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Analysis of the agrifood situation in an elementary school community

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ABSTRACT

Objective: To analyze the agrifood situation (nutritional state) of elementary school children from the San Miguel El Piñón community, located in Españita, Tlaxcala, Mexico. The objective was to identify elements that could be used to design and implement strategies aimed to improve food and nutrition security in this rural area.

Design/Methodology/Approach: A participatory action research was conducted to analyze the information collected from mothers and children (n=44) from an elementary school located in San Miguel El Piñón, Tlaxcala.

Results: Based on their weight, size, and nutritional state, 69.6% of the participating children have a healthy weight. However, 26.1% of the participating children have symptoms of malnutrition, while no data was recorded for 4.3% of the children. Food insecurity was identified in the community as a consequence of which families cannot have a well-balanced diet.

Study Limitations/Implications: The results are only valid for the selected sample. Although the situation was studied in the field, the actual sample was small. Nevertheless, the national trend on this subject was confirmed.

Findings/Conclusions: This is a worrisome situation that can impact the physical, psychosocial, and cognitive growth and development of children. The sample evaluation revealed symptoms of malnutrition.

Keywords: school food, child nutrition, rural area.

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INTRODUCTION

All over the world, particularly in Latin America and the Caribbean, the food situation has undergone a critical transformation. This situation has caused a complex problem regarding inadequate child nutrition. Other factors —such as high malnutrition rates, hidden hunger (lack of vitamins and minerals), the rapid increase of overweight during the last three decades, and obesity, the most severe form of overweight— also impact children health (FAO, 2023). Overweight increased from 21.5% (2000) to 30.6% (2016) in children and teenagers (5-19 years old). According to UNICEF (2019), the triple burden of malnutrition threatens the survival, growth, and development of children, teenagers, economies, and nations.

In this context, the Food Security and Nutrition in the World 2020 report (FAO, 2020) indicated that food insecurity in Mexico increased from 8% (2014-2016) to 11.5% (2017-2019). Most of the Mexican population does not have access to enough nutritious and safe food and, consequently, one out of eight children suffers chronic malnutrition and one out of three children (6-19 years old) is overweight or obese (UNICEF, 2019). UNICEF (2023) points out that four out of ten children and teenagers in Mexico are obese and overweight,

while five out of ten usually eat snacks, desserts, and candies as part of their daily diet. In contrast, only two out of ten children in elementary school include legumes and vegetables and only four out of ten include fruits in their daily diet (Secretaría de Salud, 2023).

Food is an essential factor of human development. However, the diet of Mexicans in the 21st century is very different from the diet of the recent past. Torres and Rojas (2018) have proved that the change of the traditional diet —based on grains, cereals, and legumes— for a fast food and industrial diet promoted by the industry —based on refined diets and sugary beverages— are key factors of the obesity problem in the country.

Overweight is an excessive fat accumulation in the body, while obesity is a chronic complex disease defined by excessive fat deposits for a person of a given size, weight, and gender (OMS, 2024). These metabolic disorders can be determined by genetic factors; however, they are mainly related to environmental factors such as unhealthy lifestyles, a combination of poor diets, sedentarism, and physical inactivity (Torres and Rojas, 2018, p. 149).

According to UNICEF (2023), overweight and obesity impact the health of children and teenagers, putting them at a premature risk of developing several chronic degenerative diseases, including type 2 diabetes, heart diseases, hypertension, metabolic syndrome, and certain types of cancer. In addition, overweight and obese children can suffer negative psychosocial effects, such as anxiety, depression, and low self-esteem, as a consequence of the stigmatization, discrimination, and rejection that impact their school performance and quality of life.

Meanwhile, the 2018 Encuesta Nacional en Salud y Nutrición (ENSANUT) evaluated the nutritional state of children between 5 and 11 years old in Mexican elementary schools. The results of the survey indicated a higher overweight prevalence in girls (18%) than in boys (17%). Nevertheless, the obesity percentage was higher (5.1% difference) in boys than in girls. Additionally, 22.2% of the boys and 16.9% of the girls that live in urban areas are obese; meanwhile, 14.6% of the boys and 10.2% of the girls that live in rural areas are obese (Shamah-Levy *et al.*, 2020).

The overweight and obesity levels begin to increase when children start to attend elementary school (at 6 years old). The average overweight and obesity rate is 24.3%. In addition, 12-year old children have an overweight and obesity index of 32.5% when they finish elementary school, accounting for a 12.2% increase (Barquera *et al.*, 2010).

