

Alteration in eating habits among shift workers of a poultry processing plant in southern Brazil

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Abstract *The relationship between shift work and the eating habits of workers was investigated in a slaughterhouse in southern Brazil. It involved a cross-sectional study with 1,206 workers of both sexes between 18 and 50 years of age. A standardized questionnaire was used to gather demographic, socioeconomic, work shift and eating habit information. The shift of work was categorized into daytime and nighttime, based on the starting and ending times of the shift. The eating habits of workers were evaluated as follows: number and type of meals eaten during the 24 hours of a normal day, the inappropriateness of the hour- of these meals and the dietary risk score. This was built on the risk score of the weekly consumption of 13 food items. After adjusting for potential confounders, non-Caucasian and younger male workers were more likely to manifest eating risk habits. Nighttimeshift workers consumed a higher number of meals/day with greater inappropriateness of meal times than daytimeshift workers. The night shift can negatively influence the eating habits of workers of that shift.*

Key words *Shift work, Night work, Eating habits, Occupational health*

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Introduction

A new organizational paradigm for production in the twentieth century has been formed in the West since the early 1970s. Industrial production, which had until then been organized for mass production in accordance with the Taylor model of Scientific Management, was supplanted by a more flexible model of production, known as the Toyotism model¹. This flexibility in the production process included concepts related to work versatility, decentralization and service outsourcing, as well as working hours, shifts and how the time a person has spent working is distributed over their lifetime².

In this context, at the beginning of the twentieth century, the workplace began to experience a process known as job insecurity, which was understood to involve instability and working conditions as well as the objective and subjective effects that these had on the lives of individuals and groups². Within the framework established over recent decades, the pace of these new economic processes have required industries to function beyond normal daily working hours and so-called working days. Their employees are spread between shifts, that function 24 hours a day³. Although each company has its own way of organizing work timetables and routines, at the moment, shift work is defined as that which is performed out of normal working hours (which start at 8am or 9am; ending at 5pm or 6pm) or, even, as work that is performed continually for 24 hours by rotating work teams⁴.

The scientific literature suggests that shift work can influence the risk of developing chronic, non-communicable diseases (NCDs) including: obesity, cardiovascular diseases, metabolic syndromes and cancer⁵⁻¹⁰. The behavioral factors involved in the development of these disorders include lack of sleep, smoking, the consumption of alcoholic stimulants and changes in the food consumed by these workers¹¹. Some international studies show that shift work can affect the nutritional quality of a person's diet, as well as the frequency with which they consume certain foods (snacks, sweets, coffee)¹²⁻¹⁸. Concomitantly, an increase in the number of meals consumed, in particular snacks, or even skipping any main meal, has been indicated as a risk factor for diabetes mellitus¹⁹.

Meanwhile, in Brazil, studies on eating habits among shift workers are still scarce^{20,21}. Furthermore, the eating habits of workers can vary according to the type of activity they perform,

so that further studies are required to investigate different scenarios so as to better understand this relationship. Thus, the aim of this study is to investigate the influence that shift work has on the eating habits of workers at a slaughterhouse in southern Brazil.

Methods

A cross-sectional study was conducted using a sample of 1,206 workers, aged between 18 and 50 years old, of both sexes, from a refrigerated slaughterhouse in southern Brazil. This company was selected for reasons of convenience, and the interviews were conducted between January and May 2010 in the workers' own homes. This paper is part of the study "The relationship between shift work and excess weight and metabolic syndrome among workers at a poultry slaughterhouse in southern Brazil."

The size of the sample was calculated for the broader study (outcome of obesity and shift work exposure) based on the following assumptions: 95% confidence level; 80% statistical power, non-exposure ratio: exposure of 1:2 with a 1.30 risk ratio. The sample size was increased by 10% to compensate for possible losses or rejections, with 1,125 employees being required. Those considered to be vulnerable were nighttime shift workers; daytime shift workers were considered to be non-vulnerable. Pregnant women and employees who had not been to work for more than ten days during the research period were excluded from the survey.

