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Original Research Article

Educational intervention instrument for self-care in nutritional health: evaluation in Mayan Mexican communities

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ABSTRACT

Background: In rural communities, foodborne illnesses pose a significant public health challenge due to limited access to education and health resources, which increases the risk of improper food practices. It is crucial to develop and implement targeted educational interventions tailored to the specific needs and characteristics of these areas to effectively prevent these health issues. This study aimed to design and validate an educational intervention instrument adapted to rural communities based on five essential keys to prevent foodborne diseases.
Methods: The study population (n=90) comprised adult from the Mayan communities of Mexico. Participants were stratified into three groups according to their level of academic education: primary (GES), secondary (GHS), and mixed (GM). A pre-and posttest was designed to incorporate 36 variables: knowledge, 25 attitudes, and 26 habits. An inferential X_2 analysis was performed to reveal the differences between the pretest and posttest.
Results: The intervention registered an advance in knowledge of 13% of the GM, 40% of the GES, and 7% of GHS. Progress was made in attitudes by 79% of GM, 59% of GES, and 80% of GHS. Regarding habits, the association of the term health with behavior was demonstrated, and this was achieved by 82% GM, 66% GES, and 67% GHS.
Conclusions: Participants improved their understanding of the personal and psychological factors related to their lifestyle. However, the instrument should be further adapted for groups with varying levels of initial knowledge. New items should be designed and added to emphasize the importance of adopting healthy attitudes and habits.

Keywords: Educational intervention, Five essential keys for preventing foodborne diseases, Health education, Rural communities

INTRODUCTION

Food education involves designing and implementing educational strategies and learning activities that, when supplemented with a healthy food environment, would assist people and their communities in improving their diets and food choices, developing their capacity to adapt to changes, and acting as agents of change. In Latin America, rural communities experience foodborne diseases (FBDs) as major health concerns. FBDs occur for various reasons, such as lack of access to adequate health services, poor hygiene in living conditions, limited access to drinking water, and the use of traditional agricultural practices.[1]

Most of these FBDs are attributable to poor food handling due to the poor hygiene habits of the people handling the food, contamination of cooked foods with raw foods or contaminated surfaces, poor cooking practices, or poor storage of food items. The lack of adequate infrastructure, hygiene education, and limited access to healthcare contribute significantly to the prevalence of FBDs.

In Mexico, one of the most common causes of FBDs includes contamination of food with bacteria such as

Salmonella, *Escherichia coli*, and *Campylobacter* present in raw or undercooked foods, particularly foods of animal origin, or viruses such as Norovirus and Rotavirus that spread due to poor hygiene during food handling, protozoa such as *Giardia* and *Cryptosporidium* present in contaminated water, and poorly washed or poorly cooked foods. Another common cause of FBDs is parasitosis, such as cysticercoses caused by the ingestion of food contaminated with *Taenia solium* eggs, which occurs mainly because of a lack of sanitation and inappropriate agricultural practices. In Mayan communities, diarrhea is the primary cause of the demand for care for individuals who request the services of traditional community therapists.[2] Diarrhea is also one of the leading causes of death in populations of all ages, particularly in children under five years of age.[3]

Improvements in food security, promotion of hygiene practices, and provision of health education are crucial for addressing the above issues in rural communities. Therefore, considering the requirement for suitable tools to promote healthy lifestyles, the World Health Organization (WHO) published a paper titled "The five basic keys to prevent food contamination," to support the educational community (teachers, and professors) with tools or guides providing five basic rules for safe food maintenance and consumption.[4]

Behaviors that allow individuals to take charge of the care and protection of their diet form an important component of health education. The education process begins with transmitting knowledge, followed by adapting to individual reality, and finally appropriation and concluding in a habit.[5] The appropriation of knowledge directly affects an individual's lifestyle activities, which collectively represent a series of attitudes that reflect the values and express the behavior of the individual regarding their care.[6] This process involves a change in attitude, which is, at the basic level, a value judgment that directs personal intentions and influences the behavior of the individual in a particular situation.[7]