Childhood obesity is a chronic and multifactorial disease, characterized by a fat excess. Children are considered obese when their weight surpasses their ideal weight by more than 20% (Castro *et al.*, 2012). In this regard, several researches carried out in Mexican elementary schools showed a high availability of processed food, such as potato chips and sugary beverages and candies. In addition, children eat more of this type of products during their school hours, consuming a greater volume than the average recommended, in shorter periods (Rivera *et al.*, 2015). In this sense, 92% of children between 5 and 11 years old consume sugary beverages and more than 50% consume snacks, candies, and processed cereals (Ensanut, 2021).

Consequently, the scientific evidence has proved that elementary schools contribute to overweight and obesity of children. However, they can also be the right place to implement

effective interventions aimed to reduce both situations (Procter *et al.*, 2008). Elementary schools are an ideal milieu for the promotion of a healthy diet and physical activities that can be adopted for life (Coleman *et al.*, 2012).

In addition, elementary schools can improve the quality of the diets of children and, at the same time, they can reduce food and child health inequality. The findings support a comprehensive approach that consist of food quality consistency, food culture, and food education (Bryant *et al.*, 2023). Therefore, the objective of this research was to analyze the agrifood situation of the San Miguel El Piñón community, in Españita, Tlaxcala, based on the nutritional state of children in elementary school. The aim was to identify elements that could be used for the design and implementation of strategies to improve the food and nutrition security of this rural area, particularly for children in elementary school. The first hypothesis was that children from families with higher incomes have a higher probability of becoming overweight or obese, because they can buy more unhealthy industrialized products. These types of products prevail in obesogenic environments and are already established in rural areas. The second hypothesis was that children from families that produce their own food have a more balanced diet and, consequently, have a better nutritional state.

MATERIALS AND METHODS

Study area

San Miguel El Piñón is located at −98.403611 longitude and 19.419444 latitude, at 2,640 meters, in the municipality of Españita, Región Poniente-Calpulalpan, state of Tlaxcala, Mexico. The area has a 14 °C mean annual temperature, with a 25 °C maximum mean temperature, during April and May, and a minimum average temperature of 1.5 °C in January. The mean annual precipitation in the state reaches 720 mm, with summer rains from June to September (INEGI, 2024). The locality has 325 inhabitants, divided into 118 men and 132 women. The total inhabitant distribution by age was: 35.6% (under 18 years old), 57.1% (18-64 years old), and 7.3% (older than 65) (Censo local, 2023).

Participatory action research and information sources

Participatory action research (PAR) is a qualitative trend that arose in the 1970s. PAR was a response to the traditional social science crisis in face of social reality (Rahman and Fals Borda, 1989). A group of Latin American thinkers, headed by Orlando Fals Borda, defined the theoretical and conceptual basis and the practices of PAR. They were influenced by Dewey's pragmatic philosophy, Lewin's social change and knowledge generation theories, Marxism, Rousseau's liberal theories, Freire's political proposal about popular education, Bacon's philosophy, and even Ghandi and other authors from various disciplines (Zapata and Rondán, 2016).

Therefore, they established three main challenges that made up the main epistemic principles of PAR: 1) considering science as a social construct that, consequently, should be subordinated to reinterpretation, evaluation, adjustment, and improvement; 2) dialectical praxis and theory, which involves an active intervention in a given reality (praxis) and the construction of a theory or knowledge; and 3) rupture of the connection between the subject

and the object of the research, positivist inheritance from natural sciences, adopting a horizontal subject-subject relationship which, from their collective and creative conscience, generates knowledge for social transformation (Zapata and Rondán, 2016; Gallego, 2007).

Delgado (2021) pointed out that PAR seeks a comprehensive understanding about the phenomenon: the qualitative vision of contextual comprehension, based on the incidence of subjects that interacts with the said phenomenon. Therefore, this study focused on determining the nutritional state of children from the Lázaro Cárdenas elementary school and dismissing anemia between them. In addition, a rural participatory analysis (RPA) of the agrifood area was carried out with the mothers and three teachers. This is a federal elementary school with multigrade teaching and one P.E. teacher, who teaches two hours per week.

The nutritional evaluation was carried out on October 2023, with the support of a nutritionist. A hemoglobin test was carried out and the anthropometric data (weight and size) of 42 children (out of the 46 that attend the school) were taken. Meanwhile, the RPA complemented the study and helped to develop a more comprehensive analysis of the students' agrifood context. In addition, workshops and in-depth interviews were carried out with the school principal, teachers, and 36 mothers. The workshops and interviews were focused on food production, availability, access, and consumption, both in and outside the school. A brief questionnaire was also applied to the 36 mothers; the questions included family data, such as income, family members, and education.

