

Mothers' perceived barriers following nutrition education during the COVID-19 pandemic in a fishing community in northwest Mexico

Barreras percibidas por madres de familia para seguir educación nutricional durante la pandemia de COVID-19 en una comunidad pesquera del noroeste de México

Karla Denisse Murillo Castillo¹✉, Michelle Maree Haby de Sosa¹✉, Berenice Zapata Jaime¹✉, Armida Espinoza López²✉ and Trinidad Quizán Plata^{1*}✉

¹ Department of Chemical-Biological Sciences, University of Sonora, Hermosillo, Sonora, Mexico.

² Department of Research and Postgraduate Studies in Food (retired), University of Sonora, Hermosillo, Sonora, Mexico.

ABSTRACT

Nutrition education improves the knowledge and skills needed to achieve food security in low-income families. However, the family economy and food environment were negatively affected by the COVID-19 pandemic. The objective was to analyze mothers' perceived barriers following nutrition education during the COVID-19 pandemic in a fishing community in northwest Mexico. A secondary objective was to analyze the impact of food insecurity on children's performance in the workshops. A socioeconomic survey and the Mexican Food Security Scale were applied. Five nutrition education workshops were implemented. A semi-structured interview was conducted to analyze the barriers perceived by the mothers. Multiple logistic regression and constant comparison methods were used. Children with severe food insecurity had 9.07 times higher odds of not passing the workshops ($p = 0.01$). Mothers found it difficult to follow the workshops recommendations because of the community's economic situation, which worsened during the pandemic. Nutrition education can improve knowledge about healthy eating, but comprehensive support is needed through programs that strengthen mothers' finances, especially in times of crisis.

Keywords: Mothers; perceived barriers; nutrition education; COVID-19; fishing community in northwest Mexico.

RESUMEN

La educación nutricional mejora los conocimientos y las habilidades necesarias para alcanzar la seguridad alimentaria en familias con bajos ingresos. Sin embargo, la economía familiar y el ambiente alimentario fueron afectados negativamente por la pandemia de COVID-19. El objetivo fue analizar las barreras percibidas por madres de familia para seguir la educación nutricional durante la pandemia de COVID-19 en una comunidad pesquera del noroeste de México. De manera secundaria, se analizó el efecto de la inseguridad alimentaria en el desempeño de escolares en los talleres. Se aplicaron una encuesta socioeconómica y la Escala Mexicana de Seguridad Alimentaria. Se implementaron cinco talleres de educación nutricional. Se realizó una entrevista semiestructurada para

analizar las barreras percibidas por las madres. Se utilizaron regresión logística múltiple y el método de comparación constante. Escolares con inseguridad alimentaria severa tenían 9.07 veces más probabilidades de no aprobar los talleres ($p = 0.01$). Las madres percibieron ser difícil de seguir las recomendaciones de los talleres debido a la situación económica de la comunidad, la cual se agravó durante la pandemia. La educación nutricional puede mejorar los conocimientos en alimentación saludable, pero es necesario el soporte integral con programas que fortalezcan la economía de las madres, especialmente durante épocas de crisis.

Palabras clave: Madres; barreras percibidas; educación nutricional; COVID-19; comunidad pesquera en el noroeste de México.

INTRODUCTION

Food insecurity exists when people worry about how to ensure availability and their access to food, when they consume food of inadequate quality and quantity, or when they acquire their food in ways that are not socially acceptable (Leroy *et al.*, 2015).

In 2023, 28.9 % of the world's population lacked adequate food (FAO *et al.*, 2024). In the same year, 44.6 % of households in Mexico experienced some level of food insecurity; 25.8 % were mildly insecure, 9.7 % were moderately insecure, and 9 % were severely insecure (Shamah-Levy *et al.*, 2024).

In adults, food insecurity has been associated with an increased risk of obesity, diabetes, hypertension, cancer, iron deficiency anemia, osteoporosis, sleep disturbance, anxiety, stress and depression (Gundersen and Ziliak, 2015; Hejazi *et al.*, 2023). However, the link between food insecurity and mental health problems is particularly strong among women and mothers (Quizán-Plata *et al.*, 2013; Gundersen and Ziliak, 2015). In children, food insecurity is associated with lower nutrient intake, iron deficiency anemia, tooth decay, delayed growth and development, obesity, infectious and chronic diseases, behavioral and mental health problems, and poor academic performance (Gundersen and Ziliak, 2015; Fought *et al.*, 2017; Hartline-Grafton and Hassink, 2021; Hejazi *et al.*, 2023).

