



# Dietary and nutrient intake among participants of a Brazilian health promotion programme: a cross-sectional study

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Submitted 29 October 2020: Final revision received 29 April 2021: Accepted 20 May 2021: First published online 26 May 2021

## Abstract

**Objective:** Developing health promotion activities, aimed at healthy food intake, is essential for improving quality of life and reducing the prevalence of chronic diseases. Thus, the objective of this study is to describe both dietary and nutrient intake, according to length of participation in a health promotion service (*Programa Academia da Saúde – PAS*).

**Design:** A cross-sectional study was carried out with a representative sample of PAS units in vulnerable areas of the city. Dietary and nutrient intake were assessed, using the average of two 24-h recalls. Food was categorised according to the NOVA (a systematic grouping of all foods according to the nature, extent and purpose of the industrial processes they undergo) classification. The length of participation in PAS is presented in months and is then examined in tertiles for analysis.

**Setting:** Belo Horizonte – Brazil.

**Participants:** 3372 adults ( $\geq 20$  years).

**Results:** Users in the third tertile of PAS (24.4–61.6 months) experienced less energy intake, lipids and ultra-processed foods, and more culinary preparations, compared to others. Users in the second (10.1–24.3 months) and third tertiles of PAS had higher carbohydrate intake, Ca and vitamin C *v* those in the first tertile (0–10 months).

**Conclusions:** Results suggest that greater participation in PAS can improve dietary and nutrient intake, showing its potential to promote healthy lifestyles, prevent chronic diseases and offer longitudinal health care.

**Keywords**  
Health promotion  
Health services  
Primary health care  
Food processing  
Food intake  
Nutrients

In Brazil, it has been observed that 55.4% of the population is overweight or obese, 24.5% has a diagnosis of arterial hypertension and 7.4% has diabetes<sup>(1)</sup>. Among the risk behaviour patterns for the development of chronic non-communicable diseases (NCD) were identified physical inactivity in leisure time, sedentary behaviour, inadequate consumption of fruits and vegetables, saturated fat and sugar<sup>(2)</sup>.

Recent data show that physical inactivity is associated with a higher incidence of diabetes mellitus (DM), heart disease and stroke<sup>(3)</sup>. There has been increased consumption of ultra-processed foods (UPF), decreased consumption of unprocessed and minimally processed foods in Brazil, which includes a global perspective<sup>(4,5)</sup>, thereby contributing to the development of NCD<sup>(6–9)</sup>. Health promotion programmes focussing on healthy eating habits and physical activity are essential for improving quality of life and reducing NCD<sup>(10,11)</sup>.

Given this increasing evidence, the Brazilian government strengthened health promotion programmes within the public health system (Sistema Único de Saúde (SUS), Portuguese), with comprehensive and longitudinal care of subjects and collectives<sup>(12)</sup>. In this study, we examine the initiative aimed at increasing physical activity and healthy eating habits under the Health Academy Program (Programa Academia da Saúde (PAS), Portuguese).

In 2011, PAS was implemented nationwide with the objective of promoting interdisciplinary health education. This programme consists of centres with health-promoting activities, including group activities guided by a physical education professional. Equipment like dumbbells, steps, mats, ropes and resistance bands can be used in classes to mix aerobic and strength exercises. All participants undergo a physical assessment before starting activities<sup>(13)</sup>. The programme is financed by the federal government and offers exercise, guided by an

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instructor for 60 min, three times a week. It also offers actions to promote the healthy eating habits, the well-being of its citizens and leisure time at no cost<sup>(14)</sup>. In 2016, PAS included a total of 2847 municipalities in all regions of Brazil, with 3790 units at some stage of construction, with 450 units in operation<sup>(15)</sup>. The 2017 program endorsed healthy eating in 82% of these units<sup>(16)</sup>.

Actions to promote healthy eating habits implemented in conjunction with physical activities can lead to improvement in dietary intake. An intervention study of PAS users revealed that, after 11 months, there was an increased daily intake of fruits, milk and dairy products, and a decrease in per capita daily use of oil and sugar. It also identified a decrease of 1.3 kg in average body weight<sup>(17)</sup>. However, there are no studies that assess the relationship between length of participation in the programme and improvement in certain habits. This analysis was relevant in showing the importance of the PAS in longitudinal health care, plus healthy eating habits. The objective of this study is to evaluate changes to diet and nutrient intake after participating in a Brazilian health promotion service, over time.

## Methods

### *Design and locale of study*

This is a cross-sectional study developed from a controlled, randomised community trial with PAS users; it was carried out in the city of Belo Horizonte, the capital of the state of Minas Gerais (MG), and the sixth largest city in Brazil; around 2.5 million people live in the territorial extension of approximately 330,000 km<sup>2</sup><sup>(18)</sup>. The municipality is subdivided into nine administrative regions, with census sectors of the Health Vulnerability Index (HVI) at four levels (low, medium, high and very high) for adequate planning of health actions. HVI is a composite index of socioeconomic and environmental variables, assigning weight to sanitation, housing, education, income and health focusing on interventions and resource allocation<sup>(19)</sup>.

The PAS was implemented in Belo Horizonte in 2006, primarily in areas of high and very high HVI, to promote access to health care for the most vulnerable populations<sup>(13)</sup>. Currently in Belo Horizonte, the programme has 79 units.

### *Study sample*

Sampling was carried out by a simple conglomerate, stratified into nine regions of the city. Criteria for selecting PAS units were morning operation and location in an area of medium, high or very high HVI (main characteristics of service operation), but not subjected to research related to food, and nutrition over the past 2 years<sup>(20)</sup>.

