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Assessment of the Physicochemical and Microbiological Quality of Swimming Pool Water in Hotels in Ouagadougou, Burkina Faso

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Abstract: Public swimming pools constitute health-risk environments when water treatment and monitoring are inadequate. This study aimed to assess the physicochemical and microbiological quality of water from three hotel swimming pools in Ouagadougou in order to determine compliance with current sanitary requirements. This was a descriptive study conducted in three pools selected according to their level of use, water circulation system, and chlorine treatment. Repeated water samples were collected over three days and analyzed for temperature, pH, turbidity, free chlorine, revivable bacteria, total coliforms, Escherichia coli, and staphylococci. The results showed several non-compliances, particularly in pools H1 and H2, with elevated temperatures, insufficient free chlorine levels, variable turbidity, and the presence of indicator organisms in some sampling series. Escherichia coli was not detected in any of the analyzed samples, whereas staphylococci were found in all three pools. Pool H3 generally showed better physicochemical and microbiological control than H1 and H2. These findings highlight the need to strengthen sanitary surveillance, free chlorine and pH monitoring, and maintenance of filtration systems in hotel swimming pools. They also underscore the importance of compliance with regulatory requirements and staff training for pool operation.

Keywords: Swimming pool water quality, Physicochemical parameters, Microbiological contamination, Chlorine disinfection, Public health surveillance, ANSSEAT: National Agency for Environmental, Food, Occupational Health and Health Product Safety, LNSP: National Public Health Laboratory, WHO: World Health Organization, CDC: Centers for Disease Control and Prevention, ECDC: European Centre for Disease Prevention and Control, PWTAG: Pool Water Treatment Advisory Group

INTRODUCTION

Water is essential to human health and daily life, yet it can also serve as a medium for exposure to biological and physicochemical hazards when its quality is not properly controlled. Among recreational water environments, swimming pools occupy an important place because they support leisure, sport, and social activities, particularly in urban areas

and hotel facilities. However, when treatment, monitoring, and maintenance are inadequate, swimming pools may become environments that pose significant health risks to users due to contamination.

The sanitary quality of swimming pool water depends on a delicate balance between filtration, disinfection, swimmer load, water temperature, pH, and operational management. In warm climates such as Burkina Faso, elevated temperatures may reduce chlorine effectiveness and favor microbial proliferation, especially when pH is not adequately controlled. In addition, swimmers continuously introduce organic matter, skin microorganisms, and environmental particles into the water, thereby increasing disinfectant demand and the likelihood of contamination.

Hotel swimming pools have expanded with the growth of the tourism and hospitality sectors in Ouagadougou, where they now represent an increasingly frequented recreational setting. Yet, the increase in pool use has not always been matched by equally rigorous sanitary surveillance and maintenance practices. As a result, water quality may vary considerably from one facility to another, depending on treatment procedures, circulation systems, attendance levels, and the regularity of monitoring.

Microbiological indicators such as revivable bacteria, total coliforms, Escherichia coli, and staphylococci are commonly used to assess the sanitary quality of pool water and the effectiveness of treatment processes. Likewise, physicochemical parameters such as temperature, pH, turbidity, and free chlorine provide essential information on the operational status of the pool and the conditions that may favor or limit microbial survival. Although the absence of Escherichia coli may suggest a lack of recent fecal contamination, it does not exclude other forms of microbiological or operational non-compliance.

In Burkina Faso, regulatory requirements define hygiene and safety standards applicable to swimming pools and bathing facilities. However, the extent to which hotel swimming pools comply with these requirements remains insufficiently documented in the local context. This study was therefore undertaken to assess the physicochemical and microbiological quality of water in three hotel swimming pools in Ouagadougou and to determine their compliance with current sanitary requirements.

STUDY OBJECTIVES

The overall objective of this study was to assess the sanitary quality of swimming pool water in hotels in Ouagadougou from a legal and regulatory perspective. This was pursued through specific objectives, namely: microbiological analysis of revivable bacteria, total coliforms, *Escherichia coli*, and staphylococci; physicochemical analysis of temperature, pH, turbidity, and free/active chlorine; comparison of the results with national and international regulatory requirements; and formulation of recommendations to improve management practices. In addition, this study contributes to improving hygiene conditions and swimming pool water quality, thereby supporting public health.

BACKGROUND / PROBLEM DESCRIPTION

Public swimming pools are highly frequented recreational spaces, particularly in urban areas and hotel establishments. However, their use exposes bathers to health risks when the water

is not properly treated, monitored, and maintained. The sanitary quality of pool water depends on a delicate balance between filtration, disinfection, user load, temperature, pH, and the organic burden introduced by swimmers.

