



Trabajo Original

Planetary health diet versus usual diet in adolescents. How do food and physical activity influence academic performance?

Dieta de salud planetaria contra dieta habitual en adolescentes. ¿Cómo impactan la alimentación y la actividad física al rendimiento escolar?

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Abstract

Objective: to analyze the relationship of the similarity of planetary health diet and habitual diet with the practice of physical activity on the academic performance of adolescent high school students by gender.

Method: 877 adolescents were evaluated. The diet is reviewed through the 24-hour reminder. Physical activity was classified according to type of activity, frequency, duration, and intensity using the APALQ questionnaire. The caloric intake of adolescents was compared with the proposal of the EAT-LANCET commission, and the relationship between physical activity and diet with academic performance was again established.

Results: Mexican adolescents do not comply with the proposal of a planetary health diet. No relationship was found between physical activity and academic performance. On the other hand, animal proteins rich in fats are consumed doubly according to the recommendation; these and whole grains, both are inversely related to better academic performance.

Conclusions: Mexican adolescents are far from consuming a planetary health diet. Physical activity was not related to academic performance, but there is an inverse relationship between fat-rich animal proteins and whole grains in relation to subjects that contribute to academic performance, which suggests that a healthy diet such as the planetary diet proposal could have an impact on environmental sustainability and favorably impact the academic performance of adolescents.

Keywords:

Adolescents. Exercise.
Healthy diet. Nutrition.
Sustainable food.

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Resumen

Objetivo: analizar la relación de la similitud entre la dieta de salud planetaria y la dieta habitual con la práctica de actividad física sobre el rendimiento académico en adolescentes estudiantes de secundaria por género.

Método: se evaluaron 877 adolescentes. La dieta se revisó a través del recordatorio de 24 horas. Se clasificó la actividad física según el tipo de actividad, frecuencia, duración e intensidad con el cuestionario APALQ. Se comparó la ingesta calórica de los adolescentes con la propuesta por la comisión EAT-LANCET y se establecieron relaciones entre la actividad física y la dieta con el rendimiento académico.

Resultados: los adolescentes mexicanos no cumplen con la propuesta de una dieta de salud planetaria. No se encontró relación entre la actividad física y el rendimiento académico. Por otro lado, las proteínas animales ricas en grasas se consumen doblemente de acuerdo con la recomendación; estas y los cereales integrales, ambos se relacionan inversamente con un mejor rendimiento académico.

Conclusiones: los adolescentes mexicanos están lejos de consumir una dieta planetaria saludable. La actividad física no se relacionó con el rendimiento académico, pero sí existe una relación inversa entre las proteínas animales ricas en grasas y los cereales integrales con relación a materias que contribuyen con el rendimiento académico, lo que sugiere que una alimentación saludable como la propuesta de la dieta planetaria podría tener impacto sobre la sostenibilidad ambiental e impactar favorablemente en el rendimiento académico de los adolescentes.

Palabras clave:

Adolescentes. Ejercicio. Alimentación saludable. Nutrición. Sustentabilidad alimentaria.

INTRODUCTION

The agenda for sustainable development represents the largest initiative in history, where all countries and governments make an effort to contribute to the emerging problems of the planet (1). Among these problems are food and climate change, which have become topics of increasing interest and concern for society and the scientific community (2). As the population grows and natural resources decline, it is essential to address the impact of food consumption patterns on the environment.

In response to this situation, the health planetary diet has emerged, which aims to address the challenges of human nutrition and environmental sustainability. This diet proposes a daily consumption of 2500 kcal for adults, where the intake of sugars, fats, and processed foods is minimized while balancing foods of animal and plant origin. Legumes are the primary source of protein in this diet to significantly reduce the number of deaths caused by inadequate diets worldwide and to be environmentally sustainable to prevent the collapse of the natural world (3).

On one hand, Mexico and the United States are among the countries with the highest rates of obesity and overweight in the world (4), particularly among the young people in Mexico (5). Globally, it is estimated that 81 % of students between 11 and 17 years of age do not meet the minimum recommendations for physical activity (6).

On the other hand, there is a concerning situation of low academic performance in Latin American schools since, according to the results obtained in the Program for International Student Assessment (PISA) exam, only 1 % of students achieved outstanding performance in reading, mathematics, and science (7). Given this panorama, the school environment presents an ideal setting for implementing comprehensive strategies to address these issues jointly.

