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The Impact of Swimming on Oral Health: A Cross-Sectional Analysis of Prevalence and Correlates of Extrinsic Tooth Stains

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Abstract **Objectives:** Swimmers are associated with various oral manifestations such as dental erosion, calculus formation and stain, a phenomenon which is referred to as swimmer's mouth. Extrinsic stains are the most frequently encountered presentation, which are attributed to the added antimicrobials (chlorine) in the pool water. Improper pool maintenance, leading to acidic pH, is the main contributory factor for organic deposits on the swimmer's teeth. Hence, the study planned to evaluate the association between the frequency of swimming on the prevalence of extrinsic stains among swimmers. **Methods:** Professional and recreational swimmers were identified and evaluated using a fourteen-item questionnaire. Oral screening and complete evaluation were done. The level of extrinsic stain was evaluated using the Lobene-stain-index. The results were tabulated using Statistical Package for Social Sciences (Version 17.0) software and subgroup analysis was done using Fisher's exact test for statistical significance. **Results:** Among the 150 participants, 74% were professional swimmers and 26% were recreational swimmers. 47% of the swimmers have been swimming for a period of more than 8 years. Extrinsic stains were more prevalent in tooth 33 (63% of the participants), followed by teeth 23 and 43 (61% of the participants). Swimmers who brushed more than once daily had fewer stains compared to those who brushed only once a day. **Conclusions:** The current study showed that maxillary and mandibular canines are more susceptible to stains. Improving pool maintenance and usage of fluoridated toothpaste and powered toothbrushes can aid in reducing the intensity of the stains.

Keywords Swimmers, Extrinsic Stains, Lobene-Stain Index, Fluorosis

1. Introduction

Dental trauma is an injury to the mouth, especially the teeth and periodontia, caused by an external mechanical force [1]. Besides road traffic accidents, construction and factory workers, farmers, craftsmen, and sportsmen can also be affected by traumatic dental injury [2]. Sportsmen such as athletes, cricketers, and football and basketball players are highly susceptible to temporomandibular joint and maxillofacial fractures, tooth avulsion, hemoptysis, and mucosal trauma [3]. On the other hand, swimmers are associated with various oral manifestations such as dental erosion, calculus formation, and stains, a phenomenon which is referred to as swimmer's mouth. However, swimmers are not faced with acute traumas because water buoyancy reduces impact, stress, and swelling [4].

Swimmers also have a high bone turnover rate which provides higher resistance to fractures [5]. They face chronic and slow-growing injuries that degrade the natural tooth structure and change the pH of saliva. An optimum pH of 7.4 retains the tooth structure [6]. The critical pH of enamel and dentin is 5.5 and 6.2, respectively, and when the pH drops below this, the demineralization-remineralization cycle is disturbed [7]. Eventually, it leads to persistent superficial stains, caused by chlorinated pool water and is immedicable.

Among the various oral manifestations in swimmers, extrinsic stains are the most frequently encountered presentation, which is attributed to the added antimicrobials (chlorine) and pH of the pool water. Improper pool maintenance, leading to acidic pH, is the main contributory factor for organic deposits on the swimmer's teeth. A study found the incidence of dental stains to be higher in competitive swimmers compared to non-competitive ones as they spend more hours training in pool water [8]. Another study interpreted that all the swimmers had staining of the teeth, despite most of them reporting brushing their teeth two to three times per day [9]. In a recent study, it has been found that professional swimmers are likely to exhibit a higher prevalence of generalized erosion of dental enamel, generalized dental stain, and chlorine-induced calculus as opposed to individuals who are not exposed to chlorinated water [10].

Determining the presence of extrinsic stains among swimmers is quite an unexplored topic. Though studies have been conducted, only a few have explored the pattern and severity of extrinsic stains. These limited studies evaluated colony formation of bacteria and pH of pool water but possessed limitations, such as small sample size and use of the DMFT Index which only detects caries and not extrinsic stains. Hence, in this study, we planned to explore the pattern and severity of extrinsic stains with frequency of swimming using the Lobene Stain Index, which measures the intensity and extent of extrinsic dental stains on the facial surface of the anterior teeth.

2. Methods

2.1. Ethical Approval and Informed Consent

The study period of this research was 6 months and ethical approval to conduct this study was granted by the Institutional Ethics Committee (CSP/21/DEC/103/614). The selected participants provided written informed consent before participation.