This company employs 2,645 male and female workers, who live in the same municipality where the company's headquarters are based, or in the other six neighboring municipalities. For logistical reasons, such as distance and urban area location, all employees residing in the municipality where the company is based and in the two closest municipalities who work in the evisceration, gutting room and thermal processing sectors, were included in the study ($n = 1,270$). In all, there was a total of 64 losses and rejections, which left 1,206 workers to participate in the analyses. For the purpose of this study, a calculation was made of the a posteriori sampling power for the outcome of eating habit risk factors, the current sample size being capable of detecting differences of 30% between the vulnerable and non-vulnerable sections, with a power of 80. In the investigation involving demographic, socio-economic, work shift and eating habit char-

acteristics, a standard pre-codified and pre-tested questionnaire was used.

The demographic and socio-economic variables investigated were as follows: age, registered for each full year and divided into quintiles; skin color, as described by the interviewee and classified as Caucasian and non-Caucasian; marital status, as informed by the interviewee and categorized as being with a partner and without a partner; education, relevant to full years of study and classified as: first to fourth grade, fifth to eighth grade, incomplete secondary education, completed secondary or higher education; per capita family income, based on information provided about the income of each family member during the previous month and classified into quartiles.

Work shifts were classified as daytime and nighttime, in that vulnerable workers were considered to be those who spent more than 90% of their working time in night/early morning shifts (nighttime shift workers), in other words, those who begin their working day at 5pm. Non-vulnerable workers were those working daytime shifts who began their working day at 6am. The company's working hours are fixed, totaling 44 working hours per week with one day off, either on Saturday or Sunday.

Eating habits were classified as follows: the number and types of meals consumed during one typical working day; a rating system was established for dietary risk factors based on a person's normal weekly food consumption.

Information was collected about the meals and snacks consumed by the workers during a normal day (breakfast, morning snack, lunch, afternoon snack and nighttime snack), together with meal times. Based on this information, a classification was made of the number of meals consumed per day and the inappropriateness of meal times. In order to establish inappropriate meal times, cultural and physiological factors were taken into account. Thus, the following classification was used: an inappropriate breakfast was consumed outside the hours of 6am - 8:30am; an inappropriate morning snack was consumed outside the hours of 9am - 11am; an inappropriate lunch was outside the hours of 11am - 2pm; an inappropriate afternoon snack was consumed outside the hours of 3pm to 6pm; an inappropriate supper was consumed outside the hours of 6pm - 9pm; an inappropriate evening snack was consumed outside the hours of 8pm - 12pm.

The dietary risk score was established based on the risk factor classification for a normal

weekly consumption of thirteen different food items. This classification of a risk factor diet was based on the recommendations issued by the Dietary Guidelines for the Brazilian Population²². Ratings were given according to the nature of each food item, taking into account the way that information relating to its consumption was collected. In the case of food items measured using a quantitative rating system, these were divided into terciles, while all the others were measured according to their recommended intake.

Information about the consumption of beans, rice, cassava, sweets, soft drinks, cookies/crackers and sugar was calculated according to "days of the week" (varying between 0 and 7) and "times per day" (varying from 1 to 4). Thus, each food item was transformed into the "number of times it was consumed per week," the number of days being multiplied by the number of times consumed. Then the number of times/week was divided into terciles.

In the case of the consumption of fruit and greens/vegetables, this was recorded based on weekly consumption (every day; 5 or 6 days a week; 3 to 4 days a week; 1 or 2 days a week; never/almost never) and the number of portions consumed during one normal day (1 portion; 2 portions; 3 portions and 4 portions or more). Thus, these two items of information were transformed into the number of portions of fruit and greens/vegetables consumed per week, as follows: first, the frequency categories were transformed into continual variables (every day = 7; 5 to 6 days = 5.5; 3 to 4 days = 3.5; 1 to 2 days = 1.5; never/almost never = 0) and then multiplied by the number of portions. Then the number of portions/week was divided into terciles.