In hot regions such as Burkina Faso, elevated water temperature may reduce chlorine effectiveness and promote microbial growth when pH is not properly adjusted. In addition, swimmers continuously introduce organic matter, skin and mucosal microorganisms, and environmental particles into the water, thereby increasing disinfectant demand and facilitating contamination of the basin. Thus, a visually clear pool may still present significant microbiological contamination.

Microbiological indicators such as revivable bacteria, total coliforms, *Escherichia coli*, and staphylococci are used to indirectly assess the sanitary quality of water and the effectiveness of treatment. The presence of coliforms indicates a failure in sanitary control, while the detection of staphylococci often reflects swimmer-associated contamination. The absence of *E. coli* is reassuring with regard to immediate fecal contamination, but it does not by itself guarantee fully controlled water quality.

In Burkina Faso, the growth of the hotel sector in Ouagadougou has led to an increase in the number of swimming pools and swimmers, although sanitary control has not always kept pace with this expansion. However, national regulations establish specific requirements for hygiene, safety, and swimming pool water control. In this context, the assessment of physicochemical and microbiological water quality in swimming pools is a major public health issue.

This issue is consistent with findings from other settings. Outbreaks associated with treated recreational waters show that swimming pools, spas, and related facilities may be sources of infectious episodes when sanitary control is insufficient. Hlavsa et al. showed, in a U.S. surveillance review, that public pools and other bathing facilities were among the main settings involved in outbreaks linked to treated recreational waters. Likewise, CDC technical guidance emphasizes that pool safety relies on regular monitoring of disinfectant levels, pH, and operational conditions.

MATERIALS AND METHODS

This study was based on documentary research conducted in the libraries of the National Agency for Food, Environmental and Occupational Health Safety (ANSSEAT, Ex LNSP) and the Institute of Environmental Engineering and Sustainable Development (2iE), on specialized websites, and through interviews with key informants. Twenty hotels with swimming pools were visited, and discussions were held with pool managers as well as with technicians and engineers from the LNSP. A cross-sectional analytical study was conducted in February 2007 in Ouagadougou, Burkina Faso.

Three hotel pools with similar characteristics were selected from the twenty pools identified in Ouagadougou. Sites were chosen according to criteria including attendance, mode of operation, treatment, and average number of swimmers per year. The studied pools were located within hotel premises. Water samples were collected from different points of the pools over three days, with a two-day interval between sampling series.

Samples were stored under appropriate conditions and then transported to the laboratory for analysis. The microbiological parameters studied were revivable bacteria, total coliforms, *Escherichia coli*, and staphylococci. The physicochemical parameters

included temperature, pH, turbidity, and free/active chlorine. The methods used corresponded to classical swimming pool water control techniques.

Revivable bacteria were investigated by agar incorporation according to standard procedures. Total coliforms and *E. coli* were analyzed by membrane filtration according to NF EN ISO 9308-1. Staphylococci were also investigated by membrane filtration and appropriate confirmatory tests. Temperature, pH, and turbidity were measured in situ. Free/active chlorine was determined according to standard swimming pool water control procedures.

This approach is consistent with recent technical guidance, which emphasizes regular on-site measurements and traceability of monitoring operations. PWTAG, in particular, recommends structured management of treatment, monitoring, and maintenance operations to keep operational parameters within expected ranges. The 2026 recommendations for managers of collective-use swimming pools also stress daily control of critical parameters and formalization of internal procedures.

RESULTS

General Characteristics of the Pools

The three pools had different levels of annual attendance but similar operational characteristics. H1 was located in sector 05, while H2 and H3 were located in sector 15. All three pools used mixed circulation and chlorine treatment. Their estimated annual attendance was 8,000 swimmers for H1, 8,300 for H2, and 3,000 for H3.

Table 1: General Characteristics

Pool	Sector	Circulation	Treatment	Attendance/Year
H1	05	Mixed	Chlorine	8 000
H2	15	Mixed	Chlorine	8 300
H3	15	Mixed	Chlorine	3 000

Microbiological Results

The microbiological findings showed marked differences between the three pools. As presented in the table on revivable bacteria, H1 and H2 exceeded 100 CFU/mL on day 1, indicating non-compliance at the start of the monitoring period, whereas H3 remained compliant with 49 CFU/mL. By days 2 and 3, the bacterial load generally decreased in all three pools, suggesting improved treatment conditions or reduced contamination pressure.

