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Research Article

Relationship of Food Groups Intake and a Social Inclusion and Welfare Strategy among Mexican Beneficiaries Younger than 5 Years Old

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ABSTRACT

Introduction: A social inclusion and welfare strategy focused on the population living in poverty conditions and without food access was implemented during 2014 in Mexico.

Objective: Assess the association of the participation in the social inclusion and welfare strategy and food insecurity condition with differences in food groups' intake among children younger than five years of age.

Methods: Comparative study of children under five years of age, including beneficiaries and no beneficiaries from a social inclusion and welfare strategy and two study periods (2014 and 2015). Multivariate analysis of variance (MANOVA) was used to assess the association of the intervention group, study period and food insecurity classification (FI), with the consumption of food groups. Classification and Regression Tree (CART) analysis was used to establish classification criteria for food group intake, FI and socioeconomic index.

Results: Belonging to the second study period and being beneficiary from the social inclusion and welfare strategy were associated with increased consumption levels of meat, sugary drinks, fruits and vegetables; the consumption of these foods increased with food security.

Conclusion: The social inclusion and welfare strategy had a significant positive effect on the diet of the beneficiary population. Nevertheless, it is necessary to encourage efficient public policies that guarantee food and nutrition security in Mexico.

Keywords: Food insecurity; Food group intake; Mexican children

INTRODUCTION

Different countries of Latin America have problems related to food and nutrition, such as stunted growth due to undernutrition and food insecurity, are primarily associated with inequity in food access and availability, especially among vulnerable populations. Therefore, many of them have been directed towards the Sustainable Development Goals (SDG), particularly number 2, Hunger Zero, which is intended to end hunger, achieve security and improve nutrition and promote sustainable agriculture before 2030, demanding that the countries develop public policies that contribute to the improvement of the food systems so they would be able to provide food for the entire population in a sustainable way. For this purpose, various food programs and laws have been developed and implemented in Latin America to achieve this objective [1].

Such is the case of Brazil, where the government has implemented since 2003 the Bolsa Familia Program which is based on monetary transfers with the objective of benefiting families with children and adolescents from 0 to 17 years old living in poverty and extreme poverty [2]. Another case is Mexico, where has increased their efforts to address problems of food insecurity among low income populations, and has gathered plenty information that supports the efficacy and effectiveness of food assistance programs and supplemental nutrition programs on the reduction of anaemia and low height in the vulnerable population [3,4]. However, these initiatives are currently facing new challenges related to consumers'

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behaviour and attitudes, nutritional transition, economic growth and urbanization, etc.; this makes necessary that food insecurity reduction efforts must integrate actions focused to improve food consumption patterns in the poorest population due to an observed increase in the prevalence of overweight, obesity and chronic diseases.

Regarding the evaluation of the strategies implemented to fight hunger, a study carried out on 2016 in Brazil was observed changes in food intake among the beneficiaries of the Conditional Cash Transfer Program (CCT) implemented in the Bolsa Família Program, perceiving that diversity in diet and family food expenditures increased, especially in the purchase of food for children [5]. On the other hand, several studies have reported that, during food insecurity events, the consumption of fruits, vegetables, meat and dairy products decreases and, in some cases, the consumption of cereals, sweets and fats, increases, causing malnutrition (deficiencies in the consumption of energy, micronutrients, or both), obesity and other non-infectious diseases [6,7].

In 2012, the National Council for the Evaluation of Social Development Policy (Consejo Nacional de Evaluación de la Política de Desarrollo Social – CONEVAL) estimated that approximately one-fourth of Mexican households suffer from deprivation due to food access [8]. To help the populations in poverty and food insecurity, on January 22, 2012, the Government of the Mexican Republic established the National System for the Crusade against Hunger (Sistema Nacional para la Cruzada contra el Hambre), currently called the National Crusade Against Hunger (Cruzada Nacional Contra el Hambre – CNCH), a social inclusion and welfare strategy focused on the population living in poverty conditions and without food access [9]. It objectives are: 1) Zero Hunger: to provide adequate food and nutrition to people in poverty and with food access deficiency; and 2) to eliminate acute infant undernutrition and to improve childhood weight and height indices [10].