For food items considered as factors of healthy eating habits, a lower score (1) was given to consumers with the highest intake (T3), a medium score (2) for consumers with a moderate intake (T2) and a higher score (3) for consumers with the lowest intake (T1). For food items considered to be a risk factor, a higher score (3) was given to consumers who had the highest intake (T3), a medium score (2) for those with a moderate intake (T2) and a lower score (1) for consumers with the lowest intake (T1).

For all other food items - described below, the responses categories were rated according to the degree that the consumption recommendations were adhered to, that is: a higher score (3) was given to those who did not adhere to the recommendations; a medium score (2) to those who partially adhered; and a lower score (1) to those

who adhered to the recommended intake. Items with response options and their respective scores were as follows: consumption of red meat – fat removed (1); with fat (3), do not eat red meat (1); eat chicken – with skin removed (1), with skin (3), do not eat chicken (1); type of fat used in food preparation – lard (3), soya oil (1), sunflower oil (1), maize/corn oil (1), cottonseed oil (1), rapeseed oil (1), margarine (3), olive oil (1), don't know (3); consumption of fried food/processed meat – every day (3), 5 to 6 days/week (3), 3 to 4 days/week (3), 1 or 2 times/week (2), hardly ever/never (1).

Thus, the total score was obtained by adding the number of points given to each one of the thirteen food items. The lowest score was 13 points, representing the lowest score for dietary risk; and the maximum score was 39 points, indicating the highest score for dietary risk. The total number of points was divided into a tercile, a “dietary risk” rating being given to those workers who belong to tercile 3 (≥ 29 points) and the standard category rating refers to individuals with terciles 1 and 2.

Data input was conducted using the Epi Info 6.0 Program in duplicate, and the Stata version 11 program was used for the statistical data analysis. Variables were described by means of absolute and relative frequencies in the association test between socio-demographic variables, and a chi-squared test for heterogeneity was applied to shift workers.

The estimated for crude and adjusted prevalence ratios and respective confidence intervals of 95% were calculated by means of the Poisson regression method with robust variance – the Wald linear trend test was used to determine linear trends of association, in all other cases the Wald test was used for heterogeneity. Variables with a significance level of $p \leq 0.20$ in the crude analysis were considered as a potential confounding factor and taken to the multivariable model. A multi-variable test was conducted following the hierarchical concept model, where variables are grouped on the basis of distal and proximal association with the food consumption rating. Variables with a significance level of $p \leq 0.20$ were maintained in the subsequent level of analysis. Thus, the demographic variables (sex, age, skin color and marital status) were mutually adjusted (1st level); socio-economic variables (education and income) and work shifts were adjusted for demographics and mutually (2nd level). Associated factors were considered to be those that had a significance level less than or equal to 5%.

This project was submitted to and approved by the Research Ethics Committee of the University of Vale do Rio dos Sinos, Rio Grande do Sul, Brazil, in accordance with recommendations contained in Resolution 196/96²³.

Results

The final sample consisted of workers with an average age of 30.5 (DP: ± 8.7). Table 1 shows the demographic, socio-economic characteristics and the work shift sample included in this study. Most of the sample consisted of women (65%), those with partners (67%) and who had completed secondary education (48%). With respect to shift workers, 66% of these workers performed their activities at night (information not presented in the Table). Table 1 also shows that there was no significant association between socio-demographic variables and nighttime work.

Table 2 shows the crude and adjusted analyses of the demographic, socio-economic and shift work characteristics with their consumption risk factor ratings. It may be observed that, after adjusting the multivariable model, women had an 18% lower probability than men of a risk factor in their food consumption. The non-Caucasian workers had a 33% lower probability of presenting an outcome. Age presented an inverse relationship with food risk factors, in that individuals aged 40 and over had a nearly 50% lower probability when compared to younger men (aged 18 - 22). Education lost its statistical significance once the multivariable model had been adjusted.

Graph 1 shows the number and types of meals consumed during the day according to work shifts. It may be observed that a higher percentage of nighttime workers consumed three or four meals a day, compared to daytime workers. When analyzing the type of meal consumed, it was seen that nighttime workers show a greater incidence of afternoon snack and lunch consumption. On the other hand, daytime workers showed a higher prevalence of breakfast and nighttime snack consumption.

