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Actions to prevent obesity and promote good health in adolescents enrolled in a rural Mexican High School

Acciones para prevenir la obesidad y promover el buen estado de salud en adoleccentes inscritos en una preparatoria rural mexicana

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Abstract:

Introduction: Currently the main chronic degenerative diseases are caused by overweight and obesity in the world, leading to significant damage in infants, children, and adolescents. Therefore, several studies have been carried out about the effect of physical activity, related to reversing the inflammation process produced by overweight and obesity in the body, as well as a balanced diet. Objective: Develop a nutritional and aerobic activity proposal in order to prevent and/or reverse the condition of overweight and obesity in adolescents enrolled in the Universidad Autónoma del Estado de Hidalgo, High School Huejutla campus. Methodology: Descriptive cross study was carried out. Somatometric data were developed in the study sample to measure variables such as height, weight, waist and arm circumference. Subsequently, these measurements were categorized according to the nutritional status of each individual and a diet high in antioxidants was developed. The purpose of the study was to reduce the level of oxidative stress and systemic inflammation to prevent future metabolic complications. Results: According to the categorization of adolescents with respect to the body mass index in percentiles, 6.6% (6) were underweight, 71.71 % (71) normal weight, 18.18 % (18) overweight, 4.4 % (4) obese. Conclusion: In the present study, several nutritional diets were developed, as well as an aerobic exercise plan, to prevent oxidative stress, overweight and obesity in adolescents enrolled in the ESH High school. It also recommends actions to maintain good health in rural and marginal populations in Mexico.

Keywords:

Low-calorie diet, aerobic physical activity, adolescents, obesity, overweight, nutrition

Resumen:

Introducción: actualmente en el mundo las principales enfermedades crónico degenerativas, son causadas por el sobrepeso y la obesidad, lo cual ha desarrollado un daño significativo en lactantes, niños y adolescentes. Por lo tanto, se han realizado varios estudios sobre el efecto de la actividad física, relacionado con revertir el proceso de inflamación producido por el sobrepeso y la obesidad en el cuerpo, así como una dieta equilibrada. Objetivo: Desarrollar una propuesta de actividad nutricional y aeróbica para prevenir y/o revertir la condición de sobrepeso y obesidad en adolescentes matriculados en el campus de Huejutla de la Universidad Autónoma del Estado de Hidalgo. Metodología: Se llevo a cabo un estudio transversal descriptivo. Los datos somatométricos que se utilizaron en la muestra fueron; la altura, el peso, la cintura y la circunferencia del brazo. Posteriormente, se clasificaron según el estado nutricional de cada individuo y la propuesta de una dieta alta en antioxidantes, con el propósito de reducir el nivel de estrés oxidativo y la inflamación sistémica para prevenir futuras complicaciones metabólicas. Resultados: la categorización de adolescentes se determinó con respecto al índice de masa corporal en percentiles, 6.6% (6) tienen bajo peso, 71.71% (71) peso normal, 18.18% (18) sobrepeso, 4.4% (4) en obesidad. Conclusión: En el presente estudio, se desarrollaron varias dietas nutricionales, así como un plan de ejercicios aeróbicos para prevenir y mantener el buen desarrollo de los adolescentes inscritos en la escuela secundaria ESH, enfatizando en acciones de prevención hacia la población rural y marginal en México.

Palabras Clave:

Dieta baja en calorías, actividad física aeróbica, adolescentes, obesidad, sobrepeso, nutrición

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INTRODUCTION

Huejutla de Reyes, in the State of Hidalgo, Mexico, is a municipality with 189 locations, with a population of 123,000 inhabitants, and it is rich in natural resources and fauna. This geographical condition particularly influences the development of primary activities such as corn cultivation, fodder, beans, sugar cane, coffee, orange, mango, and avocado among others. Another important characteristic is its socioeconomic status since Huejutla represents a degree of average marginalization, placing it in one of the five poorest states of Mexico. According to the indicators of poverty, social deprivation, and lack of well-being, these factors increase the risk of disruptions in the development of its population, both biological and psychosocial advancement.[1] In this context, a similar study was carried out using a theoretical-logical model in rural schools in a marginalized area from the Amazon in children and adolescents. The work was aimed at preventing obesity and promoting physical activity and healthy eating in school children, considering the imminent peculiarities within the context of the low socioeconomic level of this region.[2]