Various research studies have linked physical activity and academic performance (8), as well as nutrition and its implications on school performance (9). These studies indicate that schools are an ideal medium for reinforcing food education and addressing this need, given that eating habits worldwide and current diets do not meet the criteria for physical health in adolescents, as mentioned by Marshall et al. (2024), Montero et al. (2017), Boushey et al. (2020) (10-12) and UNICEF, where it is mentioned

that at least 1 in 3 boys and girls under the age of five years in the world are undernourished or overweight (13). Moreover, only one in three young children follow a diet that meets the minimum criteria for dietary diversity (14) and, globally, adolescents are the group that mostly fails to engage in moderate to intense physical activity for at least 60 minutes per day, thus not meeting the physical activity recommendations (6).

Regular physical activity and a proper diet are associated with a natural reduction in obesity and a decreased risk of cardiometabolic diseases (15,16). However, controlling dietary habits is complex because they are influenced by various factors, such as place of origin, social and physical environment, culture, relationships, socioeconomic status, food availability, age, and gender (17).

On the other hand, physical activity has been studied for its effects on the health of the central nervous system at all stages of life (18). During the early stages of life, the brain changes both structure and function (19). In this regard, regular physical activity is effective in increasing the cognitive capacity of students (20). Studies have shown that acute physical activity has a positive effect on attention, while longitudinal physical activity programs have a positive impact on executive functions and academic performance (21).

Furthermore, the quality of the diet can influence the cognitive capacity and academic performance of adolescent students. For instance, the intake of foods high in sugar is associated with difficulty concentrating, poor memory, and impaired reasoning, while foods with a low glycemic index and sufficient supply of omega-6:3 fatty acids and amino acids are related to better memory and reduced cognitive decline (22,23).

Indeed, adolescence is an ideal stage to teach food education along with promoting healthy lifestyles. Educating school students about the importance of a balanced and sustainable diet and how regular physical activity is connected to good academic performance will help shape healthy citizens ready to face global challenges. Therefore, this research had two main objectives: first, to compare the habitual diet with the planetary diet, and second, to correlate the habitual diet with the practice of physical activity and academic performance in adolescents from northern Mexico, analyzing the data based on gender differences.

METHODS

A quantitative study with a cross-sectional-descriptive design was carried out and approved by the Faculty of Physical Culture Sciences scientific committee under folio 03032022-031. All students gave their consent for voluntary participation, while the parents or guardians signed the informed consent letter. The procedures and measurements were carried out under the ethical guidelines of the Helsinki Treaty (24).

SAMPLE SELECTION

A total of 877 students, aged between 12 and 15 years (13.4 ± 0.4 years), belonging to the first, second, and third grades of three high schools located in the south, center, and north of Chihuahua, Mexico, participated in this research. Exclusion criteria were established as those students with difficulties who, due to some pathological condition or disability, could not perform regular physical activities or answer the questionnaires, which were on a diet, used controlled medication or were not enrolled in secondary sports school, invalid data and that did not comply with all the evaluations, obtaining a final sample of 525 adolescent students.

PROCEDURE AND VARIABLES

The data was collected during the evaluation period in March 2022. An electronic questionnaire was designed to record physical activity and nutrition data. A pilot questionnaire was previously carried out to observe possible questions that did not provide the necessary information; after analyzing the answers, the invalid or confusing questions were adjusted. The directors were asked to hand out personally the questionnaire form to each of the student's parents, all this was through the tutors, who explained the correct way to answer the form. The students were informed, and explanations were given about the variables during their healthy life class by personnel from the area of physical culture.

Since the objective of the study was to analyze the relationship between the similarity with the planetary health diet (kcal consumed from vegetables, fruits, legumes, low-fat animal protein, high-fat animal protein, saturated fats, unsaturated fats, tubers, dairy products, grains whole, and added sugars) and usual diet, then the practice of physical activity (level of sedentary lifestyle, moderately active and very active classification) on academic performance in adolescent high school students from northern Mexico by gender.

The variables studied that were self-reported included: eating, physical activity, and academic performance.

