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Meat consumption and racial/ethnic disparities in population-based study in the city Campinas, Brazil*

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The aim of the present study was to investigate meat consumption among adults residing in a city in the countryside of São Paulo, Campinas, according to ethnicity/skin color in two periods: 2008/2009 and 2014/2015, given the scarce literature on the subject. Thus, we sought to evaluate the association between race/color and consumption of meat, a food of great cultural value, based on the hypothesis that this demographic marker is relevant to explain food choices. A cross-sectional population-based study evaluating participants from the Health Survey of the City of Campinas (ISACAMP) was conducted in 2008/2009 and 2014/2015, with 2,354 and 1,606 individuals respectively, aged 20y or older. Food consumption data were collected using the 24-hour food recall method and meats were classified according to animal origin and type of processing. Linear regression models were run to assess the association between meat consumption and sociodemographic variables with a significance level of 5%. Lower total consumption of meat, red meat, beef and fish was found among individuals with self-declared black skin color compared to those with self-declared white skin color. Red meat consumption varied from 109.4g to 157.9g in 2008/2009 and from 102.1g to 125.1g in 2014/2015 between the groups, remaining above the recommendation in both periods. The World Cancer Research Fund recommends consuming between 50 and 71.4 g/day of red meat; thus, these findings reinforce the importance of studies that investigate the impact of ethnicity on food consumption, since racial disparities may be in the origin of the insufficient or excessive consumption of certain types of meat, and understanding the factors associated with the consumption of types of meat is relevant for the adoption of health actions aimed at adequate food intake.

Keywords: Meat. Food consumption. Diet. Ethnicity. Animal products.

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Introduction

Despite the recognized nutritional contribution of food products of animal origin (Astrup *et al.*, 2020; World Cancer Research Fund; American Institute for Cancer Research, 2007) the International Agency for Research on Cancer of the World Health Organization categorizes red meat as "probable carcinogenic" and processed meat as "carcinogenic" for humans (Bouvard *et al.*, 2015). The Food Guide for the Brazilian Population and the report of the EAT-Lancet Commission state that eating patterns with small quantities of red and processed meats can provide considerable health and environmental benefits, such as reducing greenhouse gases, deforestation, intensive water use and diseases such as cardiovascular disease and cancer (Brasil, 2014; Willett *et al.*, 2019).

Various recommendations advised reducing meat consumption, such as the World Cancer Research Fund's recommendation of 50 to 71.4 g/day of red meat and little or no processed meat (World Cancer Research Fund / American Institute for Cancer Research, 2018). Studies linking meat consumption and health are essential for drawing up nutritional guidelines, but gaps and difficulties have been identified in these studies (Astrup *et al.*, 2020; Klurfeld, 2015).

Epidemiological studies have associated meat consumption with chronic diseases, but most observational studies have reported small increased risks and presented limitations to the reliability of the results. These include the difficulty in estimating consumption accurately, the lack of pre-specified hypothesis, confounding factors such as body weight, fruit and vegetable intake, physical activity, and smoking, alcohol use, chronic diseases and cancer, which correlate significantly positively or negatively with meat intake. For this reason, the most conservative recommendation has been to indicate a moderate consumption of these foods, through a diversified diet, and in small portions (Astrup *et al.*, 2020; Klurfeld, 2015).

In addition to analyzing the relationship between meat consumption and health outcomes, several studies have evaluated the influence of sociodemographic factors such as gender, age group, place of residence (urban or rural), country region, schooling and income, which have been studied as factors associated with dietary patterns. The least explored sociodemographic fraction in studies on diet-related disparities is ethnicity, with ethnic groups facing disparities in health care and disease prevention (Satia, 2009).

When considering ethnicity/skin color, differences have been found in meat consumption (Guenther *et al.*, 2005; Wang *et al.*, 2010; Zeng *et al.*, 2019) and acquisition by type of meat (Coelho; Aguiar; Fernandes, 2009). It was also observed that black, brown and indigenous individuals suffer a greater impact from inequalities in diet quality (De Mello *et al.*, 2018).

Populations from racial or ethnic minority groups in the US are more susceptible to ethnic disparities related to diet as observed by Satia, who presents data indicating that a poor diet, with high consumption of fats, small amounts of fruits, vegetables and whole

grains and high salt consumption is related to these minority groups, defined as blacks or African-Americans, Hispanics, Asians and American Indians/Alaska Natives (Satia, 2009).

These disparities can affect food – and consequently meat – consumption, reflecting the situation of food and nutritional security, which "consists of the realization of everyone's right to regular and permanent access to quality food, in sufficient quantity, without compromising access to other essential needs, based on health-promoting dietary practices that respect cultural diversity and are environmentally, culturally, economically and socially sustainable" (Brasil, 2006).

Other factors such as the presence of residents under the age of 18, the number of residents, the sex or race of the head of the household, and household income are socioeconomic variables and characteristics of the composition of household residents related to the presence of food insecurity in Brazilian households and can compromise meat consumption (IBGE, 2020; Salles-Costa, 2018; Santos, 2018).

The recognition of sociodemographic variables constitutes a complex network that contributes to the identification of factors determining food consumption; in the Brazilian population it is important to consider the social and economic inequalities in food and nutrition associated with ethnicity. Therefore, the aim of this study was to identify meat consumption according to ethnicity/skin color in two periods: 2008/2009 and 2014/2015.

Methods

Population study

We conducted a cross-sectional study employing secondary data from the 2008-2009 (from February 2008 to Abril 2009) and 2014-2015 (from December 2013 to August 2015) Campinas Health Surveys and Campinas Food Intake and Nutrition Surveys. Data were collected from male and female community-dwelling individuals residing in urban areas of the city of Campinas, Brazil, and organized into three age groups: adolescents (10 to 19 years), adults (20 to 59 years) and seniors (60 years or older) (WHO, 2003). More details about sampling are available on the study website (Alves, 2009, 2015). In this study, only data from adults and seniors were considered.

