ISSN: 2447-3359

REVISTA DE GEOCIÊNCIAS DO NORDESTE

Northeast Geosciences Journal

v. 12, nº 02 (2026)

https://doi.org/10.21680/2447-3359.2026v12n2ID43514

Quality of water supply and implications for public health in the Agreste mesoregion of Pernambucano

Qualidade da água de abastecimento e implicações à saúde da população na mesorregião do Agreste Pernambucano

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Abstract: Considering the importance of chlorine in the disinfection process in water supply systems, this study aimed to assess residual chlorine compliance and its implications for public health in the Agreste region of Pernambucano. The data were obtained from the National Sanitation Information System and the Brazilian Institute of Geography and Statistics. The methodology includedassessment of normality using the Shapiro-Wilk test; hypothesis testing using the Student's t-test; and Pearson's correlation analysis. The results demonstrate that municipalities with non-compliant residual chlorine samples are more susceptible to acute diarrheal diseases. They also indicate the need to improve water treatment systems regarding the guarantee of minimum residual chlorine levels, especially in the Central Agreste region, where most of the non-compliant municipalities are located.

Keywords: Basic sanitation; Water supply; Residual chlorine.

Resumo: Considerando a importância do cloro para o processo de desinfecção nos sistemas de abastecimento de água, este trabalho teve como objetivo avaliar a conformidade do cloro residual e as implicações à saúde da população na região do Agreste Pernambucano. As informações foram oriundas do Sistema Nacional de Informações Sobre Saneamento e do Instituto Brasileiro de Geografia e Estatística. A metodologia incluiu a verificação de normalidade, com o teste de Shapiro-Wilk; o teste de hipótese, com t-Student, e a análise de correlação de Pearson. Os resultados indicaram que os municípios com amostras de cloro residual fora do padrão estão mais sujeitos às Doenças Diarreicas Agudas e a necessidade de melhoria dos sistemas de tratamento da água no que se refere à garantia dos valores mínimos de cloro residual, principalmente na região do Agreste Central, onde se encontra a maioria dos municípios em desconformidade.

Palavras-chaves: Saneamento básico; Abastecimento de água; Cloro residual.

Received: 04/04/2026; Accepted: 11/08/2026; Published: 02/09/2026.

1. Introduction

The relationship between the efficiency of water supply and people's quality of life is widely documented in the academic literature. In this context, the international legal framework, represented by United Nations (UN) Resolution No. A/64 of 2010, recognizes access to water of sufficient quality and quantity as a fundamental human right. The Brazilian State, not only as a signatory to this global legislation but also, as noted by Costa (2023) and Klaus Júnior, Ogoshi and Martins (2024), in accordance with its own Constitution, must guarantee this right to its citizens. However, according to data from the National Sanitation Information System presented by Instituto Trata Brasil (2024), approximately 32 million Brazilians do not have satisfactory access to water in their homes.

Despite the advances observed in recent decades, the challenges to achieving universal water supply coverage, particularly in the North and Northeast regions of Brazil, as pointed out by Coelho and Campos (2014) and Andrade (2015), remain serious and persistent. Even within the Northeast region, there are considerable internal disparities in the population's access to public services and, according to Hissa-Texeira (2018) and Porto (2024), these are related to the historical context of the economic development of cities, with policies that have proven insufficient to consistently improve social indicators, further exacerbating inequalities. Along the same lines, but specifically regarding policies for access to sanitation services, Correia *et al.* (2023) observe that these follow a center-periphery model that has historically prioritized wealthier regions to the detriment of those inhabited by the most vulnerable populations.

Located entirely within the Northeast region, the Brazilian semiarid region has the lowest rainfall levels in the country. According to Caetano *et al.* (2020), characteristics such as a high aridity index, shallow and impermeable soils, and intermittent rivers are aggravating factors that result in insufficient per capita water availability. Monteiro *et al.* (2024) and Rocha *et al.* (2025) exemplify this condition by demonstrating the difficulties associated with water supply in rural communities in the Brazilian semiarid region of the state of Pernambuco.

As with universal coverage, the quality of the water supplied, according to Heller and Pádua (2010), Poague and Heller (2019), and Schafaschek *et al.* (2024), is also an important issue concerning water supply systems. Problems arising from water quality include various waterborne diseases associated with inadequate sanitation (Rufino *et al*., 2016). Citing WHO and UNICEF data, Prolagos (2021) notes that, among these, diarrheal diseases are the most significant, accounting for more than 80% of the total and approximately 40% of hospitalizations among children under five years of age.