Mexico has a long story implementing programs and policies oriented to improve nutrition among vulnerable groups [11], including children under 5 years of age, stage in which physical, motor and socioemotional development is established. Hence, the CNCH is a strategy that encompasses 56 Federal programs related to aspects of food, health, education and social development (housing, access to safe drinking water and basic sanitation). These programs are based primarily on increasing income (from monetary transfer programs), and physical access to food (Food distribution programs or food distribution at low cost) [12]. Cash transfers aim to reduce poverty and inequality in vulnerable population, which were designed to avoid duplication in the provision of public resources and distribute them properly.

CNCH strategy was implemented in two stages. The first stage started in January 2013 and included 400 municipalities, with 3.6 million Mexican equivalents to the 51.7% of the population in extreme poverty. The second stage developed in 2014, included 612 additional municipalities with 5.5 million people representing 26.8%, in order to reach 5.5 million people representing 79.5% of these population. The municipalities considered in the CNCH strategy have the highest density of population in poverty and food insecurity, according to the CONEVAL criteria [9,12].

Since the CNCH is an important strategy focused to decrease food insecurity, the present study aimed to assess the association of the participation in the National Crusade against Hunger (Cruzada Nacional Contra el Hambre – CNCH) and food insecurity condition with differences in food groups' intake among children under five years of age.

METHODS

Study design

A comparative observational study was conducted with children younger than five years of age. Four study groups were included: two groups were defined by type of intervention (CNCH group –beneficiaries- and comparison group -no beneficiaries of CNCH). Other two groups were determined by the study periods. The first sample was collected in August and September 2014 and the second sample was collected similarly in 2015 (Both were independent samples and including a CNCH beneficiaries and no beneficiaries). The characteristics of each group are described in Figure 1.

To select households with eligible children was used a probabilistic three stage procedure. In the first sampling stage, the Basic Geo-Statistical Areas (BGSA) from the 2010 national census (INEGI 2010) was used as primary sampling units. 218 BGSA were selected for the CNCH group and 114 for de comparison group, using a probability proportional to size procedure using the number of children <5 y old as a size measure. In the second stage, 4 city blocks were randomly selected in each selected BGSA. Finally, 8 households were selected systematically form the inhabited households found in each selected city block.

Based on data from the evaluation of Food Aid Program (Programa de Ayuda Alimentaria- PAL; PAL 2005), the number of food groups found in households with children younger than five years was used to determine the sample size. Beneficiary households receiving food items and in those receiving monetary aid, an approximate standard deviation of 8.2 foods groups per household was estimated, and a minimum mean difference of 1.36 food groups was selected [13]. The confidence level was set to 95%, with 80% test power, and an approximate design effect of 3.0 was chosen a priori drives to a sample size of 2,300 children for each study period. The sample was divided into 1,500 children in the CNCH group and 800 children in the comparison group for each study period.

The number of children per household was used to estimate a contact rate and the required 6,976 households to visit for the CNCH group and 3,630 for the comparison group, in order to obtain the effective sample size. Lastly, data on 4,966 children younger than five years of age were collected for the whole study (Figure 2).

		Group	
		CNCH group	Comparison
Period	2014	Children <5 years from households in poverty and food insecurity with recent entry to the CNCH	Children <5 years from households in poverty and food insecurity without the programs of CNCH
	2015	Children <5 years from households in poverty and food insecurity with one year of entry to the CNCH	Children <5 years from households in poverty and food insecurity without the programs of CNCH

Figure 1: Characteristics of study groups.