For both studies, data were obtained from individuals who lived in the urban area of the city of Campinas between February 2008 and April 2009 and December 2013 and August 2015, of both sexes and not institutionalized; food consumption data correspond to the period 2008-2009 and 2014-2015.

Taking into account the maximum variability of the frequencies of the outcomes of interest (p=0.50), 95% confidence level, sampling error between 4 and 5 points and design effect (deff) of 2, independent samples of 1,000 people were drawn in each domain. In order to obtain the desired sample size, an expected non-response rate of 20% was established, and households were randomly selected for data collection with participants from the two

age groups – adults and the elderly, respectively, in 50 census tracts in 2008-2009. In 2014-2015, the expected 22% and 20% non-response rates were considered for adults and the elderly, respectively, in 70 census tracts. The person/household ratio in each age group was used to estimate the number of families.

Data collection and assessment of food intake

Data collected from interviewees were recorded on a questionnaire organized into 14 topics in print form previously tested in a pilot study in 2008, and 13 topics in 2014 with the aid of an electronic device (tablet). Demographic, socioeconomic and lifestyle information was collected, as well as information on the use of health services and morbidities, among others. The questionnaires were administered by trained, supervised interviewers. In 2008, the topic on dietary assessment included a food frequency questionnaire (FFQ), self-reported weight and height and a 24-hour recall (24hR). In 2014, a specific questionnaire on nutrition was used, with the evaluation of food intake (24hR and FFQ) and nutritional status (weight, height and waist circumference).

The 24hR was collected using the Multiple-Pass Method (MPM), according to the protocol proposed by the US Department of Agriculture; the use of the MPM has helped to reduce the error in estimating food consumption, as it provides a strategy that facilitates the response by the participant (Steinfeldt; Anand; Murayi, 2013). This method is based on a structured interview in five phases: a quick list; questioning about frequently forgotten foods; naming the time and place of meals; a detailed cycle of each food consumed, including preparation methods, composition of preparations, type of food and respective quantities; and a final review of the foods consumed and reported. Interviews were collected covering different months and week days.

Data from the 24-hour dietary recalls were entered into the Nutrition Data System for Research – NDS-R software, versions 2007 and 2015 (NCC Food and Nutrient Database, Universidade de Minnesota, Minneapolis, MN, EUA). The ISACamp-Nutri and ISACamp 2008-2009 and 2014-2015 questionnaires were entered into a database using EpiData software version 3.1 (EpiData Assoc., Odense, Denmark).

The data were quantified in units of weight and volume (grams or milliliters) (Fisberg; Slater Villar, 2002; Pinheiro *et al.*, 2005) and processed using the Nutrition Data System for Research, versions 2007 and 2015 (NCC Food and Nutrient Database, University of Minnesota, Minneapolis, MN, USA). This software uses data from the main food composition database in the United States, the USDA National Nutrient Database for Standard Reference, and was chosen because it contains a wide variety of foods (more than 18,000) and product brands (7,000), making it possible to generate specific databases for analysis focused on the consumption of food, nutrients and meals per individual. Another advantage is the possibility for users to add culinary preparations to a recipe file, stored separately from their database, making it possible to include regional foods/preparations.

The questionnaires of the 2008-2009 and 2014-2015 Campinas Health Surveys and Campinas Food Intake and Nutritional State Surveys were entered into a databank created with the EpiData program, version 3.1 (EpiData Assoc., Odense, Denmark).

Study variables

Meat was classified according to animal origin and type of processing: beef, poultry, pork, fish, innards, sheep and processed meat (meat of any origin submitted to industrial processing, such as wiener, sausage, hamburger, nuggets and luncheon meat). Consumption was analyzed in total and by type: red (beef, pork, innards and sheep), poultry, fish and processed. Median consumption (g/day) was calculated according to the categories of the following independent variables: a) demographic – sex, age group (20-59, 60 years or older), self-reported ethnicity/skin color (white, black, brown, yellow/indigenous/other); b) socioeconomic – schooling (0-7, 8-11, 12 or more years of study), employment status (employed, unemployed), marital status (with or without a spouse) and monthly family income *per capita* (categorized in tertiles).

The variables selected took into account the various studies carried out using data from the Health Surveys of the Municipality of Campinas – ISA-Camp, which sought to investigate which sociodemographic variables could relate to food and/or nutrient consumption, such as age, income, race/skin color, marital status, schooling, among others (Assumpção, 2017; Carvalho, 2020; Pereira, 2021; Silva, 2021). In addition, economic, demographic, social, nutritional and cultural factors can strongly influence dietary patterns (Cardoso, 2016), including meat consumption.

To assess income, in 2008, the Socioeconomic Characteristics block – block M of the main field questionnaire, included information on the net income of interviewees in the previous month and the Family and Household Characteristics block – block N, information on the net income of each family member in the previous month. In 2014, in the Socioeconomic Characteristics block – block L, in addition to information on net income in the previous month, the average net income of the previous month was recorded in minimum wages (less than 1 minimum wage, between 1 and 2 minimum wages, between 3 and 4 minimum wages, between 5 and 9 minimum wages; between 10 and 20 minimum wages, and above 20 minimum wages). In block M – Family and Household Characteristics, information was collected on the net income of each family member in the previous month, net income, average net income of the family in the previous month in minimum wages (less than 1 minimum wage, between 1 and 2 minimum wages, between 3 and 4 minimum wages, between 5 and 9 minimum wages; between 10 and 20 minimum wages, and above 20 minimum wages).

Data analysis

Food intake data were considered on 2354 individuals in 2008-2009 and 1606 individuals in 2014-2015, 148 and 117 of whom were excluded, respectively, for having an implausible total energy intake (‹ 800 or › 4000 kcal/day for men and ‹ 500 or › 3500 kcal/day for women) (Willett, 2013). Furthermore, 882 and 856 adolescents were not included in 2008-2009 and 2014-2015, respectively.

