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ORIGINAL ARTICLE

## Knowledge, risk perception and behaviours in swimming pool users of Palermo city, Sicily

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### Abstract

To assess knowledge, risk perception and behaviours of a sample of swimming pool users in Palermo. A total of 498 subjects were interviewed by self-administered anonymous questionnaire including socio-demographic questions, knowledge/risk perception and behaviours. Overall, 289 subjects (58%) had a mean of  $1.9 \pm 1.2$  healthy behaviours. Age older than 30 years (OR = 0.46; 95% CI = 0.26–0.81), female sex (OR = 0.52; 95% CI = 0.35–0.76) and a high knowledge score (OR = 0.15; 95% CI = 0.03–0.69) were significantly associated with having healthy behaviours in both univariate and multivariate analysis. Unhealthy behaviours can be frequently found in swimming pool bathers and, particularly, in some target groups. Public health prevention strategies should be implemented to improve public awareness and information on a safe use of recreational water environments.

**Keywords:** *Swimming pool, survey, KAP questionnaire, health risks*

### Introduction

Swimming is the third most popular physical activity in Italy (CONI, 2011), involving approximately 3.5 millions of persons per year (ISTAT, 2008) with a popularity that is increasing year by year. The high attractiveness of swimming may be explained by considering its health benefits in healthy general population as well as in subjects with chronic diseases (CDC, 2010) and swimmers have been found to have about half risk of death compared with inactive people (Chase, Sui, & Blair, 2008). Unhappily, the health benefits of swimming may be tempered by different risks. Drowning and injuries are probably the most obvious hazards relating to pools and similar environments, although there are also less visible hazards, including those posed by chemicals and microbes. In particular, microbial contamination may be considered a daily risk that can originate from human faeces accidentally released in the water,

non-faecal human-shedding (e.g. vomit, mucus, saliva, skin) and several environmental sources.

Different waterborne diseases and outbreaks have been documented in swimming pools as a consequence of contamination due to viruses (rotavirus, norovirus, adenovirus, enterovirus and hepatitis A virus), faecally derived (*Escherichia coli* O157 and *Shigella* species) and non-faecally derived bacteria (*Legionella* spp. *Pseudomonas aeruginosa*, non-tuberculous mycobacteria, *Staphylococcus aureus* and *Leptospira* spp.), protozoa (*Giardia*, *Cryptosporidium* spp., *Acanthamoeba* spp., *Naegleria fowleri* and *Plasmodium* spp.) and fungi (*Trichophyton* spp. and *Epidemophyton floccosum*) (WHO, 2006), and gastroenteritis was the most frequently reported water illness (CDC, 2008). Several unhealthy swimming pool users’ behaviours, such as swimming without showering first or while having a diarrheal illness, may increase the infection risk for everyone using the swimming pool whereas other habits such as

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swimming with open wounds may expose themselves and the other swimmers to the risk of transmission of pathogens. In order to better understand the size and the features of these risks, we designed and conducted a survey assessing knowledge, perceptions and behaviours of a sample of swimming pool users in Palermo, Italy.

## Methods

From June to September 2010, a cross-sectional epidemiologic survey was carried out in two main swimming pools in Palermo (Italy) including 2732 bathers who were regularly registered. A sample of 546 subjects who consecutively attended the two structures in the period under study were asked to take part in the study and 498 (91.2%) of them, after giving their informed consent, were interviewed by a self-administered anonymous questionnaire. No information was available on subjects who refused to participate in the study and those who did not attend the swimming pool during the study period.

### Questionnaire

A preliminary version of the questionnaire was drafted and tested on a pilot sample of 30 swimming pool users for evaluating its reliability and validity. The final version of the questionnaire included 24 items organised into four different sections:

1. Socio-demographic data included age, gender and education as defined by the Italian Education System Organisation as defined by the Italian Ministry of Education, Universities and Research (MIUR, 2011).
2. Habits regarding swimming such as years of practice, frequency, bath duration and swimming activities.
3. Knowledge/risk perception: it was investigated if participants had read swimming pool rules and regulations (yes/no) and if they had awareness of infectious recreational water illnesses such as gastrointestinal diseases (yes/no), respiratory diseases (yes/no) and cutaneous diseases (yes/no).
4. Behaviours while attending swimming pool:
  - Before bathing: participants were asked about their compliance with taking a shower (yes, always/never or sometimes) and wearing slippers within the swimming area (yes, always/never or sometimes).
  - During bathing: it was investigated the use of swimming goggles (yes, always/never or sometimes), cap (yes, always/never or sometimes; bald people were considered as always wearing cap), body accessories as

watches, rings and bracelets (never/yes, always or sometimes). Moreover, participants were also asked to report behaviours such as chewing gums/candies (never/yes, always or sometimes), rinsing mouth (never/yes, always or sometimes), blowing nose (never/yes, always or sometimes), urinating while bathing (never/yes, always or sometimes), swimming while having recent skin wounds (never/yes, always or sometimes), with infectious disease of skin (never/yes, always or sometimes) and with diarrheic disease (never/yes, always or sometimes).

