

Risk Assessment in Artisanal Fisheries in Developing Countries: A Systematic Review



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Introduction: Artisanal fisheries generally do not have injury prevention plans and safety or quality management systems on board, thus making them prone to more fatal and nonfatal injuries. The objective of the study is to systematically review and synthesize the literature to identify the risks of injuries (fatal and nonfatal) and health problems in artisanal fisheries in developing countries.

Methods: A systematic literature search was carried out from December 2019 to March 2020. Articles were included with at least 1 outcome of interest (fatal injuries, nonfatal injuries, health problems, causal factors). In all, 18 articles on occupational safety and health aspects in artisanal fisheries from developing countries were kept for final analysis.

Results: Of the 4 studies on fatal injuries, only 1 reported fatal incidence rates (14 per 1,000 person-years). Vessel disasters were the most common cause of fatal injuries, with 14.3%–81% drownings. The prevalence of nonfatal injuries was between 55% and 61%. The most common causes were falls on the deck or into the sea/river, blows from objects/tools, punctures and cuts by fish-hooks/fish rays and fishing equipment, and animal attacks or bites. Health problems included eye, ear, cardiovascular (hypertension), respiratory (decompression sickness), dermatological, and musculoskeletal problems.

Discussion: There is a serious gap of health and safety information in artisanal fishery, which is more extensive in developing countries. Epidemiological studies are needed with comparable incidence and prevalence rates. For adequate prevention and compliance with the UN sustainable goals, there is an urgent need to establish a health information system in the countries to register the relevant demographic and epidemiologic characteristics of the population.

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INTRODUCTION

The fishing industry is of prime importance for food supply and employment. Globally, fish production provides the major portion of animal proteins to billions of people. In addition to this, millions of people find a source of income and livelihood in the fisheries sector. About 40.4 million people are employed in the fisheries sector worldwide, comprising a significant portion of the global population.¹ Despite the important role fishing plays in global food production and economy, it faces numerous occupational health hazards and risks. Exposure to cold, wind, rough seas, and a high physical work load are some of the

common hazards faced by fishermen.² Fishermen also have to work in difficult working conditions, such as constantly moving decks, isolated locations, long

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working hours, and days with little rest.³ Fishermen are thus susceptible to injuries (fatal and nonfatal) and health problems caused by the working conditions and risks associated with this type of work.

Fishing is known to be one of the most dangerous professions. Numerous studies highlight that fatal and nonfatal injuries are too high among fishermen than in other professions.^{4–8} The incidence rate of injuries is also very high in the fishing industry.^{9–12} Although the trend of fatal injuries in fishing is decreasing in developed countries,^{13–15} the number of injuries remain high in developing countries.¹⁶

The focus of this study is on artisanal fisheries in developing countries owing to their high operation, employment, and global fish production in the fishery sector. Artisanal fisheries employ 90% of the 120 million full-time and part-time global commercial catchers and contribute to >46% of global catches (including inland catches). About 90% of these fisheries operate in developing countries and contribute to about 39% of global catches (including inland catches).¹⁷ The incidence rate of fatalities in the fleets of small boats are considerably higher than medium to larger coastal fleets and deep sea fleets.¹³ They generally do not have injury prevention plans and safety or quality management systems on board, making them prone to more injuries and fatalities.¹⁸ So far, very little is known about the number of occupational hazards in small-scale fisheries owing to a lack of comprehensive information systems in developing countries.

The objective of this study is to systematically review and synthesize the literature to identify the risks of injuries (fatal and nonfatal) and health problems and their causes in artisanal fisheries in developing countries.

METHODS

This systematic literature review was performed according to PRISMA guidelines.¹⁹ For the purpose of this study, *artisanal*

(*small-scale*) fisheries were defined as traditional fisheries involving fishing households, using relatively small fishing vessels up to 12 feet long, making short fishing trips close to shore, mainly for local consumption.²⁰ The study was registered in PROSPERO, with registration number CRD42021247598.

Data Sources and Search Strategy

The literature search was carried out in multiple electronic databases, including PubMed, Embase (Ovid database), Scopus, Web of Science Core Collection, Google Scholar, and Academia, from December 2019 to March 2020. Articles were included from inception until March 2020 without restrictions on the date of publication to make the review as comprehensive as possible.