In Northeast Brazil, between the beginning of 2019 and the end of 2023, nearly 90,000 hospitalizations due to diarrheal diseases were recorded among children up to 14 years of age, at a cost exceeding 32 million reais (Cordeiro Aranha *et al.,* 2024). In Brazil, the impact of this health condition on healthcare systems is so significant that, by decision of the Ministry of Health, individual cases of Acute Diarrheal Diseases (ADD) are classified as compulsorily notifiable diseases. This information is periodically made publicly available by the Health and Environment Surveillance Secretariat (SVSA), under the Ministry of Health.

To ensure the quality of the water supplied, the disinfection process is essential for eliminating waterborne pathogens. Richter (2009) notes that chlorine, a chemical element belonging to the halogen family, has become the most widely used disinfectant in water treatment systems in Brazil due to its characteristics, which include its affordable cost, ease of transportation and handling, and ability to eliminate most harmful microorganisms present in water.

Ministry of Health Ordinance No. 888, presented in Brasil (2021), describes the procedures for controlling and monitoring the quality of water intended for human consumption. Chapter V of this Ordinance, which specifically addresses drinking water standards, establishes the requirement to maintain a minimum concentration of 0.2 mg/L of residual chlorine or chlorine dioxide, or 2 mg/L of combined residual chlorine, throughout the entire distribution system and at the final points of consumption. To assess compliance with this Ordinance, the companies responsible for water supply must continuously and systematically calculate and disclose the results of several indicators, such as the compliance rate for the number of residual chlorine samples and the incidence of residual chlorine analyses outside the established standard (ICR). These indicators are available in the National Sanitation Information System (Brasil, 2023).

This study, conducted in the semiarid region of the Agreste of Pernambuco, aimed primarily to investigate the adequacy of water supply systems in relation to the requirements established by the aforementioned Ordinance concerning the maintenance of the minimum residual chlorine concentration, and the consequences of noncompliance for public health, represented by the number of cases of acute diarrheal diseases reported by the Health and Environment

Surveillance Secretariat. The study thus seeks to contribute to identifying priorities for improving the water supply system, with a specific focus on public health.

2. Methodology

2.1 Study area

The study was conducted in the Agreste mesoregion of Pernambuco, located in the central portion of the state, bordered by the state of Paraíba to the north, the state of Alagoas to the south, the Zona da Mata region of Pernambuco to the east, and the Sertão region of Pernambuco to the west. It is divided into three microregions: Southern Agreste (AM), with 26 municipalities; Central Agreste (AC), also with 26; and Northern Agreste (AS), with 19, totaling 71 municipalities. Its population of approximately 2.34 million inhabitants is distributed over an area of 24 thousand square kilometers, resulting in a population density of 97.5 inhabitants/km², which characterizes it as a densely populated semiarid region.

According to Rodrigues *et al*. (2017), the predominant climate is typical of the semiarid regions of Northeast Brazil: hot and dry tropical or hot tropical to dry subhumid, with irregular rainfall and potential evapotranspiration exceeding precipitation, resulting in a water deficit. Regarding temperatures, Rodrigues *et al*. (*op. cit*.) report maximum temperatures between 24 and 31°C from November to February and minimum temperatures between 16 and 20°C, recorded in July and August.

Figure 1 presents a map of the study area, comprising the municipalities of the Agreste region of Pernambuco, distributed among its three microregions: Southern Agreste (AM), to the south; Central Agreste (AC), in the central region; and Northern Agreste (AS), to the north. The municipality of Tacaimbó is an exception, as it was excluded from the study due to the unavailability of data required for the research for the year 2022 from the Health and Environment Surveillance Secretariat.