Thus, for 50 PAS units operating at the time of the study, 42 were eligible and 2 units were randomly selected by region in the municipality of the study, totalling 18 units. This represented the PAS units in Belo Horizonte-MG,

located in medium, high and very high HVI areas, with a 95% CI and an error less than 1.4%<sup>(20)</sup>.

Within sampled PAS units, all individuals aged  $\geq 20$  years (cut-off point to standardise assessment of nutritional status of adults and the elderly in the programme and taking part in physical exercise in the preceding month for data collection) were interviewed. Pregnant women and those with any cognitive impairment were excluded. Thus, 3763 users were eligible, but due to 237 refusals and 112 exclusions, 3414 users were interviewed. We also excluded those without information on food consumption ( $n$  6) and those who reported low energy intake ( $< 500$  kcal/d) ( $n$  35) or high energy intake ( $> 7000$  kcal/d) ( $n$  1)<sup>(21)</sup>. As such, a total of 3372 participants were included and analysed.

### *Data collection*

Data collection took place in 2013 and 2014 through face-to-face interviews by trained personnel, supervised by a dietitian. A field manual was used to clarify questions, while semiannual training took place to standardise data collection and minimise errors. The semiannual training included an analysis of research objectives, user approach techniques, application of the information letter and consent form, simulation of interviews, and measurements of anthropometric measurements. To avoid errors and methodological inconsistencies, new interviewers were used in the field after observing an interview, along with supervision. When deemed fit, they began to interview, but were initially observed on a daily basis<sup>(20)</sup>.

Sociodemographic and health data were collected, and a 24-h dietary recall amassed food consumption data. The 24-h dietary recall is an instrument to determine food consumption over the last 24 h. An interviewer usually records intake the day before the collection. The respondent must address everything consumed at all meals, detailing the time of the meal, the type of food consumed (including brand name of processed foods, recipes for home-made foods and preparation methods) and quantity consumed. In addition, the interviewer asked about foods, beverages and eating occasions, such as snacks that might be omitted. The 24-h dietary recall is a dietary assessment tool for correlations between diet and other variables<sup>(22)</sup>. The USDA five-step multiple-pass method was used, with a kit of household measures to minimise bias in estimating portion size<sup>(23)</sup>. Participants' weight and height were also measured. On a non-consecutive day, a second 24-h dietary recall tool was applied.

### *Outcome variable: Dietary and nutrient intake*

For analysis of dietary and nutrient intake, an average of two 24-h dietary recall tools were used on non-consecutive days in face-to-face interviews with trained personnel. We included information from those who responded to one recall, as it was impossible to contact the user again (5.9%). Foods and beverages and their household

measurements were converted to grams or millilitres<sup>(24,25)</sup>, and tabulated with specific software, *Brasil Nutri*, then processed with data analysis and statistical software (Stata), v. 14.0.

To assess food to the degree of industrial processing, the NOVA (a systematic grouping of all foods according to the nature, extent and purpose of the industrial processes they undergo) classification system was applied. Foods were classified into four groups: unprocessed and minimally processed foods, processed culinary ingredients, processed foods and UPF. Unprocessed foods came from plants or animals and were ready for consumption without any changes. Minimally processed foods were fresh, with minimal changes, such as removal of inedible parts, drying, dehydration, roasting, pasteurisation or refrigeration. We cite fresh fruit, leafy and root vegetables, or grains like rice, maize, wheat; legumes such as beans, lentils, and chickpeas, roots and tubers, like potatoes, sweet potatoes, and cassava, with meat, poultry, fish and seafood, and fresh eggs, powdered or pasteurised milk, fresh or pasteurised plain yoghurt, along with tea, coffee, and drinking water. Culinary ingredients include substances extracted from foods in the first group or in nature, which undergo processing and are consumed in culinary preparations, such as vegetable oils crushed from seeds, nuts or fruits (notably olives); this includes butter and lard from milk and pork, and sugar and molasses from cane or beet. Processed foods, however, are products manufactured with the addition of salt, sugar and oil, or another group 2 substance (canned or bottled vegetables and legumes in brine, salted or sugared nuts and seeds, salted, dried, cured, or smoked meats and fish, canned fish (with or without added preservatives), fruit in syrup (with or without added antioxidants), and freshly made unpackaged breads and cheeses). UPF are industrial formulations, with little or no fresh food. High levels of sugar and fats are added to these products, with antioxidants, stabilisers and preservatives, for example, many ready-to-consumer products, such as carbonated soft drinks, sweet or savoury packaged snacks, chocolates, candies (confectionery) ice cream, mass-produced packaged breads and buns, margarines and other spreads, cookies (biscuits), pastries, cakes, and cake mixes, breakfast 'cereals' and 'energy' bars, 'energy' drinks, milk drinks, 'fruit' yoghurts and 'fruit' drinks: 'cocoa' drinks and 'instant' sauces. Many pre-prepared ready-to-heat products like pies, pasta, and pizza dishes, poultry, fish 'nuggets', and 'sticks', sausages, burgers, hot dogs, and reconstituted meat products, or powdered and packaged 'instant' soups, noodles, and desserts. This includes 'health' or 'slimming' products, such as meal replacement shakes and powders, among others.<sup>(6)</sup>

These four food groups were condensed into three in order to evaluate food intake: (1) culinary preparations (unprocessed, minimally processed foods and processed culinary ingredients), (2) processed foods and (3) UPF. We also investigated energy intake and energetic percentage of macronutrients (carbohydrates, proteins, total

saturated and trans fats), nutrient density of fibres, minerals (Ca, Fe, Na and K), and vitamins (A, B<sub>12</sub>, C and D) in grams (g), milligrams (mg) or micrograms ( $\mu$ g) per 1000 kcal<sup>(26)</sup>.

