

Article

Brazilian Community Restaurants' Low-Income Food Handlers: Association between the Nutritional Status and the Presence of Non-Communicable Chronic Diseases

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Received: 12 March 2020; Accepted: 19 April 2020; Published: 24 April 2020



Abstract: This cross-sectional study aimed primarily to determine the association between the nutritional status and the presence of non-communicable chronic diseases (NCDs) among community restaurants' food handlers, since their access to food can influence their body mass index (BMI). The study discusses the socio-demographic status of participants, dietary intake, the prevalence of overweightness/obesity, and self-reported diagnosed NCDs. In 36 Community Restaurants (CRs) from all of the Brazilian regions, we collected data from 559 food handlers. We used a questionnaire to collect socio-demographic data and the reported diagnosed chronic diseases. For the anthropometric evaluation with Body Mass Index calculation, we measured the weight and the height of the individuals. They were all weighed before having lunch at the CR, without shoes and coats. Associations between variables were analyzed by the chi-square test and Poisson regression at a significance level of 5%, considering health as the outcome variable. Most of the food handlers were female (63.1%), married or with a partner (51.7%), and overweight (59.9%). Among the food handlers that presented diagnosed NCDs (n = 96, 17.2% of food handlers), 45.8% (n = 44) presented hypertension and 12.5% (n = 12) type 2 diabetes mellitus. There was a significant association between BMI and NCD status in the studied population. The total daily sodium intake of food handlers was higher than the recommendations of the World Health Organization (WHO), especially from the CR lunch, which may raise the risk of chronic diseases such as hypertension (the most prevalent non-communicable disease found in our study). Despite that, in general, the CRs provide access to cheap and adequate meals to their workers, considering energy intake and the proportion of macronutrients. In this population, overweightness and obesity were prevalent; there was an association of obesity with chronic disease in the study population. Therefore, it is necessary for better menu planning for CRs to guarantee sodium reduction throughout time.

Keywords: work environment; non-communicable diseases; community restaurants; low income; food access

1. Introduction

Food insecurity and low income are a burden influencing the populations' health and sustainability [1–5]. Food security is a basic need covering access to safe, sufficient, and proper nutritional food for individuals [6,7], in which food access must encompass sustainable premises [8].

In the last decades, globalization influenced feeding habits, increasing the consumption of more sugary and fatty products with low fiber content and high energy density (ED). Additionally, people are eating more outside their homes because they have less time to prepare meals. In Brazil, to the low-income population, eating out tends to represent an intake of cheaper and fast snacks, usually representing inadequate nutrient intake [6,9–11]. In addition, the last Brazilian study “Surveillance of Risk and Protection Factors for Chronic Diseases” with 52,392 individuals showed that 55.7% are overweight and 19.8% are obese, which are risk factors for non-communicable chronic diseases (NCDs) [12]. Therefore, attention to the low-income population is necessary to improve the national public health and nutrition and to reduce rates of NCDs [3,6,13–17].

In this sense, the Brazilian Government created the Community Restaurants (CRs) as a Food Assistance Program to offer cheap and healthy meals to the low-income population [13,18]. The government created this program because food access has a substantial impact on the prevention and treatment of several diseases. It is a way to guarantee feeding social rights [7] and to improve the Brazilian low-income populations’ health. Among the CR program’s objectives, the program offers a healthy lunch for those who eat out on a low budget, charging from 0.30 to 0.60 USD per person. It is necessary to plan a low-cost menu by including low-cost ingredients, restricting the number of dishes [13,19,20], and hiring employees at the minimum wage to provide the low-income population with a large number of meals. In Brazil, low-cost food services more frequently hire untrained and low-educational-level food handlers [21,22]. All of these factors can impact the social and economic aspects of sustainability [5,23–25].

Previous studies evaluated the profile, body mass index (BMI), food insecurity, and food intake of CR customers [9,13,14,16,26]. Carrijo et al. [13] showed that CRs’ external customers had an average lunch intake of 881 kcal. Most meals were classified as low energy density but high in sodium. However, to our knowledge, there is no study about the characterization of the CRs’ food handlers. They are also internal customers for CR meals, and generally do not receive reasonable payments, making it difficult to obtain suitable food access outside of the CR. As CRs’ internal customers, food handlers tend to differ from others, considering that they work with total access to food, which is an excellent opportunity to pinch food, which may favor a high caloric intake and consequent weight gain [27,28]. However, the profile, nutritional status, and dietary intake of this kind of vulnerable group are not well known. Therefore, this study aimed primarily to determine the association between the nutritional status and the presence of NCDs among Community Restaurants’ food handlers, since their work environment can influence their access to food and their BMI. We expect to subsidize interventions to improve dietary intake and knowledge about the health aspects of their diet, affecting this vulnerable group’s health and quality of life.

