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SEMI-QUANTITATIVE STUDY OF THE POLYPHENOL CONTENT IN THE DIET OF SCHOOLCHILDREN IN THE JUNDIAÍ ELEMENTARY SCHOOL SYSTEM BEFORE AND AFTER EDUCATIONAL INTERVENTION

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Abstract: Introduction: In the face of dietary changes in the 20th and 21st centuries, consumption of processed and ultra-processed foods, classified according to the Food Guide for the Brazilian Population and the NOVA classification, has been increasing at different ages, especially among younger people. Studies suggest that diets rich in these foods are associated with the prevalence of overweight, obesity, chronic non-communicable diseases, especially diabetes mellitus and cardiovascular diseases. Therefore, this study seeks to intervene in the diet of elementary school students, proposing a lower consumption of these industrialized foods and a higher consumption of polyphenols, micronutrients which, in addition to improving insulin resistance and reducing the risk of DM-2 and/or its progression, also contribute to improving the lipid profile, lowering blood pressure and body weight in individuals who have been diagnosed with metabolic syndrome. **Objective**: **To** evaluate the polyphenol content and the impact of an educational talk on the diet of EMEB children using food diaries (DAs) and data from the Phenol - Explorer platform. **Materials and Methods**: Semi-quantitative before-and-after intervention study with 8 to 12-year-old students from the participating EMEBs in Jundiaí, mainly comparing polyphenol consumption through the use of food diaries. **Results**: 168 diaries were collected in the first application (pre-intervention), 103 in the second application (post-intervention) and 96 in the third application (post-intervention). The data collected showed a reduced intake of polyphenols, since the highest average in the descriptive analysis of the consumption of legumes and vegetables was 0.67 portions in the first application; 0.79 in the second application and 0.49 in the third application. Meanwhile, consumption of refined carbohydrates (white bread, cake, cookies and toast) although significantly higher, decreased after the intervention, as the average was 1.62 portions in the first application; 1.5 in the second and 1.05 in the third application. In a comparative analysis with repeated measures between the first and second application of the DAs (before and after the educational talk), there was no change in the intake of polyphenols, nor was there any significant change in the comparison between the first and third application of the DAs. **Conclusion**: It can be concluded that there was no significant improvement in polyphenol consumption after the educational intervention. However, it can be seen that in the pre-intervention the intake of these micronutrients was already lower than the healthy eating standard, a fact that may be related to socio-economic factors and low dietary education, which is reflected in the drop in adherence to filling in food diaries. Finally, we conclude that educational talks like this are necessary and should be routinely encouraged to improve children's dietary education, since we were able to intervene positively in this target audience.

Keywords: Polyphenols; Dietary fiber; Food diary; Type 2 Diabetes Mellitus; Metabolic Syndrome

INTRODUCTION

The 1970s were marked by a process of rural exodus in Brazil, as well as intense industrialization and urbanization. According to the National Household Sample Survey (PNAD) 2015, 84.72% of Brazilians live in urban areas (IBGE, 2015). One of the consequences of this has been a nutritional transition. Author of this concept in 1993, Richard Popkin states that changes in dietary patterns accompany the economic, demographic and epidemiological changes of the period (BATISTA FILHO; RISSIN, 2003). Thus, there was an increase in diets rich in fats, refined foods and a reduction in complex carbohydrates and fiber. At the same

time, there was an increase in the prevalence of overweight, obesity and chronic non-communicable diseases (diabetes mellitus and cardiovascular diseases). (BICALHO DE SOUZA, 2010).

In 2017, 424.9 million people in the world had Type 2 Diabetes Mellitus (DM-2), characterized by insulin resistance and hyperglycemia (GOLBERT; et al, 2019). Between 2001 and 2009, there was a 30.5% increase in the prevalence of DM-2 in individuals aged 0-19 years in the United States of America (USA) (DABELEA; et al, 2014). In Brazil, the Study of Cardiovascular Risks in Adolescents (ERICA) concluded in 2017 that the prevalence of DM-2 and prediabetes in Brazilians aged 12 to 17 is 3.3% and 22%, respectively (TELO; et al, 2019).

