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Risk perception of Ciguatera in the fishing village of Cojímar, Havana, Cuba

Abstract

This study aims to assess the risk perception associated with Ciguatera and the level ofimpact of this food poisoning in the town of Cojímar, located in the municipality of Habana del Este, Havana province, Cuba, during the second quarter of 2024. Cojímar is characterized as a fishing village, situated at coordinates 23º09'47" N and 82º17'38" W. It has a population of 20,390 inhabitants and covers an area of 4.2 km². The study reveals that 89% of respondents are aware of the basic aspects of the poisoning, including its symptoms, treatment, and diagnostic methods. The most frequently mentioned symptoms were gastrointestinal (emesis and liquid stools) and muscle pain. Most subjects were unaware of which fish species caused their Ciguatera episode or the case described during the survey, and only 34% were diagnosed by authorized medical personnel. Among the species with the highest incidence, the Barracuda (Sphyraena barracuda), the Horse-eye Jack (Caranx latus), and the Yellow Jack (Caranx bartholomaei) were reported, mostly caught locally by fishermen and consumed despite awareness of the risk of Ciguatera. Statistical analysis shows that men are more likely to experience paresthesia during the illness.

Keywords: Ciguatera, polls, intoxication, epidemiology, recreational fishing.

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Introduction

Ciguatera is a foodborne illness (FBI) known since ancient times of Spanish colonization. It has been recorded in different regions of the world, reaching in Europe countries such as Germany, where cases have been reported from the consumption of snapper imported from the tropics,[1] and the Canary Islands, Spain, where the presence of toxins associated with Ciguatera was reported in groupers and moray eels.[2] This disease is not transmitted from person to person and is only contracted by consuming food containing ciguatoxins (CTXs). Its highest incidence is found in tropical and subtropical regions.[3]

The disease is caused by a group of dinoflagellates belonging primarily to the genera Gamberdiscus and Fukuyoa. These typically live on macroalgae and corals. They produce various toxins, such as C-CTX5, which are difficult to identify and whose production varies depending on location and climatic conditions. Furthermore, their accumulation in fish depends on the fish's diet, size, and habitat range (Mudge).[4] It is worth noting that some studies carried out in Cuba have found the presence of these microorganisms in coastal areas, making it possible to study their behavior.[5,6]

In America, it has affected countries like Colombia,[7] Mexico[8] and different Caribbean islands[9] where cases of the disease and the presence of dinoflagellates commonly linked to the production of CTXs have been reported.

Ciguatoxins cause a range of symptoms in those poisoned, but to date, they are not confirmed by laboratory tests, and cases are only treated based on a differential diagnosis performed in medical institutions. It is estimated that only 2-10% of actual cases worldwide are reported, potentially exceeding 50,000 affected individuals annually (World Health Organization). This diagnosis is not widely recognized in areas where the poisoning is not officially reported, and it is considered a rare disease in European countries.[1]

Cuba, given its status as an archipelago located in the Caribbean, is considered an endemic area for ciguatera. On the island, the disease is not considered a reportable illness.[10] This leads to cases sometimes not being reported properly, which shows that they are not always included in the statistics, or are recorded incorrectly.[11] When fish carrying the biotoxins that cause Ciguatera are sold in the unofficial or informal market without legal authorization, reports of cases and outbreaks of poisoning increase.

An example of this is the work carried out with the barracuda (Sphyraena barracuda, Edwards, 1771), captured on the north coast of Havana, Cuba, which allowed us to identify that the consumption of this species caught in this area, in the months of July to September, is a risk for consumption and poisoning by Ciguatera.[3] This species is included in the official list of the Ministry of the Food Industry (MINAL) of toxic species in Resolution No. 457/96,[12] and yet in other regions it is consumed without causing symptoms or Ciguatera poisoning.

Epidemiological studies on knowledge, experiences, and risk perception in the population regarding poisoning allow for the collection of relevant data to guide educational actions, also favoring the preparation of management activities and the prevention of the disease.[13]

On the other hand, case reports make it easier to document the symptoms and the time that elapses between their onset and consumption of thecontaminated fish. Furthermore, they allow for comparison of how the poisoning manifests among different patients, within a national or international context. In Cuba, there are publications on this topic.[10,14-17] which confirm the historical nature of the poisoning on the island. These are complemented by another group of epidemiological investigations in different locations.[18] Despite the wealth of information available within the archipelago, the Cojímar area has not been extensively studied, even though it is a town with fishing traditions.