2.2. Sample Size

The sample size was calculated using the formula $\eta = Z^2_{1-\alpha/2}\ P\ (1\text{-}P)\ /\ d^2$ where, an expected proportion of 80, relative precision of 8%, and desired confidence level of 95. The sample size was 150.

2.3. Study Site and Population

Nine sports centers with designated swimming pool facilities for professional and recreational swimmers were randomly selected across the city. A total of 150 professional and recreational swimmers were recruited (Professional - 111, Recreational - 39) by simple random sampling method. The recruited swimmers were assessed by two trained investigators in two phases.

2.4. Selection Criteria

Inclusion Criteria

- Swimmers aged between 18 and 45 years
- Swimmers (professional and recreational) who swam at least for a minimum of 4-5 hours of duration per week were included
- Swimmers who spent six months swimming consistently
- Swimmers who swam in chlorinated water

Exclusion Criteria

- Active smokers and tobacco users
- Participants below the age of 18 years
- Swimmers with anterior veneers, dentures, missing teeth and those undergoing orthodontic treatment
- Para swimmers
- Swimmers who had undergone teeth whitening and bleaching procedures within a period of 1 year
- Swimmers under chronic medications causing teeth pigmentation

2.5. Data Collection

The data from the participants were collected in 2 phases.

- Phase 1: A questionnaire survey

A self-administered 7-item questionnaire was filled out by each swimmer which had questions regarding their frequency of swimming, food habits, oral habits, etc. The average time taken for each participant ranged from two to five minutes (Table 1).

- Phase 2: Oral examination

Oral screening and complete evaluation were done by two qualified and trained investigators using a mouth mirror, explorer, and cheek retractor. Facial or labial surfaces of maxillary and mandibular anterior teeth from central incisors to canines were considered for assessment. The stains were evaluated starting from the maxillary right central incisor to the maxillary right canine of the first quadrant followed by the second, third, and fourth quadrants of the oral cavity in the same manner. Photographs of the above-mentioned teeth were taken for documentation purposes (Figure 1).

Table 1. Questionnaire which was filled out by the participant swimmers

QUESTIONNAIRE RESULTS	SWIMMERS (N=150)	%
1. Gender		
a. Male	98	65.3
b. Female	52	34.7
2. Are you a professional or a recreational swimmer?		
a. Professional	111	74
b. Recreational	39	26
3. How long have you been swimming (in years)?		
a. 1-2 years	20	13.3
b. 4-7 years	60	40
c. >8 years	70	46.7
4. Frequency of swimming (how many hours per week)		
a. 4-5 hours	35	23.3
b. 6-8 hours	11	7.3
c. >8 hours	114	69.3
5. Have you ever had your teeth professionally cleaned by a dentist?		
a. Yes	37	24.7
b. No	113	75.3
6. How many times do you brush your teeth?		
a. Once	80	53.3
b. Twice	66	44
c. More than twice	4	2.7
7. Do you drink tea/coffee/coke regularly?		
a. Once a day	54	36
b. Twice a day	19	12.7
c. More than twice a day	8	5.3
d. Never	69	46

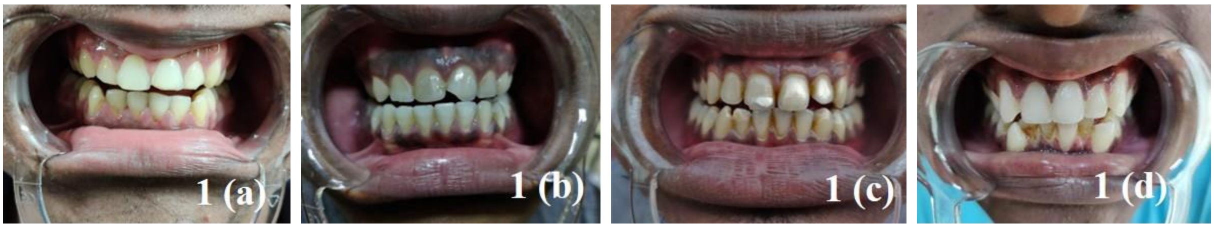

Figure 1. (a) shows no stain in the maxillary central incisor. The tooth surface appears smooth and glossy; 1 (b) shows a thin band of stain in the mandibular central incisor with yellowish discoloration and loss of luster; 1 (c) shows a moderate band of stain in the mandibular central incisor not covering the entire tooth surface; 1(d) shows stains covering the total area in the mandibular lateral incisor with a widespread brown stain and a corroded appearance