According to the 2019 National Health Survey carried out by the Brazilian Institute of Geography and Statistics (IBGE) involving 108,000 households, one in four people aged 18 or over were obese (Body Mass Index - BMI - above 30). Overweight (BMI above 25) affects 60.3% of this population. In addition, 18% of adolescents are overweight; 9.53% are obese; and 3.98% have severe obesity (GOVERNMENT OF BRAZIL, 2020). While 352,800 children between the ages of 5 and 9 are obese, 670,900 are overweight and 200,000 are severely obese, according to the Atlas of Childhood Obesity in Brazil (MINISTÉRIO DA SAÚDE, 2019).

This highlights the urbanized child: the one who grows up without contact with rural sources of plant and animal foods, and is familiar with processed foods. According to the NOVA classification and the Food Guide for the Brazilian population, fresh foods are those obtained directly from plants or animals and purchased for consumption without alterations after leaving nature (MINISTÉRIO DA SAÚDE, 2014), and are only seen in their natural form in supermarkets.

On the other hand, in the urbanized environment, many supermarket foods are processed, being manufactured by adding salt or sugar to the fresh or minimally processed food, such as pickled vegetables, cheeses and breads; or ultra-processed, which involves manufacturing in several stages and processing techniques and the addition of various ingredients, many of which are used exclusively industrially, for example, stuffed cookies and "instant noodles". (MINISTÉRIO DA SAÚDE, 2014), being foods that have a very high calorie and fat content. A study published in 2021 in the USA, which followed around 3,000 volunteers for two decades, linked high consumption of ultra-processed foods to a higher incidence of cardiovascular disease (JUUL; et al, 2021).

When analyzing the micronutrients in processed or ultra-processed foods, there is a low amount of soluble fiber and polyphenols. These phenols are defined as a "large and heterogeneous group of phytochemicals containing phenolic rings, divided into flavonoids, phenolic acids, stilbenes and lignans" (GUASCH-FERRÉ; et al, 2017) that are found in products of plant origin. They can have benefits for human health, as has been demonstrated in in vitro and in vivo studies, showing antioxidant and anti-inflammatory effects (CHIVA BLANCH; BADIMON, 2017). Evidence shows that their intake can exert beneficial effects in the treatment and prevention of DM-2, such as delaying the digestion and absorption of carbohydrates by interacting in the oral cavity, intestinal alpha-amylase, intestinal alpha-glucosity and sodium-dependent glucose transporter; stimulates the protein kinase pathway, promoting greater insulin secretion, reduces oxidative damage to the pancreatic beta cell, modulates hepatic glucose release, activates glucose uptake receptors in insulin-sensitive tissue such as GLUT-2 and GLUT-4. (GUASCH-FERRÉ; et al, 2017).

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In addition to these benefits, it has been shown to contribute to improving the lipid profile, lowering blood pressure and body weight in individuals who have been diagnosed with metabolic syndrome, a chronic, systemic and low-grade inflammation (CHIVA BLANCH; BADIMON, 2017). In the cross-sectional HAPIEE study comprising more than 8,800 Poles aged 45 to 69 (GROSSO; et al, 2016), it was shown that BMI, waist circumference, systemic blood pressure and triglycerides were lower among individuals with a higher polyphenol intake, assessed by food frequency questionnaires that were compared with data from the Phenol-Explorer (PE) platform, a database covering the content of polyphenols in foods, containing more than 35.000 content values for 500 different polyphenols in more than 400 foods (PHENOL EXPLORER, 2021). In addition, the cross-sectional HELENA study evaluated the polyphenol intake of 657 European adolescents using anthropometric measurements, blood samples, food diaries (DAs) combined with PE data, and found that higher consumption was inversely associated with BMI (WIRAPUSPITA WISNUWARDANI; et al, 2020). A nutritional survey in Argentina based on 24-hour diaries and the PE website evaluated the polyphenol consumption of 241 schoolchildren aged 6 to 12, concluding that the consumption of vegetables and fruit was low compared to the recommendations (SAMMAN, 2016).

When analyzing the content of the Phenol-Explorer (PE) website, polyphenols are found predominantly in fresh and minimally processed foods, such as fruit (oranges, apples, strawberries and grapes), vegetables (beet, broccoli and tomatoes), grains (rice, beans and lentils) and nuts (chestnuts and walnuts). It should be noted that the way in which food is prepared can affect the amount of phenolic compounds. Fried foods have a greater loss of polyphenols, while boiled or steamed foods can generally preserve these micronutrients better. In addition, the preservation of one type of polyphenol in a specific food can be benefited by one method of preparation, while other polyphenols can be harmed by the same method (ROTHWELL; et al, 2019).

