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Musculoskeletal disorders of fishermen in the artisanal and coastal sector

Omar Laraqui[1], Christine Roland-Lévy[1], Tarik Ghailan[2], Hicham El Bouri[3], Nadia Manar[4], Frédéric Deschamps[5], Chakib El Houssine Laraqui[4]

[1]Laboratoire de psychologie, Cognition, Santé, Socialisation, Reims, France
[2]Moroccan Society of Maritime Health, Tangier, Morocco
[3]Faculty of Medicine and Pharmacy of Tangier, Morocco
[4]Graduate School of Health Engineering, Casablanca, Morocco
[5]University Institute of Occupational Health and Environmental Medicine, Reims, France

ABSTRACT

Background: *The aim of this study was to screen for musculoskeletal disorders (MSD) complaints, to analyse the activity and to identify their risk factors.*

Materials and methods: *This cross-sectional epidemiological study involved 903 men aged > 20 years and with a seniority > 2 years. It included a questionnaire and an ergonomic analysis of the activity. The questionnaire included: socio-demographic and occupational characteristics, health status and life habits, stress and items from the Nordic questionnaire. The observation of work situations required video recordings and the use of three methods: Occupational Safety and Health Administration (OSHA), Rapid Upper Limb Assessment (RULA) and the Gesture Tracking and Assessment Tool (*Outil de Repérage et d'Évaluation des Gestes: *OREGE).*

Results: *The prevalence of MSDs was 61.9%. It was significantly higher among deckhands than among other professionals (65.6% vs 27.4%; p < 0.001) and in seasonal workers than in permanent workers (67.8% vs 43.1%; p < 0.001). A positive correlation was noted between MSDs and daily work duration. Stress was an aggravating factor, whereas leisure activities were protective. The prevalence of MSDs was 40.5% (lower back), 40.4% (wrist/hand joints), 34.6% (neck) and 31.7% (shoulders). The ergonomic analysis of the workstation was performed on a deckhand who unloaded the fish crates out of the hold of a trawler. OSHA score = 12 (normal < 5); significant risk of upper limb MSD. RULA total score = 7 (acceptable between 1 and 2); immediate modification. OREGE scores evaluating effort, repetitiveness and joint positions indicate that the actions were not recommended or to be avoided.*

Conclusions: *The analysis made it possible to evaluate the difficulty of the job and to note a high risk of MSDs requiring ergonomic and organizational improvements.*

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Keywords: fishermen, musculoskeletal disorders, screening, biomechanics, risk factors

INTRODUCTION

In many sectors of activity, musculoskeletal disorders (MSDs) are the most frequent compensable occupational diseases and the main source of work-related limitations [1]. MSDs encompass a wide range of diagnoses and symptoms, which primarily cover pain. They are multifactorial, involving individual susceptibility factors and occupational biomechanical, organizational and psychosocial fac-

Chakib El Houssine Laraqui Hossini, Graduate School of Health Engineering, Casablanca, Morocco, e-mail: chlaraqui51@gmail.com

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tors. The available literature on the association between psychosocial risks and MSDs relates mainly to painful symptoms and less often to specific pathologies. Their chronicity has negative repercussions on workers' health. Sea fishermen (SF) in the small-scale and coastal sector are a particular target because they are confronted with biomechanical constraints linked to the arduousness of the work, unfavourable weather conditions, high occupational stress and financial difficulties with concerns about their daily income [2]. In the international literature, the overall prevalence of MSDs among SF varies from 15% to 93% [3]. The variations observed in these prevalences could be due to differences in methodology, the characteristics of the populations and the definition of MSDs (subjective complaint or objective diagnosis) [3]. Nevertheless, the literature has reported a high risk of MSDs in SF, and has highlighted the arduous nature of their profession, linked to heavy workloads and a dangerous, uncontrollable environment. This calls for ergonomic and organizational improvements [4]. No study has been carried out on MSD among fishermen in Morocco. The aim of this study was to detect and assess the prevalence of MSDs in SF, to specify their locations and to identify their risk factors. An ergonomic analysis of the activity using the observation of work situations, video recordings and the use of three methods (OSHA, RULA and OREGE) allowed us to identify their risk factors [5–7].