Understanding personal, cognitive, social, and affective skills is essential to foster motivation and self-esteem. The level of education influences the habits of individuals, as observed in numerous cases, although few statistics precisely demonstrate how knowledge influences human behavior.[8] Studies have also demonstrated that individuals in socioeconomic positions with higher incomes differ from those with lower incomes in their eating habits. Individuals in lower positions and economically disadvantaged conditions are less likely to adopt healthy eating habits. In terms of food selection, education level is particularly associated with dietary indicators of health.[9] However, in rural communities, food health training must be implemented using a holistic approach that links food selection to environmental conditions appropriate for the maintenance of health.[10]

This study focuses on the hypothesis that knowledge must be contextualized within the cultural bases of individuals to be internalized and achieve its objective. Furthermore, changes in attitudes and habits linked to behavior are associated with a greater or lesser ability to understand reality. This challenges us to ask ourselves how to design an instrument that manages to awaken people's critical thinking depending on their background. In this context, the present study adopted the principles of the five essential keys to prevent foodborne diseases dictated by the WHO to design and validate an educational intervention instrument adapted for Mayan-speaking communities. We designed a pre/post-test that included 36 knowledge variables, 25 attitudes, and 26 habits, all focused on identifying the knowledge, attitudes, and habits necessary for effective incorporation. The instrument was validated in a field test, and participants were stratified according to their highest academic level. This study aims to disseminate the methodology of adaptation of the "five keys to food security" as an intervention model for social groups with vulnerable economic contexts.

METHODS

Study population and sociocultural context

The study subjects were heads of families from different communities in the Cuxtal Ecological Reserve (20°47' and 20°55' N and 89°33' and 89°40' W), which is in the state of Yucatán, Mexico. The Cuxtal Ecological Reserve provides numerous pieces of evidence of the existence of human occupation of pre-Hispanic origin (late pre-classic period from 300 BC to 300 AD), which is linked to the Mayan history of the region. The territory has witnessed multiple environmental and social transitions throughout its history, one of which is the Mayan settlement in the late period of civilization. Another transition is represented by the period of landowners and the intensive production of Henequen. The end of this henequen production period was another transition that led to a period of recovery until the declaration of this region as a municipal-protected natural area.[11] Currently, the population of this region is distributed across nine regions under their respective police stations, and each region is characterized by its unique knowledge, practices, and customs, with 36% of the population speaking Mayan.[12]

This study was conducted between June 2022 and August 2024 using non-probability convenience sampling. Participants from three communities within the Cuxtal Ecological Reserve were selected based on their availability, accessibility, and willingness to participate in the research. Inclusion criteria required individuals to be over 18 years of age, have completed at least primary education, demonstrate willingness to participate, be available for scheduled sessions, and possess proficiency in either Spanish or Mayan, with translation services provided for the latter to ensure accessibility. Conversely, individuals were excluded if they did not meet the educational requirements, had severe cognitive

impairments that hindered comprehension of the topics, lacked proficiency in both Spanish and Mayan, experienced serious health conditions that limited their involvement, or were unable to commit to regular attendance in the program. The study population was divided into three non-overlapping strata based on the academic education of the participants. The variables of the intervention model were designed to be applied to three strata: participants with complete primary education (GES), participants with complete secondary education (GHS), and a mixed education group (GM). The final sample was randomly selected from each stratum, with 30 participants per stratum (n=30) to conduct the research. Ethical approval for this educational intervention study was granted by the Ethics Committee of University Marist of Mérida. All participants provided informed consent prior to their inclusion in the study. Participation was voluntary, and individuals were free to withdraw at any time without any repercussions.

The instrument

The pre-/post-test was designed with 36 variables on knowledge, 25 variables on attitudes, and 26 variables on personal habits. The WHO's methodology of "The 5 keys to maintaining food safe" was adopted with a few modifications. The keys were defined as follows: key 1 (K1): "production of safe food"; key 2 (K2): "practice cleaning"; key 3 (K3): "appropriate separation of foods"; key 4 (K4): "selection of foods correctly"; and key 5 (K5): "safe handling of foods". The developed instrument was then applied to all participants to evaluate their knowledge levels, attitudes, and habits related to food safety practices. The details of the assessment instrument are outlined below, presenting each key variable along with its respective components, categorized by the evaluation criteria: level of knowledge, attitudes, and habits. The complete variables by key used to evaluate knowledge, attitudes, and habits are available at doi.org/10.5281/zenodo.14536845.