The objective of this study is to assess the risk perception associated with Ciguatera and the level of impact of this food poisoning in the town of Cojímar, belonging to the municipality of Habana del Este, Havana province, Cuba.

Materials and methods

Study site

The área object of study was he populated Cojímar (Figure 1).

Figure 1 Geographic location of the town of Cojímar, in the municipality of Habana del Este, Havana province, Cuba.

This is a community located on the north coast of the municipality of Habana del Este. It has an area of 4.2km² and its coastline is approximately 2.20km long. It has 20,390 inhabitants according to the latest provincial census. Due to the national exodus from which the area is not excluded, this Figure 2 could actually be around 18,000 inhabitants, or less.

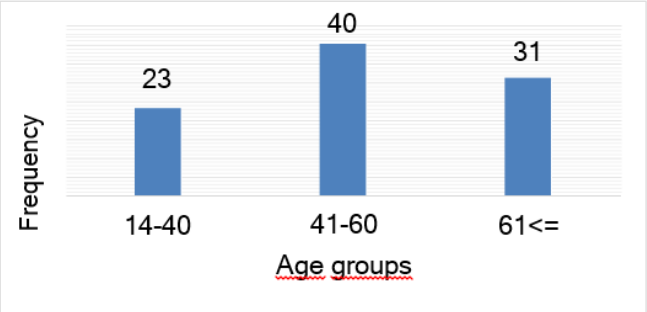

Figure 2 Age groups in the sample.

Among the local population, there is a notable inclination towards artisanal, recreational, and commercial fishing. These practices are evident year-round, disregarding current regulations and closed seasons, thus impacting local marine fauna. Other studies have demonstrated that artisanal fishing can seriously harm local marine species when carried out without restrictions or oversight from authorities.[19]

Data collection statistics and processing

Data collection was carried out using the direct survey method, with the model used in other studies conducted in Cuba.[8,11,20]

The questionnaire (Appendix 1) was administered to 100 randomly selected individuals from the population of Cojímar. Of these, 94 were processed, and 6 were discarded due to inconsistencies in their responses. It consisted of 10 closed-ended, multiple-choice questions about ciguatera poisoning, the individual's experience with the condition, and a final section for the respondent to add their own comments.

The statistical analysis was completed using Microsoft Excel software and the Statistica statistical program version 8.0. Counts were made of the positive and negative responses to the questions of greatest interest, and the associated percentages were obtained in this way.

The normality of the age variable was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests, with Lilliefors correction, and then the mean ages were compared among the most frequently reported symptoms. Frequency and percentage calculations were performed for categorical variables, and mean and standard deviation for age.

Pearson's chi-squared test was used to compare proportions. This was compared with Fisher's exact test when more than 20% of the cells had expected frequencies less than 5. Odds ratios (OR) with their 95% confidence intervals were estimated.

In addition, a binary logistic regression model was fitted to assess the association between sex and paresthesias, controlling for age.

The calculations were corrected with the statistical program R version 2026.1.1.0 with which the normality graph will be made for better visualization.

Results

General frecuencies and percentages; socio-demographic characteristics of the sample

The study sample consisted of 94 people, with a mean age of 52years (Table 1). Males represented 59.6% of the total. Most people answered positively regarding what Ciguatera is, although there were inaccuracies in their use of terms such as "intoxication," "disease," and "poisoning" when referring to the condition, demonstrating awareness of its existence but not its conceptual meaning. 89% of the positive responses corresponded to 84 people in the total sample, while 11% of the negative responses corresponded to 10 people in the total sample (Figure 3).

Table 1 Socio-demographic characteristics of the studied sample. SD corresponds to Standard Derivation. The percentages (%) were calculated on the total sample (94)

Variable	Category / Statistic	n	%
Age (years)	Average (DE)	52.6	15.7
	Range	14-87	-
Age Group	14-40 years	23	24.5
	41-60 years	40	42.6
	60 years	21	33
Sex	Female	38	40.4
	Male	56	59.6
Knowledge about Ciguatera	He knows	84	89.4
	He doesn't know	10	10.6
He received medical treatment	Yeah	32	34
	No	15	16
	He doesn't know	47	50

Citation: Chica MKG, Arencibia-Carballo G, Ramírez MELGA. Risk perception of Ciguatera in the fishing village of Cojímar, Havana, Cuba. *J Aquac Mar Biol.* 2026;15(1):57–62. DOI: 10.15406/jamb.2026.15.00441