MATERIALS AND METHODS

TYPE OF STUDY

This observational, cross-sectional epidemiological study took place in three fishing ports in northern Morocco (Tangiers, Larache and M'diq) in 2021.

POPULATION

The activity being exclusively male, our representative sample therefore included 1404 male fishermen aged over 20 and with more than two years' seniority. They were selected by drawing lots in an elementary fashion from the computerized administrative list of all 4,212 SF in the craft and coastal sectors. The sample size was 33.3% of the total workforce. The SF worked every day except Fridays, public holidays and when the weather did not allow going to sea. In the inshore sector, sardine fishermen worked night shifts, longliners alternated shifts and trawlers worked irregular shifts. The first boats held around thirty people, the second and third boats between 10 and 20 people. The sardine boats set off each day at sunset and returned in the morning at around 8 am. Longliners sailed for 3 to 6 days and stayed in port for one or two days between tides. Trawlers were at sea for 4 to 6 days and work on board was done on a rota system, often in two or three shifts.

The average shift lasted 11 to 12 hours. In the small-scale fishing sector, sea trips lasted a maximum of sixteen hours in small boats with fewer than five people.

APPROACH TO IMPLEMENTING THE STUDY

This was inspired by the "Screening, Observation, Analysis, Assessment (SOBANE)" risk prevention strategy [8].

Our method consisted of two stages:

The first: screening for MSDs using a questionnaire and the Occupational Safety and Health Administration (OSHA) checklist, which is a method for screening work situations likely to be at risk of upper limb MSDs [5].

The second: observation and ergonomic analysis of activity using two easy and validated methods (RULA and OREGE) [6, 7]. Video recordings of an entire work cycle were made and meticulously analysed. The biometric study was carried out at the workstation of a seaman working in inshore fishing on board a trawler. The choice of this workstation was dictated by the results of the questionnaire, which showed an increased risk of upper limb MSD in this operator.

STUDY TOOLS

The MSD screening questionnaire included:

— Socio-demographic and occupational parameters: age, level of education, professional training, professional category, job seniority, type of employment (seasonal or permanent), daily working hours.

— Health parameters and lifestyle habits: body mass index (BMI), regular physical activity — Sports (at least three times a week), consumption of psychoactive substances (tobacco, cannabis, alcohol), and stress-related psychosomatic symptoms. The latter include neurovegetative disorders (palpitations, precordial pain, difficulty breathing, sweating in the absence of physical effort, dry mouth), mood disorders (anxiety, irritability, nervousness) and sleep disorders (difficulty falling asleep, interrupted sleep, sensation of not having slept). For these disorders, the items were expressed on a discontinuous Likert-type frequency scale. The answers "never" and "rarely" were considered as rejected and the answers "always", "sometimes" and "often" as present. The self-assessed state of stress was estimated according to the response to the following question: "In the past six months, have you felt stressed? or did you feel like the demands of your job have exceeded your capabilities?" Responses were expressed on a discontinuous Likert-type intensity scale. The responses "not at all" and "a little" were considered negative while the responses "quite a bit" and "a lot" were considered positive.

— Items from the Nordic MSD Screening Questionnaire, in particular the question relating to pain and discomfort limiting work activity during the previous twelve months

[9]. The responses were expressed on a discontinuous Likert-type frequency scale. The answers "almost never; every 6 months" and "rarely; every 3 months" were considered to be rejected, while the answers "sometimes; every month", "often; every week" and "almost always; every day" were considered to be present.

— The Occupational Safety and Health Administration (OSHA) checklist: The principle consists of questioning the operator about his working conditions and estimating the MSD risk factors relating to the upper limbs. The answers are scored using a standard grid. The MSD risk factors, assessed according to the duration of exposure, are repetitiveness, manual effort, awkward postures, excess skin pressure, vibrations, the physical environment and control of work rates. The total score must be less than 5 [5].