Procedure

The fieldwork comprised six consecutive sessions with a total duration of 15 hours. The activities conducted in each session were designed, organized, and recorded in descriptive letters. Each activity comprised five moments of remembering previous knowledge, and new knowledge was presented theoretically and practically. Participants with deficiencies in understanding and reading Spanish were provided support for the translation of all deliverables into the Mayan language.

In the first session, participants were taught how to respond to the questions. The dichotomous "true/false" response methodology was adopted for the knowledge questions, and participants were asked to select a single answer between two distinctly opposite options in terms of knowledge. Multiple choice responses were adopted for attitudes, such as "I agree/I don't know/I do not agree". The objective was to collect information to assist in undertaking decisions and identifying areas for improvement while transmitting knowledge. Responses were obtained using an assessment scale to quantify general feelings of conformity. The items on the scale were rated as "always/almost always/sometimes/rarely/never".

The main objective of K1 was to present management measures in the field of food production, using safety measures, ecological pest control, and organic fertilization. K2 aimed to convey the concept of cross-contamination, its associated risks, and prevention strategies. K3 communicated regarding safe cooking temperatures and the dangers of microorganism proliferation according to the temperature fluctuations. K4 aimed to train participants to inculcate in them the ability to select and consume foods using information on the current front labeling. In Mexico, official food regulations, mainly comprise octagon markings placed on the packaging of industrialized foods for consumers to make better purchasing decisions according to their nutritional criteria.[13] Finally, K5 aimed to teach different forms of food preservation, particularly regarding the preparation of preserved vegetables, thereby reducing food waste produced in the field. At the beginning of each session, participants' doubts regarding the meaning of terminology were removed. Later, knowledge was transmitted via images and examples, followed by a practical activity conducted in subgroups to consolidate learning. Each session was concluded with questions to stimulate group discussion. Finally, the conclusions of the module were established.

Data analysis

Participants' responses to all items were recorded using an Excel sheet. Descriptive statistics were used to calculate the frequencies and percentages of each variable and the response options. An inferential analysis was then conducted using the X^2 test for proportions with a significance value of 5% to reveal the differences between the pre-test and post-test results for each key.

RESULTS

Effect of intervention on the community

Table 1 presents the percentage of learning of the corresponding "knowledge" and "attitude" variables for the three groups of subjects. GM increased knowledge by 13%, from 59% in the pre-test to 72% in the post-test. No significant differences were noted between the initial knowledge and post-test knowledge, as the initial knowledge level exceeded 50% of the correct answers (Table 2). About the "attitudes" variable, an increase of 25% was achieved in the results obtained after the post-test, from the initial percentage of 54% to 79% reached in the post-test (Table 1). Significant differences ($p<0.01$) were noted in both K1 and K4, with a change of 35% in the participants' attitude regarding "safe food production" (K1) and 46% in the participants' attitude regarding the "correct choice of food" (K4).

Table 1: Effect of the educational intervention on dietary health in adult participants from Mayan communities and stratified according to their academic educational level.

Participants and variables	Successes (%)		Learning (%)
	Pre-test	Post-test	
GM			
Knowledge	59	72	13
Attitudes	54	79	25
Habits	48	82	34
GES			
Knowledge	25	65	40
Attitudes	48	59	11
Habits	38	66	28
GHS			
Knowledge	73	80	7
Attitudes	72	80	8
Habits	62	67	5

GM=Mixed group; GES=primary school; GHS=high school

In regard to the "habits" variable, an increase of 34% was noted in the post-test results, with significant differences ($p<0.01$) noted in keys 1, 2, 3, and 4 (Table 3). The habit of acting "always" increased by 41% for K1, 33% for K2, 27% for K3, and 44% for K4. However, no significant differences were noted in the habits of the K5. This was probably because, in the pre-test, the habit of keeping food safe (K5) exceeded 50%, whereas in the post-test, this habit increased to 79%. The percentage of no habit ("never") decreased in the post-test, reaching 0% from the initial 23%, with "always" and "almost always" accounting for a large portion of responses, reflecting the effect of knowledge on the change of habits.

