

Tropical medicine rounds

# The skin health of fishermen in Guanabara Bay, Rio de Janeiro, Brazil

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## Introduction

Daily activities in fishing communities expose fishermen to risks of accidents and diseases.<sup>1-4</sup> Injuries in the marine environments are caused by a wide variety of animals, fishing materials, and sharps.<sup>1,4</sup> Many of the tidal and deep water animals of

## Abstract

**Background** Fishing is an important economic activity worldwide, but there are only a few studies on the skin health of fishermen. Daily activities in fishing communities expose fishermen to risks of traumatic, actinic, and sea dermatoses.

**Methods** A semi-structured questionnaire was applied to 388 fishermen from 2014 to 2015 at their workplace (Z-8 to Z-13 fishing communities). The data collected were evaluated for descriptive analysis. In the bivariate analysis of the data, the Pearson chi-square test was used. The multinomial logistic regression was used to obtain estimates of odds ratios and adjusted confidence intervals for confounding variables.

**Results** Three hundred and nine (79.6%) fishermen reported accidents during their fishing activity. The main fish species implicated were *Genidens genidens* and *Scorpaena brasiliensis*. Inappropriate or potentially harmful traditional treatments without scientific evidence of efficacy were recorded as main/auxiliary treatment. Other significant skin injuries were due to trauma from fishing tackle and exposure to ultraviolet radiation. Three hundred and twenty (82.5%) fishermen reported that they had never used any sun protective devices or sunscreen.

**Conclusions** Traumatic injuries due to fish stings were the most common accidents in this group. Despite chronic occupational sun exposure and its hazards, most fishermen did not adopt any method of photoprotection. Health educational activities as well as a specific health program for these professionals are necessary to improve the health of fishermen in Guanabara Bay area.

temperate and tropical waters are potentially dangerous and may be responsible for accidents involving humans.<sup>1,2,5</sup> Due to the great influx of beach-goers and the increase in commercial and sport fishing, besides other activities, such as scuba diving and deep sea fishing, accidents involving aquatic animals have increased year after year.<sup>2,3</sup>

According to the 2012 general record of the fishing activity of the Ministry of Fisheries and Aquaculture, the state of Rio de Janeiro has about 14,000 registered fishermen, but approximately 30,000 are estimated to be involved in such activity.<sup>6</sup> The fishing in Guanabara Bay (GB) represents around one-third of the fishing activity of the entire Rio de Janeiro state.<sup>7</sup> Despite increased pollution, the number of fishermen in the region has increased each year. Currently, there are five areas of fisheries in GB, traditionally known as fishermen's colonies. They are located at traditional fishing places and near fish market areas. The activities developed by the fishing communities are artisanal and/or commercial fishing, and crab and shellfish collecting. Ten species of fish caught in the state of Rio de Janeiro are subject to periods of temporary cessation of fishing for their preservation (closed fishing season).<sup>8</sup>

The GB is the third largest bay in Brazil, with 380 km<sup>2</sup> of surface area, 59 km<sup>2</sup> of islands, and 80 km<sup>2</sup> of mangroves.<sup>9</sup> The tributary watershed covers an area of approximately 4,000 km<sup>2</sup> and 35 main rivers enter the sea in GB. These rivers are highly polluted by the raw or partially treated domestic effluents of about 10 million inhabitants and industrial effluents from more than 12,000 industries.<sup>10</sup>

The area with poorest water quality at GB is the channel between the Governor and Fundão Islands and the mainland due to significant release of raw or partially treated effluents from low-income residential and industrial areas in the north of the city of Rio de Janeiro.<sup>10,11</sup> In this region, the water quality is like that of partially treated sanitary sewers; thus, problems of odor are also significant.<sup>10-13</sup>

Injuries and poisoning in professional fishermen are common and poorly studied.<sup>1,2</sup> Data collection of fishing activity is essential as a basis for any policy to support fishing, organization of the sector, and quantification of any losses resulting from fishing accidents or environmental hazards. Our findings can help public health authorities in developing educational and preventive strategies to address this occupational health problem. Therefore, the objective of this study was to identify fishermen's traumatic, actinic, and sea dermatoses in Guanabara Bay, Rio de Janeiro, and provide a basis to implement preventive/therapeutic measures to help diminish fishermen's occupational skin diseases.