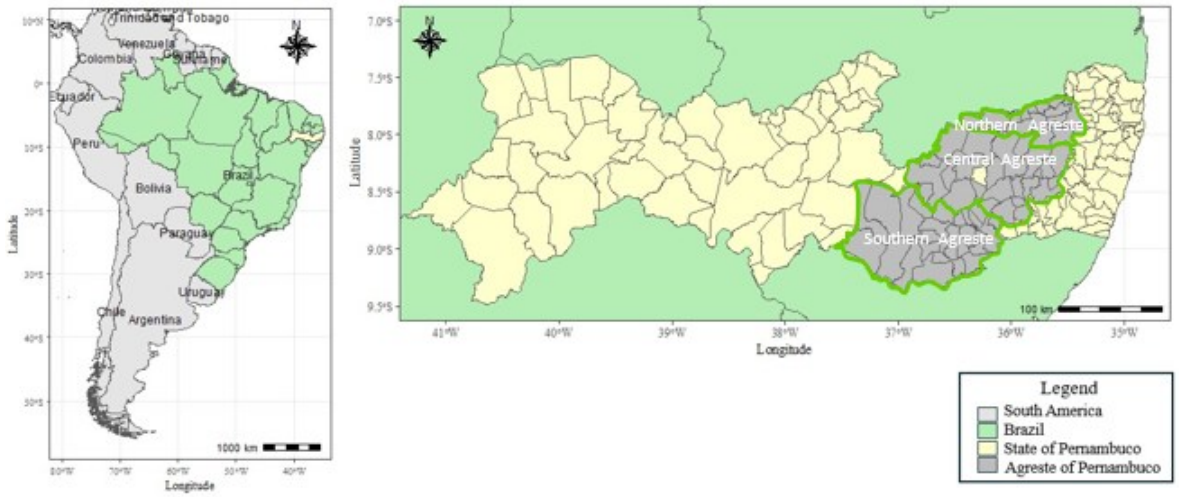

Figure 1 - Location of the study area
Source: IBGE database (2023). Prepared by the authors **(2025).**

2.2 Data collection

The research, characterized as a quantitative cross-sectional study, as described by Raimundo et al. (2018), was conducted using data for the year 2022, made available in 2023. Information on the indicator of noncompliance with the residual chlorine standard was obtained from the National Sanitation Information System (SNIS), managed by the National Secretariat for Environmental Sanitation, under the Ministry of Cities, and available in Brasil (2023). In the SNIS, data on the diagnosis of Water and Sewage Services for 2022 are provided in the table of disaggregated and aggregated indicators, which was generated from data supplied by the Pernambuco Sanitation Company (COMPESA).

Information on Acute Diarrheal Diseases in the municipalities of the Agreste region of Pernambuco was obtained by summing the data for the 52 weeks of 2022, generated in September 2023 and updated in June 2024 by the Health and Environment Surveillance Secretariat (SVSA), under the Ministry of Health (Brasil, 2024).

Population data for the 70 municipalities comprising the study area were obtained from the website of the Brazilian Institute of Geography and Statistics (IBGE), based on the 2022 Demographic Census, released in June 2023.

2.3 Data analysis

According to the residual chlorine indicator (ICR), the municipalities were divided into two groups. The first group comprises those municipalities in which the indicator complies with GM/MS Ordinance No. 888 in all samples analyzed. The second group comprises those municipalities that had samples outside the values prescribed by the Ordinance.

In both groups, the initial assessment of position and dispersion and the presence of outliers in the data on relative ADD cases was performed by constructing and analyzing a boxplot. Subsequently, after removing the outliers, and with a view to using parametric analyses, particularly hypothesis testing and correlation analysis, normality was assessed using the Shapiro–Wilk test at a 5% significance level. In this case, normality is confirmed when the calculated test statistic W is greater than the tabulated value Wα, obtained as a function of the significance level and sample size, such that normality is accepted if $p > 0.05$.

The hypothesis test applied was the one-tailed Student's *t*-test for unpaired samples at a 5% significance level. The null hypothesis, or H0, was that the mean number of ADD cases per thousand inhabitants in municipalities in which all samples had compliant residual chlorine values is less than or equal to the mean number of ADD cases per thousand inhabitants in municipalities with samples presenting residual chlorine values that do not comply with the requirements of GM/MS Ordinance No. 888. The alternative hypothesis, or H1, is that the first group, comprising compliant municipalities, has a higher number of relative ADD cases than the second group.

Pearson correlation analysis, made possible by the normality of the data, was evaluated based on the correlation (r) and determination (r^2) coefficients, with reference to the values presented in Hopkins (2000). Linear regression, used to obtain the model describing the relationship between the residual chlorine compliance indicator and the relative number of ADD cases, is in accordance with Hopkins. (*op. cit.*).