The GES participants exhibited an increase of 40% in the "knowledge" and 11% in the "attitudes" attitude variables (Table 1). This group began with a low level of knowledge (25%), which was surpassed by a 40% knowledge level in the post-test, with significant differences noted in K1, K2, K3, and K5 (Table 2).

The variables corresponding to habits increased by 28% in the post-test (Table 1). Significant differences were noted in K1, with the percentage of "sometimes decreasing to the level of "always". A similar trend was observed in K4, which exhibited an increase of 44% in the "always" responses.

In K2 and K5, the percentages of "almost always" were high in the pretest and then decreased in the post-test, which could have contributed to the increase in the "always" responses (Table 3). K3 demonstrated a different trend, with the percentages of "almost always" and "never" being maintained, while the "rarely" responses transitioned to "always" (Table 3). The "never" habit was reduced in almost all keys, except K3.

The GHS participants increased their knowledge by 7%, with 73% and 80% correct results obtained in the pre-test and post-test, respectively. The community demonstrated clear concepts for most of the items in the knowledge module (Table 1). Significant differences were noted in K4, with a 24% increase in the correct answers in the post-test (Table 2). About the "attitudes," the increase was 8%, from the initial 72% certainty, which reached 80% after the intervention (Table 1). In "attitudes," significant differences ($p<0.01$) were noted in K2, and the intervention managed to increase the percentage of correct answers by 12%.

The habits increased by 5% in the post-test (Table 1). The habit of acting "always" increased by 18% in K1, which was probably due to a significant transition ($p<0.05$) of responses from "almost always" to "always" in the post-test. Interestingly, the "never" responses decreased significantly in the post-test, a percentage that also contributed to the increase in good habits. No significant differences were noted in K2, even though the percentage of "almost always" responses decreased by 2%, which should have been in favor of "always" responses (Table 3).

K3 demonstrated the opposite trend, with 2% of the habits marked as "always" in the pretest transitioning to "almost always" in the post-test; that is, the percentage increased from 18% to 22%. The most significant effect was noted in K4, with the habit of selecting foods correctly decreasing by 20% from "sometimes," which was in favor of 7% of the "always" responses and 7% of the "almost always" responses in the post-test.

Another noteworthy result is that the percentage of "never" responses increased by 3%. This value indicates that a few people who believed that they had selected their foods correctly in the pre-test realized that their selection criteria were incorrect after the intervention. A similar trend was observed in K5, in which the percentage of "almost always" responses in the pre-test decreased significantly in favor of "always" and "almost always" responses. The percentage of "never" responses increased by 2%, indicating that certain participants noticed that they were not keeping their food safe, and this is the first step toward taking charge of their food consumption.

Evaluation of the effect of the developed intervention based on the keys

The information provided to the participants in K1, and K2 increased their expected knowledge by 18.3% (Table 4), and 59.0% of the participants clearly understood the K1 and K2 keys. After the intervention, this percentage increased further by 18.3%. In the development process of both keys, participants learned the importance of working with the land correctly, using pesticides, and managing manure for safe food production. At K2, the participants conceptualized the value of hygiene and its relevance as a primary prevention tool in the transmission of diseases.

Table 2: Effect of the intervention on knowledge and attitudes in adult participants from Mayan communities and stratified according to their academic educational level.

GM group					GES group					GHS group				
Key	Successes (%)					Successes (%)					Successes (%)			
	Pre-test	Post-test	X^2	P value	Key	Pre-test	Post-test	X^2	P value	Key	Pre-test	Post-test	X^2	P value
Knowledge														
K1	64	74	0.281	0.596	K1	22	75	4.374	0.045	K1	69	83	0.537	0.464
K2	56	75	0.959	0.328	K2	17	56	3.969	0.047	K2	80	74	0.102	0.750
K3	67	81	0.611	0.434	K3	8	71	4.983	0.026	K3	82	90	0.266	0.606
K4	58	70	0.375	0.540	K4	30	40	3.841	0.704	K4	74	98	4.392	0.041
K5	51	63	0.353	0.553	K5	13	75	4.680	0.031	K5	64	65	0.002	0.963
Attitudes														
K1	50	85	3.351	0.041	K1	50	68	0.402	0.526	K1	61	69	0.141	0.708
K2	50	71	1.107	0.293	K2	38	44	0.045	0.833	K2	78	90	0.536	0.049
K3	83	81	0.016	0.899	K3	50	67	0.357	0.550	K3	63	67	0.035	0.851
K4	35	81	5.212	0.022	K4	33	50	0.357	0.550	K4	85	88	0.039	0.844
K5	70	77	0.151	0.642	K5	70	65	0.034	0.853	K5	74	87	0.538	0.463