## Methods

This is a retrospective, descriptive, epidemiological survey. A total of 38 visits to the fishermen colonies were carried out. The sample size of this study consisted of 51 fishermen interviewed in 2014 and 337 in 2015. The individuals were interviewed orally at the workplaces (beaches, near mangroves, and channels of the region, and at fish markets). Fishermen were invited to participate in the survey to increase awareness of the skin health in Guanabara Bay fishermen by a display announcing the study that was fixed at strategic locations within

fishing communities. This showed illustrations of accidents caused by fish, and it contained the following core questions: (A) Do you worry about the effects of the sun on your skin? (B) Have you ever been injured during fishing? and (C) Have you ever received medical advice regarding the precautions you should take to prevent accidents? These questions provide motivation for participation in the study. The inclusion criteria were: fishermen from Guanabara Bay fishing communities (wards Z-8, Z-9, Z-10, Z-11, and Z-12) of Niterói, Rio de Janeiro, São Gonçalo, Itaboraí, Magé, and Guapimirim municipalities, and ward Z-13 fishing community (from Urca to Pontal do Recreio). Exclusion criteria were fishermen under 18 years of age, fishermen from other fishing colonies outside GB, except Z-13 colony ocean areas, those with any disability that limited fishing practice, and any difficulty in understanding the informed consent and/or the research questionnaire.

For the interviews, a semi-structured questionnaire was used for the analysis, based on previous studies,<sup>1,2,5</sup> which included questions about issues related to socioeconomic profile, season of year and the fishing practice schedule, use of sunscreen, history of skin lesions and/or poisoning related to the practice of fishing, body site where the injury occurred, causes, symptoms and treatments of injuries and/or poisoning, number of accidents, and absenteeism.

The frequency and proportion of accidents caused by aquatic animals calculated for the numerical variables of the survey (age and gender) were evaluated. Epidemiological data were included in a Microsoft Excel spreadsheet for descriptive analysis. The variables were adjusted and expressed as continuous or categorical. In the bivariate analysis of the data, the Pearson chi-square test was used. Multinomial logistic regression was used to obtain estimates of odds ratios and adjusted confidence intervals for confounding variables. Multivariate logistic regression analysis was performed to verify the hypothesis of association between age and the number of years since they started fishing as predictors for injury caused by fishing activity. Data analysis was performed using the SOPAS software (Version 17.0).

This study was approved by the Research Ethics Committee of the Hospital Federal dos Servidores do Estado do Rio de Janeiro (Protocol CEP-HFSE-RJ: 000,537) on August 11, 2014. Participation was voluntary, and all participants signed an informed consent form.

## Results

A total of 388 fishermen participated in the study (Fig. 1). Their ages ranged from 18 to 86 years, with a mean of 46 years, of which 368 (94.8%) were male and 20 (5.2%) female. Number of years fishing, schooling, and monthly income of the study population are shown in Table 1.

Regarding the months used for fishing throughout the year, there was relative constancy. Sunscreen use was reported by



**Figure 1** Distribution of the 388 fishermen interviewed in this survey from various fishing communities in Guanabara Bay, Rio de Janeiro

68 (17.5%) fishermen. The period of the day in which fishermen practice fishing, the presence or absence of injury caused by fishing and location on the body in which the injury occurred, the causes of the injuries in the fishermen, and the signs and symptoms, as well as the treatment performed in cases of injuries, are reported in Table 1. It should be highlighted that *Genidens genidens* (catfish) was responsible for 201 (65%) marine accidents, and *Scorpaena brasiliensis* (red barb fish, orange scorpionfish) caused 56 (18.1%) marine accidents and accounted for 100% of accidental poisoning. Figure 2a–h illustrates some of the above-mentioned occupational accidents and dermatoses observed in sea fishermen.