3. Results and discussion

Table 1 presents data from 51 municipalities in the Agreste region of Pernambuco classified in the first group, that is, those in which the residual chlorine indicator (ICR) showed satisfactory results for all samples analyzed. The second column presents the absolute number of ADD cases; the third, the municipality's population; and the fourth, the relative number of ADD cases per thousand inhabitants, calculated based on these two values.

The total range of relative ADD cases was 101.41 cases per thousand inhabitants, calculated as the difference between the highest value, observed in Santa Cruz do Capibaribe, with 103.40 cases per thousand inhabitants, and the lowest, in Itaíba, with 1.99 cases per thousand inhabitants. When compared with the order of magnitude of the data, the total range indicates high dispersion in the relative number of ADD cases, or the presence of possible outliers.

Table 1 - Municipalities with a satisfactory residual chlorine indicator (ICR)

Municipality (Microregion)	**ADD** (Cases)	**Pop.** (inhab.)	**Cases** (1,000 inhab)	**Municipality**	**ADD** (Cases)	**Pop.** (inhab)	**Cases** (1,000 inhab)
Águas Belas (AM)	1289	41548	31.02	Ibirajuba (AC)	67	7114	9.42
Altinho (AC)	742	20674	35.89	Itaíba (AM)	65	32650	1.99
Angelim (AM)	56	10241	5.47	João Alfredo (AS)	646	27725	23.30
Barra Guabiraba (AC)	52	12263	4.24	Jucati (AM)	94	11517	8.16
Bezerros (AC)	3318	61694	53.78	Jupi (AM)	123	15329	8.02
Bom Conselho (AM)	1516	44294	34.23	Lagoa do Ouro (AM)	480	11933	40.22
Bom Jardim (AS)	1173	37629	31.17	Lagoa dos Gatos (AC)	203	14076	14.42
Bonito (AC)	1658	37474	44.24	Limoeiro (AS)	1609	56510	28.47

Brejão (AM)	68	9079	7.49	Palmeirina (AM)	182	7031	25.89
Brejo M. Deus (AC)	3761	48648	77.31	Panelas (AC)	1045	22991	45.45
Buíque (AM)	1620	52097	31.10	Paranatama (AM)	550	12199	45.09
Cachoeirinha (AC)	1205	19899	60.56	Passira (AS)	1346	28340	47.49
Caetés (AM)	783	28827	27.16	Pedra (AM)	823	22795	36.10
Calçado (AM)	242	11093	21.82	Poção (AC)	297	10500	28.29
Camocim S Felix (AC)	1145	17419	65.73	Sairé (AC)	75	10887	6.89
Canhotinho (AM)	453	24329	18.62	Salgadinho (AS)	307	5727	53.61
Capoeiras (AM)	527	18338	28.74	Saloá (AM)	187	13836	13.52
Casinhas (AS)	322	12967	24.83	Sta C. Capibaribe (AS)	10159	98254	103.40
Correntes (AM)	212	17131	12.38	São João (AM)	216	23837	9.06
Cumaru (AS)	584	15920	36.68	São V Férrer (AS)	930	16677	55.77
Cupira (AC)	1498	23518	63.70	Surubim (AS)	579	64120	9.03
Feira Nova (AS)	1584	21427	73.93	Terezinha (AM)	315	6513	48.36
Frei Miguelino (AS)	399	13636	29.26	Tupanatinga (AM)	649	26937	24.09
Garanhuns (AM)	2356	142506	16.53	Venturosa (AM)	1580	17251	91.59
Gravatá (AC)	5551	86516	64.16	Vertente do Lério (AS)	98	7558	12.97
Iati (AM)	820	17165	47,77				

Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors (2025).

Table 2 presents data from 19 municipalities in the Agreste region of Pernambuco classified in the second group, that is, those in which the residual chlorine indicator (ICR) did not show satisfactory values in all samples analyzed. Among these, the municipality of Tacaimbó is absent; it should have been included in the second group but was excluded from the study because the Health and Environment Surveillance Secretariat had no records available on cases of acute diarrheal diseases for the year 2022.

The number of municipalities included in Table 2, corresponding to the second group, 19 out of a total of 70 municipalities, reveals that approximately 27% of the municipalities in the study area do not comply with the requirements of Ministry of Health GM/MS Ordinance No. 888 regarding the need to maintain the minimum residual chlorine level in all samples analyzed. This is a concerning figure, considering the importance of chlorine for disinfection and for ensuring the quality of water intended for human consumption.

