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Assessment of the microbiological quality of water in public fountains in Cascavel – Paraná

Diagnóstico da qualidade microbiológica da água em fontes públicas em Cascavel – Paraná

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ABSTRACT: Water quality is an essential factor for public health, and contamination by pathogenic microorganisms represents a direct risk to the population. In Cascavel (Paraná), several public fountains used collectively have a history of microbiological contamination. This study aimed to assess the potability of public fountains in Cascavel by identifying the presence of total coliforms and *Escherichia coli* and relating the results to climatic, seasonal, and spatial factors. A total of 141 water samples were analyzed, collected from 14 public fountains and two watercourses between October 2019 and April 2025. The presence of total coliforms was detected in 93.6% of the samples, and *E. coli* in 38.3%, classifying all fountains as unsuitable for human consumption. The variables "month" and "season" showed a significant influence on the presence of total coliforms, while the mean maximum temperature was correlated with the occurrence of *E. coli*. The fountains with the highest contamination levels were located in the urbanized basins of the Iguaçu and Piquiri Rivers. The results demonstrate persistent fecal contamination and a high sanitary risk, indicating the need for preventive measures, deactivation of critical points, regular publications of monitoring reports, and stronger public policies for sanitation and protection of urban springs.

Keywords: Coliforms; *Escherichia coli*; Fresh Water; Potability; Public Health.

RESUMO: A qualidade da água é um fator essencial para a saúde pública, e sua contaminação por microrganismos patogênicos representa risco direto à população. Cascavel (PR) possui diversas fontes públicas de uso coletivo, vem apresentando históricos de contaminação microbiológica. Este estudo teve como objetivo avaliar a potabilidade das fontes públicas de Cascavel, identificando a presença de coliformes totais e *Escherichia coli* e relacionando os resultados com fatores climáticos, sazonais e espaciais. Foram analisadas 141 amostras de água coletadas em 14 fontes públicas e dois cursos hídricos entre outubro de 2019 e abril de 2025. Verificou-se presença de coliformes totais em 93,6% das amostras e de *E. coli* em 38,3%, classificando todas as fontes como impróprias para consumo humano. As variáveis "mês" e "estação do ano" apresentaram influência significativa na presença de coliformes totais, enquanto a temperatura máxima média correlacionou-se com a ocorrência de *E. coli*. As fontes com maiores índices de contaminação localizam-se nas bacias urbanizadas do Rio Iguaçu e do Rio Piquiri. Os resultados evidenciam contaminação fecal persistente e risco sanitário elevado, indicando a necessidade de ações preventivas, desativação de pontos críticos, divulgação periódica de relatórios e fortalecimento das políticas públicas de saneamento e proteção das nascentes urbanas.

Palavras-chave: Água Doce; Coliformes; *Escherichia coli*; Potabilidade; Saúde Pública.

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1 INTRODUCTION

The city of Cascavel is an economic hub in the western region of the state of Paraná, Brazil, with a population of approximately 364,000 inhabitants. The municipality has 22 urban springs used by the local population, and in 2025 it was ordered to pay compensation of R$70,000 for withholding information about water contamination in these fountains from the public, following a conviction by the Public Prosecutor's Office of Paraná (MPPR) (IPARDES, 2025; MPPR, 2025).

All 22 fountains were deemed unsuitable for human consumption. Technical reports showed the presence of total coliforms and *Escherichia coli* in the municipal fountain waters, whereas the water potability standard established by Ordinance GM/MS No. 888/2021 requires the absence of any type of pathogenic contaminant (MPPR, 2025; Ministério da Saúde, 2021).

The group of bacteria known as coliforms is a subdivision of the Enterobacteriaceae family, composed of gram-negative bacilli (GNB) that ferment lactose. Some of these microorganisms inhabit the intestines of animals and are called fecal coliforms, a group that includes *Escherichia coli*, while others that are not necessarily restricted to the intestinal environment are referred to as total coliforms. *E. coli* is the gold standard indicator of fecal contamination and is only found in natural waters if recent fecal contamination has occurred (Tortora *et al*., 2017; Brasil, 2000).

Many socially vulnerable individuals rely primarily on water from public fountains. Because they are more exposed to precarious and fragile conditions, they are more susceptible to diseases caused by pathogens and contaminants present in this water (Neves-Silva, Martins; Heller, 2018). In addition, residents living near public fountains often use them daily for various domestic purposes.

Findings of *E. coli* in water intended for human use are alarming. This research aims to analyze the potability of public water fountains. It is already known that Cascavel has contamination in its public fountains and is currently seeking solutions to this issue. Therefore, this study aimed to evaluate the presence of total coliforms and Escherichia coli in public fountains in Cascavel (PR), correlating the results with climatic and seasonal factors, in order to support public policies for water monitoring and safety.