Likewise, in Mexico, between 2012 and 2016 the nutritional status of the population between 12 and 19 years old was evaluated in 2581 individuals representing 18,492,890 adolescents throughout the country to determine the prevalence of overweight and obesity through a national probabilistic survey (ENSANUT), the risk of overweight and obesity is classified according to the WHO reference pattern, the sociodemographic variables associated with overweight are studied through logistic regression, the national prevalence by sex is compared. The result of the evaluation in the adolescent population was 36.3% (95% CI: 32.6, 40.1), 1.4 percentage points higher than the prevalence in 2012 (34.9% (95% CI%: 33.7, 36.2).[3]

Obesity is considered a state of low-grade inflammation, which probably contributes to some populations being more susceptible to developing other chronic diseases, in addition to obesity.[4] Many studies suggest that obesity in humans focus on several aspects of the metabolic syndrome, described as the accumulation of a number of factors of risk such as insulin resistance or hyperinsulinemia, increased body fat percentage, increased waist circumference, dyslipidaemias, hypertension and dysglycemia.[5] In this context, it is suggested that all chronic diseases associated with obesity are identified, with the common denominator being the development of inflammation.

Another consideration in the development of nutritional plans for adolescents is that the estimated energy needs (EEN) vary considerably between boys and girls due to changes in growth rate, body composition and level of physical activity (LPA). In adolescents, EEN is calculated using the sex, age, height, weight, and LPA of the adolescent plus an additional 25 kilocalories (Kcal) per day added from energy deposits or growth.[6] To determine the adequate energy intake, the evaluation of physical activity is necessary, consequently energy needs can be differentiated into four levels of activity (sedentary, poorly active, active and very active), which reflect the energy consumed in activities different from daily life. Proper execution of aerobic exercise is key to the maintenance of cardiovascular health, the caloric expenditure that promotes fat reduction. A physical activity <150 min/week has minimal effects on weight loss. Physical activity > 150 min/week usually achieves modest weight loss (defined as 2 to 3 kg), while physical activity between 225 and 420 min/week achieves the greatest weight loss (5 to 7.5 kg). Research on weight maintenance indicates that moderately vigorous physical activity of 150 to 250 min per week for equivalent energy of 1,200 to 2,000 kcal per week (around 20 to 32 km of continuous running per week) is sufficient to avoid weight gain.[7] It is vital to mention that the nutritional assessment in each individual begins frequently with the collection of data on the food patterns that give us information on the consumption of food and liquids.

Aerobic exercise is the most appropriate activity to reduce the percentage of body fat. Lomauro et al. in 2016, conducted a study with 11 adolescents using a 3-week multidisciplinary program that included a hypocaloric diet, nutritional counselling, aerobic physical activity and resistance training of respiratory musculature. The percentage of body fat at the beginning of the test was 38.4%. At the end of the intervention, weight loss had been concentrated in the abdominal area, apart from having obtained other beneficial effects, such as the improvement in sports performance, the reduction of dyspnoea and the better functioning of the muscles involved in breathing.[8] Similarly, Monteiro and others, in 2015, compared the effects on body composition and metabolic profile of obese adolescents using 2 types of exercise, aerobic and concurrent. After a 50-minute workout, 3 times a week for 20 weeks, obese adolescents in both training groups (aerobic and concurrent), significantly reduced the percentage of body fat (2.9 and 3.6%, respectively) compared to group control.[9] Likewise, diets low in carbohydrates favour a faster weight loss than low-fat diets during the first 6 months of treatment, probably because proteins have greater satiety than carbohydrates.[10] Weight loss seems to be related only to the duration of the diet and the degree of energy restriction.[11]

An individual's dietary intake is affected by factors such as socio-economic capacity, the availability of good quality food and eating habits. Once the data on the dietary intake of each individual is collected, the content of nutrients and phytonutrients is analysed. These values are compared with the recommendations and particular needs of each person or group in relation to their somatometric data.[12]

Therefore, the main objective of this study was to determine the anthropometric conditions in adolescents between 14 and 17 years old enrolled in the ESH-High School in Huejutla. Based on the above, a nutritional and aerobic activity proposal is presented in order to prevent and / or reverse the condition of overweight and obesity that occurs in this study sample. The ultimate goal of this work is to positively impact the health of adolescents

living in a rural zone, who today represent the most vulnerable population to develop chronic degenerative diseases at an early age.