There was no statistically significant difference when comparing the variables schooling and accidents resulting from the fishing activity, as well as between income distribution and accidents due to fishing activity. Fishermen with skin lesions caused during fishing have a significantly higher average age (48.52 years) than those without injury (36.97) ( $P < 0.001$ ).

Among the fishermen with up to 1 year of fishing practice, and from 2 to 5 years, the percentage of those without injury is higher than those with injury, 29.1% > 1.6% and 17.7% > 5.2%,

respectively. Among fishermen with more than 10 years of fishing, the percentage of those with injury is higher than those without injury (86.7% > 44.3%). Therefore, the longer the fisherman has been fishing, the greater the possibility of injury resulting from this activity ( $P < 0.001$ ).

We found that age ( $P = 0.03$ ) and length of time in the occupation of fishing ( $P < 0.001$ ) had an influence on injury even when observed together. Each additional year of age increases on average the chance of having an injury (95% CI = 1.002–1.005) by 2.5%. Fishermen who have 1–5 years of fishing practice are 6.3 times more likely to be injured compared to those who have less than 1 year of fishing practice (95% CI = 1.84–21.60); those with 5–10 years of fishing time are 13.7 times more likely to be injured than those who are less than 1 year (95% CI = 13.71–51.05); those with over 10 years of fishing experience are 23.95 times more likely to be injured than those with less than 1 year (95% CI = 8.15–70.40).

Seventy-nine (20.4%) fishermen reported that they had never suffered an accident during their fishing activity. Regarding the number of accidents at work, 30 (9.7%) fishermen reported having had a single accident, 40 (12.9%) from two to five accidents,

**Table 1** Fishing time, schooling, and monthly income of the fishermen who answered the questionnaire (R\$ 724.00 corresponds to the Brazilian minimum wage in force at the time of the study), period of the day on which the fishermen participating in the study practice fishing, the presence or absence of injury caused by the fishing activity, site on the body where the injury occurred, the prevalence of injuries during fishing activity, signals and symptoms, as well as the treatment performed in cases of injuries

Variable	n	%
Fishing time		
<1 year	28	7.2
1–5 years	30	7.7
6–10 years	27	7.0
>10 years	303	78.1
Schooling		
Illiterate	6	1.6
Up to the 5th year of elementary school	134	34.5
From the 6th to the 9th year of elementary school	111	28.6
Incomplete high school	71	18.3
Complete high school	49	12.6
Incomplete higher education	10	2.6
Complete higher education	7	1.8
Monthly <i>per capita</i> income		
R\$ 724.00 or less	93	24
More than R\$ 724.00 to R\$ 1,448.00	167	43
More than R\$ 1,448.00 to R\$ 3,620.00	86	22.2
More than R\$ 3,620.00 to R\$ 7,240.00	15	3.9
More than R\$ 7,240.00	1	0.25
Refused to answer	26	6.7
Day period		
Morning	362	93.3
Afternoon	309	79.6
Night	243	62.6
Any injury sustained during fishing		
Yes	309	79.6
No	79	20.4
Body site where the injury occurred		
Hands	287	92.9
Feet	206	66.7
Forearms and/or arms	149	48.2
Thighs and/or legs	138	44.7
Abdomen	61	19.7
Chest	59	19.1
Back	58	18.8
Head	28	9.1
Aquatic animals that cause injuries		
Catfish ( <i>Genidens genidens</i> )	201	65
Different crab species	165	53.4
Jellyfish, caravel	114	36.4
Sea urchin	100	32.4
Swordfish ( <i>Trichiurus lepturus</i> )	98	31.7
Corals	82	26.5
Stingrays	68	22
Anchovy ( <i>Pomatomus saltatrix</i> )	66	21.4
Red barb fish, orange scorpionfish ( <i>Scorpaena brasiliensis</i> )	56	18.1

