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Design and evaluation of a program to improve food and nutrition security in mothers and their school-age children from Kino Bay, Sonora

TESIS

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"El saber de mis hijos hará mi grandeza"

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OBJECTIVES

General Objective

- To design and evaluate a program to improve food and nutrition security in mothers and their school-age children from Kino Bay, Sonora.

Specific Objectives

- To evaluate the degree of food security, socioeconomic situation, and nutritional status of mothers and their school-age children from Kino Bay.
- To evaluate the knowledge and attitudes in nutrition, in mothers and their school-age children from Kino Bay, as well as their habits of personal hygiene during the consumption and preparation of food.
- To develop and implement strategies that contribute to improving economic access, availability, and food utilization in mothers and their school-age children from Kino Bay.
- To evaluate the outcomes of the program at the end of its implementation.

HYPOTHESES

General Hypothesis

- Mothers and their school-age children from Kino Bay completing the "Program to improve food and nutrition security in mothers and their school-age children from Kino Bay, Sonora" will have a better degree of food and nutrition security compared to the degree prior to the implementation of the program.

Specific Hypotheses

- Mothers and their school-age children completing the program will have:
  - Better knowledge and better attitudes related to nutrition.
  - Better personal hygiene and food preparation practices.
  - Greater availability and access to healthy food.
  - Better anthropometric and biochemical measures.

ABSTRACT

Food insecurity is one of the main problems that affects the availability and access of food for families whose main livelihood is fishing. Due to the negative effects of food insecurity on nutritional and health status, targeted interventions to vulnerable groups in fishing communities are needed. Therefore, the objective of this investigation was to design and evaluate a program to improve the food and nutrition security in mothers and their school-age children from Kino Bay, Sonora. The evaluation had a quasi-experimental design with assessments before and after its implementation. In September 2016, 116 families were recruited for the study, which included 116 mothers (89.2% of those eligible) and 131 children (89.1% of those eligible). A survey about socio-economic and demographic conditions was applied to know the general characteristics of the families. Food security was assessed in mothers and their children through economic access, availability, and utilization of food. For access to food, the Mexican Food Security Scale was used. Through dietary measures the availability of food was assessed. Food utilization was assessed using anthropometric, and biochemical measures. In addition, knowledge of nutrition and hygiene practices was assessed. A 64.7% (n = 75) of households reported experiencing food insecurity. In mothers, food insecurity was associated with lower intake of protein and iodine, and higher intake of carbohydrates. Mothers with food insecurity had 3.68 and 3.22 times higher odds of not consuming vegetables and fruits, respectively, and 4.87 times higher odds of consuming sweetened non-dairy drinks compared to mothers with food security (P = 0.04, 0.04, and 0.05, respectively). In children, food insecurity was also negatively associated with the consumption of fruits and fruits plus vegetables. An 88% (n = 89) of mothers were overweight or obese and 93% (n = 92) had abdominal obesity, but there were no significant associations between overweight, obesity, and abdominal obesity with food insecurity. On the other hand, 50% (n = 51) of children were overweight or obese, and food insecurity was associated with lower prevalence of overweight and obesity, both in

boys and girls. Mothers with food security had 12.01 mg/dL higher HDL cholesterol than those with severe food insecurity. In children there was no significant association between hemoglobin level or the prevalence of anemia and the severity of food insecurity. In mothers, the average score of the nutrition knowledge and hygiene practices in food consumption questionnaire was 14.0 ± 2.7 points (out of a maximum of 25 points). Higher questionnaire score was associated with a lower food insecurity score. The aforementioned results regarding the associations between dietary and biochemical measures of mothers with food insecurity were published in an original article in the journal of Nutrición Hospitalaria. While the results on the associations between dietary and anthropometric measures of children and food insecurity were published in the journal of Ecology of Food and Nutrition. With the information collected, intervention strategies were designed, which included nutritional education, healthy meal plans, and home gardens. A 3.4% (n = 4) of families changed their residence to another community prior to the implementation of program interventions. Therefore, 112 mothers and 126 school-age children participated in the program's interventions. An 84.8% (n = 95) and 73% (n = 92) of the mothers and children, respectively, participated in all the nutrition education workshops. Additionally, mothers received the manual "Guide to improve food and nutrition" in printed format, which will help them to review the topics taught in the workshops. About two-thirds (65.2%, n = 73) of the mothers received two healthy meal plans. One quarter (25.8%, n = 17) had an average weight loss of 3.5 kg between the beginning of the program and before receiving the first meal plan. However, 68.2% (n = 45) had a weight gain of 4.1 kg in the same period. Home gardens were implemented in 81.3% (n = 91) of the participating households, of which 80.2% (n = 73) of families had success in growing some crops within their home garden, regardless of their degree of food insecurity. Due to the health contingency COVID-19, it was not possible to conduct all final assessments. However, through telephone calls, the Mexican Food Security Scale was applied to 31.3% (n = 35) of the mothers. When comparing the scores and the food insecurity categories obtained from applying the scale to this percentage of mothers, there

were no statistically significant differences in food security between pre-test and post-test assessments. This may be due to the negative effects on income and diet that mothers reported experiencing during the previous months due to the pandemic. Food insecurity is a problem that is affecting the nutritional and health status of mothers and their children from Kino Bay. However, families are willing to seek ways to counteract this situation, so it is important to increase their participation in intervention programs that contribute to achieving food and nutrition security in the families of this community.

RESUMEN

La inseguridad alimentaria es uno de los principales problemas que afecta la disponibilidad y el acceso a los alimentos de las familias cuyo principal medio de vida es la pesca. Debido a los efectos negativos de la inseguridad alimentaria en el estado nutricional y de salud, se necesitan intervenciones específicas para los grupos vulnerables de las comunidades pesqueras. Por lo tanto, el objetivo de esta investigación fue diseñar y evaluar un programa para mejorar la seguridad alimentaria y nutricional en madres de familia y sus hijos en edad escolar de Bahía de Kino, Sonora. La evaluación tuvo un diseño cuasi-experimental con mediciones antes y después de su implementación. En septiembre de 2016, se reclutaron 116 familias para el estudio, que incluyó 116 madres (89.2% de las elegibles) y 131 niños (89.1% de los elegibles). Se aplicó una encuesta socio-económica y demográfica para conocer las características generales de las familias. Se evaluó la seguridad alimentaria de las madres de familia y sus hijos a través del acceso económico, la disponibilidad y la utilización de los alimentos. Para el acceso a los alimentos se utilizó la Escala Mexicana de Seguridad Alimentaria. Se aplicó una entrevista semiestructurada para evaluar la disponibilidad física de alimentos en la comunidad. A través de medidas dietéticas se evaluó la disponibilidad de alimentos. La utilización de los alimentos se evaluó mediante medidas antropométricas y bioquímicas. Un 64.7% (n = 75) de los hogares informó experimentar inseguridad alimentaria. En las madres de familia, la inseguridad alimentaria se asoció con una menor ingesta de proteínas y yodo y una mayor ingesta de carbohidratos. Las madres de familia con inseguridad alimentaria tuvieron 3.68 y 3.22 veces más probabilidades de no consumir verduras y frutas, respectivamente y 4.87 veces más probabilidades de consumir bebidas no lácteas endulzadas en comparación con las madres con seguridad alimentaria (P = 0.04, 0.04 y 0.05, respectivamente). En los niños, la inseguridad alimentaria también se asoció negativamente con el consumo de frutas y frutas más verduras. Un 88% (n = 89) de las madres tenían sobrepeso u obesidad y el 93% (n = 92) tenía obesidad abdominal, pero no existieron asociaciones significativas

entre sobrepeso, obesidad y obesidad abdominal con inseguridad alimentaria. Por otro lado, 50% (n = 51) de los niños tuvo sobrepeso u obesidad y la inseguridad alimentaria se asoció con una menor prevalencia de sobrepeso y obesidad, tanto en niños como en niñas. Las madres con seguridad alimentaria tuvieron 12.01 mg/dL más colesterol HDL que aquellas con inseguridad alimentaria severa. En los niños no hubo una asociación significativa entre el nivel de hemoglobina o la prevalencia de anemia y la severidad de la inseguridad alimentaria. En las madres de familia, la puntuación media del cuestionario sobre conocimientos en nutrición y prácticas de higiene en la preparación de alimentos fue 14.0 ± 2.7 puntos (de un máximo de 25 puntos). Mayor puntuación en el cuestionario se asoció con una puntuación más baja de inseguridad alimentaria. Los resultados antes mencionados sobre las asociaciones entre medidas dietéticas y bioquímicas de las madres de familia e inseguridad alimentaria fueron publicados en un artículo original en la revista Nutrición Hospitalaria. Mientras que los resultados sobre las asociaciones entre las medidas dietéticas y antropométricas de los niños e inseguridad alimentaria se publicaron en la revista Ecology of Food and Nutrition. Con la información recolectada se diseñaron estrategias de intervención, que incluyeron educación nutricional, planes de alimentación saludable y huertos familiares. Un 3.4% (n = 4) de las familias cambiaron de residencia a otra comunidad antes de la implementación de las intervenciones del programa. Por ello, 112 madres de familia y 126 niños en edad escolar participaron en las intervenciones del programa. El 84.8% (n = 95) y 73% (n = 92) de las madres y los niños, respectivamente, participaron en todos los talleres de educación nutricional. Adicionalmente, las madres recibieron el manual "Guía para mejorar la alimentación y la nutrición" en formato impreso, que les ayudará a repasar los temas enseñados en los talleres. Aproximadamente dos tercios (65.2%, n = 73) de las madres recibió dos planes de alimentación saludable. Un cuarto (25.8%, n = 17) tuvo una pérdida de peso media de 3.5 kg entre el inicio del programa y antes de recibir el primer plan de alimentación. Sin embargo, el 68.2% (n = 45) tuvo un aumento de peso de 4.1 kg en el mismo período. Se implementaron huertos familiares en el 81.3% (n = 91) de los hogares participantes, de los cuales 80.2% (n = 73)

de las familias tuvieron éxito en cultivar algunos cultivos dentro de su huerto familiar, independientemente de su grado de inseguridad alimentaria. Debido a la contingencia sanitaria COVID-19, no fue posible realizar todas las evaluaciones finales. Sin embargo, a través de llamadas telefónicas, se aplicó la Escala Mexicana de Seguridad Alimentaria al 31.3% (n = 35) de las madres. Al comparar las puntuaciones y las categorías de inseguridad alimentaria obtenidos de la aplicación de la escala a ese porcentaje de madres de familia, no hubo diferencias estadísticamente significativas en la seguridad alimentaria entre los datos de las evaluaciones pre-prueba y post-prueba. Esto puede deberse a los efectos negativos sobre los ingresos y la dieta que las madres informaron haber experimentado durante los meses anteriores debido a la pandemia. La inseguridad alimentaria es un problema que está afectando el estado nutricional y de salud de madres de familia y sus hijos de Bahía de Kino. Sin embargo, las familias están dispuestas a buscar formas de contrarrestar esta situación, por lo que es importante aumentar su participación en programas de intervención que contribuyan a lograr la seguridad alimentaria y nutricional en las familias de esta comunidad.

INTRODUCTION

Food insecurity is experienced when there is uncertainty about future food availability and access, inadequate quality and quantity of food, or the need to use socially unacceptable ways to acquire food (Leroy et al., 2015).

Since 2014, food insecurity has increased globally, mainly in Africa and Latin America. In 2019, 26.4% of the world's population was food insecure, of which 52% was in Asia, 34% was in Africa, and 9% was in Latin America (FAO et al., 2019).

In the same year, 55.5% of Mexican households experienced some degree of food insecurity, of which 32.8% was mild food insecurity, 14.1% moderate food insecurity, and 8.6% severe food insecurity (Shamah-Levy et al., 2020).

The lack of sufficient and nutritionally adequate food that people experience during food insecurity affects their nutritional and health status (FAO et al., 2019).

Undernutrition is one of the most obvious consequences of food insecurity, however it has a wide range of another negative health impacts. Food insecurity has been associated with risk factors for chronic degenerative diseases, such as obesity and abnormal blood lipids. In addition, an association has been found between food insecurity and high blood pressure and diabetes. Particularly in women, household food insecurity has also been linked to high levels of perceived stress, depression, and anxiety. Among children, food insecurity has been established as a risk factor for delayed growth and development, poor physical and mental health, behavioral problems, and poor academic performance (Weiser et al., 2015).

In view of the above, the policies and programs adopted by governments against food insecurity and malnutrition cover a very wide range, ranging from general macroeconomic interventions to the design of highly focused specialized programs (Cuéllar, 2011).

Sonora is one of the states that has the largest production of food of animal origin and rural economic units in the country. However, despite efforts to develop food social

support programs that improve the food security situation in the state's communities, the policies include a centralist vision that does not make distinctions between the different capacities and particularities of each region. Policies are applied as a mechanical exercise without mediating differential criteria on the productive traditions and the nutritional needs of each population. Furthermore, policies focus more on presenting results than on offering spaces for discussion and participation by citizens and research institutions with a view to devising autonomous food security programs based on the specific problems of the different regions (Sandoval et al., 2008).

As an example of the above is Kino Bay, one of the most important fishing communities in the state, which has been included in programs to improve the food situation. However, the activities in these programs do not cover the fishing sector despite food insecurity having been identified long ago as one of the main problems that affects the availability and access of food for families whose main livelihood is fishing (Bené et al., 2007; FAO et al., 2017).

There are no studies about the situation and consequences of food insecurity in Kino Bay, but existing information establishes serious problems in this sector: the storage, transport, and distribution techniques are insufficient. These deficiencies force fishermen to sell most of the fish they catch at low prices. Consequently, their income and access to other nutrient-dense foods are limited, which may adversely affect food security and economic development, and reduce the social welfare of the population, especially in vulnerable groups like women and children (Moreno et al., 2005).

For all the above, the present work had the objective of developing, implementing, and evaluating a program that improves food and nutritional security in fishing families from Kino Bay, following the methodology for planning community nutrition programs. Focusing on contributing to shorten the generation gap in poverty, through multidisciplinary actions that allow productive decision-making, establishment of alliances and, above all, the empowerment of the population.

BACKGROUND

Food and Nutrition Security

Food Security

The concept of food security appeared in the mid-1970s in the midst of a global food crisis that led to higher cereal prices and increased concern about the scale of world hunger. Food security at that time was defined primarily in terms of food supply at the international level. During the United Nations World Food Conference, held in 1974, food security was defined for the first time as: “availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” (Clapp, 2015).

During 1980 and 1990 the way of thinking about food security changed. Amartya Sen's work showed that hunger not only depended on the availability of food at the social level, but was also linked to individual access to food, which in turn depended on the ability of people to obtain resources to produce, buy or exchange food. With this, it was established that to fight against hunger it was not enough to increase the availability of food, but it was also necessary to improve its access, considering that poverty and social status are determining factors. This new conception of food security was established in the World Bank’s 1986 report, Poverty and Hunger, which defined food security as “access of all people at all times to enough food for an active, healthy life” (Clapp, 2015).

During subsequent decades, the concept of food security was refined. In 1996, the World Food Summit incorporated the nutritional and cultural dimensions and later, in 2001, the word social was included, giving rise to the most widely used and accepted definition of food security: “food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life”. This definition implies that food security is based on three pillars or dimensions: availability, access, and

utilization. In 2006, the Food and Agriculture Organization of the United Nations (FAO) added a fourth dimension, stability, to indicate that the existence of food security depends on the continuity over time of the other three pillars (Clapp, 2015).

Nutrition Security

The term of nutrition security emerged with the recognition of the necessity to include nutritional aspects into food security. Nutrition adds the aspects of health services, healthy environment and caring practices. Therefore "a person is considered nutrition secure when she or he has a nutritionally adequate diet and the food consumed is biologically utilized such that adequate performance is maintained in growth, resisting or recovering from disease, pregnancy, lactation, and physical work". Recently, FAO has defined nutrition security as "a condition when all people at all times consume food of sufficient quantity and quality in terms of variety, diversity, nutrient content, and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health and care" (Pangaribowo et al., 2013).

Food and Nutrition Security

The term food and nutrition security combines the aspects of food security and nutrition security and indicates the relationship that exists between them (Pangaribowo et al., 2013). This relationship is affected by factors at the individual, local, regional, national, and global level. In this sense, nutritional security can be seen as a process at the individual level, which is achieved when the cells of the human body are adequately nourished. However, nutritional security depends on both food security and health security, since it requires the existence of access to nutritious food as well as access to health services. Furthermore, both food security and health security are closely linked to income at the household level. But in addition, food security depends on the availability of nutritious food at the local, regional, and national levels. And this availability of food, in turn, depends on production for local consumption, as well as the ability to import food. To

achieve food security and nutritional security, a stable and sustainable supply of food is required worldwide (Pérez-Escamilla et al., 2008).

In this sense, food and nutritional security has been defined as "a condition under which adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily utilized by all individuals at all times to live a healthy and happy life" (Pangaribowo et al., 2013).

Food Security Dimensions

According to its basic definition, food security can be understood by considering the following four dimensions:

Availability

Food availability refers to the physical existence of food, be it from own production or on the markets. The term is most often applied in reference to food supply at the regional or national level. Is the result of the internal production of both products primary as industrialized, the level of reserves, imports, exports, food aid, storage, and mobilization capacity (Weingärtner, 2004; CONEVAL, 2010).

This availability must be stable so that there is sufficient food throughout the year. It must also be appropriate to social and cultural conditions, and with innocuous products, that is, without substances harmful to health (CONEVAL, 2010).

Access

Access to food refers to all households or individuals having sufficient resources to obtain healthy and nutritious food. Limited access to food is directly related to people's purchasing power, as well as to the structural conditions that allow access to food, such as road and rail density, household income and spending, and prices (Weingärtner, 2004; CONEVAL, 2010).

Likewise, access to food also depends on the physical, social, and political environment, which determines the way in which households can use their resources to

achieve their food security objectives. Unfortunate events such as floods, periods of drought or social conflicts, not only alter food production, but also threaten access to food by affected families (Weingärtner, 2004).

Utilization

Food utilization refers to the socioeconomic aspect of food security. If food is available and accessible, the household must make decisions about what food it will buy, how it will prepare it, and how it will be distributed within the family. The utilization is not only a result of the purchasing power of households, but also of who makes the purchases and prepares the food, in addition to knowledge, habits, and culture, which in turn are influenced by advertising and the media (Weingärtner, 2004; CONEVAL, 2010).

The choices of the consumption of certain types of foods and their state (fresh, frozen, canned, and prepared) depend on the potential time of obtaining the ingredients and preparing the food; time constraints may be greater in households with children and when women participate in the labor market (CONEVAL, 2010).

At the individual level it also requires taking into account the biological utilization of food, which refers to the ability of the human body to take food and convert it into energy for the proper functioning. Thus, this utilization will depend on an adequate diet, infrastructure conditions of the household (i.e. access to water and sanitation), and the techniques of food preparation and storage (Weingärtner, 2004; CONEVAL, 2010).

Stability

Stability is related to risk factors that can negatively affect the availability or access to food, including negative shocks such as volatility in the prices of staple foods, fluctuations in the supply of food in the market, political instability, climatic events, and social conflicts. Therefore, stability indicates that even in these negative situations, a person or household must be able to ensure the availability and access to adequate food to maintain the state of food security at all times (Weingärtner, 2004).

Food Security in Fishing Communities

Fishing is an important economic activity to guarantee food security worldwide, by directly providing nutritious food and indirectly providing income for the purchase of other types of food. Mexico is an emerging economy that due to its wide marine diversity is among the top 15 fishing nations worldwide. Therefore, the Mexican fishing sector constitutes an important source of food and employment at the local level (Aguilar-Ibarra et al., 2013).

Fish can contribute to food and nutrition security through three distinct pathways. The first one is the direct nutritional contribution from fish consumption. Fish are rich in essential nutrients, hence households engaged in fisheries could improve their nutritional status by consuming some of the fish they catch (Kawarazuka et al., 2010).

For many poor households engaged in full-time, seasonal or occasional small-scale fishing activities, such contributions are crucial to food security (FAO, 2005).

However, the percentage of catch that the household allocates for self-consumption depends on the amount of product that is marketed as well as the household's poverty level. Furthermore, the relationship between poverty and the amount of catch consumed is also complex. Generally, it is considered that low-income households consume a greater amount of the captured products than households with high resources, however this situation does not always occur in this way. Recent studies have shown that households, especially those with low resources, consume less of the captured products because they prefer to sell it in order to obtain income and buy other types of food. Consequently, the direct and nutritional contribution of fish to food security in this type of household may be less than expected (FAO, 2005).

From a nutritional point of view, fish is an important source of animal protein, especially when other protein sources are scarce or expensive. The FAO has estimated that in developing countries, fish provides about 19% of their protein intake. This amount represents a global average, so it does not reflect the characteristics of each nation and

region. In reality, the contribution of fish to protein intake can reach 25% in poor countries and up to 90% in islands and isolated coastal areas (FAO, 2005).

In terms of energy, it is estimated that in these communities where there is a lack of other sources of animal protein, fish can contribute up to 180 calories per capita per day. But, in general, fish only provides 20 to 30 calories per capita per day. Also, in many low-income countries, staple foods such as rice, wheat, and maize are the main sources of energy. Unlike fish, these foods are not usually important sources of some essential micronutrients such as iron, iodine, zinc, calcium, vitamin A and C, and essential fatty acids. Thus, the importance of including fish in the diet is recognized, especially in young children, infants, and pregnant women from vulnerable sectors (FAO, 2005).

The second pathway relates to income. Households engaged in fisheries can increase their income by selling fish. Which in turn allows them to access other foods and improve their dietary quality (Kawarazuka et al., 2010).

Fish is not only a direct source of food security. The generation of income derived from its commercialization, also makes it an indirect source of food security. Fish catching, processing, and marketing is an important source of employment and income for millions of people around the world. Although, in some fishing communities, having a job is not a guarantee of food security. In these communities the lack of land to carry out other types of commercial activities makes fishing the best opportunity for families to improve their food and nutrition security. In these circumstances, access to tools and materials to capture, process or commercialize marine products may represent the only option available for living and maintaining the food purchasing power (FAO, 2005).

The third pathway is related to improving the economic status of women through involving them in fisheries-related activities (i.e. processing and trading), since women exercise great control over family income that impacts on the food and nutrition security of the family (Kawarazuka et al., 2010).

When analyzing the effect of fishing on food security, it is also important to consider fish production. As fish are an important component of the human diet, their production is likely to be unable to meet long-term demand. A decrease in the supply of fish would imply an increase in its price and a lesser variety of fish-based products. Faced with this decrease in the supply of fish, it is likely that households from middle and upper socioeconomic levels have sufficient resources to meet their needs for protein and nutrients from other food sources. However, for low-income people whose diet depends mainly on fish, a reduction in their supply can have serious economic and nutritional consequences (Kent, 1997).

The depletion of marine populations has negative consequences for food and nutritional security, economic development, and social well-being worldwide, still, it is more evident in regions that depend on fish as the main source of animal protein and economic income. Therefore, it is necessary to implement measures that allow the capture of marine species in a sustainable way (FAO, 2013).

Kino Bay

Kino Bay is located in Sonora, under the jurisdiction of the municipality of Hermosillo, capital of the state, and is located 100.9 kilometers to the southwest of such city (Delgado-Ramírez, 2003).

Kino Bay is divided into two settlements of different socioeconomic origins: New Kino and Old Kino. On the one hand, New Kino is basically a tourist settlement; its infrastructure is made up of "country houses", hotels and "trailer parks", restaurants, water, electricity, and drainage, as well as small shops. The tourism it receives comes, basically, from Hermosillo and the rest of the state, from the states closest to Sonora and from the southern United States. Local tourism, mainly from Hermosillo, frequents the bay on weekends, especially on paydays and on "bridges"; national tourism, much of which comes from Chihuahua, visits Kino Bay during the Easter and summer holidays (in July and August) and foreign tourism, made up mostly of retired adults, (predominantly

American known as “snowbird”) begins to arrive from November to February. A part of this foreign tourism actually lives temporarily in New Kino (during the winter), and has built houses and even has a club through which it organizes daily recreational activities. Foreigners who do not have a home in New Kino arrive with trailer houses and settle in one of the multiple "trailer parks" of the place. Between national and foreign tourism there is a difference in its relationship with Kino Bay; national tourism is an effective consumer of tourism services, on the other hand, the relationship of foreign tourism with the people in commercial terms is almost nil since they bring their food, their camps, and even drinking water from the United States and/or the shopping centers of the city of Hermosillo. However, they have supported the population of Old Kino with clothing, blankets, construction material, and other things during natural disasters (Delgado-Ramírez, 2003).

Old Kino concentrates most of the population. In 1990, the population did not exceed 3,700 inhabitants. According to 2010 data, it is estimated that the population has reached 6050 inhabitants, of which 3073 are men and 2977 are women. It is here where the elementary services are found, such as the educational, public, medical, religious, and political services used by the population (Delgado-Ramírez, 2003; INEGI, 2010).

Fishing in Kino Bay and its Implications for Food Security

The consolidation of Kino Bay as a population center has always been closely linked to the use of marine resources in its surroundings. Historically, the population has depended on these resources for their economic development, due to the absence of lands, which is why livestock and agriculture cannot be developed commercially (Delgado-Ramírez, 2003). For this reason, the primary sector of the population is mainly made up of small-scale or coastal fishing activity (Moreno et al., 2005).

In the Gross Domestic Product of Kino Bay, fishing represents 46.4%. Just over 50% of the population of this town depends on commercial fishing directly, and on a large number of economic activities indirectly related to it (Moreno et al., 2005). The patterns

of human use of the area are largely determined by the dynamics and characteristics of this activity. Until three decades ago, the fishermen of Kino Bay did not need to travel long distances to fish, they left Kino in the morning and returned in the afternoon, reaching satisfactory production levels. Over time, there were several changes that led to more distant fishing trips (Delgado-Ramírez, 2003).

First, the increase in the rate of immigration in the region and the greater demand for marine products caused that fishing increased and the populations of fish and other marine resources that were near the coasts decreased. The populations of marine species, which were distributed in the waters surrounding the communities, were logistically easier to exploit and began to decrease; as a consequence, the fishermen had to travel longer distances to catch enough product in one working day (Delgado-Ramírez, 2003).

Second, the implementation of new technologies such as better "pangas" (boats), more powerful engines, and more modern and efficient equipment for fishing. New technology allowed them to travel further, fish deeper, and explore new terrain. The distance from the fishing sites increased until: 1) it was no longer possible to capture enough product in one day to cover the costs of the used gasoline; 2) it was necessary to move to more distant areas, which had not been exploited, in order to gather the necessary amount of product in a shorter time and as a consequence, 3) it was no longer logistically possible to return to the town the same day, so it was done necessary to spend the night on some intermediate coast, close to the exploited areas, to continue working the following days until completing the amount necessary to pay the operating costs and make a profit (Delgado-Ramírez, 2003).

