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Identification of the Skin Injuries Causes That Affecting the Rowers' Performance

Mohamed A. Salama[1] ,Waleed M. Hedya[2] and Abeer M. Salama[3]

[1] **Professor at Sports Management and Recreation Department , Faculty of Sport Education for Men, Alexandria University, Egypt**
[2] **Assistant professor at Biological Sciences and sports health Department, Faculty of Sport Education for Men, Matrouh University, Egypt**
[3] **Lecturer of Environmental Biology Sciences Department, Faculty of Science, Port Said University, Egypt**

Abstract

[Purpose] The purpose of this study was to identify the causes of skin injuries that affecting the rowers' performance. [Subjects and Methods] The study was applied in July - September 2019, Port Said rowing club, Egypt. The study sample was divided to two fungi isolation sources the rower body source (hand, fingers press, between fingers, knee, foot, toes press, between toes and groin area) of fourteen rowers and the other source was the rowing boat units (oar, seat and foot-stretcher) of seven rowing boats. Conventional swabbing and the press culture techniques were used to isolate the pathogenic microorganisms and spread on the modified Sabouraud Dextrose agar media, immediately after training. The growing fungi were purified in pure cultures on slants of the same medium. Ten pure culture fungal slants were identified. [Results] Ten fungal isolates were isolated from twenty one different sources (rowers' body and rowing boat units) with total count 4371 and 465 respectively. For rowers' body maximum count was detected with between fingers (Right and Left), and minimum count was detected with groin area. While for rowing boat units' maximum count was detected with foot-stretcher (Right and Left), and minimum count was detected with seat after 14 days of incubation. Conclusion: It appears that the rowers' body source of fourteen rowers and the rowing boat units of seven rowing boats have different fungal species that may cause skin disease for the rowers.

Keywords: *Skin, Injuries, Rowers, Performance.*

Introduction

The nature of water based physical activity makes the athletes must participate in water, indoors and outdoors environment. Water sports are activities on, under or in water. Motorised activities can be involved whereby the engine is used as a means to provide momentum for the activity (e.g. rowing), offer safety cover or access to the activity/environment (Inglés and McClure 2017).

Athletes are subject to the same skin conditions as other, but participation in sport places unique stresses on the skin such as exposure to friction, trauma, and the environment predisposes to unique conditions, not normally seen in inactive individuals (Freiman et al., 2004).

Compounded by perspiration, this friction commonly results in blisters that can be quite painful and diminishes the athlete's ability to compete, skin diseases can be particularly upsetting to athletes because they are often unsightly and the athlete may not even have a pre-existing that diseases condition to develop it (Basler, 2000).

There are many cutaneous problems which are related to water based physical activities and these are known as sports dermatophytes. A diagnostic and therapeutic knowledge of several sport-related dermatoses results in early and suitable treatment of skin disorder in athletes (Shaukat et al., 2015).

Dermatophytes are the most common type of cutaneous fungal infections seen in man and animals affecting skin, hair, nail. These are caused by group of closely related Keratinophilic fungi, which are capable to invade keratinized tissues of skin and its appendages and are collectively known as dermatophytes. The other frequently used terms like tinea and ringworm infections are symptoms of dermatophytoses (Bhadauria and Kumar 2015).

Rowing as a sport is growing at both the competitive and recreational levels. There is also rising enthusiasm for

recreational and competitive use of rowing machines, which spread of the rowing season and make rowing available to those who have never set a boat on the water. The acceptance of rowing means that primary care physicians are progressively likely to see rowing related harms (Karlson, 2000).

Dermatologic issues, common in rowing, are usually not significant, but should be checked closely for signs of infection due to excessive friction with oars; as the hand and knee blisters that occur during transition periods from land to water or with changes in equipment, humidity, or intensity of training (Rumball et al., 2005).

It is important to ensure that handle are properly cleaned, present blisters kept bendable, and grip material intact. Open blisters in contact with handles shared among team members can rise exposure to microbial infection (Thornton et al., 2016).