Eating

The 24-hour food reminder (R24h) was digitized, and parents with their children were asked to select the food consumed the

previous day respectively to the food groups according to the Mexican system of equivalent foods distributed in groups. Concordant to the proposal of the EAT-LANCET commission (whole grains, tubers, vegetables, fruits, dairy products, animal protein, vegetable protein, fats, and sugars), the kcal of each food group were subsequently counted to determine the percentage of consumption of each child proposed according to the planetary health diet.

The R24h was digitized and sent to the mother or guardian of the student, with the instruction to fill it out together with the student while they were in the kitchen. The digitalized recall presented foods described and accompanied by photographs, grouped according to the food groups based on the Mexican System of Equivalent Foods (whole grains, tubers, vegetables, fruits, dairy products, animal protein, vegetable protein, fats, and sugars). Each food item was described in portions. The number of portions was multiplied by the calories according to the food group based on this Equivalent Food System. Then the mother, together with the adolescent, selected in the digital form the number of portions of each food consumed, if applicable. The recall was conducted in the middle of the week to have records of two weekdays and one weekend day.

The portions recorded were subsequently converted into grams and then into calories (Kcal) to compare them with the proposed daily caloric intake of the planetary diet.

Recorded physical activity

It was investigated through the Physical Activity Levels Assessment Questionnaire (APALQ) (25), which consists of five questions that are measured on a Likert-type scale in which 1 is the lowest value, and 4 or 5 is the highest, having a summative character. The minimum score obtained is 5 and the maximum is 20, from which the following classification is obtained: from 5-10: sedentary level; 11-16: moderately active level; ≥ 17 : very active level (26).

Academic performance

The campus management awarded the grades of eight subjects belonging to the second period which was carried out during the evaluation of the questionnaire. The subjects that were the same for the first, second, and third years were recorded, as well as the final average of academic performance. The ranges established were excellent (10), very good (9.0-9.9), good (8.0-8.9), sufficient (7.0-7.9), regular (6.0-6.9), and insufficient (< 6.0).

Data analysis

The Kolmogorov-Smirnov test was used to determine the normality of the data ($p > 0.05$). The means and standard deviations were reported for the variables related to physical activity and the 25th, 50th, and 75th percentiles for the food data. Student's t-test was used for independent samples to identify differences

between sexes regarding physical activity data, as well as the comparison of means of a sample using the cut-off point of the suggested kcals of each feeding group versus the consumed kcals. Likewise, a one-sample-Student's t-test was applied to a sample to compare the mean kcals of each food group in our study with what is recommended in the planetary health diet. A Spearman's correlation was performed to see the relationship between physical activity and diet on academic performance by subjects and by the final average of academic performance. All tests were performed at a confidence level of 95 % and were carried out in the statistical package SPSS V.15 for Windows.

RESULTS

FOOD GROUPS AND THEIR RELATIONSHIP WITH THE RECOMMENDATION OF THE EAT-LANCET COMMISSION

The data about the diet registered through the R24H show that the studied population consumes fruits, animal proteins, saturated fats, and whole grains, and far below the proposal of a planetary health diet, legumes ($p < 0.05$). The figure 1 shows the difference in calorie consumption by sex shown in table I.