The following search terms comprising keywords, Medical Subject Headings, and Emtree terms were used: *fisheries, fishing, fishermen, artisanal fisheries, artisanal fishermen, small-scale fisheries, small-scale fishermen, traditional fisheries, coastal fisheries, coastal fishermen, occupational risks, occupational hazards, risk assessment, risk factors, occupational safety, occupational health, occupational accidents, casualties, incidence, injuries, fatalities, (vessel) loss, missing, capsizing, nonfatal injury, collision, drowning, life loss, occupational health, occupational diseases, work-related diseases, developing countries, low-income countries, South-east Asia, Africa, and Latin America*. Among these, search terms *developing countries, low-income countries, South-east Asia, Africa, and Latin America* were used in combination with other search terms for searching articles only in Google Scholar and Academia.

The building block search strategy was used, dividing the topic into 3 focus areas: fisheries, occupational risks and hazards, and occupational safety and health. The focus area fisheries included the terms *fisheries, fishing, fishermen, artisanal fisheries, artisanal fishermen, small-scale fisheries, small-scale fishermen, traditional fisheries, coastal fisheries, and coastal fishermen*. The focus area occupational risks and hazards included the terms *occupational risks, occupational hazards, risk assessment, and risk factors*. The focus area occupational safety and health included the terms *occupational safety, occupational health, occupational accidents, casualties, incidence, injuries, fatalities, (vessel) loss, missing, capsizing, nonfatal injury, collision, drowning, life loss, occupational health, occupational diseases, and work-related diseases*. The search words for each focus area were written down in each block where the Boolean operator OR was used to divide the search words in the same block and the Boolean operator AND was used to divide the search words in various blocks.

Table 1. Fatal Injuries in the Artisanal Fishing Communities in Developing Countries

Author (year)	Country	Time period	Number of fatalities	% Drowning
Mandal (2017) ²¹	Bangladesh ^a	2012–2016	68	N/A
Kobusingye (2017) ²²	Uganda ^b	N/A	141	39
Otieno and Godfrey (2019) ²³	Kenya ^c	1998–2000	3,058	14.3
Whitworth (2019) ²⁴	Tanzania ^d	2 years	70	81

Note: Fatal incidence rates could not be determined in the studies from Bangladesh, Uganda, and Kenya owing to insufficient information of denominators.

^aA total of 68 fishermen lost their lives owing to cyclones, the vessel taking in water, or capsizing and sinking.

^bA total of 141 persons drowned in a household population of 2,804 persons around Lake Victoria. Overall, 39.0% of drowning was during fishing and 61.0% during water transport.

^cIn the Riparian Counties of Lake Victoria, Kenya, 3,058 fishermen lost their lives during the period 1998–2000. Overall, 14.3% of deaths were caused by drowning, and the rest died of malaria and other diseases.

^dIncidence rate of fatal drowning among fishermen was 14.2 per 1,000 person-years and 81% of all drownings in the 8 communities were fishermen. N/A, not applicable.

Table 2. Nonfatal Injuries in the Artisanal Fishing in Developing Countries

Author, year	Country	Time period	Number of injuries	Sample size	Prevalence, %
Percin (2012) ²⁸	Turkey ^a	1 year	641	1,166	55
Mandal (2017) ²¹	Bangladesh ^b	1 year	22	40	55
Kolawole (2018) ²⁹	Botswana ^c	Lifetime	27	44	61.4

^aOut of 1,166 fishermen respondents who participated in a questionnaire survey, 55% had suffered from occupational injuries. Of 641 injured fishermen, 230 (36%) had serious injuries.

^bA total of 40 fishermen respondents were selected randomly for household data collection, out of which 22 (55%) reported injuries during the 12-month period.

^cOverall, 61.4% of the fishers reported that they had at least ≥ 1 injuries during fishing ($n=44$).

An example of the search words used in PubMed is presented in Appendix Table 1 (available online) and the search strings used in PubMed for searching articles are presented in Appendix Table 2 (available online).