For rowers the foot-stretcher could contribute to the enhancement of rowing performance (Liu et al., 2018) and also it may be source for athlete's foot infection (Tinea pedis). Tinea pedis is one of the most common foot diseases. It is a fungal infection that can be transmitted by direct contact (skin to skin) or from surface contact (shoes, floors, mats etc). The skin is most susceptible when it is warm, moist and irritated or compromised (Gupta et al., 2016), such as with rowing sport.

The present study aimed to identify the causes of skin injuries that affecting the rowers' performance.

Materials and methods

Study sample

The study sample was divided to two isolation sources the rowers' body source (hand, fingers press, between fingers, knee, foot, toes press, between toes and groin area) of fourteen rowers and the other source was the rowing boat units (oar, seat and foot-stretcher) of seven rowing boats. Isolation was done immediately after training.

Study domains

Study time

Period: From July - September 2019.

Study place

Sampling was performed at Port Said rowing club. Mycological study conducted in faculty of science Port Said University. Pure culture fungal slants were identified in the regional center for mycology and biotechnology at Al-Azhar University, Egypt.

Study approach

Study was performed using the descriptive approach with scanning method.

Experimental setup and working

Media used

The modified Sabouraud Dextrose agar media, pH 5.6 was used, this media is specific for routine isolation, growth, and cultivation of fungi, and it is composed of (g/l): dextrose (40), peptic digest of animal tissue (5), pancreatic digest of casein (5) and agar (15). Chloramphenicol 500 mg (antibiotic) in 10 ml of water for inhibition of bacteria was added to molten medium and stir, autoclave (Ferreira et al., 2016).

Media preparation

Dissolve agar in 500 ml distilled water, dissolve dextrose, peptic digest of animal tissue and pancreatic digest of casein in 500 ml distilled water and warm to 50°C, combine. Chloramphenicol 500 mg in 10 ml of water was add to molten medium and stir, distribute in flasks, autoclave at 115°C for 15 minutes. The pH is about 5.6 (Ferreira et al., 2016).

Isolation techniques

Swabbing

Conventional swabbing is the recommended method; it is commonly used on different surfaces to detect pathogenic microorganisms. In this technique, the fungal species were isolated immediately after practice before any cleansing was done, to improve the chance of finding organisms. The cotton swab bud applied on a surface recovers fungi spores, cotton swabs were then used to distribute fungi on the media in Petri-dishes (Bodur and Cagri-Mehmetoglu 2012; Ismaïl et al., 2013).

Press culture

The press culture method was applied (Maruyama et al., 1989), to isolate fungi from rower's skin from fingers and toes. The fingers and toes of fifteen rowers were pressed onto modified Sabourauds Dextrose agar medium prepared in a culture sterilized plastic Petri-dishes.

Isolated fungi incubation

The dishes of isolated fungi were incubated at 25 °C, examined the agar plates daily for 14 days for growth (Méndez-Vilas 2012). For purification and identification of fungi, the growing fungi were purified in pure cultures

on slants of the medium. Ten pure culture fungal slants were identified.

Results and discussion

Ten fungal species which isolated from 21 sources (rowers' body and rowing boat units) with total count 4371 and 465 respectively. For rowers' body maximum count was detected with between fingers (Right and Left), and minimum count was detected with groin area. While for rowing boat units' maximum count was detected with foot-stretcher (Right and Left), and minimum count was detected with seat after 14 days of incubation. after 14 days of incubation. Results were presented in Tables 3.1-3.3 and Figures 3.1-3.4.

Table 3.1. Mean, ± SD and total count of fungal spores isolated from rowers' body.