Data analysis

The hemoglobin test detects anemia, analyzing a 10 μl of blood sample with a HemoCue® hemoglobin photometer. The sample is collected in a microcuvette covered with dry reagents that reacts with the sample, disintegrating the erythrocyte membrane and allowing the release of hemoglobin. The results are shown in g/dL. The normal value of reference of hemoglobin for children between 6 and 12 years old is 11.5 to 15.5 g/dL (García and Sánchez *et al.*, 2002).

The body mass index (BMI) was calculated to evaluate the children nutritional state. This is the most frequently used indicator for the identification of overweight and obesity in children older than 5 years and 6 months. BMI is the ratio between the body weight (kg) and the size and height (m) and is calculated by dividing a person's weight in kilograms by the square of their height in meters. According to the World Health Organization (WHO), a ≥25 BMI determines overweight, while a ≥30 BMI indicates obesity (Salud-Tlaxcala, 2014). The Instituto Mexicano del Seguro Social (IMSS) uses BMI tables to monitor and evaluate the nutritional state of children. These tables include reference values based on age, which were taken into account in this study. The results were analyzed based on the information from the RPA of the agrifood area.

RESULTS AND DISCUSSION

School context

This school has a canteen that resumed its activity on January 2023, after the Coronavirus SARS-Cov-2 pandemic. Although the school receives the support of the

Desayunos Escolares del Sistema Nacional para el Desarrollo Integral de la Familia (SNDIF), families still pay a small fee for warm meals at the school canteen, because the said program only provides cold breakfasts. In addition, the school has an educational-productive school garden, where they grow vegetables, prickly-pears, fruits, and medicinal plants for self-consumption. This project is supported by Unidad de Servicios Educativos del Estado de Tlaxcala (USET) and El Colegio de Tlaxcala A.C. The latter also offers food and nutrition workshops to children, teachers, and mothers.

The school has a good environment; the relationships among children are based on companionship, mutual respect, solidarity, and unity. Stable social, empathic, and friendly relationships predominate in the different activities of the school. However, in fifth and sixth year some students start to express their ideas in an individualistic and controversial way, which creates problems in school and community processes.

Family context

The school community is currently made up by 36 families, 10 out of which send two of their children to school. In average, each family had 4 to 5 members, out of which 2 children in average are younger than 11 years old. Likewise, 80% of the families in this student collective are nuclear families and 20% are single-parent families. Nuclear families are composed of mother, father, and their children; this is the most traditional family model. Single-parent families are currently understood as families with only one parent, whether as a result of death or separation or because the children were born outside of marriage (Puello *et al*., 2014).

Children spend most of their time with their mothers, who feed and take care of them; likewise, mothers support the school activities of children and attend meetings, among other activities. Only in 10% of the cases grandparents act as guardians of the children and are therefore in charge of these activities. Consequently, determining the education of mothers and guardians was important for this study: 11% attended primary school, 44% junior high school, 27.8% technical certificate school, 11.1% high school, 2.8% technical degree college, and 2.8% undergraduate studies.

Agrifood diagnosis of the school community

Few families in the community of San Miguel El Piñón currently work on agriculture. This activity has undergone a progressive and significant decrease, mainly as a result of the fragmentation and the diminishing of cultivation plots. Water scarcity and adverse climate changes, along with the constant increase in the cost of agricultural inputs and the lack of governmental support, have hindered local agriculture.

However, 16 families (44.4% of the 36 families that make up the school community) carry out some kind of food production. Annual crops are grown in small spaces and, given the erratic and reduced rainy weather, families mostly grow corn, squash, beans, and prickly pears and, to a lesser extent, broad beans, barley, wheat, and some vegetables and fruits. Meanwhile, some families have a few animals, including backyard poultry (laying hens and chickens), pigs, and sheep. The families have a low agricultural and/or livestock production, which they consequently use for self-consumption. Only seven families reported

that they sell the production excess within the locality. Therefore, local food production and availability are much lower than the demand of the community.

In this regard, most of the products consumed in the community are bought by the mothers in the San Martín Texmelucan open-air market (Puebla). In addition, mothers pointed out that food prices have significantly increased, particularly after the COVID pandemic. This situation, along with the low income of most families, hinders the constant access to a diverse variety of good quality food. Lemos *et al.* (2018) pointed out that the worldwide increase of food prices has been obviously reflected in Mexico, causing a significant increase in the cost of the basic food basket. Along with low incomes, this phenomenon means that millions of Mexicans lack economic access to the said basket.