Eligibility Criteria

In this review, only articles published in English were included with no restrictions applied to the date of publication. Only peer-reviewed articles were included. The articles were included if the study population had male or female individuals working as fishermen in artisanal fisheries anywhere worldwide; they were epidemiologic studies with a cohort, case-control, or cross-sectional study design; and had at least information on 1 outcome of interest (fatal injuries, nonfatal injuries, health problems, causal factors). The inclusion criteria initially included studies with fishermen in artisanal fisheries anywhere worldwide, to elucidate the global scenario of artisanal fisheries. Inclusion criteria were then narrowed in the full-text review to include studies only from developing countries. Only fishermen working in the harvesting sector were included and those working in handling and processing of fish were excluded. Because this study was confined to artisanal fisheries, studies related to recreational fishermen, seafarers, and large-scale (industrial) fishermen were excluded.

Study Selection

The records identified from initial search through database searching in PubMed, Embase, Scopus, and Web of Science were imported in the literature reference software EndNote, version 9, and duplicate records were removed. After removing the duplicates, 2 reviewers (SS and BS) independently reviewed and screened the articles based on titles and abstracts to select the studies on artisanal fisheries and occupational risks/hazards and occupational safety and health for full-text review. The retrieved full-text articles were reviewed to determine their eligibility for final analysis. The studies in which it was difficult to distinguish the fishery types, whether artisanal fisheries or industrial fisheries, were further included in full-text review. The articles that did not include details about the type and size of vessels (and therefore the inclusion criteria could not be verified) were excluded from the full-text review. After extraction of the data, a narrative synthesis was done to summarize the findings of the included studies to answer the research questions.

Data Extraction

Data extraction was conducted by a single author (SS), with all data checked by other authors (BS, DAB, OJ) for confirmation.

Any discrepancies were resolved by discussion within the research team. The extracted data were classified according to outcome of interest: fatal injuries, nonfatal injuries, and health problems. The causes of injuries and health problems were also extracted from the included studies.

Synthesis of Results

After extraction of data, a narrative synthesis was conducted to summarize the findings of the included studies. All reviewers were involved in the synthesis of the results and agreed that the studies were important to include. Quality assessment of the included studies was not performed.

RESULTS

The flow chart in Figure 1 shows the data retrieval and search process. The initial literature search in the 4 electronic databases (PubMed, Embase, Scopus, and Web of Science) identified 8,016 records. After removal of duplicates, the titles and abstracts of 4,909 articles were screened for eligibility. A total of 4,835 articles were excluded owing to irrelevance to the topic and 74 articles were identified as relevant. Full texts of the remaining 74 articles were retrieved and reviewed to determine eligibility for final analysis. In addition, the references of retrieved articles were checked to find any additional articles of interest, but none were identified. Of 74 articles, 18 articles addressed studies on occupational safety and health aspects in artisanal fisheries from developing countries and were kept for final analysis. The majority of studies were from Brazil ($n=7$), and the remaining were from Tanzania, Uganda, Kenya, Botswana, Chile, Morocco, Nigeria, Ecuador, Bangladesh, South Korea, and Indonesia ($n=1$ for each).

Fatal Injuries

Drowning was reported as the most common contributor to fatalities among fishermen in the included artisanal fishing studies (Table 1).^{21–24} Of the 4 studies on fatal injuries, only 1 study reported a fatal incidence rate. In 2019, Whitworth et al.²⁴ reported that the incidence rate of fatal drowning among fishermen ($n=2,472$) was 14.2 per 1,000 person-years. In this study, only the incidence rate of drowning was given, so the total number