### **Explanatory variable of interest: Length of participation in PAS**

Participation in PAS was determined by when the user joined, through a controlled spreadsheet of professionals for each PAS unit, and date of the baseline interview (date of baseline interview – PAS entry date). Time in months was used in tertiles for analysis.

### **Covariables**

The sociodemographic characteristics were age, sex, marital status (married: married/consensual union, or single: single/separated/widowed), education (incomplete elementary school, incomplete high school, incomplete college or graduated), occupation (homemaker, retired, unemployed or employed) and per capita income (for one minimum wage, between one and three minimum wages, or more than three minimum wages).

Individual concerns were found in a self-reported medical diagnosis, including DM, arterial hypertension and dyslipidemia – while health perception was seen as very good/good, regular, bad/very bad. To assess nutritional status, weight and height measurements were calculated for BMI ( $\text{BMI} = (\text{weight (kg)}/\text{height (m)}^2)$ ). BMI was assessed with criteria from the WHO<sup>(27)</sup> and classified into two categories: not overweight ( $< 25.0 \text{ kg/m}^2$  for adults and  $< 27.0 \text{ kg/m}^2$  for the elderly) and overweight ( $\geq 25.0 \text{ kg/m}^2$  for adults and  $\geq 27.0 \text{ kg/m}^2$  for the elderly).

### **Statistical analysis**

Data were tabulated into *Brasil Nutri* software and Microsoft Access v. 7.0 by a trained team. Analyses were carried out with the Stata programme, v. 14.0. A significance level of 5% was applied. Continuous variables were presented as the median and interquartile range (P<sub>25</sub>–P<sub>75</sub>) and were categorical percentages with a 95% CI (IC95%).

To analyse the association between tertiles at the time of participation in PAS and dietary and nutrient intake, the Kruskal–Wallis test and Dunn's multiple comparison *post hoc* test were used. The chi-square test was also used for categorical variables.

### **Results**

The study included 3372 individuals: 88.0% women, with a median age of 58 (49–65) years, with 47.1% having a per capita income of up to one minimum wage. Most had an incomplete high school education (53.8%) and were married (61.6%), while 65.4% were retired or homemakers. In regard to health status, most were overweight (64.2%) with



arterial hypertension (53.1%), but rated their health as good/very good (71.9%) (Table 1).

The length of active participation in the programme was divided into tertiles: 0 to 10.0 months; 10.1 to 24.3 months; and 24.4 to 61.6 months. Users with the longest participation in the PAS (> 24.4 months) were older (59 (52–66) *v* 54 (45–63) years old;  $p < 0.001$ ), were retired (40.5% *v* 30.8%;  $p < 0.001$ ) and did not finish elementary school (45.8% *v* 29.8%;  $p < 0.001$ ), compared to those with less time in PAS (to 10 months). They had a higher prevalence of arterial hypertension (57.9% *v* 48.9%;  $p < 0.001$ ) and dyslipidemia (49.2% *v* 39.0%;  $p < 0.001$ ), and a lower prevalence of poor health perception, such as bad/very bad (2.5% *v* 5.1%;  $p < 0.001$ ), and a lower BMI (27.2 kg/m<sup>2</sup> *v* 27.8 kg/m<sup>2</sup>;  $p < 0.001$ ) (Table 1).

The median energetic contribution of culinary preparations, processed and UPF were 61.8% (51.6–72.1), 9.4% (3.9–16.0) and 26.3% (16.4–37.7), respectively. It was observed that users in the 3rd tertile of PAS had a greater energetic contribution of culinary preparations (63.19% *v* 60.71%;  $p = 0.001$ ) and reduced energetic contribution of UPF (25.17% *v* 27.28%;  $p = 0.016$ ) (Figure 1).

Analysis of energy and nutrient intake found those in the second and last tertiles of the programme with lower values of energy intake (1323.04 kcal and 1344.55 kcal *v* 1392.23;  $p < 0.001$ ) and lipids (29.29% *v* 29.35%;  $p = 0.022$ ), and higher values of carbohydrates (54.18% and 53.89% *v* 53.07%;  $p = 0.021$ ) and Ca (338.42 mg/1000 kcal and 353.10 mg/1000 kcal *v* 332.13 mg/1000 kcal;  $p = 0.036$ ), compared to those with less time in PAS (up to 10.1 months). Vitamin A intake was similar in the 3rd and 1st tertiles, while each had significantly lower values than the 2nd tertile (307.43 µg/1000 kcal and 306.48 µg/1000 kcal *v* 328.02 µg/1000 kcal;  $p = 0.014$ ). For vitamin C intake, participants in the 3rd tertile reported higher values than those of the 1st; both groups were lower than the 2nd tertile (50.58 mg/1000 kcal *v* 59.04 mg/1000 kcal *v* 47.39 mg/1000 kcal;  $p < 0.001$ ) (Table 2).

## Discussion

In this study, we aimed to describe dietary and nutrient intake, according to length of participation in the PAS health promotion service. Our findings suggest that longer participation in PAS activities likely contributed to a favourable food and nutrient profile. Users in the 2nd and 3rd tertiles of PAS used more carbohydrates, Ca and vitamin C; those in the 3rd tertile used more culinary preparations, with lower consumption of energy, UPF and total fat.

