

Overview of Swimming Pool Sanitation Conditions in Cimahi City Public Swimming Pools in 2024

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ABSTRACT: This study evaluates the sanitation conditions, disinfection practices, and presence of *E. coli* in Swimming Pool, Cimahi City. Using a descriptive survey method, we assessed water quality and staff behavior. The sample in this study was one of the swimming pools with the most users, which is around 48 people/pool /day. The data analysis of this study is a descriptive with observation and measurement methods which aims to describe and explain the sanitary conditions of swimming pools, the behavior of swimming pool staff regarding disinfection, and *Escherichia coli* bacteria. Results showed unqualified free chlorine levels (0 mg/l) and high *E. coli* counts (6–75 CFU/100 ml). Sanitation practices were rated as unhealthy (72.2%), and staff performance in disinfection was very poor. These findings indicate a need for immediate improvements in pool sanitation to protect public health.

KEYWORDS: Sanitation; swimming pool; *E. coli* bacteria; behavior

1. Introduction

Swimming pools are popular public facilities that people frequently visit for swimming and recreational activities. However, they also have the potential to transmit diseases. To protect public health from disease transmission and other health risks, proper supervision of swimming pools is necessary [1]. Poor environmental conditions in public places can increase the risk of disease spread and environmental pollution, making it essential to implement proper sanitation measures [2]. A study on the sanitation conditions of swimming pools in Wunut, Klaten Regency, found them unfit for health due to several deficiencies. The pool construction did not include curved bottom corners (conus), foot wash basins, or rinse showers. Additionally, the available trash cans lacked lids, there was no separation between male and female toilets, and no announcement board was present to prohibit swimming for individuals with skin diseases, genital infections, epilepsy, or heart conditions. Furthermore, there were no instruments to measure pH levels and residual chlorine in the pool water [3].

Laboratory tests of swimming pools in Jayapura City revealed contamination by coliform bacteria, with MPN values of 91/100 ml and >1100/100 ml. Fecal coliform bacteria were detected with MPN values of 23/100 ml and 20/100 ml. Moreover, the measured residual chlorine levels in Jayapura City swimming pool water did not meet the required standard of 0.3 mg/l, with recorded levels of 0.23 mg/l and 5 mg/l [4]. Similarly, an assessment of chlorine residual and *E. coli* levels in 10 swimming pools within the Sukodono Puskesmas work area

found that all 10 pools failed to meet chlorine residual standards, and 9 of them did not comply with *E. coli* contamination limits set by Permenkes No. 32 of 2017 [1]. Swimming Pool X is one of the largest outdoor pools in Cimahi. It serves as both a recreational facility and a venue for school swimming assessments. Observations conducted by researchers indicated that the free residual chlorine level in the Cimahi City swimming pool was 0 mg/L, while the *E. coli* bacteria level was 25 CFU/100 ml. The sanitary conditions were inadequate, as there was no small pool available for foot washing or disinfection before swimming. Additionally, the pool staff relied on visual estimation to determine when disinfection was necessary, typically when the water appeared cloudy.

The presence of microorganisms in swimming pool water can lead to waterborne diseases. *Escherichia coli* (*E. coli*) is a bacteria that can cause diarrheal diseases, and its presence in swimming pools may result from both natural factors and human activity. While swimming pool water is not intended for consumption, swimmers may accidentally ingest small amounts. Therefore, maintaining microbiologically clean pool water is crucial [5]. A study on swimming pools in Gorontalo found that 2 out of 4 pools were contaminated with *E. coli* bacteria. The contamination was attributed to poor sanitation, as these two pools did not meet the required swimming pool sanitation standards [6]. The purpose of this study is to assess the sanitary conditions of swimming pools, the presence of *E. coli* bacteria, and the disinfection practices of pool staff at Cimahi City Swimming Pool in 2024.

2. Materials and Methods

This research was a descriptive study using observation and measurement methods to describe and explain the sanitary conditions of swimming pools, the behavior of swimming pool attendants regarding disinfection, and the presence of *E. coli* bacteria in Cimahi City Swimming Pool, Cimahi City, in 2024. The study was conducted in one of the swimming pools with the highest number of users, with a capacity of approximately 30 people per pool and an average of 48 users per pool per day. Laboratory tests were carried out at the Poltekkes Kemenkes Bandung Department of Environmental Health. This research took place from January 2024 to June 2024.