2 MATERIALS AND METHODS

2.1 STUDY AREA

The study was conducted through water sampling in 14 public fountains located in the city of Cascavel, namely: Fonte Brasmadeira, Fonte Cascavel Velho, Fonte Cataratas, Fonte Jardim Guarujá, Fonte Jardim Padovani, Fonte Jardim Santos Dumont, Fonte Jardim Universitário, Fonte Jardim União, Fonte Leões, Fonte Morumbi, Fonte Mosaicos, Fonte Pacaembu, Fonte Parque Tarquínio, and Fonte Parque Vitória. Additionally, a single sample was collected at two points of natural watercourses (springs). The location of the fountains is shown in Figure 1.

Figure 1. Location of sampling points in the municipality of Cascavel. Source: Google Earth (2025). Prepared by the authors.

Cascavel is located among three hydrographic basins: the Piquiri River Basin (BRP), the Iguaçu River Basin (BRI), and the Paraná 3 River Basin (BRP3), as shown in Figure 2. The fountains located in the BRP are Brasmadeira, Cataratas, and Morumbi. Those in the BRI are Cascavel Velho, Guarujá, Jardim Padovani, Jardim Universitário, Jardim União, Leões, Pacaembu, and Parque Tarquínio. The fountains in BRP3 are Jardim Santos Dumont, Mosaicos, and Parque Vitória.

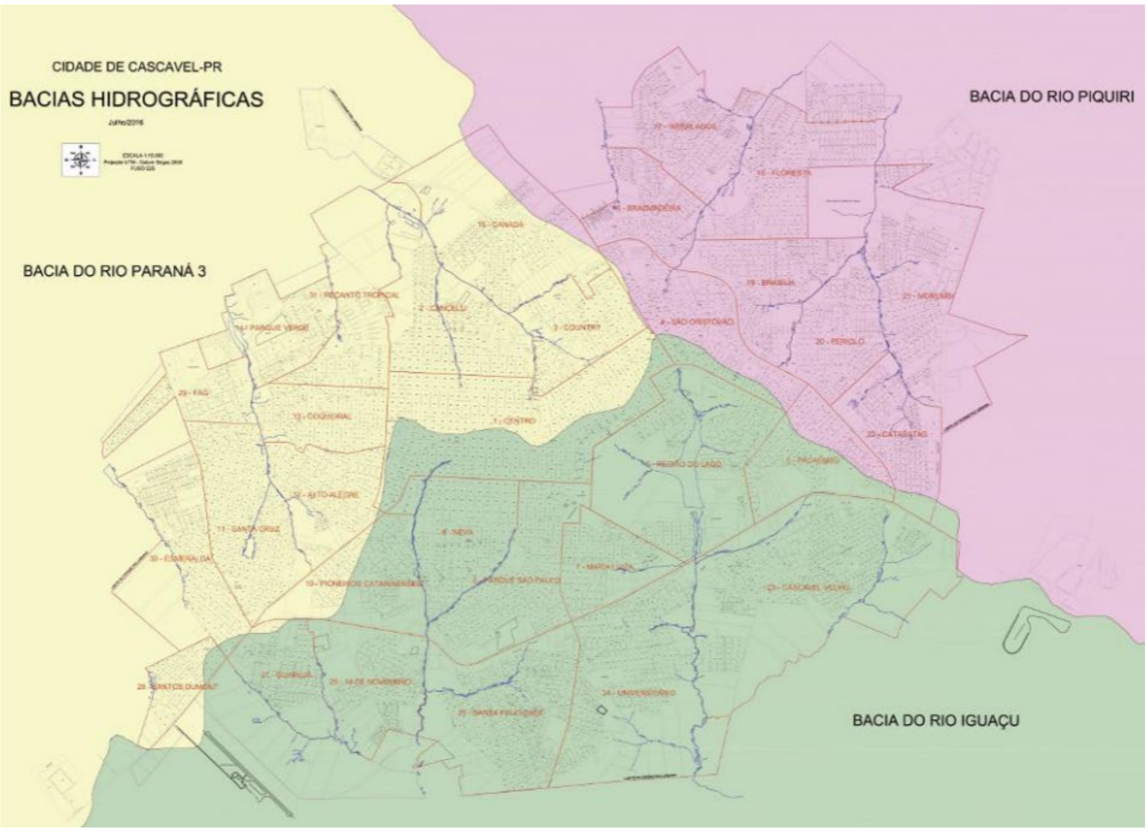

Figure 2. Hydrographic Basins of Cascavel-PR. Source: Riboli (2023).

