

Morbidity Pattern and Usage of Swimming Gear among Swimmers in South India¹

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Abstract Swimming is recommended for its several health benefits. However, swimmers are at risk of acquiring several diseases. This could be both due to constant exposure to water and non-usage of swimming gear. This study was hence done to study the morbidities, the usage patterns of swimming gear and its determinant among swimming pool users. This cross-sectional study was conducted among 162 swimmers visiting eight public swimming pools in Mangalore. The minimum sample size of 122 was calculated using the formula $Z_{\alpha}^2 pq/d^2$, at 95% CI and 15% relative precisions. Data were collected using a semi-structured interview schedule. Chi-square test and Fisher's Exact test were used to test association. A p value less than 0.05 was considered a statistically significant association. Swimming caps, goggles, ear plugs, and nose clips were always worn by 121(74.7%), 104(64.2%), 19(11.7%), and 2(1.2%) participants respectively over the past year. The most common self-reported morbidities related to swimming reported in nearly half of the participants were redness and burning sensation in the eyes over the past year. These were significantly more among swimmers who did not always wear goggles, and among occasional swimmers. Burning sensation in the eyes was seen more among those who started swimming ≤ 1 year ago while redness of the eyes was seen more among those who were swimming for more than 5 years. There was a statistically significant association between not always wearing swimming cap and males, not always wearing

goggles, swimming for more than 5 years, occasional swimmers, and swimming for half an hour or less on each occasion in a day over the past year. There was a statistically significant association between not always wearing goggles and occasional swimmers and swimming for half an hour or less on each occasion in a day over the past year. Several participants in this study did not always wear the personal protective swimming gear. This was associated with certain common morbidities and various swimming-related characteristics among the swimmers. Hence there is a need to periodically screen swimmers for various morbidities and to educate them and encourage them to wear swimming gear on every occasion.

Keywords Swimmers, Personal Protective Gear, Morbidities, Determinants

1. Introduction

Swimming is an essential sports activity that has been recommended for people of all age groups. Individuals with pain in weight-bearing joints experience better comfort while exercising in a pool than elsewhere. Swimming involves complete body exercise. It also helps in functional improvement of vital organs like the lungs and heart. It can be performed around the year and is thus

the most popular sport pursued for recreation [1-3].

Swimming in addition to other exercises like brisk walking, jogging, and cycling constitutes moderate intensity physical activity recommended by the WHO to be performed at least 150 minutes per week or 30 minutes on five occasions per week. In a pan-India survey in 2017 conducted among adults more than 18 years old, 42.9% of them reported meeting the WHO recommendations of physical activity [4]. Another survey in 2014 among people from three states and one union territory in India found that 45.6% of them were physically active indulging in exercises such as swimming. However, the average time of exercise amounted to just 19 minutes per day in comparison to the 30 minutes recommended by the WHO [5].

Although swimming is recommended for its several health benefits, swimmers risk acquiring several diseases following exposure to fellow swimmers and to contaminated pool water. Cryptosporidium and Giardia, which are common causes of diarrhoeal illness, resist the usual dose of chlorine used in swimming pools [6]. Norovirus, known for its resistance to common disinfectants [7], was responsible for past outbreak of acute gastroenteritis among swimming pool users [8]. Epidemiological studies also found high prevalence rates of respiratory symptoms among swimmers following exposure to chemical derivatives from disinfectants used to treat pool water [9,10]. In another regional study done in 2019 at Hubballi, situated in south India, 63% of swimming pool users suffered from one or other morbidity such as headache, burning sensation and irritation in the eyes, sore throat, cough, tinnitus, and generalized itching [11].

Using swimming gear for personal protection has not always been complete among swimmers. In the study done in Hubballi, south India as many as 17.5% and 52.5% of swimmers did not wear swimming caps and goggles respectively while swimming [11]. This has further made swimmers in India more vulnerable to various health problems. Non-usage of personal protective gears like goggles exposes swimmers to the harmful effects of chlorine derivatives such as chloramines resulting in symptoms like redness, itching, burning, and watering of the eyes [12].