*Autor para correspondencia: Trinidad Quizán Plata
Correo-e: trinidad.quizan@unison.mx

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Fishing families are at greater risk of food insecurity since their food and nutrition security depends on consuming the food they catch and selling it to generate income to buy other food. Risk may be greater in communities where fishing is a primary commercial activity, where access to other productive resources is limited, and where fishing is considered a social and cultural way of life (Gibson *et al.*, 2021).

In previous publications about families in the northwest of Mexico who are dependent on the fishing activity, food insecurity was associated with lower fruit and vegetable consumption among both mothers and their children. In addition, food insecure mothers had a lower dietary score and lower HDL cholesterol levels than food secure mothers (Murillo-Castillo *et al.*, 2018; Murillo-Castillo *et al.*, 2020; Quizán-Plata *et al.*, 2020).

Reducing food insecurity requires the implementation of multiple interventions that increase households' purchasing power, but also improve their nutrition knowledge (Mortazavi *et al.*, 2021).

Food-insecure families identify economic barriers and knowledge gaps, to maintain healthy homes, which needs to be addressed through nutrition education (Oliver *et al.*, 2023).

Nutrition education is one of the more feasible, sustainable and less costly intervention strategies that can improve food security and nutritional status by changing the inappropriate dietary patterns that characterize food-insecure households (FAO, 2011; Mortazavi *et al.*, 2021; Hejazi *et al.*, 2023). Nutrition education provides people with the skills and knowledge to improve resource management and thus cope with negative situations, such as the decline in economic resources (FAO, 2011; Hejazi *et al.*, 2023).

However, the measures taken to contain the spread of the COVID-19 pandemic, including the closure of economic activities for several months, had a negative impact on the economic situation, food environment and food security, especially for vulnerable populations such as fishing communities (Rodríguez-Ramírez *et al.*, 2021), which can make it difficult to follow nutrition education recommendations.

Considering that women can play a fundamental role in family nutrition, which affects the food and nutrition security of the rest of the family (Aziz *et al.*, 2022), this study aimed to analyze mothers' perceived barriers following nutrition education during the COVID-19 pandemic in a fishing community in northwest Mexico. A secondary objective was to analyze the impact of food insecurity on children's performance in the nutrition education workshops.

MATERIAL AND METHODS

Participants and recruitment

The study population consisted of mothers and their school-aged children from Bahía de Kino Viejo, a fishing community in northwest Mexico. The recruitment process is described in a previous study conducted by the research team. One hundred and sixteen mothers and their 131 school-aged children were invited to participate in the general project

(Murillo-Castillo *et al.*, 2018). During the intervention phase of the project, 95 mothers and 92 children participated in the nutrition education workshops.

Ethical aspects

The Research Ethics Committee of the University of Sonora approved this research project (Project Number USO313002489), and it adheres to the principles set forth in the Declaration of Helsinki. All participants gave their consent to participate in the project. Their data were kept strictly confidential and used for this research under numerical codes.

Assessments prior to the implementation of nutrition education workshops

From September 2016 to September 2017, a socio-economic and demographic survey and the Mexican Food Security Scale were applied to mothers.

The socio-economic and demographic survey was used to obtain the number of family members, number of children, education level of the mother, marital status, main provider at home, family income, food expenditures, and family participation in government assistance programs.

The Mexican Food Security Scale was used to assess household food insecurity (Carrasco *et al.*, 2010). The scale asks 12 questions, from least to most severe, about whether household members have experienced a decrease in the variety, quality, or quantity of food consumed in the past three months due to a lack of income or other resources, and, in the worst case, hunger. Each item can be answered affirmatively or negatively (i.e., yes or no). The scale distinguishes between households with only members over 18 and households with both adults and members under 18, and identifies four levels of food insecurity. Positive responses are summed to determine the household's category of food insecurity. If all responses are negative, the household is considered food secure. From 1 to 3 positive responses, there is mild food insecurity; from 4 to 7 positive responses, there is moderate food insecurity; and from 8 to 12 positive responses, there is severe food insecurity (Carrasco *et al.*, 2010).