Analysis of the activity through observation of work situations and video recordings, and assessment of the musculoskeletal constraints resulting from the performance of the task using two simple, rapid and validated methods.

*The Rapid Upper Limb Assessment (RULA) method, which requires observation over several work cycles in order to select the most frequent posture and/or the one that is the most restrictive a priori. It is a reference method for rating joint positions. It takes into account the totality of body posture, muscular activity and the forces required, using scores and grids. The A score corresponds to the position of the shoulder (arm), elbow (forearm), wrist (hand) and wrist pronosupination. It is deduced from a grid. The C score = A score (posture) + M score (muscular activity) + F score (effort and weight of the load handled). The B score corresponds to the position of the neck, trunk and legs. It is deduced from a grid. Score D = score B (posture) + score M (muscular activity) + score F (effort and weight of the load handled). The final score, representative of the risk of MSDs, is obtained by cross-referencing score C and score D on a grid. If the final score is equal to 1 or 2, the situation is acceptable, at 3 or 4 modifications may be necessary, at 5 or 6 modifications are necessary without delay, or greater than or equal to 7, modifications must be immediate [6].

*The Gesture Tracking and Assessment Tool (*Outil de Repérage et d'Évaluation des Gestes*: OREGE) is used to evaluate the biomechanical risk factors for MSDs in the upper limbs. This analytical biometric method is based on meticulous observation of work cycles and different postures. It makes it possible to assess the three biomechanical risk factors: effort, repetitiveness and joint positions. The assessment of effort and repetitiveness is based on a comparison between the assessment of the health and safety officer and that of the operator, using a visual analogue scale from 0 to 10. Joint positions are assessed by measuring angles. For each joint, there are acceptable or comfort zones and risk zones. The scores awarded are 1 for the comfort zone, 2 for the not recommended zone and 3 for the zone to be avoided. The combination of the three risk factors leads to the conclusion that the level of risk is acceptable if equal to 1, not recommended if equal to 2 or to be avoided if equal to 3 [7].

CONDUCTING THE SURVEY

Before setting up the survey, we contacted the doctors in charge of the seafarers' health units and the members of the board of the SF association to explain the aim of the study and obtain their support. Free and informed consent was obtained from all participants in the study. The interviews took place at the seafarers' health centre in the port. The one-to-one discussion with each fisherman was conducted confidentially after he had been informed of the purpose of our study. The interview lasted between 15 and 20 minutes for each person. The questions were formulated orally, translated into dialectal Arabic if necessary, and explained in simple terms accessible to all.

STATISTICAL ANALYSIS

The statistical study was based on analysis of variance and Student's t-test for comparison of means. For qualitative variables, it is based on the Chi-square test for one degree of freedom. The significance threshold chosen corresponds to a p-value of less than 0.05. The software used is epi info (version 6.04 dfr). For the proportions, the lower and upper limits of the 95% confidence intervals (CI) were calculated.

RESULTS

Of the 1404 SF drawn at random, 903 agreed to take part in the study, representing a participation rate of 64.3%.

PREVALENCE OF MSDS ACCORDING TO SOCIO-DEMOGRAPHIC CHARACTERISTICS (TABLE 1)

The prevalence of MSDs in the total population was 61.9%. It increased with age, reaching 68.9% in SF aged over 50. In people aged under 40, it was 57.4% and 66.7% in those over 40 ($p = 0.005$). It was significantly higher among the illiterate than among those who had attended school (71.5% vs 57.8%; $p < 0.0001$). It was significantly higher among those with a traditional apprenticeship than among those with a fishing diploma (67.2% vs 44.3%; $p < 0.0001$).