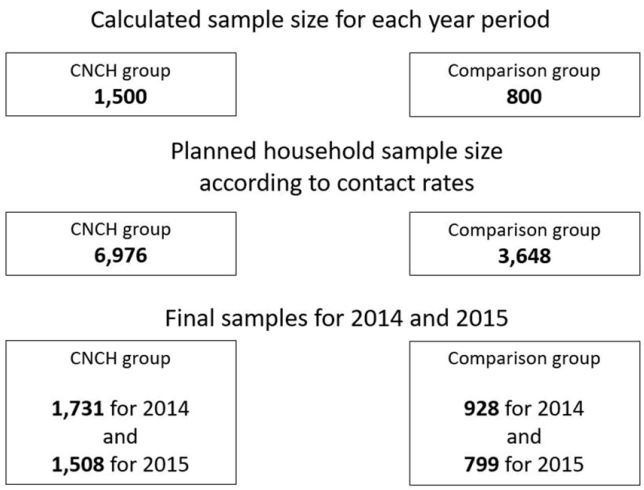

Figure 2: Calculated sample size for each year period.

Operationalization of the study variables

CNCH beneficiary: for research purposes, there was asked only about food assistance programs that are part of the CNCH, and which are related directly on food and nutrition.

The head of the household was asked whether any household member received aid from a supplemental nutrition assistance program within the National Crusade Against Hunger (Cruzada Nacional Contra el Hambre – CNCH). To create this variable, the following programs, which had achieved the greatest coverage in the population at the time of the study, were included: Prospera, which is a federal intervention focused on human development of those living in poverty, including assistance to access education, health, cash support and food supplement; the Milk Supply Welfare Program (Abasto Social de Leche Liconsa) and Food Aid Program (Programa de Ayuda Alimentaria-PAL); soup kitchens, hot and cold breakfasts by National System for Integral Family Development (Sistema Nacional para el Desarrollo Integral de la Familia-DIF) and food banks.

Household food insecurity (FI): The Latin American and Caribbean Food Security Scale (ELCSA in Spanish) to assess FI was used. This scale measures the experience and perception of individuals regarding their household food security in a reference period of three months prior to the determination of the scale. The questions address concerns about food shortage, decreases in food quality and quantity, suffering hunger or skipping meals or not eating for a whole day. The ELCSA includes 15 dichotomous questions ("yes" or "no") and classifies households into four categories, depending on the number of positive answers and whether or not they have children younger than 18 years. The households were classified into mild FI when they scored from 1 to 5 when the household included children younger than 18 years and from 1 to 3 contrarily; into moderate FI when they scored from 6 to 10 and from 4 to 6 oppositely; and into severe FI when they scored from 11 to 15 and from 7 to 8 otherwise. These data are presented at the household level. The ELCSA has been validated with Mexican populations [14].

Food group consumption: this measure was assessed using a seven-day food frequency questionnaire which was previously validated for the energy and nutriments consumption in Mexican population [15]. This questionnaire was applied to the mother or guardian, who were asked to recall all foods (and portions) consumed by the child during the seven days prior to the interview. Then they were asked to specify the number of days and the number of times per day the child consumed each food item during the last seven days, as well as the number of portions consumed on each occasion. For consumption estimations, the number of days was multiplied by the number of times per day that the food item was consumed in the last seven days. The questionnaire assessed food consumption using a list of approximately 100 foods [16].

Subsequently, each food was classified into a total of nine groups: 1) Cereals, 2) Legumes, 3) Dairy products, 4) Meat, 5) Fruits and vegetables, 6) Fats and oils and 7) Eggs. This classification was primarily based on the profiles of macronutrients, vitamins and minerals of each food. In addition, it was included the consumption of 8) Sugary drinks and 9) Candies and sugar due to their high energy content and their importance in the malnutrition problems in Mexican infant population [17].

Food group intake was considered when food from a particular group was consumed three or more days of the week to identify the food groups usually consumed.

Welfare condition index: a multivariate indicator was calculated using variables of the characteristics of the homes: type of floor, wall and ceiling materials; the ratio of number of rooms used for sleeping to number of persons residing in the household; basic service infrastructure including water source and water disposal; and possession of domestic appliances such as a refrigerator, washing machine, microwave oven, stove, boiler, radio, television, cable television signal, telephone and computer. Principal Component Analysis was used based on the polychoric correlation matrix. The first component to accumulate 50.5% of the total variability, with an eigenvalue (lambda) of 4.55, was selected as the index. Lastly, the index was classified into three and five ordered categories, using tertiles and quintiles as cut-off points, respectively.