Implementation of nutrition education workshops

From May 2018 to March 2019, five workshops were given to mothers and their children on topics that reinforce the importance of healthy eating and good hygiene practices: 1) nutrients and their functions; 2) the Mexican Food Guide and recommended servings of food groups for children; 3) sugar, sodium and fats; 4) the Mexican Beverage Guide and the importance of drinking pure water; and, 5) personal hygiene and food safety (Casanueva *et al.*, 2002; WHO, 2006; Bonvecchio-Arenas *et al.*, 2015).

Workshops were held once a week for 5 weeks during the regular school day in both elementary schools of Bahía de Kino Viejo, with a duration of 1 hour per session.

Considering the facilities provided by the principals of both elementary schools, the workshops were held in the first school from May to June 2018, and in the second school from

February to March 2019. On the day of the implementation of the workshop, children received the nutrition education workshop first, while the workshop for the mothers was implemented in the next hour. Informational and didactic materials (e.g., posters, flashcards, videos) designed by the research team were used to deliver the workshops.

For children, each workshop also included a reinforcement activity to assess the children's performance in the workshop. Each reinforcement activity was scored from 0 to 10. If the children completed the activity correctly and independently, they received 10 points. However, points were deducted depending on the mistakes the child made and whether he or she needed help from the instructors to complete the activity. Children were considered to have passed the nutrition education course if they scored at least 30 points in the 5 workshops.

For mothers, the information presented at each workshop was compiled into a manual entitled "Guide to Improving Food and Nutrition". Each participating mother received a printed copy of the manual.

All workshops were conducted by members of the research team who had been previously trained in the topics to be presented, the use of the didactic materials, and the methodology of the reinforcement activity.

Outcomes of the implementation of nutrition education workshops

From August 2019 to February 2020, semi-structured interviews were conducted with mothers to understand their perspectives on the overall project interventions, including the nutrition education workshops. Before the field work, a script for the semi-structured interview was prepared that included a item about the perceived barriers to follow workshops recommendations.

After the beginning of the COVID-19 pandemic, it was not possible to continue visiting Bahia de Kino Viejo, therefore, a semi-structured interview was conducted over the phone. Items regarding perceived barriers to maintain proper nutrition during the COVID-19 pandemic were added to the script.

With participants' prior consent, audio recordings of the telephone interviews were made. The interviews lasted 40 minutes on average. The information collected in each interview was transcribed, preserving the original statements. It was then categorized according to the aforementioned themes.

Data analysis

Descriptive statistics were used to estimate the mean, standard deviation, and percentage of the variables. Logistic regression was used to determine the effect of food insecurity on children's performance in the nutrition education workshops. For this analysis, the independent variable was the four categories of food security (i.e., food secure, mild, moderate, and severe food insecurity), with food security as the reference category. The dependent variable was child

performance as measured by the evaluation's results, of the nutrition education course, where 0 = the child passed the course and 1 = the child did not pass the course. Adjustment for age and sex was made in the association analysis.

The qualitative information from the semi-structured interviews was analyzed using the constant comparison method. This method was developed by Glaser and Strauss (1967) and adopted by Strauss *et al.* (1991). The method consists of a continuous analysis and comparison of the data to determine the similarities and differences between them (García, 2019). Following this method, the information from semi-structured interviews was analyzed to identify common comments for each of the items covered in the interview script (i.e., pre-pandemic item: perceived barriers to follow workshop recommendations; and additional item during the pandemic: perceived barriers to maintain proper nutrition during the COVID-19 pandemic).

All analyses were performed in Stata version 11 and a p -value ≤ 0.05 was considered as statistically significant.

RESULTS

Assessments prior to the nutrition education workshops implementation

Ninety-five mothers and 92 school-aged children participated in the nutrition education workshops. The mean ages of the mothers and children were 35.6 ± 7.6 years and 8.9 ± 1.6 years, respectively.

The average number of family members was 4.8 ± 1.3 persons (Table 1). A 38.5 percent of mothers had only an elementary school or junior high school education, and 91.7 % were married or living in a common-law marriage.

About one-third (33.9 %) of mothers worked, and although 92.7 % of families had health coverage, 78.2 % of families were enrolled in Seguro Popular (the government health service for the unemployed, which was eliminated in November 2019, but the program was active at the time of the survey). In addition, 38.5 % of the households were beneficiaries of social programs. The average monthly family income was US\$ 360.8 ± 185.2 , of which 65.2 % was used to purchase food.

Approximately two-thirds (64.2 %) of the households reported experiencing food insecurity, with 33 % experiencing mild food insecurity, 20.2 % experiencing moderate food insecurity, and 11.0 % experiencing severe food insecurity.