Studies in developing countries on using swimming gear and morbidities among swimmers are lacking. This study was hence done to assess the morbidities and usage patterns of swimming gear and its determinants among swimming pool users.

2. Materials and Methods

This cross-sectional study was done among swimmers visiting eight public swimming pools in Mangalore city situated in the southern part of India. The Institutional Ethics Committee approval and the commencement of the

study took place in March 2019. This research was completed in accordance with the Helsinki Declaration.

The minimum sample size was calculated as 122, using the formula $Z_{\alpha}^2 pq/d^2$, at 95% CI and 15% relative precisions. p was substituted as 58.5%, which was the proportion of swimmers with redness of the eyes, as reported in an Italian study [13]. The participants were enrolled in this study using a convenience sampling method. Written informed consent was taken from participants aged 18 years and above after explaining to them the nature and purpose of this study. All consenting participants were interviewed in the waiting area before they entered the pool. For children aged from 11 to 17 years, assent for participation was taken from them, and consent was taken from their parents or legal guardians accompanying them to the pool. Those participants who refused to consent, those aged between 11 and 17 years but not accompanied by a legal guardian, and those aged 10 years and below were excluded from this study.

Data were recorded using a semi-structured interview schedule. Interview was conducted in English or local language Kannada. Content validation of the schedule was done with the help of two subject experts from the Department of Community Medicine. Language validation of the Kannada version of the schedule was done by the process of translating it to English by one language expert, and translating it back into Kannada by another language expert, and comparing the two Kannada versions for any disparity. The interview schedule had three sections. Section A enquired about the socio-demographic details of the participants like age, gender, occupation, co-morbidities, and habits like smoking, tobacco chewing, and alcohol consumption. Section B enquired about their swimming-related characteristics, such as swimming duration, average frequency of usage, and average time spent in the swimming pool on each occasion in a day over the past year. Section C enquired about the frequency of use of various personal protective gear among swimmers over the past year. Section D enquired about the morbidities due to swimming over the past year, as self-reported by the participants. The interview schedule was pilot tested among five participants who were not part of the main study.

Usage of swimming gear was categorized as “always or most of the time” if worn while swimming on more than 75% of occasions, “sometimes” if worn on 25% to 75% occasions, and “rarely” when worn on less than 25% occasions over the past year by the participants. “Occasional swimmers” were considered as those who used the pool less than once a month.

The data collected were entered into MS Excel and transferred to SPSS version 20.0 for data analysis. Chi-square test and Fisher’s Exact test were used to test association. A p value less than 0.05 was considered a statistically significant association. The Cronbach’s alpha value of the reliability of this questionnaire was found to be

0.839, indicating good internal consistency.

3. Results

A total of 200 swimmers were approached to take part in this study. Among them, 162 (81%) consented to participate in this study.

The mean age of the participants was 31.8 ± 13.3 years. Gender distribution among the participants was almost equal, and the majority were students [91(56.2%)] (Table 1).

The most common co-morbidity self-reported by the

participants was allergy [26(16%)] (Table 1). Among them, a history of allergy was specified for dust by 14, food substances by 10, pollen grains by 5, and chlorine used in water purification by 2 participants. Of the total participants, 13 consumed alcohol, 2 were smokers, and 4 used both (Table 1).

The majority of the participants [93(57.4%)] have been using the swimming pool for ≤ 5 years. The majority [91(56.2%)] of the swimmers used the pool almost every day in the past year. The majority [125(77.2%)] of the participants usually spent 31 to 60 minutes in the pool on each occasion in a day over the past year (Table 2).