The objects of this study were swimming pools, disinfection officers, and swimming pool water at Cimahi City Swimming Pool. Samples for this study were collected by filling $\frac{3}{4}$ of the volume of a sterilized sample bottle to measure *E. coli* bacteria, taken from a single point. The samples were kept in a cool box with ice packs to maintain a temperature of 4°C until they were delivered to the laboratory. Sample transportation to the laboratory was conducted as soon as possible and always within 24 hours of collection. Microbiological examination was carried out using the filtration method with a membrane, based on SNI ISO 9308-1:2010 Water Quality. Primary data were obtained through direct observation at the location using an observation sheet and interviews with pool staff. The data obtained from observations were processed and analyzed descriptively in tabular form, then compared with *Peraturan Menteri Kesehatan No. 061 Tahun 1991 Tentang Persyaratan Kesehatan Kolam Renang dan Pemandian Umum* and *Peraturan Menteri Kesehatan Nomor 2 Tahun 2023 Tentang Peraturan Pelaksanaan Peraturan Pemerintah Nomor 66 Tahun 2014 Tentang Kesehatan Lingkungan*.

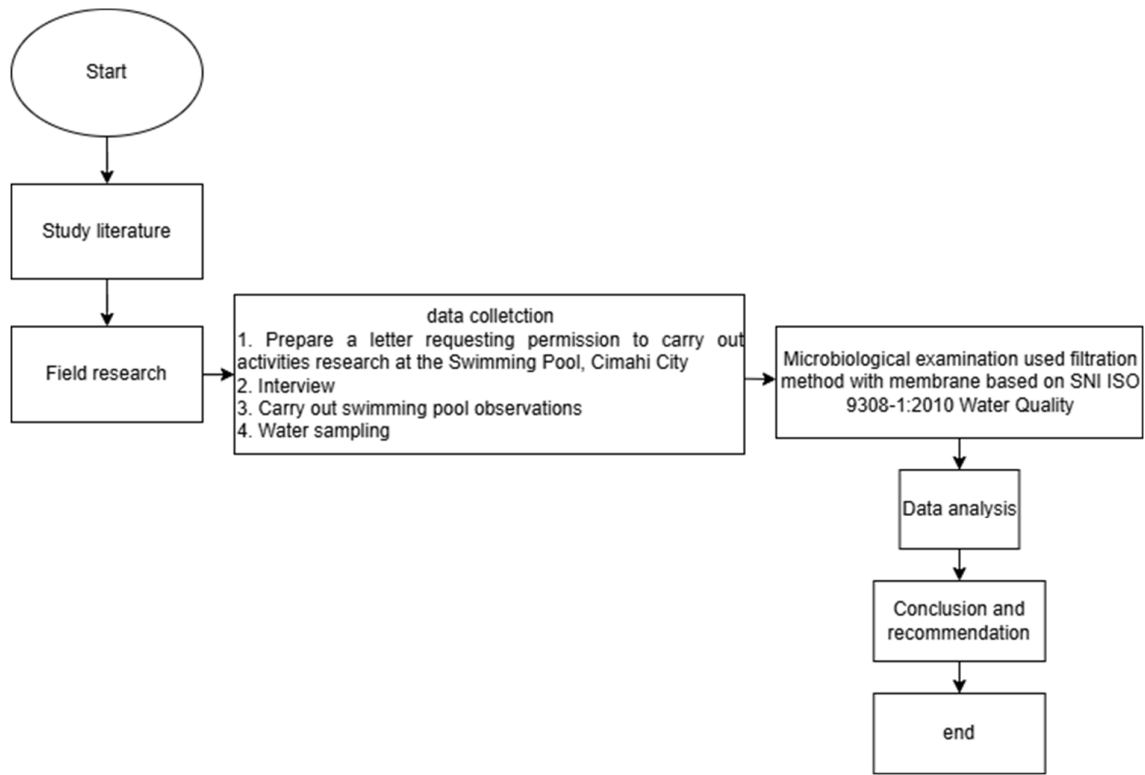


Figure 1. Flow diagram.