The high costs of gasoline, the wear and tear of motors and boats, and the need to minimize the risks associated with having to navigate long distances daily also contributed to deciding to establish these camps on islands and islets. As a requirement for this stay, it was necessary to have methods and equipment for ice or salt preservation and storage

of the captured product, which would allow them to remain in these isolated sites for a few days before the product went bad (Delgado-Ramírez, 2003).

In environmental matters, the aquifer resources and their ecosystems constitute the base for the development of artisanal fishing, for which the fishing families and communities are the main stakeholders in their conservation and sustainable management (Cotto et al., 2008). Unfortunately, the disorganized and indiscriminate use of natural resources, mainly due to the prevailing disorder due to non-compliance with fishing or environmental regulations, has led to the use of fishing techniques and gear that impact the ecosystem and are reducing the fishing and tourism potential of the region. The environmental quality of the region is decreasing, and the sustainability of its development is threatened (Moreno et al., 2005).

Although there are regulations and sanctions, both for the use of suitable fishing gear, application of closed seasons in breeding and refuge areas, pollution of a different nature, safety, etc., institutional action for implementation is limited and more coordination is needed for widespread compliance (Cotto et al., 2008).

In addition to the above, there is another problem related to the fishing sector. The Kino Bay group of fishermen is divided into fishermen and divers. In a good number of cases both activities, fishing and diving, complement each other during the annual catch cycle, in others the distinction between being a diver or being a small-scale fisherman has been building part of an identity and status in the community of Kino Bay (Delgado-Ramírez, 2003).

Within the fishing sector, the group of riparian fishermen is the group of social actors least benefited by fishing and is, in turn, the most important for its participation in various stages of the production process such as capture, cleaning, and filleting, and even the trading stage. As a group, they are in a marginal position and this is mainly due to its almost zero decision-making capacity and interference in beach prices, market prices, the

regulation of fishing activity and the difficulty of acquiring its own working instruments (Delgado-Ramírez, 2003).

This marginality is manifested, at the level of social, political, and economic relations (characterized by a high level of interdependence and asymmetry), which are built between the three sectors of riparian fishing, that is, between fishermen, licensees, and buyers, and also at the level of family relationships through the composition, organization, and reproduction of a common space in which fishermen and divers reproduce socially and as a daily workforce (Delgado-Ramírez, 2003).

The returns that artisanal fishermen receive for this activity, both in terms of food and income, are insufficient to satisfy the basic needs of their families and to ensure a decent life. Indeed, the families of artisanal fishermen have the lowest rates of human development, the highest relative poverty rates, and a high vulnerability to food insecurity (Cotto et al., 2008).

Food represents the greatest expenditure of the family and when the economic crisis worsens in fishing, it is common for the income to be insufficient, even for family food (Delgado-Ramírez, 2003). To obtain income, which is not always used to buy food, families sell most of the product they fish at low prices, because they cannot store and keep fish for a long time, since they lack conditions to store it in good condition for a long time; therefore, the presence of other basic foods is limited by a low purchasing power (Cotto et al., 2008).

On other occasions, the fishermen ask the permit holder for loans and their women go to the store to buy the basics: beans, potatoes, chorizo, pasta, flour, and butter. This indebts the fishermen with the permit and when they are finally paid a week or two of production and the loans are discounted, there is practically nothing left (Delgado-Ramírez, 2003).

In addition to the above, some people must make trips outside the community, to supply their family food consumption. The stores in the region are supplied with products from the city of Hermosillo, which induces their prices to rise considerably within the town. It

is common for the people of Kino Bay to go to the town of Miguel Aleman to acquire goods for domestic consumption, which is located half an hour away. For its part, the population also usually goes to the city of Hermosillo to have access to health services and higher education (high school and superior) (Delgado-Ramírez, 2003).

Currently, there are no studies on the food and nutrition security situation present in the families of this locality. However, the existing information establishes serious problems in the community, particularly those that depend on the fishing sector as their main livelihood, which can have a negative impact on food and nutrition security, especially in those who depend on fish as the main source of income and animal protein (Moreno et al., 2005).

Programs to Improve Food Security in the World

It is recognized that the inability of households to meet their minimum nutritional needs is the result of multiple causes, including: the low productivity of agriculture that prevents reaching a sufficient supply of food; the low level of household income, and restricted access to basic health and hygiene services, which reduces the efficiency in the absorption of nutrients present in food (Cuéllar, 2011).

Since food and nutrition insecurity stem from multiple causes, government interventions to resolve and prevent it encompass a wide range of possibilities (Cuéllar, 2011).

Conditional and Unconditional Cash Transfers to Consumers

Food insecurity and poverty are closely intertwined. In fact, one of the criteria commonly used by economists to establish the poverty line in a country is the cost of acquiring a food basket equivalent to the daily caloric intake necessary for a person to maintain their body weight and the performance of their labors (Cuéllar, 2011).

If a person (or household) does not have enough income to purchase the food they need, then a cash transfer should solve the problem. For the solution to be effective, two

conditions must be met: 1) that the transfer does not distort the beneficiary's leisure and work decisions, and 2) that the extra income is used to buy the food that is needed (Cuéllar, 2011).

In the theory of consumer choice, it is highlighted that the consumer chooses the levels of leisure and work that maximize their utility, based on a budget constraint. Since leisure is a normal good, an exogenous increase in income increases its consumption. Thus, this kind of programs may decrease the number of hours worked by beneficiaries. In that case, what the program contributes to it, the household loses via lower labor income and food expenses remain the same. To prevent this from happening, the amount of the supports is limited, so that they do not discourage the work effort of the household members (Cuéllar, 2011).

Regarding the second condition, the evidence shows that the person who generates the income has a greater influence on household consumption decisions. When the preferences of the decision maker are not focused on ensuring access to sufficient food for all members, programs of this type lose their effectiveness. To avoid this, the transfer can focus on the person most committed to the well-being of the home. Generally, women are considered to fulfill this role better, so multiple programs are designed to channel support towards the head of the household or the woman with the highest hierarchical status (Cuéllar, 2011).

Another possibility is to condition the transfer to compliance with certain rules. The most obvious is that the resources are used to buy food, as in the case of the United States' coupon program, or to condition them on sending children to school, visits to the doctor, among others (Cuéllar, 2011).

Conditional cash transfer programs have been implemented in the last 25 years in many countries in Latin America and the Caribbean. By 2005 the number of beneficiary households reached close to 26 million households. Regarding conditional transfers, the United Nations Development Programme (UNDP) report highlights that “the success

achieved in various countries, especially in terms of the increase in the use of educational and health services, has placed them in a privileged place among national policy strategies social" (Cuéllar, 2011).

The impact of conditional transfers on household consumption is positive. In the UNDP work (2010) it is pointed out that programs of this type increased 7% per capita consumption in the case of Brazil, 10% in Colombia, 7% in Honduras, 7.8% in Mexico, and 29.3% in Nicaragua. Due to the poverty condition of the beneficiary households, it is very likely that most of this increase has been destined to buy more food. But, the source does not mention what the effect of the transfers was on household food security (Cuéllar, 2011).

Consumer transfer programs are relatively new in developing countries in Asia, Africa, and Latin America. However, in the United States, experience with a program of this category, but on a larger scale, is broad: The Food Stamp Program in the United States (FSP-SNAP) (Cuéllar, 2011).

The FSP is the largest food safety program in the United States. On October 1, 2008 it was renamed the Supplemental Nutrition Assistance Program (SNAP), reflecting the recent modernization of the program and the emphasis on its nutritional impact (Cuéllar, 2011).

Participation in the SNAP is conditioned on meeting eligibility requirements based primarily on the financial need of the applicants. Qualifying for the program requires income below 130% of the federal poverty line level, possessing no more than $ 2,000 in liquid assets (for example, funds deposited in bank accounts), meet certain job requirements (unemployed people can only be supported for up to 6 months), and be a US citizen (Cuéllar, 2011).

SNAP benefits can only be used to buy food that will be consumed at home (breads and cereals, fruits, vegetables, red meat, poultry, fish, and dairy products), or seeds and plants used to produce food that will later they will be consumed by the beneficiary

household. SNAP cannot be used to purchase wines and spirits, vitamins, medications, non-food products, or food consumed at the store or restaurants. Transfers are distributed through the use of an electronic card that can be used in establishments authorized by the program (Cuéllar, 2011).

Studies have shown that SNAP reduces the probability of being in a situation of food insecurity by 16.2 percentage points, which translates into a reduction of 31.2% compared to the situation that would exist if households did not have access to the program. Likewise, participation in the SNAP reduces the probability of being in a situation of serious food insecurity by 3.9 percentage points, equivalent to a reduction of 20.2% compared to the situation without the program (Cuéllar, 2011).

Marketing of Food at Subsidized Prices

An alternative to granting cash transfers to households is to reduce food prices, particularly those that occupy a basic place in the diet of the poorest population. To achieve this, the government can intervene directly as a producer and/or marketer in the market, competing with private companies or reserving the right to be the only one authorized to produce, and/or sell the products to be channeled to the neediest households (Cuéllar, 2011).

Since the objective of these programs is to sell at below-market prices, public finances generally absorb the operating deficit. India has built one of the largest commodity marketing networks in the world: The Public Distribution Program (Cuéllar, 2011).

The Public Distribution System (PDS) is one of the instruments used by the Indian government to improve household food security. The PDS ensures the availability of basic necessities such as rice, wheat, and edible oils at prices below market prices, marketed in the network of stores established for this purpose. Over time, the system has grown to 462,000 establishments serving 160 million families, making it one of the largest food distribution networks in the world (Cuéllar, 2011).

However, the use of this type of program has recently been reduced. The high fiscal cost and the difficulty in targeting benefits to groups at risk are its major weaknesses. This, and the emergence of transfer programs (easier to administer, less expensive, and highly focused) has led to a decline in the importance of interventions of this type of program (Cuéllar, 2011).

Transfers in Kind

Cash transfers, particularly unconditional ones, do not guarantee that the beneficiary household increases its total consumption of food. As in the example of the United States coupon program, even though the support can only be used on food, participants can use the released income to buy other types of goods. It is in this case that food support displaces private spending (displacement effect). In extreme cases, the effect of cash transfers on food and calorie intake can be nil (Cuéllar, 2011).

In addition, the displacement effect generates incentives so that those who do not actually face an insecure situation can participate in food programs. For them, support means extra income that can be used to consume goods that are not essential (Cuéllar, 2011).

In the case of the beneficiaries who spend the transfer on more food, nothing ensures that their choices are the most nutritionally appropriate. Critics of the SNAP, for example, point out that the high rates of obesity in some low-income groups in the United States are a consequence of the program. It has been found that in the case of boys, old men, and adult men, the SNAP does not produce increases in the body mass index (BMI) nor in the probability of being overweight or obese. However, for the participating adult women (28% of the total beneficiaries) there is evidence on the interrelationship between participation in the program, a higher BMI and an increase in the prevalence of obesity (Cuéllar, 2011).

On the other hand, it is possible that the members of the household obtain a caloric intake higher than the recommended and remain in a situation of malnutrition. This is

because there are various micronutrients (iron, iodine, vitamin A) that can remain below the recommended limits even when consuming more calories than necessary (Cuéllar, 2011).

Barrett (2002) points out that micronutrient deficiencies are increasingly seen as a serious and widespread problem, not only in poor countries, but worldwide. Therefore, various programs have considered granting in-kind supports as an alternative to money transfers (Cuéllar, 2011).

In this case, the beneficiary receives food, generally prepared, instead of cash. Although this does not completely resolve the displacement effect, the program can be designed so that only a specific group of nutrients or micronutrients of interest are transferred. In this case, households will continue to use the rest of their income to buy food and the micronutrients received will serve to supplement the diet and even improve its use (Cuéllar, 2011).

Another possibility is to grant the transfer in kind at specific places and times, to particularly vulnerable groups, such as children, women, and the elderly. Such is the case of support programs for lactating women and school breakfasts. One of these programs is The Special Nutritional Support Program for Women and Children (WIC) from United States (Cuéllar, 2011).

The WIC aims to protect the health of low-income women, infants, and children under five years of age at nutritional risk. Due to its size, it ranks third among the most important food support programs in the United States. In 2009, an average of 9.1 million people participated each month. As it is a highly focused program, participants must meet certain criteria (Cuéllar, 2011).

Beneficiaries receive a supplemental food package, nutrition education, counseling, and referral to health care services. Each package is designed to meet the particular nutritional needs of the target population. For example, babies of mothers who are not breastfeeding receive cans of powdered milk formulated for each stage of their

development. An important point is that the food package is supplemental. In other words, their intention is not to constitute the primary source of household food (Cuéllar, 2011).

Products distributed include iron-fortified baby formulas, iron-fortified cereal, vitamin C-rich fruits and vegetables, fruit and vegetable juices, eggs, milk, cheese, beans, tuna, carrots, and peanut butter. The average monthly cost of each package awarded varies between $25 and $97 (Cuéllar, 2011).

Older studies suggest that the program increases participants' energy intake, as well as their consumption of protein, vitamin C, iron, and calcium. However, it is not known whether this effect remains to date. Mardis et al., (2000) did not find statistically significant differences in the pattern of consumption of fats, saturated fats, cholesterol, and sodium between the participants and non-participants. The interesting thing is that, except for cholesterol, the intake in both groups exceeded the limits recommended by the United States Food Guide, which suggests that the sample analyzed did not have very restricted access to food (Cuéllar, 2011).

Programs to Improve Food Security in Mexico

The first feeding programs in Mexico arose from the 1920s, when the post-revolutionary governments established the first programs of social assistance and subsidies for agricultural and livestock production. The actions undertaken include implementing the first school breakfast programs, organizing popular cooperatives, promoting credits for agricultural producers, and combating agricultural and livestock pests (Cuéllar, 2011).

Between 1961 and 1965 efforts to subsidize food consumption in the country intensified. At the same time, an attempt was made to increase the income of rural producers through guarantee prices (Cuéllar, 2011).

During this period, National Company of Popular Subsistence (CONASUPO according to its initials in Spanish) was created, whose direct intervention both on the supply side (buying grains at guaranteed prices) and on the demand side (mobilizing products and

selling them at subsidized prices), allowed that in the decades of the 1960s and 1970s the price control system was consolidated. At that time, the policy had set itself the goal of achieving food self-sufficiency and CONASUPO became its main tool. However, the benefits of putting cheap food on the table for Mexicans went mainly to urban areas. The marginalized and less organized rural populations were favored to a lesser extent. As time went by, some of CONASUPO's subsidiaries broke off and became independent companies, of which only two survive so far: Industrialized Milk (LICONSA) and CONASUPO Distributor System (DICONSA) (Cuéllar, 2011).

LICONSA was created in 1965 to improve the nutritional situation of children from low-income families by distributing fluid and powdered milk at subsidized prices. Currently, it oversees the Social Milk Supply Program, which impact was evaluated in 2004 and 2009. Nevertheless, in none of these years was it possible to attribute the reduction in the prevalence of short stature, low weight, and anemia in children aged 12 to 30 months and 5 to 8 years to LICONSA's iron fortification of milk, due to methodological problems (Cuéllar, 2011).

DICONSA was created in 1972 with the objective of distributing basic agricultural products (corn, beans, sugar, rice, and flour), powdered milk and tortillas at subsidized prices in rural and marginal urban areas. Currently, its purpose is to contribute to overcoming food poverty, by supplying basic and complementary products to rural towns with high and very high marginalization, based on organization and community participation. To achieve this, DICONSA currently operates the Rural Supply Program. The most recent evaluation carried out by CONEVAL indicates that this program does not have impact measurements. However, it was possible to identify a problem based on its targeting, since it is estimated that 51.7% of the locations served do not correspond to the current target population, as the stores were opened under other operating rules (Cuéllar, 2011).

In 1979, the Mexican Food System (SAM according to its initials in Spanish) was created, a program to stimulate the production of basic foods through the provision of credits and the raising of guarantee prices (Cuéllar, 2011).

SAM was an innovative program in several ways. First, it represented a planning effort worth noting. Through the use of linear programming and a series of sectoral models, it was possible to estimate the production goals and the prices necessary to ensure that the target population consumed the basic basket at the lowest possible cost, after taking into account the resource restrictions in the economy (Cuéllar, 2011).

Second, the SAM components not only sought to increase food production, but also emphasized changing the consumption decisions of the population in order to promote healthier eating patterns in accordance with national idiosyncrasy (Cuéllar, 2011).

The third point to highlight was the attempt to articulate primary production with secondary production by promoting producer associations to participate in the constitution of national agro-industries that compete with the already established transnational corporations (Cuéllar, 2011).

Finally, a fourth innovative element was the design of the product systems for basic grains, oilseeds, meats, fishing, sugar, fruits, and vegetables. Unfortunately, due to SAM's short operating time, all these innovations could not be put into practice corporations (Cuéllar, 2011).

The 1982 debt crisis and the drop in oil revenues in 1985 significantly reduced the revenues of the Mexican government. In this context of shortage of fiscal funds and trade openness, it was impossible to continue with the subsidy system on which the food security policy was based until then. As a result, between 1985 and 1994 most of the elements that had characterized it since the 1940s disappeared. The elimination of guarantee prices and the elimination or sale of entities such as CONASUPO was followed by the appearance of entities and programs that would define the new approach to food security in the country (Cuéllar, 2011).

In the social sphere, in 1989 the National Solidarity Program (PRONASOL according to its initials in Spanish) was created in order to combat social marginalization and extreme poverty, focusing on three population groups: indigenous people, peasants from arid zones, and inhabitants of urban-popular colonies. The action of the program was developed in four strands: Social Welfare Programs (which included food and supply), Solidarity for Production, Regional Development and Special Programs, such as Women in Solidarity and Agricultural Laborers. In the studies on the subject, it has been concluded that the resources available to PRONASOL were not sufficient given the magnitude of the problem it sought to solve, even though its budget increased year by year (Cuéllar, 2011).

In response to the economic crisis of December 1994, in 1995 the incoming government created the Education, Health and Food Program (PROGRESA according to its initials in Spanish), an ambitious human development investment program. In this, a series of learnings and applications of development theory were incorporated, highlighting the importance of forming human capital to escape poverty. This program used conditional cash transfers as a mechanism to encourage investment in children's health, food, and education. The target population of the program were families in extreme poverty and its main purpose was to break the cycle of intergenerational transmission of poverty. The beneficiary families received a health and nutrition education package, as well as a scholarship for each of the children under the age of 18 who studied between third grade of primary and third grade of secondary school in public schools. Access to the Basic Package of Health Services and a transfer of resources to selected families were also provided to improve the quantity and diversity of food consumption. In the case of children from 4 to 23 months of age, malnourished children of 24 to 59 months, and pregnant women, a food supplement designed to provide around 20% of calories and 100% of micronutrients necessary for each one was also distributed (Cuéllar, 2011).

PROGRESA's evaluation showed a significant increase in nutritional control and vaccination rates. Children under three years of age who participated in the program increased their attendance at growth controls between 30% and 60% and beneficiaries

between 0 and 5 years of age reduced the incidence of diseases by 12% compared to children who did not participate in the program. Regarding its effect on nutrition, the average consumption of PROGRESA households rose 14%. Food expenditure after the first year of program operation was 11% higher, compared to non-participating households. In addition, the average caloric intake rose 7.8% and some diversification was observed in their diet towards animal products, fruits, and vegetables (Cuéllar, 2011).

In 1994, shortly before PROGRESA, Direct Support to the Field Program (PROCAMPO according to its initials in Spanish) appeared in Mexico, which from its inception became the most important program in national agricultural policy. PROCAMPO was a payment program unrelated to production. The requirement to access the program was that the farm be dedicated to the production of one of the nine basic crops (rice, corn, wheat, beans, sesame, cotton, soybeans, sorghum, and barley) during one of the three agricultural years prior to 1993/1994 cycle. Payment was made per hectare, so that as more area was registered, the higher the payment was (Cuéllar, 2011).

Initially, the beneficiary had to demonstrate that the surface registered in the register produced one of the basic crops. As time passed, the requirement was relaxed to allow the planting of any legal product or forestry activities. In practice it had always been difficult to verify that the property was indeed in production. To receive the payment, it had always been necessary for it to remain in the list of beneficiaries, which had changed little over time. Once the resource was received, there were no requirements regarding its use, so it was an unconditional cash transfer. PROCAMPO's objective was to contribute to raising the income and productivity of producers. The program was not considered as a mechanism to improve the food security situation of those who receive it, since the payment was not required to be dedicated to buying food, nor was it conditioned on meeting education or health objectives (Cuéllar, 2011).

Studies that have compared the effects of PROCAMPO and PROGRESA on food security have sought to answer the question of whether an unconditional transfer that aims

to increase agricultural productivity can have the same impact on food security as a conditional transfer program. Surprisingly, the authors find that both programs increase total food consumption and calorie intake by the same proportion. In the study in question, PROCAMPO has a greater impact on the consumption of meat and vegetables, while PROGRESA impacts more on the heading of other foods. Furthermore, the authors found that while PROGRESA increases food consumption through increased household purchases, PROCAMPO does so by investing more in food production at home (Cuéllar 2011).

In October 1995, Alliance for the Field was created, a program to capitalize the country's agricultural production units. It focused on acquiring productive assets and providing basic services for rural producers, particularly those related to animal and plant health. The requirement that the beneficiary contribute a significant amount of the resource to buy the assets (up to 50%) made it regressive, since it was advantageous to the producers with more resources, who could finance larger projects. The program stopped operating in 2007. As in PROCAMPO, Alliance for the Field did not seek to improve the food security condition of the beneficiaries. Despite this, one of its components, Rural Development, was designed to operate in areas with high and very high marginalization (Cuéllar, 2011).

After the important transformation that Mexico's food policy underwent in the 1990s, the following decade was characterized by giving continuity to the efforts begun previously, without introducing radical changes. Regarding social development, PROGRESA, who became OPORTUNIDADES program, continued to be the guide for improving the living and nutritional conditions of Mexicans. In addition to this, the milk supply and distribution programs in rural and marginalized areas (LICONSA and DICONSA) continued to operate. The conceptual basis of social policy has been maintained, based on the granting of conditional transfers. At the agricultural policy level, PROCAMPO, Alliance for the Field and the Objective Income Program dominated the scene for almost the entire decade (Cuéllar, 2011).

Programs exclusively linked to food security were few and of limited resources: the Strategic Food Security Program (PESA according to its initials in Spanish) and the Emerging Maize and Bean Program (PROMAF according to its initials in Spanish) (Cuéllar, 2011).

PESA is a project of Ministry of Agriculture and Rural Development promoted with the technical support of FAO, whose objective is to contribute to the development of capacities of individuals and families who are in highly marginalized communities, so that they are the main actors in identifying and solving their food security problems. The program started in Mexico in 2002 in a pilot phase. For 2005, it expanded its operation to cover 16 states. In 2008, it served 52,220 families in 3,730 communities in 641 municipalities in the country. In terms of results, the most important strengths of the PESA have been increasing the availability and access to food in the areas of high and very high marginalization in which it has been implemented, as well as consolidating a range of professional technical assistance services in areas where these services did not reach. The program has been shown to statistically significantly reduce household concern about insufficient food and an inability to supply it; the cessation of the customary food intake in the home by a member due to lack of resources; the perception of reduction in the quantity of food served due to lack of resources; and fasting in some of the usual meal times in the home by a member due to lack of resources. The evaluation found a considerable, significant, and in the expected direction effect on variables such as income, production, and sale of agricultural products, saving, and food consumption (Cuéllar, 2011).

PROMAF's objective was to increase the production and productivity of corn and beans, two staple foods in the diet in Mexico. It was created in 2006 and the target population was the economic organizations made up of Mexican corn and/or bean producers legally constituted, in ownership or possession of agricultural surface with medium or high productive potential, according to the classification of the National Institute of Forest, Agricultural and Livestock Research. PROMAF encouraged the

application of technological packages that increased the production of corn and beans. Direct supports were also given for technical support, formulating projects, organizational development and building basic productive infrastructure. Beneficiaries could stay for up to three years, but participation in the second and third year was conditional on recovering at least 60% of the support received (Cuéllar, 2011). In 2012, PROMAF became the Incentive Program for Maize and Bean Producers (PIMAF according to its initials in Spanish). This is one of the subcomponents of the Small Producers Support Program, whose general objective is for rural economic units to increase the availability of food. Coverage is national in rural and peri-urban areas, but priority is given to corn and/or bean producers located in municipalities stratified as highly and very highly marginalize (CEDRSSA, 2018).

In September 2014, with the change of government, the OPORTUNIDADES program became the Social Inclusion Program (PROSPERA according to its initials in Spanish), whose objective was to help strengthen the effective fulfillment of social rights that enhance the capacities of people in poverty through actions that expand the development of their capacities in food, health and education, and access to other dimensions of well-being to help break the intergenerational cycle of poverty (Vizuet-Vega et al., 2016).

According to the presidential speech, the youth of the beneficiary families would receive scholarships for university studies or higher technicians, and those who look for a job would have priority in the National Employment System. Additionally, the program would facilitate the access of its beneficiaries to financial education, savings, insurance and credit, and to 15 productive programs, including, among others, the National Fund for Entrepreneurs, Scholarship Program, the Productive ProAgro and the Program for the Improvement of Indigenous Production and Productivity (Cuéllar, 2011).

Within its operating rules, the three traditional components remained: educational component, food component, and health component; but in addition, four new lines of action were defined: productive inclusion, labor inclusion, financial inclusion, and social

inclusion, which the government discourse relates to generating additional income for beneficiary families (Cuéllar, 2011).

In early 2019, Mexico began to advance in the opposite direction to the rest of Latin America in the application of social programs. While the rest of the region continues to bet on conditional resource transfer plans, social assistance programs to reduce poverty, the current government decided to take a radical turn by eliminating the PROSPERA program and transferred economic resources to the Social Program of Benito Juarez Scholarships for Well-Being. The government justified its decision by stating that the PROSPERA program was, in practice, a source of corruption.

The Benito Juarez Scholarships for Well-Being Program, in administrative and implementation terms, is replacing PROSPERA, but its characteristics are not the same. This scholarship program offers monetary support to students from initial education to university level. But the beneficiaries will no longer receive the components of the food transfer, nor the preventive medical consultations, nor self-care workshops offered by PROSPERA. In terms of education, although the scholarship program requires children to be enrolled in school, it does not monitor attendance; and in health, it does not oblige families to take talks about feeding their children, nor to go to preventive medical services.