Participation time in programmes similar to PAS can be influenced by sociodemographic characteristics, such as participant age and sex, with a higher chance of the elderly and women remaining longer<sup>(28)</sup>. Age was the most important factor for staying in the programme. Similarly, participation time in PAS can be influenced by working fewer

hours: e.g. for more free time, better health and disposition, greater confidence in individual skills, and improved financial conditions<sup>(29)</sup>. This may explain why parameters associated with the length of time in PAS, beyond age, were related to retirement. They likely have more flexible hours for activity and perceived health as good to very good. As age increases, there tends to be an increase in the development of disease<sup>(30)</sup>, so having a health promotion programme that attracts the public also generates benefits for the family, the community and the entire health system.

Users in the 3rd tertile of PAS had a higher prevalence of arterial hypertension and dyslipidemia, compared to those in the 1st tertile. Other studies show that people who join health promotion programmes tend to have more health problems. Research conducted in Recife showed that 74.8% of participants in physical exercise programmes had hypertension<sup>(31)</sup>. A study carried out with users of PAS in the city of Belo Horizonte evaluated the service between the second and fourth years of operation and identified hypertension for 41.6% of users, with approximately 54% having from one to three NCD<sup>(32)</sup>. As such, individuals with health problems may remain in the programme longer to avoid complications of the disease. Yet, they are also guided by health professionals to adopt healthier lifestyle habits.

The analysis showed a lower prevalence of overweight status among users in the 2nd and 3rd tertiles *v* those in the 1st tertile. Similar data on longitudinal evaluation were carried out in a programme preceding PAS in Aracaju, Sergipe, Brazil. After 2 years of follow-up, being an ex-user or non-user of the programme increased the chances of presenting two or more NCD, being overweight, and having a negative perception of health for programme users<sup>(33)</sup>. This result is encouraging, as being overweight is a risk factor for the development of NCD<sup>(34)</sup>, although participating in PAS can contribute to maintaining and monitoring a healthy weight.

These positive results can be explained by improvement of food consumption in those with longer participation in PAS. Individuals in the 3rd tertile of PAS presented a reduction in energetic contribution of UPF and increased culinary preparations. The consumption of UPF has been growing in Brazil as well as the world, parallel to a reduction in consumption of culinary preparations. Between 2000 and 2013, sales of UPF increased 43.7% globally and 48.0% in Latin America<sup>(4)</sup>. For the last 15 years in Brazil, there has been an increase of 5.8% in acquisition<sup>(35)</sup>, emphasizing that potential participation is a positive way to reduce consumption.

The increase in the UPF intake was related to obesity, CVD, type 2 DM, breast cancer, depression, irritable bowel syndrome (IBS) and increased risk of pre-mature mortality<sup>(6,7,36,37)</sup>. Culinary preparations (made with unprocessed foods, minimally processed foods and culinary ingredients) decreased that risk<sup>(8,9)</sup>. In contrast to UPF, culinary preparations have 2.5 times less energy per gram, 2 times less free sugar, 1.5 times less fat and saturated fat, and 8 times less



**Table 1** Sociodemographic, health and anthropometric characteristics according to time in the Programa Academia da Saúde. Belo Horizonte-MG. 2013/2014