2. Materials and Methods

2.1. Study Design, Settings, and Participants

This is a nationally cross-sectional study in Brazilian Community Restaurants. The official list of Community Restaurants (CRs) from the Program of the Department for Social Development and Hunger Fighting (*Ministério do Desenvolvimento Social e Combate à Fome*, MDS) was the basis for the sample calculation [18]. The research was conducted in CRs that focus on the low-income population in Brazil. It is a nationwide program offering meals from Monday to Friday. By choosing CRs, we got food handlers in different Brazilian regions and with the same types of work conditions. We also received permission to enter all of the CRs in the country, as this was faster than finding and asking for permission for individual restaurants. We used the following inclusion criteria: A food service belonging to the Brazilian CR program, signature of the Institutional Acknowledgement Agreement by the responsible technical person of the CR, and a daily offer of more than 500 meals. Restaurants with more than 500 meals allowed the researchers to evaluate a large number of individuals, achieving a representative sample. Restaurants that provide less than 500 daily meals are considered small and

present a smaller number of food handlers compared to medium- (500–2000 daily meals) or large-size restaurants (>2000 daily meals) [29]. Therefore, all 65 of the existing CRs were eligible to be part of the study. From the CRs (N), we calculated a sampling plan, considering a level of significance (α) of 5% [30]. With the “survey select” of the SAS 9.1.3 program, we estimated a simple random sample. From the 65 CRs and the sampling plan, a minimum of 31 CRs were randomly selected to be part of the study. From the existing CRs in each of the five Brazilian regions (North, Northeast, Midwest, South, and Southeast), CRs were randomly selected to be part of the sample. The researchers visited thirty-six CRs and included them in the sample. All of the food handlers that work in the 36 selected CRs were invited to participate in this study. Only the CR food handlers that agreed to participate in the study were interviewed and included in the study. Some food handlers refused to join because they did not want to stop working, or they were worried about employability. Even though researchers explained that participation would not influence their work, some decided not to be part of the study. Therefore, from a total of 1062 handlers, 559 (52.64%) agreed to participate. A total of 533 individuals was necessary to be a representative sample for the study, with a 95% confidence and an error of 3%.

2.2. Data Collection

Trained researchers performed data collection using standardized instruments and by applying a questionnaire to identify sociodemographic characteristics (gender, age, educational level, per capita income, marital status, smoking, participation in a government program, and working time in the restaurant) [30]. Participants declared the presence of diagnosed NCDs (by a physician), and the information was recorded in a specific form. Researchers classified the target population by the presence or absence of one or more than one of the following NCDs: Systemic arterial hypertension (SAH), type 2 diabetes mellitus (DM), and others (cancer, dyslipidemia, cardiovascular diseases, respiratory diseases, depression). We used the self-reported NCD data, since population studies widely use this method for its convenience and economy [31,32].

In each CR, food handlers' evaluation occurred for three consecutive days. On the first day (Monday), individuals who agreed to participate signed the acknowledgment form. Each food handler received information about the research and the need to come to work at the CR for at least two more days to complete the research protocol. On the second day of the study, in each CR, before participants' lunch in a reserved room, we performed the procedures for weight and height measurements with a Plenna[®] (São Paulo, Brazil) weighing scale (150 kg) and a stadiometer (220 cm). Participants had to take off their shoes and coats. After that, the BMI was calculated. Food handlers also had to complete three days of consumption evaluation to complete the protocol. Researchers interviewed participants to complete 24 h recalls for one weekend day and two weekdays. They were asked about the whole previous day of consumption. The evaluation of three consecutive days of food consumption is representative of an individual's diet [33]. The same researchers conducted interviews with customers and followed the protocol designed for the study.