2.2 SAMPLE COLLECTION

Water samples were collected using sterile bottles containing sodium thiosulfate, which neutralizes residual chlorine, thereby preserving the original water conditions and preventing the inactivation of microorganisms present in the samples. All procedures followed the methods described in the *Standard Methods for the Examination of Water and Wastewater*, 24th edition (APHA, 2022).

The bottles were placed directly at the point of outflow of the running water from the fountains. After sampling, the bottles were stored in an insulated box with ice and transported to the laboratory responsible for the analyses.

Sampling was carried out between October 2019 and April 2025.

2.3 MICROBIOLOGICAL ANALYSES

Microbiological analyses followed the methodology recommended by the American Public Health Association (APHA, 2022). The method applied was Method 9223 from the *Standard Methods for the Examination of Water and Wastewater*, 24th edition, 2022. This technique is based on the detection of characteristic enzymes from total coliforms and *E. coli*.

2.4 DATA ANALYSES

Meteorological data were obtained from the website of the National Institute of Meteorology (INMET), using data from the automatic station S807 – Cascavel, PR. Weather data covered up to 15 days preceding each sampling event, including the day of collection.

Data were organized in Microsoft Excel 365®, and statistical analyses were performed using XLSTAT® software. The Chi-square test (χ^2) was used to verify associations between categorical variables, while numerical variables were compared using Analysis of Variance (ANOVA). For all tests, a significance level of 5% ($p < 0.05$) was adopted to determine statistically significant differences.

3 RESULTS AND DISCUSSION

The microbiological evaluation of public fountains in Cascavel revealed a concerning contamination scenario, reinforcing the importance of continuous monitoring of water quality in urban environments. The presence of total coliforms and *Escherichia coli* in water samples intended for human use indicates the existence of recent fecal pollution sources, possibly associated with domestic effluent infiltration, drainage system failures, and improper waste disposal.

Ordinance GM/MS Nº 888/2021 establishes that water intended for human consumption must be completely free of such microorganisms, meaning that any detection represents a sanitary risk. In this study, the objective was not only to verify contamination occurrence but also to understand the relationships among climatic, seasonal, and spatial variables that may influence the microbiological dynamics of the fountains.

Factors such as temperature, precipitation, and season are known to affect the survival and proliferation of pathogenic microorganisms in aquatic environments, particularly in subtropical regions such as western Paraná (Tortora *et al.*, 2017; Rocha, 2020). Variations in these parameters may therefore favor bacterial growth in certain periods, increasing risks to public health.

Among the 141 samples analyzed, the presence of total coliforms was observed in 93.6% (n = 132) and absence in 6.4% (n = 9). *Escherichia coli* was detected in 38.3% (n = 54) of samples, indicating a high risk of fecal contamination. These percentages show that the vast majority of the analyzed fountains are unfit for consumption, contrary to current potability standards.

Statistical analysis demonstrated that the variables "month" and "season of the year" had significant influence ($p < 0.05$) on the presence of total coliforms, whereas climatic conditions (mean temperature and precipitation) showed no direct correlation with their occurrence. For *E. coli*, the opposite was observed: there was no significant seasonal relationship, but mean maximum temperature showed statistical dependence ($p < 0.05$), suggesting greater bacterial survival during warmer periods. In addition, the variable "collection site" showed a strong correlation with the presence of *E. coli* ($p < 0.0001$), evidencing that some fountains present higher levels of fecal contamination than others.

The statistical findings are discussed in detail according to each variable below and are summarized in Table 1.

3.1 TOTAL COLIFORMS

3.1.1 Months and Seasons of the Year

Statistical analyses of the two variables in relation to the presence or absence of total coliforms revealed p-values < 0.05, indicating that both seasons and months influence the occurrence of total coliforms in the fountains.

The city is located in a temperate, humid climate region, or subtropical humid zone, characterized by high temperatures in summer and frost during winter. Cascavel can be divided climatically into warm and cool seasons. The warm season has a daily maximum mean temperature above 27°C and lasts approximately 5.4 months, from October 15 to March 27, with January being the hottest month. The cool season, defined by daily maximum mean temperatures below 22°C, lasts about 2.6 months, from May 14 to August 1, with July as the coldest month (Prefeitura Municipal de Cascavel, 2004; WeatherSpark, 2025).

As shown In Table 1, the months with the highest percentage of presence were October (16.7%) and April (13.6%), both showing 0% absence, meaning these months consistently presented total coliforms. Coliform absence was observed in five months: March, May, June, August, and September. Notably, absence was not observed within the city's warm season, except in March, possibly due to the seasonal transition occurring at that time.