Lobene Stain Index Evaluation

The intensity and extent of extrinsic stains on the labial surface of the maxillary and mandibular anterior teeth were assessed using the Lobene Stain Index. The stains were graded on the following scale:

0- No stain
1- Thin band of stain
2- Moderate to thick band of stain
3- Stain covering the total area

2.6. Statistical Analysis

The results were tabulated using SPSS (Version 17.0) software and subgroup analysis was performed using Fisher's exact test for statistical significance.

3. Results

The study enrolled 150 participants, comprising 98 males and 52 females. Notably, 74% were professional swimmers, while 26% swam recreationally. The participants' swimming experience varied, with 46.7% swimming for over 8 years, 40% for 4-7 years, and 13.3% for 1-2 years (Supplementary Table 1). Additionally, the weekly swimming duration ranged from 4-5 hours (23.3%) to over 8 hours (69.3%), with 7.3% swimming for 6-8 hours (Supplementary Table 2). Interestingly, most participants had never undergone professional teeth cleaning by a dentist. Their oral hygiene habits varied, with 53.3% brushing their teeth once a day, 44% brushing twice daily, and only 2.7% brushing more than twice daily (Supplementary Table 3). Notably, the majority of participants showed no visible extrinsic stains on the maxillary and mandibular central incisors and lateral incisors.

According to the Lobene Stain Index, the majority of participants exhibited a stain intensity of 1 on their remaining anterior teeth. Furthermore, it was observed that tooth 33 (mandibular left canine) was the most prone to staining, affecting 62.7% of the population, closely followed by teeth 23 and 43 (maxillary left canine and mandibular right canine, respectively), which showed staining in 61.3% of the participants (Supplementary table 4).

After assessing the anterior teeth of various swimmers and performing the Fisher's Exact Test, there were no significant p values found except for the maxillary right lateral incisor (p-value 0.050). The results showed there was no significant correlation between the frequency of swimming, measured in hours, and the severity of extrinsic tooth stains, as assessed by the Lobene Stain Index, except maxillary right lateral incisor. Notably, the analysis revealed significant p-values for several teeth, indicating a statistically significant relationship between brushing habits and the severity of extrinsic tooth stains.

4. Discussion

This cross-sectional study involved 150 professional and recreational swimmers aged 18-45 years to determine the pattern and severity of extrinsic stains with frequency of swimming using the Lobene Stain Index. To the best of our knowledge, this is the first study to assess stains on each maxillary and mandibular anterior tooth using the Lobene Stain Index.

The Lobene Stain Index was selected for this study because it allows for a straightforward evaluation of extrinsic stains with the naked eye in natural light. This method eliminates the need for disclosing solutions, which can cause allergic reactions and discomfort, as seen with the O'Leary Index. Additionally, the Silness-Loe Plaque Index focuses on gingival inflammation, which is not the focus of this research. The Lobene Stain Index offers a simple and efficient grading system, making it ideal for mass screenings where time is of the essence.

The study's findings revealed that professional swimmers were more likely to experience tooth staining compared to recreational swimmers, possibly due to their longer training hours. Furthermore, the study showed that dental erosion also affected a significant number of swimmers. These results were consistent with a previous study [11].

This study aimed to determine if there's a connection between how often someone swims and the severity of tooth stains. Our results showed no significant link between the two. However, our findings disagree with earlier research. Previous studies found that swimmers who spent more time in the water (over 6 hours) had more severe tooth stains, suggesting that swimming frequency may indeed impact tooth stain severity [11,12,13].

The present study suggested that regular dental visits and professional teeth cleaning could help reduce tooth stains. However, interestingly, even professional swimmers who received regular oral prophylaxis, still had extrinsic stains, as found in another study [7,9].

The study found that swimmers who brushed their teeth more than once a day had fewer stains compared to those who only brushed once daily. However, another study had different results, showing that the frequency of brushing didn't make a difference. Instead, the study found that participants who used electric toothbrushes had less severe stains [9].