2.3. Variables

On each day of the food handlers' interviews, researchers applied the 24 h recall. On Monday, they were asked about their consumption on Sunday for every meal in order to characterize weekend consumption. The other two days were regarding the weekday 24 h recall. During the week, food handlers consumed breakfast and lunch provided by the CR. We used 24 h recall [34] to gather information on food and the amounts consumed inside and outside of the CR. Researchers used, when necessary, utensils, and food portion photos for better accuracy of data collection.

Based on the recorded data, the nutritional value was calculated using a system database (DietWin[®], Porto Alegre, Brazil), which includes the Brazilian Food Composition Table [35]. When any dish or food information did not exist, scientific publications and labels on industrialized food products were used, and then the data were entered into the system. We assessed the nutritional composition

of meals of the day of each food handler through the Total Energy Value (TEV), macronutrients, and sodium.

Researchers collected the sociodemographic information and the anthropometric variables (weight, height) of the individuals [36]. The BMI classification followed the criteria adopted by the World Health Organization (WHO) [37], used as an indicator of an anthropometric component of nutritional status.

The presence of one or more than one of the previously described NCDs was the outcome variable, and individuals were classified as: (0) Without NCDs and (1) with NCDs. As the primary exposure variable, BMI was adopted, and individuals were classified as (0) adequate body mass, (1) overweight, or (2) obese. We categorized the adopted covariates in the study as follows: Age group ((0) <40 years; (1) ≥40 years), per capita income (lower than one minimum wage, or ≥ one minimum wage), alcohol habit ((0) no alcohol habit; (1) alcohol habit), smoking ((0) non-smoker; (1) smoker), and working time at the CR ((0) <12 months; (1) ≥12 months).

2.4. Statistical Analysis

The study sample was calculated using the likelihood-ratio test comparing two independent proportions, considering a significance level of 5% and a two-sided test [38]. This sample has a power of 99%, 90.8%, 99%, and 99% to identify prevalence rates of excess weight, obesity, hypertension, and diabetes mellitus, respectively, taking as a reference the prevalence rates of these morbidities for the Brazilian adult population reported in Schmidt et al. [39].

Data were descriptively analyzed and presented as absolute and relative frequencies (for categorical variables) and as mean and standard deviation (for continuous variables), using STATA® (StataCorp LP, College Station, TX, USA) software version 12.0. The crude association among the response variable (NCD) and the anthropometric, sociodemographic, and lifestyle variables was performed using Pearson's chi-square test, considering a significance level of 5% ($p < 0.05$). To NCD prevalence as a function of anthropometric status, we applied Poisson multiple regression using the prevalence ratio (PR), which compares the prevalence of the outcome in exposed individuals with the prevalence in unexposed individuals [40].

According to Kleinbaum and Klein [41], the choice of this model takes as a basis that, if the assumption of "rare disease" cannot be reached by the outcome variable (arbitrarily established as a prevalence of less than 10%), the Odds Ratio (OR), generated by the logistic regression, is discouraged, as it tends to be overestimated and has less accurate confidence intervals [41].

First, the univariate analysis aiming to select the suitable variables for the multivariate model and those with p -values below 20% were selected. In the final model, the variables that presented significance below 5% remained. Possible interaction terms were tested to assess the presence of a change in the effect of exposure variables on the outcome variable using the log-likelihood ratio test. We also tested the presence of confounding variables (associated with both exposure and outcome) by assessing the 10% or more significant change in PR compared with the PR of the reduced/gross model [42].

To measure the model's explanatory capacity, pseudo-R² was used for binomial models that assess log-probability fit in the complete model compared with the reduced model [43]. The Akaike Information Criterion (AIC) was used to evaluate the quality of fit of the estimated statistical model based on the relative measure of information lost in adopting a particular model. The less information lost, the better the model fit (i.e., the smaller the AIC, the better the fit) [44].

2.5. Ethics Statement

The University of Brasília Research Ethics Committee approved this under protocol number 037210, and all subjects gave their consent before they participated in the study.

3. Results

For the present study, the target population was the CRs' food handlers who agreed to participate, distributed in 36 CRs from all five Brazilian regions. From all of the 1062 Brazilian CR food handlers, 559 (52.6%) agreed to participate. Therefore, the sample presented the power of 96.8% and 99.9% to identify the prevalence of overweightness and hypertension, the most prevalent pathologies among food handlers in this category, considering, respectively, the overweightness prevalence of 60.8% [45] and 29% of hypertension [46] for the definition.