Table 2 - Municipalities with residual chlorine indicator (ICR) outside the standard

Municipality (Microregion)	**ADD** (Cases)	**Pop.** (inhab)	**Cases** (1000 inhab)	**ICR** (%)
Alagoinha (AC)	767	13542	56.64	5.45
Agrestina (AC)	414	23779	17.41	0.5
Belo Jardim (AC)	3317	79507	41.72	0.33
Caruaru (AC)	11890	378048	31.45	1.13
Jataúba (AC)	1757	15843	110.90	5.77
Jurema (AM)	495	13648	36.27	1.23
Lajedo (AM)	2416	39582	61.04	41.04
Machados (AS)	492	11333	43.41	2.78
Orobó (AS)	206	21808	9.45	15
Pesqueira (AC)	2746	62722	43.78	6.74

Riacho das Almas (AC)	794	20639	38.47	1.62
Sanharó (AC)	977	18624	52.46	12.58
Santa M. Cambuca (AS)	299	14013	21.34	3.57
São Joaquim Monte (AC)	1038	20037	51.80	0.56
São Bento do Una (AC)	3101	49449	62.71	27.88
São Caitano (AC)	2550	37126	68.69	1.03
Taquaritinga Norte (AS)	2110	24736	85.30	8.67
Toritama (AS)	1055	41137	25.65	1.35
Vertentes (AS)	948	21959	43.17	2.78

Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors (2025).

Regarding the number of reported ADD cases, in column 5 of Table 2, the municipality of Jataúba had the worst result, with 110.90 ADD cases per thousand inhabitants. The most favorable result was observed in Orobó, with 9.75. For the second group, these values resulted in a total range of 101.45 cases per thousand inhabitants. As in the first group, when compared with the order of magnitude of the data, the total range indicated high dispersion and the possible presence of *outliers*.

Regarding compliance with the Ministry of Health Ordinance, in column 4 of Table 2, the most unfavorable value was observed in the municipality of Lajedo, with 41% of samples outside the standard, that is, without the minimum amount of residual chlorine required for water disinfection.

This problem has been observed in several municipalities, particularly in the North and Northeast regions of Brazil, as pointed out by Araújo and Almeida (2025) and Ribeiro (2024). The latter researcher, with the objective of investigating the main problems related to the water supply system in the municipality of São Bento, in the state of Maranhão, found an even more serious result than that presented in Table 2. According to this researcher, 50% of the samples from the municipality of São Bento had residual chlorine levels below those recommended by the Ordinance.

Figure 2, generated based on the residual chlorine indicator values presented in Tables 1 and 2, shows the municipalities in group 1 in blue, which had all samples in compliance with Ordinance No. 888. In red are the municipalities that had samples outside the standard established by the Ordinance.