Graph 2 shows a prevalence of workers consuming their three main meals a day at inappropriate times. While in 74% of cases daytime workers ate supper at an inappropriate time, almost all nighttime workers consumed breakfast at an inappropriate time.

Table 1. Sample distribution and prevalence (CI 95%) of nighttime shift work according to demographic, socio-economic characteristics among workers in a refrigerated slaughterhouse in the South of Brazil (n = 1,206).

Variable	Nighttime shift			p-value*
	(n) %	%	(CI 95%)	
Sex				0.184
Male	(420) 35	68.81	(64.36 – 73.25)	
Female	(786) 65	65.01	(61.67 – 68.35)	
Age (years) Quintile				0.229
18 – 22	(251) 20.8	67.33	(61.49 – 73.17)	
23 – 26	(258) 21.4	71.70	(66.10 – 77.20)	
27 – 31	(218) 18.1	65.60	(59.24 – 71.95)	
32 – 39	(246) 20.4	62.60	(56.51 – 68.70)	
40 or more	(233) 19.3	63.94	(57.73 – 70.15)	
Skin color				0.131
Caucasian	(1008) 84	65.67	(62.73 – 68.61)	
Non-Caucasian	(195) 16	70.25	(63.79 – 76.73)	
Marital status				0.410
Without partner	(397) 33	64.73	(60.00 – 69.45)	
With partner	(809) 67	67.12	(63.88 – 70.36)	
Education (years) Quartile				0.673
1st to 4th grade	(212) 17.6	62.73	(56.17 – 69.30)	
5th to 8th grade	(311) 25.8	67.20	(61.95 – 72.45)	
Incomplete secondary education	(104) 8.6	67.31	(58.14 – 76.48)	
Completed secondary or higher education	(578) 48	67.12	(58.14 – 76.47)	
Family Income Quartile				0.092
I (R\$ < 1,015.00)	(295) 24.7	64.40	(58.91 – 70.00)	
II (R\$1,020.00 – 1,265.00)	(299) 25.1	63.88	(58.40 – 69.35)	
III (R\$1,268.00 – 1,610.00)	(303) 25.4	65.67	(60.30 – 71.05)	
IV (R\$ > 1,611.00)	(295) 24.7	72.54	(67.41 – 77.66)	

* Chi-squared Test for heterogeneity.

Discussion

This study investigated the relationship between shift work and the eating habits of workers at a slaughterhouse in southern Brazil. An association was found between shift work and the types of meals, frequency and times these were consumed. In addition, non-Caucasian, younger workers of the male sex showed a greater probability of presenting food consumption risk factors.

Nighttime workers habitually consume a higher number of meals per day than daytime workers. These findings may be due to the fact that these workers spent more time awake than daytime workers, and consume more snacks between main meals. Nighttime workers also show less prevalence of eating breakfast every day, probably because most of them are asleep when this meal is normally eaten.

Furthermore, when an investigation was made into the times when meals are consumed, it was seen that these were inappropriate, from a physiological and well as cultural point of view: only half the nighttime workers stated that they habitually ate breakfast and, among those who did so, in almost 100% cases, they did so at an inappropriate time.

In addition, the company offers its workers at least one full meal a day, but this meal is also offered at an inappropriate time. For workers who begin their working day in the early morning, a meal is provided at 9:30am, and at 3pm for those who begin working in the late morning, while a meal is provided at midnight for those who begin work in the afternoon.

Increasing the number of meals consumed during the day, as well as skipping breakfast or eating this meal at an inappropriate time, can represent important risk factors for the health of

Table 2. Crude and adjusted analyses for eating risk according to demographic, socio-economic and labor characteristics of shift workers in a refrigerated slaughterhouse in the south of Brazil (n = 1,206).