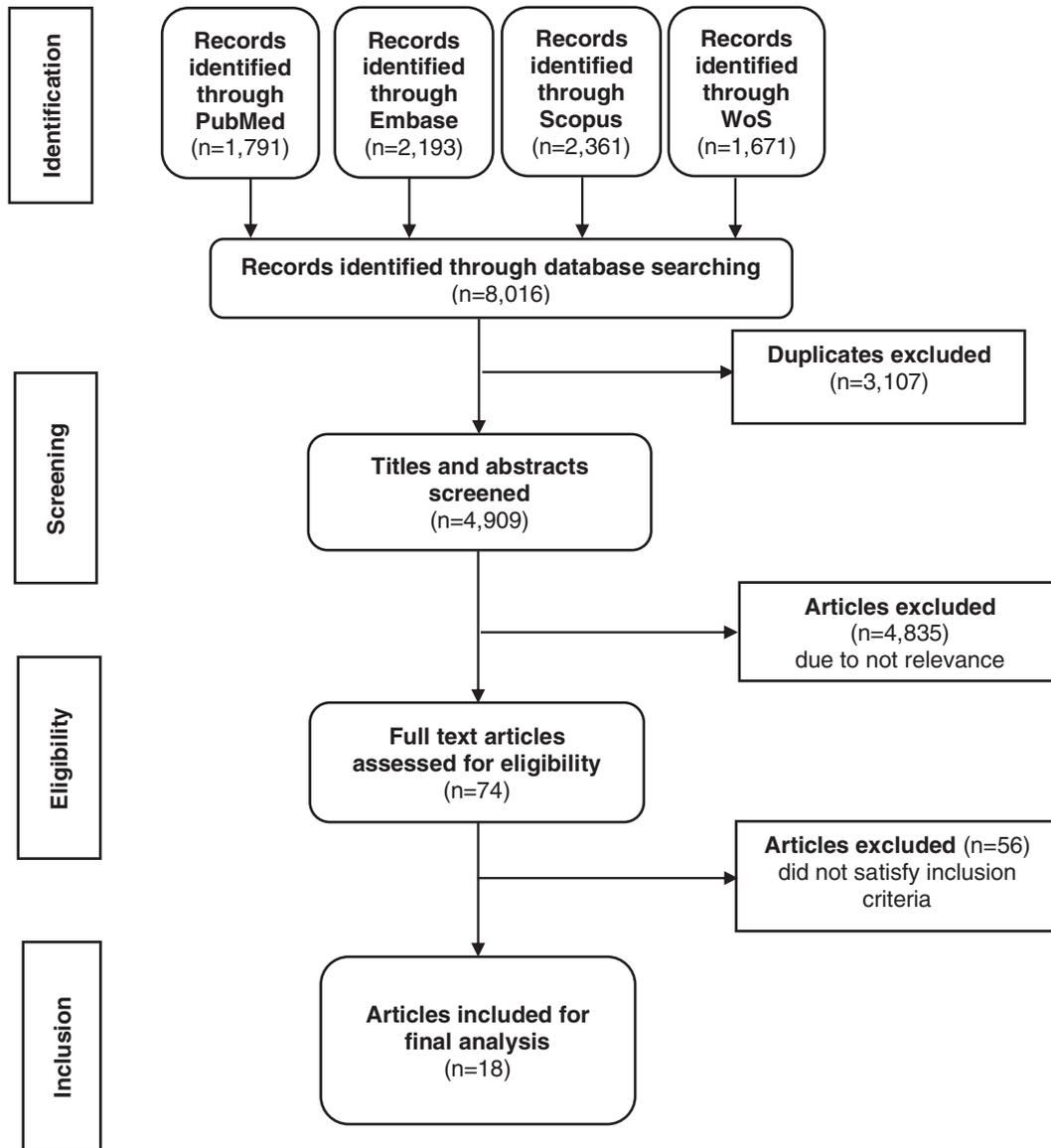


Figure 1. Flow chart for study selection.

of fatal injuries was not available. The incidence rate for drowning was not available from remaining studies owing to unavailability of denominator data.

The drowning-related fatalities were mainly caused by vessel disasters. The most common vessel disasters were boat sinking/capsizing that were reported to be caused by factors such as tropical cyclones, ocean storms, heavy rainfall,²¹ stormy weather, overloading, old age of the boats,²² bad weather, holes in or damage to the boat, collision with rocks, and collision with another boat.²⁴ Several authors have noted that the fishing communities may be subjected to climate-induced displacement and migration because they typically live on low-lying coasts and islands exposed to multiple climatic stresses and shocks.^{25–27}

Nonfatal Injury

In Turkish Aegean small-scale fishermen, 55% of reported injuries were caused by falls on the deck or into the sea (54%) and blows from objects/tools, punctures by fishhooks/fish rays, and cuts (38%) (Table 2).²⁸ Similarly, 55% of injuries reported by the fishermen in Bangladesh were caused by tropical cyclones, ocean storms, and heavy rainfall.²¹ In Botswana, 61.4% of the fishers reported that they had experienced injuries during fishing.²⁹ These injuries were caused by animal attacks or bites (29.5%), accidental falls into the river (20.5%), snake or fish bites (9.1%), fishbone pricks (4.5%), and fishing equipment (4.5%).