Summer was the only season that showed total presence of coliforms, with no absence in any sample collected during this period. Autumn had the highest frequency of absence, with absence shown in 6 samples. Spring, which had the highest number of collections, showed absence in only one case, whereas winter showed two. These results indicate that total coliform prevalence increases during summer, particularly when compared to autumn.

Microorganisms have growth limitations such as nutrient availability, oxygen levels, and pH. Temperature is one of the most critical factors. Total coliforms are classified as mesophilic bacteria, with a wide growth range of approximately 10°C to 45°C and optimal growth between 35°C and 37°C—the typical human body temperature (Tortora *et al.*, 2017). Analyzing the trend of coliform growth in Cascavel's fountains shows that their peak occurs during warmer months, decreasing during colder periods.

3.1.2 Climatic Conditions

The p-value of this analysis showed no relationship between variables ($p > 0.05$), meaning that mean maximum and minimum temperatures and accumulated precipitation did not influence the presence of total coliforms in the fountains.

As shown in Table 1, the mean maximum temperature in cases of presence was 27.6 ± 0.3°C and 26.7 ± 1.2°C in cases of absence. Considering the standard error, the means overlap, showing no significant distinction of prensence/ absence for the mean maximum temperature.

The same pattern was observed for minimum temperature: the mean for minimum temperature in presence is 16.0 ± 0.2°C and 14.6 ± 1.0°C in absence. It is observed that the mean maximum and minimum temperatures in cases of presence are contained within the mean temperatures in cases of absence, demonstrating a non-significant relationship between the variables.

The mean accumulated precipitation of coliforms was 64.8 ± 3.5 mm for presence and 55.5 ± 13.6 mm for absence, demonstrating no meaningful differences. Thus, the city's climatic conditions do not significantly affect the presence or absence of total coliforms in Cascavel's public fountains.

3.1.3 Locations

The p-value of the analysis indicated no relationship between location and the presence/absence of total coliforms ($p > 0.05$). Given the high overall incidence of contamination, presence across nearly all fountains was expected. However, statistical analyses showed that only months and seasons influenced total coliform presence.

3.2 ESCHERICHIA COLI

3.2.1 Months and Seasons of the Year

Statistical analysis of the variables in relation to the presence or absence of *E. coli* revealed p-values > 0.05, indicating that neither months nor seasons affect *E. coli* presence. This finding shows that the occurrence of *E. coli* in the fountains is not seasonal and does not follow any temporal pattern.

3.2.2 Climatic Conditions

The p-value for the relationship between *E. coli* presence and mean maximum temperature was < 0.05, indicating variable dependence. Fecal coliforms, also known as thermotolerant coliforms, inhabit the intestines of warm-blooded animals and therefore prefer higher temperatures than total coliforms, with optimal growth between 35°C and 44.5°C (Tortora *et al*., 2017). *E. coli* presence was observed at higher mean temperatures compared to absence. The mean temperature in presence is 28.4 ± 0.5°C, and absence is 27.0 ± 0.3°C, as shown in Table 1. In this case, it is observed that *E. coli* tends to proliferate in warmer conditions.

This relationship likely stems from the bacterium's temperature preference, given that neither seasons nor months showed statistical correlation. As *E. coli* thrives in higher temperatures, its growth and reproduction are more accelerated, increasing its detection likelihood during warmer weather. Moreover, because the collection sites are public fountains often located in parks, higher visitation rates during pleasant weather may also enhance human contact and contamination risks.

The analysis between E. coli presence and mean minimum temperature presents p > 0.05, i.e. it shows no correlations between the variables. The mean minimum temperature in cases of E. coli presence was 16.4 ± 0.4, while in cases of absence it was 15.6 ± 0.3.. Thus, it can be seen in Table 1 that even at lower temperatures, the bacterium was still present in the fountain waters, supporting the hypothesis of fecal contamination of the sources.

The p-value for the correlation of the accumulated precipitation variable was >0.05, indicating no dependency between the variables. The mean accumulated precipitation in cases of presence was 57.1 ± 5.5, and in cases of absence, 68.7 ± 4.4. Therefore, the analysis of variance showed that only the mean maximum temperature influenced the presence of *E. coli* in Cascavel's public fountains.

3.2.3 Locations

The p-value expressing dependence betweet the locations and presence of *E. coli* is <0,0001, considerably less the <0,05, indicating a Strong correlation between these variables. As shown in Table 1, fountains with a high frequency of presence had correspondingly low absence percentages, and vice versa.