Programs Implemented in Kino Bay to Improve Food Security

Kino Bay, as part of the municipality of Hermosillo, has been part of programs that seek to improve food security, but where most of its strategies and objectives focus on achieving food security, through the development of agriculture and livestock and with few activities focused on the fishing sector. It can be expected that the impact on food and nutrition security of this community, whose main livelihood is fishing, will be less (Moreno et al., 2005).

Programs aimed at better food and nutrition security should aim to reduce or prevent the negative impacts of a crisis on the population by reinforcing the survival mechanisms of the most vulnerable groups. The programs should start with an initial phase of analysis,

to better understand the degree of vulnerability and need of the population to which they are directed. And they must study the socioeconomic, cultural, and natural factors that affect food and nutrition security, as well as sanitary, and health conditions (FAO, 2013).

Each program must be of a unique design and with specific objectives for the population to which it is focusing. In addition, it must recognize the diverse needs and priorities of the community in order to be effective. Even consider that although the priorities are similar, the causes and resources to solve the problem may vary from one community to another and therefore, the solutions must be different (Ruel et al., 1998).

Because the program interventions have limited funding, their long-term sustainability will depend on achieving community empowerment. In this sense, by developing the program based on the capacities, skills and knowledge of the population, sustainability will be achieved and dependence on external financing will be avoided (Ruel et al., 1998).

For this reason, it is extremely important to promote community participation not only to identify the problems, needs and priorities of the population, but also to contribute to the planning of program interventions that the population consider could work to solve the problems in their community (Ruel et al., 1998).

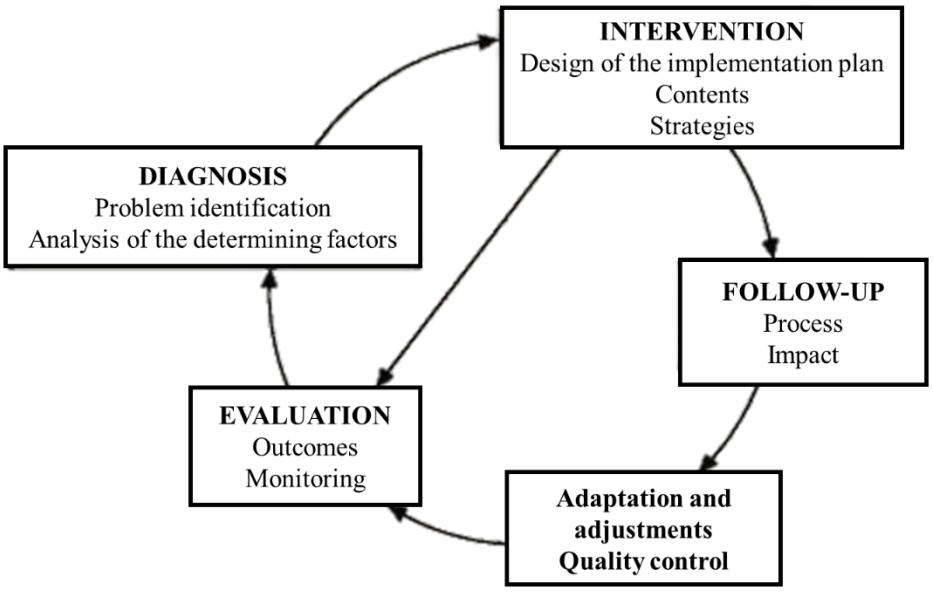
Planning of Community Nutrition Programs

The work in community nutrition comprises different sequential phases that make up a cycle for each of the programs and strategies in action (figure 1) (Aranceta, 2013).

A nutrition program is a set of organized activities, which are intended to be carried out in order to obtain a specific result on a defined population (Serra-Alias, 2012).

The fundamental elements of a nutrition program are the formulation of objectives that will be in line with the results obtained, the activities and resources necessary to achieve the objectives, and the time it will take place (Serra-Alias, 2012).

Figure 1. Phases of work in community nutrition[1].



[1]Adapted from Aranceta, 2013.

Every nutrition program requires different stages, ranging from good planning to the evaluation of the developed project (Serra-Alias, 2012; Aranceta, 2013). Thus, every program must include a sequence of stages that are described below.

Problem Identification

It is important to carry out a study of the needs of the population or the group to which the program is directed (Serra-Alias, 2012).

In this phase, the severity and magnitude of the problems and behaviors that constitute a risk factor for the specific health problem must be studied in depth (Serra-Alias, 2012).

Likewise, it is necessary to know the characteristics and peculiarities of the community, structure, form of organization, as well as the degree of training. It will also be necessary to identify key people in the community in relation to the scope of the program (Aranceta, 2013).

This phase is essential to engage the community in the program and get their participation from the earliest stages (Aranceta, 2013).

The methods for identifying problems and needs can be grouped into three groups.

Compilation of existing data: it is about collecting and synthesizing information and indicators from official statistics or other data sources. It could be the extrapolation of other studies, sociodemographic and health data (morbidity and mortality, and risk factors), use of services and resources, etc. (Serra-Alias, 2012; Aranceta, 2013).

De novo. Nutrition and health surveys: consists of obtaining information on the clinical history, dietary intake, anthropometric and biochemical measures, and level of physical activity (Serra-Alias, 2012; Aranceta, 2013).

Search for consensus and integration: techniques for the participation of the population are used, collecting their opinion and discussing topics of interest. These methods seek to obtain the opinion of the group, know how they perceive the problems, their points of

view, and reach a consensus to propose solutions to the problems detected (Serra-Alias, 2012; Aranceta, 2013).

Priority Setting

Once the problem has been identified and the specific needs of the case have been studied, it will be necessary to establish program priorities. In a community nutrition program, the criteria for establishing these priorities follow four points.

State of health or illness: the importance of the loss of productive life resulting from the disease or health problem.

The sensitivity of the disease to a health program: at this point, the theoretical effectiveness or previously established in previous studies, of the different preventive measures that can be applied in the program in question, is evaluated.

The cost of the program to fix the problem: the relationship between the costs of the intervention and available budgets helps determine the priorities of nutrition programs.

The viability of the project: from the organizational, institutional, cultural, and political point of view of the program to solve the problem (Serra-Alias, 2012; Aranceta, 2013).

Before starting an intervention, the different possible alternatives should be explored, assessing the efficacy and feasibility of the interventions that are proposed, and always taking into account the characteristics of the population to which they are aimed (Serra-Alias, 2012; Aranceta, 2013).

Determination of Objectives

The objectives can be defined as the states or health behaviors to be achieved in the target population. There are two types of objectives in community nutrition programs.

The general objective respond to the basic purpose of the program. While the specific objectives determine the type and quantity of activities to be developed and must be

related to the cognitive aspect (increase of knowledge); affective (improvement of attitudes and values); and psychomotor (skill development) (Serra-Alias, 2012; Aranceta, 2013).

Design of the Intervention

Strategies and intervention methods must be selected, the list of activities that must be carried out to achieve the proposed objectives, the material and human resources necessary to carry out the tasks, and it is also essential to establish an operations plan that determines the sequence and time intended for each of the stages (Serra-Alias, 2012).

The intervention may be very well designed, but it is useless if at the time of launching it is not used or accepted by the people or organizations to whom it is directed (Serra-Alias, 2012).

Therefore, the participation of the people who are going to receive the program during the design phase is essential so they can see that the methods used are adapted to their values, and feel that there is a relative advantage for them if they adopt the measures included in the program (Serra-Alias, 2012).

Several interventions can be included in a community nutrition program: interventions that affect the availability of food consumed, interventions that affect the impact that food has on health, and interventions that increase knowledge and interest in food and health issues (Aranceta, 2013).

The intervention strategy to be implemented will be the one that best adapts to the needs of the population and that contributes to reducing or eradicating the identified problem (Aranceta, 2013).

However, all interventions should be based on current nutritional guidelines for each community, as well as current knowledge about the relationship of food and nutrition with health and disease (Aranceta, 2013).

Resource Mobilization

Depending on the activities, the necessary resources should be chosen and mobilized.

Human: indicate the number and professional category of the necessary personnel and the proportion of the time dedicated to each activity. The human resources required should be estimated based on those available and those necessary to achieve the objectives of the program. The function to be attributed and the cost of the services provided must be stated.

Materials: indicate the equipment, tools, and places that will be required.

Economic: indicate the detailed budget and the forms of financing, public or private, as well as the payment systems. It must refer to all the necessary resources, both human and material (Serra; Aranceta, 2013).

Implementation of the Program

The implementation of the intervention must be done in the most appropriate way to modify the risk factors detected, considering the objectives that are proposed, the resources available, the group to which it is aimed, the type of intervention, and its duration (Serra; Aranceta, 2013).

For all of the above, different methods can be used but with truthful and understandable content. That they are sufficiently motivating to make a behavior change and with clear instructions to take action (Serra-Alias, 2012).

Some of the methods that can be used in the execution of community nutrition programs are: presentations (e.g. master class, demonstration, and observation), discussion (e.g. debate, round table, and focus groups), involvement (e.g. case study, self-creation, and role play), psychoeducation (e.g. self-registration, stimulus control, and nutritional coaching), and indirect methods (e.g. flyers, poster, radio, television, educational videos, internet) (Serra-Alias, 2012).

Evaluation

The evaluation must be an integral part of the design and development of any program or intervention that aims to alleviate or solve problems associated with the quality of life of people (Serra-Alias, 2012).

The purpose of this stage is to collect information that allows to introduce the necessary changes, adapt the strategy, improve the activities, continue with its implementation and judge the results obtained (Aranceta, 2013).

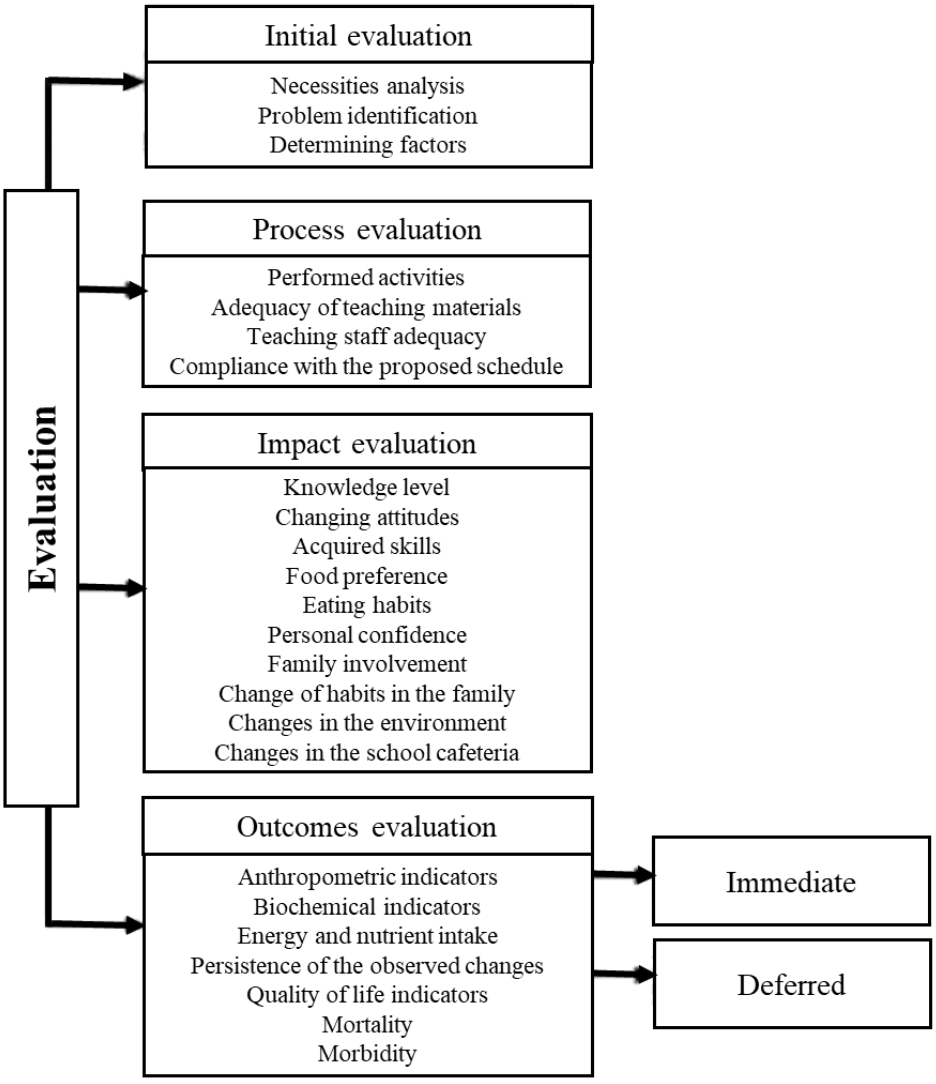
According to the scheme proposed by Green et al., (1982), the evaluation of nutritional intervention programs should contemplate three procedures, two of them included in one (figure 2) (Aranceta, 2013).

Process evaluation: it allows evaluating the adequacy of the program in its entirety to the objectives pursued in its design, making reference to the quantity and quality of the teaching staff, content, methodology used, time dedicated and support materials used. It measures the strategies and activities proposed in the intervention, and if the intervention is being carried out as designed. It helps to detect possible failures, ineffective methods, inappropriate material or any inconvenience that may arise. In this way, solutions adapted to each situation will be sought to rectify the trajectory of the program. Process evaluation considers the participation rates, characteristics of the participants and their degree of satisfaction, perceptions and reactions to the different components of the program. Also the suitability of the materials, as to whether they are interesting and easy to read (Aranceta, 2013).

Outcomes evaluation: quantifies the achievements obtained by comparing the current situation with the starting situation. There are two different aspects within this section: the impact evaluation and the outcomes evaluation in terms of health (Aranceta, 2013).

Impact evaluation: usually focuses on assessing the immediate effects of the program and, in general, correspond to its specific objectives (Aranceta, 2013).

Figure 2. Phases of the evaluation of community nutrition programs[1].



[1]Adapted from Aranceta, 2013.

It refers to the modifications in behavior or eating behavior obtained as a result of the intervention process. When nutrition education is included in the program, the impact evaluation should measure the knowledge achieved, the changes in attitude, and the development of skills related to the promotion of a more adequate diet (Aranceta, 2013).

Outcomes evaluation in terms of health: this section pursues an evaluation of the state of health with quantification of mortality and morbidity statistics, and determination of the improvement in quality of life. It can be estimated from anthropometric and biochemical measures, to show an objective reduction in risk factors. Measures the general objective of the intervention and the extent to which the results last over time, therefore, it is usually measured time after the intervention ended (Aranceta, 2013).

For all the above, the development of an intervention program based on the planning of community nutrition programs is proposed, including the adaptation and implementation of strategies that have been shown to contribute to improving food security in similar communities which are described below.

Nutrition Education

Focusing exclusively on food security does not usually serve to improve nutritional status; simply put, more food does not necessarily equate to a better diet. For example, the increase in corn production does not lead to an increase in the consumption of micronutrients, while the perception of higher income from cash crops may translate into a greater number of consumer goods in the home, but not necessarily in a better feeding of the family (FAO, 2011).

For this reason, the value of nutrition education is currently recognized as a determining factor of food and nutrition security. Nutrition education has the ability to improve eating behavior and nutritional status. In addition to affecting the nutrition of parents in the short term, and in the long term the nutrition of children, through the effect that parents have on their children. At the same time, it is an economic, viable, sustainable intervention strategy with a very extensive scope. It contributes to improving the four pillars of food and

nutrition security, but focuses particularly on those factors that influence food consumption (FAO, 2011).

Most causes of poor nutrition are attitudes and practices that education can change: food taboos, dietary and snack habits that are deeply ingrained, decisions regarding agricultural production, the distribution of food in the family, ideas about infant feeding, misleading food advertising, and ignorance about food hygiene or negative attitudes towards vegetables. For this reason, food education is defined as those learning activities whose objective is to facilitate the voluntary adoption of food and other behaviors related to nutrition that promote health and well-being (FAO, 2011).

Nutrition education can contribute to improving household food and nutrition security, particularly by helping to improve poor eating habits that commonly occur in food-insecure households. During food security assessment, the causes and consequences of inadequate feeding practices carried out by households in situations of food insecurity can be also identified. Nutrition education can be considered as a way to solve these problems, since it provides the population with skills and knowledge to cope with the complications that a negative situation implies such as the decrease in economic resources. Further, nutrition education can contribute to weight loss, and the improvement of biochemical indicators, reducing the risk of chronic degenerative diseases (Farrel, 2013).

The influence of nutrition education on food security has previously been documented. One study evaluated the effect of the Expanded Food and Nutrition Education Program (EFNEP) on a multi-ethnic, low-income population in New York. When comparing the group of people who completed the program and those who ended their participation before the end of the program, it was observed that in both, food insecurity decreased. However, it was observed that the greater the number of lessons received, the greater the decrease in food insecurity. These positive effects can be attributed to the fact that the programs must not only educate families on food and nutrition issues, but must help them

develop resource management skills, which contributes to reducing their risk of food insecurity (Farrel, 2013).

Community programs on nutrition education are programmed and designed based on the results and needs detected from epidemiological studies (Aranceta, 2013).

The development of any nutrition education program should follow the integrated phased scheme mentioned above (Aranceta, 2013).

For this reason, in any nutritional education program it is advisable to carry out an evaluation by dimensions (i.e. process and outcomes evaluation) that allows obtaining data on the improvement in attitudes and behaviors and, in the long term, allows knowing about the improvement in the health status of the individual or population group (Aranceta, 2013).

Education in Personal Hygiene Practices and Food Safety

Hygienic-sanitary quality is a factor of food and nutrition security that has been widely studied and discussed, since food-borne diseases are one of the main factors that contribute to morbidity rates in Latin American countries and from the Caribbean. Diseases that stem from contaminated food are a major public health problem. Therefore, the promotion of basic personal hygiene strategies, as well as hygiene practices that guarantee safety and quality in the production and preparation of food in homes, are particularly important (Assunta et al., 2016).

Household hygiene practices are determinants of infectious diseases in children, particularly diarrhea and undernutrition. Likewise, personal hygiene practices carried out by mothers, such as frequent hand washing and soap use, are also recognized as determinants of diarrheal diseases in children. These infectious diseases can compromise the nutritional and health status of children. It has been documented that intervention programs that promote hygiene practices can contribute to reducing the incidence of

diarrheal diseases by up to 26% and even promoting hand washing can reduce morbidity from this disease by up to 35% (Ruel et al., 1998).

Particularly in rural areas of developing countries, lack of hygiene and sanitation are recurring problems. It has been established that in these communities, mothers play a fundamental role in taking actions that reduce the exposure of children to pathogens and then prevent the development of infectious diseases. In these communities, intervention programs have been implemented that promote good hygiene practices and that provide technologies that improve sanitation conditions. An intervention in rural Bangladesh that combined hygiene education along with the introduction of hand pumps to draw water showed a decrease in the incidence of diarrheal diseases, specifically in the children of mothers who attended three of the four talks given compared to those who only received the hand pump. These types of interventions that combine hygiene education and improved sanitation conditions can achieve reductions in mortality rates from diarrheal disease by up to 50% (Ruel et al., 1998).

However, to improve people's health and nutritional status, not only are personal hygiene habits important, but hygiene practices in food handling are also important. In this sense, the diet must not only be varied and in sufficient quantity, but must be hygienic to allow each member of the family who has an adequate state of health to benefit from the nutritional point of view of the food consumed (Figueroa-Pedraza, 2003).

Sanitation and housing conditions should be considered in establishing measures to promote food and nutrition security, as well as the quality of life for families. Thus, it is necessary to consider the environment in which families live, recognizing the variables on basic sanitation that directly or indirectly affect their well-being and development, such as the source of water supply, the existence of a drainage, and collection of garbage system (Assunta et al, 2016).

Likewise, another determining factor of food and nutrition security is the condition of food storage and conservation, in which environmental factors such as temperature,

humidity, waiting time outside refrigeration after cooking and before cooking must be observed; as well as conditions of food consumption, like washing and sanitizing foods such as fruits, vegetables, and legumes (Assunta et al., 2016).

The importance of studies that go beyond traditional approaches to food and nutrition security, and that treat this phenomenon in different aspects, including health and hygiene issues, are reinforced. These studies can be decisive for the planning of preventive programs and policies and the promotion of food and nutrition security, and consequently, of the population's health (Assunta et al., 2016).

Home Gardens

A home garden can improve food availability, access, and consumption. Therefore, it represents a useful intervention strategy to achieve household food and nutritional security (Eigenbrod et al., 2015).

Home gardening is an ancient and widespread practice all over the world. It can be described as a mixed cropping system, which consists of fruits, vegetables, herbs, and ornamental plants, close to the family home. The most important benefits are the supply of fresh vegetables, savings on food expenses, and extra income if a surplus of vegetables is sold (Laleci et al., 2017).

Many people consider the home garden as a hobby, however, for low-income families this activity can be vital to guarantee their survival. These families can spend between 60% and 80% of their income on food purchases, so encouraging the implementation of gardens in their homes would allow them to improve their diet and save money to meet other basic needs (Eigenbrod et al, 2015).

In addition, a home garden can contribute to improving food security at any socioeconomic level, since it improves the availability and access to fresh food and promoting a healthier diet. Consequently, it can be a fundamental strategy to improve food

security in communities where the consumption of fresh fruits and vegetables is low due to their limited availability or because their price is high (Algert et al., 2016).

Several programs have helped low-income families to establish their own home gardens. The SNAP program allows beneficiary families to use the grants to buy seeds and plants, and thus create a home garden. In this regard, a study that evaluated the effect of the home garden on food security among families of Hispanic origin found that food security concern went from 31% before the intervention to 3% after the implementation of the home garden (Carney et al., 2012).

Implementation of home gardens also contributes to reducing the risk of overweight and obesity, by modifying unhealthy diets for higher quality diets based on fresh fruits and vegetables. Additionally, activities related to the implementation, care and maintenance of a home garden encourage physical activity. Therefore, home gardens are effective interventions in improving the nutritional and health status (Eigenbrod et al., 2015).

Other reasons for the implementation of home gardens involve financial savings as well as the desire to eat more fresh and natural foods (Algert et al., 2016).

However, the benefits of home gardens go beyond providing fresh fruits, and vegetables. Through its implementation family relationships can be established and strengthened, by helping each other in the activities that the maintenance of the family garden implies. In previous studies, it has been reported that the home garden contributes to increasing family integration, in addition to being seen as an activity to spend quality time with the family. It is also considered to have benefits in mental health, since it is a way to relax and reduce stress (Carney et al., 2012; Algert et al., 2016).

It has been reported that families give excess produce to friends and other family members, because the garden allow them to grow food for their table and for their others. Likewise, by showing them the freshness of fruits, and vegetables and their more natural

flavor, they can convince them to implement their own home garden themselves (Carney et al., 2012).

In this sense, a home gardening intervention can reduce food insecurity, improve vegetable intake, and strengthen family relationships (Algert et al., 2016).

For all the above, it is proposed to improve the food and nutrition security of families in Kino Bay, particularly in two of the most vulnerable groups to the consequences of food insecurity: mothers and children. Through the implementation of a program that includes nutritional education, healthy meal plans, promotion of hygiene habits, and the creation of home gardens. Adapting these strategies to the characteristics and particularities of the community.

SUBJECTS AND METHODS

Design of the Investigation

The "Program to improve food and nutrition security in mothers and their school-age children from Kino Bay, Sonora" was evaluated through a quasi-experimental design, with measurements before and after its implementation.

Study Population

To calculate the sample size, the formula for finite population of studies whose main variable is qualitative was used (Aguilar-Barojas, 2005). The formula was the following:

$$\frac{n = NZ^2\, pq}{d^2\,(N - 1) + Z^2\, pq}$$

Where,

n = sample size

N = population size

Z = critical value of Z, calculated from a table of areas beneath normal curve

d = absolute precision level, referred to the width of the desired confidence interval in determining the average value of the variable under study

p = approximate proportion of the phenomenon under study in the reference population

q = proportion of the reference population that does not present the phenomenon under study. The sum of p and q must always give 1 (Aguilar-Barojas, 2005).

According to the National Institute of Statistics and Geography (INEGI, 2010) Kino Bay has a population of 6,050 inhabitants. The critical Z value was 1.96 for a confidence level of 95%. The absolute precision level was 0.05. The approximate proportion of the study phenomenon was 0.89, derived from a cross-sectional study conducted in

households belonging to different places with high marginalization rates in the Northwest of Mexico, a region where the prevalence of food insecurity was 89% (Quizán-Plata et al., 2009). Therefore, the proportion of the reference population that does not present the phenomenon under study was 0.11.

The calculated sample size was 147 participants. To have a representative sample, 60% of the community streets were randomly selected. Each house in the selected streets was visited and those who had school-age children were invited to participate in the project. A total of 130 agreed to participate in the project and the mother signed the informed consent; however, after applying the exclusion criteria, the final sample size was 116 households, which included 116 mothers (89.2% of those eligible) and 131 children (89.1% of those eligible). The protocol was approved by the Research Ethics Committee of the University of Sonora (Approval number: USO313002489). The data of the participants were kept under the strictest confidentiality and were used for this research under codes.

Inclusion Criteria

- Mothers of children attending elementary school (grades 1-5) and are permanent residents of Kino Bay
- Signed informed consent

Exclusion Criteria

- Mothers with any condition that prevented them from answering the surveys

Elimination Criteria

- Change of residence to another community during the implementation of the program

Standardization of the Work Team

Training and standardization of the members of the work team was carried out in the application of diagnostic and assessments instruments, as well as in the implementation of program activities.

Pre-intervention Assessments

Socioeconomic and Demographic Characteristics

A socioeconomic and demographic survey was applied to mothers to obtain the family size, number of children, education of father and mother; mother's age, marital status, main provider at home, family income, expenditure on food, and if they were beneficiaries of government assistance programs (annex 1).

Economic Access to Food

To assess the access to food, the Mexican Food Security Scale was used (annex 2). The scale consists of 12 items that assess whether in the last three months prior to the interview, households have experienced changes in the quality and quantity of food due to lack of money or resources and, in severe situations, have experienced hunger. The questions make it possible to distinguish access to food for adults and for those under 18 years of age. Each item can be answered affirmatively or negatively. If all the answers are negative, the household have food security. The affirmative answers are added to identify the category of household food insecurity, which may be mild, moderate, or severe (Carrasco et al., 2010; Villagómez-Ornelas et al., 2014).

Availability of Food

Measures of food consumption are good indicators of food availability at individual level (Pangaribowo et al., 2013). Therefore, dietary measures were carried out on mothers of and their school-age children to assessed availability of food.