Table 1. Distribution of socio-demographic variables, lifestyle habits, and co-morbidities among the study participants

Characteristics	Number	Percentage
Age group (years)		
11-20	24	14.8
21-30	76	46.9
31-40	32	19.8
41-50	12	7.4
>50	18	11.1
Gender		
Males	82	50.6
Females	80	49.4
Occupation		
Professional/ Semi-professional	21	13.0
Businessman	15	9.3
Skilled/ Semi-skilled	23	14.2
Students	91	56.2
Housewives	9	5.5
Retired	3	1.8
Presence of co-morbidities (self-reported)*		
Allergy	26	16.0
Asthma	8	4.9
Hypertension	5	3.1
Diabetes Mellitus	2	1.2
Lifestyle habits*		
Alcohol consumption	17	10.5
Smoking	6	3.7
Total	162	100.0

*Multiple responses

Table 2. Swimming-related characteristics among the study participants

Characteristics	Number	Percentage
Knows swimming		
Yes	145	89.5
Learned swimming through (n=145)*		
Self-practice	52	35.9
Help from others	86	59.3
Certified training	24	16.5
Duration of swimming		
≤1 month	26	16.1
2 months to 1 year	19	11.7
1.1-2 years	20	12.3
2.1-5 years	28	17.3
5.1-10 years	32	19.7
10.1-15 years	22	13.6
>15 years	15	9.3
Frequency of swimming in the past year		
More than once a day	21	13.0
Once everyday	70	43.2
Two to three times a week	13	8.0
Once a week	14	8.6
Once in two weeks	8	5.0
Once a month	11	6.8
Occasionally	25	15.4
Usual time spent in the pool on each occasion in a day over the past year		
≤30 minutes	13	8.0
31-45 minutes	77	47.5
46-60 minutes	48	29.7
61-90 minutes	13	8.0
>90 minutes	11	6.8
Total	162	100.0

*Multiple responses

Self-perceived quality of water in the swimming pool was reported as usually very clean by 45(27.8%), usually clean by 91(56.2%), usually unclean by 4(2.5%), and not sure by 22(13.5%) participants.

Swimming caps and goggles were always worn by 121(74.7%) and 104(64.2%) participants, respectively. Earplugs and nose clips were always worn by 19(11.7%) and 2(1.2%) participants, respectively (Table 3).

The most common morbidities self-reported by the participants perceived to be due to swimming were redness

of the eyes [86(53.1%) followed by burning sensation in the eyes [69(42.6%)] over the past year (Table 4).

Burning sensation and redness of the eyes were seen significantly more among swimmers who did not always wear goggles and among occasional swimmers. Burning sensation in the eyes was seen more among those who started swimming ≤1 year ago while redness of the eyes was seen more among those who were swimming for more than 5 years (Table 5).

Table 3. Frequency of usage of personal protective swimming gear among the study participants over the past year (n=162)

Type of swimming gear	Frequency of usage			
	Always (%)	Sometimes (%)	Rarely (%)	Never (%)
Cap	121(74.7)	11(6.8)	8(4.9)	22(13.6)
Goggle	104(64.2)	21(13.0)	12(7.4)	25(15.4)
Ear plugs	19(11.7)	6(3.7)	13(8.0)	124(76.6)
Appropriate swimwear	140(86.4)	11(6.8)	4(2.5)	7(4.3)
Nose clip	2(1.2)	2(1.2)	4(2.5)	154(95.1)

Table 4. Self-reported morbidities perceived to be due to swimming by the study participants over the past year (n=162)

Type of morbidities*	Number	Percentage
Redness of the eyes	86	53.1
Burning sensation in the eyes	69	42.6
Nose block	61	37.6
Otalgia	55	33.9
Nasal discharge	52	32.1
Pruritis	43	26.5
Headache	42	25.9
Itchy ear canal	39	24.1
Cough	35	21.6
Skin rashes	34	21.0
Sore throat	28	17.3
Fever	25	15.4
Dizziness	25	15.4
Hoarseness of voice	24	14.8
Ear discharge	19	11.7
Pain while swallowing	19	11.7
Tooth sensitivity	16	9.9
Skin infections	14	8.6
Vaginal discharge	8	4.9
Burning micturition	7	4.3
Vomiting	6	3.7
Diarrhoea	4	2.5