Fungi		Isolation source																	Total (T)
		Foot		Toes press		Between toes		Hand		Fingers press		Between fingers		knee		Posterior knee folds		Groin area	
		R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L		
A. alternata	N	13	13	5	9	3	9	46	73	16	28	41	32	22	21	8	4	3	346
	Mean	0.93	0.93	0.36	0.64	0.21	0.64	3.29	5.21	1.14	2.00	2.93	2.29	1.57	1.50	0.57	0.29	0.21	-
	± SD	0.83	0.92	0.50	0.50	0.43	0.50	2.40	2.91	1.03	1.47	2.76	2.02	1.16	1.22	0.51	0.47	0.43	-
A. flavus	N	8	16	14	1	5	5	34	18	20	15	45	26	4	1	15	24	25	276
	Mean	0.57	1.14	1.00	0.07	0.36	0.36	2.43	1.29	1.43	1.07	3.21	1.86	0.29	0.07	1.07	1.71	1.79	-
	± SD	0.51	0.86	0.55	0.27	0.50	0.50	0.76	0.83	1.16	0.92	1.89	1.56	0.47	0.27	0.83	0.99	1.93	-
A. fumigatus	N	6	0	14	15	7	16	47	26	39	34	70	66	35	36	21	12	28	472
	Mean	0.43	0.00	1.00	1.07	0.50	1.14	3.36	1.86	2.79	2.43	5.00	4.71	2.50	2.57	1.50	0.86	2.00	-
	± SD	0.51	0.00	0.78	1.21	0.52	0.86	0.74	0.86	1.85	2.03	2.32	1.07	1.34	1.34	0.65	1.03	1.11	-
A. sydowii	N	0	9	14	8	21	23	86	44	37	15	65	61	12	13	26	18	35	487
	Mean	0.00	0.64	1.00	0.57	1.50	1.64	6.14	3.14	2.64	1.07	4.64	4.36	0.86	0.93	1.86	1.29	2.50	-
	± SD	0.00	0.50	0.39	0.94	0.65	1.15	0.95	0.86	1.34	0.83	1.15	2.53	0.66	0.83	0.53	1.07	2.10	-
versicolor	N	14	19	10	12	22	21	38	24	20	23	63	40	14	15	21	29	37	422
	Mean	1.00	1.36	0.71	0.86	1.57	1.50	2.71	1.71	1.43	1.64	4.50	2.86	1.00	1.07	1.50	2.07	2.64	-
	± SD	0.78	0.93	0.61	0.77	1.09	0.94	0.91	0.91	0.94	1.15	1.09	1.75	0.88	0.73	0.94	0.92	1.86	-

Fungi		Isolation source																	Total (T)
		Foot		Toes press		Between toes		Hand		Fingers press		Between fingers		knee		Posterior knee folds		Groin area	
		R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L		
C. albicans	N	15	45	9	31	18	38	14	42	19	22	65	43	18	10	27	17	36	469
	Mean	1.07	3.21	0.64	2.21	1.29	2.71	1.00	3.00	1.36	1.57	4.64	3.07	1.29	0.71	1.93	1.21	2.57	-
	± SD	0.62	0.80	0.50	1.05	0.99	1.54	0.78	0.88	1.01	0.94	0.84	1.00	0.91	0.73	1.33	0.80	0.51	-
N. sphaerica	N	12	18	3	16	17	35	33	19	67	50	31	10	18	10	28	19	28	414
	Mean	0.86	1.29	0.21	1.14	1.21	2.69	2.36	1.36	4.79	3.57	2.21	0.71	1.29	0.71	2.00	1.36	2.00	-
	± SD	0.36	0.83	0.43	0.77	0.97	1.60	0.74	0.84	0.89	0.51	1.25	0.47	0.83	0.47	1.18	0.74	1.18	-
S. brevicaulis	N	16	22	8	15	11	15	45	61	19	34	35	38	19	17	15	16	10	396
	Mean	1.14	1.57	0.57	1.07	0.79	1.07	3.21	4.36	1.36	2.43	2.50	2.71	1.36	1.21	1.07	1.14	0.71	-
	± SD	0.77	1.09	0.51	0.73	0.89	0.92	2.01	2.62	0.84	1.22	2.28	1.82	0.93	0.89	0.73	1.10	0.83	-
T. mentagrophytes	N	29	27	49	8	58	47	8	14	18	12	16	11	14	10	23	17	0	361
	Mean	2.07	1.93	3.50	0.57	4.14	3.36	0.57	1.00	1.29	0.86	1.14	0.79	1.00	0.71	1.64	1.21	0.00	-
	± SD	1.07	1.64	1.40	0.94	0.77	2.56	0.65	0.88	1.33	0.53	1.35	0.97	0.78	0.99	0.50	0.97	0.00	-
T. rubrum	N	81	70	68	51	42	51	15	13	33	15	38	45	65	61	15	32	33	728
	Mean	5.79	5.00	4.86	3.64	3.00	3.64	1.07	0.93	2.36	1.07	2.71	3.21	4.64	4.36	1.07	2.29	2.36	-
	± SD	3.91	2.72	1.75	2.06	1.41	2.68	0.73	1.33	1.82	0.73	1.82	0.80	1.15	1.50	0.92	5.15	1.82	-
Total (T)		194	239	194	166	204	260	366	334	288	248	469	372	221	194	199	188	235	4371