3. Results and Discussion

3.1. Results.

Table 1. Distribution of *E. coli* bacteria measurement results in Cimahi City swimming pool water in June 2024.

Date	Quality standard	Hasil (CFU/100ml)			
		08.00 AM	Description	15.00 PM	Description
Sunday, 23 June 2024		33 CFU/100 ml	Not qualified	50 CFU/100 ml	Not qualified
Tuesday, 25 June 2024	0 CFU/100 ml	61 CFU/100 ml	Not qualified	75 CFU/100 ml	Not qualified
Thursday, 27 June 2024		6 CFU/100 ml	Not qualified	11 CFU/100 ml	Not qualified

The results of the *E. coli* bacteria examination in Table 1, conducted from June 23 to June 27, 2024, show that *E. coli* bacteria levels in the morning to afternoon examinations (ranging from 6 CFU/100 ml to 75 CFU/100 ml across six tests) do not meet the requirements based on Permenkes No. 2 of 2023 [7].

Table 2. Distribution of swimming pool assessment results at Cimahi City swimming pool in May 2024.

Date	score	% score	Qualified Criteria	Description
Environmental and Building Health Requirements, Room/space Health, Sanitation Facility Health Requirements, and Swimming Pool Water Quality	1343	72,2%	Healthy (75% - 100%), not healthy (<75%)	Not healthy

The observation results in Table 2 indicate that the sanitary condition of the swimming pool environment at Cimahi City Swimming Pool falls into the unhealthy category (<75%) based on Permenkes No. 61 of 1991 [8]. The results of observations on disinfection officers, as shown in the frequency distribution of behavioral aspects in Table 3, reveal that 100% of the disinfection officers performed very poorly.

Table 3. Frequency Distribution of Behavioural Aspects of Disinfection Officers at the Cimahi City Swimming Pool in May 2024

Category	Frequency	%
Very good	0	0%
Good	0	0%
Bad	0	0%
Very bad	2	100%

3.2. Discussion.

The presence of *E. coli* bacteria in swimming pools is influenced by the sanitary conditions of swimming pool facilities, particularly the absence of foot washing basins. According to Permenkes No. 61 of 1991, foot washing basins are necessary to disinfect visitors' feet before entering the pool and to prevent contamination or disease transmission caused by unwashed feet. The absence of foot washing basins can affect the water quality of the swimming pool, making the water more prone to becoming dirty or cloudy [3]. Cleaning of the swimming pool area and facilities, as well as the process of draining water at Cimahi City Swimming Pool, was not carried out regularly; it was only done once every six months or in incidental situations, depending on the physical quality of the water. Irregular cleaning and water drainage can contribute to the presence of *E. coli* bacteria in the swimming pool. Swimming pools contaminated with *E. coli* can cause illness among users, with diarrhea being the most common illness associated with contaminated pool water. This bacterium can lead to serious or even fatal diseases, particularly for vulnerable groups such as pregnant women and children. Other health risks associated with undisinfecting swimming pool water include skin infections, sores, as well as ear and eye infections [9]. Observations at Cimahi City Swimming Pool revealed that visitors did not clean their bodies before and after swimming. Pool officials need to encourage visitors to rinse off using the shower before and after swimming. The rinse shower serves both hygiene and safety purposes; before swimming, it helps remove dirt and chemicals from the body that may react with chlorine to form chloramine, while after swimming, it helps remove residual chlorine from the skin and hair. If such facilities are unavailable, chlorine may not function effectively in eliminating bacteria present on the body[3].