The table on total coliforms also showed an unfavorable profile for H1 and H2 at day 1, with coliforms present in both pools, while H3 remained free of coliforms throughout the study. In contrast, the table on Escherichia coli showed no detection in any sample from the three pools, which is reassuring with regard to recent fecal contamination. The table on staphylococci indicated that these bacteria were detected in all three pools during the entire sampling period, suggesting contamination associated with bathers and the pool environment.

Table 2: Results of Revivable Bacteria Count

Pool	J1	J2	J3	Interpretation
H1	> 100 CFU/mL	< 100 CFU/mL	< 100 CFU/mL	Non-compliance at J1
H2	> 100 CFU/mL	< 100 CFU/mL	< 100 CFU/mL	Non-compliance at J1
H3	49 CFU/mL	< 100 CFU/mL	< 100 CFU/mL	Compliant at J1

Table 3: Results of Total Coliform Count

Pool	J1	J2	J3	Interpretation
H1	Present	Present	Present	Indicator contamination
H2	Present	Absent	Absent	Indicator contamination at J1
H3	Absent	Absent	Absent	Compliant

Table 4: Results of Escherichia coli Count

Pool	J1	J2	J3	Interpretation
H1	Not detected	Not detected	Not detected	Compliant
H2	Not detected	Not detected	Not detected	Compliant
H3	Not detected	Not detected	Not detected	Compliant

Table 5: Results of Staphylococci Count

Pool	J1	J2	J3	Interpretation
H1	Detected	Detected	Detected	Bather-related contamination
H2	Detected	Detected	Detected	Bather-related contamination
H3	Detected	Detected	Detected	Bather-related contamination

Over days 2 and 3, bacterial load generally decreased, but the persistence of microbiological indicators in some pools suggests inconsistent treatment efficiency or rapid recontamination between measurements.

Physicochemical Results

The physicochemical results showed temperatures ranging from 29.1 °C to 31.2 °C, pH values from 6.19 to 7.08, turbidity values from 0.28 to 1.38 NTU, and free chlorine levels from 0.00 to 1.20 mg/L. H1 consistently showed the lowest chlorine values, including a complete absence of free chlorine on day 2, while H3 displayed the most stable and satisfactory values overall. H2 showed intermediate conditions, with low chlorine on days 1 and 2 and improvement on day 3. The compliance summary therefore classified H1 as microbiologically poor and physicochemically poor, H2 as microbiologically poor and physicochemically moderate, and H3 as good on both levels.

Table 7 highlights marked heterogeneity in water quality across the three swimming pools studied. While H3 shows satisfactory compliance in both microbiological and physicochemical terms, H1 and H2 remain non-compliant, reflecting insufficient control of disinfection parameters, particularly free chlorine, as well as the persistence of contamination indicators. These results emphasize the importance of rigorous and continuous monitoring to ensure the sanitary safety of swimming pool water.

Table 6: Physicochemical Results

Day	Pool	T (°C)	pH	Turbidity (NTU)	Free chlorine (mg/L)
J1	H1	31,2	6,20	0,96	0,05
J1	H2	30,9	7,08	1,38	0,05
J1	H3	30,0	6,93	0,37	0,48
J2	H1	29,8	6,19	1,33	0,15
J2	H2	29,1	6,73	0,98	1,10
J2	H3	29,7	6,98	0,86	1,20
J3	H1	29,1	6,34	1,08	0,05
J3	H2	29,8	6,61	1,00	0,80
J3	H3	29,2	6,95	0,28	1,10

Table 7: Compliance Summary

Pool	Microbiological	Physicochemical	Overall
H1	Poor	Poor	✗ NCNon-compliant
H2	Poor	Moderate	✗Non-compliant
H3	Good	Good	☑Compliant

DISCUSSION

The results of this study show that swimming pool water quality depends on a fragile balance between disinfection, filtration, attendance, and physicochemical conditions. The non-compliances observed in H1 and H2 are consistent with recent recommendations emphasizing the maintenance of effective free chlorine, controlled pH, and regular monitoring of pool installations. When pH moves away from the recommended operating range, chlorine efficacy decreases, which favors persistence of microorganisms in the water.

The detection of revivable bacteria, total coliforms, and staphylococci indicates inconsistent treatment control and suggests either rapid recontamination between checks or insufficient disinfection capacity. Swimming pools are controlled-risk environments in which microbiological quality may deteriorate rapidly under high attendance or imperfect maintenance. The absence of *Escherichia coli* is reassuring, but it is not sufficient to guarantee overall sanitary compliance, since other indicators of dysfunction remain present.