Outcomes of the implementation of nutrition education workshops

Of the participating children, 74 % passed the nutrition education course. Through reinforcement activities, it was observed that 72.8 % of the participating children correctly classified foods within the group to which they belonged according to the Mexican Food Guide. Similarly, 55.4 % of children correctly identified foods and beverages high in sugar, sodium and fat, and 52.2 % correctly performed the steps for proper hand washing and tooth brushing techniques.

Table 1. General characteristics of participating mothers (n = 95) and school-aged children (n = 92).**Tabla 1.** Características generales de las madres de familia (n = 95) y escolares participantes (n = 92).

Variables	Mean $\pm$ SD or %	Range
Household size	4.8 $\pm$ 1.3	2-9
Number of school-aged children per household	1.1 $\pm$ 0.3	1-2
Monthly family income (US dollars)	360.8 $\pm$ 185.2	73.9-921.6
Monthly food expenditure (US dollars)	65.2	
Education of mother		
Incomplete elementary school	43.1	
Elementary school or junior high	38.5	
High school or superior	18.3	
Marital status		
Married or living in a common-law marriage	91.7	
Single, separated, widowed, divorced	8.3	
Working mothers	33.9	
Mother as main provider at home	12.8	
Medical service	92.7	
Seguro Popular	78.2	
Social program beneficiary	38.5	

SD indicates standard deviation, % indicates percentage.

Children from severely food insecure households were 9.07 (95 % CI 1.82 to 45.30) times more likely to fail the workshops than children from food secure households ($P = 0.01$) (Table 2). In addition, the odds of children not passing the course increased with age (AOR 1.56, 95 % CI 1.10 to 2.20, for each additional year of age, $P = 0.01$).

Prior to the start of the COVID-19 pandemic, the semi-structured interview was conducted with the 95 mothers between August 2019 and February 2020. Once the pandemic started, the semi-structured telephone interview was applied to 35.8 % (34 out of 95) of the mothers. The remaining mothers could not be contacted because they changed their phone numbers (83.3 %), did not have a phone (10 %), or did not want to participate in the interview (6.7 %).

Six themes emerged regarding perceived barriers following pre-pandemic workshops recommendations and perceived barriers to maintain proper nutrition during the COVID-19 pandemic.

Firstly and before the pandemic, mothers commented that it was difficult to follow the recommendations given in the workshops due to the economic conditions in Bahía de Kino Viejo and the high prices of healthy foods in the community:

"In many cases it has to do with the economy, because it is not enough for us and what we do, obviously we have to eat and what we do, if we have a more or less minimum salary that we have to divide into different things, the cheapest is chosen. And if the price of vegetables and things that are good for our body is very high, it is not in our hands to be able to buy them" (Mother 33 years old).

"Everything is very expensive here, vegetables are very expensive in the stores" (Mother 37 years old).

Table 2. Association between not passing the nutrition education workshops and food insecurity in school-aged children (n = 92).**Tabla 2.** Asociación entre no aprobar los talleres de educación nutricional y la inseguridad alimentaria en escolares (n = 92).

Variable	Not passing ^a		
	AOR	P	95 % CI
Category of food insecurity			
Mild food insecurity	1.72	0.41	0.47 - 6.24
Moderate food insecurity	0.79	0.77	0.16 - 3.79
Severe food insecurity	9.07	0.01	1.82 - 45.30
Age, years	1.56	0.01	1.10 - 2.20
Male	1.46	0.48	0.51 - 4.17

AOR indicates adjusted odds ratio.

^aA multiple logistic regression analysis was conducted with food security and all listed explanatory variables included in the model. The reference groups were having food security and being female.

"Because the vegetables, the fruits and the vegetables, everything is very expensive" (Mother 27 years old).

The second theme emerged during the pandemic from the follow-up semi-structured interviews conducted by telephone. According to the participating mothers, the economic situation in Bahía de Kino Viejo was further complicated by the pandemic, the income of most fishermen was affected by both the lack of employment and the low payment they received from their employers for the product they caught:

"Well, it went down, all the work that is in the pangas (boats) and here at home the business also went down because many people are not working (due to the pandemic), they are not buying the product and well, the sales and the work also went down" (Mother 31 years old).

"The products are not well received on the panga (boat)... when he (her husband) has gone fishing, they pay him very little for it (the product)" (Mother 25 years old).