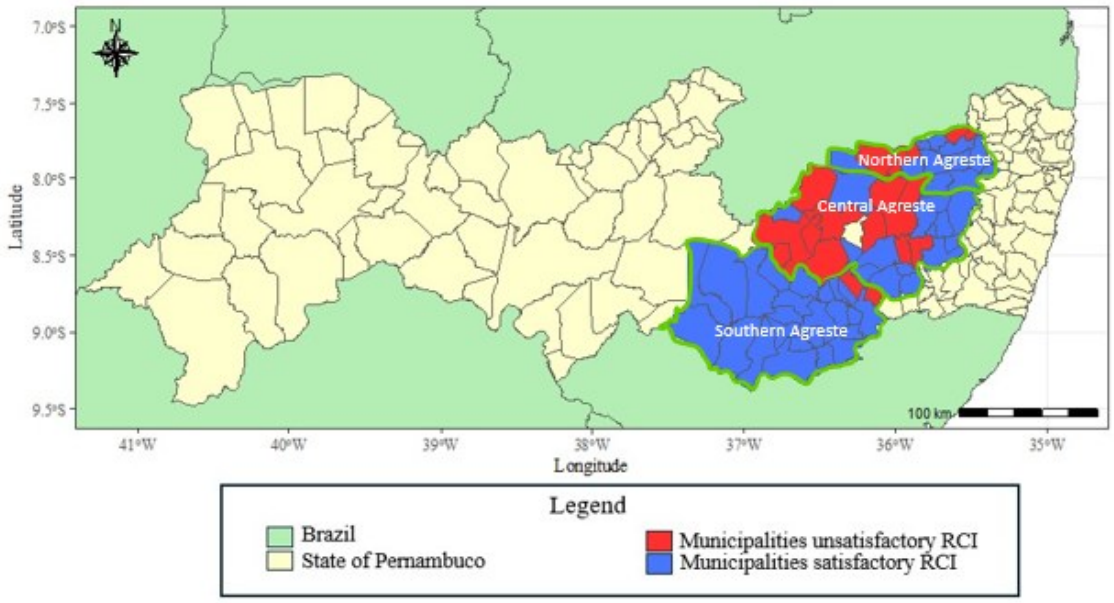

Figure 2 - Classification of the municipalities studied

Source: Brasil (2024) and IBGE (2023) databases. Prepared by the authors (2025).

In Figure 2, the Southern Agreste region is in the most favorable condition, with only two of the 26 municipalities, corresponding to 7.7%, having noncompliant residual chlorine samples. In Northern Agreste, six of the 19 municipalities, corresponding to 31.6%, had noncompliant samples. The most unfavorable situation was observed in Central Agreste, with 11 of its 26 municipalities, corresponding to 42.3%, having noncompliant residual chlorine samples. In other words, in all microregions of the Agreste region of Pernambuco, there are municipalities that do not comply with the requirements of Ministry of Health GM/MS Ordinance No. 888 regarding the minimum residual chlorine level.

For an initial assessment of the distribution of data on relative ADD cases, Figure 3 presents the *boxplots* for the municipalities in the first and second groups, constructed using the R statistical *software* based on the values presented in Tables 1 and 2. Figure 3 allows comparison between the two groups, even before assessing normality, based on the calculated medians. A considerable difference between the medians can be observed: 29.3 cases per thousand inhabitants for the first group and 43.4 cases per thousand inhabitants for the second. In each case, there is a single upper *outlier*. These values may result from overreporting errors or specific circumstances in these municipalities.

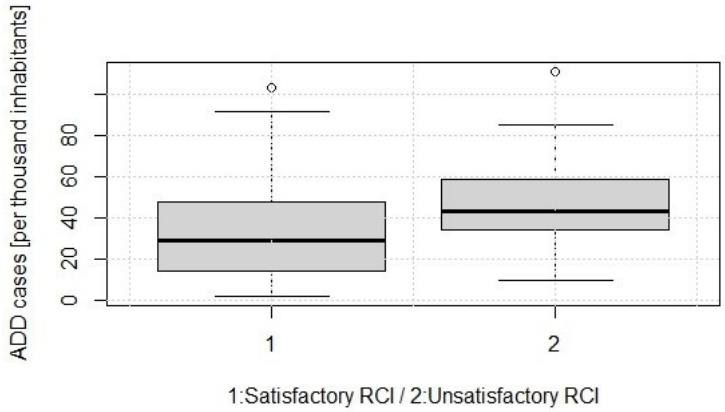

Figure 3 - *Boxplot* with *outliers*

Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors (2025).

The points identified as outliers and removed represent the municipalities of Santa Cruz do Capibaribe, from Table 1, and Jataúba, from Table 2. Calculated without these municipalities, the median was 29.0 cases per thousand inhabitants for the first group and 43.3 cases per thousand inhabitants for the second. These removals do not compromise the analyses intended in this study, which involve comparison between the groups, since the two *outliers* removed are of the same order of magnitude and each represents an upper data point within its respective group.

Table 3 presents the results of the Shapiro–Wilk test, at a 5% significance level, used to assess data normality, which is required for the subsequent application of parametric statistical methods, such as hypothesis testing and correlation analysis. The results are presented for groups 1 and 2, before and after the removal of the outliers.

Table 3 - Shapiro-Wilk test result

Group	**W**	**W_α**	**Result**
1 with outliers	0.935	0.947	Normality rejected
2 with outliers	0.949	0.901	Normality accepted
1 without outliers	0.948	0.947	Normality accepted
2 without outliers	0.989	0.897	Normality accepted

Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors(2025).

Considering the normality of the data, Figure 4 presents the histograms and normal curves for groups 1 and 2. Based on the histograms, for municipalities with ICR values and no samples outside the standard, the highest-density interval is between 5 and 10 cases per thousand inhabitants, whereas for municipalities with ICR values outside the standard, the highest-density interval is between 45 and 50 cases per thousand inhabitants.