| Variables                        | PAS time (months) |            |                             |                           |                                |                           |                                |                         | P value  |
|----------------------------------|-------------------|------------|-----------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|-------------------------|----------|
|                                  | Total n 3372      |            | 1st tertile (0–10.0) n 1126 |                           | 2nd tertile (10.1–24.3) n 1125 |                           | 3rd tertile (24.4–61.6) n 1121 |                         |          |
|                                  | %                 | IC95 %     | %                           | IC95 %                    | %                              | IC95 %                    | %                              | IC95 %                  |          |
| Age (years)                      |                   |            |                             |                           |                                |                           |                                |                         |          |
| Median                           | 58                |            | 54                          |                           | 58                             |                           | 59                             |                         | < 0.001* |
| P <sub>25</sub> –P <sub>75</sub> | 49–65             |            | 45–63 <sup>a</sup>          |                           | 50–66 <sup>b</sup>             |                           | 52–66 <sup>c</sup>             |                         |          |
| Women                            | 88.0              | 86.9, 89.1 | 87.1                        | 85.0, 88.9                | 89.0                           | 87.0, 90.7                | 88.0                           | 86.0, 89.8              | 0.398†   |
| Marital status¶                  |                   |            |                             |                           |                                |                           |                                |                         |          |
| Married‡                         | 61.6              | 60.0, 63.3 | 60.0                        | 57.1, 62.8                | 62.0                           | 59.2, 64.8                | 62.9                           | 60.0, 65.7              | 0.350†   |
| Single§                          | 38.4              | 36.7, 40.0 | 40.0                        | 37.2, 42.9                | 38.0                           | 35.2, 40.8                | 37.1                           | 34.3, 40.0              |          |
| Education  ,**                   |                   |            |                             |                           |                                |                           |                                |                         |          |
| Incomplete elementary school     | 37.6              | 35.9, 39.2 | 29.8                        | 27.2, 32.5 <sup>a</sup>   | 37.2                           | 34.5, 40.1 <sup>b</sup>   | 45.8                           | 42.9, 48.7 <sup>c</sup> | < 0.001† |
| Incomplete high school           | 53.8              | 52.1, 55.5 | 58.0                        | 55.1, 60.9                | 54.6                           | 51.6, 57.5                | 48.7                           | 45.8, 51.6              |          |
| Incomplete college               | 7.5               | 6.6, 8.4   | 10.7                        | 9.0, 12.6 <sup>a</sup>    | 7.0                            | 5.7, 8.7 <sup>b</sup>     | 4.7                            | 3.6, 6.1 <sup>b</sup>   |          |
| Graduated                        | 1.2               | 0.8, 1.6   | 1.5                         | 0.9, 2.4                  | 1.2                            | 0.7, 2.0                  | 0.8                            | 0.4, 1.5                |          |
| Occupation                       |                   |            |                             |                           |                                |                           |                                |                         |          |
| Homemaker                        | 28.7              | 27.2, 30.3 | 27.4                        | 24.8, 30.1                | 27.8                           | 25.3, 30.5                | 31.0                           | 28.4, 33.8              | < 0.001† |
| Retired                          | 36.7              | 35.0, 38.3 | 30.8                        | 28.1, 33.5 <sup>a</sup>   | 38.8                           | 35.9, 41.6 <sup>b</sup>   | 40.5                           | 37.7, 43.4 <sup>b</sup> |          |
| Unemployed                       | 2.0               | 1.6, 2.5   | 4.0                         | 3.0, 5.3 <sup>a</sup>     | 1.2                            | 0.7, 2.1 <sup>b</sup>     | 0.8                            | 0.4, 1.5 <sup>b</sup>   |          |
| Employed                         | 32.6              | 31.0, 34.2 | 37.9                        | 35.1, 40.7 <sup>a</sup>   | 32.2                           | 29.5, 35.0 <sup>b</sup>   | 27.6                           | 25.1, 30.3 <sup>b</sup> |          |
| Per capita income**              |                   |            |                             |                           |                                |                           |                                |                         |          |
| Up to 1 MW                       | 47.1              | 45.4, 48.7 | 48.4                        | 45.5, 51.3                | 45.9                           | 43.0, 48.8                | 46.9                           | 44.0, 49.8              | 0.572†   |
| 1 a 3 MW                         | 39.0              | 37.3, 40.6 | 38.0                        | 35.2, 40.9                | 39.0                           | 36.2, 41.9                | 39.9                           | 37.0, 42.8              |          |
| > 3 MW                           | 14.0              | 12.8, 15.2 | 13.6                        | 11.7, 15.7                | 15.1                           | 13.1, 17.3                | 13.2                           | 11.3, 15.3              |          |
| Diabetes mellitus††              |                   |            |                             |                           |                                |                           |                                |                         |          |
| Yes                              | 16.8              | 15.5, 18.1 | 16.5                        | 14.4, 18.8                | 15.5                           | 13.5, 17.7                | 18.3                           | 16.1, 20.7              | 0.188†   |
| No                               | 83.2              | 81.9, 84.5 | 83.5                        | 81.2, 85.6                | 84.5                           | 82.3, 86.5                | 81.7                           | 79.3, 83.8              |          |
| Hypertension**                   |                   |            |                             |                           |                                |                           |                                |                         |          |
| Yes                              | 53.1              | 51.4, 54.7 | 48.9                        | 46.0, 51.9 <sup>a</sup>   | 52.3                           | 49.4, 55.3 <sup>a,b</sup> | 57.9                           | 55.0, 60.8 <sup>b</sup> | < 0.001† |
| No                               | 46.9              | 45.3, 48.6 | 51.1                        | 48.1, 54.0 <sup>a</sup>   | 47.6                           | 44.7, 50.6 <sup>a,b</sup> | 42.1                           | 39.2, 45.0 <sup>b</sup> |          |
| Dyslipidemia‡‡                   |                   |            |                             |                           |                                |                           |                                |                         |          |
| Yes                              | 44.1              | 42.4, 45.8 | 39.0                        | 36.2, 41.9 <sup>a</sup>   | 44.1                           | 41.2, 47.0 <sup>a,b</sup> | 49.2                           | 46.2, 52.1 <sup>b</sup> | < 0.001† |
| No                               | 55.9              | 54.2, 57.6 | 61.0                        | 58.1, 63.8 <sup>a</sup>   | 55.9                           | 53.0, 58.8 <sup>a,b</sup> | 50.8                           | 47.9, 53.7 <sup>b</sup> |          |
| Perception of health             |                   |            |                             |                           |                                |                           |                                |                         |          |
| Very bad/bad                     | 3.1               | 2.5, 3.7   | 5.1                         | 4.0, 6.6 <sup>a</sup>     | 1.6                            | 1.0, 2.5 <sup>b</sup>     | 2.5                            | 1.7, 3.6 <sup>b</sup>   | < 0.001† |
| Regular                          | 25.1              | 23.6, 26.5 | 26.3                        | 23.8, 28.9 <sup>a,b</sup> | 21.9                           | 19.5, 24.4 <sup>a</sup>   | 27.0                           | 24.5, 29.7 <sup>b</sup> |          |
| Good/very good                   | 71.9              | 70.3, 73.3 | 68.6                        | 65.8, 71.2 <sup>a</sup>   | 76.5                           | 74.0, 78.9 <sup>b</sup>   | 70.5                           | 67.7, 73.1 <sup>a</sup> | < 0.001* |
| BMI (kg/m <sup>2</sup> )         |                   |            |                             |                           |                                |                           |                                |                         |          |
| Median                           | 27.3              |            | 27.8                        |                           | 27.0                           |                           | 27.2                           |                         | < 0.001* |
| P <sub>25</sub> –P <sub>75</sub> | 24.4–30.6         |            | 24.6–31.2 <sup>a</sup>      |                           | 24.3–30.0 <sup>b</sup>         |                           | 24.3–30.5 <sup>b</sup>         |                         |          |
| Overweight                       |                   |            |                             |                           |                                |                           |                                |                         |          |
| Yes                              | 64.2              | 62.6, 65.8 | 69.2                        | 66.4, 71.8 <sup>a</sup>   | 60.3                           | 57.4, 63.1 <sup>b</sup>   | 63.2                           | 60.4, 66.0 <sup>b</sup> | < 0.001† |
| No                               | 35.8              | 34.2, 37.4 | 30.8                        | 28.2, 33.6 <sup>a</sup>   | 39.7                           | 36.9, 42.6 <sup>b</sup>   | 36.7                           | 34.0, 39.6 <sup>b</sup> |          |