"Before (the pandemic) my husband earned 88.4 US dollars a day, now (during the pandemic) he earns 13.3 US dollars a day... those who buy the product, they (the concessionaires) buy it very cheap...before they paid them 0.8 US dollars for the shells, now they (the concessionaires) give them 0.3 US dollars. And the callus, for example, they (the concessionaires) paid 28.7 US dollars for it, now they pay 15.5 US dollars. In other words, it is half... the food goes up and up and the product goes down and down. That's when we started to struggle, because the food here is very expensive" (Mother 30 years old).

The third theme was related to the comments of the participating mothers regarding the fact that, despite their knowledge about the importance of consuming healthy foods, they had to reduce their consumption of fruits, vegetables, meat, milk and eggs due to the increase in their prices and the lack of work and income during the pandemic.

"My husband's job was affected, they (the fishermen) could not sell the product to commercial establishments (such as restaurants) because they were closed. Yes, it's very bad. Everything in the store is very expensive. A breakfast is almost two hundred pesos (for one family). Just now I sent my kids to buy something for breakfast and well, I had twenty pesos left over from two hundred pesos. That's a lot. Food prices have gone up a lot. We

had to cut back a bit on what we wanted to eat. And try to buy affordable things" (Mother 29 years old).

"In my case, I'm a single mother and I'm the main provider for my family, and right now I'm unemployed... we're not big meat eaters, not even chicken or anything like that, but for example, we used to eat once a week, now not so much, not anymore. Instead we eat more grains, beans, rice, potatoes, pasta" (Mother 28 years old).

"I couldn't continue to work because I clean houses, only one of my sons continued to work... I used to consume fruits and vegetables, but I stopped buying them to give priority to other foods such as beans and cheese, pasta, rice, the most essential" (Mother 41 years old).

The fourth theme that emerged from the interviews was that mothers were trying to provide food for their children first and then for themselves. However, the children were also concerned about the situation:

"Right now, for example, we are eating beans, and we are not going to eat anything else; most of the time it is beans with cheese or rice. Things that sometimes the kids get bored of and don't want, but well, I tell them, at least there's something to eat. There's not enough for the food they want, but I tell them, first you have to survive and then the rest" (Mother 43 years old).

"For example, we make pancakes or meals where I can use less eggs and have enough for several (children). Or we make chilaquiles (tortillas with tomato puree), or things (food) that they can eat with just one egg or just beans. In other words, we just change the cooking method so that there's enough for everyone and we don't waste so many eggs because they're so expensive" (Mother 41 years old).

"There are times when I only have tomato with onion and some hot tortillas. Many times, we stop buying a meal to buy breakfast, but why are we going to mortify ourselves so much? We must do it one way or another. The children eat the best and we, well, if we can, we get an egg or a tortilla with beans, but for the children there is, let's say, a chicken soup, so all the children will eat it, and I'll keep heating the soup until it's finished...Me and my father eat beans. It's better for us to get sick than for the children to get sick.... Yes, I'm hungry, but the children have to eat... my oldest daughter tells me that it doesn't matter that they always eat the same thing, but that I should eat too" (Mother 24 years old).

The use of stored food and savings as coping strategies during the pandemic was the fifth emerging theme; however, not all households had sufficient savings to cover their food needs for several months:

"I've been buying things (food) for a while, saving the basics and so on, and the truth is, it didn't affect us much in that sense because we had a reserve here at home, and right now, thank God, we still have a little bit. It has affected us in that we do not have work to buy other things" (Mother 24 years old).

"We're not so picky about what we eat anymore, because we don't have enough money saved, so we eat whatever we have, whatever we can afford, whatever we can get" (Mother 25 years old).

"I had some money saved, I went to the store, there in Miguel Aleman [the town of Miguel Aleman, is 45 km from Bahia de Kino Viejo]. Well, there it is very easy because everything is very cheap, nothing to do with it here, but after that (the pandemic) they did not even let us out. You could not buy food there. We ran out of money because everything here is very expensive" (Mother 30 years old).

As the sixth and final emerging theme, mothers commented that although families in Bahia de Kino Viejo received support during the pandemic, this support was not distributed equitably:

"Well, they supported the fishermen, but not all of them. Many who are not even fishermen have received support. Here they support those they know, family, friends and so on" (Mother 37 years old).

"We, the merchants, are looking for assistance. I don't know if some of them got it, but they were kind of selected. But those who don't sell anything, the construction worker, the carpenters, I don't think they got any support" (Mother 41 years old).