**Table 1 Continued**

Variable	n	%
Moray eel	27	8.7
Whitemouth croaker ( <i>Micropogonias furnieri</i> ) and mullet ( <i>Mugil liza</i> )	16	5.2
Sea bass ( <i>Centropomus undecimalis</i> )	13	4.2
Mussel ( <i>Perna perna</i> )	13	4.2
Puffer and leatherjacket fish ( <i>Oligoplites saurus</i> )	10	3.2
Ray-finned fish ( <i>Sphyræna spp.</i> )	9	2.9
Octopus	7	2.3
Shrimp and flying fish ( <i>flying fish</i> )	4	1.3
Hake fish ( <i>Urophycis Tenuis</i> ), frog fish ( <i>Lophius piscatorius</i> ) and white grunt ( <i>Haemulon plumieri</i> )	3	1
Triggerfish ( <i>Balistes capriscus</i> ) and dog-eye fish ( <i>Priacanthus arenatus</i> )	2	0.6
Horse-eye jack ( <i>Caranx latus</i> ), monkfish ( <i>Lophiosilurus alexandri</i> ), surgeon fish ( <i>Acanthurus chirurgus</i> ), grey triggerfish ( <i>Balistes capriscus</i> ) and skipjack tuna ( <i>Katsuwonus pelamis</i> )	1	0.3
Fishing materials (fishing line, fish hook, artificial baits, knife and fishing harpoon)	232	75.1
Sharps	122	39.4
Others		
Accident with watercraft	22	7.1
Bee/wasp sting in the mangroves	14	4.5
Eye trauma with sinker	1	0.3
Rat bite on the beach	1	0.3
Signals and symptoms		
Pain	306	99
Edema	142	45.9
Erythema	130	42.1
Fever	104	33.7
Headache	71	23
Tachycardia	58	18.8
Nausea and/or vomiting	50	16.2
Bruise	39	12.6
Adenopathy	35	11.3
Blister	21	6.8
Somnolence	9	2.9
Treatment		
Sought medical attention	132	42.7
Parts of the fish (eyes and viscera)	113	36.6
Ice	101	32.7
Alcohol	85	27.5
Urine	65	21
Salt	54	17.5
Local heat	21	6.8
Alcoholic beverage	19	6.1
Kerosene	17	5.5
Smoke	10	3.2
Tourniquet	8	2.6
Coffee powder and herb	6	1.9
Gasoline	4	1.3
Prayers	3	1
Propolis	2	0.6
Grease, saião ( <i>Kalanchoe brasiliensis</i> ), honey	1	0.3



**Figure 2** (a) Jellyfish sting; (b) catfish injury in a hand (arrow) and catfish on the beach sand (insert); (c) foot scar from moray eel injury; (d) recent hand bite by *Trichiurus lepturus* and sharp teeth of *Trichiurus lepturus* (insert); (e) Nasal ulcerated nodular basal cell carcinoma in middle-aged fisherman, observe associated ocular lesion; (f) chronic photodamage, poikiloderma, field cancerization, numerous actinic keratosis, solar lentigines, solar elastosis, and squamous cell carcinoma in an elderly fisherman; (g) Bowen disease on dorsum; (h) dermoscopy showing uniform pink/erythematous background, and white/yellowish surface scales (original magnification 10 $\times$ ); (i) traumatic deformity and amputation of right-hand fingers in the watercraft engine; (j) burn from hot engine oil; (k) rower hand with multiple calluses; (l) multiple excoriations due to fall in corals

10 (3.2%) from 6 to 10 accidents, and 229 (74.1%) more than 10 accidents. Among the fishermen who had already suffered work-related accidents, 77 (24.9%) reported that they had been absent from work due to the accident.

Three (0.8%) fishermen reported a history of leprosy, and 12 (3.1%) had a history of skin cancer. Severe photodamaged skin and cutaneous precancerous lesions or in situ carcinomas (actinic keratosis, keratoacanthoma, cutaneous horn, Bowen's disease) were also observed. Accidents reported in the fishing industry include traumatic deformities and amputations, burns, falls in watercraft, corals, among others (Fig. 2i–l). Ophthalmological lesions and other eye diseases, though not the objective of our study, were a relevant spontaneously volunteered complaint in the population we interviewed. All interviewed fishermen said they had never been visited by a doctor and/or health professional for guidance/assistance at their workplace.

