

Examining the Amount of Turbidity, Residual Chlorine and Fecal Coliform in Swimming Pools Water in Kermanshah (Iran)

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Abstract: Swimming pools, due to the presence of different society segments at them and appropriate environment for transferring different diseases are important in terms of health issues, so the aim of this study was comprehensive examining of Kermanshah's swimming pools water and comparing its results with national standards. current study was descriptive, cross-sectional study that was conducted in Kermanshah's active pools. In this study, besides determining the general characteristics of pools through interviews, fecal coliform and physicochemical parameters such as residual chlorine, turbidity in the sampling site were assessed. Finally, all calculations performed by SPSS Software (Version 16) and statistical significance was considered at 0.05. The results showed samples, 15.2% had fecal coliform and residual chlorine levels in 17.2% cases were higher than standard level. According to the results, fecal coliform has the lowest accommodation with standard indicating the requirement for continuous monitoring of water's physical, chemical and biological indicators and control filtration situation and disinfection of pools water and also alternative antibiotics is recommended.

Key words: Turbidity, residual chlorine, fecal coliform, pool, Kermanshah, Iran

INTRODUCTION

Swimming pools, due to the presence of different society segments at them and appropriate environment for transferring different diseases are important in terms of health issues, because by adding materials from the swimmer's body such as hair, fat, gastrointestinal, reproductive and respiratory microbes and other harmful bacteria and wastes on skin, pools water is contaminated and many people who use the pool are prone to various diseases (Ghaffari *et al.*, 2013; Mehdinejad, 2005). Generally, swimming pools water are contaminated through the addition of body fluids and substances such as sputum, mucus through the nose, fat, hair, gastrointestinal tract which can be removed from the body. So by chemical and biological contamination, disease transmission will be taken place (Salvato, 2003). Pool's water health criteria is similar to drinking water standards. So picking up 1 or 2 samples during week is appropriate in terms of bacteriological examinations. For optimum use of pool's water to swim and to have fun, the water must be completely clear and lucid (Sohrabi *et al.*, 2016). So, in terms of review, the situation of qualitative water health indicators in swimming pools, the physical

and biological factors are the indicators of water quality in swimming pools. Regarding the standard has a major role in the prevention of diseases. Physical factors such as turbidity, materials and bacterial factors including total coliform were assessed. Coliforms are considered as an indicator of fecal contamination. In a study by Ghaneian which was conducted in swimming pools of Yazd, the results showed that population indices of heterotrophic bacteria as well as pH and temperature had the least conformity to standards which suggests the requirement for continuous monitoring of water's physical, chemical and biological indicators and controlling the situation of filtration and disinfection of pools water. In the study by Zangiabadi *et al.* (2011) who has shown in uremia, water quality of subjected pools were not fully comply with the standard (Cappello, 2011). In a study by Nikaeen and colleagues reported in Isfahan which pH measurements parameters and residual free chlorine had the minimum comply with standards and heterotrophic bacteria and fecal coliform bacteria were the commonest detached bacteria from swimming pools (Fadaei and Amiri, 2015). In a study by Yousefi (2010) in Sari, there was an adverse statistical relationship between residual chlorine and the presence of Staphylococci. Also, the study by

Papadopoul *et al.* (2008) in Greece showed that 67% of the samples were standard in terms of microbiology, a total of 107 departed bacteria, 38 cases of resistant species were included *Pseudomonas alkali* Genesis, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* (Papadopoulou *et al.*, 2008). So, the aim of this study was examining the physical factors such as turbidity, chlorine assessment and microbial agents such as total coliform in swimming pools water of Kermanshah (Iran).

MATERIALS AND METHODS

Current study was descriptive, cross-sectional study that was conducted in Kermanshah's active pools in terms of water's physical and microbial condition were studied and in this study, 99 samples were taken from swimming pools. In order to qualitative assessment of sample in a 500 mL wide span bottles and sterile, containing 10 drops of sodium thiosulfate solution (to neutralize the residual chlorine water) was taken and was transferred to the laboratory in proximity to ice and immediately were tested. Microbiological tests were conducted in Kermanshah city's health center. Sampling time range for various swimming pools was different and was between of 9 am to 10 pm and sampling picking up time was when the swimmers swim in the pools in order to have a samples in a real and critical condition. Sampling point was chosen the exit water's root and free residual chlorine parameters was measured. Also, measuring the turbidity was performed by the turbidity meter (HANNA Model made in Italy). In order to perform the microbial tests, Standard method book 21 M (Martins *et al.*, 1995) publishing was used. Physical tests were included, turbidity and microbial tests, including coliform detection tests. Finally, the obtained results were entered to SPSS Software then these obtained results were analyzed by comparison with standard method.