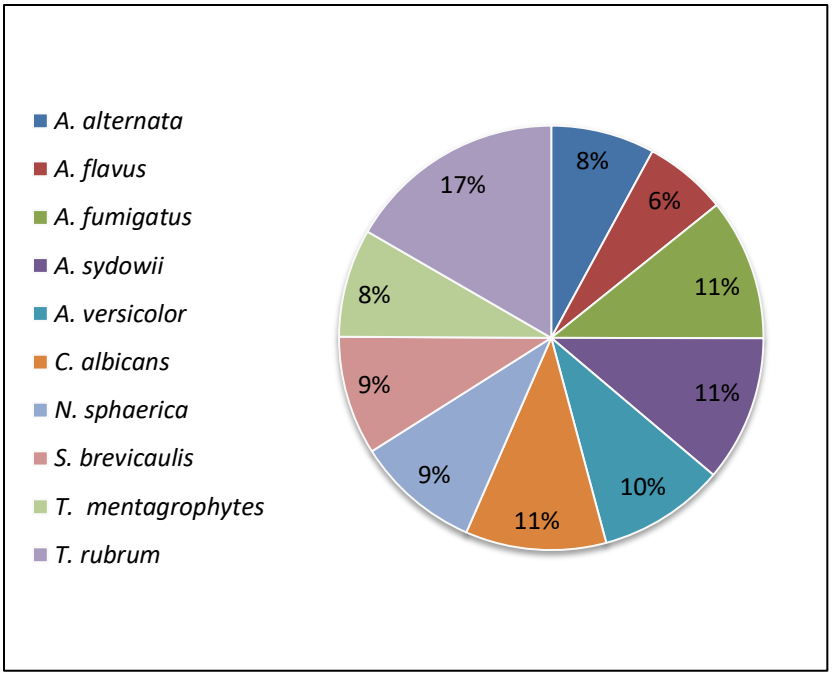

Figure 3.1. Percentage (%) of each fungal species isolated from rowers' body.

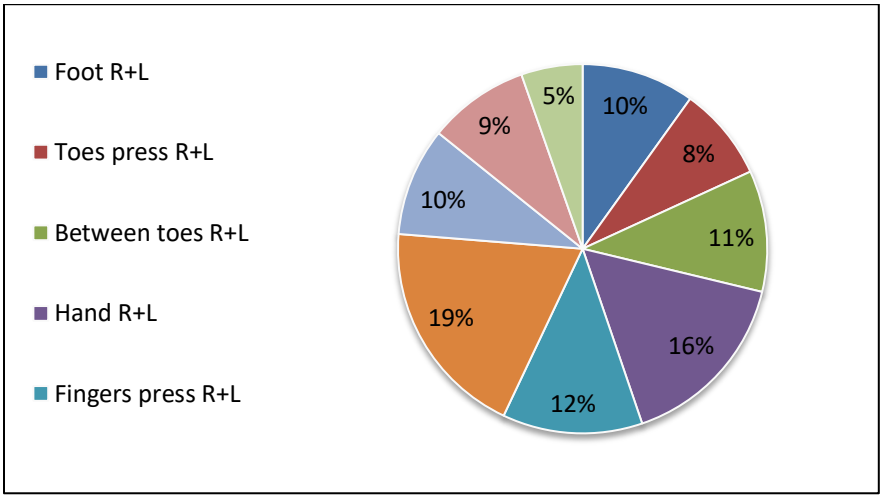

Figure 3.2. Percentage (%) of different rower's body part according to fungal spore occurs.

Table 3.2. Mean, ± SD and total count of fungal spores isolated from rowing boat units.