Unlike total coliforms, *E. coli* presence was significantly related to collection sites, rather than the seasons or months, confirming that contamination is fecal in nature and not a seasonal phenomenon.

All locations showed *E. coli* presence, an alarming finding. Technical reports provided to the Municipal Government between 2015 and 2016 had already shown contamination by thermotolerant coliforms in all fountains of Cascavel. No mitigation measures were taken, demonstrating that the problem is long-standing and persistent.

The fountains with the highest frequency of *E. coli* presence were Fonte Jardim União, Fonte Brasmadeira and Fonte dos Leões. Another fountain of interest is Jardim Padovani Fountain, which was the only one that never showed absence. This fountain had the smallest number of samples; however, when compared with Jardim Santos Dumont, which had one more collection, it was observed that Jardim Santos Dumont registered two samples with presence and two with absence.

By observing Figure 1 and Figure 2, it can be seen that most fountains with a higher frequency of *E. coli* presence are located in the Iguaçu River Basin, except for Brasmadeira Fountain, which belongs to the Piquiri River Basin.

Jardim União and Padovani Fountains are located close to each other, as shown in Figure 1, both in the Santa Felicidade neighborhood. The neighborhood is one of the most populous in the municipality, with 16,842 inhabitants in 2022, according to Instituto Brasileiro de Geografia e Estatística-IBGE (2023). Both are situated in the Iguaçu River Basin region, which, as previously mentioned, shows thermotolerant coliform levels above permitted limits.

Metropolitan areas influence water quality in river basins due to pollution and waste discharge. Both fountains originate from the Iguaçu River, which is considered the second most polluted river in Brazil, behind only the Tietê River in São Paulo (Bacovis & Lohmann, 2017; Riboli, 2023). Jardim União Fountain showed the highest frequency of *E. coli* presence at 20.4%.

One of the most well-known fountains in the city is the Leões' Fountain, located in the Paulo Gorski Ecological Park, near the municipal lake in the downtown area. It was built as part of a project for the recovery and preservation of the city's springs (Riboli, 2023). This park is frequently visited by residents for leisure activities and is well known for its walking trail. Leões' Fountain was widely used by people exercising at the municipal lake, who would often fill their water bottles at the fountain to hydrate after physical activity. The fountain showed an *E. coli* presence frequency of 18.5% among all collection sites, with only 2.3% absence. These figures indicate a constant rate of fecal contamination at the site.

Bacovis and Lohmann (2017) concluded that the water quality in certain points of the Iguaçu River Basin is influenced by land use, showing that areas with greater urbanization have lower Water Quality Index (WQI) values due to pollution and effluent discharge.

The Brasmadeira Fountain, located in the Brasmadeira neighborhood and part of the Piquiri River Basin, showed an *E. coli* presence frequency of 18.5% and only 1.1%

absence, being the fountain with the lowest absence rate—second only to Padovani Fountain and the watercourses, which showed 0%.

In 2021, a city council member from Cascavel visited the site and reported that local residents used the fountain, filling containers with its water for domestic use. At the time, he requested improvements from the Department of the Environment and called for transparency regarding water analysis reports, as well as clarification on how often and in what way the population was informed about the dangers of consuming unsafe water (Vilanova, 2021).

In 2017, the Cascavel City Council passed Law N° 6762/2017, which requires the publication of water analysis reports for fountains on the city's transparency portal. The water quality reports for all fountains can be Accessed: on the City Hall's website, with the last update dated March 2019 (Cascavel, 2017).

Both watercourses showed *E. coli* presence in their single samples. Springs are the sources of rivers and streams, and when contaminated, they pose environmental and public health risks, affecting not only biodiversity but also the entire water supply system. Cascavel has 1,082 springs within its urban perimeter, according to the Department of the Environment (Barros, Felippe; Costa, 2022; PDI, 2012).

The fountains with the highest percentage of *E. coli* absence were Pacaembu, Cascavel Velho, Tarquínio, and Mosaicos. These fountains also had low presence frequencies, though contamination was still detected.

Mosaicos' and Leões' Fountains are both located in downtown Cascavel but showed opposite results. While Leões presented a high contamination percentage, Mosaicos showed only 1.9% presence and 11.5% absence. Mosaicos' Fountain is located in Mosaicos Square, in front of the exposed spring of the São Francisco Verdadeiro River. The population, as in the case of Leões' Fountain, used to collect water from Mosaicos' Fountain for consumption.