Meat consumption (g/day) was adjusted for energy intake (kcal/day) using the residual method (Willett, 2013). Median and interquartile range of meat consumption were then calculated for the self-reported ethnicity/skin categories in both periods. Linear regression was conducted for modelling the relationship between dependent variable (total meat, red, poultry, fish and processed consumption) and independent variable (self-reported ethnicity/skin). All models were adjusted for covariates such as sex, age group, schooling, income, employment, marital status and interaction between self-reported ethnicity/skin and schooling. Statistical analyses were performed after processing in the Stata program, version 15.0 (Stata Corp., College Station, USA), using the survey data commands (svy prefix command), which considers sampling weights and sampling design. A 5% significance level was considered for all statistical analyses.

Ethical procedures

The Campinas survey studies received approval from the Research Ethics Committee of the Faculty of Medical Sciences of the State University of Campinas. All procedures were performed after agreement from the volunteer to participate in the study by signing a statement of informed consent. The present study received approval from the Research Ethics Committee.

Results

In both surveys, (2008-2009 and 2014-2015) interviewees were mostly white (74.1% and 73,1%), women (53.6% and 59.3%) with eight to eleven years of schooling (54.9% and 50%, respectively) (Table 1).

TABLE 1
Characteristics of the population, according to demographic and socioeconomic variables and period of research
Campinas – 2008-2009 and 2014-2015

Variables	2008-2009 % (CI: 95%)*	2014-2015 % (CI: 95%)*
Sex		
Male	46.4 (43.75-49.04)	40.7 (37.58-43.95)
Female	53.6 (50.96-56.25)	59.3 (56.05-62.42)
Age group (years)		
20-59	83.5 (81.00-85.81)	73.1 (69.69-76.19)
› 60	16.5 (14.19 -19.00)	26.9 (23.81-30.31)
Ethnicity/skin color		
White	74.1 (68.11-79.37)	68.1 (62.69-73.02)
Black	8.34 (5.87-11.73)	7.68 (5.79-10.11)
Brown	16.7 (12.90-21.40)	22.3 (17.98-27.27)
Yellow / indigenous groups / others	0.80 (0.31-2.01)	1.97 (1.28-3.01)
Education (in years)		
0-7	22.9 (19.20-27.07)	24.1 (20.86-27.73)
8-11	54.9 (48.55-60.86)	50.0 (45.59-54.41)
12 and over	22.3 (14.89-32.08)	25.9 (20.70-31.81)
Marital status		
Married / living with someone	60.94 (56.96-64.78)	57.87 (53.64-62.00)
Single / divorced / widowed	42.13 (38.00-46.36)	42.13 (38.00-46.36)
Occupation		
Employed	35.76 (32.67-38.97)	41.99 (38.22-45.86)
Unoccupied	64.24 (61.03-67.33)	58.01 (54.14-61.78)

Source: Health Survey of the City of Campinas (ISACAMP).
*CI 95% = Confidence interval 95%.

We estimated meat consumption considering the animal origin: beef, pork, fish, and poultry (Table 2). The highest median consumption was found to beef, except for individuals with self-reported black skin, and the lowest median consumption was found to fish, for the whole population. The individuals with self-reported black skin had the highest median consumption of poultry.

TABLE 2
Meat consumption (g/day) according to self-reported ethnicity/skin color
Campinas – 2008-2009 and 2014-2015

Meat types	2008-2009		2014-2015	
	Median	IQR	Median	IQR
Total meat				
Withe	159.7	112.5	155.0	104.4
Black	158.5	95.8	169.5	107.5
Brown	158.4	105.5	155.8	96.5
Yellow / indigenous groups / others	216.1	92.6	152.2	155.5
Red meat				
Withe	115.0	95.9	103.0	78.3
Black	109.4	96.3	102.1	92.7
Brown	111.2	102.5	114.3	73.2
Yellow / indigenous groups / others	157.9	59.7	125.1	94.0
Processed meat				
Withe	46.0	62.2	53.4	53.8
Black	53.9	73.6	65.6	66.9
Brown	53.2	52.6	62.6	47.8
Yellow / indigenous groups / others	33.9	38.6	61.4	47.3
Beef				
Withe	110.2	95.5	96.4	77.4
Black	91.7	92.1	101.8	79.3
Brown	104.1	104.2	113.0	68.8
Yellow / indigenous groups / others	157.4	63.4	125.5	74.7
Poultry				
Withe	101.0	81.9	106.2	83.0
Black	115.0	123.1	132.1	117.6
Brown	98.3	90.4	118.7	96.1
Yellow / indigenous groups / others	109.8	9.5	187.4	129.2
Fish				
Withe	68.4	152	133.8	138.4
Black	24.6	50.9	185.6	94.0
Brown	48.2	72.8	117.3	89.0
Yellow / indigenous groups / others	12.6	113.0	140.9	147.1
Pork				
Withe	105.7	107.2	96.4	69.0
Black	102.5	130.9	101.2	110.0
Brown	83.9	113.8	100.4	70.4
Yellow / indigenous groups / others	113.8	76.1	152.7	129.4

Source: Health Survey of the City of Campinas (ISACAMP).
IQR: Interquartile range.

Lower total meat, red meat, beef and fish consumption was found among individuals with self-reported black skin color compared to those with self-reported white skin color in 2008-2009 ($p < 0.05$; Tables 3). Higher red meat, total meat, beef and pork consumption was found among yellow/indigenous/other individuals compared to white individuals in 2008-2009; the same for poultry in 2014-2015 ($p < 0.05$; Table 3).

When analyzing meat consumption by race/color and schooling, a difference was observed in 2008-2009 for the consumption of total meat, red meat, beef, fish and pork, but in 2014-2015 it was only observed for poultry (p <0.05; Table 3).