Fungi		Isolation source				Total (T)
		Oar surface	Seat	Foot-stretcher		
		-	-	R	L	
A. alternata	N	9	8	13	9	39
	Mean	1.29	1.14	1.86	1.29	-
	± SD	0.49	0.90	0.38	0.95	-
A. flavus	N	11	0	18	4	33
	Mean	1.57	0.00	2.57	0.57	-
	± SD	0.79	0.00	0.53	0.98	-
A. fumigatus	N	18	10	16	9	53
	Mean	2.57	1.43	2.29	1.29	-
	± SD	1.13	0.79	1.11	0.49	-
A. sydowii	N	11	8	25	6	50
	Mean	1.57	1.14	3.57	0.86	-
	± SD	1.51	1.07	0.79	0.69	-
Versicolor	N	10	8	15	9	42
	Mean	1.43	1.14	2.14	1.29	-
	± SD	0.53	1.07	1.07	0.95	-
C. albicans	N	11	1	13	6	31
	Mean	1.57	0.14	1.86	0.86	-
	± SD	1.40	0.38	1.07	0.90	-
N. sphaerica	N	8	5	8	6	27
	Mean	1.14	0.71	1.14	0.86	-
	± SD	0.90	0.49	1.07	0.38	-
S. brevicaulis	N	9	6	10	7	32
	Mean	1.29	0.86	1.43	1.00	-
	± SD	0.76	0.69	0.79	0.82	-
T. mentagrophytes	N	5	14	28	23	70
	Mean	0.71	2.00	4.00	3.29	
	± SD	0.49	1.53	1.91	0.49	
T. rubrum	N	39	14	9	26	88
	Mean	5.57	2.00	1.29	3.71	-
	± SD	0.79	0.58	0.76	0.76	-
Total (T)		154	74	132	105	465

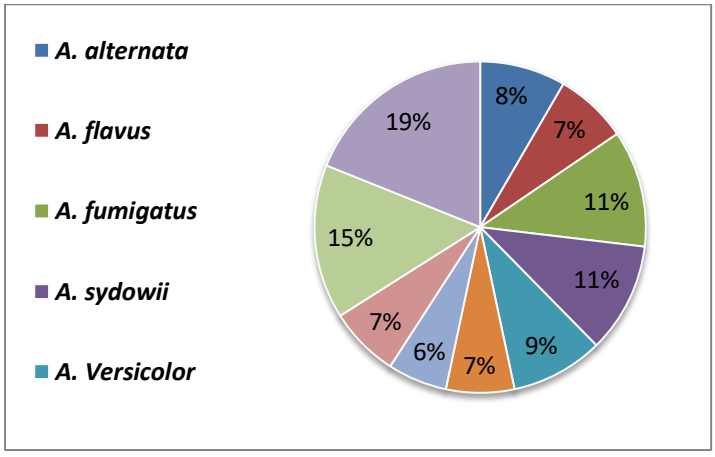

Figure 3.3. Percentage (%) of each fungal species isolated from rowing boat units.

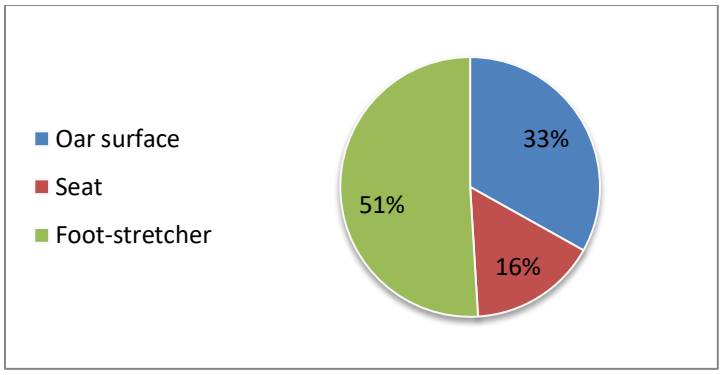

Figure 3.4. Percentage (%) of different rowing boat units according to fungal spore occurs.

Table 3.3. Name and pathogenicity of ten fungal species isolated from rowers' body and rowing boat units.