Table 1 shows the NCD status, the socio-demography, and the anthropometric profile of low-income food handlers that work in the Brazilian CRs. Most of them were female (63.1%), aged ≤ 40 years old (68.2%), with a partner (51.7%), and with a low level of education—53.3% with complete or incomplete elementary school; 79.9% present a family per capita income of lower than one minimum wage (175.90 USD per month), and have worked at CRs for more than one year (55.8%). Almost half of the CR food handlers drink alcoholic beverages (46.3%), and more than half of the CR food handlers were overweight or obese (59.9%). There were no underweight individuals. Hypertension was the most prevalent diagnosed NCD (45.8%) among the food handlers with NCDs.

Table 1. Health status, socioeconomic, and anthropometric profiles of food handlers.

Variables	Frequency (n)	%
Gender (n = 559)		
Female	353	63.1
Male	206	36.9
Age group (n = 559)		
<21 years	26	4.7
21 to 30 years	183	32.7
31 to 40 years	172	30.8
41 to 50 years	133	23.8
51 to 60 years	45	8.0
Marital status (n = 559)		
Single	225	40.2
With Partner	289	51.7
Widow	06	1.1
Divorced	39	7.0
Education level (n = 559)		
Incomplete Elementary Education	124	22.2
Elementary Education	174	31.1
High School	244	43.7
Under-graduate	17	3.0
The habit of drinking alcohol (n = 558)		
Yes	258	46.3
No	300	53.7
Smoking habit (n = 557)		
Yes	100	18.2
No	457	81.8
Income (per capita minimum wage) * (n = 538)		
Up to $\frac{1}{4}$ MW	47	8.7
$\frac{1}{4}$ to $\frac{1}{2}$ MW	171	31.8
$\frac{1}{2}$ to 1 MW	212	39.4
1 to 2 MW	91	16.9
>2 MW	17	3.2
Body mass index (BMI) (n = 556)		
Adequate weight	221	40.1
Overweight	216	38.6
Obesity	119	21.3

Table 1. Cont.

Variables	Frequency (n)	%
Non-communicable chronic disease (NCD) diagnosed (n = 559)		
No	463	82.8
Yes	96	17.2
Type of NCD (n = 96)		
Hypertension	44	45.8
Type 2 diabetes	12	12.5
Others	40	41.7
Time working at the community restaurant (n = 559)		
≤6 months	204	36.5
7 to 11 months	43	7.7
12 to 23 months	122	21.8
≥24 months	190	34.0

* Minimum wage (MW): 175.90 USD per month. The number of respondents can vary in each item, since the responses were not mandatory to continue the questionnaire.

Table 2 presents the distribution of variables by categories of the NCD response variable of the CRs' food handlers. The Chi-square test shows an association between the NCD outcome and BMI (p -value < 0.05). Statistically significant associations were also found with gender, age, education, drinking habits, and length of work in the CRs. In this sense, the prevalence of NCDs was higher among females than males ($p = 0.029$), individuals aged 40 years or more ($p < 0.001$), and individuals with a lower level of education ($p = 0.008$). Employment length in CRs and alcohol drinking habits were analyzed as possible modifiers of the effect, and there was not an interaction (p -value > 0.05).

Table 2. Distribution of variables by categories of the non-communicable chronic disease (NCD) response variable of the Community Restaurants' food handlers.

Variables	Without NCD		With NCD		p -Value *
	n	%	n	%	
Gender					
Male (n = 206)	180	87.4	26	12.6	0.029
Female (n = 353)	283	80.2	70	19.8	
Age group					
≤40 years (n = 381)	346	90.8	35	9.2	<0.001
>40 years (n = 178)	117	65.7	61	34.3	
Education level					
Elementary Education (complete/incomplete) (n = 298)	235	78.8	63	21.2	0.008
High School/Under-graduate (n = 261)	228	87.4	33	12.6	
BMI status					
Adequate weight (n = 221)	196	88.7	25	11.3	0.003
Overweight/obesity (n = 338)	267	79.0	71	21.0	
Smoking habit					
No (n = 457)	379	82.0	78	18.0	0.823
Yes (n = 100)	82	82.9	18	17.1	
The habit of drinking alcohol					
No (n = 300)	239	79.7	61	20.3	0.035
Yes (n = 258)	223	86.4	35	13.6	
Income **					
<1 minimum wage (n = 430)	359	83.5	71	16.5	0.343
≥1 minimum wage (n = 108)	86	79.6	22	20.4	
Time working at the community restaurant					
<12 months (n = 247)	215	87.0	32	13.0	0.019
≥12 months (n = 312)	248	79.5	64	20.5	

* Pearson Chi-square ($p < 0.05$); ** Minimum wage (MW): 175.90 USD per month. The number of respondents can vary in each item, since the responses were not mandatory to continue the questionnaire.