METHODOLOGY

Population and study design.

Adolescents between 14 - 17 years old and attending the General High School - the Universidad Autónoma del Estado de Hidalgo, Huejutla campus, participated in this study (N = 99). Prior to the execution of the study, the parents and/or guardians of the students signed an informed consent to participate in the research protocol as indicated by the Mexican government (NOM-012-SSA3- 2012). The consent was based on the World Medical Association Declaration of Helsinki, which established ethical principles for medical research involving human subjects. At the same time, the Ethics Committee of the Universidad Autónoma del Estado de Hidalgo, approved the descriptive cross-sectional study (Cod. Number 060).

Data collection.

Before beginning the project, the study team conducted one pilot test with 253 students from the General High School - Huejutla campus to familiarize the staff with the questionnaire application, measurement of anthropometric variables and blood pressure.

Bodyweight was measured with a precision of 0.1 kg and height was measured close to 0.1 m with a mechanical stadiometer (Detecto-439). The body mass index (BMI) was calculated as the weight in kilograms divided by the square of the height in meters. Blood pressure was determined in the left arm in triplicate with a manual sphygmomanometer, after 5 minutes of rest, in a sitting posture. Arm circumference measurements were obtained using a tape measure on the middle part of the upper arm, taking as a reference the length between the shoulder tip (acromion) and the head of the radius (olecranon). Waist circumference measurements were taken with a tape measure from the midpoint between the last rib and the top of the iliac crest (hip) following exhalation. The average of at least three readings was used in the statistical analyses. Results were grouped according to body mass index (BMI) in low weight (< 5 percentile), normal weight (5 ≤ 85 percentile), overweight (85 ≤ 95 percentile) and obese (> 95 percentile).

Statistical analysis

The data were treated as non-parametric statistics. The descriptive analysis showed the median and the range of 25 to 75 percentile of the continuous variables, and the frequencies and the percentages are shown for the categorical variables. Considering that children's BMI values change with age, Z-scores were calculated for all age-based variables and universalized data for handling. Nutritional status categories were compared with waist and arm circumference measurements to see their behavioural relationship in the participants using the Kruskal-Kwallis test with a probability result of p=0.0001. Mean, standard deviation, min-max and p50 were represented by categories of nutritional status, sex and blood pressure to represent the data collected. The analysis was performed using the statistical package STATA 12.0 (StataCorp LP).

Table 1. Demographic characteristics of the population

Characteristic	**Population (n=99) median (25^{th}, 75^{th} percentile)**
Age (year)	15 (15 – 17)
Height (z-score)	-0.74 (-2.75 -1.4)
Weight (z-score)	-0.125 (-2.6 - -2.54)
BMI (z-score)	0.545 (-3.58- 2.44)
Abdominal Circumference (cm)	76.5 (58- 130)
Arm Circumference (cm)	25 (19 - 40)
SBP (z-score)	-0.46 (-2.86 – 2.52)
DBP (z-score)	0.265 (-11.21 – 1.82)
	% (n)
Gender	
Male	37.37 (37)
Female	62.62 (62)
Body mass index	
Low weight	6.6 (6)
Normal weight	71.71 (71)
Overweight	18.18 (18)
Obesity	4.4 (4)
Blood pressure (percentile)	
Normal	82.82 (82)
Pre-Hypertension	12.12 (12)
Hypertension	5.05 (5)

Weight insufficiency registered data: Height, Weight, BMI, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were recorded in Z-Score by the development status of the sample.

RESULTS:

The nutritional status was assessed based on somatometric data of 99 subjects of both sexes, between 14 and 17 years old, who correspond to 17% of the total population of the High School in the Universidad Autónoma del Estado de Hidalgo, Huejutla de Reyes, Hidalgo campus. Furthermore, the demographic characteristics of the population are characterized in Table 1.