Health Problems

Health problems in artisanal fishermen from developing countries are outlined in [Table 3](#).

Eye Problems

In Turkey, the prevalence of self-reported eye problems was 40.4%, and 85% of the respondents reported eye problems caused by the light reflections from the sea.²⁸ Only 34% had worn sunglasses. In Bangladesh, the prevalence of self-reported eye problems faced after arriving home from fishing was 90%, which were caused by use of salt water and direct contact of raindrops into the eyes during fishing.²¹ The majority of the fishermen did not attend any training programs on their occupational activities.

Ear Problems

In a study in Brazil, most of the fishermen who worked in small vessels with no engine had normal hearing, and the fishermen who worked in vessels with engines had high-frequency hearing loss than in age- and gender-matched controls. Overall, 90% of fishermen who worked in boats with engines and no exposure to occupational noise had high-frequency hearing loss. Hearing loss among these fishermen was related to noise exposure, vibrations, and weather conditions.³⁰ The prevalence of self-reported ear problems in Turkey was 21%.²⁸ Similarly, in Bangladesh, 25% of fishermen complained of auditory problems. The majority of fishermen were exposed to sound levels of 90 dB (A) and 104 dB (A).²¹ The prevalence of hearing loss among shellfish divers in Chile was 54.4%, which was found to be associated with diving years and age.³¹

Cardiovascular Problems

In Copacabana and Ponta Grossa fishing communities in Brazil, the prevalence of hypertension among fishermen was 17% and 36%, respectively.³² It was assumed that there was higher incidence of hypertension in Ponta Grossa than in Copacabana owing to the tradition of salting and drying fish for conservation. In another study in Brazil, the prevalence of self-reported hypertension was 27.3%.³³

Respiratory Problems

Decompression sickness prevalence in divers and underwater fishermen varied from 25% to 85% in Galapagos, Indonesia, and South Korea.^{34–36}

Dermatological Problems

A total of 52% of Moroccan small-scale fishermen reported dermatological problems caused by cuts, injuries, and wounds by instruments and fish spines.³⁷

Musculoskeletal Problems

Musculoskeletal disorders (MSDs) were reported owing to the extreme physical demands during the hauling of fishing nets on the rafts in the beach of Ponta Negra, Brazil. Overall, 95% of fishermen felt some pain in the last 7 days, with a high prevalence in the lumbar vertebral spine (71%), neck (57%), knees (52%), and ankles and feet (33%), and 100% in the last 12 months, with high prevalence in lumbar spine (81%) and knees (57%).³⁸ Similarly, a high prevalence of MSDs was reported among female artisanal fishermen in Saubara, Bahia, Brazil, where 95% occurred in any body part, 71% in the neck or shoulder, and 70% in distal upper limb.³⁹ The prevalence of MSDs was 84% in Turkey and 75% in Bangladesh.^{21,28}

The prevalence of low back pain among fishermen in Oyoroknto, Nigeria was 68%.⁴⁰ Similarly, the prevalence of low back pain and discomfort among fishermen from Saubara, Bahia, Brazil in the past 12 months was 83% and 73%, respectively.⁴¹

DISCUSSION

A systematic review of the existing literature was conducted with a particular focus on occupational safety and health aspects of artisanal fisheries. The main aim of this study was to identify the risks of injuries and health problems and their causes.

Of the total 74 full-text articles retrieved for review, 18 studies were conducted in developing countries in artisanal fisheries related to occupational safety and health. There were no studies found from Asia—namely China, India, Malaysia, Philippines, Thailand, and Vietnam—where these fisheries are more prevalent. There is the possibility of missing studies from these countries given the search being limited to articles in English. It is interesting to note that artisanal fisheries in developing countries predominate almost 90% of the total 120 million full-time and part-time global commercial catchers employed within this fishery sector and contribute to about 39% of global catches (including inland catches).¹⁷ However, this review revealed that there is limited research conducted in occupational safety and health in artisanal fisheries in developing countries despite such high figures in terms of their operation, employment, and global fish production. Hence, this review suggests the urgent need for more research representing developing countries in artisanal fisheries related to occupational safety and health.