Based on the pattern of *E. coli* presence in the fountains, it can be seen that contamination does not necessarily occur in low-income areas. According to an IBGE (2010) study on per capita income by neighborhood, Cataratas was the second most economically vulnerable neighborhood, followed by Guarujá. However, both Cataratas and Guarujá Fountains presented nearly identical absolute frequencies of presence and absence of fecal coliforms compared with Parque Vitória Fountain, which is located in Country, the city's wealthiest neighborhood.

In April 2025, 14 fountains were deactivated, including Padovani, Jardim Santos Dumont, Jardim Universitário, Morumbi, and Parque Vitória. Moreover, according to the Department of the Environment, another nine were in the process of being deactivated, including Cascavel Velho, Cataratas, Guarujá, Jardim União, Leões, Mosaicos, and Tarquínio. The water flow from these fountains will be redirected to its natural course into nearby water bodies (Alexandrino, 2025). This decision came only after the municipality was convicted by the Public Prosecutor's Office of Paraná (MPPR).

Table 1. Influence of climatic characteristics on the development of coliforms and *E. coli*

Variable	Total Sample n = 141 n (%) or Mean ± SD	Total Coliforms - Presence n= 132 n (%) or Mean ± SD	Total Coliforms - Absence n = 9 n (%) or Mean ± SD	P-value	*E. coli* - Presence n= 54 n (%) or Mean ± SD	*E. coli* - Absence n = 87 n (%) or Mean ± SD	P-value
Month							
January	4 (2,8%)	4 (3,0%)	0 (0%)		0 (0%)	4 (4,6%)	
February	8 (5,7%)	8 (6,1%)	0 (0%)		3 (5,6%)	5 (5,7%)	
March	9 (6,4%)	6 (4,5%)	3 (33,3%)		4 (7,4%)	5 (5,7%)	
April	18 (12,8%)	18 (13,6%)	0 (0%)		7 (13,0%)	11 (12,6%)	
May	3 (2,1%)	2 (1,5%)	1 (11,1%)		0 (0%)	3 (3,4%)	
June	11 (7,8%)	9 (6,8%)	2 (22,2%)	**0,007**	3 (5,6%)	8 (9,2%)	0,085
July	11 (7,8%)	11 (8,3%)	0 (0%)		3 (5,6%)	8 (9,2%)	
August	11 (7,8%)	9 (6,8%)	2 (22,2%)		3 (5,6%)	8 (9,2%)	
September	17 (12,1%)	16 (12,1%)	1 (11,1%)		5 (9,3%)	12 (13,8%)	
October	22 (15,6%)	22 (16,7%)	0 (0%)		16 (29,6%)	6 (6,9%)	
November	14 (9,9%)	14 (10,6%)	0 (0%)		5 (9,3%)	9 (10,3%)	
December	13 (9,2%)	13 (9,8%)	0 (0%)		5 (9,3%)	8 (9,2%)	
Seasons of the Year							
Spring	58 (41,1%)	57 (43,2%)	1 (11,1%)		28 (51,9%)	30 (34,5%)	
Summer	17 (12,1%)	17 (12,9%)	0 (0%)	**0,030**	6 (11,1%)	11 (12,6%)	0,226
Autumn	38 (27,0%)	32 (24,2%)	6 (66,7%)		12 (22,2%)	26 (29,9%)	
Winter	28 (19,9%)	26 (19,7%)	2 (22,2%)		8 (14,8%)	20 (23,0%)	
Locations							
Watercourse 1	1 (0,7%)	1 (0,8%)	0 (0%)		1 (1,9%)	0 (0%)	
Watercourse 2	1 (0,7%)	1 (0,8%)	0 (0%)		1 (1,9%)	0 (0%)	
Fonte Brasmadeira	11 (7,8%)	11 (8,3%)	0 (0%)		10 (18,5%)	1 (1,1%)	
Fonte Cascavel Velho	12 (8,5%)	9 (6,8%)	3 (33,3%)		1 (1,9%)	11 (12,6%)	
Fonte Cataratas	11 (7,8%)	11 (8,3%)	0 (0%)	0,108	2 (3,7%)	9 (10,3%)	**<0,0001**
Fonte Jardim Guarujá	11 (7,8%)	11 (8,3%)	0 (0%)		2 (3,7%)	9 (10,3%)	
Fonte Jardim Padovani	3 (2,1%)	3 (2,3%)	0 (0%)		3 (5,6%)	0 (0%)	
Fonte Jardim Santos Dumont	4 (2,8%)	4 (3,0%)	0 (0%)		2 (3,7%)	2 (2,3%)	
Fonte Jardim Universitário	10 (7,1%)	7 (5,3%)	3 (33,3%)		3 (5,6%)	7 (5,6%)	
Fonte Jardim União	13 (9,2%)	13 (9,8%)	0 (0%)		11 (20,4%)	2 (2,3%)	
Fonte Leões	12 (8,5%)	12 (9,1%)	0 (0%)		10 (18,5%)	2 (2,3%)	
Fonte Morumbi	3 (2,1%)	3 (2,3%)	0 (0%)		1 (1,9%)	2 (2,3%)	
Fonte Mosaicos	11 (7,8%)	10 (7,6%)	1 (11,1%)	0,108	1 (1,9%)	10 (11,5%)	**<0,0001**
Fonte Pacaembu	14 (9,9%)	13 (9,8%)	1 (11,1%)		1 (1,9%)	13 (14,9%)	
Fonte Parque Tarquínio	13 (9,2%)	12 (9,1%)	1 (11,1%)		2 (3,7%)	11 (12,6%)	
Fonte Parque Vitória	11 (7,8%)	11 (8,3%)	0 (0%)		3 (5,6%)	8 (9,2%)	
Mean Maximum Temperature	27,7 ± 3,7	27,6 ± 0,3	26,7 ± 1,2	0,770	28,4 ± 0,5	27,0 ± 0,3	**0,047**