TABLE 3
Consumption of total meat, red meat, processed meat and beef, according to self-reported ethnicity/skin color Campinas – 2008-2009 and 2014-2015

Models1	2008-2009				2014-2015			
	β	P-value	CI 95%		β	P-value	CI 95%	
Total meat								
White								
Black	-44.59	**0.013**	-79.26	-9.91	-11.93	0.375	-38.60	14.74
Brown	-16.14	0.093	-35.08	2.81	5.04	0.438	-7.86	17.93
Yellow / indigenous groups / others	-24.33	**0.023**	-45.19	-3.48	49.73	**0.022**	7.34	92.12
Ethnicity/skin color x schooling								
Black x 8-11 years	2.37	0.222	-18.36	77.10	32.90	0.168	-14.25	80.05
Black x 12 years or more	38.15	0.267	-30.12	106.42	28.65	0.169	-12.46	69.76
Brown x 8-11 years	16.50	0.189	-8.42	41.41	-1.33	0.889	-20.24	17.58
Brown x 12 years or more	-4.23	0.916	-83.89	75.44	19.46	0.499	-37.78	76.70
Yellow / indigenous groups / Others x 8-11 years	153.59	**0.000**	102.10	205.08	26.29	0.646	-87.57	140.16
Yellow / indigenous groups / others x 12 years or more	46.03	**0.004**	15.87	76.20	-37.37	0.186	-93.19	18.45
Red meat								
White								
Black	-47.73	**0.004**	-79.48	-15.97	6.51	0.612	-18.97	31.99
Brown	-16.98	0.196	-43.01	9.05	-0.29	0.972	-16.68	16.11
Yellow / indigenous groups / others	-21.18	0.119	-47.98	5.63	-3.75	0.926	-84.26	76.76
Ethnicity/skin color x schooling								
Black x 8-11 years	34.39	0.174	-15.73	84.51	-17.54	0.402	-59.06	23.98
Black x 12 years or more	45.79	0.234	-30.61	122.20	12.43	0.610	-35.95	60.80
Brown x 8-11 years	9.59	0.597	-26.68	45.87	-1.39	0.899	-23.15	20.38
Brown x 12 years or more	14.24	0.626	-44.01	72.49	60.83	0.190	-31.02	152.69
Yellow / indigenous groups / others x 8-11 years	110.56	**0.001**	48.23	172.89	13.27	0.710	-57.84	84.39
Yellow / indigenous groups / others x 12 years or more	58.24	**0.013**	12.67	103.82	63.75	0.227	-40.56	168.07
Processed meat								
White								
Black	8.61	0.588	-23.08	40.29	12.03	0.358	-13.92	37.98
Brown	-14.87	0.222	-39.01	9.26	18.56	0.062	-0.94	38.06
Yellow / indigenous groups / others	14.72	0.397	-19.87	49.31	3.68	0.676	-13.83	21.18
Ethnicity/skin color x schooling								
Black x 8-11 years	-2.50	0.901	-42.56	37.55	-6.98	0.757	-51.90	37.94
Black x 12 years or more	18.50	0.680	-70.99	107.99	4.94	0.812	-36.34	46.22
Brown x 8-11 years	6.32	0.613	-18.61	31.25	-26.30	**0.014**	-47.02	-5.58
Brown x 12 years or more	3.66	0.821	-28.77	36.10	14.10	0.468	-24.54	52,74
Yellow / indigenous groups / others x 8-11 years	0				-26.29	0.236	-70.16	17.59
Yellow / indigenous groups / others x 12 years or more	-22.40	0.269	-62.64	17.83	-30.40	**0.022**	-56.22	-4.58

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(continued)

Models1	2008-2009				2014-2015			
	β	P-value	CI 95%		β	P-value	CI 95%	
Beef								
White								
Black	-48.11	**0.001**	-75.58	-20.64	7.46	0.634	-23.68	38.60
Brown	-22.21	0.076	-46.79	2.37	2.62	0.761	-14.55	19.79
Yellow / indigenous groups / others	-10.98	0.328	-33.31	11.35	-5.26	0.903	-90.90	80.37
Ethnicity/skin color x schooling								
Black x 8-11 years	30.62	0.192	-15.85	77.10	-14.28	0.523	-58.68	30.12
Black x 12 years or more	46.92	0.325	-47.90	141.73	24.74	0.388	-32.12	81.60
Brown x 8-11 years	20.60	0.257	-15.53	56.74	1.92	0.870	-21.39	25.23
Brown x 12 years or more	19.40	0.568	-48.33	87.13	76.12	0.101	-15.29	167.52
Yellow / indigenous groups / others x 8-11 years	124.90	0.107	-27.79	277.59	28.64	0.441	-45.17	102.45
Yellow / indigenous groups / others x 12 years or more	64.20	**0.001**	29.59	98.81	74.08	0.175	-33.86	182.02
Poultry								
White								
Black	20.16	0.251	-14.72	55.04	-16.67	0.484	-64.02	30.68
Brown	6.33	0.606	-18.16	30.81	1.47	0.920	-27.69	30.63
Yellow / indigenous groups/ others	3.10	0.913	-53.44	59.64	51.67	0.078	-5.95	109.29
Ethnicity/skin color x schooling								
Black x 8-11 years	-30.86	0.232	-82.08	20.36	57.23	**0.049**	0.33	114.14
Black x 12 years or more	13.79	0.834	-117.53	145.12	14.69	0.685	-57.27	86.65
Brown x 8-11 years	-0.39	0.982	-35.49	34.71	30.78	0.177	-14.32	75.88
Brown x 12 years or more	17.22	0.673	-64.36	98.81	7.69	0.812	-56.56	71.93
Yellow / indigenous groups / others x 8-11 years	5.83	0.867	-63.73	75.40	72.12	0.055	-1.57	145.81
Yellow / indigenous groups / others x 12 years or more	-9.73	0.771	-76.45	56.98	-82.15	0.081	-174.70	10.40
Fish								
White								
Black	-124.28	**0.008**	-214.09	-34.48	-79.48	0.080	-169.03	10.07
Brown	-87.86	**0.007**	-150.72	-25.00	18.17	0.601	-51.46	87.79
Yellow / indigenous groups/ others	-149.80	**0.000**	-221.48	-78.13	-20.40	0.659	-112.98	72.17
Ethnicity/skin color x schooling								
Black x 8-11 years	81.55	0.108	-18.61	181.70	194.02	0.001	83.17	304.86
Black x 12 years or more	35.30	0.477	-63.76	134.35	32.14	0.551	-75.70	139.97
Brown x 8-11 years	72.91	0.118	-19.14	164.96	-19.86	0.595	-94.72	54.99
Brown x 12 years or more	-10.89	0.774	-86.70	64.91	-146.05	**0.012**	-257.65	-34.44
Yellow / indigenous groups / others x 8-11 years	227.76	**0.000**	108.95	346.57	0			
Yellow / indigenous groups / others x 12 years or more	7.90	0.833	-67.12	82.92	-94.67	0.096	-206.93	17.59
Pork								
White								
Black	-25.17	0.358	-79.84	29.50	-19.63	0.281	-55.85	16.59
Brown	-20.15	0.726	-135.36	95.07	-26.39	0.420	-91.64	38.87
Yellow / indigenous groups / others x 8-11 years	-80.40	**0.047**	-159.85	0.94	54.70	0.170	-24.39	133.80