The results of this study revealed that there was no significant link between regular consumption of tea, coffee, or cola and the severity of tooth stains. This finding was supported by a similar study [8]. However, another study found that certain tooth-colored dental materials were prone to staining from beverages like tea, energy drinks, and soft drinks [14]. Interestingly, in another study, it was noted that staining was unrelated to oral hygiene habits or dietary factors [13].

Swimming, particularly in poorly maintained pools, can have damaging effects on dental health due to repeated exposure to harmful substances. In India, for instance, substandard pool water quality can lead to dental tissue instability. Over-chlorination of pool water is a significant factor that can cause teeth to stain more easily. Therefore, pool maintenance is an essential consideration when researching this condition. To ensure safe and healthy swimming conditions, pool water should be continuously disinfected with a suitable agent that leaves a measurable residue. Acceptable disinfectants include chlorine gas, chlorine compounds, bromine compounds, or other bactericidal agents. The pH level of pool water should be maintained between 7.2 and 8.0, with a free residual chlorine count of 0.6 to 1.5 parts per million (ppm), depending on the pH level. To adjust the pH, soda ash or caustic soda can be used. According to the Tamil Nadu Swimming Standards, pool water should be free of pathogenic staphylococcus germs that can cause dental caries [15]. Despite strict adherence to pool safety measures, extrinsic stains caused by chlorine water can't be eliminated, but their intensity can be reduced. A major concern is not only the aesthetic impact but also the potential damage to tooth integrity. Applying fluoride to teeth before swimming may help shield them from harm. Research has shown that teeth treated with fluoridated milk, with or without tannic acid, had increased protection against the erosive effects of chlorine [10]. It's essential to raise awareness about Swimmer's Mouth and encourage swimmers to seek professional dental help. Dentists should also be informed about the specific issues related to swimming to provide appropriate treatment and care for swimmers.

Swimmer's Mouth is a relatively unexplored area of research, with limited existing literature. However, the growing concern for aesthetic dental issues has sparked interest among researchers to investigate this topic further. This study stands out with its larger sample size of 150 swimmers, including both males and females. A key aspect of this research was the individual evaluation of each upper and lower front tooth, which helped identify the teeth most prone to staining. Notably, most swimmers were unaware of this issue while completing the questionnaire, highlighting the need for education. This study has not only informed a large population of swimmers about Swimmer's Mouth but also provides valuable insights for dentists. The findings of this research may encourage dentists to develop effective treatment plans for this chronic and progressive condition in the years to come.

5. Conclusions

This study contributes significantly to the existing literature, being one of the first to comprehensively examine tooth staining using the Lobene Stain Index. Despite this strength, the study has several limitations. The sample population was restricted to individuals between the ages of 18 and 45, excluding younger and older demographics. Additionally, the study did not investigate potential gender differences in tooth staining. The analysis was also limited to specific teeth, omitting the maxillary and mandibular posteriors. Furthermore, the study did not examine the impact of various brushing techniques, mouthwash use, and electric toothbrush usage on tooth staining. Nevertheless, this study provides a valuable foundation for future research, and its findings have important implications for the development of effective strategies to prevent and manage tooth staining in swimmers.

Key Learning Points

- Educational awareness about Swimmer's Mouth, its causes, and consequences
- Guidance on the importance of maintaining good oral hygiene practices
- Emphasis on the value of regular dental check-ups for preventive care and early intervention
- Maxillary and mandibular canines are more susceptible to extrinsic stains.

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Supplementary Tables

Supplementary Table 1. Signifies the association between the duration of swimming (in years) and the severity of extrinsic stains