PREVALENCE OF MSDS ACCORDING TO SOCIO-OCCUPATIONAL CHARACTERISTICS (TABLE 2)

The prevalence of MSDs was significantly higher among deckhands than among other occupational categories (65.6% vs 27.4%; $p < 0.0001$) and among seasonal workers than among permanent workers (67.8% vs 43.1%;

Table 1. Prevalence of MSDs according to socio-demographical parameters

Socio-demographical parameters	Total population		MSD	
	n = 903	95%CI	n = 559 (61.9)	95%CI
Age (years)				
21–30	209 (23.1)	[20.6; 26.1]	110 (52.6)	[46.3; 59.9]
31–40	253 (28.0)	[24.8; 31.1]	155 (61.3)	[55.3; 67.3]
41–50	232 (25.7)	[22.9; 28.6]	150 (64.7)	[58.5; 70.8]
> 50	209 (23.2)	[20.4; 26]	144 (68.9)	[63.8; 74]
Average age	39.8 ± 12	[39; 40.7]	40.8 ± 12.1	[40; 41.6]
Educational level				
Illiterate	270 (29.9)	[27.1; 33]	193 (71.5)	[66.1; 76.9]
Primary	440 (48.7)	[45.3; 52]	278 (63.2)	[61.1; 65.7]
Secondary	191 (21.2)	[18.3; 24.1]	87 (45.5)	[38.4; 52.6]
Superior	2 (0.2)	[0; 0.7]	1 (50)	[21.5; 78.5]
Professional training				
Traditional learning	693 (76.7)	[74; 79.3]	466 (67.2)	[63.9; 70.9]
Diploma in fishing studies	210 (23.3)	[20.7; 26]	93 (44.3)	[37.6; 51]

Table 2. Prevalence of MSDs according to occupational parameters

Occupational parameters	Total population		MSD	
	n = 903	95%CI	n = 559 (61.9)	95%CI
Professional categories				
Pilots	81 (9)	[7.1; 11]	44 (54.3)	[43.5; 65.1]
Mechanics on board	77 (8.5)	[6.8; 10.6]	45 (58.4)	[47.4; 69.4]
Deckhands	745 (82.5)	[80; 85]	470 (63.1)	[59,1; 67.1]
Job seniority (years)				
2–10	309 (34.2)	[30.8; 37.4]	185 (60)	[55.5; 64.6]
11–20	301 (33.3)	[30.3; 36.3]	191 (63.5)	[58.4; 69.2]
21–30	179 (19.8)	[17.1; 22.2]	111 (62)	[54.9; 69.1]
> 30	114 (12.6)	[10.4; 14.7]	72 (63.2)	[59.2; 67.2]
Average seniority	17.3 ± 10.6	[16.5; 18]	17.6 ± 10.6	[16.9; 18.3]
Daily working hours				
≤ 10 h	264 (29.2)	[26.3; 32.1]	144 (54.5)	[52.4; 64.2]
11–14 h	508 (56.3)	[60.7; 67]	332 (65.4)	[61.5; 69.7]
≥ 15 h	131 (14.5)	[12.1; 16.9]	83 (63.4)	[47.2; 64.2]
Average	13.2 ± 7.9	[12.7; 13.7]	13.2 ± 8.4	[12.7; 13.7]
Type of job				
Seasonal	687 (76.1)	[73.3; 78.9]	466 (67.8)	[63.9; 71.7]
Permanent	216 (23.9)	[21.1; 26.6]	93 (43.1)	[39; 47.2]

$p < 0.0001$). A positive correlation was noted between daily working hours and the frequency of MSDs.

PREVALENCE OF MSDS AS A FUNCTION OF HEALTH STATUS AND LIFESTYLE HABITS (TABLE 3)

BMI correlated positively with the prevalence of MSDs, but not significantly. The use of tobacco, alcohol and cannabis did not influence the prevalence of MSDs. Stress was a significantly aggravating factor ($p < 0.001$), while sport and leisure activities were protective factors ($p = 0.049$). The prevalence of MSDs was significantly higher in people with psychosomatic manifestations of stress ($p < 0.001$).

PREVALENCE OF LOCATIONS IN PEOPLE WITH MSDS (TABLE 4)

The prevalence of MSDs was higher in the lower back (40.5%), wrist/hand joints (40.4%), neck (34.6%) and shoulders (31.7%).