PAS: Programa Academia da Saúde; MW: minimum wage (\$294.78 at the time of the study).

\*Kruskal–Wallis with Dunn *post hoc* or

†chi-square. Superscript letters: different letters = different values and equal letters = equal values.

‡Married/consensual union.

§separated/single/widowed.

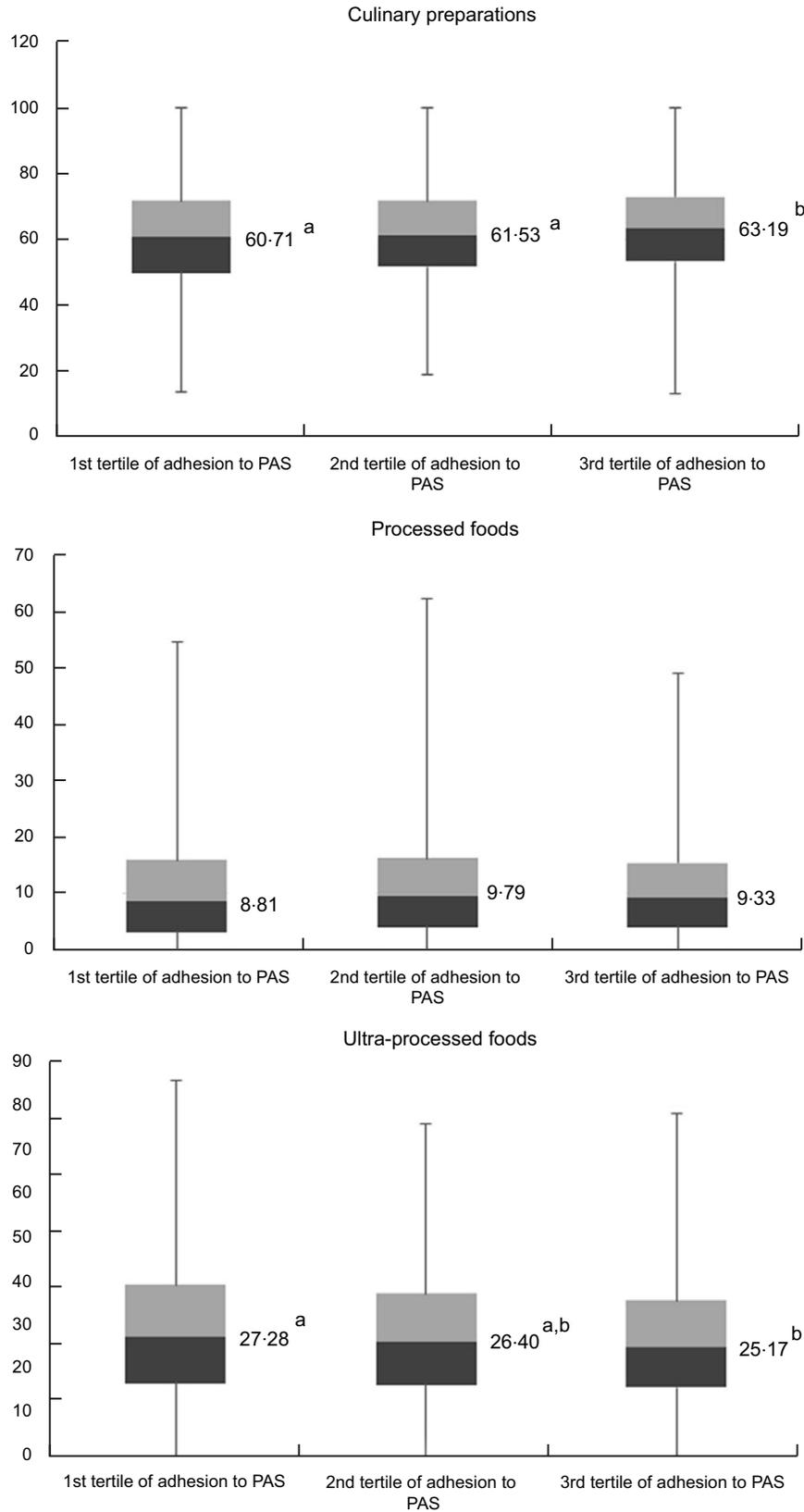
||Incomplete elementary school (< 5 years). Incomplete high school (6 to 11 years). Incomplete college (12 to 16 years). Graduated (> 17 years).

¶1 missing.

\*\*2 missing.

††6 missing.

‡‡32 missing.