Fungi	Pathogenicity
Alternaria alternate	Cause human diseases such as skin infection, sinusitis, osteomyelitis, peritonitis, ocular infections, onychomycosis and ulcerated cutaneous infections (Gallelli et al., 2006).
Aspergillus flavus	The fungus can attack on various tissues including the skin, eye, heart, brain and joint (Pal et al., 2014).
Aspergillus fumigatus	Cutaneous lesions of Aspergillus fumigatus are usually develop secondary to haematogenous dissemination from an underlying infected organ (Dal et al., 2013).
Aspergillus sydowii	Initially isolated from humans in the USA in 1989 from integumentary (e.g., skin and nails) infections (Rodriguez-Palacios et al., 2016).
Aspergillus versicolor	Causing localized skin infection, nail infection, diskospondylitis and osteomyelitis (Zhang et al., 2012).
Candida albicans	Cause infections that range from superficial infections of the skin to life-threatening systemic infections (Mayer et al., 2013).
Nigrospora sphaerica	Causes infections of the skin, nail and eye (Ananya et al., 2014).
Scopulariopsis brevicaulis	Cause infections of the skin and nail (onychomycoses), soft tissues and bone (Petanović et al., 2010).
Trichophyton mentagrophytes	Dermatophytosis and infect the hair, skin, and nails (Dai et al., 2019).
Trichophyton rubrum	Dermatophytosis (Blutfield et al., 2015).

The nature of sports activity exposes the skin of its participants to an extensive diversity of stresses. Trauma, environmental factors, and infectious microbes act together to attack the athletes' skin (Zinder et al., 2010).

The sports activities spaces that work as fungi reservoirs, is also favored by the organic matter accumulation, construction complexity, material selection, high temperatures and inadequate maintenance, some studies have shown high levels of humidity in sport environment, making it difficult to separate the high humidity effect from the fungi presence (Goyer et al., 2001).

Transmission of infectious pathogen to the host may be occurring in two ways: through direct or indirect contact. Indirect transmission refers to situations in which a susceptible person is infected by contact with a contaminated environment. This mechanism is in contrast to direct transmission which occurs when one infected person transfers the infectious agent to another through direct skin-to-skin contact (Li et al., 2016).

According to this study results, T. rubrum is the most common distributed and isolated pathogenic fungi from different isolation sources. The rowers themselves must take care of this problem, as the majority of blistering and abrasions that occurs in rowers training for several weeks (Rumball et al., 2005). Will raises the chance of this pathogenic isolate distribution and transmission.

According to Zhan et al. (2013) study results documented that, the palmar and interdigital areas of the hand are usually involved in fungal infection; the most infections are caused by T. rubrum. Hand fungal infection is often associated with feet fungal infection, pathogens of the hand(s) originated mostly from the infected feet, whether ''unilateral hand'' or ''bilateral hands'' is just the result that pathogens spread from feet to hand.

Moreover the feet, especially the soles and toe webs, are most often involved in fungal problem. The common clinical appearance is the intertriginous form, which presents with maceration, peeling, and fissuring, mainly in the spaces between the fourth and fifth toes. Another common appearance is the chronic, squamous, in which fine silvery scales cover pinkish skin of the soles, heels, and sides of the foot. The severe inflammatory condition, characterized by the formation of vesicles, pustules, and sometimes bullae, is most

frequently caused by T. rubrum (Weitzman and Summerbell 1995).

T. rubrum is the most causative agent of sport nail fungal infection (Abd Elmegeed et al., 2015). Ran et al. (2015) study results documented that, T. rubrum is a causative agent of knee skin fungal infection.

Deeper dermal dermatophytosis is lesions affected the lower extremities, including the buttocks and groin area. It tends to present with multiple nodules rather than solitary ones. The most common pathogen for this infection is T. rubrum (Okata-Karigane et al., 2018).

A main risk factor for raising a T. rubrum infection is the clothes; the fungal is transmitted via direct and indirect contact with infected skin or hair retained in footwear, clothes, caps, socks, and towels. Moreover, occurrence of skin fungal infection is higher among those using communal baths, showers, or pools (Lee et al., 2015). Kim et al. (2015) study documented that, the mean yearly incidence of T. rubrum increased due to increasing fitness facilities.