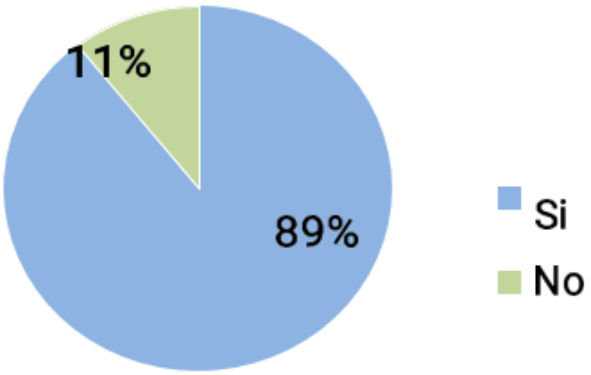

Figure 3 Percentage of positive (YES) and negative (NO) responses to the question "Do you know what Ciguatera is?".

Despite the differential diagnosis that healthcare professionals must perform to distinguish ciguatera from other disorders, 16% of the subjects reported not having received medical treatment or a diagnosis from authorized medical personnel, as they were familiar with the symptoms and had experienced the illness on previous occasions. Fifty percent did not know if they had received specialized medical care. This is dangerous because untreated ciguatera poisoning, or ciguatera poisoning mistaken for shellfish allergies, can progressively worsen symptoms and even lead to death.

The subjects were initially grouped for analysis into 3 age groups following the model used in the study by Thomas Sánchez and collaborators, 2024; "Knowledge of Ciguatera in the coastal municipalities of Havana, Cuba", from 14 to 40, from 41 to 60 and 61 years or older, represented in the graph of Figure 1, where most of the population is grouped between 41 and 60 years of age.

Most of the negative responses to the question "Do you know what Ciguatera is?" came from the youngest age group (Table 2). Adults between 41 and 60 years old provided the most positive responses, and adults over 60 accounted for the fewest negative responses.

Table 2 Relationship between age groups and negative/positive responses to the question "Do you know what Ciguatera is?"

Age Group	Knows what Ciguatera is	Does not know what Ciguatera is
14-40 years	18	5
41-60 years	37	3
6 years or older	29	2

71% of those surveyed lived in Cojímar at the time of the survey, which means that the data accurately reflect the indices measured for the local population.

Most participants did not know the name of the species that caused the poisoning. Only 18 of the total number of individuals caught it themselves, and of these, 16 did so in the coastal area of Cojímar. There are cases where the fish was purchased filleted or, as some inspectors reported, mutilated, making it difficult to identify the specific animal consumed.

00% of the people who purchased it filleted reported having bought it from private individuals. Those who purchased it whole also bought it from private individuals (Figure 3).

A total of 11 species were reported (Figures 4-6), which coincide with species cited in other reports and in the official list of potentially toxic species attached to the Official Gazette of November 28, 1996, Ordinary Edition, No. 40.

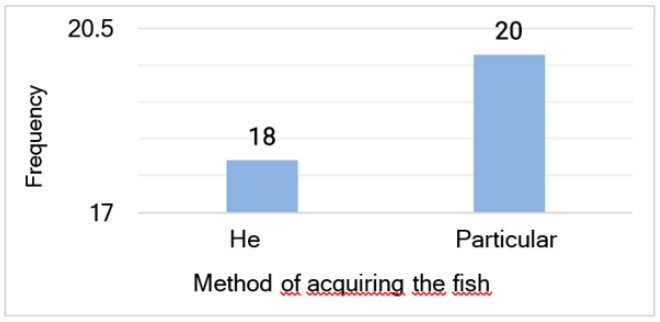

Figure 4 Number of people who caught the fish that caused the poisoning (Caught) and number of people who bought the fish from individuals (Individual).

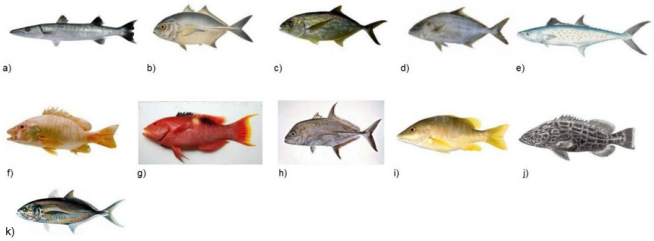

Figure 5 Species mentioned in the surveys: *a) Sphyraena barracuda, b) Caranx latus, c) C. bartholomaci, d) Seriola rivoliana, e) Scomberomorus maculatus, f) Lutjanusjocu, g) Bodianus sp., h) C. lugubris, i) L.apodus, j) Mycteropercabonaci, k) Caranxcrysos.*