DISCUSSION

A high percentage of mothers and school-aged children attended the nutrition education workshops. In addition, 74 % of the children passed the course. Children with severe food insecurity were more likely to fail the nutrition education workshops than children from food secure households. Food insecurity is a risk factor for the development of emotional and behavioral problems that can affect children's academic performance (Faught *et al.*, 2017). Faught *et al.* (2017) found a negative association between food insecurity and academic achievement among Canadian school-aged children. Children from households with very low food security were 0.65 times more likely to meet expectations in reading and 0.62 times more likely to meet expectations in math ($P < 0.05$).

Older children were more likely to fail the workshops than younger children. Because dependency on parents decreases with age, mothers may have had more influence with younger children than with older children to put into practice what they learned in the workshops (Haas *et al.*, 2003). Future interventions should consider how to motivate older children.

People who are food insecure often consume cheap foods that are high in energy and low in vitamins and minerals. This affects their overall well-being and increases their risk of malnutrition and noncommunicable diseases (Dollahite *et al.*, 2003; Barrial-Martínez and Barrial-Martínez, 2011). Nutrition education can reduce these risk factors by raising awareness, changing attitudes and developing skills that empower people to make healthy food choices, especially when they're on a limited budget. In this way, nutrition education can help food-insecure people use their income efficiently to purchase foods of higher nutritional quality (Dollahite *et al.*, 2003; Barrial-Martínez and Barrial-Martínez, 2011; Mortazavi *et al.*, 2021).

However, the COVID-19 pandemic caused significant changes in families' economic conditions and food environ-

ments (Rodríguez-Ramírez *et al.*, 2021; Felix-Gutierrez *et al.*, 2024), which may have made it difficult to follow recommendations from nutrition education workshops.

Felix-Gutierrez *et al.* (2024) analyzed the impact of the COVID-19 pandemic on the food environment and food insecurity in women and children in Hermosillo, Sonora, Mexico, with medium and high levels of marginalization. They found increases in moderate food insecurity, convenience store visits, prevalence of overweight and obesity in children, and body mass index in women. The authors conclude that health restrictions may have influenced the increase in convenience store visits, and that increased sedentary lifestyles and stress during the pandemic may have contributed to the pandemic's effects on nutritional status (Felix-Gutierrez *et al.*, 2024).

In the present study, participating mothers reported that it was difficult to follow the recommendations of the workshops due to the economic situation of the community, which worsened during the pandemic. It is important to note that Bahia de Kino is divided territorially into two parts. Kino Viejo is the town founded by fishermen, and Kino Nuevo is the town where residential tourism is the main source of income. The contrast between the two is very marked. The majority of the population is concentrated in Kino Viejo (including the participants of this project), which suffers from all kinds of social deficiencies: poor public services, unemployment, low income, social precariousness, poverty, and irregular ownership of urban land, along with the decline of its main economic activity: fishing (Enriquez-Acosta and Meza-Contreras, 2015).

Oliver *et al.* (2023) explored the perspectives of food-insecure parents in Pennsylvania regarding barriers to eating healthy in their homes. They found that despite the best intentions of parents to plan meals or recipes in advance, budget constraints can lead to the preparation of family meals with a limited number of ingredients (Oliver *et al.*, 2023).

The COVID-19 pandemic exacerbated problems related to employment, income, and food prices in Bahia de Kino Viejo, and consequently, the availability and physical and economic access to healthy food. The pandemic left the population with a dilemma: continue working to maintain income and food security or avoid the risk of contracting the disease (Bennett *et al.*, 2020).

In Mexico, the quarantine to reduce the spread of COVID-19 began on March 23, 2020, and included shutting down activities deemed non-essential but that could have affected household income and thus their food security (Rodríguez-Ramírez *et al.*, 2021).

Rodríguez-Ramírez *et al.* (2021), when analyzing the association of food insecurity with perceived changes in diet during the COVID-19 lockdown in 9,933 Mexican households, found that households that experienced severe food insecurity were more likely to perceive negative changes in their diet. In addition, those households that experienced a decrease in their income perceived a decrease in the consumption of fruits, vegetables, and foods of animal origin (Rodríguez-Ramírez *et al.*, 2021).