**Fig. 1** Dietary intake using NOVA classification according to time in the Programa Academia da Saúde. Belo Horizonte – MG. 2013/2014

Note: 1st tertile: 0–10.0 months. *n* 1-126; 2nd tertile: 10.1–24.3 months. *n* 1-125; 3rd tertile 24.4–61.6 months. *n* 1-121. PAS: Programa Academia da Saúde. *P* value: Kruskal–Wallis with Dunn’s *post hoc*. Culinary preparations: *P* = 0.001. Processed foods: *P* = 0.309. Ultra-processed foods: *P* = 0.016. Medians with different letters = different values. Medians with same letters = equal values.

**Table 2** Energy and nutrients intakes according to time in the Programa Academia da Saúde. Belo Horizonte – MG. 2013/2014

| Variables                              | PAS time (months) |                                  |         |                                  |         |                                  |                                |                                  |         |                                  |  |  | P value* |
|--|-------------------|----------------------------------|---------|----------------------------------|---------|----------------------------------|--------------------------------|----------------------------------|---------|----------------------------------|--|--|----------|
|  | Total n 3372      |                                  |         | 1st tertile (0–10.0) n 1126      |         |                                  | 2nd tertile (10.1–24.3) n 1125 |                                  |         | 3rd tertile (24.4–61.6) n 1121   |  |  |          |
|  | Median            | P <sub>25</sub> –P <sub>75</sub> | Median  | P <sub>25</sub> –P <sub>75</sub> | Median  | P <sub>25</sub> –P <sub>75</sub> | Median                         | P <sub>25</sub> –P <sub>75</sub> | Median  | P <sub>25</sub> –P <sub>75</sub> |  |  |          |
| Energy consumption (total kcal)        | 1351.71           | 1061.02–1674.47                  | 1392.23 | 1072.71–1729.66 <sup>a</sup>     | 1344.55 | 1071.84–1703.49 <sup>a</sup>     | 1323.04                        | 1042.65–1609.45 <sup>b</sup>     | < 0.001 |                                  |  |  |          |
| Proteins (% caloric)                   | 16.70             | 14.02–20.00                      | 16.83   | 13.97–20.23                      | 16.57   | 13.96–19.84                      | 16.71                          | 14.16–19.87                      | 0.593   |                                  |  |  |          |
| Carbohydrates (% caloric)              | 53.77             | 47.99–59.51                      | 53.07   | 47.61–58.85 <sup>a</sup>         | 53.89   | 48.15–59.92 <sup>b</sup>         | 54.18                          | 48.50–59.76 <sup>b</sup>         | 0.021   |                                  |  |  |          |
| Lipids (% caloric)                     | 29.70             | 24.71–34.42                      | 29.95   | 25.12–35.09 <sup>a</sup>         | 29.75   | 24.67–34.36 <sup>ab</sup>        | 29.29                          | 24.32–33.71 <sup>b</sup>         | 0.022   |                                  |  |  |          |
| SFA (% caloric)                        | 10.05             | 7.76–13.13                       | 10.07   | 7.69–13.03                       | 9.98    | 7.73–12.88                       | 10.17                          | 7.88–13.50                       | 0.171   |                                  |  |  |          |
| Fibre (g/1000 kcal)                    | 11.58             | 8.98–14.74                       | 11.28   | 8.83–14.39                       | 11.63   | 9.01–14.99                       | 11.86                          | 9.20–14.68                       | 0.063   |                                  |  |  |          |
| Ca(mg/1000 kcal)                       | 341.52            | 243.96–460.63                    | 332.13  | 236.19–451.85 <sup>a</sup>       | 353.10  | 251.48–470.22 <sup>b</sup>       | 338.42                         | 243.46–458.63 <sup>b</sup>       | 0.036   |                                  |  |  |          |
| Fe (mg/1000 kcal)                      | 4.96              | 4.12–5.91                        | 4.97    | 4.11–5.95                        | 4.98    | 4.12–5.88                        | 4.95                           | 4.12–5.94                        | 0.900   |                                  |  |  |          |
| Na (mg/1000 kcal)                      | 813.88            | 619.19–1046.93                   | 819.40  | 618.80–1058.30                   | 832.46  | 630.50–1052.60                   | 797.38                         | 608.33–1028.48                   | 0.090   |                                  |  |  |          |
| K (mg/1000 kcal)                       | 1344.46           | 1109.96–1613.37                  | 1326.66 | 1081.71–1601.16                  | 1355.04 | 1121.01–1632.25                  | 1352.42                        | 1132.66–1599.73                  | 0.062   |                                  |  |  |          |
| Vitamin A (µg/1000 kcal)               | 313.90            | 211.37–484.49                    | 306.48  | 209.41–476.76 <sup>a</sup>       | 328.02  | 221.57–515.77 <sup>b</sup>       | 307.43                         | 204.06–471.36 <sup>a</sup>       | 0.014   |                                  |  |  |          |
| Vitamin B <sub>12</sub> (mg/1000 kcal) | 1.69              | 1.17–2.46                        | 1.66    | 1.15–2.51                        | 1.73    | 1.20–2.47                        | 1.66                           | 1.16–2.39                        | 0.515   |                                  |  |  |          |
| Vitamin C (mg/1000 kcal)               | 52.35             | 22.48–100.23                     | 47.39   | 20.70–90.77 <sup>a</sup>         | 59.04   | 25.41–107.16 <sup>b</sup>        | 50.58                          | 22.66–98.17 <sup>c</sup>         | < 0.001 |                                  |  |  |          |

PAS: Programa Academia da Saúde; kcal: kilocalories. Superscript letters: different letters = different values and equal letters = equal values.