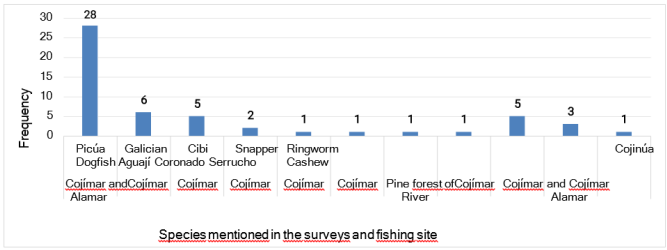

Figure 6 Species reported by their common name, frequency and percentage of reports per species.

Those who caught their own specimen claim they did not sell it but consumed it at their own risk. Others stated they received it as a gift from family members or friends who were fishermen.

The most frequently mentioned symptoms (Table 3) during data collection were theGastrointestinal symptoms (vomiting and loose stools), as well as muscle and joint pain. In more severe cases, hair and/or tooth loss and the appearance of a scaly coating on the skin.

Table 3 Symptoms mentioned in the surveys and frequency of reports. Percentages calculated on the total sample (n=94)

Symptoms	n	%
Emesis	30	31.9
Liquid evacuations	21	22.3
Myalgia / Arthralgia	21	22.3
Paresthesias	12	12.8
Fever	7	7.4
Hair Loss	6	6.4
Tooth Loss	4	4.3
Skin Rash	3	3.2
Headache	3	3.2
Thermal Inversion	1	1.1

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Normality test and Student´s t-test

After applying normality tests, it was found that the values of the age variable followed a normal distribution (p≈0.52) (Table 4 & Figure 7). This allowed for the application of Student's t-tests to compare the mean ages between sexes and between the most frequent symptoms. In neither case were significant differences found between the mean ages.

Table 4 Normality test for the age variable. Output from Statistica software

Varible	Tests of Normality (Spreadsheet1.sta)					
	N	max D	K-S p	Lilliefors p	W	p
Edad	94	0.08184	p>.20	p<.15	0.987484	0.516459

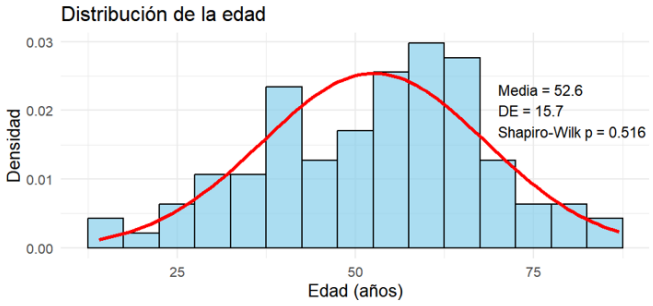

Figure 7 Histogram of the normal distribution of ages. Output from R software.

Relationship between variables

Tests were applied to assess the association between symptoms and the variables age and sex. No significant relationships were found between age and symptoms; however, a possible significant relationship was observed between sex and the likelihood of experiencing parestesia (Table 5).

Table 5 Total number of people who did/did not experience paresthesia, for each sex

Sex	Paresthesias (No)	Paresthesias (Yes)	Total	%Yes
Female	36	2	38	5.3
Male	46	10	56	17.9

Pearson's chi-squared test showed a trend close to statistical significance (χ^2 = 3.224, df = 1, p = 0.073). Since one of the cells had an expected frequency less than 5 (women with paresthesia, expected = 1.06), Yates' correction was applied (χ^2 = 2.192, df = 1, p = 0.139) and Fisher's exact test, which yielded a p-value of 0.114, indicating that the association does not reach statistical significance at the conventional level of 0.05 (Table 6).

Table 6 Statistical tests for the relationship between sex and paresthesia. Output from R software

Prueba	Estadístico	gl	p.valor	OR	IC.95
Chi-Cuadrado Pearson	3.224	1	0.0726	NA	NA
Chi-Cuadraro Yates	2.193	1	0.1387	NA	Na
Fisher exact	NA	NA	0.1142	3.86	0.75-38.47

The odds ratio (OR) calculated using Fisher's exact test was 3.86 (95% CI: 0.75 – 38.47). This value indicates that men are approximately 3.9 times more likely to experience paresthesia than women, although the confidence interval is very wide and includes the null value, reinforcing the lack of statistical significance. Nevertheless, the value of the estimate suggests a potentially relevant association (Table 7).