Dietary fibers are divided into soluble and insoluble. The former, when fermented in the large intestine, are able to reduce the absorption of macronutrients and stimulate the hormonal production of incretin GLP-1 and peptide YY, promoting greater satiety, insulin secretion and lower post-prandial glycemia (LATTIMER; HAUB, 1996). In turn, insoluble fibers potentiate the secretion of the incretin GIP, allowing the food to remain in the gastrointestinal tract for longer, with less absorption of nutrients and higher blood glucose (WEICKERT; et al, 2021).

Given this scenario, the municipality of Jundiaí has gone through the process of dietary transition. The 2020 census revealed an urbanization rate of 97.08% according to the State Data Analysis System Foundation (PREFEITURA DE JUNDIAÍ, 2020), reflecting on the diet of its population. According to a study carried out in 2017 in the municipality, which analyzed 1246 food diaries of 623 students aged 9-10 years old, it was concluded that the main source of carbohydrates for this group were ultra-processed foods (D'ABRONZO; et al, 2019). High consumption of sugary drinks was also reported. At the same time, around 50% of the schoolchildren from the Municipal Basic Education Schools (EMEBs) in Jundiaí evaluated were overweight.

As for university students, studies have shown that the majority had a diet rich in processed and ultra-processed foods and a low consumption of fresh foods, regardless of whether they were studying health courses (BERNARDO; et al, 2017).

With all these changes and bad habits mentioned above, it is necessary to intervene

in the dietary, family and physical spheres. Thus, with a view to the nutritional aspect, this study proposes that educational talks be given and food diaries organized based on the Food Guide for the Brazilian Population (MINISTÉRIO DA SAÚDE, 2014), in order to find out about the dietary situation of both EMEB schoolchildren and students at the Jundiaí Medical School (FMJ), assessing the polyphenol and fibre content present in the food compared with data from the Phenol Explorer platform and measuring the ability of our talks to interfere with the dietary pattern of this population, with a view to preventing DM and obesity.

RESULTS

A total of 168 DAs were collected in the first application (pre-intervention), 103 in the second application (post-intervention) and 96 in the third application (post-intervention). The samples showed a reduced intake of polyphenols, since the highest average in the descriptive analysis of the consumption of legumes and vegetables was 0.67 portions in the first application; 0.79 in the second application and 0.49 in the third application. Meanwhile, consumption of refined carbohydrates (white bread, cake, cookies and toast) although significantly higher, decreased after the intervention, as the average was 1.62 portions in the first application; 1.5 in the second and 1.05 in the third application. In a comparative analysis with repeated measures between the first and second application of DAs (before and after an educational talk), there was no change in polyphenol intake, nor was there any significant change when comparing the first and third application of DAs.

DISCUSSION

When analyzing the data collected from the three EMEBs evaluated, the consumption of simple carbohydrates was significantly higher than the consumption of legumes and vegetables, which are rich in polyphenols.

It was also observed that there was no significant change in dietary patterns before and after the educational talk, which took place on the second visit to the EMEBs. However, the talks were very useful, the students interacted a lot and showed interest in healthy eating. We faced difficulties in carrying out the research, which may have contributed to the final result, such as: inadequate completion of the food diaries, students forgetting to remember the food to hand in later, difficulty in collecting the diaries from the schools, low adherence by those responsible to attend the educational talk, many absences by students on days with unfavorable weather conditions.

Finally, we were also going to apply the survey to students at the Jundiaí Faculty of Medicine, but due to the low level of participation at the beginning of the year, we decided to give an educational talk and apply the DAs only to students at the EMEBs, associated with the city hall project that was underway throughout 2022.

CONCLUSIONS

It can be concluded that there was no significant improvement in polyphenol consumption after the educational intervention. However, it can be seen that in the pre-intervention the intake of these micronutrients was already lower than the healthy eating standard, a fact that may be related to socioeconomic factors and low dietary education, which is reflected in the drop in adherence to filling in food diaries. Finally, we conclude that educational talks like this are necessary and should be routinely encouraged to improve children's dietary education, since we were able to intervene positively in this target audience.

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