In this study it was used the Dish of Good Eating recommendations identifying three main food groups: fruits and vegetables, cereals and tubers, legumes and animal foods. It also suggests combining legumes and cereals so that the quality of the protein consumed is adequate see Tables 2 and 3. For healthy eating, it is recommended that at least one food from each group is consumed at each meal and combined with the consumption

of cereal with a legume to complement your protein intake. Another significant factor is the water balance that each individual must maintain in the recommended daily intake (RDI) of water, which varies between 1 to 1.2 mL for each kcal consumed. A pre-schooler requires about 1.2 L of water per day (5 cups), a schoolboy about 1.6 L (7 to 8 cups) and a teenager may require up to 2.5 L (10 or more cups).

Based on the above, different nutritional proposals were developed to focus on the different categories (normal weight, overweight, and obesity) indicated below.[13,7] See tables 4 to 9

Table 2. Food groups and nutritional contributions.

Classification	Energy	Carbohydrates	Grease	Protein
Cereals and tubers without fat	70 Kcal	15 g	0 g	2 g
Cereals and tubers with fat	115 Kcal	15 g	5 g	2 g
Vegetables free consumption	25 Kcal	4 g	0 g	2 g
Fruits rich in fibers and low in sugars	60 Kcal	15 g	0 g	0 g
Foods of animal origin very low in fat	40 Kcal	0 g	1 g	1 g
Low-fat animal foods	55 Kcal	0 g	3 g	7 g
Skim milk	95 Kcal	12 g	2 g	9g
Whole milk	150 Kcal	12 g	8 g	9g
Legumes	120 Kcal	20 g	1 g	8 g
Monounsaturated fats	70 Kcal	3 g	5 g	3 g
Polyunsaturated fats	45 Kcal	0 g	5 g	0 g
Saturated and Trans fats	45 Kcal	0 g	5 g	0 g
Sugars only consumed in case your nutritionist or doctor indicates	40 Kcal	10 g	0 g	0 g
Sugars with fat	85 Kcal	10 g	5 g	0 g

Obtained from [16-17]

Table 3.

ACRONYM	MEANING
Kcal	kilocalories, commonly named as calories
Tbsp	Tablespoon (15 ml) = 3 teaspoons
Tsp	Teaspoon (5 ml, approximately 5 g)
g	Gram
ml	Milliliter

The most common homemade nutritional measures are:

* Glass; 250 ml or ¼ litre
* Scoop: one tablespoon
* Teaspoon: a teaspoon of the coffee maker
* Piece: the most common food size
* 30 or 40 grams: approximate size of a phone card

Nutrition Diet Proposal

The diets were made according to the references [16-17]

A) Normal weight: If the BMI indicates that the weight is appropriate, an eating plan will serve to improve and maintain eating habits, as well as to prevent overweight.

Table 4. Average energy requirement for women 2200-2600 Kcal.

CALORIES	BREAKFAST	COLLATION	LUNCH	COLLATION	DINNER
2600 Kcal	3 portions of cereal and tubers. 1 vegetable 2 fruits 1 food of animal origin (moderate in fat) 1 milk and substitute 1 total fat	2 fruit	4 portions of cereal and tubers 2 vegetables 1 fruit 1 animal foods 1 total fat	1 cereal and tuber 1 milk and substitute	1 cereal and tuber 2 vegetables 1 fruit 1 food of animal origin 1 energy free food
	Mexican style egg. 2 eggs = 80Kcal. Onion; 1/4 cup = 25 Kcal 1 Green chile = 4.16 Kcal Tomato 1 pc = 25 Kcal 2 teaspoon safflower oil = 90 Kcal 5 corn tortillas = 350 Kcal Melon smoothie or melon salad 1 cup = 60 Kcal ½ piece of banana = 60 Kcal 1 cup of skim milk = 95 Kcal	1 piece of mango = 120 Kcal. 1 banana = 120 Kcal.	1 chicken breast 60 g = 80 Kcal 6 corn tortillas = 420 Kcal 1 cup cooked cauliflower = 25 Kcal 2 pcs of cooked nopal = 50 Kcal 1 pc small apple = 60 Kcal 1/3 avocado = 70 Kcal 1 cup white rice = 140 Kcal	15 pcs of sugar-free cookies = 210 Kcal 1 low fat to drink yoghurt = 95 Kcal 2 pcs of peach = 60 Kcal	2 slices of toast bread = 140 Kcal 1 cup of skim milk = 95 Kcal 1 pear = 120 Kcal

Table 5. Average energy requirement for men 2800-3200 Kcal.