Table 7 Calculation of Odds Ratio, association between male sex and paresthesia. Output from R software

Modelo	OR	IC	p.valor
Crudo (Wald)	0.26	0.05-1.24	NA
Crudo (Fisher exalto)	3.86	0.75-38.47	0.114
Ajustado por edad	4.04	0.95-27.55	0.085

Logistic regression

To control for the potential confounding effect of age, a binary logistic regression model was fitted with paresthesia as the dependent variable and sex and age as predictors. The model showed an adequate fit (deviance/df=0.70). Male sexIt presented an adjusted odds ratio of 4.04 (95% CI: 0.98 – 27.55; p = 0.085), while age did not show a significant effect (OR=0.98; 95% CI: 0.94 – 1.02; p=0.310).

Taken together, these results suggest a consistent trend toward a higher risk of paresthesia in men, although the lack of statistical significance may be attributed to the limited sample size and the low frequency of the symptom in women. Studies with larger samples are needed to confirm this association (Table 8).

Table 8 Logistic regression results. Output from R software

Variable	Coeficiente	Error Estándar	p.valor	IC-inferior	IC-superior
Intercepto	-1.874	1.201	0.119	-4.474	0.325
sexo_num	1.396	0.810	0.085	-0.022	3.316
edad	-0.020	0.020	0.310	-0.061	0.019

Discussion

The survey method provided an approach within a fishing community in Cuba to the personal experience and knowledge of the subjects interviewed with Ciguatera, but it did not allow for an exhaustive examination of more specific details; even so, given its flexibility, it facilitated the collection of data in different places within the determined area while maintaining a certain degree of anonymity for the individual,[21] inviting him to respond in an open and cooperative manner.

The results reveal that, while there is a high level of general knowledge about the disease (89%), risky practices persist, along with significant underreporting of cases, evidenced by the low percentage of people who sought medical attention (34%). Symptom analysis showed that gastrointestinal manifestations (vomiting, diarrhea) were the most frequent, which is consistent with the acute phase of the poisoning described in the literatura.[10,16,22] The presence in our series of other less common but serious symptoms, such as thermal inversion (1.1%) or hair loss (6.4%), although infrequent, underscores the variability and complexity of the clinical picture, which can affect multiple systems.

However, the most relevant finding is the possible association between male sex and the presence of paresthesia, a key neurological symptom of ciguatera. This association persisted even after controlling for the potential confounding effect of age in the logistic regression analysis, where the results were consistent. Previously, other authors had described a predominance of males in some ciguatera outbreaks, although without establishing a relationship between this characteristic and the symptoms presented.[14,15]

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Of the group studied, the youngest individuals, in addition to being the least represented group and being actively involved in fishing, showed the highest level of ignorance (Table 2) regarding ciguatera poisoning. This is concerning in a locality with a high concentration of fishermen and a cultural history closely linked to fishing, where a broad general knowledge about the poisoning would have been expected.

In surveys, the most consumed fish associated with the disease is the barracuda, which is reported worldwide as a potentially toxic fish due to its carnivorous feeding habits and high commercialization. This species is included in the legislation of Resolution No. 457/96,[12] Ministry of the Food Industry (MINAL), along with a large group of species considered potentially harmful due to ciguatera poisoning (Annex 2). This coincides with surveys carried out in other areas of Cuba[18,23] and with the study carried out in Ciego de Ávila that compiles 16 years of reports.[15]

The law in Puerto Rico also prohibits this species and includes others such as: Amberjack and Black Jack (Fishing Regulation #6768)[24] and advises eating fish of less than six pounds and avoiding eating the liver or other internal organs of fish since these accumulate a greater amount of toxin.

However, the size limitation for this species (barracuda, Sphuraena barracuda) does not currently show a correlation between size and biotoxin concentration, according to the literature. This is more closely related to the area where these species develop; if the increased availability of toxins is favored by an area highly stressed by various factors mentioned and discussed, where the species responsible for the presence of biotoxins in the food web proliferate, it would lead to an increase in the concentration of CTXs in the fish's organism. Regarding the relationshipeithern of these tensioners in thetoReef areas, the topic has already been addressed by other publications[25] which make these relationships and considerations very clear based on specific indicators.

Of the species mentioned in the surveys, only the Aguají, the Cibí amarillo, the Coronado, the Gallego, the Pargo jocú and the Picúa appear reflected in the table of Annex 2 of potentially toxic species of the MINAL, leaving out the Serrucho (Scomberomorus maculatus), the Pez perro (Bodianus sp.), the Tiñosa (Caranx lugubris), the cojinúa (Caranx crysos) and the Cají (Lutjanus apodus).