Variable	Crude Analysis			Adjusted Analysis		
	PR	CI 95%	p-value	PR	CI 95%	p-value
Sex			0.031*			0.015*
Male	1			1		
Female	0.83	(0.71 – 0.98)		0.82	(0.69 – 0.96)	
Age (years) Quintile			<0.001**			<0.001**
18 – 22	1					
23 – 26	1.05	(0.85 – 1.30)		1		
27 – 31	1.00	(0.80 – 1.26)		1.06	(0.85 – 1.31)	
32 – 39	0.68	(0.52 – 0.88)		1.00	(0.79 – 1.26)	
40 or more	0.50	(0.37 – 0.68)		0.67	(0.51 – 0.88)	
Skin color			0.107*	0.49	(0.35 – 0.67)	0.029*
Caucasian	1					
Non-Caucasian	0.82	(0.64 – 1.04)		1		
Marital status			0.118*	0.77	(0.61 – 0.97)	0.959*
Without partner	1					
With partner	0.87	(0.74 – 1.03)		1		
Education (years) Quartile			<0.001**	0.99	(0.84 – 1.20)	0.064**
1st to 4th grade	1					
5th to 8th grade	1.14	(0.84 – 1.54)				
Incomplete secondary education	1.45	(1.03 – 2.07)		1		
Completed secondary or higher education	1.58	(1.22 – 2.05)		0.92	(0.67 – 1.26)	
Family Income Quartile			0.522*	0.96	(0.66 – 1.40)	
I (R\$ < 1,015.00)	1			1.08	(0.80 – 1.44)	
II (R\$1,020.00 – 1,265.00)	0.95	(0.75 – 1.19)				
III (R\$1,268.00 – 1,610.00)	0.85	(0.67 – 1.08)				
IV (R\$ > 1,611.00)	1.11	(0.90 – 1.38)				
Shift Work			0.816*			
Daytime shift (from 6am to 2:15pm)	1					
Nighttime shift (from 2:16pm to 5:59am)	0.98	(0.82 – 1.16)				

* Values (missing information); * Wald Test for heterogeneity; ** Wald Test for linear trend.

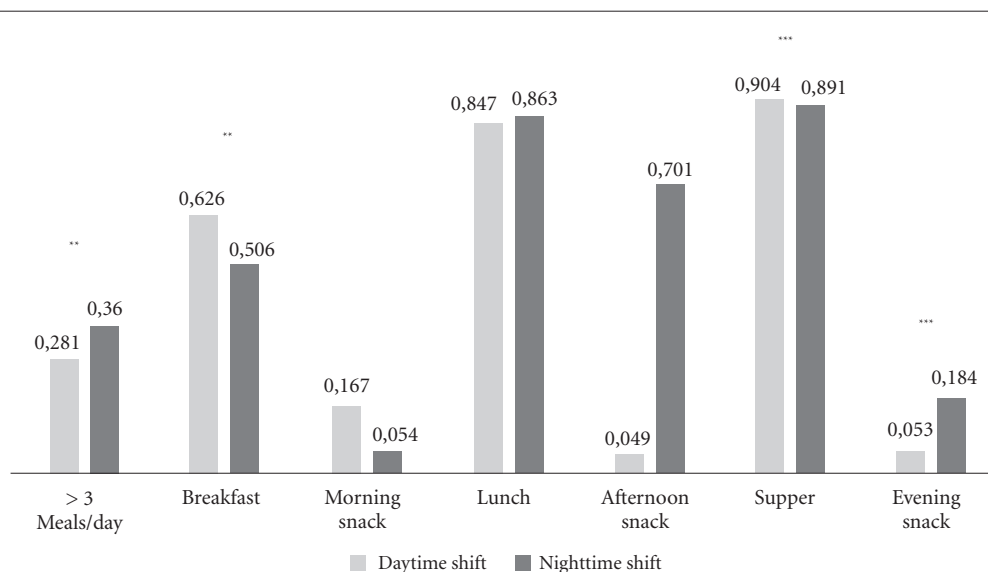
In the adjusted analysis, demographic variables (gender, age, skin color and marital status) were adjusted between each other; socio-economic variables (education and income) and shift work were adjusted for demographic variables and between each other.

these workers. A cross-sectional study, which involved 29,206 male American health professionals, showed that skipping breakfast was associated with an increased risk of type 2 diabetes in males, even after making an adjusted for BMI. The same study found a direct link between eating snacks between meals and the risk of developing type 2 diabetes, though this was based on their BMI¹⁹.