CALORIES	BREAKFAST	COLLATION	LUNCH	COLLATION	DINNER
3200 Kcal	3 portions of cereal or tubers 1 vegetable 2 fruits 2 food of animal origin (moderate in fat) 1 milk and substitute 1 total fat	2 fruit 2 vegetables	3 portions of cereal and tubers 2 vegetables 1 fruit 2 foods of animal origin 1 energy free food 1 total fat 1 milk or substitute	1 cereal and tuber 1 fruit	1 cereal and tuber 2 vegetables 1 fruit 1 food of animal origin 1 milk or substitutes
	1 cup of sugar-free cereal = 140 Kcal 1 cup of skim milk = 95 Kcal Mexican style egg. 3 egg = 120 Kcal. Onion, ½ cup = 50 Kcal 1 Green Chile = 4.16 Kcal Tomato 1 pc = 25 Kcal 3 c teaspoon safflower oil = 135 Kcal 7 corn tortillas = 490 Kcal Melon smoothie or melon salad 1 cup = 60 Kcal ½ piece of banana = 60 Kcal 1 cup of skim milk = 95 Kcal	1 piece of mango = 120 Kcal. 1 banana = 120 Kcal.	1 chicken breast 60 g = 80 Kcal 8 corn tortillas = 560 Kcal 1 cup cooked cauliflower = 25 Kcal 2 pcs of cooked nopal = 50 Kcal 1 pc small apple = 60 Kcal 1/3 avocado = 70 Kcal 1 cup white rice = 140 Kcal	15 pcs of sugar-free cookie = 210 Kcal 1 low fat yoghurt = 95 Kcal 2 pcs of peach = 60 Kcal	2 slices of bread toasted = 140 Kcal 1 cup of skim milk = 95 Kcal 1 pear = 120 Kcal

B) Overweight: If the BMI indicates that you are overweight, it is necessary to make some small changes in eating habits to achieve an appropriate weight.

Table 6. The average diet for women 2400 Kcal.

CALORIES	BREAKFAST	COLLATION	LUNCH	COLLATION	DINNER
2400 Kcal	2 portions of cereal or tubers 1 vegetable 1 fruit 1 animal food (low fat) 1 milk and substitute 1 total fat	1 fruit 1 milk and substitute	2 portions of cereal and tubers 2 vegetables 1 energy free food 2 foods of animal origin 1 total fat	1 cereal 1 milk and substitute	1 cereal and tuber 1 vegetable 1 milk and substitute 1 fruit 1 food of animal origin
	Mexican style egg. 2 egg = 80Kcal. Onion = 1/4 cup = 25 Kcal 1 Green Chile = 4.16 Kcal Tomato 1 pc = 25 Kcal 2 c teaspoon safflower oil = 90 Kcal 4 corn tortillas = 280 Kcal Melon smoothie or melon salad 1 cup = 60 Kcal ½ piece of banana = 60 Kcal 1 cup of skim milk d = 95 Kcal	1-piece of mango = 120 Kcal. 1 banana = 120 Kcal.	1 chicken breasts 60 g = 80 Kcal 4 corn tortillas = 280 Kcal 1 cup cooked cauliflower = 25 Kcal 2 pcs of cooked nopal = 50 Kcal 1 pc small apple = 60 Kcal 1/3 avocado = 70 Kcal 1 cup white rice = 140 Kcal	15 pcs of sugar-free cookie = 210 Kcal 1 low fat yoghurt = 95 Kcal 2 pcs of peach = 60 Kcal	2 slices of toast bread = 140 Kcal 1 cup of skim milk = 95 Kcal 1 pear = 120 Kcal

Table 7. The average diet for men 3000 Kcal.