\*P value: Kruskal–Wallis with Dunn post hoc.

trans fats, while having 3 times more fibre, 2 times more protein, and 2.5 times more K<sup>(38)</sup>.

Participation in the programme for a longer time was associated with increased consumption of nutrient-rich foods that protect against development of NCD, increasing the population's health and quality of life. The users in the 2nd or 3rd tertiles of PAS reported higher carbohydrates, Ca and vitamin C intake. Unprocessed foods in culinary preparations are the sources of Ca and vitamin C. Studies show that Ca has a protective role with CVD, through mechanisms that lower blood pressure, lower lipid levels and improve glycaemic control<sup>(39–41)</sup>. Vitamin C is a powerful antioxidant that acts on redox and mitochondrial pathways in the immune system, the inflammation of ageing, endothelial integrity, lipoprotein metabolism and the central nervous system by eliminating free radicals<sup>(42,43)</sup>. Higher vitamin C intake can restore gut–liver function, with antioxidants protecting development of metabolic syndrome and type 2 DM<sup>(44)</sup>.

One limitation of this study was the use of 24-h dietary recall to evaluate food and nutrient intake, which could be influenced by information bias. However, interviewers were periodically trained to apply and use home-made measures to estimate the size of food portions. In addition, NCD (DM, arterial hypertension and dyslipidemia) were self-reported, but for the conditions studied, these methods can provide a useful estimate<sup>(45)</sup>.

Another limitation is that a cross-sectional study does not allow for the identification of causality, with longitudinal assessment. The results of this article may have been influenced by consumption habits of PAS users, which differ from the rest of the Brazilian population. Participants in PAS tend to have adequate consumption of fruits and vegetables<sup>(46)</sup>, while 22.2% of the Brazilian population consumes the same within recommended guidelines<sup>(35)</sup>.

It is important that at the time of this study, the Food Guide for the Brazilian Population was not yet updated to make it consistent with the NOVA classification. It is necessary that new studies verify how participation in PAS developed, with adoption of the updated food guide.

This is a pioneering study about the consumption of all food groups, according to NOVA's classification in health promotion services, according to the time in this service, which made it possible to determine nutrient intake. The association between length of participation and improvement of one's food and nutrient profile can contribute to expansion of the PAS in Brazil, and its implementation in other countries. It is worth mentioning that longitudinal studies must be conducted to confirm this hypothesis.

Under the current federal administration, PAS is at great risk given the lack of prioritisation of health programmes. Public health has been devalued in the country. In 2019, the Extended Family Health and Primary Care Center (Núcleo Ampliado de Saúde da Família e Atenção Básica (NASF-AB), Portuguese) was extinguished through a new Primary Care financing model<sup>(47)</sup>. To consolidate this decision in January 2020, a technical note abolished the



registration of new NASF-AB teams and prevented the municipal and state managers from registering these professionals with the national register of health establishments<sup>(48)</sup>. Therefore, professionals are not linked to the state and can be released from their duties easily. The NASF-AB was created with the objective of supporting the consolidation of Primary Care in Brazil by increasing the implementation of health promotion programmes and comprehensive primary health care services. Thus, the actions to promote healthy food in the PAS also are conducted by professionals that are linked to the NASF-AB. This policy of budget reduction which disincentivises multidisciplinary teams may compromise the health promotion actions developed in PAS, especially those that promote healthy eating.

In conclusion, the participation in PAS contributed to users' improved eating habits. The benefits are clear within 1 year of being in the programme. Promoting healthy lifestyles based on self-care can lead to a higher degree of autonomy and lower costs for the public health system. These findings suggest that investment in public policies that improve population physical activity and healthy eating may provide both health and economic benefits.

### Acknowledgements

**Acknowledgements:** The team of researchers from the Research Group on Nutrition Interventions at the Universidade Federal de Minas Gerais (GIN/UFMG) for their cooperation in data collection and entry, the managers and professionals of the Programa Academia da Saúde and the Belo Horizonte Municipal Health Secretariat, Minas Gerais, Brazil, for technical and material support, the Center for Epidemiological Research in Nutrition and Health (NUPENS) for the availability of NOVA group food conversion worksheets. **Financial support:** This research was funded by Conselho Nacional de Desenvolvimento Científico e Tecnológico (numbers: 476686/2013-0 and 302978/2018-6) and Fundação de Amparo à Pesquisa de Minas Gerais (numbers: 21618/2013, APQ-03376-12 and PPM-00254-15). **Conflict of Interest:** There are no conflicts of interest. **Authorship:** Conceptualisation, A.R.S., M.S.L., P.P.F. and A.C.S.L.; methodology, A.R.S., M.S.L., S.F.C., L.C.S., P.P.F. and A.C.S.L.; software, A.R.S. and M.S.L.; formal analysis, A.R.S.; investigation, A.R.S., M.S.L., S.F.C. and P.P.F.; resources, A.R.S., M.S.L., S.F.C. and P.P.F.; data curation, M.S.L., P.P.F. and A.C.S.L.; writing – original draft preparation, A.R.S.; writing – review and editing, A.R.S., M.S.L., S.F.C., L.C.S., P.P.F. and A.C.S.L.; supervision, M.S.L. and A.C.S.L.; project administration, A.C.S.L. All authors have read and agreed to the published version of the manuscript. **Ethics of human subject participation:** This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Research Ethics Committees of the University

(Numbers: 0537.0.0203.000-11 and 52683916.0.0000.5149) and City Hall (Number: 0537.0.0203.410-11A). Written informed consent was obtained from all subjects/patients.

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