Statistical analysis

A Multivariate analysis of variance (MANOVA) model was used to establish multivariate associations of several food group consumptions related to comparison groups (beneficiaries and no beneficiaries of CNCH), study periods (2014 and 2015), Household FI and welfare condition as adjustment factor to improve comparability among groups. Several factor interactions were tested. A canonical analysis was used to represent graphically significant associations on food consumption.

Lastly, a Classification and Regression Tree (CART) analysis was performed to identify the classification criteria that establish key differences in the levels of FI prevalence. The comparison groups, study periods, welfare condition quintiles and food group consumption were included as classification variables.

Statistical analysis was performed using the JMP statistical package version 10, copyright 2012, SAS Institute Inc. SAS Campus Drive, Building T Cary, NC 27513-2414, USA.

Ethic's approval

The commission for ethics, biosafety and research from the National Institute of Public Health (Instituto Nacional de Salud Pública – INSP) approved this study protocol, the number assigned to the

study was 1239 and the approval number was 1701. Accordingly, the interviewees (mothers of the children or caregivers) were asked to provide their informed consent for their participation in the study.

RESULTS

The socio-demographic characteristics of the preschools households included in the analysis were compared between both comparison groups (beneficiaries and no beneficiaries of CNCH) and study periods (2014 and 2015). In general, no significant differences were found between either groups or study periods, except for households without a bathroom inside the home, which had the lowest proportions for both groups (beneficiaries and no beneficiaries of CNCH) in 2014 compared with the respective proportions in 2015 (Table 1).

The results from the MANOVA model with a significant Wilks' lambda, ($p<0.001$) shows significant associations between the consumption of some food groups for all considered factors. For study groups (Wilks' lambda test, p=0. 023), where only CNCH group shows higher consumption of meat (p=0.001).

For study periods (Wilks' lambda test, $p<0.001$), 2015 period with higher proportion of children who consumed legumes (p=0.033), cereals, meat, eggs, sugary drinks, candies and sugar, fruits and vegetables (all with $p<0.001$), and less consumption of fat ($p<0.001$) with respect to the consumption observed for 2014 (Figure 3).

CNCH beneficiaries also showed differences in food groups consumption (Wilks' lambda test, $p<0.001$). Figure 4 shows higher proportions of children who consumed dairy products (p=0.06), sugary drinks (p=0.019), legumes, fruits and vegetables (these three with $p<0.001$).

Food insecurity (FI) levels showed strong association with food groups consumption (Wilks' lambda test, $p<0.001$). Figure 4 shows the canonical centroid biplot, highlighting a significant trend of higher proportions of children who lives with food security to consume cereals, meat, dairy products, fruits and vegetables (all with significant at $p<0.05$ with respect to children in severe FI). Conversely, the consumption of dairy products and the consumption of sugary drinks show closer relationships with mild food insecurity. Finally, children who live with severe food insecurity showed higher proportion of consumption of egg and legumes.

The CART analysis showed that differences in FI proportions is close related to the welfare condition quintiles, contributing with 65.1% to chi-squared test for the difference between FI levels.

Table 1: Socio-demographic and household characteristics by study periods (2014-2015) and comparison groups (intervention versus comparison).