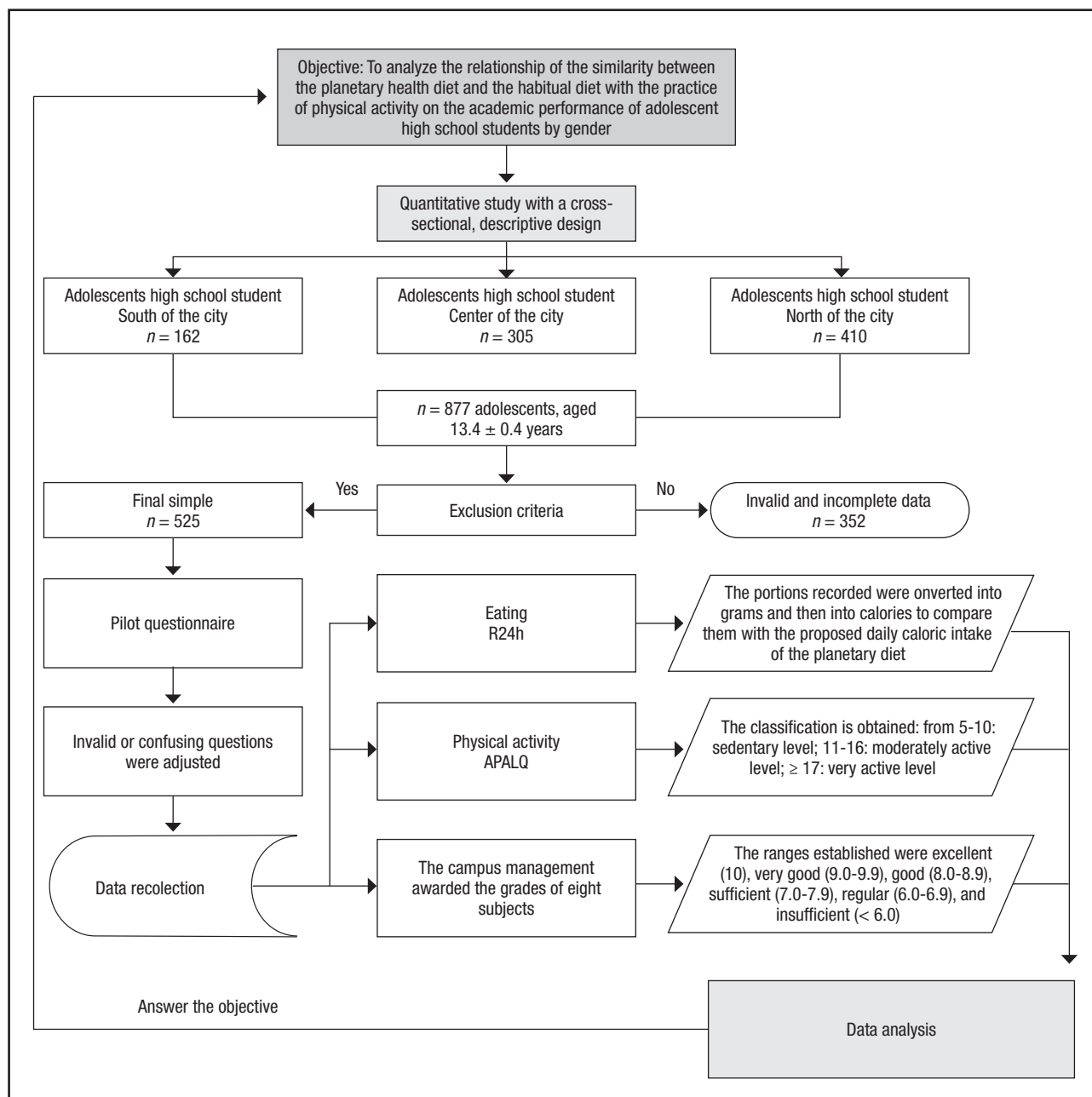


Figure 1.

Table I. Food groups and their relationship with the recommendation of the EAT-LANCET commission results, by sex

| Food group | Girls (n = 249) | | | EAT LANCET recommendation (kcal) | Boys (n = 276) | | | p |
|---|--------------------|------------------|------------------|--|-------------------|------------------|------------------|-------|
| | Percentile 25 | Percentile 50 | Percentile 75 | | Percentile 25 | Percentile 50 | Percentile 75 | |
| Vegetables (kcal) | 38 | 75 | 110 | 78 | 32.6 | 63 | 100.8 | 0.227 |
| Fruits (kcal) | 120 | 180 | 300 | 126 | 120 | 180 | 300 | 0.745 |
| Legumes (kcal) | 120 | 120 | 240 | 575 | 120 | 120 | 240 | 0.530 |
| Low-fat animal protein (kcal) | 40 | 80 | 160 | 121 | 40 | 80 | 160 | 0.469 |
| High and moderate fat animal protein (kcal) | 100 | 200 | 300 | 30 | 200 | 200 | 400 | 0.002 |
| Saturated oils (kcal) | 70 | 70 | 70 | 354 | 70 | 70 | 70 | 0.063 |
| Unsaturated oils (kcal) | 45 | 90 | 180 | 96 | 45 | 90 | 180 | 0.678 |
| Tubers or starchy vegetables (kcal) | 140 | 280 | 420 | 39 | 210 | 350 | 490 | 0.019 |
| Whole milk or equivalents (kcal) | 95 | 190 | 190 | 153 | 95 | 190 | 190 | 0.951 |
| Whole grains (kcal) | 294.9 | 589.7 | 679.45 | 811 | 294.9 | 589.7 | 884.6 | 0.900 |
| Added sugar (kcal) | 40 | 60 | 80 | 120 | 40 | 40 | 80 | 0.715 |
| Total kcal | 798.75 | 938 | 982.25 | 2500 | 711.5 | 815 | 945 | 0.041 |

n: simple; kcal: kilocalories.