Pool H3 showed better overall performance, suggesting that more rigorous treatment and monitoring can reduce microbiological load. This finding is consistent with recent studies showing that pool water quality varies greatly depending on operational conditions, monitoring frequency, and chlorine control. Simon et al. also proposed a polyvalent microbiological indicator to better assess pool sanitary quality, highlighting the limitation of relying on a single parameter. The high temperature observed in the pools may have contributed to reduced disinfectant effectiveness and increased microbiological risk. Recent operational guidance also stresses that monitoring should include not only analytical results but also maintenance, record keeping, equipment control, and management of peak attendance periods. In this context, the non-compliances observed in H1 and H2 call for stronger staff training, daily monitoring, and preventive maintenance.

The physicochemical results further support this interpretation. Relatively high temperatures may reduce chlorine effectiveness and favor microbial growth when other

treatment parameters are not adequately controlled. In addition, the pH values, though close to neutrality, were sometimes outside the optimal range, which may have compromised disinfection efficiency.

The turbidity observed in H1 and H2 is also an indicator of suboptimal operational quality. Higher turbidity may reflect inadequate filtration, increased particulate load, or accumulation of organic matter that protects microorganisms from disinfectant action. In this context, the low free chlorine levels observed in H1 and, to a lesser extent, in H2 provide a plausible explanation for the persistence of microbiological indicators.

The observed heterogeneity among pools highlights the importance of management practices in final water quality. In practice, pool safety does not depend only on chlorine treatment, but above all on consistent application, critical parameter monitoring, filtration quality, equipment maintenance, and the ability to react quickly when deviations occur. Recent technical documents recommend a structured approach to pool operation, including documented regular checks, preventive maintenance of circulation and filtration systems, and appropriate management of peak occupancy periods.

This approach is also consistent with recommendations issued by regional health agencies in France, which emphasize formalized procedures for cleaning, water monitoring, and management of quality deviations. Likewise, CDC technical frameworks and surveillance data on recreational water outbreaks show that treatment and monitoring failures account for a substantial proportion of health incidents associated with pools.

The non-compliances observed in H1 and H2 are particularly concerning because they fall short of the requirements set out in the joint decree No. 2006-247/MS/MAHRH/MCEMATD defining hygiene and safety standards applicable to swimming pools and bathing facilities. This regulatory reference confirms that the parameters observed in the two pools most affected by organic load and treatment failure do not fully meet the applicable sanitary compliance requirements.

CONCLUSION

This study highlights insufficient sanitary control in two of the three swimming pools investigated in Ouagadougou, with physicochemical and microbiological non-compliances that may compromise swimmer safety. Pool H3 showed better overall compliance, suggesting that more rigorous management can help maintain better water quality. The results confirm the importance of regular monitoring of free chlorine, pH, turbidity, and microbiological indicators in line with public health requirements. They also show that analytical surveillance alone is not sufficient without proper facility maintenance, adequate staff training, and rigorous attendance management. Strengthening pool sanitary control is therefore a priority for preventing health risks associated with exposure to inadequately treated water.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

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Competing Interests

Authors have declared that no competing interests exist.

REFERENCES

1. Agence régionale de santé Auvergne-Rhône-Alpes. Recommandations pour les responsables de piscines publiques et privées à usage collectif. 2026.
2. Arrêté conjoint n°2006-247/MS/MAHRH/MCEMATD portant définition des normes d'hygiène et de sécurité applicables aux piscines et aux baignades. Burkina Faso; 2006.
3. Centers for Disease Control and Prevention. Guidelines for Keeping Your Pool Safe and Healthy. 2025.
4. Centers for Disease Control and Prevention. 2024 Model Aquatic Health Code. 5th ed. Atlanta: CDC; 2024.
5. Centers for Disease Control and Prevention. Operating and Managing Public Pools, Hot Tubs and Splash Pads. 2025.
6. European Centre for Disease Prevention and Control. Swimming pools and recreational waters: health risks and preventive measures. Stockholm: ECDC; 2022.
7. Hlavsa MC, Roberts VA, Anderson TC, Hill VR, Kahler A, Orr M, et al. Surveillance for waterborne disease outbreaks associated with treated recreational water — United States, 2015–2019. MMWR Morb Mortal Wkly Rep. 2022;71:196-208.
8. Leoni E, Legnani P, Mastrantonio P, et al. A survey of microbiological contamination of swimming pool water and related health risk. Int J Hyg Environ Health. 2020;223:1026-33.
9. Natnael T, Hassen S, Desye B, Woretaw L. Physicochemical and bacteriological quality of swimming pool water in Kombolcha Town, Northeastern Ethiopia. Front Public Health. 2024;12:1260034.
10. National Center for Emerging and Zoonotic Infectious Diseases. Model Aquatic Health Code. 5th ed. Atlanta: CDC; 2024.
11. PWTAG. Code of Practice. Pool Water Treatment Advisory Group. 2024.
12. Rodier J, Legube B, Merlet N. L'analyse de l'eau: eaux naturelles, eaux résiduaires, eaux de mer. 10e éd. Paris: Dunod; 2016.
13. Simon N, Bignoneau M, Letort R, Mangeruca C, Faye C, Gstalder ME. Mise en place d'un indicateur polyvalent pour contrôler la qualité microbiologique dans les piscines. 2022.
14. World Health Organization. Guidelines for safe recreational water environments. Vol. 2: Swimming pools and similar environments. Geneva: WHO; 2006.