In addition, it is known that the circadian rhythm in human beings is regulated by central markers (the central nervous system) and peripheral markers (liver, muscular and adipose and pancreatic cells), and that these markers impose a 24-hour rhythmic pattern of behavior both in the form of metabolic processes (gluconeogenesis, cholesterol synthesis, insulin secretion), as well as behavioral patterns (sleeping and eating

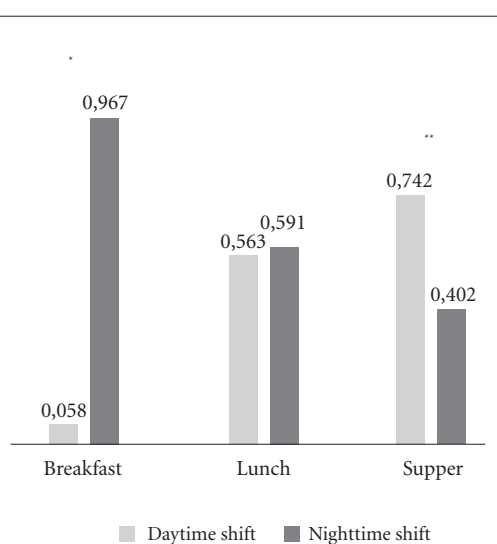
habits)²⁴. That is to say, the time chosen to have meals is not only determined socially, but is also a process that is genetically regulated to ensure that the food eaten favors a person's metabolism. Thus, it is understood that shift workers suffer from disrupted circadian rhythms, and as a result it is impossible for them to consume meals within a "physiologically programmed" timetable. The possible effects of this disruption are metabolic disturbances and even changes to their appetite²⁵.

The findings related to the standards of meal consumption found in this study, corroborate other findings in the available literature. Studies show that shift work affects the number of meals and times these are consumed rather than the overall content of a worker's diet^{14,25-27}. A French



Graph 1. Prevalence of the number and type of meals consumed throughout the day in accordance with the shift in workers in a refrigerated slaughterhouse in the south of Brazil (n = 1,206).

Caption: ** p < 0,01; *** p < 0,001.



Graph 2. Inadequate prevalence in meal times ** consumed throughout the day in accordance with the shift in workers in a refrigerated slaughterhouse in the south of Brazil (n = 1,206).

Caption: * p < 0,001; ** p < 0,05. *** considered inadequate when consumed other than at the following times: Breakfast from 6am to 8:30am; lunch from 11am to 2pm; supper from 6pm to 9pm.

nighttime workers averaged five or more meals a day, which was higher than the average consumed by daytime workers. However, nighttime shift workers ate breakfast and lunch less often than daytime workers who, in contrast, ate more snacks in between meals¹². Studies conducted by Sudo and Ohtsuka¹⁸ also found that shift workers showed a low level of adherence to breakfast, with over half of them stated they did not eat this meal.

Reasons given for alterations in the frequency and times shift workers consume their meals remain controversial. While Waterhouse et al.²⁸ showed that such changes were influenced more by habits and the time workers had available, rather than by alterations to their appetites, in an experimental study, Crispim et al.²⁹ indicated that nighttime shift workers had bigger appetites than day workers.

In this study, women showed less probability of presenting eating risk factors than men – it was also noted that the older a person is, the more this is likely to occur.