Characteristics	2014						2015					
	CNCH_2014			Comparison_2014			CNCH_2015			Comparison_2015		
	n	%	CI 95%	n	%	CI 95%	n	%	CI 95%	n	%	CI 95%
Age group (mo)												
12-23	321	24.9	(22.3-27.7)	182	26.1	(22.6-29.9)	293	27.0	(24.2-29.9)	149	21.7	(18.1-25.8)
24-35	336	28.2	(25.3-31.2)	191	28.6	(24.9-32.5)	312	25.0	(22.3-28.0)	150	25.0	(21.3-29.2)
36-47	315	23.5	(21.2-25.9)	181	25.1	(22.0-28.5)	303	26.5	(23.8-29.5)	175	30.4	(26.0-35.2)
48-59	300	23.4	(20.8-26.4)	142	20.3	(17.0-24.0)	262	21.5	(18.8-24.5)	141	22.9	(19.5-26.6)
Housing conditions												
Soil floor	55	3.5	(2.3-5.4)	15	1.7	(0.8-3.6)	40	2.6	(1.8-4.3)	18	2.0	(1.1-3.8)
Predominant construction walls material	1,558	88.7	(85.2-91.4)	864	93.2	(89.5-95.7)	1,398	92.7	(89.9-94.8)	760	94.9	(92.0-96.8)
Predominant construction roof material	1,302	74.2	(69.3-78.6)	690	74.5	(68.5-79.7)	1,100	73.4	(68.9-77.5)	617	79.2	(74.1-83.5)
No toilet inside the house	153	7.9	(5.7-10.8)[γ]	118	13.6	(9.7-18.7)[α]	443	27.8	(23.7-32.4)	216	27.8	(22.5-33.8)
Pipe water inside the house	1,224	69.7	(64.8-74.2)	632	68.5	(62.8-73.7)	958	63.7	(59.1-68.0)	498	62.1	(55.8-68.1)
Car possession	275	16.1	(13.6-19.0)	150	16.7	(13.4-20.5)	239	17.1	(14.4-20.1)	131	18.1	(14.2-22.9)
Tertile of welfare conditions (WC)												
Tertil 1 (low)	562	32.3	(27.8-37.2)	326	34.3	(28.8-40.2)	509	32.3	(28.2-36.8)	260	32.4	(26.9-38.4)
Tertil 2 (mild)	549	32.3	(28.8-35.9)	336	36.0	(31.4-41.0)	483	33.2	(29.9-36.7)	290	36.6	(32.3-41.2)
Tertil 3 (high)	620	35.4	(30.9-40.2)	266	29.7	(24.4-35.6)	516	34.5	(30.5-38.8)	249	31.0	(25.7-36.8)
Household food security												
Security	294	17.3	(14.8-20.1)	147	15.9	(12.5-20.0)	273	17.8	(15.3-20.5)	144	17.4	(14.6-20.8)
Mild food insecurity (FI)	703	39.0	(35.6-42.5)	376	41.6	(37.4-45.9)	605	40.4	(37.2-43.6)	349	43.8	(39.3-48.4)
Moderate FI	392	22.0	(19.4-25.0)	241	25.9	(22.5-29.6)	362	26.0	(23.3-28.9)	182	22.9	(19.7-26.4)
Severe FI	320	21.6	(18.6-25.0)	149	16.7	(13.5-20.3)	260	15.9	(13.7-18.3)	119	15.9	(12.6-19.7)

n 2014: intervention 1,731 and comparison 928.
n 2015: intervention 1,508 and comparison 799.
γ Intervention group: Significative differences between 2014 and 2015.
α Comparison group: Significative differences between 2014 and 2015.

The following criteria of food group consumption contribute to differentiate: first, the consumption of fruits and vegetables, with a 15.5% contribution; followed by the consumption of dairy products, with 10%; and by the consumption of eggs, cereals and meat, with less than 5% (data not show in tables).

For quintiles 1, 2 and 3 of the welfare condition, the prevalence of moderate and severe food insecurity is 61.2% and is associated with not consuming fruits and vegetables, as outlined in Table 2. Egg consumption is an indicator of increased moderate and severe FI. Moderate and severe food insecurity peaks at 77.3%, when consuming eggs, fruits and vegetables but not dairy products or meat. The consumption of dairy products, fruits and vegetables was associated with moderate and severe FI levels only in quintile 1 (low), in 52.5% of households; quintiles 2 and 3 differ from quintile 1 when no cereals are consumed, with 58.5% food insecurity, which is higher than that observed in quintile 1. In contrast, when cereals are consumed, the prevalence of FI in quintiles 2 and 3 is 41.3%. These results are similar to those of quintile 4 where no dairy products are consumed, with a prevalence of moderate and severe FI of 41.6%, whereas the prevalence in this quintile is 35.4% when dairy products are consumed. Lastly, moderate and severe FI levels are observed in quintile 5, associated with no consumption of fruits and vegetables, with a prevalence of moderate and severe FI of 39.6%; however, when fruits and vegetables are consumed, the prevalence associated with moderate and severe FI is 25.3%, which is the lowest in the sample (Table 2).