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Models1	2008-2009				2014-2015			
	β	P-value	CI 95%		β	P-value	CI 95%	
Ethnicity/skin color x schooling								
Black x 8-11 years	25.44	0.601	-72.07	122.95	-9.21	0.756	-68.51	50.09
Black x 12 years or more	-14.99	0.750	-109.26	79.28	61.99	0.189	-31.52	155.49
Brown x 8-11 years	11.66	0.850	-112.10	135.42	1.88	0.963	-79.09	82.85
Brown x 12 years or more	56.12	0.302	-52.19	164.42	-36.94	0.331	-112.69	38.81
Yellow / indigenous groups / others x 8-11 years	169.88	**0.006**	51.89	87.87	-154.51	**0.000**	-209.40	-99.62
Yellow / indigenous groups / others x 12 years or more	101.68	0.051	-0.65	204.01	0			

Source: Health Survey of the City of Campinas (ISACAMP).
Note: All models were adjusted for other covariates such as gender, age group, education, income, occupation and marital status. In bold p-value ‹ 0.05.
Variation in the minimum wage: 2008/2009: R$ 380.00 to R$ 465.00 (February 2008 - R$ 380.00; March 2008 to January 2009 - R$ 415.00; February to April 2009 - R$ 465.00). 2013/2015: R$ 678.00 to R$ 788.00 (December 2013 - R$ 678.00, January to December 2014 - R$ 724.00; January to August 2015 - R$ 788.00) (Source: DIEESE, 2024).

Discussion

In the present study, total meat, red meat, beef and fish consumption was lower among individuals with self-declared black skin color in 2008-2009, but this difference was not found in 2014-2015. Brown individuals consumed less fish, and yellow/indigenous individuals consumed less total meat, fish and pork, compared to the other groups in 2008-2009. In 2014-2015, lower consumption of total meat was observed among yellow/indigenous groups/others, which represented 0.80% of those interviewed. Despite the possibility that these groups have cultural characteristics that may influence meat consumption, the data were not disaggregated due the small number of individuals.

A study that analyzed data from the 2017-2018 POF found higher consumption of poultry among brown individuals compared to whites [6.2% (95%CI 6.0-6.3)] and higher absolute consumption of fish by indigenous people (2.2%) (Costa *et al.*, 2023). The higher consumption of meat among the yellow population and fish among indigenous people is attributable to sociocultural practices (Costa *et al.*, 2023).

Data from the 2002/2003 Brazilian Household Budget Survey on the marginal effects of variables indicative of the ethnicity of the head of the household revealed that black and brown individuals were more likely to acquire less expensive beef (known as “second rate”) and a negative probability of consuming “first rate” beef, whereas yellow individuals had a greater probability of acquiring “first rate” beef (Coelho; Aguiar; Fernandes, 2009). The consumption of “first rate” or “second rate” beef may be related to income. In the present study, beef was less consumed by black individuals in 2008-2009, but without difference between ethnic groups in 2014-2015; however, the commercial classification (first or second rate) of beef was not considered. It would be useful to identify variables related to the consumption of second-rate meat among individuals with self-declared black ethnicity/skin color, as consumption recommendations are the same, despite price differences.

Although Brazil is one of world's largest producer of meat, low income and poverty affect food intake, including meat consumption, and demonstrate the structural racism found in Brazil. Black and brown populations have the worst social indicators in the country, facing unequal situations regarding the job market and income (IBGE, 2020b).

Meat consumption is related to food security, as shown by the 2017-2018 Household Budget Survey, which presents data on annual *per capita* household purchases (kg) of meat and fish; data show that in households with food security (FS) the purchase was 23.2 kg and 2.4 kg, respectively, while in households with mild, moderate and severe food insecurity it was 18.05 kg, 16.9 kg and 14.5 kg for meat and 2.9 kg, 3.96 kg and 5.2 kg for fish (IBGE, 2020a). Higher fish purchases among individuals with higher levels of food insecurity are related to the place of residence and country region, being higher in rural areas and in the North, which has higher fish purchases due to geographical and cultural reasons, and the highest levels of FI (IBGE, 2020a).

In the II National Survey of Food Insecurity in Brazil in the Context of Covid-19 (II VIGISAN), which assessed the amount of food purchased in the three months prior to the interview, it was found that in households with severe or moderate FI, 39.4% reduced their purchase of meat and 70.4% of households with severe or moderate FI did not buy meat in the last 3 months, and this same study identified that the proportion of FI was higher in households with black or brown heads of household (Rede PENSSAN, 2022).

The change in meat consumption found among black individuals coincides with changes in the prevalence of food insecurity (FI) in the period, which differs according to the color or ethnicity of the person interviewed. In 2009 and 2013, the prevalence of FI was 43.4% and 33.4%, respectively, among black and brown residents, higher than rates found among whites in the same years (24.6% and 17.2%, respectively) (IBGE, 2010, 2014).