A study conducted among Norwegian shift workers confirmed the tendency among women to consume a better quality diet, including fruit and vegetables on a daily basis³⁰. In Japan, Kaneko et al.²⁵, using a scoring system, showed that women adopted a more healthy diet. Another study showed that men consumed low levels of healthy

study that investigated the number and types of meals consumed by shift workers, found that

foods, such as fruit and vegetables. However, after a multi-variable analysis, the proportion of workers who eat less than one portion of these foods per day was shown to be greater among younger workers, irrespective of their gender³¹. As well as this study, it should be mentioned that Olinto *et al.*³² had already found evidence, in a cross-sectional study conducted among young adults in southern Brazil, that women and non-Caucasians show a tendency to adopt healthier eating habits.

With respect to age, our finding showed that there is an inverse relationship with eating risk factors. This trend has been noted in several population studies³³⁻³⁵, although some were conducted with specific groups, such as samples that included only women³⁶. In Europe, Estaquio *et al.*³⁵ found greater adherence to healthy eating among older individuals. Similar results have been found in Brazil, which indicate that being older is directly associated with consuming more fruit, legumes and vegetables³³⁻³⁵. In contrast, Morikawa *et al.*¹⁷ showed that younger workers, aged between 20 and 29, had a total energy consumption that was lower than older workers (≥ 30 years of age).

We have also noted studies in the literature that suggest that individuals with a higher level of education tend to have healthier eating habits, consuming more fruit and vegetables and fewer industrialized foods^{30,36-38}. However, in our own study it was not possible to observe a relationship between education and food risk factors.

Finally, the fact that at least one main meal is eaten on company premises during working hours may be one of the reasons why it has been difficult to show any differences in the eating habit risk factors among nighttime and daytime shift workers. Thus, at least one daily meal is consumed under similar conditions in the case of all employees. Raulio *et al.*³⁹ stated, in their study, that the location where meals are consumed within a working environment can contribute towards the well-being and nutritional education of employees and can have significant effects on the health of workers.

Furthermore, it is worth mentioning that, in addition to the fact that there is a scarcity in Brazil of studies that investigate how shift work influences eating habits, this is the first study of its kind in the world that involves slaughterhouse

workers. Brazil is one of the four main pork and poultry producing and exporting countries in the world. This sector therefore generates jobs within the country, with an estimated five hundred thousand at poultry and pig slaughterhouses. At the same time, the media and the government have been denouncing the fact that workers in this sector suffer serious physical and mental illnesses, caused mainly by a combination of having to perform endless repetitive movements and working in a very low-temperature environment⁴⁰. These two factors can result in a greater demand for energy, which underlines the importance of studies related to the food consumption of these workers. In addition, shift work represents an occupational risk factor, which is generally neglected by studies involving this sector of society⁴¹, which affect the health and lives of these workers in ways that are still almost unknown in Brazil.

However, our finding should be interpreted in the light of some of its limitations. We know that there may be errors contained in records based on information gathered in the past, or on biased recollections. It should also be said that it was not the aim of this study to evaluate the consumption of nutrients, but rather to construct a scoring system based on several food products that form an important part of the dietary habits of these workers. In this sense, these scores have been used to characterize their eating habits, since they form a summary-measure of frequently consumed items of food. This score made it possible to group individuals into similar sections and to classify them according to established guidelines for diet risk factors^{42,43}.

This research study substantiated the relationship between the demographic characteristics of shift workers (gender, age and skin color), and their food habit risks, as well as show the different standards of meals consumed by these two groups of shift workers. Thus, our findings suggest the need to conduct further studies with workers in other sectors and thereby make it possible to extend our knowledge about the eating habits of workers, so that greater thought can be given to the changes being made within present-day working relationships, which include dealing with these types of precarious life-style habits.

Collaborators

ES Freitas and R Canuto took part in the analyses and interpretation of data and preparation of this manuscript. RL Henn contributed towards the project and overall outline as well as provided a critical review of the manuscript. BA Olinto and FM Busnello participated in the critical revision and final approval of the text to be published. JBA Macagnan contributed towards the project and overall outline and in data collection. MP Pattussi contributed substantially to the overall project outline. MTA Olinto is the coordinator of the project and overall outline, also researching data or analyzing and interpreting the same, and in providing a critical review and final approval of the text to be published.

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