In mothers, two non-consecutive 24-hour dietary recalls were applied (annex 3). To assess the usual dietary intake, dietary data was obtained on a weekday and the other at the weekend. The amount of food and beverages consumed during the 24 hours prior to the interview was recorded. Food models and sample household measurements (such as cups and spoons) were used to specify serving sizes (Suverza et al., 2010).

For the analysis of dietary information, a code was assigned to each food and beverage reported in the 24-hour dietary recalls, based on the food dictionary designed by the Nutrition Directorate of the Research Center for Food and Development A.C. (Ortega et al., 1999), which includes information on diet components from the Alim 10000 program, INNSZ tables, ESHA Hadbook No. 8 and regional dishes from Sonora.

Once the foods were identified by codes, the code of each mother was captured in Excel, as well as all the foods and beverages that she reported having consumed in both dietary recalls, with their respective grams of consumption and codes.

Through the food code located in the dictionary, the nutritional information for the consumed food and beverages was imported into the Excel database. This information refers to the amount of macronutrients (energy, protein, carbohydrates, and fats) and micronutrients (calcium, iron, potassium, sodium, zinc, iodine, magnesium, vitamin A, C, E, and folic acid) per 100 grams of consumption. Therefore, the amount of macro and micronutrients corresponding to the amount of food eaten by each mother was calculated.

Subsequently, this information was added for each 24-hour dietary recall, in such a way that the intake of macro and micronutrients was obtained for each day; followed by obtaining the average to determine the amount consumed of each nutritional component per mother. These data were used to know the average intake of energy, macro and micro nutrients, as well as to establish compliance or not of the recommendation for these nutrients according to the guidelines for the Mexican population (Suverza et al., 2010).

Additionally, it was recorded the frequency of consumption of 14 food groups, using the methodology of the 2016 National Health and Nutrition Survey. To consider a food as

consumed, mothers should have consumed ≥ 10 grams of such food. To consider a food group as consumed, mothers should have consumed it for 2 days. We also calculated the average intake of energy, macronutrients, and micronutrients, and compared them with the recommendations for their age (Suverza y col., 2010; Hernández-Ávila et al., 2016).

A short food frequency questionnaire of fruits and vegetables was applied to children in the company of their mother (Quizán-Plata et al., 2016) (annex 4). Children were asked about frequency of consumption of 36 food items including 15 fruits and 21 vegetables consumed in the previous year. Subsequently, it was asked about the amount consumed of each food based on a previously established average portion and based on three size categories: small, medium, and large; where the small and large size is defined as 0.25 and 0.75, with respect to the medium portion (0.50). So, if the child reported having consumed the same portion of food indicated in the frequency, then the medium portion category was selected. If the child reported having consumed a smaller portion than indicated in the frequency, then the small portion category was selected. Finally, if the child reported having consumed a portion larger than the one established in the frequency, then the large portion category was selected. Once the size of the portion was determined, the frequency of consumption of each fruit and vegetable listed was asked, having as options: daily, weekly, monthly, annual, and never consumption.

From the previous information, the intake in grams per day of each fruit and vegetable was calculated for each school-age child. For the above, we used a database of the Research Center for Food and Development A.C, which contains the weights in grams of various foods. If the consumption was reported with a weekly frequency, then, the calculated amount was divided by 7 to obtain the consumption of a single day: whereas if a monthly frequency was reported, then it was divided by 30, and finally, if an annual frequency was indicated, it was divided among 365. With the above data, the average consumption of fruits, vegetables, and fruits plus vegetables intake by each child was determined. This allowed knowing the percentage of children covering the minimum

recommendation of fruit and vegetable consumption established by the World Health Organization (Bonvecchio-Arenas et al., 2015).

Food Utilization

Food utilization was evaluated through the following measures:

Anthropometric measures. Weight, height, and waist circumference were measured according to internationally standardized procedures. The first two measurements were carried out on both mothers and their children, while the third was only carried out on mothers.

The weight was measured wearing light clothing, without shoes, empty pockets, without accessories (belts, necklaces, watches, etc.), standing firm, facing forward, and without movement when taking the measurement; using a digital electronic scale with capacity from 0 to 150 ± 0.05 kg.

The height was determined without shoes, feet with slightly separated toes, body completely supported by the stadiometer, head in the Frankfurt plane, hair loose, and using a Holtain stadiometer.

Waist circumference was measured using the midpoint technique between the last rib and the iliac crest, directly on the skin. If this was not possible, it was measured over a fine fabric, but not thick or bulky clothing.

For mothers, weight and height was used to obtain body mass index (BMI) and waist circumference to obtain abdominal obesity. The classification of BMI was made according to the references of the World Health Organization, where underweight was <18.5; normal weight 18.5-24.9; overweight 25-29.9; obesity class I 30-34.9; obesity class II 35-39.9; and obesity class III > 40 kg/m^2 (WHO, 1995). The cut-off for high waist circumference to define abdominal obesity was > 80 cm according to the criteria for Mexican women of the Mexican Social Security Institute (Suverza et al., 2010).

For children, weight, height, and age was used in the WHO Anthro Plus Software to obtain the body mass index-for-age z score. The cut-offs for overweight, obesity, and severe obesity were +1 SD, +2 SD, and +3 SD, respectively (WHO, 2009).

Biochemical measures. Fasting blood samples were taken to evaluate the concentrations of hemoglobin; total, HDL, and LDL cholesterol; and glucose in mothers.

For the above, the mother of the family was asked to attend with 8 hours of fasting and that she had not performed any exercise prior to drawing blood. Before taking the blood, the material was prepared, and the tubes were labeled with labels for each person. Likewise, the procedure to be carried out for each mother was explained (Andriolo et al., 2010).

The sampling was carried out with the person sitting and after having rested a few minutes. She was asked to rest her forearm on the table. The rubber tourniquet was placed a few centimeters above the puncture site, and she was asked to clench her fist to identify the veins. By palpation of the arm, an appropriate vein was chosen for puncture, which was cleaned with 70% alcohol. As soon as the needle entered the vein, the tourniquet loosened. Blood was slowly drained from the tube walls to prevent hemolysis. Finally, the needle was withdrawn, and a cotton swab was placed at the puncture site, requesting the mother to hold it down for a couple of minutes. The tubes were sealed and kept upright in a rack (Andriolo et al., 2010). Later they were transported at low temperatures to the clinical analysis laboratory of the University of Sonora (LACIUS), for their analysis.

In children, hemoglobin concentration was evaluated using the HemoCue Hb 201+ kit. To do this, each child was asked to relax his hand. Next, the middle finger of the hand the child least used, was cleaned with 70% alcohol. Using gentle pressure, the person in charge of doing the analysis, rocked her thumb from the top of the patient's distal knuckle to the fingertip. This stimulates the blood flow towards the sampling point. Later, the lancet was firmly pressed against the finger prior to activating the lancet to aid in obtaining a good sample. While maintaining gentle pressure on the tip of the finger, the lancet was

activated. It was discarded in an approved container. With a disposable tissue, the first two to three large drops of blood were cleaned, applying light pressure as necessary until another drop of blood appeared. Subsequently, the tip of the microcuvette was placed in the middle of the drop of blood and waited until it was completely filled. Excess blood was wiped from the cuvette with a disposable tissue and made sure that it did not contain air bubbles. If bubbles were observed in the microcuvette, the sampling should be carried out again. A cotton swab was placed at the puncture site requesting the child to hold it down for a couple of minutes. The filled microcuvette was placed into the cuvette holder in the HemoCue, which showed the result within 15 to 60 seconds. Finally, the microcuvette was remove and discarded it in an appropriate biohazard container (Jordan-Lechuga, 2013).

Knowledge of nutrition and hygiene practices. A questionnaire with 25 items was developed to assess the mothers' knowledge of healthy eating, physical activity, and hygiene practices in food consumption, based on the FAO guidelines for assessing nutrition-related knowledge, attitudes, and practices (Macías et al., 2014). Each correct answer was considered as 1 point, so the maximum score was 25.

Intervention Program

Following the stages of planning community nutrition programs, all the information collected in the previously described assessments, was used to design and implement a program to improve food and nutrition security for mothers and their school-age children, through the following intervention strategies:

Nutrition Education Workshops and Good Hygiene Practices

Five educational workshops were given to mothers and their school-age children on topics that promoted healthy eating and hygiene habits, and that contributed to improving the utilization of food. These workshops were held in both elementary schools of Kino Bay, both in the morning and evening shifts, offering one workshop per week, for 5 weeks, of 1 hour duration per session. Based on the agreements established with the principals of

the elementary schools, in the first elementary school the workshops were held from May to June 2018. While in the second school the workshops were held from February to March 2019.

For each workshop, didactic material was prepared that served as a guide for explaining the topic. Each workshop included carrying out a reinforcement activity. In addition, following the scheme proposed by Green et al., 1992, a process evaluation was carried out to determine the level of attendance and the adequacy of the didactic material. Furthermore, an outcomes evaluation to assess the degree of knowledge acquired (where maximum score was 10 points per session) was also implemented (Aranceta, 2013). This evaluation was performed only in school-age children, since the outcomes evaluation in mothers was planned to be carried out with the second application of the nutrition knowledge and hygiene practices in food consumption questionnaire. Children were classified as having passed the evaluation of the workshops if they achieved a score of 10 in 3 or more of the 5 sessions.

The main topics of the workshops given to program participants are described below:

Workshop 1: nutrients and their functions. The objective of this workshop was that the participants knew the concept of nutrient, as well as its classification in macronutrients and micronutrients.

To do this, the didactic material developed consisted of summarizing the reviewed information on the subject in important points, which were written on white cardboard and supplemented with drawings. The information included the concept of nutrient, macronutrient, and micronutrient. In addition, definition, main functions and food sources of protein, carbohydrates, fats, vitamins, and minerals were included. In the latter two, information was particularly included on the B vitamins, vitamins A, C, D and E, as well as calcium, iodine, iron, and potassium (Secretaría de Salud et al., 2006; 2008; Martínez-Sazo et al., 2016).

For the reinforcement activity, the didactic material consisted of a drawing of a girl on a large cardboard, to which lines were added that related some of the functions of the nutrients that would be explained in the workshop. For example, the sentence for: development of strong bones was written, which was joined with a line to the girl's legs, representing the bones. Likewise, images of various food sources of the explained nutrients were created with colored foam paper. These were used for both the reinforcement activity and the evaluation of the assistants. The first consisted of showing some of the images of the food and asking the attendees to mention which nutrient had the greatest amount of such food, as well as the main function of that nutrient. For the outcomes evaluation, each attendee was given 5 images of the food (different from those used in the reinforcement activity), so that they could individually place the image on the girl's drawing, with the help of a thumbtack, according to the function that best represented the nutrient that the food had in greater quantity. The assistant had to place the 5 images correctly to obtain the maximum score of 10 points.

Workshop 2: "plato del bien comer" and portion sizes of food. The objective of this workshop was that the participants knew the food guide for the Mexican population, as well as the recommended consumption portions of the food groups.

The didactic material used consisted of a representation of the "plato del bien comer" on dry ice, where the images of the food used in the previous workshop were reused. With the help of this model, the objective of the "plato del bien comer", the food groups it contains, the meaning of its colors and dimensions, as well as the key messages it contains, such as consuming many fruits and vegetables, combine cereals and legumes, and consume few foods of animal origin were explained (Casanueva et al., 2002; Secretaria de Salud et al., 2006, 2008; Bonvecchio-Arenas et al., 2015).

Depending on the age of the attendees, the number of recommended portions for each food group to be consumed per day and how these portions can be moderated using the hands were explained (Bonvecchio-Arenas et al., 2015).

For the reinforcement activity, after removing all the images of the food from the “plato del bien comer” model, each image was shown to the attendees and they were asked which food group the image corresponded to, in addition to mentioning how many servings a day they should consume from that group. Also, the music video "half of your plate" was shown to reinforce the message of consuming more fruits and vegetables.

For the outcomes evaluation, 5 food images were delivered to each attendee and they were asked to place them in turns in the food group to which they belonged. Additionally, they were asked, how much of that food, represented by 1 portion of their group, as well as its equivalence in hands. For example, after the participant placed the rice in the cereal group, they were asked about how much rice was equivalent to 1 serving of cereals, to which the assistant had to answer, that measuring a cup of rice represented 1 serving of cereal, and that another way to measure that cup was using 1 palm of the hand. The assistant had to place the 5 images correctly and indicate their recommended portion to obtain the maximum score of 10 points.

Workshop 3: “jarra del buen beber”. The objective of this workshop was that participants learn about the beverage guide for the Mexican population, as well as the benefits of consuming natural water and the consequences of consuming sugary drinks.

The didactic material used consisted of a representation of the “jarra del buen beber” on dry ice. Where also, a flat surface was included to be able to place empty bottles of some drinks commonly consumed by the population. With the help of this material, the purpose of the “jarra del buen beber” was explained, as well as the levels into which it is divided, its colors, dimensions and the recommended quantities for the drinks included in each one. In addition, to promote the benefits of drinking natural water and the health consequences of consuming large amounts of sugary drinks (Rivera et al., 2008; Bonvecchio-Arenas et al., 2015).

For the reinforcement activity, a digital scale, sugar, disposable cups and spoons were used to show the sugar content that is present in some of the sample drinks. The amount

of sugar included in some of the drinks was read aloud and some of the attendees were asked to add sugar, with the help of a spoon, to a glass placed on the previously tared balance, until obtaining the amount in grams that showed the label on the bottle. At the same time, the rest of the attendees were asked to count aloud the spoons of sugar that were being deposited in the glass. This with the objective that the assistants identified the drinks that exceeded the recommendation of sugar intake of 25 g or 6 tablespoons. In addition to the above, the music video "8 glasses a day" was screened so that participants learned, while singing, about the message of consuming more water.

For the outcomes evaluation, attendees were divided into teams to carry out a "jeopardy" style game with questions related to the theme of "jarra del buen beber". Each team took turns choosing and answering a question, with a certain value of points, where in the end the team with the highest score was the winner and obtained the maximum score of 10 points.

Workshop 4: sugar, salt and fat. The objective of this workshop was that the participants learn some aspects of sugar, salt, and fat in food.

The didactic material used consisted primarily of a cardboard, which included drawings and phrases related to sugar, salt, and fat in food. Two other cartons where labels and packaging of some foods dense in sugar, salt and fat, commonly consumed by the population, as well as representations of the amount of these nutrients they contain, made from sugar, salt and styling cream, as a simulation of fat, were included. This was used to explain the maximum recommended intakes of sugar, salt and fat, foods dense in these nutrients and the health consequences of excessive consumption (Bonvecchio-Arenas et al., 2015).

For the reinforcement activity, attendees were asked to mention which foods of those shown in the teaching material were normally consumed. From which, the amount of sugar, salt or fat ingested from them was added and compared with a reference model that represented the maximum amount suggested for each of them, with the aim that the

attendees concluded whether or not their consumption exceeded the recommended limit. Also, the music video “no more sugar please” was shown to promote the message of reducing the consumption of sugar-dense foods and beverages.

For the outcomes evaluation, a “jeopardy” type game was again made that included questions of the concepts and recommendations seen in the workshop. Similar to the previous workshop, attendees were divided into teams and the one with the highest score was the winner and obtained the maximum score of 10 points.

Workshop 5: habits of personal hygiene and food safety. The objective of this workshop was that the participants knew about the importance of personal hygiene habits, and in the preparation and consumption of food.

The didactic material used consisted of a paper canvas that included images about the main hygiene habits. With it, the importance of hygiene habits and the two types of hygiene to be treated in the workshop were explained: personal and food hygiene. For the first type, the importance of daily bathing, eye care, hygiene of the ears, nose and mouth, and cleaning of hands and nails were explained. For the second type of hygiene, the five keys to food safety were described, maintain cleanliness; separate raw and cooked foods; cook fully; keep food at safe temperatures; and use water and safe raw materials (Ministerio de Protección Social et al., 2006; WHO, 2006).

The reinforcement activity consisted of showing the correct technique of washing hands and brushing teeth. For both techniques, attendees were asked to follow the demonstration carried out by the work team and simulate performing each of the steps. In addition, the videos of "tooth brushing" and "rules to guarantee food safety" were shown.

The outcomes evaluation consisted of ordering some cards that included the steps for correct hand washing. To do this, the participants were divided into teams and each team had 2 minutes to order the cards. The winning team was the one that correctly ordered most of the cards and obtained the maximum score of 10 points.

Through the process evaluation it was possible to detect some weaknesses in time in the way of implementing the workshops. In the first place, it was observed that it was not convenient to work with all the children at the same time, because the youngest did not participate as much as the older ones. Therefore, after the first workshop it was decided to work separately with the first, second, and third grade. And in another session with the fourth, fifth, and sixth grade. This action motivated the younger children to participate more actively in the reinforcement activities.

Secondly, the need to improve the quality of the teaching material was also observed, since the cards with the steps for correct hand washing used for the evaluation of workshop 5 were initially printed in black and white. Mothers and children had difficulty identifying the steps on each card, so it was decided to modify the material for a more understandable design.

All the information given in the workshops was used to prepare a manual entitled "Guide to improve food and nutrition" which was delivered in print to each participating mother. The delivery and explanation of the manual were held from September 2019 to February 2020.

Healthy Meal Plans

To promote a healthier diet and contribute to reducing the prevalence of overweight and obesity, meal plans were provided to mothers every three weeks. These plans included examples of breakfast, lunch, and dinner for each day of the week, based on the recommended food group portions for the participants' age group. Each plan included examples of snacks and key messages to remember the consumption of at least 8 glasses of water a day and to perform a minimum of 30 minutes of physical activity a day (Bonvecchio-Arenas et al., 2015).

Along with the meal plan, a guide with examples of food portion sizes was delivered and explained. The above with the aim that mothers learn to adapt the meal plan according to their tastes and preferences, but above all to the resources available in their home. So,

they were explained how they could exchange some food from the meal plan for another, as long as it was from the same group and the recommended portion was respected. It was remembered how to regulate the size of the portions using the hands, cups or spoons (Bonvecchio-Arenas et al., 2015).

It was also explained to them that the meal plan included dishes that the whole family could consume, the only thing is that the portions had to be adapted to children and adolescents. So, using the information provided in "Guide to improve food and nutrition", she was reminded and instructed how to change the portions for the age group of her children (Bonvecchio-Arenas et al., 2015).

Home Garden

The work team received training on home gardens and the preparation of compost and natural pesticides at the Department of Agriculture and Livestock (DAG) of the University of Sonora from August to December 2018.

With this preparation of the work team, families were trained in the development and maintenance of a home garden. The training was carried out through posters designed by the work team, mainly by a master's student, who also contributed throughout the process of implementation, monitoring, and evaluation of home gardens. The information included in the posters was obtained from FAO technical and self-instruction manuals, as well as notes and literature reviewed during the training course at the DAG (Castaños, 2000; FAO, 2014).

During the training, the concept of a family garden and its main benefits were first explained to families. Then, with the help of images included in the posters, the steps for the implementation of the garden were shown one by one, such as: selecting an exclusive space for the garden within the family land; clean that space of land; moisten and remove the ground; prepare the seed beds; and finally, direct sowing of each of the seeds considering the characteristics of the crops that were provided as part of the project.

Subsequently, families were instructed as to the activities that had to be carried out for the care and maintenance of the garden, including frequent watering, soil cover, weed control, and prevention of diseases and pests. For this reason, they were provided with information on the preparation of homemade pesticides based on garlic or seeds and leaves of the neem tree, which should be left to dry in the sun for two weeks to facilitate their grinding and thus be able to be deposited in a container with water and alcohol. After about 20 days, the extract obtained could be emptied into an atomizer and in this way added to the plants.

Additionally, they were oriented on the manufacture of compost, as a resource to contribute to the growth of crops. They were recommended to make a hole between 30 to 60 cm deep, in some dry place within the family land, in which they would first add a layer of manure, followed by a layer of dry, and crushed grass. And then they would add ½ sachet of yeast and ½ kilogram of commercial sugar. The same procedure had to be repeated until reaching a height of approximately 1 meter. And finally, mix all the components, while moistening with water. It was indicated that the compost should be mixed and watered every third day, for the following month; in addition to suggest covering it with a plastic to avoid the spread of bad smells or the proliferation of insects.

As part of the training, families were also shown a table with the characteristics they had to consider when wanting to plant more seeds from the same crops that were being provided. Such as the depth at which the seeds should be placed, the recommended distance between plants, as well as the days necessary to achieve germination and ripening of the crops. Finally, the characteristics that each crop had to meet to carry out its harvest were explained to them as well as recommendations on how to carry out this procedure. All information related to the training was delivered in print to each participating family.

After the training on family gardens, we proceeded with the implementation of the garden, inviting families to participate and support the work team in its development. Firstly, a space of about 4 square meters was sought within the family plot, which received

enough sunlight during the day and was not near large plants. Before sowing, the soil was removed to soften and oxygenate, using a shovel and a garden rake. Following, the place was cleaned so that it was free of stones, weeds, and grass. Subsequently, the land was left flat and from there, with the help of the garden hoe and shovel, prepare the planting beds. Once this was done, direct sowing was carried out, in which 2 to 3 seeds were deposited on the ground and in small holes, at a depth not greater than three times their size.

A total of 13 vegetables and 2 fruits were planted, considering that a distance should be maintained between each plant of the same vegetable, which depended on its final size and which would also contribute so that they could grow without removing water and nutrients from other crops. The vegetables planted and their respective distances between plants were: chard (10 cm.), broccoli (50 cm.), radish (2-3 cm.), coriander (10 cm.), serrano pepper (20 cm.), tomato saladette (25 cm), Italian zucchini (60-100 cm), cabbage (10 cm), chambray onion (10 cm), cauliflower (50 cm), carrot (5-7cm), lettuce (30 cm), and cucumber (10-15 cm). While the fruits were watermelon (100 cm) and melon (30 cm). After the seeds were sown, the soil was moistened.

After the creation of the garden was completed, families were reminded of the form and frequency of watering. For example, through a watering can and two to three times a week (depending on the weather). Families were also reminded of the steps for preparing compost and pesticides, to promote growth and control pests and diseases, respectively. A sketch of the garden was also made and delivered to each family.

Follow-up visits to the homes were made every three weeks, for the control and maintenance of the garden. For this, a format was developed to evaluate the growth and development of the plants, as well as the care taken by the participants. The number of plants of each vegetable and fruit was obtained, the growth stage in which it was found, and whether there was any type of pest or nutrient deficiency that affected the plant. It was observed if the home garden had a fence, if tomato and cucumber plants were

supported with a string or another material, existence of an irrigation system, if the home garden was clean, and if the family prepared compost and organic pesticide.

Post-intervention Assessments

To estimate the effect of the program, the instruments, interviews, and measures that were used to assess availability, economic access, and utilization of food in the pre-intervention stage were planned to be applied again.

However, due to the health contingency caused by COVID-19, the way of evaluating the outcomes of the program had to be adapted. In this sense, an adaptation was made to the format to evaluate the home garden, with the aim of being able to carry out the follow-up through structured telephone interviews with mothers conducted by members of the work team. In these interviews, questions were asked about the type and number of plants that grew and were harvested. In addition, the final use of these crops, such as family consumption, sale, gift or exchange for other products. They also asked about the existence of damage, pests or diseases in the crops, as well as whether the family had planted any other vegetables. Additionally, mother was asked about the frequency and the main reasons for carrying out or not, care for its maintenance, such as frequent irrigation, fencing the garden, compost and natural pesticides, and placement of guidelines for tomato and cucumber crops. Finally, the participation of family members in the family garden, as well as their willingness to continue with this activity in the long term was ascertained.

The second application of the Mexican Food Security Scale was also carried out through telephone calls. During the call, the food security scale was first applied and later, a semi-structured interview was applied to find out if the family had been affected by the COVID-19 pandemic. For the semi-structured interview, a script was previously prepared which contained questions about the effect of the pandemic on employment, family income, food purchase, and availability of food and its prices in the community. As well as if the family had received some economic or pantry support during those months. With

the prior authorization of the participants, the calls were audio recorded. The interviews had an average duration of 40 minutes. The information was completely transcribed, preserving the original phrases of the mothers. Subsequently, the information was divided and classified into the aforementioned topics.

Statistical Analysis

Descriptive statistics were performed to estimate the mean, median, standard deviation, interquartile range, and percentage of the variables.

Likewise, association analyzes were carried out to determine the effect of food insecurity on the dietary, anthropometric, and biochemical measures of mothers and their school-age children. For these analyses, the independent variable was the food security scale score or the four categories of food security (i.e., food security, mild, moderate, and severe food insecurity) where food security was the reference category.

In mothers, the dependent variables were the intake of energy, macronutrients, and micronutrients, the consumption of food groups, prevalence of overweight and obesity, and abdominal obesity, and concentration of hemoglobin and total cholesterol, HDL and LDL.

The consumption of energy, macronutrients and micronutrients, and concentration of hemoglobin and total cholesterol, HDL and LDL were handled as continuous variables. Their association with food insecurity was analyzed using the four categories of food security and linear regression.

Consumption of food groups were handled as dichotomous variables. For food groups expected to have lower risk (i.e., fruits, vegetables, legumes, no processed meats, pure water, eggs, dairy products, and cereals), 0 = consumed the food group and 1 = did not consume the food group. For the food groups expected to have higher risk (i.e., processed meats, fast food and greasy foods, snacks, sweets and desserts, sweet cereals, non-dairy beverages and sweetened non-dairy, and dairy drinks) the categorization was reversed.

Their association with food insecurity was analyzed using the four categories of food security and logistic regression.

The prevalence of overweight and obesity and abdominal obesity were handled as dichotomous variables where 0 = the mother is not overweight or obese or has not abdominal obesity, and 1 = the mother is overweight or obese or has abdominal obesity. Their association with food insecurity was analyzed using the four categories of food security and logistic regression.

The effect of knowledge on nutrition and hygiene practices of mothers as a determinant of food insecurity score was also evaluated, using the score in the knowledge questionnaire as a continuous variable and linear regression.

In the previous analyzes, the age of the mother, number of children, main provider at home, education of her and her husband, and her employment status were used as adjustment variables.

In school-age children, the dependent variables were the grams of fruits and vegetables consumed, meeting the recommendation for fruit and vegetables consumption, the prevalence of overweight and obesity, concentration of hemoglobin, and the prevalence of anemia.

Grams of fruits and vegetables consumed were handled as continuous variables. Due to non-normal distributions, for the association between this variable and the categories of food security, linear regression with and without logarithmic transformations were used. The results were similar, however, so only the transformed (parametric data) results are reported. Tests for trends across the four categories of food insecurity considered as ordinal (0, 1, 2, 3) were conducted using linear regression.