ANNEXES

Table 8: The different microorganisms and their health risks

Microorganisms	Source	Contamination	Health consequences
Fungi			
Dermatophytes	Skin	Swimming pool water, pool edges, beach area, water games	Mycoses, herpes, etc.
Yeasts	Skin, mucous membranes	Swimming pool water, pool edges, beach area, water games	Candidiasis
Moulds	Environment	Swimming pool water, pool edges, beach area, water games	Toe infections, erythema, pustules, ear canal infections
Bacteria			
Staphylococci	Skin, lesions (impetigo, abscesses)	Swimming pool water (surface film, gutters, upper pool edges)	Furunculosis, rhinitis, conjunctivitis, pharyngitis
Streptococci	Mucous membranes of the nose and throat	Swimming pool water (surface film, gutters, upper pool edges)	Sore throat, otitis, impetigo
Pseudomonas aeruginosa	Mucous membranes	Swimming pool water (surface film, gutters, upper pool edges)	Diarrhea
Mycobacterium	Dust, feed water	Swimming pool water, floors	Granulomas of the elbows or knees
Legionella	Atmosphere	Swimming pool water	Pneumonia
Viruses			
Papillomavirus	Skin, mucous membranes	Pool edges, beach area, water games	Plantar warts (10% of bathers)
Enteroviruses	Skin, mucous membranes	Swimming pool water	Pharyngitis, diarrhea, hepatitis A
Hepatitis A virus	Skin, mucous membranes	Swimming pool water	Viral hepatitis
Adenovirus	Skin, mucous membranes	Swimming pool water	Infections, diarrhea, conjunctivitis

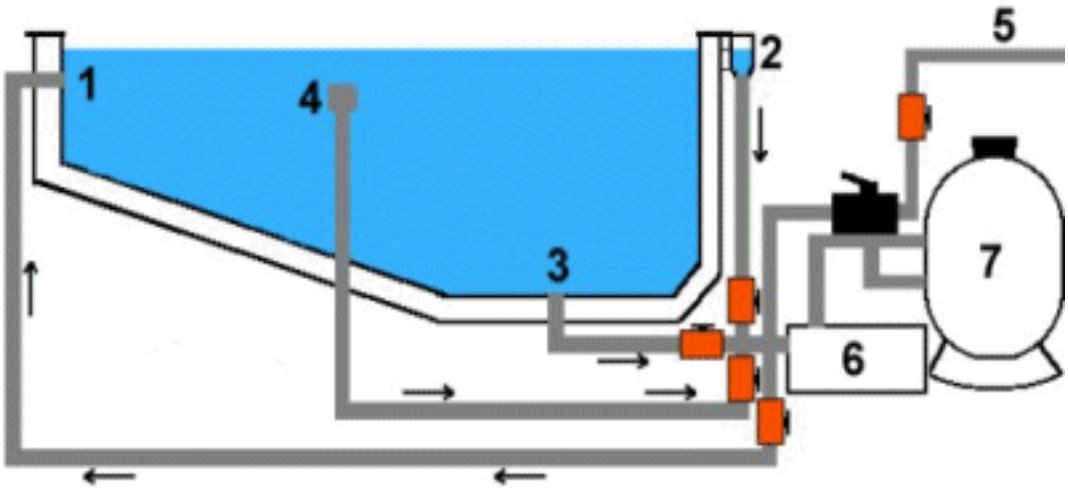

Figure 1: Operating scheme of a swimming pool

Legend: 1. Filtered water outlet, 2. Surface skimmer, 3. Main drain, 4. Vacuum point, 5. Drain pipe for filter backwash, 6. Filtration pump with pre-filter, 7. Sand filter