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What about behaviours in swimming pools? Results of an Italian multicentre study☆

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ABSTRACT

The behaviour of swimming pool users plays an important role in the prevention of chemical, microbial and physical risks associated with these recreational water environments. The aim of this study was to evaluate the hygiene-related behaviours and knowledge of users of indoor swimming pools in five Italian cities. A cross-sectional study was carried out using an anonymous self-administered questionnaire. The association between specific variables and patterns of behaviours and knowledge was assessed. A total of 4315 questionnaires were analysed. Of all respondents, 41.7% declared they had never read the swimming pool rules; 70.9% take a shower before entering the swimming pool; 13.5% said they urinated at least once in a swimming pool; 93.9% always wear proper footwear; 92.1% know what warts are and 69.3% know what mycosis is. A significant association was found between not reading the pool rules and unsafe behaviours, such as not showering (OR: 1.44, 95% CI 1.25–1.65), urinating in the pool (OR: 1.70, 95% CI 1.41–2.03) and not wearing any footwear (OR: 1.24, 95% CI 0.96–1.62). Male gender was significantly associated with urinating in the swimming pool (OR: 1.45, 95% CI 1.21–1.74) and not wearing footwear (OR: 1.71, 95% CI 1.32–2.23), but it showed to be protective against not showering (OR: 0.78, 95% CI 0.68–0.89). An age ≤18 years was a risk factor for not reading the pool rules (OR: 2.32, 95% CI 2.05–2.63), not wearing footwear (OR: 2.16, 95% CI 1.67–2.82) and not knowing what mycosis (OR: 7.04, 95% CI 5.34–9.27) and warts (OR: 7.94, 95% CI 6.86–9.20) are. Results reveal that incorrect behaviours are widespread among swimming pool users and that there is little awareness of the importance of reading pool rules for reducing health risks.

1. Introduction

The number of people who practise a water-related sport activity has been increasing, and swimming pools in particular have become places where people go not only to practise a sport, but also for recreation, relaxation and socialization. Water-related activities are excellent ways to get physically fit and gain health benefits [1,2]. However, they can also expose people to a series of chemical, microbiological and physical risks [3–20].

The risk of infection associated with swimming pools derives typically not only from faecal contamination of water, but also non-faecal microorganisms originating from the skin, hair, saliva, urine or blood may be potential causes of infection [3–5,21–24]. Chemical risks are mainly those associated with disinfectants, which can react with other chemicals in the water (e.g. human body substances such as sweat, saliva, urine, faecal matter, skin particles, hair; chemicals and organic materials from cosmetics and sunscreens, soap residues, natural organic matter) and give rise to unwanted by-products, known as disinfection by-products (DBPs) [3,11]. Besides those DBPs that are already known for being present in tap water, new DBPs were found in pool water such as nitrogen-containing DBPs (e.g. haloamides, halonitriles, haloamines) [12]. In fact urine and sweat, which contain

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nitrogen compounds such as urea, uric acid, creatinine, ammonia, and several amino acids, are the major components that are released to water by bathers [11]. It is estimated that a bather releases a mixture of 50 mL of urine and 200 mL of sweat in an average swimming event [24].

DBP concentrations will vary according to the concentration of precursor compounds, disinfectant dose, residual disinfectant level, temperature and pH [3]. It has been demonstrated that after chlorinated disinfection in pools some DBPs such as trichloramine, trihalomethanes (THMs), haloacetic acids (HAAs), chloral hydrate and haloacetonitriles (HANs), are present in a relatively high concentration in the air and water [3,15]. Swimming pool users may be exposed to DBPs through direct ingestion of water, inhalation of volatile or aerosolized solutes, dermal contact and absorption through the skin [3]. With regard to health effects, numerous publications highlight irritative ocular and respiratory symptoms and the risk of allergy and bronchial asthma, while epidemiological data about the risk of cancer are still controversial [12].

The prevention of swimming pool-related illnesses requires a combination of appropriate design and construction, pool policies and management, and public education associated with regulatory requirements [3]. The users themselves play an important part in reducing the incidence of illnesses. Personal hygiene, in particular, is essential in reducing the spread of microorganisms and minimizing the introduction of DBP chemical precursors into the water. The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) provide recommendations on personal hygiene and correct behaviours [3,25], as fundamental means to reduce the biological and chemical contamination, and every swimming pool has its own rules.