*Multiple responses

Table 5. Association of various characteristics with self-reported morbidities due to swimming over the past year among the study participants

Characteristics	Burning sensation in the eyes		Total
	Present (%)	Absent (%)	
Frequency of usage of goggles			
Always	36(34.6)	68(65.4)	104
Not always	33(56.9)	25(43.1)	58
			$X^2=7.56, p=0.01$
Duration of swimming (years)			
≤1	41(91.1)	4(8.9)	45
1-5	33(68.8)	15(31.2)	48
>5	47(68.1)	22(31.9)	69
			$X^2=8.893, p=0.01$
Frequency of swimming in the past year			
Daily	28(30.8)	63(69.2)	91
Not daily, but at least once a month	26(56.5)	20(43.5)	46
Occasionally	15(60.0)	10(40.0)	25
			$X^2=11.951, p=0.002$
Total	69	93	162
	Redness of the eyes		
Frequency of usage of goggles	Present (%)	Absent (%)	
Always	47(45.2)	57(54.8)	104
Not always	39(67.2)	19(32.8)	58
			$X^2=7.27, p=0.01$
Duration of swimming (years)			
≤1	16(35.6)	29(64.4)	45
1-5	23(47.9)	25(52.1)	48
>5	47(68.1)	22(31.9)	69
			$X^2=12.327, p<0.01$
Frequency of swimming in the past year			
Daily	35(38.5)	56(61.5)	91
Not daily, but at least once a month	31(67.4)	15(32.6)	46
Occasionally	20(80.0)	5(20.0)	25
			$X^2=18.9, p<0.01$
Total	86	76	162

Table 5 continued

		Otalgia		
Frequency of usage of earplugs	Present (%)	Absent (%)		
Always	4(21.1)	15(78.9)		19
Not always	51(35.7)	92(64.3)		143
				p=0.3
Usual time spent in the pool on each occasion in a day over the past year				
≤45 minutes	25(27.8)	65(72.2)		90
46-60 minutes	18(37.5)	30(62.5)		48
>60 minutes	12(50)	12(50)		24
				X ² =4.6, p=0.1
Total	55	107		162
		Itchy ear canal		
Frequency of usage of earplugs	Present (%)	Absent (%)		
Always	2(10.5)	17(89.5)		19
Not always	37(25.9)	106(74.1)		143
				p=0.17
Total	39	123		162
		Nose block		
Frequency of swimming in the past year	Present (%)	Absent (%)		
Daily	29(31.9)	62(68.1)		91
Not daily, but at least once a month	19(41.3)	27(58.7)		46
Occasionally	13(52)	12(48)		25
				X ² =3.75, p=0.15
Total	61	101		162

There was no association between the frequency of usage of ear plugs with the occurrence of ear discharge over the past year (p=1).

There was no association between the wearing of nose clips always among participants with the development of nasal discharge (p=1) or with the development of nasal block (p=0.14) among them over the past year.

There was no association between the usual time spent in the pool on each occasion (minutes) in a day over the past year with the presence of cough (p=0.59), nose block (p=0.43), ear discharge (p=0.83), ear pain (p=0.1), nasal discharge (p=0.22), itchy ear canal (p=0.55), redness of the eyes (p=0.77), and burning sensation of the eyes (p=0.69).

There was no association between the frequency of swimming in the past year with the presence of cough (p=0.68), ear discharge (p=0.74), ear pain (p=0.81), itchy ear canal (p=0.22), and nasal discharge (p=0.5).

There was no association between the duration of swimming (years) with the presence of cough (p=0.94), nose block (p=0.11), ear discharge (p=0.98), ear pain (p=0.41), nasal discharge (p=0.45), and itchy ear canal (p=0.14).