The variables of education level and age group were evaluated as possible confounder factors of the relationship between the outcome and explanatory factors, and also of the differences between the estimates of the prevalence ratios (PRs) of the models. For both variables, the difference in PRs of the adjusted models compared to the reduced models was less than 10%, indicating that this was not a confounding factor. However, considering the effect that these variables had on the bivariate model, they were maintained in the multivariate model.

Table 3 presents the results of Poisson regression for the relationship between anthropometric status and the presence of NCDs among food handlers. Therefore, in overweight food handlers, the prevalence of NCDs was 59% higher when compared to the prevalence of these disorders among food handlers with adequate weight (PR = 1.59 (1.01–1.54)). After adjusting for gender, age, education, and length of service, the prevalence of NCDs among overweight individuals was 49% higher than in normal-weight individuals, but without statistical significance (PR = 1.49 (0.95–2.35)) (Table 3).

The obese food handlers had a 130% higher prevalence of NCDs when compared to food handlers with adequate weight (PR = 2.30 (1.42–3.71)), and, in the adjusted model, this was regardless of gender, age, education, and length of service (PR = 2.05 (1.29–3.35)). The inclusion of covariates also increased the explanatory power of the models, since pseudo-R² increased from 1.88% in the Stock Model to 7.4% in the adjusted model. This expansion in the explanatory power of the model was accompanied by the reduction of the AIC from 521.8 in the gross model to 500.9 in the adjusted model, indicating a better fit of the final model (Table 3).

Table 3. Prevalence ratio of the association between overweightness/obesity and health problems of Brazilian Community Restaurant food handlers.

	Presence of NCDs	
	Prevalence Ratio (IC 95%); <i>p</i> -Value *	
	Food Handlers (<i>n</i> = 559)	
	Stock Model	Adjusted Model **
Adequate	Reference	Reference
Overweight	1.59 (1.01–1.54); 0.05	1.49 (0.95–2.35); 0.08
Obesity	2.30 (1.42–3.71); 0.001	2.05 (1.29–3.35); 0.002
Pseudo-R ²	1.88%	7.4%
AIC	521.8	500.9

* Poisson regression model; ** Adjusted by age, gender, education level, and time working at the community restaurant; AIC: Akaike Information Criterion.

Table 4 shows the total energetic value (TEV) and nutrient intake based on three days of 24 h recalls according to the BMI classifications of food handlers. Food handlers with adequate weight consume more energy during the day than overweight, mainly because of the higher carbohydrate intake. Macronutrient distribution was similar among groups; carbohydrates ranged from 51.7% to 53%, proteins from 17.1% to 18.7%, and lipids from 29.1% to 30.4%. The proportion of macronutrients is within the recommendations. Sodium intake is higher than recommended by the WHO for the whole day for all of the groups.

Table 4. Mean and standard deviation of food handlers' nutrient intake (24 h recall) of the Community Restaurants in Brazil (n = 559) according to body mass index (BMI).

Nutritional Profile	Adequate Weight	Overweight	Obesity	p-Value
	Mean ± SD	Mean ± SD	Mean ± SD	
Energy (kcal)	2057.4 ^a ± 722.5	1829.44 ^b ± 649.2	1918.9 ^{ab} ± 668.6	0.023
Carbohydrate (g)	272.5 ^a ± 103.6	236.4 ^b ± 85.9	249.4 ^{ab} ± 82.8	0.060
Protein (g)	88.1 ^a ± 34.4	81.9 ^a ± 30.8	89.1 ^a ± 57.2	0.330
Lipid (g)	68.3 ^a ± 29.7	61.8 ^a ± 29.3	61.8 ^a ± 28.8	0.127
Fiber (g)	11.7 ^a ± 5.6	10.8 ^a ± 5.6	11.2 ^a ± 5.5	0.706
Saturated fat (g)	6.5 ^a ± 1.8	5.7 ^a ± 2.0	5.8 ^a ± 2.3	0.556
Sodium (mg)	3982.0 ^a ± 1728.9	3837.5 ^a ± 1560.5	3801.3 ^a ± 1507.3	0.668

^{a,b} Different letters in the line show statistical differences ($p < 0.05$).