- After bathing: the compliance with taking a shower (yes, always/never or sometimes) was assessed.

### Statistical analysis

The questionnaire responses were entered in a database created by EpiInfo 3.5.1 software. In order to perform the statistical analyses, the highest education level was categorised as 'illiterate/primary school', 'secondary school' and 'university degree'; years of practice was categorised as 'less than 1', '1–2' and '3 or more'; bath duration was categorised as '< 1 hour' and '1 hour or more' per entry and swimming activities were categorised as 'free-swimming', 'assisted swimming' and 'others'.

When assessing answers of participants on knowledge and behaviours, two different scores were created (Table I).

A first score (knowledge score) included four items. Each item was scored from 0 to 1 and the sum of all items ranged from 4 (maximum knowledge level) to 0 (minimum knowledge level).

A second score (behaviour score) included 13 items. Each item was scored from 0 to 1 and the sum of all items ranged from 13 (maximum level of healthy behaviours) to 0 (minimum level of healthy behaviours).

Absolute and relative frequencies with 95% CIs were calculated for qualitative variables, while quantitative variables were summarised as mean  $\pm$  standard deviation. The relationship between independent variables and the behaviour score (dichotomised into 0 if 'absence of unhealthy behaviours' and 1 if 'presence of at least 1 unhealthy behaviour') was determined using chi-square test.

Then, a multivariate analysis by backward stepwise logistic regression was carried out to determine variables significantly associated with having at least one unhealthy behaviour (considered as dependent variable). All variables that did differ between groups ( $p < 0.10$ ) were initially entered in the model and the least significant variable ( $p < 0.05$ ) was

Table I. Items contributing to the knowledge (A) and behaviour (B) scores

(A) Knowledge score	
Question	Answer (code)
1. Reading swimming pool rules and regulations	Yes (1); No (0)
2. Awareness of IRWT <sup>a</sup> such as gastrointestinal diseases	Yes (1); No (0)
3. Awareness of IRWT <sup>a</sup> such as respiratory diseases	Yes (1); No (0)
4. Awareness of IRWT <sup>a</sup> such as cutaneous diseases	Yes (1); No (0)
(B) Behavior score	
Question	Answer (code)
1. Compliance with taking a shower before bathing	yes, always (1); never/sometimes (0)
2. Compliance with taking a shower after bathing	yes, always (1); never/sometimes (0)
3. Compliance with wearing slippers	yes, always (1); never/sometimes (0)
4. Compliance with wearing swimming goggles	yes, always (1); never/sometimes (0)
5. Compliance with wearing cap	yes, always (1); never/sometimes (0)
6. Wearing body accessories as watches, rings and bracelets	yes, always/sometimes (0); never (1)
7. Chewing gums/candies during the bath	yes, always/sometimes (0); never (1)
8. Rinsing mouth during the bath	yes, always/sometimes (0); never (1)
9. Blowing nose during the bath	yes, always/sometimes (0); never (1)
10. Urinating during the bath	yes, always/sometimes (0); never (1)
11. Swimming while having recent skin wounds	yes, always/sometimes (0); never (1)
12. Swimming while having recent infectious disease of skin	yes, always/sometimes (0); never (1)
13. Swimming while having diarrheic disease	yes, always/sometimes (0); never (1)

<sup>a</sup>IRTW, infectious recreational water illness.

removed one at a time. Several multiple logistic regression models were tested to determine the best available fit for the data available. Measures of goodness-of-fit were calculated to compare logistic regression models using Akaike’s Information Criterion (AIC) and the model with the lowest AIC was considered the best fit. The final model included the following independent variables: age, gender and knowledge/risk perception. Multicollinearity was excluded using Spearman’s correlation coefficient with a cutoff at 0.5.

The significance level chosen for all analyses was 0.05, two-tailed and no adjustment for multiple comparisons was made for the analyses. All the data were analysed using the R statistical software package (available at [www.r-project.org](http://www.r-project.org)).

**Results**

A total of 498 swimmers (mean age 32.1 ± 12.6 years) were enrolled in the survey whereas 48 (8.8%) refused to participate and were excluded from the survey. A large majority of respondents were males (64.1%) and with a secondary school level (37.8%) or a university degree (42.2%). More than half of the participants stated to attend a swimming pool since 3 years or more (59.9%), 2 or 3 times per week (56.8%), for more than 1 hour per entry (51.3%). Free swimming was the most often reported physical activity (72.9%). Four hundred seventeen (83.7%) subjects stated they had read swimming pool rules and regulations at least once (data not shown in table). Swimmers were used to associate water recreational activities with cutaneous infectious dis-

eases (89.6%), gastrointestinal diseases (36.3%) and respiratory diseases (32.9%).