CALORIES	BREAKFAST	COLLATION	LUNCH	COLLATION	DINNER
3000 Kcal	2 portions of cereal or tubers. 2 vegetables 1 fruit 1 milk and substitute 1 total fat	1 vegetable 1 food of animal origin	2 portions of cereal and tubers 2 vegetables 1 fruit 2 foods of animal origin 1 total fat 1 milk and substitute	1 cereal 1 fruit	1 cereal and tuber 2 vegetables 1 fruit 1 food of animal origin 1 energy free food
	1 cup of sugar-free cereal = 140 Kcal 1 cup of skim milk = 95 Kcal Mexican style egg. 3 egg = 120 Kcal. Onion, ½ cup = 50 Kcal 1 Green chile = 4.16 Kcal Tomato 1 pc = 25 Kcal 3 teaspoon safflower oil = 135 Kcal 6 corn tortillas = 420 Kcal Melon smoothie or salad melon 1 cup = 60 Kcal ½ piece of banana = 60 Kcal 1 cup of skim milk = 95 Kcal	1 piece of mango= 120 Kcal. 1 banana = 120 Kcal.	1 chicken breasts 60 g = 80 Kcal 6 corn tortillas = 420 Kcal 1 cup cooked cauliflower = 25 Kcal 2 pcs of cooked nopal = 50 Kcal 1 pc small apple = 60 Kcal 1/3 avocado = 70 Kcal 1 cup white rice = 140 Kcal	15 pcs of sugar-free cookie = 210 Kcal 1 low-fat yoghurt = 95 Kcal 2 pcs of peach = 60 Kcal	2 slices of toasted bread = 140 Kcal 1 cup of skim milk = 95 Kcal 1 pear = 120 Kcal

C) Obesity

Table 8. The average diet for women 2200 Kcal.

CALORIES	BREAKFAST	COLLATION	LUNCH	COLLATION	DINNER
2200 Kcal	2 portions of cereal and tubers. 1 vegetable 1 fruit 1 energy free food 1 total fat	1 cereal 1 milk or substitute	2 portions of cereal and tubers 2 vegetables 1 fruit 2 foods of animal origin (very low in fat) 1 total fat 1 milk and substitute	1 vegetable 1 milk and substitute	1 cereal and tuber 1 vegetable 1 milk and substitute
	Mexican style egg. 2 eggs = 80 Kcal. Onion = 1/4 cup = 25 Kcal 1 Green Chile = 4.16 Kcal Tomato 1 pc = 25 Kcal 2 teaspoon safflower oil = 90 Kcal 2 corn tortillas = 140 Kcal Melon smoothie, 1 cup melon salad = 60 Kcal ½ piece of banana = 60 Kcal, 1 cup of skim milk = 95 Kcal	1 piece of mango = 120 Kcal. 1 banana = 120 Kcal.	1 chicken breast 60 g= 80 Kcal 3 corn tortillas = 210 Kcal 1 cup cooked cauliflower = 25 Kcal 2 pcs of cooked nopal = 50 Kcal 1 pc small apple = 60 Kcal 1/3 avocado = 70 Kcal 1 cup white rice = 140 Kcal	15 pcs of sugar-free cookies = 210 Kcal 1 low-fat to drink yoghurt = 95 Kcal 2 pcs of peach = 60 Kcal	2 slices of toasted bread = 140 Kcal 1 cup of skim milk = 95 Kcal 1 pear = 120 Kcal

Table 9. The average diet for men 2800 Kcal.

CALORIES	BREAKFAST	COLLATION	LUNCH	COLLATION	DINNER
2800 Kcal	2 portions of cereal and tubers. 1 vegetable 1 fruit 1 food of animal origin (very low fat) 1 milk and substitute 1 total fat	1 cereal 1 milk or substitute	2 portions of cereal and tubers 2 vegetables 1 energy free food 2 foods of animal origin (very low in fat) 1 total fat	1 cereal 1 milk and substitute	1 cereal and tuber 1 vegetable 1 fruit 1 food of animal origin (very low in fat) 1 milk and substitute
1 cup of sugar- free cereal = 140 Kcal 1 cup of skim milk = 95 Kcal Mexican style egg. 3 egg = 120 Kcal. Onion, ½ cup = 50 Kcal 1 Green Chile = 4.16 Kcal Tomato 1 pc = 25 Kcal 3 teaspoon safflower oil = 135 Kcal 4 corn tortillas = 280 Kcal Melon smoothie, 1 cup chopped melon = 60 Kcal ½ piece of banana = 60 Kcal, 1 cup of skim milk = 95 Kcal		1 piece of mango = 120 Kcal. 1 banana = 120 Kcal.	1 hoe breasts 60 g = 80 Kcal 5 corn tortillas = 350 Kcal 1 cup cooked cauliflower = 25 Kcal 2 pcs of cooked nopal = 50 Kcal 1 pc small apple = 60 Kcal 1/3 avocado = 70 Kcal 1 cup white rice = 140 Kcal	15 pcs of sugar-free cookies = 210 Kcal 1 low-fat to drink yoghurt = 95 Kcal 2 pcs of peach = 60 Kcal	2 pcs of toast bread = 140 Kcal 1 cup of skim milk = 95 Kcal 1 pear = 120 Kcal