## Discussion

The high number of accidents in the fishing activity and the number of fishermen who have been absent from work due to these occurrences represent a challenge for public health

authorities. It may indicate a lack of training courses and health education directed at this population. We have evaluated a relatively small sample of the total population of fishermen of the GB (388 of an estimated population of 10,000 fishermen), from fishing communities located in less than 200 km of coastline (131 km in GB and 40 km from Leme to Pontal). Brazil has a coastline with 7,367 km. We consider it important to encourage the development of an action plan for other fishing areas along the coast of Rio de Janeiro state, as well as in the entire Brazilian coast. Primary healthcare professionals working with fishing communities, and surrounding areas, also need to be trained on specific aspects of fishermen's health and preventive measures that address their main occupational hazards.

Brazil has great fishing potential. Besides the great extent of its coastline and the diverse species that inhabit both the offshore coastal area, as well as the intertidal zone, there is a vast estuarine system that includes the Amazon, São Francisco, and Prata river basins. The barriers to improvement of fishing activity in the country include the low level of technology used in the local fishing industry, poor quality, and lack of maintenance of boats and outdated equipment, all factors that make fishing in Brazil seem outdated and inefficient rather than a modern and

sustainable activity. The risk of an ecological disaster caused by indiscriminate fishing combined with pollution draws attention to the need to introduce/enhance sustainability in the fishing industry.

Fishing is a global activity which is recognized as one of the most dangerous occupations, and this places fishermen at a sevenfold greater risk of death than all other industrial activities.<sup>3,4</sup> Shipwrecks, adverse weather conditions, and encounters with dangerous aquatic animals are the main causes of potentially life-changing accidents recorded.<sup>3,7,14</sup> These accidents involving their work are frequent and highlight the importance of implementing the use of personal protective equipment.<sup>1-3</sup>

The high number of fishermen with more than 10 years of fishing practice contrasts with the low number of those who reported using sunscreen, an alert to the risks of prolonged and chronic exposure to ultraviolet (UV) radiation in these groups.<sup>15</sup> Photoprotection should be understood as a set of measures aimed at reducing exposure to the sun and preventing the development of acute and chronic actinic damage. Increasingly UV exposure is recognized by international bodies such as the

World Health Organization as an occupational hazard. Therefore, fishermen should be made aware of the need for use of photoprotective measures. These include education about photoprotection (photoeducation), photoprotective agents, and physical photoprotection (achieved by roofs and glass, clothes and accessories).<sup>16</sup>

Among the various species of aquatic animals reported to cause skin lesions in this study, only four species (mullet, shrimp, mussels, and crab) have a closed fishing season.<sup>8</sup> The constancy of all activity during the year observed in the research suggests that the temporary stoppage for preservation of these species is either ignored and/or that fishermen change their activity during the closed seasons.

The presence of pain occurred in practically all the accidents. Microbiological studies were not in the scope of this study, therefore these were not performed, and we cannot rule out the occurrence of wound infections/superinfections caused by staphylococci, streptococci, *Vibrio*, *Escherichia coli*, *Aeromonas*, *Pseudomonas*, and *Edwardsiella* genera, among



Figure 3 Front covers of educational booklet/cartoon

others, which are described in fishing accidents.<sup>1,2</sup> Yet, only 42.7% of the fishermen reported having sought medical care when they were victims of accidents during the fishing activity. As most fishermen are out at sea during the day, it is important to note that the normal opening hours of the basic health units/family health programs are unsuitable for them. Usually when they are victims of accidents, fishermen seek medical care in emergency units, which are inappropriate sites for follow-up and preventive guidance. This reveals the need for specific public health strategies for fishermen. In GB, 24-hour health units located near the fishing communities with adequately trained health professionals to address fishermen's occupational diseases would be desirable. We consider it important to encourage the development of an action plan for other fishing areas along the coast of Rio de Janeiro state, as well as in the entire Brazilian coast. Primary healthcare professionals working with fishing communities and surrounding areas also need to be trained on specific aspects of fishermen's health and preventive measures that address their main occupational hazards.