COMPARISON OF CALORIC INTAKE CONCERNING THE EAT-LANCET PROPOSAL

Table II shows the level of significance concerning the percentage consumed by the food group with that proposed by the EAT LANCET commission. The cut-off point shows the calories suggested for the planetary health diet, then it is possible to observe where it is observed that in all food groups, there is a significant difference between what is proposed and regular consumption, except for vegetables and whole grains.

PHYSICAL ACTIVITY

The percentages of the Levels of physical activity according to APALQ, the different types of activities that the students carry out and the days and the time dedicated to physical activity, and the main differences by sex are shown. A total test score of 12.2 ± 4.6 was obtained, where it is possible to observe that it is mostly boys who fall into the classification of very active compared to girls (26.1 % vs 13.6 %, respectively), while there is a difference of a high level of a sedentary lifestyle in girls vs. boys (48.9 % vs. 30 %, respectively) as shown in table I. About the activities carried out, it is the boys who mainly participate in team sports compared to the girls (58.0 % vs 10.4 %, respectively), while girls prefer activities such as dance (8 % vs 0.7 %, respectively) and individual sports (10.8 % vs 6.9 %, respectively) compared to boys (Table III).

CORRELATION OF FOOD AND PHYSICAL ACTIVITY GROUPS WITH ACADEMIC PERFORMANCE

In the correlation analysis of the variables of food and physical activity groups with academic performance, it shows a negative correlation between the consumption of sugar ($r = -0.145$) and whole grains ($r = -0.150$), with the subject of Civic Training and Ethics as well as a negative correlation between the consumption of high-fat animal protein and saturated fats ($r = -0.158$) with the subject of mathematics and the subject of Spanish ($r = -0.109$) with the same food groups, unlike with legumes where the correlation with the subject of Spanish is positive ($r = 0.123$).

The data related to physical activity showed positive relationships between fruits and vegetables with the APALQ total score ($r = -0.124$ and $r = 0.159$, respectively, $p < 0.050$) and with the classification of the level of physical activity ($r = 0.930$ and $r = 0.180$, respectively, $p < 0.05$), respectively. In turn, physical activity was related to the subjects of Spanish ($r = 0.111$, $p < 0.05$) and mathematics ($r = 0.101$, $p < 0.05$) as shown in table IV.

DISCUSSION

EATING AND ACADEMIC PERFORMANCE

The results of this study show that there is a consumption of 2.2 portions of low-fat animal protein for every 3.1 portions of moderate and high-fat animal protein compared to the rec-

Table II. Comparison of food intake concerning the EAT-LANCET proposal

| | Number of portion Intake (students) | ELC recommendation (kcal) | Mean (kcal) Intake (students) | SD | 95 % confidence interval | | <i>p</i> |
|--------------------------------------|-------------------------------------|---------------------------|-------------------------------|-------|--------------------------|--------|----------|
| Vegetables | 2.8 | 78 | 80.9 | 55.1 | -4.9 | 4.6 | < 0.001 |
| Fruits | 3.8 | 126 | 232.8 | 182.1 | 91.2 | 122.4 | < 0.001 |
| Legumes | 1.2 | 575 | 152.7 | 80.5 | -429.2 | -415.4 | < 0.001 |
| Low-fat animal protein | 2.2 | 121 | 104.57 | 72.5 | -22.6 | -10.2 | < 0.001 |
| High and moderate fat animal protein | 3.1 | 30 | 270.1 | 193.9 | 223.3 | 256.7 | < 0.001 |
| Saturated oils | 1.3 | 96 | 61.1 | 30.2 | -37.55 | -32.33 | < 0.001 |
| Unsaturated oils | 1.7 | 354 | 119.3 | 68.2 | -240.5 | -228.8 | < 0.001 |
| Tubers or starchy vegetables | 4.9 | 39 | 349.6 | 215.0 | 292.1 | 329.0 | < 0.001 |
| Whole milk or equivalents | 0.9 | 153 | 140.2 | 57.3 | -17.7 | -7.8 | < 0.001 |
| Whole grains | 4.6 | 611 | 529.7 | 20.0 | -57.7 | 21.0 | 0.361 |
| Added sugar | 1.7 | 120 | 65.1 | 33.3 | -57.7 | -51.9 | < 0.001 |
| Kcal totals | 1.3 | 2500 | 1923 | 783.9 | -643.2 | -508.8 | < 0.001 |