GM=Mixed group; GES=primary school group; GHS=high school group; K1: production of safe food; K2: practice cleaning; K3: appropriate separation of foods; K4: selection of foods correctly; and K5: safe handling of foods

Table 3: Effect of the intervention on habits in adult participants from Mayan communities and stratified according to their academic educational level.

Groups	Pre	Post	X^2	P value	Pre	Post	X^2	P value	Pre	Post	X^2	P value	Pre	Post	X^2	P-value	Pre	Post	X^2	P value
	Key 1				Key 2				Key 3				Key 4				Key 5			
GM group																				
Always	22	63	4.26	0.04	63	96	4.04	0.04	70	97	3.07	0.05	29	73	4.60	0.03	64	67	1.69	0.19
Almost always	23	17	0.17	0.68	14	3	0.97	0.33	17	0	2.18	0.14	38	21	0.81	0.37	15	9	0.04	0.84
Sometimes	32	17	0.74	0.39	17	1	1.71	0.19	10	3	0.43	0.51	19	4	1.26	0.26	2	4	0.89	0.34
Rarely	23	3	0.78	0.38	4	0	0.51	0.48	2	0	0.25	0.65	10	2	0.71	0.40	0	5	0.31	0.58
Never	20	0	1.26	0.26	3	0	0.34	0.56	2	0	0.20	0.65	4	0	0.51	0.48	20	15	0.51	0.48
GES group																				
Always	40	60	0.04	0.84	54	79	0.05	0.82	55	60	0.00	0.96	29	73	0.05	0.82	64	67	0.05	0.83
Almost always	20	35	0.04	0.84	21	17	0.01	0.95	10	10	0.00	1.00	38	21	0.08	0.78	15	9	0.01	0.91
Sometimes	20	5	0.76	0.05	17	4	0.08	0.78	10	10	0.00	1.00	19	4	0.79	0.05	2	4	0.01	0.94
Rarely	15	0	0.70	0.15	8	0	0.08	0.77	15	10	0.01	0.92	10	2	0.02	0.89	0	5	0.01	0.91
Never	5	0	0.05	0.82	0	0			10	10	0.00	1.00	4	0			20	15	0.01	0.91

Continued.

Groups	Pre	Post	X^2	P value	Pre	Post	X^2	P value	Pre	Post	X^2	P value	Pre	Post	X^2	P-value	Pre	Post	X^2	P value
	Key 1				**Key 2**				**Key 3**				**Key 4**				**Key 5**			
GHS group																				
Always	54	72	0.03	0.87	75	77	0.00	0.98	80	78	0.00	0.98	38	45	0.00	0.93	63	67	0.00	0.97
Almost always	12	6	0.86	0.05	22	18	0.00	0.96	18	22	0.00	0.95	28	35	0.00	0.92	24	26	0.00	0.98
Sometimes	14	10	0.00	0.93	2	2	0.00	1.00	2	0	0.02	0.88	25	5	0.71	0.05	11	4	0.85	0.05
Rarely	2	2	0.00	1.00	0	0	0.00	1.00	0	0	0.00	1.00	10	13	0.00	0.96	2	2	0.00	1.00
Never	18	10	0.62	0.05	2	3	0.00	0.94	0	0	0.00	1.00	0	3	0.03	0.87	0	2	0.02	0.89

GM=Mixed group; GES=primary school group; GHS=high school group; K1: production of safe food; K2: practice cleaning; K3: appropriate separation of foods; K4: selection of foods correctly; and K5: safe handling of foods

Table 4: Results of the educational intervention dietary health in adult participants from Mayan communities according to knowledge, attitudes, and habits.