Table 5 highlights nutrient intake just for breakfast and lunch, since these meals during the week occur inside the CRs with the available food for all types of customers (external and internal). When analyzing the consumption on the weekend and weekdays, there are statistical differences for all of the nutritional components presented in Table 5. Food handlers have higher energy intake for lunch during the weekdays when they eat in the CRs, but this condition does not occur for breakfast. Sodium is also higher in weekday lunches, reaching more than the daily recommendations (2300 mg).

Table 5. Mean and standard deviation of food handlers' nutrient intake for breakfast and lunch on weekdays and the weekend—Community Restaurants in Brazil (n = 559).

Nutritional Profile	Breakfast Weekdays	Breakfast Weekend	p-Value	Lunch Weekdays	Lunch Weekend	p-Value
	Energy (kcal)	315.6 ± 215.6		390.0 ± 326.5	<0.05	
Carbohydrate (g)	53.8 ± 28.4	60.9 ± 59.1	<0.05	123.8 ± 66.6	96.9 ± 67.1	<0.05
Protein (g)	16.9 ± 26.2	10.4 ± 8.7	<0.05	53.9 ± 28.6	44.8 ± 42.5	<0.05
Lipid (g)	17.4 ± 19.2	11.9 ± 13.0	<0.05	34.4 ± 22.9	27.9 ± 32.2	<0.05
Sodium (mg)	457.2 ± 503.2	494.9 ± 450.5	<0.05	2763.2 ± 1585.5	1621.1 ± 1516.2	<0.05

4. Discussion

This study is the first to nationally evaluate the profile of food handlers that work in CRs in Brazil. Most of the workers were female (63.1%), similarly to data in most studies already performed in some Brazilian states with food handlers [27,45,47–49]. In addition, most of the CR food handlers present a low level of education (53.3% with complete or incomplete elementary school), following other studies that commonly report low educational levels of food handlers [50–56]. Moreover, 79.9% of the CR food handlers present family per capita incomes that are lower than one minimum wage (175.90 USD per month). It is common to find women in food handling activities, since, traditionally, they are responsible for household food handling and preparation [57]. Food handlers with reduced education levels are common in food services, especially in the food sectors of developing countries, where this represents a source of employment and income for unskilled workers [58]. NCDs were associated with a lower level of education ($p = 0.008$). These individuals with lower levels of education tend to be more exposed to the risk of NCDs; they also have less access to health services, health promotion, and, consequently, disease prevention practices due to their lower income [59–61].

In this sense, in Brazil, studies with low-income people showed an increase in overweightness/obesity related to the diets' poor nutritional quality [39,60]. In our study, more than half of the CR food handlers are overweight or obese (59.9%). Although this is close to the data for the general Brazilian adult population (55.7%), the overweightness prevalence among CR food handlers is higher [12]. For obesity, the prevalence identified in food service workers was higher than that observed in the Brazilian adult population (20.6%) [12]. Overweightness and obesity are considered modifiable risk factors for NCDs [62], showing the importance of the adoption of healthy eating habits.

As in our research, a study with 13,103 participants in Serbia found an association between high BMI values and the prevalence of morbidity among the adult population, with hypertension being the most common pathology for both genders, regardless of age [63]. In addition, we found a significant association between high BMI values and the prevalence of comorbidities, with the gradual increase in prevalence rates of NCDs, mainly hypertension, directly proportional to the increase in BMI [63]. Hypertension was the most prevalent diagnosed NCD (45.8%) among the food handlers with NCDs. Population studies in Brazil also show hypertension as the most prevalent NCD among the adult population. The epidemiological surveillance research of the Brazilian Health Ministry showed a prevalence of 24.7% of the medical diagnosis of hypertension among Brazilian adults [12]. Similarly to our results, in which the prevalence of NCDs was higher among females than males ($p = 0.029$), for the general Brazilian population, women present a hypertension prevalence (27.0%) higher than that of men (22.1%), with a higher percentage among those with lower income and education [12]. Our results showed a higher prevalence of obesity among CR food handlers (21.3%) than among CR customers (13.2%) [9]. In total, 59.9% of the CR food handlers and 57.9% of the CR customers [9] are overweight. Our results also showed an association between the presence of NCD and age; NCDs are more prevalent among individuals over 40 years ($p < 0.001$). This result is similar to the findings in the general Brazilian population [39]. The Centers for Disease Control and Prevention (CDC) show that the risk for NCDs increases with age [62], as in our study.