Hemoglobin concentration was handled as a continuous variable and its association with food insecurity was tested through linear regression. Because hemoglobin analysis was performed on a small number of school-age children, only three categories of food

security were used in the association analysis (i.e., food security, mild, and moderate food insecurity). None of the children tested were categorized as having severe food insecurity.

Meeting the recommendation for fruit and vegetable consumption, the prevalence of overweight and obesity and anemia were handled as dichotomous variables. For meeting the recommendation for fruit and vegetable consumption, 0 = complies with the recommendation and 1 = did not comply with the recommendation. For the prevalence of overweight and obesity, 0 = the child is not overweight or obese and 1 = the child is overweight or obese. For the regressions with this binary dependent variables, the logit of the probability for each category of food insecurity was obtained, and then linear regression was used with the four categories of food insecurity considered as ordinal (0, 1, 2, 3). For the prevalence of anemia, logistic regression analysis was performed with three categories of food security (i.e., food security, mild, and moderate food insecurity) where 0 = the child does not have anemia and 1= the child has anemia.

The association between the four categories of food insecurity and passing the nutrition education workshops was analyzed in children using logistic regression, where 0 = the child passed the course, and 1 = the child did not pass the course.

In the previous analyzes, the age and sex of the children, number of children at home, main provider at home, education of parents, and employment status of mother were used as adjustment variables.

To evaluate the results of the home garden, the Kruskal Wallis test was used to analyze the differences between the number of crops grown and harvested in households with food security and food insecurity.

To analyze changes in body weight and in the prevalence of overweight and obesity between the stage of pre-intervention assessments until before the first healthy meal plan the Wilcoxon signed rank and McNemar test for correlated samples were used.

To estimate the changes in the Mexican Food Security Scale score and categories of food insecurity the Wilcoxon signed rank and Marginal Homogeneity test for correlated samples were used.

To analyze the qualitative information collected through the telephone calls, the constant comparison method was used. This method has been developed by Glaser et al., (1967) and taken up by Strauss et al., (1991). It consists of the implementation of a systematic set of procedures that involves constant comparison to analyze the data and look for similarities and differences (García, 2019). Following this method, the interview transcripts were analyzed to detect common comments for each of the topics that were included in the interview (i.e. employment, income, purchasing power, availability and prices of food, support received).

All analyses were performed in Stata version 11 and SPSS version 26.0.0.1.

RESULTS AND DISCUSSION

Pre-Intervention Assessments

Socioecomic and Demographic Characteristics of Participating Families

The 116 participating families represent 563 people, of which 131 are school-age children aged 5 to 12 years old. The average number of family members was 4.9 ± 1.3 people and the average number of children per household was 2.5 ± 1.2 people (table I).

A 39.7% (n = 46) and 35.6% (n = 37) of mothers and fathers, respectively, have only elementary school. A 91.4% (n = 106) of fathers and mothers are married or living in a common-law marriage. Only 34.5% (n = 40) of mothers work and 12.9% (n = 15) are the main provider for their home. Although 90.5% (n = 105) of families have a medical service, in 78.1% of the cases (n = 82) it is a medical service for unemployed people. In addition, 37.1% (n = 43) of the households were beneficiaries of social programs that consisted of scholarships for children and in pantries.

The average family monthly income was $7546.6 ± 3536.8 (US $377.7 ± US $177 dollars), of which 66.3% is used for the purchase of food. This percentage is higher than that reported at the national level (35%) and that established by the Engels' law (30%) to consider a family with food security (Figueroa-Pedraza, 2005; INEGI, 2019).

Table I. Socioeconomic and demographic characteristics of participating families (n = 116)[1].

Variables	Mean ± SD or %	Range
Household size	4.9 ± 1.3	2 – 12
Number of children	2.5 ± 1.2	1 - 8
Monthly family income (US dollars)	377.7 ± 177	75.1- 935.9
Monthly food expenditure	66.3	
Education of mother		
Incomplete elementary school	43.1	
Elementary school	39.7	
High school or superior	17.2	
Education of father (n = 104)		
Incomplete elementary school	49.0	
Elementary school	35.6	
High school or superior	15.4	
Marital status		
Married or live in a common-law marriage	91.4	
Single, separated, widowed, divorced	8.6	
Main provider at home		
Mother	12.9	
Father	75.9	
Both	11.2	
Working mothers	34.5	
Medical service	90.5	
Government medical service for unemployed	78.0	
Social program beneficiary	37.1	

[1]Values are mean ± standard deviation or percentages.

Economic Access to Food

A 64.7% (n = 75) of households reported experiencing food insecurity, with 33.6% (n = 39) experiencing mild food insecurity, 19.8% (n = 23) moderate, and 11.3% (n = 13) severe (figure 3).

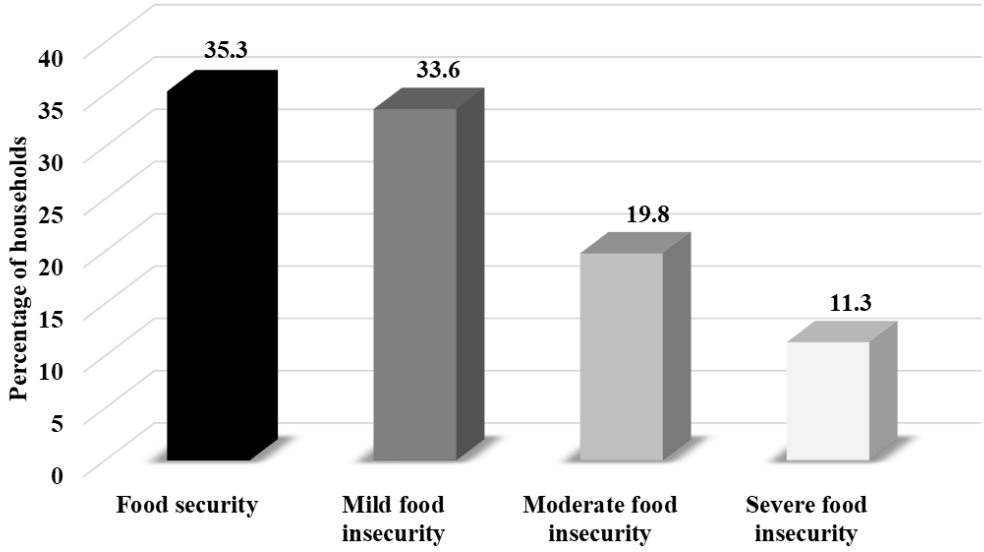
These prevalence are similar to those reported in Mexican rural households, especially in terms of severe food insecurity. According to ENSANUT 2018-2019, 69.7% of these households were identified with food insecurity, of which 40.6% presented mild food insecurity, 17.8% moderate insecurity, and the remaining 11.3% severe insecurity (Shamah-Levy et al., 2020).

The prevalence of mild and moderate food insecurity tends to be higher than that of severe food insecurity and corresponds with the notion that there are different degrees of intensity of food insecurity and that the most severe forms (i.e. when children are affected) are less frequent that moderate (i.e. only adults experience it) or mild (i.e. anxiety about the possibility that food is not enough and the reduction in the quality of food) (Valencia-Valero et al., 2014).

Availability of Food

Dietary measures in mothers. Mean energy intake was 1917 kilocalories, of which 15.6%, 50.3% and 36.7 % was protein, carbohydrate, and total fat, respectively. These intakes do not meet the recommendations established for the Mexican population (i.e. 12 to 15% of protein, 55 to 63% of carbohydrate, and 25 a 30% of fat). Likewise, mothers had a higher than recommended average intake of saturated fat (29.5% of total fat), cholesterol (406.1 mg), and sodium (2260.9 mg), but a lower than recommended intake of fiber (20.4 g), calcium (756.7 mg), iron (13.9 mg), potassium (2054.6 mg), vitamin E (10.6 mg), folic acid (421.8 mcg), iodine (35 mcg), and magnesium (246.9 mg) (Bourges et al., 2008).

Figure 3. Prevalence of food insecurity in the participating families.



Barquera et al., (2009) analyzed data from the 2006 National Health and Nutrition Survey and found that more than 20% of the Mexican population had inadequate intakes of fiber, vitamin A and C, total fat, folic acid, and calcium. After stratifying by sex, the women had a greater deficiency of folic acid, iron, and calcium, nutrients of great importance for the maintenance of long-term health. In addition, it was observed that in rural communities and with low socioeconomic status there are greater deficiencies of vitamin A and C, folic acid, zinc, and calcium, but a higher than recommended intake of energy and total fat. This establishes the need to implement intervention strategies that contribute to improving the dietary quality of the Mexican population, especially among women from rural communities and from low socioeconomic status (Barquera et al., 2009).

In the same study carried out with the participating mothers, it was observed that the intake of protein, added sugar, potassium, sodium, vitamin A, and zinc differed significantly according to the category of food insecurity in bivariate analyses (table 2) (Murillo-Castillo et al., 2018; annex 5).

After adjusting for socio-economic and demographic variables, mothers with mild and moderate food insecurity had lower intake of protein compared to mothers with food security (β = -3.22%, $P < 0.01$). Mothers with mild food insecurity had also higher intake of carbohydrates (β = 6.04%, $P = 0.02$). In addition, mothers with severe food insecurity had lower intake of iodine (β = -24.41 µg, $P = 0.03$) than mothers with food security (table 3) (Murillo-Castillo et al., 2018).

Food-insecure families often consume foods with high energy density such as refined carbohydrates, added sugars, and fats which only provide "empty calories" and therefore, do not provide vitamins, minerals, or other nutrients associated with the health and well-being of people (Seligman et al., 2007; 2010; Valencia-Valero et al., 2014).

Table II (part 1). Intake of energy, macro and micronutrients of mothers according to the category of food insecurity (n = 116)[1].

Nutrient	Food Security	Mild FI[2]	Moderate FI[2]	Severe FI[2]	P
Energy, kcal	1897 ± 610.9	1926.4 ± 721.5	1956.6 ± 823.1	1534.7 ± 590.3	0.31
Protein, %	15.8	13.2	14.5	15.3	0.04
Fiber, g	20.2 ± 8.8	20 ± 7.1	21.7 ± 11.1	16.2 ± 7.5	0.41
Carbohydrates, %	49.8	53.3	51.4	45.8	0.11
Added sugars, g	79.8 ± 46.5	94.1 ± 59	74.2 ± 48.5	70 ± 44.3	0.02
Total fat[3], %	36.1	35.3	38.9	38.4	0.20
Saturated[4]	24.5	20.8	25.7	16.6	0.08
Cholesterol, mg	416.5 ± 190.5	350.5 ± 212.4	382.7 ± 178.5	429.1 ± 176.1	0.46
Calcium, mg	845.4 ± 459.6	656.5 ± 232.7	722.7 ± 396.2	616.1 ± 277.4	0.25
Iron, mg	13.5 ± 4.8	13.8 ± 7.2	13.3 ± 6.6	10.3 ± 4.9	0.20
Potassium, mg	2158.4 ± 933.4	1954.2 ± 1049.9	2213.8 ± 1139.9	1398.8 ± 485.1	0.04
Sodium, mg	2590.7 ± 1105.7	2023.6 ± 783.2	1831.7 ± 947.9	1862 ± 845.5	0.01

[1]Values are mean ± standard deviation or percentages. Differences by Kruskal Wallis test. [2]FI – food insecurity. [3]From total energy. [4]From total fat. (Table taken from Murillo-Castillo et al., 2018).

Table II (part 2). Intake of energy, macro and micronutrients of mothers according to the category of food insecurity (n = 116)[1].

Nutrient	Food Security	Mild FI[2]	Moderate FI[2]	Severe FI[2]	P
Sodium, mg	2590.7 ± 1105.7	2023.6 ± 783.2	1831.7 ± 947.9	1862 ± 845.5	0.01
Vitamin A, µGer	1240.6 ± 1904.4	618.6 ± 617.9	965.6 ± 1767.4	334 ± 94.2	0.01
Vitamin C, mg	129.2 ± 143.9	100.2 ± 120.5	133.8 ± 170.6	36.5 ± 33.6	0.06
Folate, µGef	443.6 ± 230.1	404 ± 196	472.5 ± 331.2	348 ± 153.7	0.61
Zinc, mg	11.3 ± 5.5	10 ± 6.9	10.7 ± 4.3	7.8 ± 3	0.02
Iodine, µg	35.8 ± 37.3	31.8 ± 20.2	31.3 ± 22.4	17 ± 14.5	0.07
Magnesium	260.2 ± 166.8	225.3 ± 96	264.7 ± 149.4	238.4 ± 152.6	0.75

[1]Values are mean ± standard deviation or percentages. Differences by Kruskal Wallis test. [2]FI – food insecurity. [3]From total energy. [4]From total fat. (Table taken from Murillo-Castillo et al., 2018).

Table III. Association between nutrient intake of mothers and food insecurity (n = 116)[1].

Variables	Nutrients					
	Protein, %		Carbohydrates, %		Iodine, µg	
	β	P	β	P	β	P
Category of food insecurity						
Mild food insecurity	-3.22	0.01	6.04	0.02	-10.50	0.18
Moderate food insecurity	-2.37	0.03	-0.04	0.99	1.23	0.89
Severe food insecurity	-1.61	0.23	0.46	0.90	-24.41	0.03
Age, years	0.01	0.80	0.05	0.66	-0.42	0.28
Number of children	-0.75	0.03	0.72	0.33	-2.96	0.20
Main provider at home						
Mother	1.06	0.34	-1.93	0.53	0.81	0.93
Both	1.12	0.32	-1.01	0.73	-2.53	0.79
Education of mother						
Incomplete elementary school	1.01	0.31	1.21	0.58	-15.11	0.03
High school/superior	0.43	0.71	-2.65	0.32	-0.11	0.99
Education of father						
Incomplete elementary school	-0.63	0.45	1.81	0.37	-6.72	0.37
High school/superior	2.25	0.05	-1.60	0.57	8.96	0.38
Working mother	-1.08	0.21	3.29	0.15	0.81	0.90

[1]A multiple linear regression analysis was conducted with food security and all listed explanatory variables included in the model. The reference groups were having food security, father as main provider at home, having elementary school, and mothers who do not work. (Table adapted from Murillo-Castillo et al., 2018).

Consequently, it is expected that the consumption of proteins is significantly lower in mothers with slight insecurity since they substitute the consumption of high protein foods for foods and drinks high in carbohydrates and added sugars.

Previous studies have shown significantly lower levels of potassium and fiber intake among food-insecure groups (Laraia, 2013). Women from food-insecure households had inadequate intakes of vitamin A, E, C, and pyridoxine, as well of folate, thiamin, niacin, iron, and magnesium (Rose, 1999; Laraia, 2013). Other studies have found that in households experiencing food insecurity, there is less availability and low intakes of animal products, fruits, vegetables, milk, and lean meats (Leyna et al., 2010; Valencia-Valero et al., 2014). Particularly in studies with women living in food insecure homes, it has been reported a lower weekly consumption average of fruits, vegetables, meats, fish, seafood, milk, and milk products compared to food secure homes (Weigel et al., 2016); this can explain the low intake of micronutrients.

In this investigation, mother's consumption of potassium and vitamin A (micronutrients contained in fruits and vegetables); and iodine and zinc (contained in meats) were significantly lower as food insecurity was higher. That reflects not only restrictions on diet quality, but on economic and social access to a greater variety of foods.

Quizán-Plata et al., (2009) analyzed the causes, strategies, and consequences of food insecurity in families from urban, rural, border, and coastal areas of Northwest Mexico. In that study, diets were high in total energy, saturated fat, and sodium, as well as low in iron and vitamin A among the participants. This reflected a low consumption of fruits and vegetables and high food with high energy density, which satisfy the appetite, but not necessarily nourish adequately (Quizán-Plata et al., 2009).

In the present investigation, it was also found that there are socio-economic variables that affect the dietary intake of protein and iodine in mothers. The number of children was related to a lower protein intake. It has been established that during periods of food insecurity, mothers often carry out coping strategies in order to guarantee at least the

feeding of their children. In this sense, mothers limit the quantity and quality of the food they eat, which increases their risk of an inadequate intake of essential nutrients, compromising their nutritional and health status (Jomma et al., 2017). In this sense, the mothers of Kino Bay could be restricting their diet to favor the feeding of their children, affecting their protein intake.

Likewise, it was found that a higher education of the father is associated with higher protein consumption in the mother. It has been reported that women who married to a husband with low education did achieve a lower per capita income and the women who married to a husband with high education attained a higher per capita income. Perhaps the high education of husband influences the family income to access food that they can acquire and consume increasing the protein consumption in their wives (Garn et al., 1989).

Finally, mothers with incomplete elementary school had less iodine intake compared to mothers with basic education. Education is one of the main variables that explains the differences in eating habits. A higher education allows people to acquire more knowledge in nutrition, but also better beliefs, attitudes, and behaviors related to healthy eating. Therefore, people with a higher education will have more positive attitudes related to nutrition and a greater probability of following the dietary recommendations than a person with incomplete education (Lê et al., 2013).

In the same study with the participating mothers, the consumption of vegetables, legumes, unprocessed meats, eggs, and snacks, sweets, and desserts was higher in food-secure households than in those with food insecurity on bivariate analyses, but the difference was only significant for the consumption of vegetables (table IV) (Murillo-Castillo et al., 2018).

After adjusting for socio-economic and demographic variables, food insecurity was significantly associated with the consumption of fruits, vegetables, and sweetened non-dairy drinks. Mothers with mild food insecurity had 3.68 and 3.22 times higher odds of not consuming vegetables and fruits, respectively ($P = 0.04$) (table V).

Table IV (part 1). Frequency of food-group consumption of mothers according to the category of food insecurity (n = 116)[1].

Food groups						
Category of food insecurity	**Fruits**	**Vegetables**	**Legumes**	**No processed meats**	**Pure water**	**Egg**
Food security	57.1	39.4	33.3	33.3	45.8	34.9
Mild FI	19.0	31.8	26.2	30.6	20.8	27.9
Moderate FI	14.3	22.7	28.6	22.2	25.0	23.3
Severe FI	9.5	6.1	11.9	13.9	8.3	13.9
P	0.13	0.03	0.26	0.81	0.40	0.50

[1]Values are percentages. Differences by Chi-square test. [2]FI – food insecurity. (Table taken from Murillo-Castillo et al., 2018).

Table IV (part 2). Frequency of food-group consumption of mothers according to the category of food insecurity (n = 116)[1].

	Food groups					
Category of food insecurity	**Dairy products**	**Processed meats**	**Snacks, sweets, and desserts**	**Cereals and tubers**	**Sweet cereals**	**Sweetened non-dairy drinks**
Food security	33.3	39.4	46.7	33.0	50.0	33.3
Mild FI	40.0	39.4	33.3	35.1	36.4	37.6
Moderate FI	17.8	12.1	13.3	20.2	1.6	16.1
Severe FI	8.9	9.1	6.7	11.7	0.0	12.9
P	0.77	0.39	0.57	0.58	0.15	0.07

[1]Values are percentages. Differences by Chi-square test. [2]FI – food insecurity. (Table taken from Murillo-Castillo et al., 2018).

Table V. Association between frequency of food-groups consumption of mothers and food insecurity (n = 116)[1]

Variables	Not consuming fruits		Not consuming Vegetables		Consuming sweetened non-dairy drinks	
	AOR	**P**	**AOR**	**P**	**AOR**	**P**
Category of food insecurity						
Mild food insecurity	3.68	0.04	3.22	0.04	4.87	0.05
Moderate food insecurity	3.45	0.09	2.30	0.22	2.08	0.37
Severe food insecurity	1.66	0.56	7.95	0.01	3.20	0.24
Age, years	0.96	0.23	1.01	0.70	0.96	0.15
Number of children	1.01	0.98	1.07	0.75	0.87	0.50
Main provider at home						
Mother	4.08	0.25	5.61	0.22	0.77	0.77
Both	1.40	0.73	1.29	0.77	0.56	0.52
Education of mother						
Incomplete elementary school	2.32	0.26	1.95	0.28	1.46	0.53
High school/superior	1.09	0.91	0.14	0.08	6.85	0.08
Education of father						
Incomplete elementary school	2.07	0.22	0.79	0.71	0.76	0.60
High school/superior	0.46	0.23	0.72	0.70	1.01	0.99
Working mother	1.12	0.88	0.55	0.39	2.95	0.12

[1]AOR – adjusted odds ratio. A 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, father as main provider at home, having elementary school, and mothers who do not work. (Table adapted from Murillo-Castillo et al., 2018).

Also, mothers with mild food insecurity had 4.87 times higher odds of consuming sweetened non-dairy drinks compared to mothers with food security (P = 0.05). In addition, mothers with severe food insecurity had 7.95 times higher odds of not consuming vegetables compared to mothers with food security (P = 0.01) (Murillo-Castillo et al., 2018).

These results are consistent with the low consumption of fruits and vegetables presented by the Mexican population. In 2020, the National Health and Nutrition Survey of the Mexican population (ENSANUT) reported that only 49.7% of the adult population of the country consume fruits. In addition, the consumption is below the average in rural locations and in the northern region of the country, being consumed by 42% and 46.4% of the population, respectively. Additionally, vegetables were consumed by 44.9% of Mexican adult population, being higher in urban (48.3%) than rural (31.8%) locations (Shamah-Levy et al., 2020).

Other studies reported for the Northwest region of Mexico, especially in Sonora, have documented low consumption of fruits and vegetables. In 1997, a basket of food consumption for Sonora and its contribution of nutrients was determined. It was found that fruits and vegetables, except for those used as seasonings in stews (tomatoes, chili, and onion), are not part of the usual meals and are of secondary importance for the Sonoran population (Valencia et al., 1997).

Quizán-Plata et al., (2013) studied the conceptions and experiences of food insecurity of women who represent low-income households in Northwest Mexico. Participants recognized that fruits and vegetables were important for a healthy life, but could not acquire them due to their economic limitation (Quizán-Plata et al., 2013).

This same barrier for the consumption of fruits and vegetables was found in the ENSANUT 2016, in which it was observed that the main obstacle for eating healthy was the lack of money to buy fruits and vegetables (Hernández-Ávila et al., 2016). Other

studies have documented that the purchase of fruits and vegetables is lower as food insecurity is greater (Kendall et al., 1996).

Worldwide, food insecurity has been associated with higher intakes of fruit juice and other sugar-sweetened beverages (e.g., lemonade, sweetened tea, fruit punch, Kool-Aid) (Leung et al., 2014). In this regard, in the analysis of dietary intake, higher intake of food products containing carbohydrates and added sugar occurred among mothers with mild food security.

An interesting result was that mothers with higher education not only had a greater probability of consuming vegetables, but also a greater risk of consuming sugary drinks. It was previously indicated that a higher education is related to a greater knowledge of food and nutrition, but it is likely that this is not being applied. The nutritional knowledge per se seems more important than the overall education. However, it has been reported that there is a large discrepancy between (high) nutritional knowledge levels and (lacking) implementation (Schneider et al., 2013).

Higher educated people are less likely to cite health in the perceived role of eating when comparing pleasure and health. Higher educated people consider of greater importance pleasure in food but consider health less important (Lê et al., 2013).

The preference for consuming sugary drinks and junk food and the distaste for the taste of the vegetables are other perceived barriers to healthy eating (Hernández-Ávila et al., 2016). Food-insecure people are more likely to report cost and taste as barriers to healthy food consumption than food-secure (Mook et al., 2016).

In this sense, the low cost of energy-dense foods, as well as innate preferences for foods rich in sugars and fats, may be contributing to the association between food insecurity and the lower consumption of healthy foods (Drewnowsk et al., 2004). Previous studies have indicated that food insecurity increases the likelihood that households purchase food that is not only inexpensive, but also energy-dense and perceived as more palatable (Laraia, 2013).

In addition, households with food insecurity also guide their decisions for the acquisition of by the perception they have on the ability of the kind of food to generate satiety. Although the economic resources is the main criterion that families use to acquire food, the experience of food insecurity has other cultural or symbolic dimensions that are not exhausted in their economic dimension (Valencia-Valero et al., 2014).

Dietary measures in children. The children mean consumption of fruits, vegetables, and fruits plus vegetables was 175.4, 105.2, and 280.7 g, respectively. An 85% (n = 91) do not meet the minimum recommendation for fruit and vegetable consumption. It has been observed that the consumption of healthy food groups is low in the Mexican school population (Bonvecchio-Arenas et al., 2015; Hernández-Ávila et al., 2016; Gaona-Pineda et al., 2018). The most recent data shows that only 22% and 43.5% of Mexican school-age children regularly consume vegetables and fruits, respectively. On the contrary, 85.7% of children frequently consume sugary drinks. And a 64.6% and 52.9% consume snacks, sweets and desserts, and sweet cereals, respectively. The regular consumption by school-age children of these food groups increases their risk of developing overweight, obesity and chronic degenerative diseases in future stages of life (Shamah-Levy et al., 2020).

Consumption of fruits and fruits plus vegetables and percentage of meeting recommendations was lower in children from food-insecure households (table VI). These results are similar to those found in a previous analysis of the results of one-hundred of these children (Murillo-Castillo et al., 2020).

As reported in Murillo-Castillo et al., (2020; annex 6) in adjusted analyses food insecurity was negatively associated with the consumption of fruits and fruits plus vegetables in the overall sample (*P* for trend = 0.05 and 0.08, respectively) (table VII).

Due to the association between sex and the consumption of fruits and fruits plus vegetables, analyzes stratified by sex were carried out.

Table VI. Fruits and vegetables consumption of school-age children according to the category of food insecurity (n = 107)[1].

Category of food insecurity	Fruits, g	Vegetables, g	Fruits and vegetables, g	Met the recommendation, %
Food security	198.1 ± 121.2	121.2 ± 71	319.3 ± 203.4	50
Mild Food insecurity	176.8 ± 113.5	103.1 ± 75.5	279.9 ± 168.6	35.7
Moderate food insecurity	166.3 ± 102.6	88.2 ± 32.3	254.6 ± 114.7	12.5
Severe food insecurity	127.5 ± 56.2	100.4 ± 53.4	227.8 ± 80.8	0
P for trend	0.07	0.09	0.05	0.03

[1]Values are means ± standard deviation or percentages; tests for trend were implemented as linear regressions with categories of food insecurity considered as ordinal (0, 1, 2, 3). g – grams. (Table adapted from Murillo-Castillo et al., 2020).

Table VII. Association between fruits, vegetables, and fruits plus vegetables intakes of school-age children and food insecurity (n = 107)[1].