(continues)

(conclusion)

Variable	Total Sample n = 141 n (%) or Mean ± SD	Total Coliforms - Presence n= 132 n (%) or Mean ± SD	Total Coliforms - Absence n = 9 n (%) or Mean ± SD	P-value	*E. coli* - Presence n= 54 n (%) or Mean ± SD	*E. coli* - Absence n = 87 n (%) or Mean ± SD	P-value
Mean Minimum Temperature	15,9 ± 3,0	16,0 ± 0,2	14,6 ± 1,0	0,314	16,4 ± 0,4	15,6 ± 0,3	0,185
Accumulated Precipitation	64,2 ± 41,3	64,8 ± 3,5	55,5 ± 13,6	0,312	57,1 ± 5,5	68,7 ± 4,4	0,074

The chi-square test was applied to categorical variables (Month, Season, and Location). The ANOVA test was used for continuous variables (Mean Max. Temp., Mean Min. Temp., and Accumulated Precipitation), considering the non-normality of the residuals.

4 CONCLUSION

The results demonstrated that all public fountains in Cascavel presented contamination by *Escherichia coli*, classifying them as unfit for human consumption according to the potability standards established by Ordinance GM/MS N° 888/2021. The widespread presence of this bacterium indicates recurrent and persistent fecal pollution over time, revealing failures in control, maintenance, and risk communication to the population.

Statistical analysis showed that seasonal variables (month and season of the year) significantly influenced the presence of total coliforms, while mean maximum temperature was directly related to the occurrence of *E. coli*. On the other hand, climatic and rainfall conditions were not determining factors, suggesting that contamination is more closely associated with local factors, such as land use, inadequate management of spring surroundings, and human contact in the fountain areas.

Even after years of reports indicating contamination, mitigation measures by public authorities were delayed. Only in 2025 did the municipality begin the process of deactivating contaminated fountains, revealing the need for greater institutional responsibility and transparency in the publication of water quality reports.

Therefore, it is concluded that the management of urban fountains must be integrated into public sanitation and health policies, emphasizing actions for spring protection, control of diffuse pollution sources, and environmental education of the population. This study reinforces the urgency of continuous monitoring and periodic dissemination of results as essential tools to ensure safe access to water and to prevent public health risks.

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REFERENCES

ALEXANDRINO, E. Alerta: Fontes d'água estão todas impróprias para consumo, em Cascavel. **Gazeta do Paraná,** Cascavel, 17 abr. 2025. Available at: https://gazetadoparana.com.br/artigo/alerta-fontes-dagua-estao-todas-improprias-para-consumo-em-cascavel. Accessed: 30 sept. 2025.

AMERICAN PUBLIC HEALTH ASSOCIATION - APHA. **Standard Methods for the Examination of Water and Wastewater**. 24ª ed. Washington, D.C.: APHA, 2022.

BACOVIS, T. M.; LOHMANN, M. Variação da qualidade da água na sub-bacia hidrográfica do Alto Rio Iguaçu entre 1987 e 2012. **Revista Técnico-Científica do CREA-PR**, Curitiba, 9ª ed., dez. 2017. p. 1-19.

BARROS, R. R.; FELIPPE, M. F.; COSTA, A. Entre insuficiências e negligências: as políticas de proteção às nascentes e áreas úmidas no Brasil. **Revista da ANPEGE**, [S. l.], 2022. DOI: https://doi.org/10.5418/ra2022.v18i36.16270.