Consequently, the purchase and consumption of protein-rich food, such as meat (mainly chicken) and dairy products, is limited: families consume up to 50% more eggs than meat and dairy products. They consume the former thrice a week, while the latter is consumed only once or twice a week. As a result of the high prices, the consumption of legumes (*e.g.*, beans, peas, and lentils) also decreased. Overall, the families consume seasonal fruits and vegetables, because they are less expensive. The most consumed local produce include banana, guava, pineapple, apple, melon, cucumber, jícama, chili, tomato, and prickly pear. Meanwhile, the purchase and consumption of cereals and tubers as source of carbohydrates is limited to rice, pasta, potato, tortillas, and bread. Families consume potatoes twice a week, while tortillas and bread are consumed at least four days a week.

Consequently, families cannot achieve a permanent balanced and good quality diet through the purchase of food. This situation can cause malnutrition problems in both children and adults. These results match the findings of the Informe de Pobreza y Evaluación 2022 Tlaxcala of the Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL): the percentage of food insecurity in Tlaxcala increased from 24.3% to 34.9% (8.6%).

Diagnosis of the nutritional state of elementary school children

The hemoglobin test recorded a negative amenia result for all the evaluated children. The evaluation of the current nutritional state recorded that 69.6% (n=32) of the children have a healthy weight and 26.1% (n=12) have some malnutrition problem, while no data was recorded for 4.3% (n=2) (Table 1).

Table 1. Nutritional variables of children between 5 and 11 years old (mean±s.d.).

Nutritional status	Age (years)	Weight (kilograms)	Size (meters)	Members/family (number)
Healthy weight (n=32)	7.6±1.8	27.9±7.1	1.3±0.12	4.6±1.14
Underweight* (n=5)	7.8±2.1	23.0±4.2	1.3±0.11	4.6±2.51
Overweight (n=6)	8.0±1.7	40.6±12.1	1.4±0.13	5.0±0.63
Obesity (n=1)	7.0±0	41.5±0	1.33±0	4.0±0

Source: table developed by the authors. *Global malnutrition: children with a lower weight than the weight they should have based on their age.

Figure 1 shows that, out of the children with some malnutrition condition, five were underweight (10.9%), six were overweight (13%), and one was obese (2.2%). No data was recorded for the other 2 kids (4.3%).

According to Ensanut (2021), the overweight and obesity results are under the national average, because children between 5 and 11 years old recorded an overweight of 18.8% in 2020, while obesity reached 18.5%, showing that the prevalences increase along with the age of the children. In this study, only 2.2% of the children were obese. This result is different to the findings of Vaquero-Álvarez *et al.* (2019), who studied overweight and obesity in a rural area of Spain, recording 26.2% overweight and 22.3% obesity. Peña and Bacallao (2003) identified that, along with child malnutrition, poverty in the rural environment is a social problem associated with obesity. In 2022, moderate or serious food insecurity worldwide impacted 33.3% adults that lived in rural areas and 26% adults in urban areas. However, the purchase and consumption of ultra processed food is increasing in rural areas (FAO, 2023).

Relationship between the nutritional state of children and other socioeconomic family variables

Other variables obtained from the RPA results were analyzed to determine a wider view about the nutritional state of children. The sample consisted of 22 boys and 22 girls (50% each). Out of this total, 16 boys have a healthy weight, 3 are underweight, 3 are overweight, and 1 is obese. Meanwhile, 17 girls have a healthy weight, 2 are underweight, and 3 are overweight (Table 2).

Consequently, more boys (46.7%) than girls (29.4%) showed malnutrition problems in this study. These results are different from the national overweight trend. The results of the national study recorded a 16.6% (boys) and 21.2% (girls) prevalence. Nevertheless, the results of this study match the national obesity rates, which recorded a 23.8% and a 13.1% prevalence for boys and girls, respectively (Ensanut, 2021). Meanwhile, the underweight,