Key	Nº expected successes	Pre-test successes (%)	Post-test successes (%)	Increase in successes (%)
Knowledge				
K1	208	59.1	77.4	18.3
K2	234	59.0	71.8	12.8
K3	156	63.5	82.7	19.2
K4	130	60.0	76.2	16.2
K5	208	50.0	65.4	15.4
Attitudes				
K1	182	54.4	75.8	21.4
K2	104	63.5	69.2	5.8
K3	78	70.5	73.1	2.6
K4	156	53.8	78.8	25.0
K5	130	77.7	85.4	7.7
Habits				
K1	130	36.9	66.2	29.2
K2	156	66.0	85.9	19.9
K3	130	71.5	83.8	12.3
K4	104	35.6	62.5	26.9
K5	156	32.7	67.3	34.6

K1: production of safe food; K2: practice cleaning; K3: appropriate separation of foods; K4: selection of foods correctly; and K5: safe handling of foods

In K3, 63% of the participants had previous knowledge, and the intervention increased this percentage by 19.2%. The participants understood the importance of separating cooked and raw foods and the fundamental concept of cross-contamination in food safety. K4 involved identifying and reading the octagons on the labels of processed foods and related criteria to ensure better decisions at the time of purchase, particularly regarding children's products. Notably, 60% of participants were aware of the existence of labeling. At the end of the intervention, 76.2% of participants conceptualized the importance of correctly selecting foods based on labeling. Finally, in K5, the participants began with a previous knowledge percentage of 50%. After learning the different technologies for preserving vegetables, 65.4% expected knowledge level was reached at the end of the intervention.

The "attitudes" variables focused on the acceptance or non-acceptance of practices that determine safety in production, preparation, selection, and preservation of food as a basis for disease prevention. The attitudes related to K1 and K4 achieved the highest percentage of desired success (75.8% and 78.8%, respectively), which suggests awareness of the importance of good practices in food production and the significance of the correct selection of foods based on labeling (K4). This (K4) is the key in which 25% of the expected responses were reached (Table 1). At K2, the expected responses increased by 5.8% in the post-test, suggesting discrepancies regarding whether cleaning and hygiene measures could prevent foodborne infections. Finally, in K5 and K3, increases of only 2.6% and 7.7%, respectively, were noted in the expected correct answers. However, it should be noted that K5 and K3 began with a high percentage in the pre-test (>70%), which indicates that most participants were already undertaking measures for food separation and preservation (Table 3). The post-test results indicated that most participants strengthened and increased their perception of the importance of a proactive attitude toward correct food separation and preservation measures in favor of food safety.

The habits at the end of the intervention exceeded 60% of the expected success in all keys, which represents a satisfactory level of impact of the intervention (Table 1), at least in terms of increased awareness of the behavioral patterns aimed at self-care in terms of dietary health. K1, K4, and K5, which began with levels of 36.9%, 35.6%, and 32.7% in the pre-test, reached levels of 29.2%, 26.9%, and 34.6% in the post-test, respectively, demonstrating increased awareness regarding the impact of changes in daily life habits.

DISCUSSION

The intervention resulted in a 60% progress in knowledge (13% in GM, 40% in GES, and 7% in GHS), which represents a significant improvement relative to the baseline behavioral aspects for preventing foodborne illnesses. The differences between the groups were primarily attributed to contextual differences. Most GES participants were homemakers with primary schooling, a social environment that was limited to the community, and limited access to information. Therefore, the intervention instrument had a positive impact of 40% on these subjects. Future interventions must use simplified terminology, which would facilitate greater cultural understanding of the instrument, thereby leading to a better flow of communication in transmitting knowledge. In the GHS and GM groups, most participants worked for hours outside the community and had received high school and technical education, which was reflected in the pre-test by a significantly greater number of correct answers. The GHS and GM groups were prepared to deepen their knowledge. In short, certain key components of the instrument must be replaced with an assessment that involves further critical thinking to reach deeper fields of experience. The value of information and its correct interpretation are the solid foundations on which changes can be built. When individuals integrate knowledge with personal or psychological factors, lifestyle influences become possible, and lifestyle has been reported to be the most influential social factor for health.[6] In this context, it is important to state that in the GES community, knowledge transmission requires a more personal and practical explanation, using slower and more emotional tools to achieve knowledge mastery. The GHS community, on the other hand, has to be dealt with cognitive tools related to understanding and problem-solving. The GM community must be divided into subgroups for knowledge transmission using cognitive and affective techniques, as the population diversity in terms of schooling differs from the other two communities.