Ethnicity/skin color is one of the markers of social inequality (Malta; Moura; Bernal, 2015). Despite progress in Brazil, such as a greater increase in average income *per capita* in the black population compared to the white population, black and brown individuals still account for the majority of the low-income population (IPEA, 2011). In 2009, the average income of blacks corresponded to 55% of the income of whites (IPEA, 2011). In 2019, the income of the employed white population was, on average, 73.4% higher than that of the black or brown population (IBGE, 2020b). Among the 10% wealthiest individuals in 2009, only 24% were black. In contrast, blacks accounted for nearly three-quarters (72%) of the poorest 10% of the population. Inequalities were also significant among the extremely poor (5.2% of the population), with 7.2% composed of blacks and 3% composed of whites (IPEA, 2011). Data from the 2013 National Household Survey on the distribution of income indicate that among the poorest 10% of the population, 14.1% were black and 5.3% were white (BRASIL, 2016).

Black and brown groups still live in situations of income and work inequality, and consequently have the worst social indicators (IBGE, 2020d). The prevalence of FI changes

according to color or race of the reference person in the residence, as can be seen in the 2009 and 2013 surveys: FI was 43.4% and 33.4%, respectively, among black or brown residents, higher than that observed among whites, 24.6% and 17.2% for the same years. (IBGE, 2014, 2010). Although Brazil has experienced progress, such as the greater increase in average *per capita* income among the black population than among the white population in 2009, the population group that still lives with the lowest income largely consisted of black or brown individuals (IPEA, 2011).

In 2014, the likelihood of black and brown individuals being poor was respectively 2.1-fold and 2.6-fold greater compared to whites. This was a reduction compared to 2004, when these values were greater: 2.5-fold and 3.2-fold, respectively. While it cannot be stated that the reduction in the racial inequality of poverty was due to the reduction in the consequences of these inequalities among black and brown individuals, this reduction may be related to job market performance, the increase in the minimum wage, advances in monetary transfers, demographic variations, improvements in the level of schooling among laborers and a reduction of regional inequalities (Osorio, 2019).

It is interesting to note that the analysis of racial inequality income based indicators for the period 1986-2019, produced based on the National Household Sample Survey (PNAD) shows that, in the period, this disparity decreased insignificantly and may be related to the increase in self-declaration of race/color among black or brown individuals with higher income levels (Osorio, 2021). According to the author, among whites, average income remains double that observed among black individuals.

A study carried out by de Mello *et al.* (2018) investigated the implications of the determinants of inequalities in diet quality in the city of São Paulo, Brazil, in 2003, 2008 and 2015; the authors found that ethnicity was the main contributor to inequality in diet quality in 2003, replaced by income in 2008 and 2015.

Data from surveys conducted during the COVID-19 pandemic indicate an increase in severe FI in households with a white reference person, from 6.8% in 2020 to 10.6% in 2021/2022, but the prevalence were higher in households with a black reference person, going from 10.4% to 18.1%. Accordingly, food security is also influenced by the race of the reference person in the household, with an increase in FS among whites, from 49.7% to 53.2%, and a reduction among blacks and browns, from 41.5% to 35%. When comparing income ranges, food security and race/color of the reference person in the household, it was observed that when the reference person was black or brown, the prevalence of FS was lower in households with monthly incomes above 1 minimum wage *per capita* (SMPC), despite higher prevalences of FS being observed in households in this income range (Rede PENSSAN, 2022).

The relationship between meat consumption and sociodemographic variables has also been observed in other countries. A study on red and processed meat consumption patterns in North America used data from nationally representative cross-sectional surveys

and found that the prevalence of total meat consumers was higher in the United States than in Canada or Mexico; the study also showed greater consumption of unprocessed, processed and total red meat among men, who also had higher estimated intakes. Higher income was related to higher consumption of all meat categories in Mexico, while in the US and Canada, higher educational level was related to lower predisposition to consume total and processed meat (Frank *et al.*, 2021).

Meat consumption is also related to the location of the household in Mexico, being more common in urban populations; however, among poorer individuals, lower intake of animal proteins is related to the consumption of healthier and more traditional foods. (Guibrunet *et al.*, 2023).

A study conducted in the United States on differences in meat consumption related to ethnicity/skin color, found an increase among African Americans in the consumption of processed meats, especially fried fish, cheaply available at fast food restaurants and convenience stores (Zeng *et al.*, 2019). Understanding the contribution of meat to the diet is a complex task, and evidence suggests that consumers of pork and beef and consumers of chicken have different knowledge and attitudes regarding diet and health. Moreover, sociodemographic variables are strong predictors of the likelihood of choosing meat products and the quantities consumed (Guenther *et al.*, 2005). These authors observed that individuals in higher-income households consumed more chicken and those in lower-income families consumed more processed pork products. Higher levels of education were associated with a lower chance of beef and pork consumption, and individuals who consumed these meats were more likely to have a high-fat diet. Ethnicity is a sociodemographic variable already associated with meat consumption. Guenther *et al.* (2005) observed higher beef consumption among Mexican Americans and non-Hispanic blacks.

The relationship between schooling, race/skin color and meat consumption was observed among yellow/indigenous/other individuals for total and red meat in both schooling groups, for beef among individuals with 12 years or more of schooling and fish and pork for individuals with 8 to 11 years of schooling in 2008-2009. In 2014-2015, the highest consumption of poultry was identified among black individuals with higher levels of education and fish among black individuals with lower levels of education and brown individuals with higher levels of education. Among yellow/indigenous/other individuals, the lowest consumption of processed meat was among those with more schooling, and that of pork among those with 8 to 11 years of schooling.

Studies conducted abroad also report differences in meat consumption related to ethnicity/skin color. Cross-sectional data from three datasets for adults (≥ 18 years of age) (National Health and Nutrition Examination Survey of 1988-1994 [19,618 adults] and 1999-2004 [15,006 adults] and Continuing Survey of Food Intakes by Individuals [CSFII] of 1994-1996 [10,164 adults]) revealed a greater increase in the total consumption of meats,

poultry and seafood among black men in the period between 1994-1996 and 1999-2004 in the United States (Wang *et al.*, 2010).