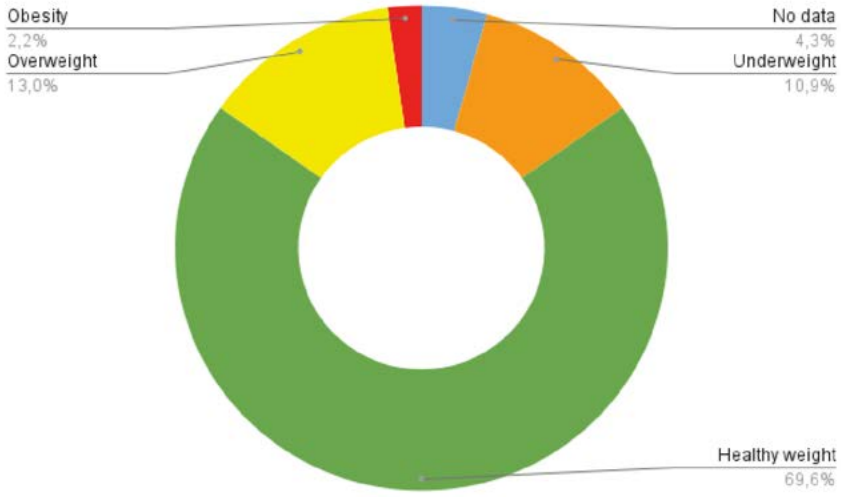

Figure 1. Diagnosis of the nutritional state of children from the Lázaro Cárdenas elementary school, Españita, Tlaxcala (2023).

Table 2. Family socioeconomic variables (%).

Nutritional status	economic income		Sex	
	1*	2*	boy	girl
Healthy weight	6	16	15	17
Underweight	1	4	3	2
Overweight	3	3	3	3
Obesity	0	1	1	0

Source: table developed by the authors. * A≤$2,375.00 and B=$2,376.00 to $6,999.00 monthly incomes.

overweight, and obesity rates did not record a significant difference regarding the age of the students. However, overweight and obesity are focused on children between 6 and 8 years old; in the case of girls, this problem starts at 10.

Although some families with higher incomes (between MXN$2,376 and MXN$6,999) have more children with some type of malnutrition than families with lower income (≤MXN$2,375) (8 and 4 children, respectively), the hypotheses of this study did not only consider overweight and obesity, but also underweight. For their part, the 16 families that grow food for self-consumption have children with healthy weights and others with malnutrition problems.

Consequently, the family income and food production for self-consumption variables are related with factors associated with the nutritional condition of the evaluated students. Nevertheless, it was no possible to identify how and to which degree these variables impacted the study area. Since the analysis of the nutritional evaluation of the family (education of the mothers or guardians, number of members, and number of children less than 11 years old) did not identify significant differences, longitudinal studies should be carried out to achieve a deeper understanding.

Therefore, malnutrition in children is related with a family diet that lacks enough quality nutritional elements. Malnutrition is consequently a multifactorial phenomenon which includes: low income, lower production of food for self-consumption, high price of food, little knowledge about food and nutrition among the family, and little physical activity. The school in question has a lower malnutrition level than the national averages, possibly as a result of its canteen, where children have access to a balanced breakfast. Likewise, the absence of a cooperative-run school store diminishes the consumption of junk or ultra-processed food, which is already available in this rural area, both in stores and during various community festivities.

Finally, the double burden of malnutrition —hereby demonstrated in a specific rural territory— has been primarily the consequence of the globalized agrifood system that has modified habits and food culture. This system creates obesogenic environments characterized by a high supply of ultra-processed foods and beverages, which have an extremely low or null nutritional quality. Given their apparent low cost and the influence of mass advertising in various media, a great part of the Mexican population chooses them. Structural factors are also involved, including public policies and changes in agricultural production.

CONCLUSIONS

The findings of this research confirm that several factors resulting from a globalized agrifood system have altered the agri-food situation of the rural community of San Miguel El Piñón, which consequently faces availability, access, and food consumption issues. This system has also negatively modified the traditional diet and continues to limit the access of many families to the basic food basket. As a consequence of this situation, the students suffer malnutrition problems. Consequently, their growth and physical, psychosocial, and cognitive development are hampered and they are also at higher risk of contracting various diseases. Therefore, this situation violates the rights of children and unleashes a series of socioeconomic and cultural problems.

The school milieu is ideal for the encouragement of healthy life styles (*e.g.*, a nutritious diet). Consequently, as the PAR advances, the issue of interest for this research changes for the benefit of the participants, since the aim of this research is to transform the social environment. Therefore, this research contributes to the improvement of the food intake and school nutrition of children, through pedagogical processes in which children, parents, teachers, and the persons in change of the school canteen participate. These processes include: a) agroecological food production; b) consumption of healthy and nutritious food; c) more information about the consequences that junk food has on human health; and d) revaluation of unprocessed local food. These four basic components of the design of regional strategies and public policy guidelines for school food will help to counteract the double burden of malnutrition in children that persists in the rural areas of Mexico.

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