In this review, 4 studies were found addressing fatal injuries in artisanal fisheries from developing countries. The included studies reported fatalities in numbers and proportions. However, a comparison between the

Table 3. Health Problems Among Artisanal Fishermen in Developing Countries

Health problems/Author	Country	Sample size (n)	Findings
Eye problems			
Percin (2012) ²⁸	Turkey	1,166	Prevalence of self-reported eye problems was 40.4%. Among interviewed fishermen, 85% reported eye problems caused by light reflection from the sea.
Mandal (2017) ²¹	Bangladesh	40	Prevalence of eye problems after arriving at home from fishing was 90%. Eye problems were caused by use of saline water and direct contact of raindrops into the eyes during fishing.
Ear problems			
Paini (2009) ³⁰	Brazil	141	Prevalence of high-frequency hearing loss was 90% in fishermen who worked in boats with engines and had no exposure of occupational noise exposure compared with age and gender-matched controls. Noise exposure, weather conditions, vibrations, and chemical exposures were mentioned as risk factors for hearing loss.
Percin (2012) ²⁸	Turkey	1,166	Prevalence of ear problems was 21%.
Mandal (2017) ²¹	Bangladesh	40	Prevalence of auditory problems was 25%.
Garrido Campos (2018) ³¹	Chile	125	Prevalence of hearing loss among shellfish divers was 54.4%. Diving years (>25 years) was associated with sensorineural and other types of hearing loss, and when age and potential risk factors were adjusted, age (≥40 years) was only associated with other type of hearing loss.
Cardiovascular problems			
Begossi (2013) ³²	Brazil	14 and 18	Hypertension was 17% in Copacabana and 36% in Ponta Grossa.
Müller (2016) ³³	Brazil	209	Hypertension was 27% in Saubara.
Respiratory problems			
Westin (2005) ³⁴	Ecuador	12	Prevalence of DCS among Galapagos underwater fishermen was 3 of 12 (25%) observed divers. DCS was common owing to diving beyond the no-decompression limits.
Wahab (2008) ³⁵	Indonesia	117	Prevalence of post-diving DCS among observed divers was 53%.
Cha (2018) ³⁶	South Korea	196	Prevalence of DCS symptoms among fishery divers was 85%, and the significant risk factors were working days per month, dives per day, average bottom time, and rapid ascent ($p<0.05$).
Dermatological problems			
Laraqui (2018) ³⁷	Morocco	1,102	Among the artisanal fishermen, 52% of scares in skin reported were caused by cuts, injuries, and wounds by instruments and fish spines. In addition, 11% of traumatic skin disorders were caused by marine creature stings.
Musculo-skeletal problems			
Jaeschke and Saldanha, (2012) ³⁸	Brazil	21	The physical demands during the hauling of fishing nets for artisan fishermen using rafts in the beach of Ponta Negra, Natal, were extreme: 95% reported feeling some pain on the last 7 days and 100% in the last 12 months in the highest lumbar vertebral spine, knees, ankles, and feet.
Falcão (2015) ³⁹	Brazil	209	Prevalence of MSDs among artisanal fisherwomen in Saubara, Bahia was 95% in any body parts, 71% in neck or shoulder, and 70% in distal upper limb.
Percin (2012) ²⁸	Turkey	1,166	Prevalence of musculoskeletal problems was 84%.
Dienye (2016) ⁴⁰	Nigeria	384	Prevalence of LBP among fishermen in Oyoroknto fishing settlements was 68%.
Mandal (2017) ²¹	Bangladesh	40	Prevalence of musculoskeletal complaints during 12-month period was 75%.
Barreto Moreira Couto (2019) ⁴¹	Brazil	209	Prevalence of low back pain or discomfort in the last 12 months and cases of lower back MSDs in Saubara, Bahia were 83% and 73%.