There was a statistically significant association between not always wearing swimming cap and males (p <0.01), those who did not always wear goggles (p<0.01), those swimming for more than 5 years (p = 0.01), occasional swimmers (p<0.01), and those swimming for half an hour or less on each occasion in a day (p=0.01) over the past year. It was worn significantly by a greater proportion of those who swam every day and those who swam more than 45 minutes on each occasion in a day over the past year (Table 6). There was no association of usage of swimming caps with knowing swimming (p=0.56), age (p=0.9), occupation (p=0.36), presence of allergy (p=0.48), and

perceived quality of water (p=1) among the participants.

There was a statistically significant association between not always wearing earplugs in the past year and age of the participants ≤30 years (p<0.01) and knowing swimming (p<0.01) (Table 6). There was no association of usage of earplugs with gender (p=0.5), occupation (p=0.52), presence of habits like smoking or alcoholism (p=1), presence of allergy (p=0.51), usage of swimming cap (p=0.16), perceived quality of water (p=1), duration of swimming (p=0.53), frequency of usage of swimming pool (p=0.25), and duration of use of swimming pool on each occasion in a day (p=0.48) over the past year among the participants.

There was a statistically significant association between not always wearing goggles and occasional swimmers (p<0.01) and those swimming for half an hour or less on each occasion in a day (p=0.01) over the past year. It was worn significantly by a greater proportion of those who swam every day and those who swam more than 45 minutes on each occasion in a day over the past year (Table 6). There was no association of usage of goggles with age (p=0.33), gender (p=0.23), occupation (p=0.23), habit of consuming alcohol or smoking (p=0.26), presence of allergy (p=0.45), knowing swimming (p=0.26), perceived quality of water (p=0.6), usage of earplugs (p=0.36), and duration of swimming (p=0.08) among the participants.

Table 6. Association between various characteristics with the usage of specific swimming gear in the past year among the study participants

Characteristics	Usage of swimming cap		Total
	Always (%)	Not always (%)	
Gender			
Males	51(62.2)	31(37.8)	82
Females	70(87.5)	10(12.5)	80
			X ² =13.72, p<0.01
Usage of goggles			
Always	91(87.5)	13(12.5)	104
Not always	30(51.7)	28(48.3)	58
			X ² =25.2, p<0.01
Duration of swimming (years)			
≤1	41(91.1)	4(8.9)	45
1-5	33(68.8)	15(31.2)	48
>5	47(68.1)	22(31.9)	69
			X ² =8.893, p=0.01
Frequency of swimming in the past year			
Daily	80(87.9)	11(12.1)	91
Not daily, but at least once a month	27(58.7)	19(41.3)	46
Occasionally	14(56)	11(44)	25
			X ² =19.26, p<0.01
Usual time spent in the pool on each occasion (minutes) in a day over the past year			
≤30	6(46.1)	7(53.9)	13
31-45	54(70.1)	23(29.9)	77
>45	61(84.7)	11(15.3)	72
			X ² =10.28, p=0.01
Total	121	41	162

Table 6 continued

	Usage of earplugs		
	Always (%)	Not always (%)	
Age group (years)			
≤30	5(5.0)	95(95.0)	100
31-50	7(15.9)	37(84.1)	44
>50	7(38.9)	11(61.1)	18
			$X^2=17.94, p<0.01$
Knowing swimming			
Yes	13(9.0)	132(91.0)	145
No	6(35.3)	11(64.7)	17
			$X^2=10.2, p<0.01$
Total	19	143	162
	Usage of goggles		
	Always (%)	Not always (%)	
Frequency of swimming in the past year			
Daily	70(76.9)	21(23.1)	91
Not daily but at least once a month	23(50)	23(50)	46
Occasionally	11(44)	14(56)	25
			$X^2=14.88, p<0.01$
Usual time spent in the pool on each occasion (minutes) in a day over the past year			
≤30	6(46.1)	7(53.9)	13
31-45	43(55.8)	34(44.2)	77
>45	55(76.4)	17(23.6)	72
			$X^2=8.8, p=0.01$
Total	104	58	162

4. Discussion

The most common self-reported morbidity perceived to be due to swimming among participants in the present study was redness of the eyes reported by 53.1% of participants. In other studies, runny nose was reported by 16.7% [14], 39% [13], 74% [15], swimming pool conjunctivitis by 20.6% [16], redness of the eyes by 58.5% [13], 86.2% [16], itchy eyes by 50% [13], nasal obstruction by 16% [15], 16.7% [14], 52.4% [13], influenza by 4.5% [17], sinusitis by 3.5% [17], headache by 1.4% [17], allergic reactions by 1% [17], cold by 72% [13], cough by 62.7% [13], skin rash by 22% [13], wheezing by 6.9% [18], and respiratory symptoms by 18% [19] participants.