In sport environment, the athletes sharing of equipment (such as worn personal protective equipment), or contact with athletic solid surfaces (sport equipment) can all be responsible for transmission of T. rubrum infection (Davies et al., 2017).

Prevention of infections caused by skin fungal pathogen is achieved primarily through good hygiene practices, not sharing equipment, and then those who manage rowing sport should develop a plan for cleaning and maintenance of a sanitary sporting environment to prevent skin fungal infection among rowers.

Conclusion

The rower body (hand, fingers press, between fingers, knee, foot, toes press, between toes and groin area) of fourteen rowers and the rowing boat units (Oar, seat and foot-stretcher) of seven rowing boats have some fungal spores that may cause skin fungal disease for the rowers. Ten fungal species isolated from 21 sources (rowers' body and rowing boat units) with total count 4371 and 465 respectively, after 14 days of incubation. Physicians, physiotherapists, athletic trainers and asymmetries would gain considerably details of the sport and specific rowing fungal infection, allowing better detection and prevention providing a safer environment for rowers.

References:

1- Abd Elmegeed A.M., Ouf S.A., Moussa T. A.A. and Eltahlawi S.M.R. 2015. Dermatophytes and other associated fungi in patients attending to some hospitals in Egypt. Brazilian journal of microbiology, 46(3): 799-805.

2- Ananya T.S., Kindo A. J., Subramanian A. and Suresh K.2014. Nigrospora sphaerica causing corneal ulcer in an immunocompetent woman: A case report. International journal of case reports and images, 5 (10).

3- Bhadauria S. and Kumar S. 2015. Clinical manifestations of dermatophytoses a review. International journal of scientific research, 4:1.

4- Blutfield M. S., Lohre J. M., Pawich De. A. and Vlahovic T. C. 2015. The immunologic response to Trichophyton Rubrum in lower extremity fungal infection. Journal of fungi, 1: 130-137.

5- Bodur T. and Cagri-Mehmetoglu A. 2012. Removal of Listeria monocytogenes, Staphylococcus aureus and Escherichia coli O157:H7 biofilms on stainless steel using scallop shell powder. Food control, 25(1): 1–9.

6- Dai P., Lv Y., Gao Y., Gong X., Zhang Y. and Zhang X. 2019. ZafA gene is important for Trichophyton mentagrophytes growth and pathogenicity. International journal of molecular sciences.

7- Dal T., Tekin A., Tekin R., Deveci Ö., Fırat U., Mete M. and Dayan S.2013. Soft tissue abscess caused by Aspergillus fumigatus in an immunosuppressive patient. Eur J Gen Med, 10(2):118-122.

8- Davies H. D., Jackson M. A. and Rice S. G. 2017. Infectious diseases associated with organized sports and outbreak control. Pediatrics, 140(4).

9- Ferreira C. M., Andrade D. R., Souza V. S., Ferreira G. M. A. and Ferreira W. A. 2016. Effectiveness of modified Sabouraud medium in Relation to the Bacterial Growth. SOJ microbiology and infectious diseases, 4(2): 1-3.

10- Freiman A., Barankin B. and Elpern D. J. 2004. Sports dermatology part 1: common dermatoses. Canadian medical association journal, 171: 851-853.

11- Gallelli B., Viviani M., Nebuloni M., Marzano A. V., Pozzi C. P. and Fogazzi G. B.2006. Skin infection due to Alternaria species in kidney allograft recipients: report of a new case and review of the literature. J nephrol, 19: 668-672.

12- Goyer N., Lavoie J., Lazure L., Marchand G. 2001. Bioaerosols in the workplace: evaluation, control and prevention guide. Bibliothèque nationale du Québec, Institut de recherché en Sante et en Securite du Travail du Quebec.

13- Gupta S. K., Deepika, Gupta V. and Monika. 2016. Aquatic sports dermatitis: An overview. Borne diseases. Air water borne diseases, 5 (1).

14- Inglés E. and McClure M. 2017. WET. Watersports Enhanced Together. A Toolkit to GET everybody WET. The Erasmus Programme of the European Union.