Another 18 traditional healing methods, without scientific evidence of efficacy, have been used as ancillary measures to accident management; however, they are considered to be unsafe and risky. Local heat application is a useful measure in the treatment of several accidents with aquatic animals, since this may denature certain poisons, causing improvement of the symptoms, mainly the pain. This method was reported in only 6.8%, demonstrating that most fishermen are unaware of immediate and simple treatment measures to manage occupational hazards and/or the treatment of professional accidents. Topical application of fish viscera is a common habit, especially in catfish lesions, and introduces a risk of secondary infection. The use of gasoline and kerosene applied to wounds may increase pain and contribute to tissue necrosis.<sup>2</sup>

The authors point out that this study ended in the year in which there were the aquatic competitions as part of the 2016 Olympics in Guanabara Bay. Throughout the study, despite the Rio de Janeiro state government's sanitation project and efforts to comply with the rules of the 2016 Olympic Games that increased the sewage treatment rate in the entire city, from 2014 to 2016 water pollution was a constant complaint during all interviews.

Approximately one-third of the fishermen interviewed had a per capita income more than double that of the Brazilian minimum wage at the time of the study. During this same period, the mean monthly income of all workers in the city of Rio de Janeiro was R\$ 1,284 (410 dollars), which represents 1.8 of minimum wage at the time of the study. Also, one-third of the fishermen interviewed had an average duration of schooling of 10 years or more which is higher than the average in Brazil, which was 7.4 years.<sup>17</sup> On the other hand, we highlight that around 65% of fishermen had less schooling (elementary school or less).

According to estimates of the Brazilian National Cancer Institute (INCA), in Rio de Janeiro city, the incidence of non-melanoma skin cancer is 181.63/100,000 inhabitants each year, with 4,960 new cases in men, and 7,100 new cases in women.<sup>18</sup> In our survey, 3.1% fishermen reported history of skin cancer. The main risk factor for skin cancer is excessive exposure to UV radiation. Generally, squamous cell carcinoma is associated with the accumulation of doses of sun exposure, whereas basal cell carcinoma seems to be more associated with intermittent exposure to high doses of solar radiation. This risk was aggravated by the high UV index observed throughout the year in Guanabara Bay area despite UV index seasonal variations. It is very likely that there is an underreporting of skin cancer in this group due to underdiagnosis, which may underestimate the incidence rates and the expected numbers of new cases.

As to accidental poisoning by *Scorpaena brasiliensis*, comparing the data from our research with data from a survey of 100 professional river fishermen,<sup>2</sup> the presence of edema was slightly higher among river fishermen (48% vs. 45.9%), but in our study, the other symptoms were more frequent: erythema (42.1% vs. 26%), fever (33.5% vs. 10%), tachycardia (18.8% vs. 2%), and nausea/vomiting (16.2% vs. 1%).

Some important sea-related dermatoses were observed but not collected in the questionnaire, and thus we could not include these in our categories, such as athlete's foot, xerosis to repeated immersion, contact dermatitis to swimwear and diving equipment, and contact urticaria from polluted water.

This is the first study with fishermen from Rio de Janeiro, and based on our findings an educational booklet was produced to alert those working in the fishing industry about the measures that should be taken to manage major accidents with aquatic animals, sharp objects, and fishing materials, as well as measures that address photoeducation, awareness of skin cancer, and the risk of pollution as this affects fishing activity as well as general health.<sup>19</sup> A cartoon book was also created characterizing a fisherman's son from Rio de Janeiro who instructs fishermen about the measures taken to manage fishing accidents, sun exposure, and the importance of seeking medical advice when necessary (Fig. 3). The empowerment of fishermen is part of an effective strategy for health promotion and education in public health.

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