EQUATIONS USED TO ESTIMATE BASELINE OR RESTING ENERGY EXPENDITURE IN CHILDREN

The first prediction equations to calculate resting energy expenditure in children were created in 1985 by Schofield; they consisted of a series of linear equations that predicted resting energy expenditure by sex and age group, which included the groups of school children (3 to 10 years old) and adolescents(10 to 18 years old), from weight (Schofield-p) or the combination of height and weight (Schofield-pe).[14] Table 10.

Table 10. Equations used to estimate baseline or resting energy expenditure in children.

Author	Sex	Age (Years)	Prediction equation
Schofield with weight	Men	10-18	(16.25 × P) + (137.2 × E) + 515.5b
	Women	10-18	(8.365 × P) + (465 × E) + 200b
Schofield with weight and height	Men	10-18	(17.686 × P) + 658.2 b
	Women	10-18	(13.384 × P) + 692.6 b

[a]P: weight (kg) (varies from 25.0 to 124.9 kg); E: height (kg) (varies from 1.51 to 2.00 m); [b]P: weight (kg); E: height (cm); c MLG: fat-free mass (kg); MG: fat mass (kg).

Table 11. Percentage of physical activation.

Activity	Additional about GEB	Activity category
Very sedentary	30%	Activities in sitting and standing position, sedentary, e.g., paint, handle, iron, cook, office work
Sedentary	50%	Standing activities, in a closed and temperate outdoor environment without greater wear, e.g. take a moderate walk, work in a restaurant, golf, table tennis, childcare
Moderate	75%	Outdoor activities with a lot of wear, e.g. intense walking, carrying a load, cycling, skiing, tennis, dancing
Active	100%	Outdoor activities, with intense wear, e.g. uphill walks, basketball, soccer

To obtain the total energy expenditure, the following categories of physical activity are used: Total energy expenditure (kcal/day) = basal energy expenditure + physical activity factor [15].

PROPOSED AEROBIC EXERCISE

According to a report by the WHO in 2009, physical inactivity is the fourth most important risk factor for mortality worldwide (6% of deaths worldwide). Only hypertension (13%), smoking (9%) and excess blood glucose (6%) exceed a sedentary lifestyle as a risk factor. Overweight and obesity represent 5% of world mortality.[16] By developing constant physical activity, focused on certain exercises or physical routine, it favours the good functioning and well-being of our body, see Table 11.

In 2007, the WHO again stated that physical inactivity is increasingly widespread in many countries, and this has had a considerable impact on the general health of the world population, on the prevalence of noncommunicable diseases (NCDs), for example: cardiovascular diseases, diabetes or cancer and its risk factors, such as hypertension, excess blood glucose or overweight. It is estimated that physical inactivity is the main cause of approximately 21-25% of breast and colon cancers, 27% of diabetes, and approximately 30% of ischemic heart disease.[17] In addition, NCDs currently represent almost half of the total global burden of disease. It has been estimated that, of every 10 deaths, six are attributable to NCDs.[18]

Regular physical activity has been shown to reduce the risk of coronary heart disease and stroke, type II diabetes, hypertension, colon cancer, breast cancer, and depression. In addition, physical activity is a determining factor in energy consumption, so it is essential to balance energy use and weight control.[19,7]

Physical activity recommendations for children and adolescents from 5 to 17 years old include: 1) Practice at least 60 minutes a day of moderate or intense physical activity. Durations greater than 60 minutes of physical activity provide even greater health benefits. This should include activities that strengthen muscles and bones, at least three times per week[20]; 2) Aerobic activities include walking (30 minutes daily, 5 times a week at a moderate intensity), cycling (30 minutes daily, 5 times a week at a moderate intensity), running (30 minutes daily, 5 times a week at moderate intensity), or walking (15 minutes) and running (15 minutes daily 5 times a week at a moderate intensity); 3) Muscle strengthening activities including upper limbs (perform 12 repetitions of each flexion and extension exercise 3 times a week); lower limbs (perform 12 repetitions of each exercise, squats and lower limb lift, 3 times a week); abdominal muscles (12 repetitions 3 times a week).[21]