DCS, decompression sickness; LBP, low back pain; MSD, musculoskeletal disorder.

countries is not possible given the difference in data collection and analysis methods and the reference population (denominator) is unknown. As shown in [Table 1](#), the proportion of drowning-related fatal injuries were reported between 14.3% and 81% in an 18-month period. A total of 3 studies addressed nonfatal injuries in artisanal fisheries. These studies also reported injuries in numbers and proportions only. As shown in [Table 2](#), these studies reported proportions of nonfatal injuries between 55% and 61%. The data related to fatal and nonfatal injury provided here are not sufficient to generalize the risk of injuries, because the studies address a small sample size with a poor study design. The possible reason behind the lack of research studies in this field is likely to be institutional or resource related (funding, low research priority, lack of data availability). Simultaneously, the poor documentation and reporting system of injuries also seem to result in the lack of necessary information/data needed for adequate analysis and the establishment of prevention interventions. This could also be because relevant studies might have been published only in the national language.

This review suggests that the leading cause of fatalities in artisanal fisheries in developing countries was drowning. Drowning resulted mainly because of vessel disasters and falls overboard. The factors contributing to vessel disasters were diverse and multiple, including tropical cyclones, ocean storms and heavy rainfalls, stormy weather, overloading, unseaworthy vessels, collisions, weather changes during fishing, and unstable river topography. Many of these fatalities could have been prevented with the availability of communication systems and safety gear. The use of safety gear, such as life jackets or any type of personal flotation device, by crew and passengers on small boats has been proved to be beneficial for the prevention of drowning.^{42–44} By contrast, the causes of nonfatal injuries were animal attacks or bites, accidental falls, snake or fish bites, fishbone pricks, and fishing equipment. Many of these injuries could have been prevented or minimized by providing training and carrying first aid supplies on board. Increased awareness and safety training for fishermen are needed.¹⁶

Studies on injuries from developing countries reported numbers and proportions of injuries and fatalities among fishermen, but information about the population at-risk was not mentioned. Thus, the incidence rate could not be determined in any of these studies.⁴⁵ However, the difficulty in calculating incidence rates in fatal injuries in fishing characterizes both developed and developing countries and has been documented in the scientific literature extensively. Fatal and nonfatal injuries among fishermen in developing countries are much

likely to be higher than those reported given reasons such as lack of available data. There are no proper reporting systems for injuries at sea, and injuries are often not reported.¹⁶ Therefore, it is important to be cautious when drawing comparisons based on these data given the higher possibility that many incidents might go underreported.

This review did find studies among artisanal fishermen reporting specific health problems, namely eye problems, hearing loss, hypertension, decompression sickness, skin problems, and MSDs. The majority of these studies addressed the problems of MSD and pain. The prevalence of MSDs among fishermen in Nigeria, Turkey, Bangladesh, and Brazil ranged from 68% to 95%. Contrary to the prevalence of MSDs reported in a study in Andalusia, Spain, a developed country,⁴⁶ the prevalence reported in these countries was much higher. Low back (lumbar spine) pain was the most prevalent MSD, and other body parts affected were the neck, shoulders, and knees. The main cause of MSDs was ergonomic conditions. MSDs were associated with aggregate physical demands, age, daily work hours, work posture, educational status, and type of boats used. The prevalence of self-reported eye problems among fishermen in Turkey and Bangladesh was 41% and 90%, respectively. The prevalence of hearing problems varied from 21% to 90% in Turkey, Bangladesh, Chile, and Brazil. These results are higher than the prevalence of eye and hearing problems reported in Andalusia, Spain.⁴⁶ The prevalence of dermatological problems was high among Moroccan artisanal fishermen. The review also suggests that skin disorders were caused not only by infections, but also because of trauma. A total of 52.2% of fishermen reported scars in skin caused by cuts, injuries, and wounds by instruments and fish spines. Quite possibly, skin disease could also have been caused by the polluted water, which is not mentioned here.