Variables	Fruits, g		Vegetables, g		Fruits and vegetables, g	
	β	P for trend	β	P for trend	B	P for trend
Food insecurity	-26.95	0.05	-6.55	0.37	-33.51	0.08
Age, years	-16.36	0.04	3.95	0.34	-12.42	0.25
Sex	64.21	0.01	15.36	0.25	79.57	0.03
Number of children	3.69	0.69	-5.62	0.25	-1.93	0.88
Main provider at home						
Mother	-21.13	0.72	-45.55	0.14	-66.67	0.41
Both	-1.15	0.98	-0.65	0.98	-1.80	0.97
Education of mother						
Incomplete elementary school	12.49	0.69	20.38	0.22	32.87	0.44
High school/superior	43.68	0.25	28.09	0.16	71.77	0.17
Education of father						
Incomplete elementary school	-27.87	0.37	-28.54	0.09	-56.41	0.19
High school/superior	-29.05	0.48	-4.79	0.82	-32.84	0.54
Mother working	14.29	0.65	-3.64	0.82	10.65	0.81

[1]Tests for trend were implemented as linear regressions with categories of food insecurity considered as ordinal (0, 1, 2, 3). g – grams. The reference groups were having food security, being a girl, father as main provider at home, having elementary school, and mothers who do not work. (Table adapted from Murillo-Castillo et al., 2020).

Food insecurity was associated with lower consumption of fruits and fruits plus vegetables in boys (*P* for trend = 0.07 and 0.05, respectively), but there were no significant associations among girls (tables VIII and IX).

Food insecurity was associated with lower chance to meet the recommendation of fruit and vegetable consumption in a dose response manner (*P* for trend in logit < 0.001) (table X).

After stratifying by sex, it was observed that only 33.3% (n = 5) of boys and 14.3% (n = 3) of girls with food security meet the minimum recommendation for fruits and vegetables. No boy or girl with severe food insecurity meets the recommendation. Food insecurity continued to be associated with a lower probability of meeting the recommendation in a dose-response manner (*P* for trend in logit < 0.001) (table X).

The differences in the intake of fruits and vegetables observed between boys and girls could be because socially it is considered that boys should consume food in greater quantity and quality than girls, because in future stages of life, jobs related to boys will involve greater physical dexterity than related jobs for girls (Ali et al., 2007; Vega-Macedo et al., 2014). In rural and indigenous Mexican communities, priority is given to feeding boys and adult men because they constitute the labor force (Vega-Macedo et al., 2014). In addition, it has been observed that the intra-family distribution of food favors boys more than girls, since it is they who tend to spend more time in school and that in the following years they will be the ones who will contribute the most to family income (Aurino, 2017).

Likewise, an association was observed between the intake of fruits and vegetables and the age of the school-age children. Male school-age children consume less fruit and fruits plus vegetables at an older age. While girls consume more vegetables at an older age. Previous research has documented age and gender differences in children's food preferences. Data have demonstrated that as boys age, they are more likely to expand their animal product-related foods, while girls avoid foods that may cause weight gain.

Table VIII. Association between fruits, vegetables, and fruits plus vegetables intakes of boys and food insecurity (n = 55)[1].

Variables	Fruits, g		Vegetables, g		Fruits and vegetables, g	
	β	P for trend	β	P for trend	β	P for trend
Food insecurity	-36.46	0.07	-16.13	0.10	-52.58	0.05
Age, years	-28.30	0.02	-0.06	0.99	-28.36	0.08
Number of children	4.75	0.78	1.69	0.84	6.44	0.78
Main provider at home						
Mother	-34.06	0.54	-45.89	0.10	-79.96	0.28
Both	-46.04	0.39	-23.67	0.36	-69.71	0.33
Education of mother						
Incomplete elementary school	-28.34	0.50	0.27	0.99	-28.08	0.62
High school/superior	41.53	0.49	3.80	0.90	45.33	0.57
Education of father						
Incomplete elementary school	-23.06	0.61	-23.87	0.22	-46.93	0.42
High school/superior	33.93	0.54	34.89	0.15	68.82	0.34
Mother working	-1.85	0.96	-18.06	0.33	-19.91	0.71

[1]Tests for trend were implemented as linear regressions with categories of food insecurity considered as ordinal (0, 1, 2, 3). g – grams. The reference groups were having food security, father as main provider at home, having elementary school, and mothers who do not work. (Table adapted from Murillo-Castillo et al., 2020).

Table IX. Association between fruits, vegetables, and fruits plus vegetables intakes of girls and food insecurity (n = 52)[1].

Variables	Fruits, g		Vegetables, g		Fruits and vegetables, g	
	β	P for trend	β	P for trend	B	P for trend
Food insecurity	-11.02	0.49	1.31	0.90	-9.71	0.67
Age, years	0.42	0.96	11.07	0.06	11.50	0.37
Number of children	9.89	0.27	-4.35	0.44	5.53	0.66
Main provider at home						
Mother	34.64	0.63	-22.91	0.61	11.73	0.91
Both	52.63	0.25	21.27	0.45	73.90	0.25
Education of mother						
Incomplete elementary school	19.87	0.61	19.47	0.43	39.34	0.48
High school/superior	76.27	0.09	70.02	0.02	146.29	0.02
Education of father						
Incomplete elementary school	-30.64	0.45	-15.67	0.54	-46.31	0.42
High school/superior	-73.67	0.16	-31.79	0.33	-105.46	0.16
Mother working	-5.37	0.88	-9.34	0.67	-14.71	0.77

[1]Tests for trend were implemented as linear regressions with categories of food insecurity considered as ordinal (0, 1, 2, 3). g – grams. The reference groups were having food security, father as main provider at home, having elementary school, and mothers who do not work. (Table adapted from Murillo-Castillo et al., 2020).

Table X. Association between meeting the recommendation of minimum consumption of fruits and vegetables in school-age children and food insecurity (n = 107)[1].

Category of food insecurity	Met the recommendation, %
All	
Food security	28.6
Mild food insecurity	23.1
Moderate food insecurity	8.3
Severe food insecurity	0
P for trend in logit	< 0.001
Boys	
Food security	33.3
Mild food insecurity	21.1
Moderate food insecurity	13.3
Severe food insecurity	0
P for trend in logit	< 0.001
Girls	
Food security	14.3
Mild food insecurity	15.4
Moderate food insecurity	0
Severe food insecurity	0
P for trend in logit	< 0.001

[1]Values are percentages; tests for trend were implemented as linear regressions with categories of food insecurity considered as ordinal (0, 1, 2, 3) with the logit of the probability as the dependent variable. Significant association $P \leq 0.05$. Adjusted for age, number of children, the main provider at home, education of parents, and employment status of mother. (Table adapted from Murillo-Castillo et al., 2020).

Girls tend to have higher preferences for foods such as fruits and vegetables, while boys prefer foods dense in fats, sugars, and animal protein. Boys will have higher energy needs than girls throughout the life cycle, which could indicate that boys' preference for energy-dense foods constitutes an adaptive response to those needs. On the contrary, as time passes, social standards can lead to girls developing a greater concern than boys for dietary quality and thus preferring the consumption of healthier foods (Cooke et al., 2005; Caine-Bish et al., 2009).

It was observed that the education of both parents affects the consumption of fruits and vegetables in children, where those whose father have no basic education eat fewer vegetables. While girls whose mother have high school or superior education eat more fruits and vegetables. The association between education and the probability of buying fruits and vegetables has previously been established. In particular, it has been observed that there is a higher purchase and intake of fruits and vegetables in those households where the education of both parents is high. Higher education is related to greater knowledge of nutrition and better attitudes towards healthy eating. In addition, higher education implies greater income to be able to buy healthy food (Elfhag et al., 2008).

Previously, it was found that mothers with higher education had a higher risk of consuming sugary drinks, so it was hypothesized that even if they had a higher education, it did not necessarily translate into greater knowledge of nutrition. Furthermore, it could be that they did have knowledge in food and nutrition, but they do not apply it. In view of the effect of the education on the consumption of fruits and vegetables in their children, parents with a higher education may have knowledge of nutrition, but the social, economic and environmental conditions of the community allows them only to apply the knowledge to their children and not to themselves. Trying to ensure the best possible nutrition for their children with the resources available (Jomaa et al., 2017).

In Mexico, households from low socioeconomic status limit the purchase of healthy food, since its high price implies investing a large part of the family budget (Mundo-Rosas et al., 2014; Gaona-Pineda et al., 2018).

Families recognize that it is important to consume healthy foods such as fruits and vegetables for proper health, especially in children. However, they consider that these foods are too expensive, especially at the end of the month when the family budget is more limited (Canter et al., 2017). Therefore, in food insecure households, families tend to choose to buy less expensive foods that are usually high in energy and low in micronutrients, since it is considered that it is not only important to save money on food but also to select foods that produce a greater sense of satiety (Matheson et al., 2002; Mundo-Rosas et al., 2014).

Previous studies have established that food insecurity is related to lower intake of foods rich in vitamin A and C, potassium, iron, and fiber in children. (Kendall et al., 1996; Laraia, 2013; Mundo-Rosas et al., 2014). Consequently, in these households, the risk of children developing diseases due to micronutrient deficiencies increases, compromising their adequate growth and development (Vega-Macedo et al., 2014).

Although in the present study it was observed that the highest percentage of children who meet the minimum recommendation for fruits and vegetables belong to households with food security, this percentage is relatively low. Which could suggest that despite having sufficient financial resources to purchase healthy food, there are other factors that prevent buying them.

Inadequate intake of fruits and vegetables could also be due to the limited availability of these food groups in stores located in the community. As mentioned above, when visiting the places where families buy their food, a lack of availability of healthy foods was observed, especially in convenience stores. But on the contrary, a large availability of processed foods such as breads, cookies, sweet cereals, sugary drinks, snacks, desserts and processed meats was observed.

It has been established that the quality of available food is an important factor that determines the type of food that the population buys and consumes, especially in low-income regions (Canter et al., 2017).

Food Utilization

Anthropometric measures in mothers. Average age of mothers was 36.2 ± 9.7 years. Mothers had an average weight, height, body mass index and waist circumference of 78.1 ± 17.1 kg; 6 ± 0.1 m; 31.5 ± 6.5 kg/m^2; and 100.9 ± 17.0 cm, respectively. The overall sample included 30.7% overweight (n = 31) and 57.4% (n = 58) obese. Only 3% (n = 3) were underweight, thus those underweight and normal weight were pooled into one group in the analyses. Waist circumference was identified as at risk in 93% (n = 92) of mothers.

There were no significant associations between overweight, obesity and abdominal obesity and food insecurity categories (table XI and XII).

The relationship between anthropometric measures and food insecurity is complex. On the one hand, food insecurity is related to unhealthy eating patterns, characterized by a higher consumption of cheap and energy-dense foods but poor in micronutrients, which increases the risk of overweight and obesity (Morales et al., 2016).

At the same time, food insecurity, especially in its most extreme forms, can also be linked to lower energy intake and experiences of hunger, leading to weight loss and increased risk of undernutrition (Morales et al., 2016).

Therefore, it is likely that as a result of food insecurity, some people have low energy and nutrients consumption; others a higher consumption of energy and nutrients; and some people do not present any change in their energy and nutrient intake (Morales et al., 2016).

This could explain why the studies that evaluate the association between food insecurity and overweight and obesity in adults present mixed results (Morales et al., 2016).

Table XI. Association between overweight and obesity in mothers and food insecurity (n = 101)[1].

Variables	Overweight and obesity	
	AOR	**P**
Category of food insecurity		
Mild food insecurity	1.05	0.96
Moderate food insecurity	0.42	0.45
Severe food insecurity	0.96	0.98
Age, years	1.10	0.18
Number of children	0.59	0.14
Main provider at home		
Mother	0.59	0.53
Both	0.65	0.61
Education of mother		
Incomplete elementary school	0.31	0.22
Education of father		
Incomplete elementary school	4.36	0.16
Working mother	0.86	0.88

[1]AOR – adjusted odds ratio. A 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, father as main provider at home, having elementary school, high school or superior, and mothers who do not work.

Table XII. Association between abdominal obesity in mothers and food insecurity (n = 101)[1].

Variables	Abdominal obesity	
	AOR	**P**
Category of food insecurity		
Mild food insecurity	0.34	0.37
Moderate food insecurity	0.48	0.63
Severe food insecurity	0.38	0.54
Age, years	1.13	0.12
Number of children	0.63	0.13
Main provider at home		
Mother	0.19	0.17
Both	0.34	0.45
Education of mother		
Incomplete elementary school	0.66	0.68
Education of father		
Incomplete elementary school	3.91	0.23
Working mother	1.59	0.69

[1]AOR – adjusted odds ratio. A 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, father as main provider at home, having elementary school, high school or superior, and mothers who do not work.

Leung et al., (2012) analyzed the association between food insecurity and BMI and obesity in a multi-racial sample of 35,747 low-income adults. The authors found that very low food security was associated with higher BMI and higher prevalence of obesity in Hispanic men and women, as well as in multiracial men compared to those from food-secure households. Furthermore, low food security was also associated with higher BMI in Asian women. No positive associations were found between food insecurity and non-Hispanic whites, African Americans, and Asian men or non-Hispanic whites, African Americans, and multi-racial women (Morales et al., 2016).

Nguyen et al., (2015) evaluated whether SNAP participation affected the association between food insecurity, dietary quality, and risk of obesity in 8,333 American adults. Food insecurity was found to be associated with poor dietary quality and a higher prevalence of obesity. However, participation in the program protected the population from an unhealthy diet and developing obesity (Morales et al., 2016).

Other studies have found that food insecurity is associated with obesity in women but not in men. Martin et al., (1982) analyzed the negative correlation between income and obesity in 7,931 American adults. It was observed that mothers with food insecurity had a higher risk of developing overweight or obesity than fathers. It was concluded that this association was not related to biological changes derived from pregnancy, but rather to the role that women are expected to fulfill as responsible for family nutrition, which is compromised in situations of food insecurity (Morales et al., 2016).

Similarly, Gooding et al., (2012) analyzed the association between food insecurity and BMI in 13,720 American young adults. The authors found a higher prevalence of food insecurity in women than in men. Likewise, it was observed that women from food insecure households had a higher BMI than those from food-secure households. However, no significant associations were found between food insecurity and BMI in men (Morales et al., 2016).

Other studies have found negative associations between food insecurity and overweight and obesity. Mohammadi et al., (2013) analyzed the association between food insecurity and body weight in 412 Iranian adult women. The authors found that moderate food insecure women were less likely to be overweight compared to their counterparts in food-secure households (Morales et al., 2016).

Shariff et al., (2014) examined the association between food insecurity and metabolic syndrome in 625 low-income women in Malaysia, they found that women with food insecurity had a lower risk of metabolic syndrome, abdominal obesity, and alterations in the levels of glucose, total cholesterol, and LDL than women with food security (Morales et al., 2016).

Finally, some studies have not found a significant association between food insecurity and being overweight or obese. Bawadi et al., (2012) studied the association between food insecurity and body weight in 500 Jordanian women. The authors found no evidence to support the relationship between food insecurity and obesity. Similarly, Robaina et al., (2013) analyzed the relationship between food insecurity, dietary quality, and BMI in 212 American adults. Although women were found to have a higher risk of obesity than men, no significant association was found between food insecurity and obesity in any of the participants (Morales et al., 2016).

Most of the studies that have not found a significant association between food insecurity and obesity are cross-sectional studies, where a small sample size has also been used. One of the few longitudinal studies that has analyzed this association was published by Cheung et al., (2015). The authors followed 457 patients from a community health center in the United States for 3 years. Food insecurity was observed to increase BMI by $0.15 kg/m^2$ per year compared to the control group (Morales et al., 2016). This is evidence of the health consequences that experiencing food insecurity can cause in the long term.

Anthropometric measures in children. Average age of children was 9.2 ± 1.7 years. Children had an average weight and height of 36.6 ± 12.9 kg; and 1.4 ± 0.1 m, respectively.

A 25.5% (n = 26) of children were overweight and 24.5% (n = 25) were obese, of which 7.8% (n = 8) were severely obese.

As reported in Murillo-Castillo et al., 2020, food insecurity was associated with lower prevalence of overweight and obesity (*P* for trend in logit < 0.001), even after stratifying for sex (table XIII).

These results are similar to those reported in other cross-sectional studies with Hispanic children (Dinour et al., 2007).

Matheson et al., (2002) analyzed the relationship between food insecurity and BMI in 124 Hispanic children who were in fifth grade in California schools. A significant difference was found between the BMI of children with food security and food insecurity, being higher in children belonging to households with food security.

Rose et al., (2006) published the analysis of the association between food insecurity and overweight in 16,889 American preschoolers. Food insecure children were found to be up to 20% less likely to be overweight than food secure children (Dinour et al., 2007).

Likewise, Isanaka et al., (2007) analyzed the relationship between food insecurity and underweight or overweight in 2,526 Colombian school-age children. The authors found that food insecurity was not a predictor of overweight in this population, since on the contrary, school-age children with food insecurity were up to 3 times more likely to be underweight than their food-secure counterparts (Isanaka et al., (2007)

As with the adult population, research that has studied the association between food insecurity and body weight in children shows mixed results. Some studies indicate a positive association between food insecurity and being overweight or obese. Although it seems that the association varies by age, sex, and race. Others studies link food insecurity with underweight and malnutrition. Finally, other studies do not find any type of association (Rosas et al., 2011; Eisenmann et al., 2011).

Table XIII. Association between overweight and obesity in school-age children and food insecurity (n = 102)[1].

Category of food insecurity	Overweight and obesity, %
All	
Food security	52.8
Mild food insecurity	55.6
Moderate food insecurity	51.9
Severe food insecurity	25
P for trend in logit	< 0.001
Boys	
Food security	53.3
Mild food insecurity	50
Moderate food insecurity	53.3
Severe food insecurity	16.7
P for trend in logit	< 0.001
Girls	
Food security	52.4
Mild food insecurity	61.5
Moderate food insecurity	50
Severe food insecurity	33.3
P for trend in logit	0.002

[1]Values are percentages; tests for trend were implemented as linear regressions with categories of food insecurity considered as ordinal (0, 1, 2, 3) with the logit of the probability as the dependent variable. Significant association $P \leq 0.05$. Adjusted for age, number of children the main provider at home, education of parents, and employment status of mother. (Table adapted from Murillo-Castillo et al., 2020).

Furthermore, few studies have analyzed this association in Mexican children.

One of them is the study carried out by Ortíz-Hernández et al., (2007). The authors analyzed the relationship between food insecurity and being overweight in 768 Mexican school-age children. The highest prevalence of overweight was found in school-age children from severely food insecure households, followed by children with moderate food insecurity. Finally, those who presented the lowest prevalence of overweight were school-age children from households with food security.

These results are contrary to those found in the present investigation, since the lowest prevalence of overweight and obesity was found in children with severe food insecurity, even after stratifying by sex.

However, Rosas et al., (2011), when analyzing the determinants of overweight and obesity in 603 children of Mexican origin, found a positive association between very low food insecurity and overweight and obesity (Rosas et al., 2011).

In periods of time where households have sufficient financial resources, they can buy a greater quantity of healthy foods, but also a greater quantity of non-recommended foods. At such times, parents can be more permissive with their children and buy more energy, fat and sugar dense foods, in a way to compensate for the lack of these products in times of scarce resources. But, when a lean period occurs again, parents should again limit and restrict the purchase and consumption of these products. Which will make children more in demand for them in the future. So, when the economic situation improves, children will ask their parents to buy these products but in greater quantity. The ability to meet this demand will be more feasible in households with mild food insecurity than in those with severe food insecurity (Kaiser et al., 2002).

Commonly, in households with mild food insecurity, the limited budget is used for the purchase of cheap and energy-dense foods, which would be related to higher energy intake and consequently, an increase in body weight in children. In contrast, in severely food-insecure households, financial resources are so scarce that they may not even have enough

for this type of food, so energy intake could be lower and lead to weight loss instead of being overweight or obese (Isanaka et al. 2007). In the present investigation, it was observed that the intake of snacks, sweets, and desserts was lower in mothers with severe food insecurity.

Previous studies with Latino children have found less availability and consumption of processed foods, desserts, snacks, and sugary drinks in households with severe food insecurity. Furthermore, it has been observed that food insecure children are given less money to spend outside their home, which reduces their economic access to this type of foods (Isanaka et al., 2007).

Therefore, income could be one of the reasons why children with food security present a high prevalence of overweight and obesity. It has been observed that in Mexico, the population of high socioeconomic levels, where food security is evident, has a higher consumption of healthy foods, such as fruits, vegetables, dairy products and water, but is also characterized by a high consumption of non-healthy foods like processed meats, fast food, desserts, and sugary drinks (Gaona-Pineda et al., 2018).

Biochemical measures in mothers. In the previous study carried out with participating mothers it was observed that on average they had normal hemoglobin levels (12.2 ± 0.95 g/dL), glucose (94.15 ± 24.93 mg/dL), and total cholesterol levels (178.30 ± 31.07 mg/dL), but they had inadequate levels of HDL (50.16 ± 9.07 mg/dL) and LDL cholesterol (114.38 ± 31.24 mg/dL).

Only 3.3% (n = 2) had an inadequate glucose level. A 31.7% (n = 19) and 61.7% (n = 37) respectively, had a lower than recommended level of hemoglobin and HDL cholesterol. And, an 81.7% (n = 49) had a level higher than the reference value for LDL cholesterol.

It was found that mothers with food security had 12.01 mg/dL more of HDL cholesterol than those with severe food insecurity (P = 0.03) (table XIV) (Murillo-Castillo et al., 2018).

Table XIV. Association between biochemical measures of mothers and food insecurity (n = 60)[1].

Variables	Total cholesterol (mg/dL)		HDL cholesterol (mg/dL)	
	β	P	β	P
Category of food insecurity				
Mild food insecurity	2.26	0.83	4.16	0.19
Moderate food insecurity	8.29	0.48	3.44	0.34
Severe food insecurity	-51.18	0.01	-12.01	0.03
Age, years	0.54	0.40	0.18	0.29
Number of children	-8.05	0.05	-0.05	0.96
Main provider at home				
Mother	5.05	0.82	-0.31	0.96
Both	-23.86	0.22	-7.82	0.11
Education of mother				
Incomplete elementary school	12.19	0.30	-1.54	0.62
High school/superior	13.34	0.34	0.93	0.80
Education of father				
Incomplete elementary school	5.61	0.65	1.20	0.71
High school/superior	-18.85	0.21	-6.49	0.10
Working mother	-2.95	0.83	4.06	0.25

[1]A multiple linear regression analysis was conducted with food security and all listed explanatory variables included in the model. The reference groups were having food security, age, number of children, father as main provider at home, having elementary school, and mothers who do not work. (Table adapted from Murillo-Castillo et al., 2018).

In previous studies, low serum levels of HDL cholesterol, albumin, and vitamin A and E have been observed in food insecure population (Laraia, 2013).

One of the possible explanations for why food insecurity is related to lower concentrations of HDL cholesterol, particularly in women, could be the effect of obesity (Shin et al., 2015).

Obesity lowers the proportion of HDL cholesterol by inducing hypertriglyceridemia, impairing lipolysis of chylomicrons, and increasing exchange of cholesterol esters and triglycerides between very low-density lipoproteins (VLDL) and HDL and low-density lipoproteins (LDL) by cholesteryl ester-transfer-protein (Shin et al., 2015).

Likewise, the relationship between a low level of HDL cholesterol and food insecurity may be the consequence of a lack of sufficient economic resources to acquire food in adequate quantity and quality and therefore obtain essential nutrients to maintain a normal lipid profile (Shin et al., 2015).

In the present investigation it was observed that the number of children was negatively associated with total cholesterol. Pregnancy has a negative effect on the mother's lipid profile. Gunderson et al., (2004) published the analysis of the association between childbirth and changes in the lipid profile of 1952 American women. The authors found that for each birth there is a decrease in total and HDL cholesterol in white women. The decreases in total cholesterol are in turn due to decreases in HDL cholesterol (Gunderson et al., 2004).

Biochemical measures in children. Overall, children had low hemoglobin (10.8 ± 1.26 g/dL). A 68.2% (n = 15) had anemia, of which 93.3% (n = 14) was moderate anemia (i.e. a hemoglobin level of 8.0 to 10.9 g/dL). There was no significant association between hemoglobin level and the prevalence of anemia with the category of food insecurity (table XV and XVI). This may be due to the limited number of school-age children to whom the measurement was performed. It is recommended to increase the sample size for further analysis.

Table XV. Association between hemoglobin in school-age children and food insecurity (n = 22)[1].

Variables	Hemoglobin (g/dL)	
	β	**P**
Category of food insecurity		
Mild food insecurity	-0.53	0.61
Moderate food insecurity	-0.87	0.38
Age, years	0.01	0.98
Sex	-0.80	0.28
Number of children	-0.47	0.30
Main provider at home		
Mother	3.12	0.07
Education of mother		
Incomplete elementary school	0.38	0.82
Education of father		
Incomplete elementary school	-0.20	0.89
Working mother	0.27	0.73

[1]A multiple linear regression analysis was conducted with food security and all listed explanatory variables included in the model. The reference groups were having food security, being a girl, father or both parents as main provider at home, having elementary school, high school or superior, and mothers who do not work.

Table XVI. Association between anemia in school-age children and food insecurity (n = 22)[1].

Variables	Anemia	
	AOR	**P**
Category of food insecurity		
Mild food insecurity	2.65	0.62
Moderate food insecurity	6.75	0.46
Age, years	2.25	0.35
Sex	15.79	0.22
Number of children	11.78	0.12
Main provider at home		
Mother	0.01	0.04
Education of mother		
Incomplete elementary school	0.18	0.16
Education of father		
Incomplete elementary school	0.22	0.24
Working mother	0.27	0.18

[1]AOR – adjusted odds ratio. A 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, being a girl, father or both parents as main provider at home, having elementary school, high school or superior, and mothers who do not work.

However, it was observed that children from households where mother is the main provider at home, have high hemoglobin and lower risk of anemia.

This result is contrary to that reported by Schmeer (2012), where the association between family structure and iron-deficient anemia among children ages 3-12 in Mexico was evaluated (Schmeer, 2012).

The author found that family structure was significantly associated with anemia in children, the risk being higher in households with single mothers (Schmeer, 2012).

However, the study also analyzed the effect of grandparents on the prevalence of anemia in children. In this sense, the author found a negative association between resident maternal grandparents and child anemia (Schmeer, 2012).

It has been documented that grandparents who are caring for their grandchildren have a positive influence on their diet and nutrition, as well as financially supporting mothers, especially those who are single. If children of single mothers spend much of their time in the care of their grandparents, it is likely that they have a more adequate diet and therefore a sufficient intake of essential micronutrients such as iron, which would reduce their risk of anemia (Schmeer, 2012).

