, C. *Avaliação do Desperdício Alimentar da Refeição Almoço em Duas Escolas Públicas do Distrito De Aveiro*; Acta Portuguesa de Nutrição: Porto, Portugal, 2020; pp. 30–35. [CrossRef]
20. Adams, M.A.; Pelletier, R.L.; Zive, M.M.; Sallis, J.F. Salad bars and fruit and vegetable consumption in elementary schools: A plate waste study. *J. Am. Diet. Assoc.* **2005**, *105*, 1789–1792. [CrossRef]
21. Dinis, D.; Martins, M.L.; Rocha, A. Plate waste as an indicator of portions inadequacy at school lunch. *World Acad. Sci. Eng. Technol.* **2013**, *7*, 417–421. [CrossRef]
22. Hakim, S.M.; Meissen, G. Increasing consumption of fruits and vegetables in the school cafeteria: The influence of active choice. *J. Health Care Poor Underserved* **2013**, *24*, 145–157. [CrossRef]
23. Hoffman, J.A.; Franko, D.L.; Thompson, D.R.; Power, T.J.; Stallings, V.A. Longitudinal behavioral effects of a school-based fruit and vegetable promotion program. *J. Pediatr. Psychol.* **2010**, *35*, 61–71. [CrossRef] [PubMed]
24. Marlette, M.A.; Templeton, S.B.; Panemangalore, M. Food type, food preparation, and competitive food purchases impact school lunch plate waste by sixth-grade students. *J. Am. Diet. Assoc.* **2005**, *105*, 1779–1782. [CrossRef] [PubMed]
25. Meiselman, H.L.; Johnson, J.L.; Reeve, W.; Crouch, J.E. Demonstrations of the influence of the eating environment on food acceptance. *Appetite* **2000**, *35*, 231–237. [CrossRef]
26. Nicklas, T.A.; Liu, Y.; Stuff, J.E.; Fisher, J.O.; Mendonza, J.A.; O'neil, C.E. Characterizing lunch meals served and consumed by pre-school children in Head Start. *Public Health Nutr.* **2013**, *16*, 2169–2177. [CrossRef] [PubMed]
27. Salomé, I. Um Estudo Sobre Desperdício Alimentar: O Caso da Escola de Hotelaria e Turismo de Coimbra. Master's Dissertation, Faculdade de Farmácia, Universidade de Coimbra, Coimbra, Portugal, 2019. Available online: https://eg.uc.pt/bitstream/10316/88237/1/Dissertac%CC%A7a%CC%83o%20Ine%CC%82s%20Salome%CC%81%20MSA%202019-%20Final%20FR.pdf (accessed on 10 June 2022).
28. Araújo, L.; Rocha, A. *Avaliação e Controlo do Desperdício Alimentar em Refeitórios Escolares do Município de Barcelos*; Acta Portuguesa de Nutrição: Porto, Portugal, 2017; pp. 6–21. [CrossRef]
29. Vaz, C. *Restaurantes: Controlando Custos e Aumentando Lucros*; LGE: Brasília, Brazil, 2006.
30. Lima, R. Orientações sobre Ementas e Refeitórios Escolares. 2018. Available online: http://www.dge.mec.pt/sites/default/files/Esaude/oere.pdf (accessed on 7 June 2022).
31. Muller, P. Avaliação do Desperdício de Alimentos na Distribuição do Almoço Servido para os Funcionários de um Hospital Público de Porto Alegre. Master's Dissertation, Faculdade de Medicina, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, 2008. Available online: https://lume.ufrgs.br/handle/10183/16556 (accessed on 10 June 2022).
32. Carvalho, J.; Lima, J.; Rocha, A. Desperdício alimentar e satisfação do consumidor com o serviço de alimentação da Escola de Hotelaria e Turismo de Coimbra, Portugal. *Demetra Aliment. Nutr. Saúde* **2015**, *10*, 405–418. [CrossRef]
33. Machado, J. Desperdício Percecionado e Desperdício Real em Utilizadores de Cantina Institucional. Master's Dissertation, Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Porto, Portugal, 2017. Available online: https://repositorio-aberto.up.pt/bitstream/10216/109369/2/234891.pdf (accessed on 7 June 2022).