Table 3. Prevalence of MSDs according to health status and lifestyle habits

Health status and lifestyle habits	Total population		MSD		
	n = 903	95%CI	n = 559 (61.9)	95%CI	p
Body mass index [kg/m²]					0.398
Normal	505 (55.9)	[52.7; 59.1]	306 (60.6)	[56.5; 64.6]	
Overweight	353 (39.1)	[35.9; 42.3]	221 (62.6)	[58.6; 66.6]	
Obesity	45 (5)	[3.6; 6.4]	32 (71.1)	[67.3; 74.9]	
Average	24.9 ± 3.1	[24.7; 25.1]	24.85 ± 2.8	[24.6; 25.1]	
Toxic habits					0,580
Tobacco	555 (61.5)	[58.3; 64.7]	348 (62.7)	[58.7; 66.7]	0.08
Alcohol	131 (14.5)	[12.2; 16.8]	85 (64.9)	[60.9; 68.9]	0.898
Cannabis yes	245 (27.1)	[24,2; 30]	153 (62.4)	[58.4; 66.4]	
Sports and leisure	153 (16.9)	[14.5; 19.3]	106 (69.3)	[65.5; 73.1]	0.049
Self-reported stress	469 (51.9)	[48.6; 55.2]	351 (74.8)	[71.2; 78.4]	< 0.001
Psychosomatic symptoms of stress	585 (64.8)	[61.7; 67.9]	446 (76.2)	[72.7; 79.7]	< 0.001
Neurovegetative disorders	456 (50.5)	[47.2; 53.8]	338 (74.1)	[70.5; 77.7]	< 0.001
Mood disorders	540 (59.8)	[56.6; 63]	368 (68.1)	[64.2; 72]	< 0.001
Sleeping disorders	343 (38)	[34.8; 41.2]	227 (66.2)	[62. ; 70.1]	0.045

Table 4. Prevalence of locations in people with MSDs

Locations of MDS	MSD 559/903 (61.9)	IC 95%
Neck	194 (34.6)	[30.7; 38.8]
Shoulders	177 (31.7)	[27.8; 35.6]
Elbows	107 (19.1)	[16; 22.4]
Wrists/hands	226 (40.4)	[36.6; 44.8]
Top of the back	140 (25)	[21.7; 28.8]
Lower back	227 (40.5)	[36.7; 44.9]
One or two hips	59 (10.5)	[8.2; 13.2]
One or two knees	126 (22.5)	[18.7; 26.2]
One or two ankles	102 (18.2)	[15; 21.4]

ERGONOMIC ANALYSIS OF THE WORKSTATION USING THREE METHODS FOR A DECKHAND WORKING ON A TRAWLER

Working conditions

The study was carried out on a trawler deckhand who was unloading crates of fish. The deckhand was 53 years old, 1.71 m tall and weighed 75 kg. He had no medical or surgical history, but was a smoker and cannabis user. He had worked for the company for 20 years. He had received no vocational training and was paid by the share.

The trawler hold was a space in the basement of the trawler where fishing products were stored, the size of which varied from trawler to trawler. It was 6m long, 5m wide and 2.70 m high. The ambient temperature was 4 °C with a relative humidity of 80%. The hold was narrow, damp and cold. The floor was slippery and the crates of fish poorly stored. These constraints put the fisherman at risk of falling, especially as he was lifting crates weighing 20 to 25 kg higher than he was tall. The deckhand wore a mackintosh with braces and boots, but no gloves.

The analysis of the activity consisted of unloading the crates of fish from the trawler's hold. The duration of this activity depended on the number of crates to be unloaded, which varied according to the catch. During our study, this activity lasted 1 hour. The deckhand's activity was divided into 3 phases. During the first phase, the deckhand bent down to grasp the crate of fish held out by a colleague. During the second, he carried and held the crate with his hands and turned around. Finally, he lifted it and handed it to another colleague.

Screening for MSD risk factors using the OSHA method

The score for this job was 12; the seafarer was highly exposed to MSD risks.

Assessment of biomechanical risk factors using the RULA method

The C score, calculated from the A = 3 score, the M = 1 score and the F = 3 score, was equal to 7 and reflects stress in the wrists and forearms. Score D, calculated from score B = 5, score M = 1 and score F = 3, was equal to 9 and reflects stress in the trunk (spine) and neck. The final score, deduced from scores C and D, was equal to 7 and recommends immediate preventive measures.