Kcal: kilocalories; SD: standard deviation; ELP: Eat Lancet Proposal.

Table III. Physical activity performed by sex

| | Girls (n = 249) | | Boys (n = 276) | | <i>p</i> |
|-------------------------------------|-----------------|------------|----------------|------------|----------|
| | f | Percentage | f | Percentage | |
| Sedentary level | 120 | 48.9 | 83 | 30.0 | |
| Moderately active level | 91 | 37.3 | 120 | 43.8 | |
| Very active level | 34 | 13.6 | 71 | 26.1 | |
| No activity | 4 | 0.2 | 2 | 0.1 | |
| More activities practiced | | | | | |
| Set sport | 26 | 10.4 | 69 | 25.0 | |
| Dance | 8 | 3.2 | 2 | 0.7 | |
| Individual sport | 27 | 10.8 | 19 | 6.9 | |
| Physical exercise | 56 | 22.4 | 63 | 22.8 | |
| | Mean | DS | Mean | DS | |
| APALQ score | 11.4 | 4.1 | 13.0 | 4.2 | 0.000 |
| Days with physical activity | 1.9 | 2.1 | 2.5 | 2.0 | 0.002 |
| Time allocated to physical activity | 37.6 | 46.8 | 48.8 | 48.0 | 0.007 |

n: simple; f: frequency; p = < 0.05.

ommendations made for a sustainable diet such as the planetary health diet (3).

Although the kilocalories distribution of the planetary diet is suggested for adults, it should range from 2548 kcal/day for men and 2276 kcal/day for women (27) so the differences are not far from the Eat Lancet Commission recommendations. The dietary recommendations suggest that adolescents ingest these amounts of kcals due to the stage of growth in which they are. Although the data shows that adolescents consume 2.2 times more protein of animal origin in relation to the planetary health diet, it is far from being an alarming figure, since with respect

to protein consumption, the recommendation for men should be between 1.0 and 0.95 g/kg/day, and in women between 0.95 and 0.85 g/kg/day. Despite this, the American Heart Association recommends not consuming more than two servings of animal protein per day for adults, and only one serving for adolescents (27). Although for the Spanish population, the recommendation is that 10 to 30 % of the kcals consumed be protein (28), however, these recommendations are not the same for the Mexican population studied (27).

Currently, the effects of a sustainable diet have begun to be researched to plan a food supply for the population without dam-

Table IV. Correlation of food intake, physical activity, and academic performance

| | APALQ total score | APALQ Level | Grammar | Math | Foreign language | Science | History | Values & ethics | Physical education | Arts | Average |
|--------------------------------------|-------------------|-------------|---------|--------|------------------|---------|---------|-----------------|--------------------|--------|---------|
| Vegetables | 0.124 | 0.930 | - | - | - | - | - | - | - | - | - |
| Fruits | 0.159 | 0.180 | - | - | - | - | - | - | - | - | - |
| Legumes | 0.099 | - | -0.123 | - | - | - | -0.134 | - | - | -0.015 | - |
| Low-fat animal protein | - | - | - | - | - | - | - | - | - | - | - |
| High and moderate fat animal protein | 0.117 | 0.115 | -0.109 | -0.158 | - | - | -0.166 | -0.069 | -0.089 | -0.016 | -0.088 |
| Saturated oils | 0.117 | 0.113 | -0.109 | -0.158 | - | - | -0.166 | - | - | - | - |
| Unsaturated oils | - | - | - | - | - | - | - | - | - | - | - |
| Tubers or starchy vegetables | - | - | - | - | - | - | - | - | - | - | - |
| Whole milk or equivalents | -0.089 | - | - | - | - | - | - | - | - | - | - |
| Whole grains | - | - | -0.121 | - | -0.122 | -0.139 | -0.175 | -0.150 | - | -0.106 | -0.112 |
| Added sugar | | | - | -0.131 | -0.09 | -0.099 | - | -0.145 | - | - | - |
| APALQ level | 0.933 | 1.000 | -0.111 | 0.101 | - | - | -0.098 | - | - | - | - |
| APALQ total score | 1.000 | 0.933 | - | - | - | - | - | - | - | - | - |