There is variation in prevalence of health outcomes across countries, which could be caused by differences in geographic location, weather conditions, and types of fishing methods, equipment, or techniques used. In addition, MSDs have received more attention than some other health problems from only a limited number of studies. This could be because of the researcher's interest and focus. This review finds a lack of research attention of mental health issues in artisanal fisheries in developing countries. They work in extreme conditions and face several unexpected events at sea, including catastrophic disasters.^{47,48} Such work environments obviously place them at high risk for mental health conditions.

The scarcity of studies in artisanal fisheries related to safety and health in developing countries showed a clear gap in scientific inquiry/research. A recent review

conducted in Latin America that primarily consisted of small vessels also found that fatal and nonfatal injury studies were absent in this area.⁴⁹ It is increasingly clear that there is a need for conducting well-designed safety and health studies in artisanal fisheries. In addition, the existing data reported in available studies are insufficient to better understand the patterns and determinants of injuries, fatalities, and health problems. Therefore, proper reporting systems for injuries, fatalities, and health in this fishery sector is badly needed in developing countries. The Food and Agriculture Organization (FAO) has developed guidelines for an accident reporting and analysis system for small fishing vessels to support improving the safety of fishermen worldwide and particularly in developing countries that are often the most vulnerable.⁵⁰ The guidelines have been tested in 3 countries, Cambodia, Indonesia, and Timor-Leste.⁵¹ The development of effective intervention plans would be greatly enhanced by understanding the patterns and determinants of injuries, fatalities, and health problems.

The lack of national health information systems prevents governments and the national maritime authorities from planning, implementing, and obtaining feedback on strategies to decrease injuries and fatalities. FAO has developed voluntary guidelines for securing sustainable small-scale fisheries to help improve the conditions for these workers.⁵² However, with the small number of studies on fatalities, nonfatal injuries, and health problems and lack of monitoring of the incidents, it is difficult or impossible to follow the FAO guidelines and make a difference in the vast number of population's lives.

In contrast, fishermen in developed countries routinely learn how to conduct and record a risk assessment and how safety management systems can help to improve safety on fishing vessels. Most countries have made it obligatory for young fishermen to be aware of the importance of conducting a risk assessment before leaving shore. These experiences should also be used in developing countries. The need for fishermen safety training is not reflected sufficiently in the literature and should be included in future research.

Limitations

This review has significant limitations. The articles were included if they met the 3 criteria of the building block search strategy. Only articles in English were considered eligible, and thus relevant research in other languages might have been missed. Calculation of incidence rates was not possible owing to unavailability of denominator data. Only fishermen working in the harvesting sector were included. In many artisanal fisheries, the fishermen may perform both harvesting and post-harvesting

processing of fish, but occurrence of injuries or fatalities might not be reported separately.

CONCLUSIONS

In all, 18 articles on occupational safety and health in artisanal fisheries from developing countries were kept for final analysis. Only 4 studies were on fatal accidents, and only 1 calculated incidence rates. Although most of the studies fail to use epidemiologic incidence and prevalence rates, there is an urgent need to establish a health information system in developing countries. In addition, the authors support FAO efforts to create a global monitoring system in which all injuries, including fatal accidents, should be recorded in the logbook on board and reported to the local harbor control authorities. Such control authorities should be established in the states where they are absent. The registry should include epidemiologic denominators with the number of annual fishermen and days at sea to calculate the injury incidence rates. Fishing vessels and safety equipment should be inspected annually in the ports. In addition, an annual medical health examination of the fishermen should be established globally.

The lack of occupational injury studies in fishing is striking, and this urgently calls for establishment of occupational injury registers and constant safety monitoring in fishing in all developing countries. The UN FAO program for sustainable fishing in developing countries could be prompted to include a Public Health Program in the Sustainable Fishing Programs. Finally, universities should include research training programs to overcome the gap of information and safety training for all fishermen.

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CREDIT AUTHOR STATEMENT

Sharad Shrestha: Data curation; Formal analysis; Investigation; Writing - original draft; Writing - review and editing. Bipna Shrestha: Data curation; Formal analysis; Investigation; Writing - original draft; Writing - review and editing. Despena Andrioti Bygvraa: Conceptualization; Methodology; Supervision; Writing - review and editing. Olaf Jensen: Methodology; Supervision; Validation; Writing - review and editing.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at <https://doi.org/10.1016/j.amepre.2021.08.031>.

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