Assessment of biomechanical risk factors using the OREGE method

The duration of the crate unloading activity was 1 hour. This method was used to assess the effort, repetitiveness

and joint positions for the 3 actions, each lasting three seconds. Action 1 consisted of bending down to grasp the crate with both hands. Action 2 consisted of carrying and holding the crate with both hands. Action 3 consisted of lifting and handing the crate to the colleague. The effort score was 6 for action 1, 3 for action 2 and 8 for action 3. The repetitiveness score for the 3 actions was 7, which corresponds to high repetitiveness. The joint position scores were for action 1 (2 for the neck, 2 for the shoulder, 2 for the elbow and 2 for the wrist), for action 2 (2 for the neck, 2 for the shoulder, 1 for the elbow and 2 for the wrist) and for action 3 (2 for the neck, 3 for the shoulder, 1 for the elbow and 2 for the wrist). The combination of these scores confirmed that the risk level was equal to 2, i.e. not recommended, for actions 1 and 2, and equal to 3, i.e. to be avoided, for action 3. The combination of scores for effort, repetitiveness and joint positions highlighted a strong predisposition of deckhands to the risk of upper limb MSDs.

DISCUSSION

Small-scale and inshore maritime fishing is perceived as a dangerous and arduous profession, for which studies have reported an excessive risk of MSDs [3]. The workload consists essentially of dynamic work and frequent manual handling of the catch (lifting, pushing and pulling), which affect the musculoskeletal system. The term MSD covers several inflammatory and degenerative diseases and disorders, and can result from a single or cumulative trauma, causing acute or recurrent long-term pain and disability. MSDs therefore have a negative impact on an individual's quality of life, with an alteration in physical and mental well-being, absenteeism and early retirement. Multiple environmental exposures have an impact on the daily lives of fishermen: limited shifts, long working hours in the cold and bad weather, insufficient sleep and irregular rest periods, with the manual handling of heavy loads on small, damp, slippery and mobile surfaces. Sudden movements of the vessel lead to poor weight distribution when lifting or pushing heavy equipment, increasing the risk of injury. Restricted or limited working spaces also reduce the possibility of adopting healthy working postures and varying working positions [3]. In our study, the prevalence of subjectively reported MSDs was 61.9%. It was 84%, 89.7% and 94% respectively in Turkish, Brazilian and Egyptian SF [10–12]. In a Sri Lankan study, 61% had pain for more than 3 days a week [13]. Pain was experienced in the last 3 months by 82% of a random sample of fishermen in the United States [14]. In England, a prevalence of 15% of MSDs was noted for sufficiently serious cases requiring medical consultation or absences of more than three days from work during the previous 12 months [15]. This prevalence was 29% among Andalusian fishermen [16]. These significant variations in prevalence are thought to be due to the working conditions in each country, the different methods used in the studies and the transactional models. The perception of the work situation and the implementation of adaptation mechanisms by the individual (coping strategies) may explain the individual variability. Some people are resilient to psychosocial risks, including MSDs, while others suffer from them [17, 18]. The prevalence of low back pain among our SF was the highest at 40.5%, followed by hand/wrist pain (40.4%). A systematic review including thirteen publications reported that low back pain was mainly the most affected body area. Other specific body areas were the shoulder, hand/wrist and knee [3]. The prevalences of MSD-related complaints and illnesses were variable but high in all the studies. Their variations could be explained by differences in the characteristics of the population and the sources of information (complaints or confirmed illnesses). Self-reported MSD complaints are more frequent than musculoskeletal diseases [3]. According to the 2017 Danish National Health Report, 70% of the people often experienced pain or discomfort, while only 21% had osteoarthritis and 14% were diagnosed with spinal or thoracolumbar disc abnormalities [3]. Three studies evaluating complaints using the Nordic questionnaire reported high prevalences ranging from 74% to 83% [19, 20]. In a study of the French working population, nearly 84% of respondents had experienced pain in at least one area of the body in the last year, and 33% of men had experienced pain in the last 30 days [21]. In Norway, the Nordic MSD questionnaire was used in healthy individuals and showed a prevalence of complaint over 12 months ranging from 69% to 82% [22]. It seems that the prevalence of self-reported MSDs in FM worldwide is comparable to that found in general populations, but MSDs in FM are more severe [3]. This severity is linked to the numerous biomechanical and psychosocial constraints. Seamen in this sector are multi-skilled, maintaining boats and nets while taking part in fishing. It appears that self-reported MSDs in SF worldwide are comparable to those found in general populations, but MSDs in SF are thought to be more severe [3]. Multi-skilled, the deckhand in this sector maintains the boats and nets while taking part in the fishing. He prepares the various fishing instruments: nets, lines, trawls. They plunge them into the sea, keep an eye on them and haul them back up when enough fish have been caught. These very physical tasks are carried out by hand or with basic mechanical tools: winches or lifting gear. Depending on the size of the boat and the type of fishing, the division of labour can vary. On a small vessel, the fisherman sorts the different types of catch, crates them and preserves them by salting or covering them with ice. The deckhand also carries out repairs, routine maintenance (greasing, painting) and cleaning work on the boat. On watch, they take it in turns to ensure that