The frequencies of the different investigated behaviours are given in Table II. More than 95% of the participants stated they used to take a shower before/after the bath and wear slippers and swimming caps. Swimming goggles were reported to be worn by 50% of the interviewed whereas a percentage ranging from 10 to 25% of swimmers declared to have swum while wearing body accessories or having recent skin wounds. Rinsing mouth during the bath and blowing nose in the swimming pool were reported in 16.6% and 17.9% of the participants, respectively.

Overall, 209 subjects (42%) have healthy behaviours (data not shown) whereas the remaining 289 (58%) had a mean of 1.9 ± 1.2 unhealthy behaviours. As shown in Table III, subjects older than 30 years (OR = 0.46; 95% CI = 0.26–0.81), female sex (OR = 0.52; 95% CI = 0.35–0.76) and a maximum knowledge score (OR = 0.15; 95% CI = 0.03–0.69) were significantly associated with having healthy behaviours in both univariate and multivariate analysis.

**Discussion**

The analysis of the health risks for swimming pool bathers usually considers hazards associated with structural and microclimatic parameters, whereas less frequently takes into account that each subject could harm himself/herself and the others. In particular, it has been well documented that transmission and acquisition of pathogens are relatively frequent

Table II. Behaviours of the interviewed subjects before, during and after the bath

	N (%)
<b>Taking a shower before bathing<sup>a</sup></b>	
Yes, always	478 (96.2)
Sometimes/never	19 (3.8)
<b>Wearing slippers within the swimming area</b>	
Yes, always	493 (99)
Sometimes/never	5 (1)
<b>Using swimming cap<sup>a</sup></b>	
Yes, always	474 (95.6)
Sometimes/never	22 (4.4)
<b>Using swimming goggles</b>	
Yes, always	447 (89.8)
Sometimes/never	51 (10.2)
<b>Using body accessories<sup>a</sup></b>	
Never	432 (87.3)
Sometimes/always	63 (12.7)
<b>Chewing gums/candies during the bath<sup>a</sup></b>	
Never	481 (97.4)
Sometimes/always	13 (2.6)
<b>Rinsing mouth during the bath<sup>a</sup></b>	
Never	411 (83.4)
Sometimes/always	82 (16.6)
<b>Blowing nose in the swimming pool<sup>a</sup></b>	
Never	375 (82.1)
Sometimes/always	122 (17.9)
<b>Urinating while bathing</b>	
Never	474 (95.2)
Sometimes/always	24 (4.8)
<b>Swimming while having recent skin wounds</b>	
Never	386 (77.5)
Sometimes/always	112 (22.5)
<b>Swimming with infectious disease of skin</b>	
Never	484 (97.2)
Sometimes/always	14 (2.8)
<b>Swimming with diarrheic disease</b>	
Never	493 (99)
Sometimes/always	5 (1)
<b>Taking a shower after the bath<sup>a</sup></b>	
Yes, always	482 (97.2)
Sometimes/never	14 (2.8)

<sup>a</sup>Numbers may not sum to 498 due to missing answers.

events (Craun, Calderon, & Craun, 2005; Prüss, 1998). A lack of awareness by the general public about healthy swimming behaviours has been also proved to increase the risk of acquiring recreational water illness and contaminating recreational water (CDC, 2006). Despite these remarks, in literature studies that have investigated factors influencing healthy behaviours in swimmers are scarce. A PubMed research using the terms 'swimming pool', 'knowledge' and 'behaviours' found only two studies in indexed literature highlighting a general lack of knowledge on the topic and, probably, an underestimation of the problem.

In opposite with these considerations, our study reveals that at least one unhealthy behaviour may occur in more than 50% of swimmers even if rules and regulations are available in the structure. Although

practices such as urinating in the swimming pool or swimming with diarrheic disease have been found to be not very common (from 1 to 5%), their frequency cannot be neglected because of the important health risks that they may pose. Moreover, similar frequencies should not be considered rare among bathers and about 10% of subjects participating in another Italian study reported they had urinated in the swimming pool at least once (Liguori et al., 2007). Conversely, in our study the prevalence of some behaviours such as swimming with a recent skin wound, rinsing mouth during the bath and blowing nose in the swimming pool result alarmingly high, ranging from 15 to 25%, even if lower than that found in a survey carried out in Italy in 2005 (about 35%) (Liguori et al., 2007). In our study, the relatively high prevalence of unhealthy behaviours may be partially explained by considering that swimmers had a low perception of the risk of acquiring infectious diseases by the faecal-oral or respiratory route. Studies on infectious disease have found that perceived risk is an important predictor for persons taking protective actions (van der Pligt, 1998).