Previous studies showed that the meals produced at CRs are nutritionally adequate for their customers [13,14,17], except for the sodium content at lunch [13]. Our results showed that the amount of sodium intake by all groups of food handlers (Table 4) is higher than the recommendation for the whole day [64]. Food handlers consumed more sodium on weekdays than on the weekend (Table 5) for lunch (the main meal in Brazil). Lunch should cover 40% of the total energetic value (TEV). In this sense, lunch should have up to 960 mg of sodium [15]. Our findings showed that, at lunch, CR food handlers' sodium intake ranged from 1621.1 ± 1516.2 to 2763.2 ± 1585.5 mg during weekends and weekdays, respectively, with the consumption at CR close to the total amount of sodium expected for the entire day (2300 mg) [64].

Since the dietary reference intakes (DRI) is based on daily consumption and, in Brazil, breakfast should cover 20% of the daily TEV ingestion [15,17], the maximum limit of sodium for breakfast should be 460 mg. CR food handlers' intake of sodium ranged from 457.2 ± 503.2 to 494.9 ± 450.5 mg on weekdays and weekends, respectively (Table 5). The intake of sodium in CR breakfast is according to recommendations. However, on the weekend, food handlers consumed more sodium than recommended. A study with Brazilian CR external customers that evaluated the sodium consumption showed that the mean sodium intake at breakfast (436 mg) [17] was lower than our findings for internal consumers (food handlers) (Table 5). Therefore, the CR food handlers seem to consume a higher amount of sodium during breakfast than the general Brazilian low-income population [17]. Although CR food handlers' sodium intake for breakfast on weekdays is adequate, it is essential to highlight that this intake for breakfast associated with the sodium intake at lunch is higher than the daily required amount of sodium. In addition, the total daily sodium ingestion is almost 1.7 times higher than the recommendation. The high sodium intake is associated with NCD development, mainly hypertension (the most frequent NCD found in our sample); it needs to be monitored to achieve a healthy diet. Since the CR food handlers consume the two main meals (breakfast and lunch) at the CR, the restaurant is contributing to their high sodium intake, probably impacting the hypertension prevalence among the NCDs. In addition, the weekdays' consumption of lipids is statistically more elevated than the weekends' intake (Table 5), showing higher use of fats to prepare food in the CRs by the food handlers. Therefore, these data highlight a need to critically examine recipes while still considering the taste and acceptability of the meals.

Differently from the CR food handlers, the CR external customers have the protein dishes portioned by the CR employees (food handlers) [13]. The amount of protein consumed on a weekday (at CR) (16.9 ± 26.2) is significantly higher ($p < 0.05$) than that consumed on weekends (10.4 ± 8.7) for breakfast

as well as for lunch (53.9 ± 28.6 and 44.8 ± 42.5 ; $p < 0.05$). Considering that the CRs' food handlers ate two (breakfast and lunch) of the three main meals at the CRs and that they do not have any restrictions on the portioning of the food (differently from the customers), they have access to more protein and calories than the CRs' customers. CR food handlers' total energetic value (TEV) ingestion for lunch in weekdays is higher (1013.1 ± 511.3 kcal) than for CR customers (900.9 kcal) [13], but lower (817.5 ± 578.4 kcal) on the weekends. The TEV intakes by obese food handlers and adequate-weight ones were similar ($p > 0.05$), as well as between obese and overweight food handlers ($p > 0.05$). However, the daily TEV ingestion of adequate-weight food handlers was higher than that of the overweight ones. One of the limitations of our study was the inability to quantify pinching while food handlers were preparing food at CRs. They confirmed tasting food while production was happening, but they could not quantify it.