the trawler runs smoothly. Back in port, they are responsible for unloading the fish for sale at the auction. Seamen work as part of a team in a confined space: the boat's deck, machinery, storage hold, gangway or saloon. The physical workload and awkward postures on a moving surface can be considered a difficult condition for all fishermen, whatever the boat or type of work [23].

Numerous publications on SF have revealed that part-time work is a risk factor for MSDs [3]. In our study, the prevalence of self-reported MSDs was significantly higher among seasonal SF than among permanent workers (67.8% vs 43.1%; $p < 0.0001$). There are several possible causes for this phenomenon. Seasonal SF may have other jobs that contribute to a higher degree of pain [3]. More than three quarters of our deckhands worked on a seasonal basis during the fishing season for certain profitable catches (octopus, swordfish, etc.). This type of work represented the best earning opportunity of the year, but it also meant long periods at sea with frenetic activity, minimal and irregular opportunities for rest, fatigue and reduced alertness [24]. Of rural origin, they worked in agriculture or construction during biological rest periods and during ploughing, sowing and harvesting.

Although age as a personal risk factor is associated with MSDs, this is not reflected in the risk related to the years of experience of fishermen [3]. Indeed, in our study, the prevalence of MSDs in SF aged under 40 was 56% and that of those aged over 40 was 66.8%. Contradictory results have been found between job seniority and MSDs. An Egyptian study showed a positive association, whereas no significant association was found in the Danish study [10, 25]. Age and job tenure are not necessarily correlated, but fishing is often an occupation entered in early adulthood, which increases the possibility of such a correlation.

The combination of MSD and RPS is a major issue for the health of SF in this sector, who work in almost all weathers, exposed to bad weather and to physical, chemical and psychosocial risks. Working hours are long and often atypical (alternating or night shifts). The pace is frenetic, and the adage "when you're fishing, the fish is in charge" still applies in the small-scale and inshore maritime fishing sector. It controls the length and hours of work, the method of remuneration, crew cohesion and risk-taking [26]. The organization and conditions of work represent a set of constraints that can generate RPS. Working in small boats forces the SF to live together in cramped spaces. Conflicts, discrimination and hidden harassment occur. The performance-based pay system is calculated on the basis of turnover from the sale of the catch. It is often unrewarding and imposes an intense rhythm and an increase in working hours [26]. This insufficient and uncertain income, combined with a lack of career prospects and social benefits, leads to job dissatisfaction and is a major risk factor for stress and MSDs [26, 27]. Inadequate social protection, which does not allow for quality care, and poverty are factors which aggravate the insecurity of the work situation. The risk-taking behaviour of SF encourages the onset of MSDs and makes prevention difficult [28].