TOOTH NUMBER	NO. OF YEARS IN SWIMMING	LOBENE STAIN INDEX				P VALUE
		0	1	2	3	
T11	**1-2 YRS**	9(45%)	8(40%)	3(15%)	0(0%)	0.711
	4-7 YRS	29(48%)	23(38%)	6(10%)	2(3%)	
	MORE THAN 8 YRS	34(49%)	29(42%)	6(9%)	0(0%)	
T12	**1-2 YRS**	9(45%)	8(40%)	3(15%)	0(0%)	0.594
	4-7 YRS	17(28%)	31(52%)	11(18%)	1(2%)	
	MORE THAN 8 YRS	18(26%)	42(61%)	8(12%)	1(1%)	
T13	**1-2 YRS**	6(30%)	8(40%)	4(20%)	2(10%)	0.138
	4-7 YRS	18(30%)	26(43%)	10(17%)	6(10%)	
	MORE THAN 8 YRS	19(28%)	41(59%)	9(13%)	0(0%)	
T21	**1-2 YRS**	8(40%)	9(45%)	3(15%)	0(0%)	0.511
	4-7 YRS	27(45%)	27(45%)	4(7%)	2(3%)	
	MORE THAN 8 YRS	36(52%)	26(38%)	7(10%)	0(0%)	
T22	**1-2 YRS**	12(60%)	3(15%)	4(20%)	1(5%)	0.201
	4-7 YRS	22(37%)	25(42%)	11(18%)	2(3%)	
	MORE THAN 8 YRS	29(42%)	32(46%)	7(10%)	1(1%)	
T23	**1-2 YRS**	7(35%)	11(55%)	2(10%)	0(0%)	0.869
	4-7 YRS	16(27%)	26(60%)	7(12%)	1(2%)	
	MORE THAN 8 YRS	17(25%)	45(65%)	7(10%)	0(0%)	
T31	**1-2 YRS**	7(35%)	7(35%)	4(20%)	2(10%)	0.252
	4-7 YRS	23(38%)	27(45%)	9(15%)	1(2%)	
	MORE THAN 8 YRS	21(30%)	40(58%)	6(9%)	2(3%)	
T32	**1-2 YRS**	6(30%)	10(50%)	4(20%)	0(0%)	0.173
	4-7 YRS	19(32%)	23(38%)	14(23%)	4(7%)	
	MORE THAN 8 YRS	18(26%)	41(59%)	6(9%)	4(6%)	
T33	**1-2 YRS**	5(25%)	13(65%)	2(10%)	0(0%)	0.907
	4-7 YRS	15(25%)	35(58%)	9(15%)	1(2%)	
	MORE THAN 8 YRS	13(19%)	46(67%)	8(12%)	2(3%)	
T41	**1-2 YRS**	5(25%)	11(55%)	4(20%)	0(0%)	0.102
	4-7 YRS	23(28%)	22(37%)	12(20%)	3(5%)	
	MORE THAN 8 YRS	19(28%)	42(61%)	5(7%)	3(4%)	
T42	**1-2 YRS**	5(25%)	12(60%)	3(15%)	0(0%)	0.122
	4-7 YRS	11(18%)	25(42%)	15(25%)	9(15%)	
	MORE THAN 8 YRS	16(23%)	40(58%)	8(11.6%)	5(7.2%)	
T43	**1-2 YRS**	4(20%)	12(60%)	4(20%)	0(0%)	0.917
	4-7 YRS	15(25%)	34(57%)	10(17%)	1(2%)	
	MORE THAN 8 YRS	13(19%)	46(67%)	9(13%)	1(1%)	

Supplementary Table 2. Signifies the association between the frequency of swimming in hours and the severity of extrinsic stains