All users should be encouraged to use the toilets before bathing and whenever necessary, in order to minimize urination in the pool. CDC guidelines recommend that children are taken on bathroom breaks every 60 min or have their diapers checked every 30–60 min [25]. Taking a pre-swim shower before entering the swimming pool is essential to reduce the number of microorganisms and organic DBP precursors that bathers transfer to the water, in order to ensure a good water and air quality and to prevent biological and chemical risks [21,23]. The 2010 Centers for Disease Control and Prevention (CDC) guidelines recommend showering with soap [25]. The York Region (Canada) on its official website (www.york.ca) underlines that a quick rinse over a swim suit will not do much good, suggesting nude showering with soap and warm water and an adequate rinse to eliminate any traces of soap. In the majority of cases, rules in swimming pools include a compulsory shower, but do not specify the use of soap. There is no universally accepted standard for proper showering methods for swimmers. However, a recent study indicates that a simple rinse shower is enough to remove some contaminants [23]. In order to minimize and control water contamination, the use of a footbath is also recommended. The footbath represents a barrier between outdoor dirt and the pool and can minimize the transfer of dirt into the pool. WHO guidelines, in particular, recommend a strategic placement of footbaths [3].

Many studies exist on the quality of water in swimming pools, the risks associated with chemical and microbial contamination, the best preventive strategies for the maintenance of swimming pools, and the various ways to disinfect, filtrate and recirculate water in a pool [3,26–29]. But the behaviour of pool users seems to be a neglected subject. Even though there is a perception of general low compliance with the most elementary hygiene-related rules, very few studies have been performed to assess the actual compliance of users and their awareness of the risks associated with bathing in swimming pools [30–34].

In order to increase public attention on this topic, we performed a multicentre study on the behaviour and knowledge of indoor swimming pool users in five Italian cities.

2. Materials and methods

2.1. Study design

A cross-sectional study was carried out in indoor swimming pools in five Italian cities: two in the North (Crema and Parma), one in the Centre (Perugia) and two in the South (Naples and Bari).

An anonymous self-administered questionnaire was distributed in each facility during the course of one calendar month, in different days of the week, so as to include all types of customers (swimming courses' attendants, professional swimmers and recreational swimmers).

Overall, 4750 questionnaires were distributed to everyone ≥ 6 years old who entered the swimming pool on the days of the survey. Questionnaires were handed out together with an explanation sheet describing the study and the confidentiality of the interviewee's personal data.

The 38 items included in the questionnaire were divided into three sections: the first section collected personal data, previous attendance of a swimming pool and previous/current attendance of a swimming course. The second part asked whether or not the interviewee had read the swimming pool rules, and what his/her behaviour had been while in the swimming pool; the third part inquired about the user's knowledge of the risks associated with swimming pools and the rationale behind some typical swimming pool rules.

2.2. Statistical analysis

A descriptive analysis was carried out to calculate the frequencies, percentages and frequency tables of categorical variables, and the mean and standard deviation of quantitative variables.

Subsequently, bivariate analyses [Chi-squared test and odds ratio (OR) with 95% confidence interval (CI)] were performed to assess the association between specific variables and unsafe behaviours. The level of significance was set at $P < 0.05$. To investigate potential independent predictors of incorrect behaviours and lack of awareness, a logistic regression model was used. Independent variables were: not having read the pool rules, an age ≤ 18 years, being a male, and having previously attended a course. Dependent variables were: not showering, urinating in the swimming pool, not using footwear, not knowing what warts are, not knowing what mycosis is, and not reading the pool rules.

Statistical Package for the Social Sciences Version 19 (SPSS Inc., Chicago, IL, USA) was used for the statistical evaluation.

3. Results and discussion

3.1. Sample characteristics

A total of 4315 questionnaires were analysed (90.8% response rate): 2029 (47.02%) males, 2283 (52.91%) females, and 3 (0.07%) subjects who did not state their sex were interviewed. Among the respondents, 1122 (26%) were from Crema, 1251 (29%) from Parma, 392 (9.1%) from Perugia, 594 (13.8%) from Bari, and 956 (22.2%) from Naples. The age of participants ranged from 6 to 86 years (mean $\pm$ standard deviation 25.7 $\pm$ 15.17; median 24). Fig. 1 shows the age distribution of the interviewees. Of all the respondents, 62.5% had previously attended or were currently attending a swimming course.

3.2. Behaviour

Table 1 shows the answers of swimming pool users divided by city and sex. Fig. 2 shows the behaviours divided by age and gender.

According to the answers, about two thirds of users (70.9%) always shower before entering a swimming pool, with the highest value being found in Parma (74.8%) and the lowest in Perugia (41.6%).