34. Silva, C. A Importância Da Alimentação Saudável Para O Desenvolvimento Humano. *Hum. Sociais E Apl.* **2020**, *10*, 46–62. [CrossRef]
35. Teixeira, A. Impacto de Uma Ação de Redução do Desperdício Alimentar ao Nível do Consumidor num Serviço de Alimentação do Ensino Superior Português. Master´s Dissertation, Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Porto, Portugal, 2017. Available online: https://repositorio-aberto.up.pt/handle/10216/111205 (accessed on 6 June 2022).
36. Martins, M. Avaliação e Controlo do Desperdício Alimentar no Almoço Escolar nas Escolas Básicas de Ensino Público do Município do Porto: Estratégias para a Redução do Desperdício. Ph.D. Dissertation, Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto, Porto, Portugal, 2013.
37. Kim, S.; Moore, L.; Galuska, D.; Wright, A.; Harris, D.; Grummer-Strawn, L.; Merlo, C.; Nihiser, A.; Rhodes, D. Vital Signs: Fruit and Vegetable Intake Among Children—United States, 2003–2010. In *MMWR Morb. Mortal Wkly. Rep.*; 2014; 63, pp. 671–676. Available online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4584658/pdf/671-676.pdf (accessed on 15 May 2022).
38. Lewis, M. An evaluation of fruit and vegetables consumption in selected primary school children in Trinidad and Tobago. *Int. J. Educ. Res.* **2013**, *1*, 1–14. Available online: https://www.researchgate.net/publication/268515821_An_evaluation_of_fruit_and_vegetables_consumption_in_selected_primary_school_children_in_Trinidad_and_Tobago (accessed on 9 June 2022).
39. Pereira, B.; Alvim, A.; Poinhos, R.; Franchini, B.; Almeida, M. Do Portuguese Children eat enough fruit and vegetables? In Proceedings of the Poster presented at II World Congress of Public Health Nutrition/I Latinamerican Congress of Community Nutrition, Porto, Portugal, 23–25 September 2010. Available online: https://repositorio-aberto.up.pt/bitstream/10216/54210/2/990.pdf (accessed on 6 June 2022).
40. Sumonja, S.; Novakovic, B. Determinants of fruit, vegetable, and dairy consumption in a sample of schoolchildren, northern Serbia, 2012. *Prev. Chronic Dis.* **2010**, *10*, E178. [CrossRef]
41. WHO. *Young People's Health in Context: Health Behaviour in School-Aged Children (HBSC) Study: International Report from the 2001/2002 Survey*; Health Policy for Children and Adolescents; WHO Regional Office for Europe: Copenhagen, Denmark, 2004; pp. 1–248. Available online: https://www.euro.who.int/__data/assets/pdf_file/0008/110231/e82923.pdf (accessed on 6 June 2022).
42. Gomes, S.; Ávila, H.; Oliveira, B.; Franchini, B. Capitações de Géneros Alimentícios para Refeições em meio Escolar: Fundamentos, Consensos e Reflexões. 2015. Available online: https://www.apn.org.pt/documentos/manuais/Manual_capitacoes_GA_refeicoes_em_ME.pdf (accessed on 6 June 2022).

43. Miller, N.; Reicks, M.; Redden, J.P.; Mann, T.; Mykerezi, E.; Vickers, Z. Increasing portion sizes of fruits and vegetables in an elementary school lunch program can increase fruit and vegetable consumption. *Appetite* **2015**, *91*, 426–430. [CrossRef]
44. Duarte, A. *Avaliação do Desperdício Alimentar em Escolas Básicas do 1.º ciclo do Município do Porto. Graduation's Investigation Work*; Faculdade de Ciências da Nutrição e Alimentação, Universidade do Porto: Porto, Portugal, 2018. Available online: https://repositorio-aberto.up.pt/bitstream/10216/113286/2/275062.pdf (accessed on 10 June 2022).
45. Reis, E. A Alimentação dos Alunos no Refeitório: Um Estudo Numa Escola de 2.º e 3.º Ciclos. Master's Dissertation, Escola de Ciências Sociais, Universidade de Évora, Évora, Portugal, 2012. Available online: https://dspace.uevora.pt/rdpc/bitstream/10174/14972/1/Disserta%C3%A7%C3%A3o_ElsaReis_MEpS_2012.pdf (accessed on 10 June 2022).
46. Stroebele, N.; De Castro, J.M. Effect of ambience on food intake and food choice. *Nutrition* **2004**, *20*, 821–838. [CrossRef] [PubMed]
47. WHO. *Food and Nutrition Policy for Schools: A Tool for the Development of School Nutrition Programmes in the European Region*; Copenhagen WHO Regional Office for Europe: København, Denmark, 2006. Available online: https://apps.who.int/iris/handle/10665/107797 (accessed on 6 June 2022).