López-Toledo (2025), analyzed the impact of the COVID-19 pandemic on food security of 500 families in the state of Oaxaca, Mexico. They found that 62.2 % of families lost their level of food security during the pandemic. In addition, it was observed that the percentage of families with an income of less than \$4,000 pesos per month increased from 8.6 % to 74.6 %, and that 7.2 % of the population suffered from hunger due to lack of access to food (López-Toledo, 2025).

Although the entire world population was at risk of experiencing the adverse effects of the pandemic, some populations were more severely affected due to their social, economic, or cultural circumstances (Bennett *et al.*, 2020). These populations include communities whose primary economic activity is fishing, where public health measures implemented by authorities included the closure of commercial activities from catching to selling marine products (Bennett *et al.*, 2020).

In addition, the inability to work as a result of COVID-19 infection, the implementation of workplace health measures, the decline in demand for high-value seafood products and the closure of international markets also had a negative impact on fishing activity (Castillo-Figueroa, 2023).

As a large part of the population living in fishing communities saw their income reduced, they had to engage in activities to cope with the situation and meet their food needs (Bennett *et al.*, 2020). In this sense, families in Bahia de Kino stopped buying high-priced foods, such as fruits, vegetables, milk, red meat, chicken and eggs, which usually have a high nutritional content. These adjustments in food purchases could result in savings in economic resources for the household, but this compromises the quality of the food they consume and increases the risk of developing some nutritional problem (Laborde *et al.*, 2020). In some small or isolated communities, such as Bahia Kino Viejo, food prices were higher than before the pandemic because most of the food sold in Bahia Kino Viejo is imported from other communities. This made access to food even more difficult, especially for low-income families (Laborde *et al.*, 2020).

Sandoval-Moreno (2025) analyzed the pandemic's impact on fishing families in Petatan, La Palma, and San Pedro Cahro communities in Michoacan, between November 2021 and May 2023. It was found that participants reported a decrease in fish sales, which negatively impacted their income. In addition, their food consumption was affected by the increase in price or because it was no longer sold within the community, so their diet depended on what they could catch and store at home (Sandoval-Moreno, 2025).

Since the main impact of the pandemic was on the population's income and ability to purchase food, government institutions implemented several strategies to support families in Bahia de Kino Viejo, such as providing food packages, granting loans to fishermen and merchants, supporting local community kitchens, allowing the opening of local businesses and fishing activities according to health recommendations, and improving the coverage and attention of services at the health center. However, according to

participating mothers, the support received in Bahía de Kino Viejo during the pandemic was not equitably distributed.

In general, Mexican initiatives in support of fishing communities have focused on the reduction of fishing closures to allow the capture of certain marine species, as well as the streamlining of support for social programs targeting fishermen. In some states, such as Sonora (where Bahía de Kino Viejo is located) additional measures were implemented, such as the distribution of food and financial support to fishermen, especially at the beginning of the pandemic. However, the initiatives were not applied to the entire population, and it was even reported that assistance arrived up to a year after the set date (Castillo-Figueroa, 2023).

One of the strengths of this research is that it is one of the first studies to analyze mothers' perspectives on the implementation of nutrition education workshops in a food-insecure fishing community from northwest Mexico. Another strength is that randomization was used to select the streets of Bahía de Kino Viejo that were visited to recruit households; thus, ensuring that the participating households were representative of the total population of the community. In addition, there was a high participation rate, both in the pre-intervention phase and during the implementation of the nutrition education workshops, which shows the interest of the mothers and school-aged children of Bahía de Kino Viejo in participating in interventions that contribute to the improvement of their nutrition and health status.

One limitation is the study design. The single-group pretest-posttest design of this study allowed the authors to manipulate exposure. However, this design cannot guarantee that the observed changes were due to the intervention, and not to other interventions or uncontrolled factors, such as the COVID-19 pandemic. Nevertheless, no other interventions were introduced to the families during the years of this study.

CONCLUSIONS

Food insecurity is prevalent among fishing families in northwest Mexico and has a negative impact on children's performance in nutrition education workshops. Mothers' perceived barriers following the workshop recommendations due to the economic situation in Bahía de Kino, which was further affected during the COVID-19 pandemic, exacerbating the community's problems with employment, income, and food prices. Comprehensive support is needed through programs that strengthen mothers' finances, especially in times of crisis. In this sense, nutrition education will contribute to the reduction of food insecurity and its negative impact on the nutritional status and health of children and adults living in vulnerable communities, such as those that are dedicated to fishing.

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CONFLICTS OF INTEREST

The authors have stated that they do not have any conflicts of interest.

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