DISCUSSION

Several cross-sectional studies that have been developed in some parts of the world such as; United States, China, Spain, and India have shown that the prevalence of obesity and overweight in children and adolescents between 6 to 18 years old has increased in rural zones.[22-24] These results indicate that it is strategic worldwide to educate and raise awareness among the population that a balanced diet is one of the most effective means to increase the production of endogenous antioxidant substances, or provide exogenous antioxidants. Maintaining good nutrition and health status in infants, children, and adolescents, in Mexico and the world have become a problem of high impact at the public health level.[1] Therefore, it is important to highlight that, in this study sample, despite showing a 71.71% presence of normal weight, the change of nutritional category towards overweight or obesity in the future is not ruled out, since environmental factors and socioeconomic condition are obstacles that we can prevent and reverse in large part with this proposal.

The grouping of the greatest risk factors for metabolic cardio diseases are during childhood and adolescence.[25] The "obesogenic" environment seems to be largely oriented to the market for teenagers, which makes healthy choices even harder. Therefore, the main nutritional recommendations in this period of life are to achieve an optimal nutritional status and maintain an adequate growth rate, which will improve the state of health at this stage and in adulthood, as well as prevent chronic diseases

that can manifest in later stages of life.[26] The energy needs of adolescents are higher than those at any other age and are related to the speed of growth and physical activity that modulates the daily energy intake. Thus, the need to carry out and / or redirect school programs to promote healthy habits is vital, paying special attention to the population groups at risk. This work of promoting a typical Mediterranean diet is more relevant in adolescents because it is considered a key stage where the personality of the individual is consolidated and, by extension, the lifestyle.[27,28] The main ingredients are described in the pyramid for food selection and the number of servings for children from 7 to 14 years old.

For adequate management of nutritional intake for age and gender of adolescents according to the needs in their stage of development, an appropriate calculation is required for this population. The Harris and Benedict equation has been used frequently since its publication (1919) to determine total energy expenditure (TEE) in healthy and normal-weight adult individuals. However, there is evidence that the frequency of error in the estimation of TEE is high using this equation in the paediatric population, although it can be used after 10 years of age. In 1985, Schofield evaluated the data of 114 studies on energy expenditure and published other equations for children and adults.[29]

In addition, the constant development of high-performance aerobic exercise was demonstrated in a study conducted in 21 soccer athletes who were randomly assigned to two groups: placebo and antioxidants administered in the form of vitamin C (500 mg/day) and vitamin E (400 IU / day) for 7 days. These subjects underwent an exercise-induced oxidative stress protocol and it was concluded that antioxidant supplementation does not attenuate elevated markers of muscle damage or muscle pain promoted by acute exercise and does not exert any ergogenic effect on the physical performance of young athletes, although it did reduce oxidative stress.[30] Likewise, Mankowski TR et al. (2015) reported that prolonged exercise produces an increase in the production of oxidants in skeletal muscle and, therefore, the constant stimulation of enzymatic mechanisms with the activity of antioxidants induces adaptations that result in a positive regulation of the activity of GPx, CAT and SOD.[31]

Finally, a strategy was developed to prevent overweight and obesity in adolescents from a rural zone. In addition, it was planned to modify the culture to increase physical activity in schools and communities, create more opportunities so families could do aerobic activities, limit the exposure of young children to the intense publicity of foods rich in energy and low in micronutrients, and offer health information campaigns and tools that are necessary to make correct choices regarding food. All these actions are aimed at reinforcing the main objective of preventive medicine in Mexico.

CONCLUSION

The purpose of this study was to develop preventive measures in adolescents at risk of developing cardiometabolic diseases, through a balanced diet and the development of cardiovascular physical exercise program. As future lines of research, these subjects will be monitored to observe the evolution of their anthropometric parameters, the pertinent information of their eating habits and how often they practice physical activity. The results will greatly benefit our understanding of how diet and exercise influence the anthropometric and health status of adolescent subjects from a rural and marginalized zone.

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