48. Spigarolo, R.; Donegani, G.; Giorgi, G.; Sarti, V. *Differences between Real and Perceived Quality among Users of School Catering-Survey on 40 Italian Schools*; International Centre for Research in Organic Food Systems: Tjele, Denmark, 2010.
49. Ramsay, S.; Safaii, S.; Croschere, T.; Branen, L.; Wiest, M. Kindergarteners' entree intake increases when served a larger entree portion in school lunch: A quasi-experiment. *J. Sch. Health* **2013**, *83*, 239–242. [CrossRef] [PubMed]
50. Tikkanen, I. Nutritionally balanced school meal model for a comprehensive school. *Br. Food J.* **2011**, *113*, 222–233. [CrossRef]
51. Baxter, S.; Thompson, W.; Davis, H. Fourth-grade children's observed consumption of, and preferences for, school lunch foods. *Nutr. Res.* **2000**, *20*, 439–443. [CrossRef]
52. Buzky, J.; Guthrie, J. *Plate waste in school nutrition programs Final Report to Congress*; Economic Research Service: Washington, DC, USA, 2002.
53. Canali, M.; Östergren, K.; Amani, P.; Aramyan, L.; Sijtsema, S.; Korhonen, O.; Silvennoinen, K.; Moates, G.; Waldron, K.K.; O'Connor, C. *Drivers of Current Food Waste Generation, Threats of Future Increase and Opportunities for Reduction*; Wageningen University Publishing: Wageningen, The Netherlands, 2014.
54. Yoon, S.; Kim, H. Elementary school students' perception of food waste and factors affecting plate waste rate of school foodservice in the Gyeongnam area. *J. Korean Diet. Assoc.* **2012**, *18*, 126–140. [CrossRef]
55. Pérez-Rodrigo, C.; Aranceta, J. School-based nutrition education: Lessons learned and new perspectives. *Public Health Nutr.* **2001**, *4*, 131–139. [CrossRef] [PubMed]
56. Rosário, R.; Araújo, A.; Oliveira, B.; Padrão, P.; Lopes, O.; Teixeira, V.; Moreira, A.; Barros, R.; Pereira, B.; Moreira, B. The impact of an intervention taught by trained teachers on childhood fruit and vegetable intake: A randomized trial. *J. Obes.* **2012**, *2012*, 342138. [CrossRef]
57. Barbosa, M.S.; Marques, H.; Rocha, A. Caracterização da prestação do serviço de refeições escolares pelos municípios portugueses. *Nutrícias* **2012**, *13*, 3–8. Available online: https://repositorio-aberto.up.pt/handle/10216/65759 (accessed on 9 June 2022).
58. Barratt, D.; Cross, N.; Mildred, K.; Mattfeldt-Beman, M.; Katz, B. School policies that promote healthy eating: A survey of foodservice directors in North Carolina public schools. *J. Child Nutr. Manag.* **2004**, *28*. Available online: https://schoolnutrition.org/uploadedFiles/5_News_and_Publications/4_The_Journal_of_Child_Nutrition_and_Management/Spring_2004/3-barratt.pdf (accessed on 9 June 2022).
59. Ohri-Vachaspati, P.; Turner, L.; Chaloupka, F.J. Fresh Fruit and Vegetable Program participation in elementary schools in the United States and availability of fruits and vegetables in school lunch meals. *J. Acad. Nutr. Diet.* **2012**, *112*, 921–926. [CrossRef]
60. Faria, R.; Sousa, B. *A Educação Alimentar Em Meio Escolar e a Figura do Nutricionista Escolar*; Acta Portuguesa de Nutrição: Porto, Portugal, 2020; pp. 20–25. [CrossRef]
61. Martins, M.; Rodrigues, S.; Cunha, L.; Rocha, A. Strategies to reduce plate waste in primary schools–experimental evaluation. *Public Health Nutr.* **2016**, *19*, 1517–1525. [CrossRef] [PubMed]
62. Silva, R. *Consumo de Hortícolas em Crianças do Pré-Escolar e Primeiro Ciclo do Ensino Básico*; Graduation's Investigation Work, Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto: Porto, Portugal, 2018. Available online: https://repositorio-aberto.up.pt/bitstream/10216/113395/2/275422.pdf (accessed on 9 June 2022).