Regarding "attitudes," specific authors have pointed out knowledge as a fundamental component of attitudes.[14] In the case of attitude toward an object or fact, it is necessary to have a specific cognitive representation of the object in question.[15] When this cognitive representation of attitudes is vague or erroneous, a person's affect toward the object tends to be superficial. Therefore, based on the participants' achievement in the knowledge variable, the conscious behaviors that lead to health, which are referred to as health-protective factors, as well as the element's precision and integrity, are influenced.[6] The cognitive aspect of attitudes is consistent with the acquired knowledge. Considering these terms, the result obtained for the "attitudes" variable, particularly in the GES community, for which the posttest increased the variable by just 11%, indicates that it is an element that should be emphasized (Table 1).

The results were different for GHS and GM. GHS began with a community that had a solid cognitive representation of knowledge, which was reflected in the results obtained for the "attitudes" variable. The change in attitudes implies an understanding and self-appropriation of a fact or situation and a hypothetical projection of its benefits. The developed educational intervention was, for most participants in the GES community, the first access to new knowledge regarding food safety, which limited these

subjects from analyzing the situation with greater objectivity. GM, which is a community defined by cognitive diversity, presented a significant change in the "attitudes" variable, exhibiting an increase of 25% in the post-test result. The intervention allowed participants to hypothetically visualize the benefits of a change in attitudes and understand the situation beyond what is happening in their immediate social circle. It was evident that one must insist even further on reinforcing the "attitudes" component of the developed educational intervention to achieve health benefits for the entire community. The responses obtained regarding habits were quite encouraging, demonstrating the acceptance and connection of the term health with behavior in a certain way. "Health is either behavioral health or nothing".[16] Lifestyles are social factors that are modifiable through adequate promotion or primary prevention activities.[17] The GM community responded better to changing habits compared to the GES community, demonstrating that the formers were in better condition to take charge of the care and protection of their health. Nonetheless, the GES community recorded a 28% increase in positive responses in the post-test, implying that these participants understood the importance of developing and maintaining healthy habits to improve their quality of life. Regarding GHS, much work has to be done as the results were dichotomous in the sense that while the population demonstrated knowledge and self-care attitude (post-test 80%), it was not reflected well in the establishment of habits (post-test 67%). The causes underlying this phenomenon must be identified first, and the barriers that prevent people from adopting a habit even when they understand its benefits must be addressed. It is a matter of concern that raising people's education level and awareness is not considered a component of preventive medicine. Some authors have pointed out that habits are deeply rooted in emotional factors and influence the social environment.[18,19] The obstacles preventing this group from adopting healthy habits must be identified, worked upon, and eliminated to increase the probability of success in preventing foodborne diseases.

CONCLUSION

The educational intervention resulted in a 60% improvement in knowledge, a 44% enhancement in attitudes, and a 67% increase in positive personal habits. Participants demonstrated improved personal and psychological factors related to their lifestyle, placing them in a better position to take responsibility for their health and well-being. However, the instrument developed for this intervention should be refined to accommodate groups with higher baseline knowledge and include new components to emphasize the importance of adopting healthy habits. While the research design was suitable for exploring the objectives within a specific context, its applicability to broader populations may be limited. Despite this, the study provided valuable insights into preliminary patterns and trends within the target population, offering a foundation for future research employing more representative designs. Continuing educational initiatives focused on food hygiene is crucial, particularly in communities with limited access to information. These efforts are essential to equip residents with the necessary "knowledge," "attitudes," and "personal habits" to take control of their health, exercise their human rights, and address fundamental needs.

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