In general, the average energy intake for CR food handlers on weekends for breakfast (390.0 ± 326.5 kcal) and lunch (817.5 ± 578.4 kcal) and for customers at lunch [13] and breakfast [17] is similar to the recommendations of the Brazilian Worker Food Program (WFP). The program recommends 800 kcal for lunch [65] and 400 kcal for breakfast to guarantee adequate energy intake to maintain the organism. However, for food handlers, lunch on weekdays is higher than the recommendation. Therefore, if the TEV intake was the single parameter to guarantee health, the CR program would not be reaching its goal for their food handlers, exposing them to high ingestion of calories. However, despite the adequate TEV intake along the day by CR food handlers (Table 4), it could be underestimated by the lack of information on pinching (since they have access to small amounts of ingredients/meals to taste during their work time), potentially influencing the obesity prevalence.

Regarding food handlers, the act of tasting food during its preparation and the habit of "pinching" food during the workday due to easy access to food may be frequent among these workers [27]. A previous study performed in Brazil showed that men and women who are food handlers often taste food at work, 5.7 and 3.9 times more than men and women that work in the laundry service, respectively [27]. For overweight individuals, the values go to 7.7 times higher among men and 4.2 times higher among women. This fact reinforces the hypothesis that access to food may be related to overweightness. Therefore, more studies are needed to investigate this consumption practice and the potential influences of the food handling environment in the CR food handlers' overweightness. Researchers were not able to evaluate the amount of food intake by food handlers while they were tasting food. However, participants reported tasting all types of food while preparing them, but they could not tell the amount and how many times they tasted during food preparation.

The study has limitations in its cross-sectional design. Data on exposure and outcome were obtained at a single moment in time, thus not establishing a causal relationship between obesity and NCDs in the studied population, making it necessary to carry out confirmatory studies of the hypotheses raised here. However, this allows characterization of the population and identification of associated factors, which are necessary to create strategies for the prevention and control of health problems in low-income food handlers. The use of self-reported morbidity reports can also be pointed out as a limitation of the study. Still, self-reported data have been used in Brazilian and international population studies, and the validity of this information is increasingly recognized. In addition, the methodological rigor and robust statistical analyses applied to this study strengthen the evidence recorded in our study [32,66,67].

5. Conclusions

The results of this study highlight CR food handlers as a population with a high prevalence of overweightness, with obesity strongly associated with the presence of NCDs, especially hypertension, in this group. The overweightness prevalence for CR food handlers is higher than for CR costumers [9] and the general Brazilian adult population [12]. This work fills a gap in the health profile of this population, as it is the first study to evaluate workers from all regions of Brazil. The data suggest the

need for policies aimed at the health care of low-income food handlers, mainly because they develop their activities in a place designed to promote food and nutritional security.

Concerning sodium content in the two main meals, CRs are putting Brazilian low-income food handlers at risk for chronic diseases, mainly cardiovascular diseases such as hypertension (the most prevalent NCD found in our study). A better menu planning (by the dietitians) and execution (by the food handlers) is necessary for CRs to guarantee sodium reduction over time. In general, the CRs provide access to cheap and adequate meals to their workers as their social contribution. Considering energy intake and the proportion of macronutrients, CRs contribute to promoting health for their food handlers. However, a food handling environment, allowing direct access to food during work time, can be contributing to overweightness. This program is a big step in guaranteeing the universal right to food to the low-income population of Brazilian food handlers. Further studies are necessary to investigate this consumption practice and the potential influences of the food handling environment in the CR food handlers' overweightness.

Author Contributions: Conceptualization, R.B.A.B. and R.d.C.C.d.A.A.; Methodology, R.B.A.B., R.d.C.C.d.A.A., and P.R.F.C.; Validation, P.R.F.C. and J.C.-S.; Formal analysis, R.d.C.C.d.A.A., P.R.F.C., J.C.-S., and R.P.Z.; investigation, I.C.F.; Writing—Original draft preparation, R.P.Z. and I.C.F.; Writing—Review and editing, R.P.Z. and R.B.A.B.; Project administration, R.B.A.B. and R.d.C.C.d.A.A.; Funding acquisition, R.B.A.B. and R.d.C.C.d.A.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by University of Brasília, grant number *Edital* DPI 004/2019.

Acknowledgments: We acknowledge the Ministry of Social Development of the Brazilian Government by the support.

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

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