DISCUSSION

Important changes in food groups' intake were reported by the earlier social inclusion and welfare strategy (CNCH) beneficiaries.

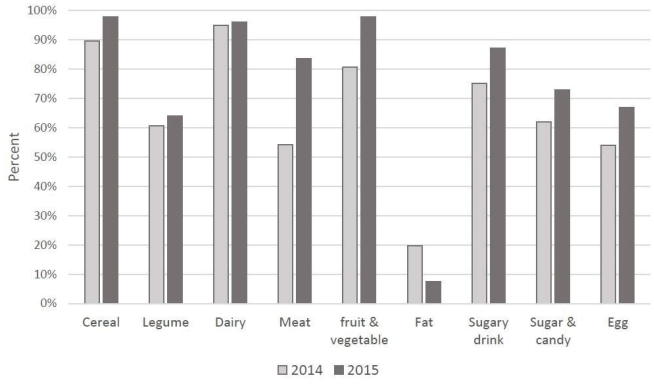

Figure 3: Food groups consumption by year of study.

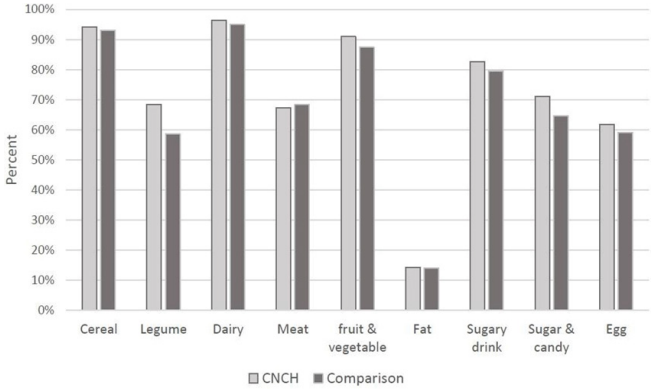

Figure 4: Food groups consumption by study group.

Similar results were reported by previous studies conducted in Mexico to evaluate the impact of the Progresa program (further known as Oportunidades and later as Prospera) where the conditional cash transfers to the beneficiary families incremented the consumption of meat, fruits and vegetables due to the increase in family income [18,19]. Also in an evaluation of the Bolsa Família Programme in Brazil was observed an increased availability of food items such as meat, roots, tubers and vegetables [5].

Though, with the increase of healthy food groups intake, there also was a mayor consume of sugar (soft drinks, candies and sugar) among children younger than five years, consistent findings have been reported by other authors, where conditioned cash transfers programs beneficiaries consume more fats, sweets, soft drinks and energy-dense foods [5,20]. In this regard, although the food assistance programs actually contribute to increasing the consumption of foods of high nutritional value, such as meats, fruits and vegetables, they also tends to increase the people's range of food choices with the increase in income, it is noteworthy that choosing foods not only based on health or financial determinants, but also involve a number of other conditions such as taste, convenience of preparation, time spent processing, the symbolic, cultural and psychosocial aspects of food consumption [20-25].

Furthermore, the present study showed that the most serious levels of household food insecurity and low welfare conditions affect negatively the consumption of dairy products, meat, fruits and vegetables among children younger than five years.

Currently, it is known that the higher the proportion of the family income spent on food purchasing, a common case among poor families, the greater the negative implications of the increase in food prices on the consumption and nutritional status of the family members will be [26,27]. Therefore, energy cost has been identified as a major constraint in decisions regarding food, especially in the lower-income population, because industrialized energy-dense foods are cheaper than fresh foods [22], that is why one of the most common strategies used by poor families is to reduce the purchase of meat, fish, milk, fruits and vegetables (which are not only the most expensive but also the most nutrient-rich foods) [28] and to increase the purchase of low-cost protein sources, such as eggs and legumes, in addition to prioritizing the purchase of basic foods that ensure the supply of energy, such as low-cost cereals, sugar and oil (which are of lower nutritional quality and are low in micronutrients) [29-31], with important consequences to the population health.