Personal protective gear like swimming caps, goggles, ear plugs, and nose clips were worn always by 74.7%,

64.2%, 11.7%, and 1.2% participants, respectively in the present study. This was much more than that reported in an Ethiopian study where 7.9% swimmers used goggles always, and 10% of them used caps always [20].

Earplugs and nose clips were not always used by most of the swimmers. Non-usage of ear plugs exposes the external ear to infection from contaminated pool water. The water pressure also gets transmitted to the middle ear and inner ear [21]. Constant water exposure leads to maceration of the epithelium of the skin lining the external auditory canal leading to itchy ear canal, and otitis externa (swimmer's ear), a painful ear condition. To reduce the moisture in the ear canal, drying the external auditory meatus with a hair dryer is suggested as a beneficial practice after swimming [21].

Non-usage of nose clips exposes the airway mucosa to

the irritant effects of chlorine present in the pool water [22,23]. This results in inflammation of the mucosa, nasal congestion, sinusitis, and asthma among swimmers [24-26]. Gelardi et al. [27] reported a significant reduction in various nasal symptoms among swimmers after 30 days of usage of the nose clip. Usage of nose clips resulted in the reduction of cellular infiltration and nasal resistances and provided clinical improvement in swimmers with rhinitis [28].

The other gear which was less commonly worn over the past year by the participants in this study was goggles and caps. Goggles prevent the entry of microorganisms into the eyes. Caps protect hairs from chlorine or sun damage and help to keep water out of the ear canal.

Infrequent usage of personal protective gear and swimming habits such as frequency and duration of swimming were associated with common swimming-related morbidities among participants in the present study. In an Italian study, family history of allergic diseases and pool attendance were significantly associated with various respiratory symptoms among swimmers [18]. In a study done in Finland, swimmers who spent more than 90 minutes for a session, those who swam more than 2000 metres, and those with allergies reported significantly more respiratory symptoms than others [19].

Age, gender, usage of one or other swimming gear, and certain swimming-related characteristics were associated with the usage of various swimming gear always among the participants of this study over the past year. In a study done in Ethiopia, prior knowledge about the health risks associated with swimming, educational status, and age more than 28 years was associated with positive health-related behaviours among swimmers, including using swimming caps and goggles [20].

Given the popularity of swimming among people of all age groups, more extensive studies are needed to identify determinants that lead to various morbidities and usage of personal protective gear among swimmers to frame suitable preventive strategies.

5. Conclusions

Several participants in this study did not always wear the personal protective swimming gear while swimming. This was associated with certain common morbidities and various swimming-related characteristics among them. Hence there is a need to educate swimmers on the importance of wearing swimming gear always while swimming. This needs to be emphasized particularly among occasional swimmers and those swimming for half an hour or less on each occasion in a day over the past year. Screening swimmers periodically for morbidities is also recommended to maintain their health and fitness.

6. Limitations

Information related to morbidities due to swimming was

self-reported by the participants and was not diagnosed based on medical examination. There is also a possibility of participants giving a socially desirable response to the usage of swimming gear. The findings of this study also may not be generalizable to the broader population of swimmers across the country as the participants were enrolled in this study using a non-random sampling method.

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Conflicts of Interest

None declared.

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ⁱ Availability of data and material: Figshare: "Morbidity pattern and usage of swimming gear among swimmers in south India" <https://doi.org/10.6084/m9.figshare.23896665>