In a study analyzing food intake among 14,262 Americans (4802 children between two and 18 years of age, 4642 women and 4818 men) using data from the 1994-1996 CSFII, greater consumption of beef was found among Mexican Americans and non-Hispanic blacks (Guenther *et al.*, 2005). Another study conducted with Americans analyzing information from 43,995 adults over 20 years old found that non-Hispanic white individuals consumed more processed meat and less poultry and fish, whereas non-Hispanic black individuals consumed a greater quantity of chicken and lower quantify of processed red meats (Zeng *et al.*, 2019).

A study conducted in the United Kingdom evaluated the consumption of 15,655 individuals between 1.5 and 96 years of age in the periods 2008-09 and 2018-2019; authors found a reduction in the mean consumption *per capita*/day of meat from 103.7 to 86.3 g/day ($p < 0.0001$) as well as an absolute reduction in the consumption of red meat (-13.7 g; $p < 0.0001$), absolute reduction in the consumption of processed meat (-7.0 g; $p < 0.0001$) and an increase in the consumption of white meat (3.2 g; $p = 0.0027$). The highest consumption was found among white individuals. In the study, only 2.4% of the individuals analyzed were black or British black, which obstructs the analysis of the trend in this group (Stewart *et al.*, 2021).

These studies used data from national surveys and therefore had a greater number of individuals in comparison to the present investigation as well as different sociodemographic characteristics than the Brazilian population. However, the studies point out differences in meat consumption according to skin color or ethnicity. Guenther *et al.* (2005) found a greater consumption of beef among Mexican Americans and non-Hispanic blacks, but the data were presented for the general population of the sample, which included children, limiting the comparison to the data of the present study.

Poorer populations generally consume less or no foods of animal origin for different reasons, such as low availability, high price, eating patterns related to customs, religious taboos and a lack of knowledge on the nutritional importance of these foods (FAO, 2020). However, greater consumption of processed pork products was found among low-income Americans (Guenther *et al.*, 2005), greater consumption of red and processed meats was found among low-income Brazilians (Aprelini *et al.*, 2019) and greater meat consumption was found among Germans with less schooling, a low occupational status of the head of the family and low income per person (Koch *et al.*, 2019).

The present study found lower total meat, red meat, beef and fish consumption among black individuals in 2008-2009, with no significant differences in the latter period compared to other categories of ethnicity/skin color. It is not possible to identify the factors influencing the changes in meat consumption in the present study. However, the consumption of red

meat was above the recommendations of the World Cancer Research Fund (50 to 71.4 g/day) in all categories of ethnicity/skin color in both 2008-2009 and 2014-2015. These findings underscore the need for a better understanding of the determinant factors of meat consumption, considering the recommendations for a reduction in consumption (World Cancer Research Fund / American Institute for Cancer Research, 2018a).

Several recommendations have guided the reduction of meat consumption, such as the Dietary Guidelines for the Brazilian Population (Brasil, 2014), the 2015-2020 and 2020-2025 Dietary Guidelines for the United States (U.S. Department of Agriculture; U.S. Department of Health; Human Services, 2020; U.S. Department of Health; Human Services; U.S. Department of Agriculture., 2015), the UK dietary guidelines (Public Health England, 2018); the World Cancer Research Fund from 2007 and 2018 (World Cancer Research Fund / American Institute for Cancer Research, 2007, 2018b). The World Health Organization's International Agency for Research on Cancer has identified the consumption of red meat as "probably carcinogenic" and processed meat as "carcinogenic" for humans, contributing to the maintenance of the recommendations presented in the various dietary guidelines (Bouvard *et al.*, 2015).

The findings of a literature review conducted by González and colleagues (2020) support the recommendation for a significant reduction in meat consumption made by the International Agency for Research on Cancer (IARC). Besides the health consequences, meat consumption has negative implications related to the environment in the form of the emission of greenhouse gases (Farchi *et al.*, 2017; Milner *et al.*, 2015), water pollution and scarcity (so-called "water footprint") (Farchi *et al.*, 2017) and environmental contaminants (Cantlay; Ingram; Meredith, 2017).

The annual consumption of products of animal origin ranges from less than 4 kg per person in some countries to more than 100 kg per person in others (FAO, 2020). Excessive consumption of some animal products increases the risk of noncommunicable diseases, such as cardiovascular disease and some types of cancer, which leads to an increase in public health expenditure (FAO, 2020). The consumption of red meat is considered a probable cause of colorectal cancer (World Cancer Research Fund / American Institute for Cancer Research, 2018a) and disparities in the start of treatment in Brazil are related to socioeconomic and geographical issues. For example, regarding rectal cancer, belonging to the black race is associated with greater chances of delay in treatment (Lima; Villela, 2021).

A study that evaluated colorectal cancer mortality rates from 1996 to 2012 in Brazilian states found that the increase in mortality rates remained significant in some states and could be associated with increased incidence and late diagnosis and treatment, while racial disparities were not evaluated (Oliveira *et al.*, 2018). In the United States, these disparities are observed, with colorectal cancer disproportionately affecting the African-American population, with higher incidence and mortality rates compared to the white population, 23% and 53% higher in African-American men and 22% and 46% higher in African-American women (Desantis; Naishadham; Jemal, 2013). In the United States, red meat is widely

consumed, and this type of meat, associated with an increased risk of cancer, accounted for 58% of consumption and processed meat for 22% (Daniel *et al.*, 2011).

The National Health Policy for the Black Population recognizes the greater prevalence of some chronic diseases, such as arterial hypertension and diabetes mellitus among black individuals (Brasil, 2017), with risk factors related to diet. Malta and colleagues (2015) found a greater occurrence of hypertension and a greater consumption of fatty meats among black men. Canuto *et al.* (2019) found a greater consumption of meats with excess fat among markers of risk foods for chronic noncommunicable diseases related to brown and black skin color.