$p < 0.05$.

aging the environment (1). In a study conducted in Europe, it was found that mainly in the north-west, most consumers saw the importance of making the food system more sustainable and tried to reduce meat consumption as part of a healthy and sustainable diet (29). The high consumption of protein of animal origin found in the adolescents in this study can help us become aware and promote a more sustainable diet, trying to reduce the consumption of products of animal origin and promoting fruit foods, as well as vegetables just as suggested by Boer et al. (29), Dwivedi et al., (30) and Araneda et al. (31).

Similarly, the results found in this research are similar to those found by Morales et al. (32) in the population of Havana, Cuba, where students showed a high consumption of added sugars and fats. However, they differ from the study by Araneda et al. (31), who observed that 60 % of Chilean adolescents do not meet the recommended protein intake. This situation can be explained by the ecological model of food and nutrition proposed by Housni et al. (17). According to this model, the habitual diet depends mainly on the environment in which a person lives, including natural resources, society, organizations, culture, industry, technological advancements, and even nutritional needs. These factors act bidirectionally to influence the quality of the diet.

Due to the lack of literature about the planetary health diet, we have compared studies where factors associated with the Mediterranean diet, which is a form of food based on plant-based foods, such as whole grains, vegetables (33), legumes, fruits, nuts, seeds, herbs, and spices, and where olive oil is the main source of added fat. Fish, shellfish, dairy products, and poultry are included sparingly with red meat and sweets eaten only occasionally. Mediterranean diets are observed in different population groups, and are those that resemble the planetary health diet most. The Mediterranean diet is a type of diet based on the tradi-

tional cuisine of the countries bordering the Mediterranean sea, which involves a high intake of vegetables, fruits, whole grains, beans, nuts, and seeds, along with olive oil. The Mediterranean diet is currently the most aligned with a sustainable diet, and the evidence suggests that it is young women who have greater adherence, however, these data are not yet conclusive (34-36).

Regarding the intake of meat and academic performance, our findings suggest a negative relationship between the consumption of animal fat and academic performance, as this relationship was observed in seven out of nine academic subjects. Possibly due to this, the EAT-LANCET commission has recommended consuming only 30 kcal per day from high-fat animal sources, which is equivalent to 28 grams of beef, pork, or lamb. As we can observe, the average consumption of animal protein was high compared to the recommendation by the EAT-LANCET commission. In the literature, it has been reported that a high consumption of red meat is inversely associated with poor cognition in 6 to 8-year-old schoolchildren (37).

Studies such as the one by Sánchez-Hernando et al. (38) show a positive relationship between the consumption of fruits, vegetables, and fish with academic performance, although in our study, the consumption of vegetables can be associated with planetary diet. This does not show a correlation on any of the subjects or the final average to evaluate academic performance, the same situation that occurs with protein of low-fat animal origin (fish); the amount of intake is not established similar to the planetary health diet when analyzing the amount exceeding its consumption, and this did not show any relationship with academic performance either, while it was presented with the protein of high-fat animals such as beef, unlike the initially mentioned study.

Regarding the consumption of foods of animal origin and the academic performance of the subjects, they suggest a negative

relationship, since it was observed in seven of nine subjects. Possibly, it is due to one of the factors referred to by Infantozzi, (39), since the subjects of this research do not meet the requirement according to the equivalent Mexican system (27) and according to the EAT-LANCET commission 30 kcal daily of animal origin would be insufficient for this type of population since they need to ingest twice the portion, two and a half portions, depending on the person, because an equivalent of moderate animal origin in fat is 75 kcal of energy, of which 7 g are proteins and 5 g are lipids. Adolescents need to consume enough for optimal musculoskeletal development.