TOOTH NUMBER	FREQUENCY OF SWIMMING IN HRS	LOBENE STAIN INDEX				P VALUE
		0	1	2	3	
T11	4-5 HRS	18(51%)	16(46%)	1(3%)	0(0%)	0.683
	6-8 HRS	6(55%)	4(36%)	1(9%)	0(0%)	
	MORE THAN 8 HRS	48(47%)	40(39%)	13(13%)	2(2%)	
T12	4-5 HRS	16(46%)	15(43%)	3(9%)	1(3%)	0.215
	6-8 HRS	2(18%)	6(55%)	3(27%)	0(0%)	
	MORE THAN 8 HRS	26(25%)	60(58%)	16(16%)	1(1%)	
T13	4-5 HRS	10(29%)	21(60%)	2(6%)	2(6%)	0.391
	6-8 HRS	1(9%)	7(64%)	2(18%)	1(9%)	
	MORE THAN 8 HRS	32(31%)	47(46%)	19(18%)	5(5%)	
T21	4-5 HRS	18(51%)	16(46%)	1(3%)	0(0%)	0.733
	6-8 HRS	6(55%)	4(36%)	1(9%)	0(0%)	
	MORE THAN 8 HRS	47(46%)	42(43%)	12(12%)	2(2%)	
T22	4-5 HRS	18(51%)	12(34%)	5(14%)	0(0%)	0.566
	6-8 HRS	3(27%)	5(46%)	3(27%)	0(0%)	
	MORE THAN 8 HRS	42(41%)	43(42%)	14(14%)	4(4%)	
T23	4-5 HRS	8(23%)	22(63%)	4(11%)	1(3%)	0.411
	6-8 HRS	1(9%)	8(73%)	2(18%)	0(0%)	
	MORE THAN 8 HRS	31(30%)	62(60%)	10(10%)	0(0%)	
T31	4-5 HRS	13(37%)	17(49%)	3(9%)	2(6%)	0.912
	6-8 HRS	4(36%)	6(55%)	1(9%)	0(0%)	
	MORE THAN 8 HRS	34(33%)	51(50%)	15(15%)	3(3%)	
T32	4-5 HRS	9(26%)	18(51%)	7(20%)	1(3%)	0.867
	6-8 HRS	4(36%)	6(55%)	1(9%)	0(0%)	
	MORE THAN 8 HRS	30(29%)	50(49%)	16(16%)	7(7%)	
T33	4-5 HRS	9(26%)	20(57%)	5(14%)	1(3%)	0.976
	6-8 HRS	2(18%)	8(73%)	1(9%)	0(0%)	
	MORE THAN 8 HRS	22(21%)	66(64%)	13(13%)	2(2%)	
T41	4-5 HRS	10(29%)	22(63%)	2(6%)	1(3%)	0.563
	6-8 HRS	3(27%)	6(55%)	2(18%)	0(0%)	
	MORE THAN 8 HRS	34(33%)	47(46%)	17(17%)	5(3%)	
T42	4-5 HRS	10(29%)	18(51%)	7(20%)	0(0%)	0.112
	6-8 HRS	2(18%)	5(46%)	4(36%)	0(0%)	
	MORE THAN 8 HRS	20(19%)	54(52%)	15(15%)	14(14%)	
T43	4-5 HRS	9(26%)	18(51%)	7(20%)	1(3%)	0.833
	6-8 HRS	2(18%)	7(64%)	2(18%)	0(0%)	
	MORE THAN 8 HRS	21(20%)	67(65%)	14(14%)	1(1%)	

Supplementary Table 3. Signifies the association between brushing habits and the severity of extrinsic stains

TOOTH NUMBER	BRUSHING HABITS	LOBENE STAIN INDEX				P VALUE
		0	1	2	3	
T11	ONCE A DAY	32(40%)	36(45%)	11(14%)	1(1%)	0.198
	TWICE A DAY	39(60%)	22(34%)	3(5%)	1(2%)	
	MORE THAN TWICE A DAY	1(25%)	2(50%)	1(25%)	0(0%)	
T12	ONCE A DAY	22(28%)	39(49%)	18(23%)	1(1%)	0.195
	TWICE A DAY	21(32%)	39(60%)	4(6%)	1(2%)	
	MORE THAN TWICE A DAY	1(25%)	3(75%)	0(0%)	0(0%)	
T13	ONCE A DAY	20(25%)	41(51%)	14(18%)	5(6%)	0.316
	TWICE A DAY	23(35%)	32(49%)	8(12%)	2(3%)	
	MORE THAN TWICE A DAY	0(0%)	2(50%)	1(25%)	1(25%)	
T21	ONCE A DAY	37(46%)	30(38%)	11(14%)	2(3%)	0.207
	TWICE A DAY	33(51%)	30(46%)	2(3%)	0(0%)	
	MORE THAN TWICE A DAY	1(25%)	2(50%)	1(25%)	0(0%)	
T22	ONCE A DAY	30(38%)	33(41%)	14(18%)	3(4%)	0.012
	TWICE A DAY	32(49%)	27(42%)	5(8%)	1(2%)	
	MORE THAN TWICE A DAY	1(25%)	0(0%)	3(75%)	0(0%)	
T23	ONCE A DAY	17(21%)	52(65%)	10(13%)	1(1%)	0.560
	TWICE A DAY	22(34%)	38(59%)	5(8%)	0(0%)	
	MORE THAN TWICE A DAY	1(25%)	2(50%)	1(25%)	0(0%)	
T31	ONCE A DAY	19(24%)	48(60%)	10(13%)	3(4%)	0.005
	TWICE A DAY	32(49%)	24(37%)	8(12%)	1(2%)	
	MORE THAN TWICE A DAY	0(0%)	2(50%)	1(25%)	1(25%)	
T32	ONCE A DAY	22(28%)	40(50%)	14(18%)	4(5%)	0.552
	TWICE A DAY	21(32%)	32(49%)	9(14%)	3(5%)	
	MORE THAN TWICE A DAY	0(0%)	2(50%)	1(25%)	1(25%)	
T33	ONCE A DAY	18(23%)	48(60%)	12(15%)	2(3%)	0.952
	TWICE A DAY	14(22%)	43(66%)	7(11%)	1(2%)	
	MORE THAN TWICE A DAY	1(25%)	3(75%)	0(0%)	0(0%)	
T41	ONCE A DAY	21(26%)	41(51%)	14(18%)	4(5%)	0.085
	TWICE A DAY	26(40%)	32(49%)	6(9%)	1(2%)	
	MORE THAN TWICE A DAY	0(0%)	2(50%)	1(25%)	1(25%)	
T42	ONCE A DAY	17(21%)	40(50%)	16(20%)	7(9%)	0.026
	TWICE A DAY	15(23%)	37(57%)	8(12%)	5(7%)	
	MORE THAN TWICE A DAY	0(0%)	0(0%)	2(50%)	2(50%)	
T43	ONCE A DAY	18(23%)	46(58%)	15(19%)	1(1%)	0.884
	TWICE A DAY	13(20%)	43(66%)	8(12%)	1(2%)	
	MORE THAN TWICE A DAY	1(25%)	3(75%)	0(0%)	0(0%)	