The main limitation of our work is that the CNCH strategy integrates several programs of food assistance, so each household could receive one or more of these programs with different times of antiquity; consequently hiding the existence of possible intervention effects. On the other hand, the definition of the comparison groups according to the stages of the program coverage, and the inclusion of new members in the late intervention group made difficult the establishment of a valid comparative design for addressing impact evaluation.

In spite of the importance of these study results' about the state of food security and diet, it is very important to mention that nevertheless the supplemental nutrition assistance programs from de CNCH strategy the prevalence of moderate and severe

Table 2: Food insecurity levels associated to welfare condition quintiles and the food groups consumed.

Welfare condition§	Percent of household in food insecurity			Food groups consumed				
	Secure %	Low %	Moderate+ Severe %	Fruit and vegetables	Dairy products	Egg	Cereals	Meat
Q1, Q2 y Q3	7.3	31.6	61.2	no	-	-	-	-
Q1, Q2 y Q3	7.5	15.2	77.3	yes	no	yes	-	no
Q1, Q2 y Q3	10.5	34.6	54.9	yes	no	yes	-	yes
Q1, Q2 y Q3	15.8	35.2	49.0	yes	no	no	-	-
Q1	10.3	37.2	52.5	yes	yes	-	-	-
Q2 y Q3	7.3	34.2	58.5	yes	yes	-	no	-
Q2 y Q3	14.3	44.4	41.3	yes	yes	-	yes	-
Q4	16.7	41.7	41.6	-	no	-	-	-
Q4	20.7	43.9	35.4	-	yes	-	-	-
Q5	22.9	37.6	39.6	no	-	-	-	-
Q5	31.1	43.6	25.3	yes	-	-	-	-

§Welfare condition is presented in Quintiles of de index ordered from Q1 (lower) to Q5 (higher).

food insecurity among beneficiaries is alarming. According to the United Nations Development Programme (UNDP), in Mexico during 2014, 28 million people lived in food poverty and from August of 2015 there were 6.5 million people in extreme poverty with lack of food access [32].

This is a call of attention to the authorities for creating and reinforcing public policies that include actions that encourage and guarantee the adequate production of healthy food, considering factors that determine it like climate change, which has modified the farming systems due to the nutrient content of soil, water, livestock production systems, among other factors [33]; and the use and regulation of pesticides to effectively control risks to human health and contribute to the safe food access [34,35]. Therefore, a healthy and sustainable diet has been proposed in view of the growth of the world population, to counteract the real threat to the climatic stability of the planet in the face of the threat posed by the current production of food [36]. In addition, actions that advocate and warrant the consumption of healthy foods since the income increase is no warrant of the efficient use of the benefit received in the family's diet, and to evaluate the nutritional contributions of the foods provided by food distribution programs like food banks, breakfasts or meals distributed to ensuring a proper and healthy diet, which may help to reduce nutritional deficiencies among the population while carefully avoiding the excessive contribution of foods high in energy but poor in nutrients.

CONCLUSIONS

The social inclusion and welfare strategy had a significant positive effect on the diet of the beneficiary population. Nevertheless, it is necessary to encourage efficient public policies that guarantee food and nutrition security in Mexico, especially in children under 5 years old because of their biological vulnerability and emphasize the availability of healthy foods to promote healthy eating habits. All the above, to reinforce the commitment to achieve the Number 2 Sustainable Development Goal and put an end to hunger and achieve all people a healthy and nutritional food security.

Finally, it is important to carry out integral strategies that contribute to improve and maintain suitable nutrition in children as an important public health issue in countries where people live in poverty, in addition to the double burden of malnutrition.

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CONFLICTS OF INTEREST

The authors declare no competing interests.

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