15- Ismaïl R., Aviat F., Michel V., Le Bayon I, Gay-Perret P., Kutnik M and Fédérighi M. 2013. Methods for recovering microorganisms from solid surfaces used in the food industry: A Review of the literature international journal of environmental research and public health, 10: 6169-6183.

16- Karlson K. A. 2000. Rowing injuries: Identifying and treating musculoskeletal and non-musculoskeletal conditions. The physician and sport science, 28(4).

17- Kim S. L., Lee K. C., Jang Y. H., Lee S.J., Kim D. W., Lee W. J., Bang Y. J. and Jun J. B. 2015. The epidemiology of dermatophyte Iinfection in southeastern Korea (1979∼2013). The Korean dermatological association and the Korean society for investigative dermatology.

18- Lee W. J., Kim S. Li., Jang Y. H., Lee S., Kim D. W., Bang Y. J. and Jun J. B.2015. Increasing prevalence of Trichophyton rubrum identified through an analysis of 115,846 cases over the last 37 years. Journal of korean medical science, 30: 639-643.

19- Li M., Jin Z., Sun G. and Zhang J. 2016. Modeling direct and indirect disease transmission using multi-group model. Journal of mathematical analysis and applications, 446: 1292–1309.

20- Liu Y., Gao B., Li J., Ma Z. and Sun Y.2018. Increased foot-stretcher height improves rowing performance: evidence from biomechanical perspectives on water. Journal sports biomechanics.

21- Maruyama R., Katoh T. and Nishioka K. 1989. Demonstration of dermatophyte dissemination from the infected soles using the foot-press method. Mycoses, 41: 145-151

22- Mayer F.L., Wilson D. and Hube B.2013. Candida albicans pathogenicity mechanisms. Virulence, 4(2):119-28.

23- Méndez-Vilas A. 2012. Microbes in applied research: Current advances and challenges. World scientific publishing company, 677.

24- Okata-Karigane U., Hatab Y., Watanabe-Okadaa E., Miyakawaa S., Otac M., Uzawad Y., Iguchid S., Yoshidad A. and Kikuchid K.2018. Subcutaneous abscesses caused by Trichophyton rubrum in the unilateral groin of an immunocompromised patient: A case report. Medical mycology case reports, 21: 16–19.

25- Pal M., Dave P. and Manna A. K.2014. Emerging role of Aspergillus flavus in human and animal disorders. J. Mycopathol. Res., 52(2): 211-216.

26- Petanović M., Paradžik M. T., Krištof Ž, Cvitković A. and Topolovac Z.2010. Scopulariopsis brevicaulis as the cause of Dermatomycosis. Acta dermatovenerol croat, 18(1):8-13.

27- Ran X., Zhuang K. and Ran Y.2015. Tinea corporis on the stump leg with Trichophyton rubrum infection. Medical mycology case reports, 9:31–33.

28- Rodriguez-Palacios A., Aladyshkina N, Retuerto M., Hager C. L., Ilic S., Ghannoum M. A. and Cominelli F.2016. Clinical effects of gamma-radiation-resistant Aspergillus sydowii on germ-free mice immunologically prone to inflammatory bowel disease. Journal of pathogens.

29- Rumball J.S., Lebrun C.M., Ciacca S. and Orlando K. 2005. Rowing injuries. Sports Med, 35(6): 537–55.

30- Shaukat S., Aman S. and, Kazmi A. H. 2015. Skin and sports. Journal of Pakistan association of dermatologists, 25 (3): 206-211.

31- Thornton J. S., Vinther A., Wilson F., Lebrun C. M., Wilkinson M., Ciacca S. R., Orlando K. and Smoljanovic T.2016. Rowing injuries: An updated review. Sports medicine.

32- Weitzman I. and Summerbell R. C. 1995. Dermatophytes. Clinical microbiology reviews, 240–259.

33- Zhang S., Corapi W., Quist E., Griffin S. and Zhang M. 2012. Aspergillus versicolor, a new causative agent of canine disseminated aspergillosis. Journal of clinical microbiology, 187–191.

34- Zinder S. M., Basler R. S. W., Foley A., Scarlata C. and Vasily D. B.2010. National athletic trainers' association position statement: Skin diseases. Journal of athletic training, 45(4): 411–428.