RESULTS AND DISCUSSION

The results of turbidity, chlorimetry tests and fecal coliform detection test is shown in Table 1. According to the results of table, the residual chlorine was less than standard limit and the amount of fecal coliform contamination was much higher than the standard range specified by the institute of Standards and Industrial Research of Iran, WHO and EPA (Fig. 1 and 2).

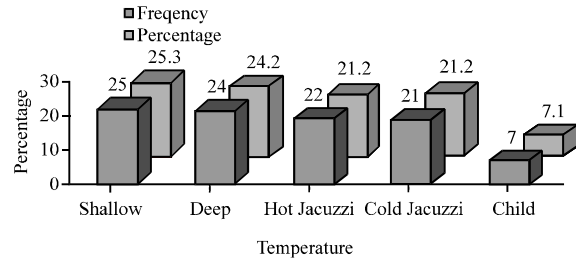


Fig. 1: Percentage of frequency of swimming pool kind

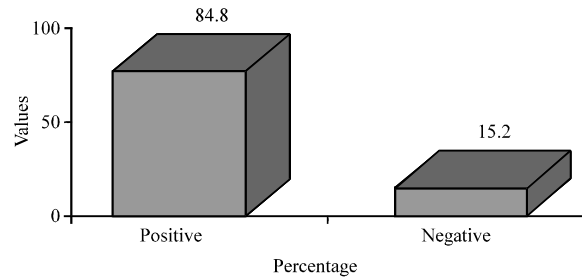


Fig. 2: Frequency percentage of microorganisms in pools water

Table 1: Mean and standard deviation of turbidity, chlorine and MPN

Variables	Number	Min.	Max.	Mean	SD
Turbidity	99	0	8	1.24	0.878
Chlorine	99	0	3	1.10	0.896
MPN	99	0	1150	20.32	124.203

CONCLUSION

Daily expansion use of swimming pools and on the other hand improper monitoring and maintenance them can cause serious risk in terms of public health. The results of this study showed that in some subjected pools, microbial contamination has been shown which in other similar studies have shown consistence results with our study (Mazaheri, 2009; Salvato, 1992; WHO, 2000). The study by Papadopoulou in Greece showed that in 32.9% samples the microbial contamination were above the standard level that had smaller amounts than present study. Martins and colleagues in a study in swimming pools in Brazil showed that HPC (70.4%), Total coliforms (13.3%), *Staphylococcus aureus* (9.1%) fecal streptococci (7/7%) fecal coliform (5.6%) and *Pseudomonas* (2%) were positive tested (15). In a study by Yousefi (2010) in Sari showed that 91.3% of samples existed *Staphylococcus aureus*, also in line with the current results, there was an adverse statistical relationship between residual chlorine and the presence of *Staphylococci* (Yousefi, 2010) which show more than current study. Given that *Pseudomonas aeruginosa* and

Escherichia coli are sensitive to chlorine, their existence in water pools is a strong evidence in incomplete disinfection of the subjected pools water. This represents that favorable residual chlorine and appropriate use of purification and chlorination systems and not entering the environmental contaminations to pools water can remove this bacteria and other important bacteria and thereby can guarantee swimmer's health. According to the results of current study showed that 15.2% of examined samples were observed fecal coliforms. According to the results that there was an adverse statistical relationship between residual chlorine and coliform contamination. In line with our results, in a study conducted in Italy on swimming pools, 36% of subjects have been observed bacterial contamination (Tesauro *et al.*, 2009). Other studies confirmed our results (Alborzi *et al.*, 2000; Japoni *et al.*, 2004). Also, a study conducted in United States, 11% of Pools was shown microbial contamination which the most principle contamination was mentioned the inaccurate and insufficient exploitation of the pool filtration systems (Cappello, 2011). Pearson correlation test showed an adverse relationship between free residual chlorine and subjected bacteria.

Considering that the aim of this study was comprehensive examining of Kermanshah's swimming pools water and comparing its results with national standards. This current study was descriptive, cross-sectional that was conducted in Kermanshah's active pools the results of fecal coliform had the lowest correlation with the standard which shows the requirement for continuous monitoring of water's physical, chemical and biological indicators and controlling filtration condition and disinfection of pools water also recommends antibiotics alternative.

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