This situation could explain why there is a higher level of hemoglobin and less risk of anemia among children from Kino Bay, who belong to homes where the mother is the main provider. Since during the visits to the families' households, the presence of maternal grandparents, particularly grandmothers, was observed. Some of the children and their mothers even spend part of the day at their grandmothers' homes. It is considered that the influence of the maternal grandmother could be contributing to the nutritional status of this children. So, it is important to evaluate this possible effect in future studies with a larger sample number, especially in those who live in food insecurity.

Children from food-insecure households are at greater risk of consuming a low-quality diet deficient in essential micronutrients for proper maintenance of their health. Previously, it has been observed that food insecure children have a limited consumption

of foods rich in iron such as meat products, because their price is usually high. Consequently, these children are at risk of not ingesting adequate amounts of iron for proper growth and development, increasing their risk of developing iron deficiency anemia (Eicher-Miller et al., 2009).

Nutritional knowledge of mothers. The average score of the nutrition knowledge and hygiene practices in food consumption questionnaire was 14.0 ± 2.7 points. A higher score in the questionnaire was associated with lower food insecurity (table XVII).

The association between nutrition knowledge and food insecurity seems to vary according to the severity of food insecurity. It has previously been established that a low level of knowledge in nutrition is associated with an increased risk of mild food insecurity, but not with severe insecurity. This could imply that a greater knowledge of healthy eating can protect families from the slightest categories of food insecurity, especially if they are also taught to develop skills for an adequate management of economic resources. However, in severe food insecure households other interventions will be required in addition to nutrition education and resource management, since it will be essential to first increase their economic access and physical availability of food (Fitzgeral et al., 2011).

Table XVII. Association between nutrition knowledge score and hygiene practices in food questionnaire in mothers and food insecurity (n = 95)[1].

Variables	Food insecurity, score	
	β	P
Nutrition knowledge and hygiene practices in food questionnaire, score	-0.39	0.01
Age, years	0.04	0.43
Number of children	0.26	0.43
Main provider at home		
Mother	2.64	0.28
Both	1.25	0.35
Education of mother		
Incomplete elementary school	-0.31	0.98
High school/superior	-0.92	0.37
Education of father		
Incomplete elementary school	-0.39	0.68
High school/superior	-1.27	0.27
Working mother	-0.90	0.40

[1]A multiple linear regression analysis was conducted with food security and all listed explanatory variables included in the model. The reference groups were having food security, number of children, father as main provider at home, having elementary school, and mothers who do not work.

Intervention Outcomes

Of the 116 families that started the program, 4 changed their residence to another city prior to the implementation of program interventions. Therefore, the results presented below are based on the 112 families that continued in the project, including 126 school-age children.

Nutrition Education Workshops

An 84.8% (n = 95) of the mothers participated in all the nutrition education workshops and received the manual "Guide to improve food and nutrition" in printed format, which would help them review the topics taught in the workshops. Unfortunately, due to the health contingency due to COVID-19, it was not possible to evaluate the outcomes of the nutrition education workshops on mothers through the application of the final questionnaire on nutritional knowledge and hygiene practices.

However, 73% (n = 92) of the school-age children participated in all the workshops, of which, 73.9% (n = 68) passed the nutritional education course. Analyzing the most common troubles that school-age children had in understanding the nutritional topics, it was found that 44.6% (n = 41) of children had problems with identifying foods and beverages high in sugar, fat, and sodium. In addition, 47.8% (n = 44) had difficulties in performing the correct techniques of hand washing and tooth brushing. Also, 27.2% (n = 25) of children had problems in classifying foods according to the food groups included in “el plato del bien comer”. This situation is worrisome because images of the guide were observed in the classrooms; and when questioning the children about it, they commented that it is part of the topics seen in class. This shows that it would be necessary to analyze the way in which dietary guidelines are taught in schools. Only 5.4% (n = 5) of children had difficulties in identifying the main nutrients that foods provide, as well as identify their functions in the human body.

As part of these reinforcement activities and evaluations, it was found that food insecurity was associated with a higher risk of not passing the workshops. Children from

severe food insecure households had 8.24 times higher odds of not passing the nutrition education workshops than children from food secure households ($P = 0.04$) (table XVIII).

Food insecurity has been associated with negative effects on mental health and cognitive development in school-age children, as well as with the development of emotional and behavioral problems, which compromises their academic performance. Children from food-insecure households are also more likely to have high rates of absenteeism and tardiness (Faught et al., 2017).

In addition, at an older age there is a greater risk that children will not pass educational workshops. The knowledge obtained by the mothers through the same nutritional education workshops could have had a greater influence on the knowledge of the youngest children than the older ones. For example, the development of nutritional problems during childhood is associated with the characteristics of the family environment, while in adolescence these problems are mainly caused by individual circumstances. One of those characteristics of the family environment that can have the greatest influence during childhood is the education of the parents (Hass et al., 2003).

Parents with a higher education have a greater knowledge of nutrition and can promote better lifestyles in their young children. However, in stages such as adolescence, the influence of parents and therefore the effect of their education on adolescents eating behavior decreases. There is a greater freedom for adolescents to make their own decisions regarding their eating habits and physical activity, as well as, to a greater susceptibility to the influence of friends and publicity (Hass et al., 2003).

Because dependency on parents decreased with age, it is likely that the mothers could have a greater influence on younger children to put into practice the knowledge obtained in the workshops, so that these children were learning from home what would later be taught in the workshops at school, getting more positive test results than older children. In this sense it might be necessary adapt future interventions considering these factors.

Table XVIII. Association between not passing the nutrition education workshops in school-age children and food insecurity (n = 92)[1].

Variable	Not passing	
	AOR	**P**
Category of food insecurity		
Mild food insecurity	1.21	0.81
Moderate food insecurity	0.49	0.52
Severe food insecurity	8.24	0.04
Age, years	1.53	0.02
Sex	1.83	0.30
Number of children	0.87	0.54
Main provider at home		
Mother	2.33	0.54
Both	1.50	0.63
Education of mother		
Incomplete elementary school	0.67	0.59
High school/superior	0.96	0.97
Education of father		
Incomplete elementary school	1.86	0.44
High school/superior	1.25	0.81
Working mother	0.53	0.43

[1]AOR – adjusted odds ratio. A 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, being a girl, number of children, father as main provider at home, having elementary school, and mothers who do not work.

Nutrition education has the potential to play an important role in ensuring food security and improving nutritional status in vulnerable, low-income populations (Farrell, 2013).

Through food education, educational actions can be carried out and information is provided to increase knowledge regarding nutrition and food, and therefore, the improvement of eating behavior, the acquisition of knowledge and the adoption of positive attitudes (Barrial-Martínez et al., 2011).

These modifications of eating behavior in food insecure people can contribute to weight loss as well as improve biochemical indicators that reduce their risk of developing chronic degenerative diseases (Farrel, 2013).

Likewise, in food insecure people who already have a chronic disease, nutrition education can contribute to a better adherence to treatment. For example, in people with diabetes and food insecurity, nutrition education can contribute to a better follow-up of medical recommendations for better control of diabetes. Nutrition education in people with diabetes from households with food insecurity has previously been shown to improve their levels of glycated hemoglobin due to the implementation of healthier eating habits and physical activity, compared to people with diabetes from households with food security but not received nutrition education (Gucciardi et al., 2014).

In addition to reducing the risk of developing complications from chronic degenerative diseases in food insecure people, nutrition education can improve food insecurity status. As previously discussed, people from food-insecure households tend to have a diet characterized by the consumption of cheap but energy-dense, micronutrient-poor foods. Through nutrition education, these risk factors can be reduced, not only through increasing knowledge and improving attitudes and beliefs in food habits, but also, nutrition education can include topics that help the population develop skills for a better management of economic resources. Allowing food insecure people to make the most of their economic resources to acquire a higher quality diet (Dollahite et al., 2003).

Eicher-Miller et al., (2009) evaluated the effect of the Food Stamp Nutrition Education Program on the food security of low-income American women. The authors found that women who received nutrition education lessons that included topics related to improving budget management skills, healthy food selection, and meal preparation tips significantly decreased their degree of food insecurity compared to the control group (Farrel, 2013).

Healthy Meal Plans

Two thirds (65.2%, n = 73) of the mothers received 2 healthy meal plans. During the delivery of the first healthy meal plan, body weight was measured in 90.4% (n = 66) of them. The reason body weight was measured again at this stage of the program is that two years had passed since the baseline measurement. Therefore, it was wanted to know the body weight that the mothers had at the time of starting the delivery of meal plans.

It was observed that one quarter (25.8%, n = 17) had an average weight loss of 3.5 kg in that 2-year period. However, 68.2% (n = 45) had a weight gain of 4.1 kilograms in the same period. The remaining 6% (n = 4) maintained their body weight.

Through process evaluation of the program, it was observed that mothers had a higher body weight and BMI before the first healthy meal plan compared to baseline data. Although, a lower percentage of overweight was observed during the follow-up evaluation, the percentage of obesity increased considerably (table XIX).

Of the 2 mothers who were classified as underweight at the beginning of the program, both improved their nutritional status and where classified as normal weight at the follow-up visit. Of the 5 mothers who were classified within the normal range, 4 remained in that classification, however, 1 of them became overweight. Of the 25 mothers who were overweight, 7 were classified as obese in the process evaluation, and the rest remained overweight. Finally, of the 34 mothers who were obese, 2 decreased their BMI to be classified as overweight and one more in a less severe degree of obesity. Four of them increased their obesity classification to more severe degrees. The rest remained in the same classification.

Table XIX. Change in weight, BMI, overweight, and obesity between baseline and before first healthy meal plan (n = 66)[1].

Variable	Baseline	Before first meal plan	P
Weigh, kg	76.7 ± 17.2	78.9 ± 19.9	< 0.001[2]
BMI, kg/m^2	30.27 ± 6.97	31.23 ± 7.56	< 0.001[2]
Overweight, %	37.9	30.3	0.18[3]
Obesity, %	51.5	60.6	0.07[3]

[1]Values are median ± interquartile range or percentages. [2]Differences by Wilcoxon signed rank test. [3]Differences by McNemar test.

This increase in the prevalence of obesity in that 2-year period, from the initial diagnosis to the beginning of the implementation of healthy meal plans, indicates that in addition to carrying out nutrition education workshops, it is important to design and implement individualized nutrition consultations in mothers that promote weight loss.

Motivation, time, support, flexibility, and creativity have been identified as contributing factors to weight loss success among low-income women (Banerjee et al., 2018).

In previous studies, it has been reported that women consider the health benefits and physical appearance they could obtain as motivational factors for weight loss. Weight loss is also favored when women consider the benefits it would entail in improving mobility and reducing the discomfort caused by excess weight. Finally, it has been observed that some women are motivated to lose weight because they want to be better role models for their children (Banerjee et al., 2018).

Women have identified that family support and availability of time are facilitators for weight loss (Banerjee et al., 2018).

In studies with Mexican American women, cultural context, specifically the role of familism, have been shown to interfere with successful weight loss. Women have reported that they do not have enough time to carry out activities that favor their health, such as eating healthier meals or doing physical activity, due to the responsibilities they have within their home, mainly taking care of their children. In addition, they considered that they did not receive the necessary support from their family to achieve a successful weight loss, since the changes towards a healthy lifestyle go against the customs and preferences of their family. Likewise, women commented that the rest of the family used to make fun of them for trying to lose weight and even made it difficult for them to comply with the recommendations of the eating plan, especially in family gatherings (McLaughlin et al., 2017).

Women have reported that they sometimes receive mixed messages from their families about whether or not they should lose weight. Historically in Mexican culture, a higher value has been given to women with high weight, because it represents a better state of health, so losing weight could not be well seen by the family and society. Which constitutes one more barrier for women to consider losing weight despite the negative health consequences of being overweight and obese (McLaughlin et al., 2017).

However, women have also identified opportunities to increase family support and continue food traditions. For this reason, they suggest that programs that seek to promote weight loss include lessons that provide women with practical advice to prepare healthy meals using new foods and traditional and cultural foods. Which would make healthy meals more attractive to the rest of the family (McLaughlin et al., 2017).

Women suggest that programs should provide advice to control unhealthy eating behaviors such as eating leftover food left by children, even when women are not hungry, in order to avoid wasting food. Or, not taking enough time to eat in the right quantity and quality due to the tasks they have to do as mothers. Since these habits prevent them from meeting weight loss goals (McLaughlin et al., 2017).

Therefore, programs that seek to improve the nutritional status of women must consider the effect that the family has on weight loss. It will be necessary to promote adequate communication in order to know the opinions of the rest of the family on the participation of women (especially mothers) in weight loss programs. As well as convincing them that successful weight loss not only has beneficial effects on the health of women, but also has a positive impact on the family (McLaughlin et al., 2017).

With the implementation of this program, we seeked that the meal plans were adapted by the mothers to the rest of their family, promoting, more than weight loss, the acquisition of healthy eating habits among all family members. But, due to the high prevalence of overweight and obesity, it is important to continue working on interventions focused on combating this problem and promoting weight loss, through individualized meal plans,

and promoting other healthy habits such as physical activity, in addition to motivational support.

Home Gardens

Home gardens were implemented in 81.3% (n = 91) of the participating households. Families participated in the implementation of 67% (n = 61) of the home gardens. From 1 to 6 people per household, including children and adults, contributed in the preparation of the land, the formation of the seed beads, the direct sowing of the seeds, the irrigation and the distribution of compost over the garden.

Family and community gardens have been considered as a way to spend time with the family and to fostering learning and cooperation among family members (Algert et al., 2016).

During follow-up visits, it was observed that children and adults worked together on activities that would help the home garden succeed. For example, a 58.2% (n = 53) of the families fenced their garden, being in 94.3% (n = 50) of the cases, a fence formed of sheet, chicken wire or hammock for fishing, attached with wire to 4 wooden boards (1 board in each corner of the garden), such materials were already available in the homes, since they were materials used for the fishing work they usually do. Likewise, in 13.2% (n = 12) of the home gardens, families worked together to create an irrigation system using materials they had at home, as well as adapting the drainage of laundries and washing machines to water the garden.

Crop growth was observed in 80.2% (n = 73) of the home gardens. Among the factors that contributed to this success, it was found that 63% (n = 46) of households fenced their garden and frequently watered the garden. Finally, as a way to contribute to the growth of the garden, in 42.5% (n = 31) and 37% (n = 27) of the home gardens compost and soil from under the mesquite trees were added, respectively.

Table XX shows the number and type of plants that grew in households with food security and food insecurity. Only successful growth of Italian zucchini was statistically different between food-secure and food-insecure households.

Of the 100% of vegetables and fruits that grew, 77.6% were harvested. Only carrot was statistically different between food-secure and food-insecure households (table XXI).

The lack of compost or other material that provided nutrients was the main reason that some of the crops did not reach their maximum growth in 45.7% (n = 16) of home gardens. Lack of an appropriate fence and an inadequate irrigation system along with lack of control of weed growth, affected 51.4% (n = 18) of the home gardens. Finally, in 2.9% (n = 1) of home gardens the proximity to other plants impeded the adequate growth of crops.

Likewise, through telephone calls it was possible to know that about 10 families shared the harvested vegetables with other family members and neighbors.

Overall, there was a high acceptability of this type of intervention among the participating families, which is reflected in the lack of significant differences in the number of most crops that grew and were harvested among households with food security and food insecurity.

De Medeiros et al., (2019), analyzed the characteristics of home gardens and their relationship with the food security of 118 Brazilian families (De Medeiros et al., 2019).

The authors found no significant associations between food insecurity and home garden success. Rather, it was observed that the factors that determined the production of the home garden were related to family interests, space conditions, growing seasons, and previous knowledge about the implementation of home gardens (De Medeiros et al., 2019).

Table XX. Number of vegetables and fruits that grew in households with food security and food insecurity (n = 91)[1].

Vegetable	Growth		
	Food security	**Food insecurity**	**P**
Chard	29	99	0.72
Broccoli	34	83	0.47
Radish	66	192	0.49
Coriander	54	101	0.51
Serrano pepper	12	26	0.73
Tomato saladette	29	62	0.42
Italian zucchini	5	20	0.03
Cabbage	33	88	0.82
Cambray onion	23	11	0.51
Cauliflower	6	0	-
Carrot	24	100	0.40
Lettuce	5	51	0.30
Cucumber	8	25	0.37
Watermelon	7	6	0.22
Melon	9	11	0.10

[1]Values are number of plants. Differences by Kruskal Wallis test.

Table XXI. Number of vegetables and fruits harvested in households with food security and food insecurity (n = 91)[1].

Vegetable	Harvest		
	Food security	**Food insecurity**	**P**
Chard	20	86	0.65
Broccoli	9	22	1.00
Radish	51	159	0.97
Coriander	37	81	0.22
Serrano pepper	0	0	-
Tomato saladette	100	220	0.55
Italian zucchini	0	0	-
Cabbage	21	29	0.13
Cambray onion	4	10	0.16
Cauliflower	0	0	-
Carrot	14	55	0.03
Lettuce	1	27	0.31
Cucumber	0	0	-
Watermelon	0	0	-
Melon	0	0	-

[1]Values are number of crops. Differences by Kruskal Wallis test.

Even so, several studies have shown the beneficial effects of the implementation of home gardens for food security, since they constitute an important activity to improve the physical availability and economic access to healthy food, and contribute to reduce micronutrient deficiencies (Bushamuka et al., 2005).

Bushamuka et al., (2005) evaluated the positive effects of the implementation of home gardens in 2,160 households in Bangladesh. It was found that home garden increased the availability and the access of families to healthy foods such as fruits and vegetables, which implied an improvement in nutritional quality. Likewise, it was observed that households used the extra income they obtained from the sale of garden products to purchase a greater variety of foods that increased their consumption of protein. Finally, it was found that the participating women increased their knowledge in nutrition as well as their skills in managing the home garden, which contributed to greater production and greater income generation (Bushamuka et al., 2005).

Although the fundamental role that women play in family nutrition is considered, in some societies their participation in food production is limited. However, in an area where women can exercise greater control and positively influence the availability of food for family nutrition, is the implementation of home gardens. Studies have shown that even the development of a family garden in small spaces of land can constitute an appropriate source of fresh and nutritious food. Women can use these foods in various preparations and, together with foods purchased from other sources, expand the diversity of the diet (Baliki et al., 2019).

It is important that home garden implementation programs train women in the selection of the most appropriate place to establish the garden, the preparation of the land, planting techniques, the care for the maintenance of the garden as well as how to harvest crops. It is important to include nutritional education in these trainings, so that mothers can learn about the main nutrients they can obtain from home gardens and the most appropriate options for cooking crops (Baliki et al., 2019).

Home gardens constitute an important intervention strategy to improve the dietary quality, especially in people with food insecurity. The implementation of strategies such as fortification and supplementation contributes to reducing the risk of nutritional deficiencies, but they are not always available to the population of unfavorable socioeconomic strata. Increasing the diversification of diets through home gardens will be a more appropriate strategy for this population and will achieve better long-term positive effects (Baliki et al., 2019).

Therefore, integrated interventions must be implemented: showing families the health and food security benefits of developing a home garden; strengthening the knowledge and skills of families in the implementation and maintenance of the home garden; and favoring the participation of women in all decisions regarding the home garden, since its creation to the consumption and commercialization of crops (Baliki et al., 2019). In this way, it will be possible to reduce micronutrient deficiencies, poverty, and food insecurity (Bushamuka et al., 2005).

Post-Intervention Assessments

Economic Access to Food

Through telephone calls, the Mexican Food Security Scale was applied to 31.3% (35 out of 112) of the mothers. We were unable to contact the remaining mothers to participate in the follow-up data collection due to: change of phone number (n = 64), not have a cell phone (n = 9), and reluctance to respond to questions (n = 4).

When comparing the scores obtained from the application of the scale, there were not statistically significant differences in food security when pre-test score and post-test score were compared. The same result was obtained when comparing the percentages of the categories of food insecurity (table XXII).

In general, 14 of the mothers interviewed perceived themselves as having food security at the beginning of the program. While 10, 8, and 3 mothers were considered mild, moderate, and severely food insecure, respectively.

After the implementation of the program, the number of mothers who considered their home as food-secure decreased to 13.

While the number of households with mild and severe food insecurity increased to 11 and 4, respectively. However, households with moderate insecurity decreased to 7.

Specifically, of the 14 mothers who were classified with food security before the implementation of the program, only 9 of them continued to perceive themselves in that classification in the final assessment. The rest were perceived as mild (3 cases) or moderate (2 cases) insecurity.

In this regard, mothers commented that the health situation due to COVID-19 affected the variety of food at home due to the increase in food prices: *"I could not buy fruits, vegetables and meat because they increased in price during the pandemic".*

Table XXII. Change in Mexican Food Security Scale score and categories of food insecurity between pre- and post-intervention (n = 35)[1].

Variable	Pre-test	Post-test	P
Food insecurity, score	2 ± 4	2 ± 4	0.29[2]
Food security, %	40	37.1	0.72[3]
Mild food insecurity, %	28.6	31.4	
Moderate food insecurity, %	22.8	20	
Severe food insecurity, %	8.6	11.4	

[1]Values are median ± interquartile range or percentages. [2]No differences by Wilcoxon signed rank test. [3]No differences by Marginal homogeneity test.

Likewise, the lack of employment reduced the economic income for food: *"I could not continue working because I clean houses, only one son of mine continued… I used to consume a lot of fruits and vegetables, but I stopped buying them to give priority to other foods such as beans and cheese, soup, rice, the most essential"*.

For their part, those who continued to perceive themselves as food secure commented that they had not seen their family diet so affected by the pandemic, since they continued working and continued receiving the same income.

Some of them received food pantries as part of community support. On other occasions, their sons helped them with expenses during these months. In addition, some commented that fruits and vegetables were greatly increased in price, but they continued to buy them, especially for their children.

Of the 10 mothers who were perceived as mildly food insecure, 7 continued at that category after the program. Two of them advanced to more severe degree of food insecurity, but one of them to a food secure household.

Mothers who remained mildly food insecure commented that although they stopped buying food such as meat, eggs, fruits, and vegetables because their prices increased, it was thanks to the pantries they received during these months that they were able to satisfy their food needs: *"We received a pantry and we feel relieved"*. On other occasions, they helped themselves from fishing: "*We have eaten more seafood. Yes we eat before, but now more, as my husband goes and fishes, then he has been taking a lot of seafood, thank God and that we have tried to use, more seafood than other foods"*.

Those who perceived themselves with more severe degree of food insecurity commented that despite the pantries, these were not enough to cover all their food needs, coupled with job loss: "*I was a hotel receptionist, since the pandemic began, we lasted 3 months with the hotel closed, because there was no work, of course it affected us a lot ... there were times when there was only one or two (meals) ... we always eat rice, soy and so on, because they were supporting us with weekly pantries, but in the last days when*

things end, there were times when we could only cook white rice, or sometimes we received soy milk and made rice pudding, not foods with many nutrients, but it was what we had... we had to limit ourselves to eating little to save for another day, it happened to all of us, we had to have only one meal and that one member did not have it".

Finally, the mother who reported perceiving with food security commented that it was due to not having stopped receiving income, because despite the pandemic situation, they had the need to find work due to the birth of her baby: "*Well, he (her husband) who is dedicated to tourism, they closed the beach you see, but still, he did not stop working because he got a job elsewhere and well there he is, precisely since all this began, they closed the jobs.. It was a month away (for the birth of her baby), imagine how we were going to do it? Thank God he found that job".*

Of the 8 mothers who were considered moderately food insecure, only 3 of them remained in this category in the final assessment. One of them was classified as severe insecurity, but another one went to the milder degree of food insecurity. Likewise, 3 improved their situation by perceiving themselves as food secure.

In those mothers who continued in moderate insecurity, they mainly commented that their accessibility and availability of food had been affected, since their work situation was affected: *"One struggles a lot to buy things, there is no work, we don't have enough for many things, but beans and tortillas are always there"*. The products that could be obtained from fishing and the lack of support for this sector were also affected: *"Well, the truth is, I was working and they closed the tortilla shop where I worked and my brother was going to the sea, he is a fisherman, but yes it has affected us because the products have dropped. There have been many contrasts. Have you heard that some fishermen got help? But not others, no one came to help us".*

On the other hand, the mother who was perceived as mildly insecure commented that although the economy was greatly affected, they continued to receive income because her husband left Kino Bay to get a job elsewhere: *"We continue working but my husband was*

affected by the closure of there, of all work, because they did not pass the product to where they sold it, and well, I think I'm going to stop working because, well, my husband got a job in San Felipe and I'm going there with him".

In the case of the mother whose food security situation became severe, she commented that it was mainly due to the lack of employment and that it could have been worse if she had not received support from neighbors and food pantries from associations. Even part of that help came from one of the other mothers who began to perceive herself with food security: "*The neighbor was a little while who did not have a good job and they came, and I said, well if we have the way, then we have to help them. And right now she has already started working and they already have something to eat. But, here we are all very united, of a single thing we can make two meals"*.

She also commented that she had prepared long before, in addition to using the vegetables from the home garden: *"We personally have not seen ourselves very adjusted because when this was starting I prepared myself with time, I bought and stored basic food, so in that sense this has not affected us much because we had a reserve here at home and right now, thank God we still have a little. And then with the vegetable (from the garden) it has helped us too. It has affected us in that we do not have work for certain things, but thanks to God we have not needed food"*.

Another of the mothers commented that in these months she got a job with a good salary in New Kino, which she continued to keep in these months of the pandemic, which has allowed her not only to improve her food situation but also to help her neighbors during these months: "*With this issue it affected me in another way, the number of mouths to feed increased, not because I had more family, because of the school issue, that everything is being done from home, the person who takes care of my daughter came to take care of her at home, and because taking advantage she brought her son and daughter ... I had more expenses in these matters, but it is not an affectation"*.

Finally, of the 3 mothers who initially perceived themselves as severely insecure, only 2 remained in this category, while 1 of them was considered moderately insecure.

Those who have remained in this situation, comment that despite the home garden, the lack of employment, income and help (financial or in food pantry) severely affected the family's diet during these months and that they try to get the children to eat first and insure them; however, they are also affected and worried about their situation: *"There are times when I have only tomato with onion and some hot tortillas. Many times we stop buying a meal to buy breakfast, but why we are going to mortify so much? One way or another we have to do it. The children eat the best and we, well, if we can get an egg or a tortilla with beans, but for the children there is, let's suppose a chicken soup, so all the children are going to eat it and there I am heating them until the soup runs out… me and my father eat beans. Let the children get sick, I better get sick… yes I am hungry, but the kids need eat… my oldest daughter tells me that it doesn't matter that they always eat the same thing, but that I should eat too"*.