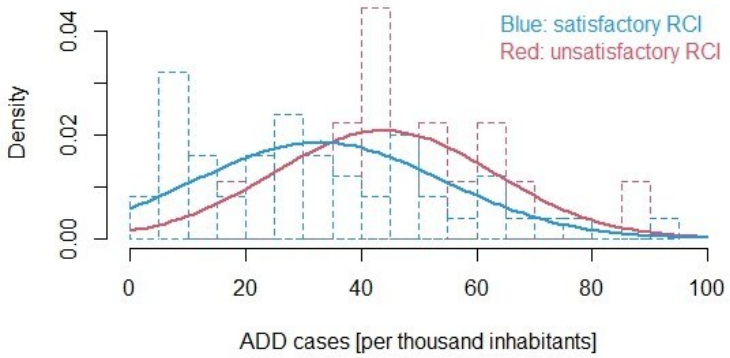

Figure 4 - Histograms and normal curves for the two groups
Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors(2025).

Still in Figure 4, the flattening of the two normal curves, associated with high kurtosis, is related to relatively high standard deviations and, consequently, to less centralized data distributions. In other words, although ADD cases occur more prominently in some municipalities, they significantly affect the vast majority of them.

For the comparison between groups 1 and 2, the hypothesis test yielded a p-value of 0.9764 at a 5% significance level, confirming the null hypothesis. Thus, it can be stated that ADD cases in municipalities with a compliance indicator meeting the requirements of GM/MS Ordinance No. 888 of 2021 in all samples, with a mean of 32.7 and a standard deviation of 21.5 cases per thousand inhabitants, are statistically lower than those in the group of municipalities in which not all samples were compliant, with a mean of 43.9 and a standard deviation of 19.2 cases per thousand inhabitants. In summary, based on the hypothesis test, it was possible to state with 95% confidence that inadequate residual chlorine levels in the water supply system are associated with an increase in ADD cases in the Agreste region of Pernambuco.

The importance of chlorine as a water disinfectant, specifically for the control of ADD, can also be observed in Solomon *et al.* (2020), who, based on research conducted in a rural region of Ethiopia, state that its use can considerably reduce severe episodes of diarrhea, particularly among children under 5 years of age.

Finally, Figure 5 presents the scatter plot of the indicator of residual chlorine samples outside the standard versus relative ADD cases per thousand inhabitants, as well as the linear fit model.

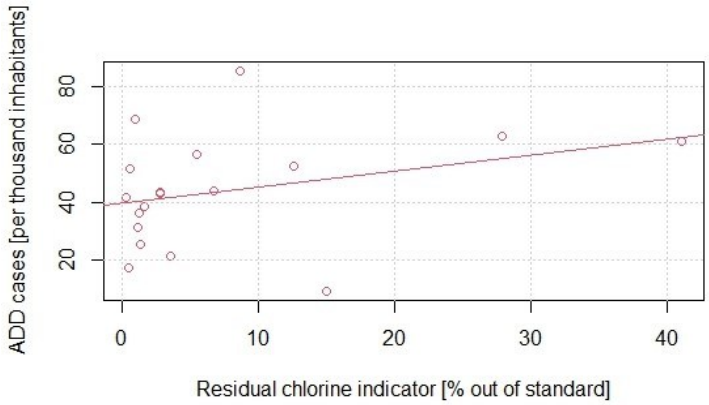

Figure 5 - Scatter plot and correlation
Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors, 2025.

The linear fit model presented in Figure 5 has a slope coefficient of 0.55 and an intercept of 39.83. The positive slope coefficient indicates that the number of samples outside the standard is directly associated with an increase in notifications of relative ADD cases. The degree of correlation was estimated using a correlation coefficient of 0.31, indicating, according to Hopkins (2000), a moderate correlation between the variables. Figure 6 presents the distribution of the residuals from the linear model.