BRASIL. Ministério da Saúde. Gabinete do Ministro. **Portaria nº 2.914, de 12 de dezembro de 2011**. Brasília, 2011.

BRASIL. Ministério da Saúde. Gabinete do Ministro. **Portaria GM/MS nº 888, de 4 de maio de 2021**. Brasília, 2021.

BRASIL. **Resolução CONAMA nº 274, de 29 de novembro de 2000.** Brasília, 2000.

CASCAVEL. INSTITUTO PARANAENSE DE DESENVOLVIMENTO ECONÔMICO E SOCIAL. **Caderno Estatístico de Cascavel**. Cascavel, Março 2025. Available at: http://www.ipardes.gov.br/cadernos/MontaCadPdf1.php?Municipio=85800. Accessed: 29 sept 2025.

CASCAVEL. **LEI Nº 6762 de 09 de outubro de 2017**. Cascavel, 2017.

GOOGLE. **Google Earth**. Website. Available at: https://www.google.com.br/earth/. Acesso em 28 sept 2025.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). **Censo Brasileiro de 2022**. Rio de Janeiro, 2023. Available at: https://cidades.ibge.gov.br/brasil/pr/cascavel/panorama. Accessed: 30 sept 2025.

INSTITUTO NACIONAL DE METEOROLOGIA. **Mapa de Estações**. Available at: https://mapas.inmet.gov.br. Accessed: 04 sept 2025.

INSTITUTO PARANAENSE DE DESENVOLVIMENTO ECONÔMICO E SOCIAL – IPARDES. Downloads. 2010. Available at: https://www.ibge.gov.br/estatisticas/downloads-estatisticas.html. Accessed: 30 sept 2025.

MINISTÉRIO PÚBLICO DO PARANÁ (MPPR). **A partir de ação civil pública do MPPR, Município de Cascavel é condenado a indenizar por omitir informações sobre contaminação de água em fontes públicas**. 07 jan. 2025. Available at: https://mppr.mp.br/Noticia/partir-de-acao-civil-publica-do-MPPR-Municipio-de-Cascavel-e-condenado-indenizar-por-omitir. Accessed: 30 sept 2025.

NEVES-SILVA, P.; MARTINS, G. I.; HELLER, L. "A gente tem acesso de favores, né?". A percepção de pessoas em situação de rua sobre os direitos humanos à água e ao esgotamento sanitário. **Cadernos de Saúde Pública**, [S. l.], v. 34, n. 3, 26 mar. 2018. DOI 10.1590/0102-311X00024017.

PREFEITURA MUNICIPAL DE CASCAVEL. **Dados Geofísicos**, 2004.

PREFEITURA MUNICIPAL DE CASCAVEL. **Parques**. Cascavel, 2025a. Available at: https://cascavel.atende.net/cidadao/pagina/parques. Accessed: 28 sept 2025.

PREFEITURA MUNICIPAL DE CASCAVEL. **Qualidade da Água das Fontes Urbanas**. Cascavel, 2025b. Available at: https://cascavel.atende.net/cidadao/pagina/qualidade-da-agua-das-fontes-urbanas. Accessed: 29 sept 2025.

PROGRAMA DE DESENVOLVIMENTO INTEGRADO DE CASCACAVEL – PDI. **Relatório de avaliação ambiental**. Cascavel, 2012.

RIBOLI, S. A. **Qualidade da água de fontes de Cascavel-Pr utilizando análise de componentes principais (PCA)**. 2023. 62 f. Dissertação (Mestrado em Ciências Ambientais) - Universidade Estadual do Oeste do Paraná, Toledo, 2023.

ROCHA, M. C. V. **Microbiologia ambiental**. 1. ed. Curitiba: Intersaberes, 2020.

TORTORA, G. J; CASE, C. L.; FUNKE, B. R. **Microbiologia**. 12. ed. Artmed, 2017.

VILANOVA, E. **Emerson Vilanova pede melhorias para fontes de água em Cascavel e alerta para riscos.** Câmara Municipal de Cascavel, 06 ago. 2021. Available at: https://www.camaracascavel.pr.gov.br/comunicacao/noticias/emerson-vilanova-pede-melhorias-para-fontes-de-agua-em-cascavel-e-alerta-para-riscos. Accessed: 02 oct. 2025.

WEATHERSPARK. **Clima, condições meteorológicas e temperatura média por mês de Cascavel (Paraná, Brasil)**. 2025. Available at: https://pt.weatherspark.com/y/29585/Clima-característico-em-Cascavel-Paraná-Brasil-durante-o-ano. Accessed: 28 sept 2025.