This relation could occur because the primary requirements in the brain are glucose, lipids, and essential amino acids since they are essential for brain function and are administered by fatty acids to the bloodstream, while amino acids are essential for the synthesis of proteins and neurotransmitters, all of them found in beef, lamb and pork and whole grains, respectively (40).

PHYSICAL ACTIVITY AND ACADEMIC PERFORMANCE

A systematic review shows that physical activity is related to adherence to the Mediterranean diet (41), a situation that did not occur in this study about the planetary health diet, since the only relationships between physical activity and the food groups consumed, which were vegetables, fruits, legumes, high-fat animal protein, and dairy products; according to the intake recorded there are significant differences with the proposal of the planetary health diet, with values far from the recommendation.

Physical activity was decreased due to the effect of the COVID-19 pandemic lockdown (42). Due to the little physical activity carried out by adolescents, there are problems derived such as the high prevalence of overweight, obesity, and a high percentage of body fat in regions with characteristics similar to those of the present study (43); however, according to the one conducted in Spain, when evaluating the relationship of high adiposity can be mitigated through a moderate adherence to the Mediterranean diet, which similar to that proposed by the EAT-LANCET commission (44).

Boys were the ones who engaged in activities of higher intensity compared to girls, this situation has been previously reported in studies such as Chen et al. (45), and Abalde et al. (46). Furthermore, when comparing the study carried out by Burrows et al. (9), they mention that around 80 % of the students evaluated reported less than 2 hours of weekly scheduled exercise, a situation like the data presented in this study since they are the 19.85 % of the entire sample classified as very active. The boys present moderately active levels of physical activity compared to the girls with a higher percentage classified in the level of sedentary lifestyle (43.8 % vs 30 %), this not being the case for women, since the percentage of sedentary girls is higher than that of moderately active girls (37.3 % vs 48.9 %), with almost half of the population of girls studied is not performing enough activities to classify at some higher level of physical activity.

Physical activity had a relationship with the subjects of grammar and math in the present study, which coincides with the study by Ibarra (47), who mentions that those students who show higher levels of physical activity are associated with better nutrition and with better academic performance. Similarly, we can find a similarity in the literature since the recorded physical activity was related to high consumption of fruits and vegetables (although these exceeded the limits of kcal per food group of the Planetary Health Diet) as well as with raw materials, grammar, math, and history. This similar situation is also observed in a study by Abalde (46), in which a higher level of adherence to the Mediterranean diet was positively associated with academic performance. In turn, a systematic review carried out by Wunsch et al. (48) mentions that one out of every four studies showed a significant effect of a higher level of physical activity and better results in academic performance.

Concerning this topic, Restland et al. (49) show how the regular practice of physical activity during school hours with 90 min/week of physically active educational lessons, did not show significant relationships with academic performance, the same situation identified in this study when registering the days in which sports or physical activity are carried out within the school for at least 20 minutes, no type of relationship was found, so we can assume that when the only practice of physical activity is at school, is insufficient to generate favorable changes in academic performance.

CONCLUSIONS

Adolescent students from northern Mexico exceed the caloric intake of most of the food groups of a planetary health diet, a situation that can trigger damage to the ecosystem in the medium term, such as an increase in global temperature, as well as damage to the environment and the health of individuals due to the high amounts of red meat and saturated fat. Lifestyle is a determining factor for academic performance; to this end, it is necessary to carry out a regular and systematic practice of physical activity, as well as a balanced, healthy diet to show improvements in the academic performance of high school students. It is concluded that having a higher frequency of physical activity and a lower consumption of animal protein high in fat and saturated fat could improve the grades of secondary school students and contribute to global health.

OUTLOOK STATEMENT

The dietary findings suggest the need to design future diets that are nature-friendly, nutritionally adequate, accessible, and culturally acceptable for adolescents. These diets should aim to include different dietary patterns and be suitable for the specific location where they reside. The discrepancies with the planetary health diet shown in the present study indicate that the cultural and regional dietary context, particularly related to livestock

farming, plays an important role in the characterization of sustainable diets for this population. This, in turn, leads to a higher consumption of animal-based protein.

It is necessary to develop food education and physical activity programs during adolescence to raise awareness about the benefits of a healthy lifestyle, schools being the ideal environment for this type of teaching.

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