PREVENTIVE APPROACH

Preventing MSDs requires a comprehensive and integrated approach, giving priority to reducing risks at source by improving working conditions and identifying and treating affected workers at an early stage. However, in the small-scale and coastal maritime fishing sector, this primary prevention is not easy to put in place because of the environment, which is difficult to control [4]. Article 24 of the Labour Code states that the employer is obliged to take all necessary measures to protect the safety, health and dignity of employees. In addition, the right to a safe and healthy working environment has been incorporated into the ILO Declaration on Fundamental Principles and Rights at Work. This decision, taken in 2022, confers a fundamental character to Conventions no. 155 on the safety and health of workers (1981) and no. 187 on the promotional framework for the safety and health of workers (2006). Under this declaration, all Member States undertake to respect and promote this fundamental right. In addition, ILO Convention 188 on work in the fishing industry was ratified by Morocco in 2013. Its effective adoption will constitute a step forward in decent work for all those working on board fishing vessels.

It should be pointed out that the fishing industry has only benefited from organized occupational medical cover since the 1996 joint agreement between the Ministry of Health and the Ministry of Fishing [29]. MSD prevention requires knowledge of work situations and practices and ergonomic analysis [30, 31]. Its aim is to reduce the incidence of work-related morbidity. The occupational physician, in his capacity as legal advisor to shipowners and SF in matters of health and hygiene, must understand the organization and situations of work as part of his technical time. He must draw up the health and hygiene assessment, monitoring and control sheet for ships, which records living and working conditions on board and existing occupational hazards. The participative prevention approach must be given priority and is based on three axes: mobilization of players, investigation and control of MSD risks. However, technological and ergonomic improvements in this sector are limited by the small size of boats and the financial capacities of shipowners.

A government support program for sea fishing called "*Ibhar*, sailing in English", which has two objectives: to upgrade coastal and small-scale fleets and to improve living, working and safety conditions on board, has not achieved its

second objective, scheduled for 2020 [29]. Two questions seem essential. What is the financial capacity of the owners of small-scale fishing vessels who are supposed to plan and organize prevention? Shouldn't protecting health and safety at work in this hard-working and precarious sector be a government obligation? Modernizing the oldest ships is costly and limited by the lack of space on board. New ships can be designed with safety in mind, with features that make work more comfortable and therefore safer. However, technology will certainly take the strain off the skeleton, but could it make work even more frenetic? The progress that should normally relieve people makes them more dependent, dissatisfied and suffering.

Times are speeding up, and people are racing to keep up with the infernal pace of new technologies, machines and economic constraints, results and profit [32]. As a result, SF still have to rely on a fair amount of manual handling. Ordalic behavior and denial of the importance of risks are part of the culture and cohesion of the group. Ordalic behavior, the artisanal nature of fishing and precariousness hinder prevention, safety and health at work [26].

INTEREST AND LIMITATIONS OF THIS STUDY

This cross-sectional study had two main limitations. The healthy worker effect may create a selection bias in that active fishermen would be in better health than the rest of the population, since those whose health is impaired are supposed to be absent. The weaknesses of subjective self-reporting must be emphasised. There is no solution to avoid or limit individual variations. However, our study, the main objective of which is a global approach, can be considered a reliable representation of the situation. The value of our study lies in the use of analytical biometric methods based on the meticulous and objective observation of the various postures and work cycles, making it possible to assess the three biomechanical risk factors: effort, extreme joint positions and repetitiveness.

Values and culture, determining in the understanding of man at work, would bring additional richness to the perception of the suffering of FM. Epidemiological precision cannot replace analyses relating to the human system of the crew and the fishing organization [33].

CONCLUSION

MSDs are a reality among our FM and their risk factors are multiple. An integrated prevention management system must encourage a planned and graduated approach.

A global and participatory approach from all social partners is necessary and the FMs must constitute the main actors in preventive actions and the promotion of health at work, taking into account the importance of collecting data based on real-world experience. As part of the multidisciplinary approach, work and organizational psychology will make it possible to better understand, analyse and explain the processes involved in the appearance of MSDs.

ARTICLE INFORMATION AND DECLARATIONS

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