This study has limitations that should be considered. Information was collected through interviews and is therefore subject to information bias. The cross-sectional design does not enable the establishment of causal relationships between variables in the associations found. Despite these limitations, this study was carried out with a population representative of the city of Campinas, in the state of São Paulo, Brazil, with adjustments for confounding factors. The 2014 survey included the ISACamp Nutri 2014 Questionnaire to assess nutritional status, but both used the R24 to assess food consumption. The expansion factors used were different in each of the studies, so it was not possible to infer a statistical difference in meat consumption between the years. There was also a change in the methodology used to assess *per capita* income, but this did not affect the results presented. Despite these limitations, the present study was conducted with a representative population of a city of considerable importance in the state of São Paulo, Brazil, with adjustments made for confounding factors.

Conclusions

The present study found a reduction in differences related to meat consumption among white, black and brown individuals in 2014-2015 compared to 2008-2009. However, red meat consumption was above the recommended quantity in all ethnicities. Thus, there is a need to understand the dynamics diet choices, as current recommendations call for reductions in the consumption of red and processed meats. During the period studied, a downward trend in food insecurity was observed, but during the COVID-19 pandemic, the situation of food insecurity worsened again and, in the outskirts of cities and in some regions of the country, racial inequality in food continues to be a reality. Meat consumption is also influenced by its symbolic value. Therefore, it is important to evaluate the consumption of other food groups according to ethnicity/skin color to identify possible associations similar to those found for meat consumption, and changes in dietary patterns in periods of greater food security, with a view to developing strategies that contribute to reducing diet racial inequality.

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Natália Simonian Rodrigues Valente Ghedini: data curation; formal analysis; resources; writing – review & editing.
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Resumo

Consumo de carne e disparidades raciais/étnicas em estudo de base populacional na cidade de Campinas, Brasil

O objetivo do presente estudo foi investigar o consumo de carne na população adulta residente em um município do interior de São Paulo, Campinas, segundo raça/cor da pele em dois períodos: 2008/2009 e 2014/2015, frente à lacuna na literatura sobre a temática. Assim, buscou-se avaliar a associação entre raça/cor e consumo de carne, um alimento de grande valor cultural, a partir da hipótese de que este marcador demográfico tem relevância para explicar escolhas alimentares. Trata-se de estudo transversal de base populacional, avaliando participantes do Inquérito de Saúde do Município de Campinas (ISACamp) realizado em 2008/2009 e 2014/2015, com, respectivamente. 2.354 e 1.606 indivíduos com 20 anos ou mais de idade. Os dados de consumo alimentar foram coletados pelo método recordatório alimentar de 24 horas e as carnes foram classificadas de acordo com a origem animal e o tipo de processamento. Modelos de regressão linear foram executados para avaliar a associação entre consumo de carnes e variáveis sociodemográficas com nível de significância de 5%. Foi encontrado menor consumo total de carnes, carne vermelha, carne bovina e peixe entre indivíduos com cor de pele autodeclarada preta em comparação àqueles com cor de pele autodeclarada branca. O consumo de carne vermelha variou de 109,4g a 157,9g em 2008/2009 e de 102,1g a 125,1g em 2014/2015 entre os grupos, ficando acima da recomendação em ambos os períodos. O Fundo Mundial de Pesquisa do Câncer orienta o consumo de carne vermelha entre 50 e 71,4g/dia; assim, esses achados reforçam a importância de estudos que investiguem o impacto da etnia sobre o consumo alimentar, já que as disparidades raciais podem estar na origem do consumo insuficiente ou em excesso de determinados tipos de carne, sendo que a compreensão dos fatores associados ao consumo dos tipos de carnes é relevante para a adoção de ações de saúde voltadas à ingestão alimentar adequada.

Palavras-chave: Carne. Consumo alimentar. Dieta. Etnia. Produtos de origem animal.

Resumen

Consumo de carne y disparidades étnico-raciales en un estudio poblacional en la ciudad de Campinas, Brasil

El objetivo de este estudio fue investigar el consumo de carne en la población adulta residente en un municipio del interior de São Paulo, Campinas, según raza/color de piel en dos períodos: 2008/2009 y 2014/2015, ya que hay poca literatura sobre el tema. Así, se buscó evaluar la asociación entre raza/color y consumo de carne, alimento de gran valor cultural, a partir de la hipótesis de que este marcador demográfico es relevante para explicar las elecciones alimentarias. Se trata de un estudio transversal de base poblacional que evaluó a participantes de las encuestas de salud del municipio de Campinas (Isacamp) de 2008/2009 y 2014/2015, con 2354 individuos y 1606 individuos, respectivamente, de edades iguales o superiores a 20 años. Los datos de consumo de alimentos se recogieron utilizando el método de recuerdo dietético de 24 horas y la carne se clasificó según el origen animal y el tipo de procesamiento. Se construyeron modelos de regresión lineal para evaluar la asociación entre el consumo de carne y las variables sociodemográficas con un nivel de significación del 5 %. Se observó un

menor consumo de carne total, carne roja, carne de vacuno y pescado entre los individuos con un color de piel negro autodeclarado en comparación con los que tenían un color de piel blanco autodeclarado. El consumo de carne roja osciló entre 109,4 g y 157,9 g en 2008/2009 y entre 102,1 g y 125,1 g en 2014/2015 entre los grupos, estando por encima de la recomendación en ambos períodos. El Fondo Mundial para la Investigación del Cáncer orienta el consumo de carne roja de 50 a 71,4 g/día. Por lo tanto, estos hallazgos refuerzan la importancia de los estudios que investigan el impacto del origen étnico en el consumo de alimentos, ya que las disparidades raciales pueden estar en el origen del consumo insuficiente o excesivo de ciertos tipos de carne, y la comprensión de los factores asociados con el consumo de tipos de carne relevantes para el adopción de acciones sanitarias encaminadas a una ingesta dietética adecuada.

Palabras clave: Carne. Consumo de alimentos. Dieta. Etnia. Productos animales.

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