This study aligns with research conducted by Wahyuningtias, which found that two out of four swimming pools in Gorontalo were contaminated with *E. coli* bacteria due to inadequate sanitation measures [6]. The number of *E. coli* bacteria in the morning before pool users arrived differed from the number recorded in the afternoon after pool usage. The higher the number of visitors, the greater the bacterial contamination in the pool water. The increase in *E. coli* bacteria was most significant on Sundays, which had the highest visitor count (130 people), compared to other days such as Tuesdays and Thursdays. A large number of visitors can contribute to the proliferation of *E. coli* and coliform bacteria due to the release of bodily waste, including urine, saliva, sweat, and other contaminants. Waterborne diseases associated with poor swimming pool sanitation include diarrhea, filariasis, and dysentery [10]. Similarly,

research conducted by Faridatul Umaroh found a significant difference in the bacterial count in swimming pool water before and after visitor use. The more visitors a pool had, the higher the bacterial count. Higher visitor numbers on certain days resulted in a greater increase in bacterial contamination compared to days with fewer visitors [11]. The increase in *E. coli* bacteria at Cimahi City Swimming Pool was also influenced by water temperature, which ranged from 26.3°C to 31.5°C—an optimal range for *E. coli* growth. *E. coli* bacteria can survive in temperatures between 7°C and 44°C, with an optimal growth temperature of 37°C. If the water temperature exceeds 44°C, *E. coli* bacteria become inactivated [12].

The behavior of disinfection officers at Cimahi City Swimming Pool was found to be poor. Observations of two disinfection officers revealed that 100% exhibited inadequate disinfection practices. Both officers only applied chlorine when the water appeared cloudy, failed to measure pH before disinfection, did not check chlorine residual levels before adding chlorine, did not monitor water temperature, did not properly measure chlorine requirements, and did not use complete personal protective equipment (PPE) while working. At Cimahi City Swimming Pool, chlorination was carried out only once or twice a week, depending on the physical appearance of the water, using 60% chlorine. The chlorine was dissolved in a bucket before being distributed throughout the pool. High levels of turbidity could protect microorganisms from the effects of disinfection, stimulate the growth of bacteria and give rise to a significant chlorine demand. It is essential that an overall management strategy is implemented in which multiple barriers, including source water protection and appropriate treatment processes, as well as protection during storage and distribution, are used in conjunction with disinfection to prevent or remove microbial contamination [13].

Proper chlorination is essential, as chlorine must be well-dissolved to ensure effective bacterial eradication. Poorly dissolved chlorine can leave harmful residues in the water. Excessive chlorine dosing beyond optimal levels can result in free chlorine accumulation, which may pose health risks. Residual chlorine in swimming pool water is critical, as it functions as a disinfectant. Chlorine levels must be carefully regulated to meet safety standards. Excessive chlorine levels can produce a strong chlorine odor, which can be harmful to health. Additionally, a side effect of the chlorination process is the formation of trihalomethanes (THMs), which are carcinogenic byproducts of chlorination. Conversely, insufficient chlorine concentrations may lead to inadequate bacterial disinfection in swimming pool water [1]. Interviews with swimming pool officers indicated that their performance was poor due to a lack of chlorine dosing training. The pool management had never provided training on proper chlorine application, and there was no supporting equipment for monitoring swimming pool water quality at Cimahi City Swimming Pool. Training plays a crucial role in improving knowledge and influencing self-reliant attitudes. Employees who receive training tend to be more motivated to perform their tasks effectively. Research has shown that training leads to behavioral changes, including increased knowledge, enhanced expertise, improved skills, and a stronger sense of independence [15].

4. Conclusions

The *E. coli* bacteria levels in Cimahi City Swimming Pool ranged from 6 CFU/100 ml to 75 CFU/100 ml. The sanitation condition of the swimming pool was categorized as unhealthy, with a percentage of 72.2%. Additionally, the behavior of the disinfection staff during the disinfection process was rated as 100% very poor. To improve sanitation, the swimming pool

manager should conduct routine monitoring at least once a week, disinfect the swimming pool daily, construct a foot washing basin to prevent bacterial contamination, enforce regulations requiring visitors to rinse their bodies before and after swimming, and provide training for disinfection officers.

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Author Contribution

Conceptualization: Gilang Tri Rizki Al Sunandar, Kahar; Methodology: Gilang Tri Rizki Al Sunandar, Jyoti Singh; Data Collection: Gilang Tri Rizki Al Sunandar; Data Analysis: Gilang Tri Rizki Al Sunandar, Unis Musu Lebbie; Writing: Gilang Tri Rizki Al Sunandar, Jyoti Singh; Supervision: Kahar, Muhamad Iqbal, Agus Somad Saputra, Unis Musu Lebbie.

Competing Interest

The authors declare no conflict of interest.

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