The Tiñosa is mentioned in Resolution No. 457/96 of the Ministry of the Fishing Industry, published in the Official Gazette of the Republic of Cuba, Ordinary Edition, Havana, November 28, 1996, year XCIV, number 40, page 641, in the corresponding annex, and its capture, landing and commercialization without weight restriction is prohibited for the entire Cuban peninsula.

Other investigations cite reports of poisoning due to the consumption of species of the genera Mycteroperca and Lutjanus in Baja California, the Gulf of Mexico, the Caribbean and China[26] and is associated with Seriolarivoliana with the first Ciguatera poisoning event in the Canary Islands, a species that continues to appear in this location related to other outbreaks of the disease.[27]

Furthermore, the symptoms obtained from the surveys are widely described in the literature. Authors such as Gouveia et al,[28] state that gastrointestinal symptoms are frequent among patients and are among the first to appear, commonly associated with cardiovascular symptoms that were not reported by the subjects of this study.

The identification of male sex as an independent risk factor for paresthesia can be interpreted within a social and cultural context. In the context of Cojímar, it should be noted that men are the sex most exposed to poisoning. They are the ones who perform fishing tasks and are more vulnerable to self-consumption. Even so, a differential biological susceptibility to CTXs or their metabolites should not be ruled out, although there is little existing evidence and further studies are needed.

This gives rise to an alternative and little-explored hypothesis: the possible transmission of the toxin via semen. The presence of ciguatoxin in the semen of affected men has been suggested in the literature, which could trigger symptoms in their partners during sexual intercourse, as well as genitourinary symptoms in the men themselves, such as painful ejaculation. Although this route does not explain all the observed differences, and was not the focus of the present study, it opens a novel line of research, especially considering the high lipophilicity of ciguatoxins, which could facilitate their passage into tissues such as the testes.

No significant association was found between age and the presence of specific symptoms such as paresthesia after adjusting for sex. While bivariate analysis suggested an older age group, logistic regression showed that this effect disappeared when sex was included in the model. This suggests that age is not an independent predictor for this particular symptom, and that the initially observed association could be explained by other unmeasured factors.

During the study, it was found that only 37% of those affected received medical attention or a differential diagnosis, opting instead to self-medicate based on experience from previous episodes. This behavior has profound implications for public health; it perpetuates a serious underreporting of the disease, preventing us from knowing its true magnitude and hindering the implementation of effective control measures. It is estimated that only between 2% and 10% of cases are reported worldwide, and our data suggest that in Cojímar this figure could be even lower. Furthermore, it carries a significant clinical risk, since a misdiagnosed poisoning, or one mistaken for an allergy, can worsen, and the opportunity to administer treatments such as intravenous mannitol, which can be effective in the first few hours if administered correctly, is lost.[22]

Empirical knowledge of the disease acts as a barrier to proper epidemiological surveillance. This phenomenon is not exclusive to Cuba and has been described in other endemic regions, which reinforces the need to implement active case-finding strategies and health education aimed not only at preventing the consumption of high-risk species, but also at promoting early medical consultation.[29,30]

It is important to interpret the results of this research considering the limitations present. First, the sample size, while adequate for descriptive analyses, may be limited for detecting associations in subgroups of infrequent symptoms (such as thermal inversion or tooth loss), where the number of affirmative cases was very low. Second, there is a potential memory or information bias, since the data on symptoms and type of fish consumed were based the responders´recall, wich could afect the precision of the estimates. Third, although a logistic regression model was fitted, there is a possibility of residual confounding factors not measured in this study, such as the amount of fish ingested, the size of the fish, cooking techniques, or concurrent alcohol consumption, which could influence the clinical presentation of the poisoning.

Conclusion

I. The results show that in the area there is still a risk of contracting poisoning from the consumption of toxic species, some of them

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prohibited for Cuba, such as the Tiñosa and the Picúa, although the consumption of fish in the community has decreased notably due to the high prices.

II. The younger population of the area is unaware of important aspects of Ciguatera poisoning or even its existence, despite living in a town with a strong inclination towards fishing.

III. The barracuda is the fish most frequently reported as a vector of the disease.

IV. The most common symptoms were vomiting and liquid bowel movements.

V. There is a clear underreporting of the actual cases of Ciguatera that are reported.

VI. A possible significant relationship was found between male sex and paresthesias.

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Conflict of interest

Authors declare that theere is no confict of interest.

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