Supplementary Table 4. Signifying the association between the type of swimmer and the severity of extrinsic stains

TOOTH NUMBER	TYPE OF SWIMMER	LOBENE STAIN INDEX				P VALUE
		0	1	2	3	
T11	PROFESSIONAL	49(45%)	46(42%)	13(12%)	2(2%)	0.323
	RECREATIONAL	23(59%)	14(36%)	2(5%)	0(0%)	
T12	PROFESSIONAL	26(24%)	63(57%)	20(18%)	1(1%)	0.023
	RECREATIONAL	18(46%)	18(46%)	2(5%)	1(3%)	
T13	PROFESSIONAL	31(28%)	53(48%)	20(18%)	6(6%)	0.473
	RECREATIONAL	12(31%)	22(56%)	3(8%)	2(5%)	
T21	PROFESSIONAL	47(43%)	49(45%)	12(11%)	2(2%)	0.192
	RECREATIONAL	24(62%)	13(33%)	2(5%)	0(0%)	
T22	PROFESSIONAL	43(40%)	45(41%)	18(16%)	4(4%)	0.362
	RECREATIONAL	20(51%)	15(39%)	4(10%)	0(0%)	
T23	PROFESSIONAL	29(26%)	68(62%)	13(12%)	0(0%)	0.346
	RECREATIONAL	11(29%)	24(62%)	3(8%)	1(3%)	
T31	PROFESSIONAL	39(36%)	54(49%)	14(13%)	3(3%)	0.871
	RECREATIONAL	12(31%)	20(51%)	5(13%)	2(5%)	
T32	PROFESSIONAL	32(29%)	53(49%)	19(17%)	6(6%)	0.907
	RECREATIONAL	11(28%)	21(54%)	5(13%)	2(5%)	
T33	PROFESSIONAL	24(22%)	69(63%)	15(14%)	2(2%)	0.947
	RECREATIONAL	9(23%)	25(64%)	4(10%)	1(3%)	
T41	PROFESSIONAL	38(35%)	49(45%)	18(16%)	5(5%)	0.121
	RECREATIONAL	9(23%)	26(67%)	3(8%)	1(3%)	
T42	PROFESSIONAL	23(21%)	53(48%)	20(18%)	14(13%)	0.105
	RECREATIONAL	9(23%)	24(62%)	6(15%)	0(0%)	
T43	PROFESSIONAL	24(22%)	69(63%)	16(15%)	1(1%)	0.827
	RECREATIONAL	8(21%)	23(59%)	7(18%)	1(3%)	

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