Those who improved their situation to a moderate degree, commented that their work has decreased which has prevented them from buying vegetables and meats, but that as far as possible they continued to eat the three meals, but in smaller portions so that it would be enough for all members of the family; basing their diet mainly on beans, soup and rice, since they were the main foods in the pantries they received.

As the COVID-19 pandemic progresses, a dilemma has emerged: slow the spread of the virus or avoid negative effects on the economy and food security. Although the entire population has been directly or indirectly affected by the pandemic, some population groups due to their vulnerable condition, are more susceptible to its negative effects. For many years the communities that depend on fishing for their main livelihood have faced social, economic, and environmental problems that will be aggravated due to the pandemic (Bennett et al., 2020).

During the pandemic, many of the fishing communities had to completely stop their commercial activity, prohibiting everything from the capture of marine products to their commercialization. Additionally, some of these communities depend on tourism as a source of income, which was similarly affected. Stopping commercial activity was a necessary action to prevent the spread of the virus, but it was observed that it did not affect all economic sectors in the same way. Some sectors continued their activity, as they were considered essential for food supply. But, given the claim of society about the economic and food importance of fishing, some countries had to allow fishing under certain restrictions (Bennett et al., 2020).

During the interviews, the majority of mothers commented about the lack of employment due to the closure of shops, the stop of tourism and restrictions on fishing, which is the main form of family sustenance. They even commented on doing it illegally in order to obtain resources: *"My husband stopped working I don't know how many months, they cut him off and recently they called him again. They closed the crab and we were secretly working anyway ... we would sell it in the afternoon, otherwise we wouldn't get out of this situation, we weren't working"*.

They commented on the protests carried out by the community asking the government for permission to open commercial and fishing activity at least on weekends, due to the lack of income and food satisfaction: *"The merchants marched, because they were right, they were starving. They had nothing to eat. They held a march to open them on Saturday and Sunday so that tourism could come in to provide"*. However, when COVID-19 cases were reported, activities were suspended again.

The demand for seafood has also declined as a result of the pandemic. In general, people's economic resources has been affected by the decrease labor activity, which has caused families to reduce the income that is used to buy food such as fish and shellfish. In addition, the closure of restaurants and hotels has led to less demand for this type of

products. Therefore, fishermen must sell the little product they catch at a price below normal, further increasing their risk of food insecurity (Bennett et al., 2020).

Kino Bay has not been the exception. According to the comments of the mothers, most of the fishermen had an impact on their income not only due to lack of employment, but also because the little marine product they were taking out, employers were buying it very cheaply: *"Before my husband earned two thousand pesos or fifteen hundred a day, now he is earning three hundred, four hundred pesos a day ... those who buy the product, they buy it very cheap ... they paid them before twenty pesos for the shells and now they are giving in six. And the callus, for example, they paid for six hundred and fifty, now they pay for three fifty. In other words, it is half ... And the food rises and rises, and the product falls and falls. It is there where we begin to fight because here the food is very expensive"*.

Faced with this situation, fishermen must decide if they suffer from hunger or continue with their commercial activity and risk becoming infected with the virus. Since, in communities such as Kino Bay, boats, places for processing marine products, shops and tourist sites are small spaces with a large influx of people, so these could constitute an important source of infection and spread of the virus. In some of these communities a large part of the population lacks basic services and environmental sanitation. Likewise, there are only a couple of health centers that do not have the preparation or the equipment to perform diagnostic tests and provide adequate treatment against COVID-19 (Bennett et al., 2020).

In countries with food insecurity, COVID-19 is considered a "crisis within a crisis", because it has come to complicate the social, economic, political, and environmental problems that already arose in these nations (Bennett et al., 2020).

The pandemic is affecting all dimensions of food security, especially access to food. In recent months, a large part of the population has seen their income decreased, so they have resorted to certain coping strategies to meet their food needs. In this sense, families have chosen to stop buying expensive foods, which are usually those with the highest nutrient

density. These adjustments in the family budget compromise their dietary quality and increase their risk of adverse health consequences. In addition, in some small or isolated communities, food prices have risen above normal, as most of the products are brought from other communities. Making their access even more difficult, especially for low-income families. Therefore, the effects on the population's diet have not been mainly due to the lack of availability of food, but due to the increase in its prices and the lack of purchasing power in families (Laborde et al., 2020).

Mothers commented that there were no food shortages in the stores in Kino Bay, but that prices increased considerably: "*There was always food, the stores never ran out of anything, just changing prices". "Vegetables increased in price and beans also increased, meat also increased a lot". "It seems that it was competition to see who sold the most expensive". "There were some places that wanted to raise prices when it started, the egg, beans, things like that, flours, Maseca, but they came to check, reported it and had to keep prices as they were"*.

They commented that they have decreased the consumption of fruits, meats, milk, and eggs, mainly due to their price increase and the lack of economic income; but on the contrary, they increased the intake of beans, rice, lentils, potatoes, soups, and tortillas.

Although the purchase of vegetables was limited, they used those harvested in the family garden to complete their diet. In addition, they reported increasing the consumption of shellfish and fish, replacing meat and chicken, since due to the lack of demand for the product, fishermen began to sell them at a lower price: *"What we have gotten the most here to eat it is seafood, because here you get it very cheap, and more in these months"*.

Additionally, mothers commented that the restriction measures established prevented them from leaving the community to buy food at more accessible prices in supermarkets in nearby towns, however, families were willing to take the risk in order to get cheaper food: "*They are supermarkets where you can buy, we always go to the town of Miguel Aleman, to the Aurrera or San Francisco, because you buy more food and cheaper than*

here. And since we couldn't go out, we had to buy things here, but prices began to rise and people began to complain and things have already been lowered. But that's what they wanted to do at first. Besides, people would go to look for food in another place, because even if they can´t, they would go to Miguel Aleman to buy things, they would take risks".

Rundown of savings has been a key coping strategy, but few households have enough savings to meet their food needs for a several months: *"I had a little money saved, I went to the store, there at Miguel Aleman. Well, there is very easy because everything is very cheap, nothing to do with here, but afterwards they did not even let us out. Food could no longer be bought there. It is where we begin to battle. The money ran out because here was very expensive".*

Although most of the news related to the pandemic are bad, it has also been a time of solidarity among fishing families for carrying out activities that help improve food security for the entire community. Several cases have been reported where small-scale fishermen come together to catch fish and shellfish that are then distributed free of charge to community members. On other occasions, the captured product is destined for places that serve vulnerable populations, such as nursing homes, community kitchens, and food banks (Bennett et al., 2020).

Similarly, in Kino Bay, it was found that participating families shared part of the vegetables harvested in their garden with the rest of the extended family as well as with neighbors. During these pandemic months, some families reported having the opportunity to help their neighbors and acquaintances with meals and/or food. And vice versa, since other participating families commented to received help from relatives and neighbors: "*We eat a lot of seafood because where my husband works, as his cousin is the owner there, sometimes he gives him a kilo of fish, thanks to God that has not been lacking; and then my brother-in-law goes fishing and if he brought, he would distribute us there and so on, and well, we don't mind eating so much seafood".*

Because the main negative effect of the pandemic is related to the lack of economic access to food, government institutions will have to implement strategies to help mitigate this problem (Laborde et al., 2020). For this reason, it is suggested to provide pantries to vulnerable families, grant loans to fishermen and merchants, support community kitchens and food banks, improve the conditions of health services, approve commercial opening as long as conditions allow it, and protect fishermen, fish workers, and merchants from being infected by COVID-19 (Bennett et al., 2020).

Targeting of assistance is particularly important to ensure that the benefits reach those most in need (Bennett et al. 2020). According to the mothers of families, the support received during these months of the pandemic was not distributed correctly: *"The support that entered the town here, was from the fishermen, the fishermen received it and no more. And one that they gave was a loan of 25,000 pesos, but it went to business. And another of 6,000 but only for some people, not for us". "Well, they did support the fishermen but not all. Many who are not even fishermen received support. In other words, people made and undone. Here they give support to those who they know, family, friends and so on"*.

Likewise, the community was also supported with pantries, however, they were not support from the government, but from groups of North Americans together with the owner of the largest store in the town, who organized to provide pantries to families and even hot meals on the weekend: *"What they have given as support is from the Americans. A group of them who are living in New Kino and they are the ones who are supporting the town"*.

There was disagreement regarding the distribution of the pantries: *"Here they did support with pantries, but as always, the same people all the time". "They were giving pantries in the town, but they supported the same people all the time. I thought they were going to give it to all the people because all the people were not working but no". "Here in Kino there were many people who delivered pantries, but some abuse of course, some families took up to four". "They have delivered pantries, but they have not given us. I say*

that since they see that our house is made of concrete and we have a car, maybe they think we don't need it, that's why they don't give us. Neither have we asked, because we are not like that, but we also need it, because we have had to modify the money for food, to measure ourselves and so on. But as I told you, they have passed, but they have not given us a pantry, I say that's why".

It is important that vulnerable populations receive food and financial support first. However, it is very likely that the support will not be enough to alleviate the food insecurity situation of the fishing communities. Therefore, it is essential that economic activities related to food supply continue to be carried out, although under adequate sanitary conditions (Laborde et al., 2020).

Future Opportunities

Once sanitary conditions allow it, the work team will return to Kino Bay to continue evaluating the outcomes of the intervention strategies implemented. First, changes in knowledge and attitudes of nutrition and good hygiene practices in mothers would be evaluated. Followed by changes in food availability and access for families. And finally, the changes in dietary, anthropometric, and biochemical measures of both mothers and their school-age children would be analyzed.

The implementation of this program establishes the basis for future interventions in the community. Families are interested in participating in this type of program, because they want to learn how to improve their food and health situation. In addition, the advances made in the community in recent months, such as the establishment of a drinking water system and electricity, especially in marginalized neighborhoods, establish facilitators for the implementation of future programs, which combine nutritional education, food orientation and home gardens.

In this sense, nutrition education will contribute to improving nutrition knowledge. Also, if the workshops includes topics that promote the management of economic resources, nutrition education will allow families to make better use of their income and to be able to acquire a greater variety of foods (Morón, 2006).

Although the entire population requires nutrition education, mothers are a target group due to the influence they have on the family's food and nutrition. Likewise, the school stage is a window of opportunity to establish healthy lifestyles that last throughout life (Morón, 2006).

Schools are an ideal place to promote nutrition education, through workshops and dynamic activities that encourage parents and teacher participation. However, nutrition education will be even more effective if it is supported by other strategies that also promote healthy eating (Morón, 2006).

School, family and community gardens constitute a strategy to increase the availability of fresh and healthy food (i.e. fruits, vegetables, tubers, and roots) especially in low-income communities. Home gardens can also contribute to improve income if the surplus product is sold. This will increase the population's access to other types of foods that complement their diet (Morón, 2006). Gardens can be the responsibility of the whole family or community, but, women can play an important role in ensuring the proper use of the products obtained from the garden (Morón, 2006).

In addition, gardens provide benefits beyond the nutritional aspect, since they foster social and cooperative relationships among family and community members (Morón, 2006).

Whatever intervention is to be implemented within the program, it is important to remember that it is a planning process, where it is first necessary to identify the problems and needs of the population, as well as their causes and consequences. Followed by establishing an order and selecting the problem that is a priority. To later formulate the objectives to be achieved. Afterwards, the most appropriate intervention strategy will be selected and finally, the evaluation system will be developed. Taking special attention to encourage community participation throughout the process (Morón, 2006).

Strengths and Limitations

The main strength of this research is that it is part of the first studies that analyzed and sought to improve the food security situation in families of Kino Bay, Sonora. This study provides evidence on the negative effects of food insecurity in the community, particularly in fishing families, as well as the intervention strategies that could be applied to continue improving the food and nutrition security of the population

Likewise, the number of participating households is representative of the total population of the community. In addition, randomization was used to select the streets of Kino Bay that were visited to obtain those participating households.

Other strengths of this research are the high response rate during the pre-intervention stage. As well as the high participation rate of mothers and their school-age children in the intervention strategies. This establishes the great interest of the community to participate in activities that contribute to improving their nutritional and health status. Opening a window for the implementation of future intervention programs.

A limitation is the study design. By their nature, before-after designs with a single group allow the researcher to manipulate the exposure, however, it cannot be guaranteed that the changes that appear are due to the intervention itself, rather than to other interventions or uncontrolled factors.

Finally, due to the health contingency by COVID-19, it was not possible to carry out all the post-intervention assessments. However, once conditions permit, visits to the community will resume to continue fieldwork.

CONCLUSIONS

The intervention program to improve food and nutrition security in mothers and their children from Kino Bay managed to evaluate the effect of nutrition education workshops on school-age children and home gardens in participating households.

In this regard, the implemented program managed to increase nutrition knowledge in three quarters of the children and the home gardens constituted a strategy to complement the families' diet.

On the other hand, no effect of the program was found on the food and nutrition security of the families. However, due to the COVID-19, only a third of the families were evaluated, so it is necessary to confirm these results, by evaluating 100% of the sample.

Likewise, it was not possible to evaluate the effect of the interventions on the nutritional status, nutrient intake, and diet variety of mothers and their children. Therefore, the continuity and implementation of the complete program after the pandemic is recommended.

The qualitative information collected shows the negative effect of the current pandemic on the food, economic, labor and food insecurity situation of the families of Kino Bay. Therefore, it is recommended to apply strategies to mitigate the negative effects on food and nutritional security related to emerging phenomena such as that experienced in previous months, especially in families with economic deficiencies.

Finally, it is considered that the nutrition workshops and home gardens were important components of the program that can be implemented in other communities with economic, social and cultural conditions similar to this community.

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ANNEXES

Annex 1: Socioeconomic and Demographic Survey

Interviewee: _____

Date: l___l___l l___l___l l___l___|

1.- Number of people living in the home.

How many people normally live in this home, counting young children and the elderly?

[___|___]

Total people

2.- Identification of the number of households.

In this household, how many households or groups of people have separate expenses for food, counting yours?

[_____]

Number of households

How many children are per family? _____

How many children do you have? _____

How many children live with you? _____

3.- What is your marital status?

a) Married

b) Live in a common-law marriage

c) Divorced

d) Single

e) Widowed

f) Separated

4.- Please who is the main provider of this home?

a) Husband b) Father c) Mother d) Grandfather/grandmother

e) Uncle/aunt f) Brother/Sister g) Other _____

5.- Are you affiliated or registered with any medical insurance?

Yes _____ No ____

If so, in which institution or program?

a) IMSS b) Government medical service for unemployed c) ISSSTESON

d) ISSSTE e) Navy / National Defense f) PEMEX

g) Particular h) Other_____

6.- What was your last school grade?

a) None

b) Elementary school 1 2 3 4 5 6

c) Junior high school 1 2 3

d) Technical/commercial career (After junior high school) 1 2 3

e) High school 1 2 3

f) Technical/commercial career (After high school) 1 2 3

g) Bachelor 1 2 3 4 5

h) Master 1 2 3

i) Doctorate 1 2 3

7.- What was the last school grade of your partner?

a) None

b) Elementary school 1 2 3 4 5 6

c) Junior high school 1 2 3

d) Technical/commercial career 1 2 3
(After junior high school)

e) High school 1 2 3

f) Technical/commercial career 1 2 3
(After high school)

g) Bachelor 1 2 3 4 5

h) Master 1 2 3

i) Doctorate 1 2 3

8.- Do you currently work?

Yes _____ No ____

9.- How much is your income: _____

10.- How often do you receive this income:

a) Daily

b) Weekly

c) Biweekly

d) Monthly

11.- Does your partner currently work?

Yes _____ No ____

12.- How much is your partner's income? _____

13.- How often does he receive this income?

a) Daily

b) Weekly

c) Biweekly

d) Monthly

14.- In addition to you and/or your partner, does anyone else contribute your income to household expenses?

Yes _____ No ____

If so, who does it and how much is that income?

_____ _____

15.- How much do you spend weekly to buy food?_____

16.- How much do you spend weekly to buy food outside the home?_____

17.- Do you receive any financial, pantry or other support from an institution, family or friends?

Yes _____ No ____

If so, what is the support and how often do you receive it?

_____

Annex 2: Mexican Food Security Scale

Hello, good day we are applying a survey related to food, would you like to participate? Next I will ask you some questions related to eating at home (thinking about the last three months). You only have to answer with a Yes or No.

Date: _____/_____/_____ Interviewer: _____

Interviewee: _____ Address: _____

First 6 questions for households with members over 18 years of age

1. In the last three months, due to lack of money or resources, have you or any adult in your household ever had a diet based on very little variety of foods?

Yes_____ No_____

2. In the last three months, due to lack of money or resources, have you or any adult in your household ever stopped eating breakfast, lunch or dinner?

Yes_____ No_____

3. In the last three months, due to lack of money or resources, did you or any adult in your household ever eat less than you think you should?

Yes_____ No_____

4. In the last three months, due to lack of money or resources, have you ever run out of food?

Yes_____ No_____

5. In the last three months, due to lack of money or resources, have you or an adult in this household ever felt hungry but did not eat?

Yes_____ No_____

6. In the last three months, due to lack of money or resources, did you or any adult in your household ever eat only once a day or did you stop eating for a whole day?

Yes_____ No_____

Additional questions for households where people under 18 live:

7. In the last three months, due to lack of money or resources, has anyone under the age of 18 in your household ever had a diet based on very little variety of foods?

Yes_____ No_____

8. In the last three months, due to lack of money or resources, did anyone under the age of 18 in your household ever eat less than they should?

Yes_____ No_____

9. In the last three months, due to lack of money or resources, have you ever had to reduce the amount served at meals to someone under 18 in the household?

Yes_____ No_____

10. In the last three months, due to lack of money or resources, has anyone under 18 years of age ever felt hungry but did not eat?

Yes_____ No_____

11. In the last three months, due to lack of money or resources, did anyone under the age of 18 ever go to bed hungry?

Yes_____ No_____

12. In the last three months, due to lack of money or resources, has anyone under the age of 18 ever eaten once a day or stopped eating all day?

Yes_____ No_____

Annex 3: 24-hour Dietary Recall

Code_____ Date: /____/____/____/ Page____of_____
Day Month Year

Interviewee: _____/_____
Name Last names

Start time: _____

Meal	Time (24 h)	Description and food preparation	Portion Consumed	Grams	Food code	Place

Meal	Time (24 h)	Description and food preparation	Portion Consumed	Grams	Food code	Place

Was this a normal drinking day?

1. ____Yes
2. ____No Why?_____

Are you currently taking any supplements, vitamins, tea, or special foods?

1.____No
2.____Yes Which? _____ How often? _____

Are you on a special diet? No _____ Yes _____ Why? _____

Reported day
1.- Mondey 5.- Friday
2.- Tuesday 6.- Saturday
3.- Wednesday 7.- Sunday
4.- Thursday

Intake
1.- Normal
2.- Less than usual
3.- More than usual

Interview
1.- Reliable
2.- She didn't remember a meal
3.- No reliable. Specify _____

Interviewer name _____

Annex 4: Food Frequency Questionnaire

Name of the scholar _____ Date ____/_____/_____

Please thin about the past year and answer the following questions.

Please answer our questions about how much of these fruits and vegetables you ate during the past year

Food	Mean portion	Size			Frequency					Quantity (g)	Code
		S	M	L	D	W	M	Y	N		
Fruit (fruit and fresh juice)											
Banana	1 medium										
Cantaloupe	1/4 medium										
Grapefruit	1/2 medium										
Grapes	15 pieces										
Jicama	1 slice medium										
Orange	1 small										
Orange juice (fresh)	1 medium glass										
Papaya	1 medium slice										
Pear	1 medium										
Peeled mango	1 small										
Pineapple	1 slice										
Strawberry	4 medium										
Tangerine	1 small										
Watermelon	1 medium slice										
Whole apple	1 medium										
Other fruit not listed											
Vegetables (fresh or cooked)											
Anaheim chili	1 small										
Avocado (California)	1/8 medium										

Broccoli	1/4 medium										
Cabbage	1 1/2 tablespoon										
Carrot (cooked)	1/2 medium										
Carrot (fresh)	1/2 medium										
Celery	1/2 medium rod										
Coriander (cooked)	1 spring										
Cucumber	1/3 medium										
Jalapeno pepper (canned)	3 slices										
Lemon (fresh)	1 small										
Lemonade (natural)	1 medium glass										
Lettuce	1leaf										
Lime	1 medium										
Onion (white)	1 single slice										
Onion (cooked)	1 tablespoon										
Radish	1 small										
Red pepper (powder)	2 tablespoon										
Spinach (fresh)	1 cooking spoon										
Tomatoes (fresh)	1 small										
Zucchini (cooked)	1/2 cooking spoon										
Other vegetable not listed											

Annex 5

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ARÁN

Nutrición Hospitalaria

Trabajo Original

Epidemiología y dietética

Food insecurity was associated with low quality diet and low HDL level in mothers of Northwest Mexico relying on fisheries for livelihood

La inseguridad alimentaria se asoció con una dieta de baja calidad y bajo nivel de HDL en madres de familia del noroeste de México que dependen de la pesca como medio de subsistencia

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Abstract

Background: food insecurity occurs when quality and quantity of food is insufficient for maintaining healthy nutritional and food profiles.

Objectives: to determine if food insecurity is associated with dietary and biochemical measures in mothers of the northwest of Mexico, which relies primarily on fisheries for livelihood.

Methods: a cross-sectional study was conducted with 116 mothers of the Northwest of Mexico. A socioeconomic survey, food security scale, and two non-consecutive 24-hour recalls were applied. Anthropometric measurements were made and hemoglobin, glucose and cholesterol levels were measured. The association between key measures and food insecurity was assessed using logistic and linear regression.

Results: two-thirds (68%) of households experienced food insecurity. Mothers with mild insecurity had 3.7 and 3.2 times higher odds of not consuming fruits and vegetables, respectively, and 4.9 times higher odds of consuming sweetened non-dairy drinks ($p = 0.04$; 0.04 and 0.05, respectively). In addition, they consumed less protein ($\beta = -3.22\%$; $p < 0.01$) and more carbohydrates ($\beta = 6.04\%$; $p = 0.02$) compared with mothers with food security. Mothers with severe insecurity consumed less iodine ($\beta = -24.41$ µg; $p = 0.03$) and had lower levels of HDL cholesterol ($\beta = -12.01$ mg/dl; $p = 0.03$) than mothers with food security.

Conclusions: food insecurity was associated with low quality diet and low levels of HDL cholesterol in mothers of Northwest Mexico relying on fisheries for livelihood.

Key words:

Food insecurity. Dietary measures. Biochemical measures. Mothers of Northwest Mexico. Fisheries.

Resumen

Introducción: la inseguridad alimentaria ocurre cuando la calidad y la cantidad de alimentos son insuficientes para mantener un perfil nutricional y alimentario saludable.

Objetivos: determinar si la inseguridad alimentaria está asociada con indicadores dietéticos y bioquímicos en madres del noroeste de México que dependen principalmente de la pesca como medio de subsistencia.

Métodos: se realizó un estudio transversal con 116 madres del noroeste de México. Se aplicó una encuesta socioeconómica, una escala de seguridad alimentaria y dos recordatorios de 24 horas. Se realizaron mediciones antropométricas y se midieron los niveles de hemoglobina, glucosa y colesterol. La asociación entre las medidas clave y la inseguridad alimentaria se evaluó mediante regresión logística y lineal.

Resultados: dos tercios (68%) de los hogares experimentaron inseguridad alimentaria. Las madres con inseguridad leve tuvieron una probabilidad 3,7 y 3,2 veces mayor de no consumir frutas y verduras, respectivamente, y 4,9 veces más probabilidad de consumir bebidas endulzadas no lácteas ($p = 0,04$; 0,04 y 0,05, respectivamente). Además, consumieron menos proteínas ($\beta = -3,22\%$; $p < 0,01$) y más carbohidratos ($\beta = 6,04\%$; $p = 0,02$) en comparación con madres con seguridad alimentaria. Las madres con inseguridad severa consumieron menos yodo ($\beta = -24,41$ µg; $p = 0,03$) y tuvieron niveles más bajos de colesterol HDL ($\beta = -12,01$ mg/dl; $p = 0,03$) que las madres con seguridad alimentaria.

Conclusiones: la inseguridad alimentaria se asoció con una dieta de baja calidad y bajos niveles de colesterol HDL en madres del noroeste de México que dependen de la pesca como medio de vida.

Palabras clave:

Seguridad alimentaria. Indicadores dietéticos. Medidas bioquímicas. Madres de familia del noroeste de México. Pesca.

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Annex 6

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Food Insecurity Was Associated with Lower Fruits and Vegetables Consumption but Not with Overweight and Obesity in Children from Mexican Fishing Communities

Karla D. Murillo-Castillo, Edward A. Frongillo, María Alba Corella-Madueño & Trinidad Quizán-Plata

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Food Insecurity Was Associated with Lower Fruits and Vegetables Consumption but Not with Overweight and Obesity in Children from Mexican Fishing Communities

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ABSTRACT

Food insecurity has been associated with decreased household food supplies, which could affect children's fruit and vegetables intakes and increases their risk of being overweight or obese. The aim of this study was to determine if food insecurity was associated with lower fruit and vegetables consumption and overweight and obesity in children from Mexican fishing communities. A cross-sectional study was 4conducted with 100 elementary-school children aged 6–12 years. A survey that evaluated socioeconomic conditions, food insecurity, and fruits and vegetables consumption was applied. Weight and height were measured. The association between key variables and food insecurity was assessed using linear regression. Sixty-four percent of households experienced food insecurity. Food-insecure children reported lower consumption of fruits and fruits plus vegetables than did their peers with food security (P trend = 0.040 and 0.038, respectively). Food insecurity was also associated with lower chance to meet the recommendation of fruit and vegetable consumption (P trend in logit < 0.001), but was negatively associated with the prevalence of overweight and obesity (P trend in logit < 0.001). Food-insecure children had lower fruits and vegetables consumption but were no more likely to be overweight or obese than their food-secure counterparts.

KEYWORDS

Food insecurity; fruits and vegetables consumption; overweight and obesity; elementary-school children; Mexican fishing communities

Introduction

Household food insecurity is experienced when there is uncertainty about future food availability and access, insufficiency of the amount and kinds of foods (quality) required for a healthy lifestyle, or the need to use socially unacceptable ways to acquire food (Leroy et al. 2015). In Mexico, according to the National Health and Nutrition Survey of 2016, the prevalence of food insecurity was 69.6% among Mexican households. The survey reported mild

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