Also in our survey self-reported knowledge of the rules/regulations and high risk perception were good predictors of healthy behaviours after controlling for confounding also. This last finding focuses on education and training as a measure for promoting the adoption of preventive behaviours. Moreover, considering that a younger age and a male sex were associated with unhealthy behaviours, it may be possible to define target groups for which tailored courses should be implemented.

The present study has some limitations. Firstly, the use of a convenience sample may have introduced some selection bias. Accordingly, the sample was largely well educated (about 40% of the swimmers had a university degree) and, thus, the generalisability of the results may be limited to individuals with medium-high education background. Moreover, despite the high response rate, individuals who answered the questionnaire could be different from those who did not respond, which suggests that this study may have underestimated the prevalence of inappropriate behaviours. As a third problematic issue, interviewed participants may have underreported unhealthy behaviours so that a social desirability bias cannot be excluded.

Considering these limitations, this study can be seen as a preliminary exploratory investigation able to provide descriptive measures, but not confirmatory evidence. Further studies should be performed in other geographic areas to confirm our results by monitoring unhealthy behaviours that could be frequently found in swimming pool bathers and, particularly, in some target groups.

Table III. Univariate and multivariate analysis on interviewed characteristics/habits and their association with healthy behaviors in swimming pool

	At least one inappropriate behaviour		Unadjusted OR	Adjusted OR
	n/row total	% (95% CI)	(95% CI)	(95% CI)
<b>Age in years<sup>a</sup></b>				
Less than 20	61/86	70.9 (60.0–80.0)	Referent	Referent
20–29	97/159	61.0 (52.9–68.5)	0.64 (0.36–1.13)	0.68 (0.38–1.22)
30 or more	131/253	51.8 (45.4–58.1)	0.44 (0.26–0.75)	0.46 (0.26–0.81)
<b>Gender<sup>a</sup></b>				
Male	203/319	63.6 (58.1–68.9)	Referent	Referent
Female	86/179	48.0 (40.6–55.6)	0.53 (0.36–0.78)	0.52 (0.35–0.76)
<b>Education<sup>b,c</sup></b>				
Illiterate/primary school	66/95	69.5 (59.1–78.3)	Referent	
Secondary school	104/189	55.0 (47.6–62.2)	0.54 (0.32–0.9)	
University degree	116/210	55.2 (48.2–62.0)	0.54 (0.32–0.91)	
<b>Years of swimming practice<sup>b</sup></b>				
Less than 1	66/108	61.1 (51.2–70.2)	Referent	
1–2	51/90	56.7 (45.8–66.9)	0.83 (0.47–1.47)	
3 or more	168/296	56.8 (50.9–62.4)	0.83 (0.53–1.31)	
<b>Frequency per week<sup>b,c</sup></b>				
1 or less	27/53	50.9 (37.0–64.7)	Referent	
2 or 3	161/281	57.3 (51.3–63.1)	1.29 (0.72–2.32)	
4–6	60/99	60.6 (50.2–70.1)	1.63 (0.77–3.44)	
Every day	39/62	62.9 (49.7–74.6)	1.48 (0.75–2.9)	
<b>Bath duration in hours<sup>b</sup></b>				
Less than 1	134/241	55.6 (49.1–61.9)	Referent	
1 or more	153/254	60.2 (53.9–66.2)	1.21 (0.85–1.73)	
<b>Swimming activities<sup>b</sup></b>				
Assisted swimming	66/98	67.3 (57.0–76.3)	Referent	
Free-swimming	196/363	54.0 (48.7–59.2)	0.57 (0.36–0.91)	
Others	27/37	73.0 (55.6–85.6)	1.31 (0.57–3.03)	
<b>Knowledge/risk perception, score<sup>a</sup></b>				
0	11/13	84.6 (53.7–97.3)	Referent	Referent
1	48/74	64.9 (52.8–75.4)	0.33 (0.07–1.63)	0.35 (0.07–1.73)
2	117/205	57.1 (50.0–63.9)	0.24 (0.05–1.12)	0.32 (0.07–1.51)
3	66/100	66.0 (55.8–75.0)	0.35 (0.07–1.68)	0.46 (0.09–2.26)
4	47/106	44.3 (34.8–54.3)	0.15 (0.03–0.69)	0.2 (0.04–0.97)

<sup>a</sup>Included in the best fitting multivariate logistic regression model.

<sup>b</sup>Not included in the best fitting multivariate logistic regression model.

<sup>c</sup>Numbers may not sum to 498 due to missing answers.

As recommended by the World Health Organization (WHO), facility workers, local authorities, public health bodies, pool-based clubs (such as swimming clubs, aqua-aerobics classes, scuba clubs and so on) and sports bodies could play an important role in minimising unhealthy behaviours and ensuring pool safety through public education and appropriate and targeted information to pool users (WHO, 2006).

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