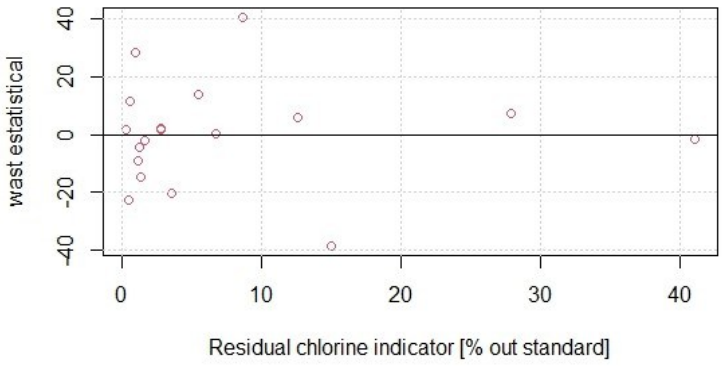

Figure 6 - Distribution of residuals
Sources: Brasil (2024) and IBGE (2023) databases. Prepared by the authors, 2025.

Figure 6 shows a random distribution of residuals around zero, confirming the validity of the linear model presented in Figure 5. Despite the observed correlation, this study did not investigate a cause-and-effect relationship between the indicator of residual chlorine samples outside the standard and relative ADD cases.

The relationship between water supply systems and public health observed in this study is similar to the findings of Ribeiro (2024), who, in a municipality in the state of Maranhão, associates noncompliance with residual chlorine standards with the presence of contaminants, such as total coliforms and *Escherichia coli*, in the water supply. Along the same lines, Monteiro *et al*. (2024), in a qualitative study conducted in the Agreste region of Pernambuco, although not investigating the quality of water supply systems but rather the negative impact of their absence, reached related findings. These researchers state that, although the direct impact of water supply on hospitalizations due to diarrhea cannot be confirmed, the only municipality studied that lacked a water supply system had a higher number of hospitalizations.

Regarding the importance of water supply quality, Richter (2009) states that, among the factors contributing to contamination of water distribution networks in Brazil, cross-connections, in this case with stormwater or wastewater networks, and backflow, which is characterized by the return of water into the distribution network due to negative pressures in the system, are particularly noteworthy. This phenomenon was confirmed by Castro, Cruvinel and Oliveira (2020), who observed a deterioration in water quality during water rationing periods in the Federal District.

According to information from COMPESA (2024), the vast majority of municipalities in Pernambuco, and all municipalities located in the Agreste region, are subject to "water supply schedules" associated with relatively frequent interruptions, making the region extremely susceptible to backflow. Under these conditions, the disinfection strategies employed in water supply systems, which include maintaining a minimum level of residual chlorine, chlorine dioxide, or combined residual chlorine, in accordance with the requirements established by the Ministry of Health through GM/MS Ordinance No. 888, are even more important for supplying water free of contaminants that may compromise public health.

The issues addressed in this study regarding the consequences of inefficient water supply are directly related to the population's water security. According to Nicolas-Artero and Blanco (2024), water insecurity is a problem in the vast majority of Latin American countries and, in the absence of broad and continuous policies, is expected to worsen further as a result of the consequences of climate change.

4. Final considerations

After confirming the normality of the data on ADD cases, the distribution curves of the two groups evaluated showed flattening due to kurtosis and a high standard deviation, indicating that, although ADD cases occur more prominently in some municipalities, they affect the entire study region.

The hypothesis test applied confirms, with 95% confidence, that the group comprising municipalities in which all residual chlorine samples complied with GM/MS Ordinance No. 888 has fewer ADD cases than the municipalities with noncompliant samples. This result reinforces the need for improvements in the water treatment system, particularly in the Central Agreste microregion, where 42.3% of the municipalities have noncompliant residual chlorine samples.

The linear regression fit indicated a positive relationship between the indicator of residual chlorine samples outside the standard and relative ADD cases. However, the linear correlation coefficient demonstrates that this correlation is only moderate. Although this study confirms the relationship between residual chlorine and the incidence of Acute Diarrheal Diseases, it did not investigate cause-and-effect relationships between the variables. Investigations in this regard are suggested for future research.

In semiarid regions, the inevitability of water scarcity ultimately directs most public policies toward the need to achieve universal access to water. However, the results of this study indicate that, in the Agreste region of Pernambuco, water quality is also an essential issue that may limit quality of life. Considering the observed adverse effects on public health, as well as the fact that costs related to the disinfection process account for only a small proportion of the total costs of water supply systems, it is essential and urgent to ensure the potability of the water supplied.

Acknowledgments

The authors thank the University of Pernambuco for the support necessary to conduct this research, as well as the National Council for Scientific and Technological Development (CNPq) for the scholarship awarded to the second author (grant No.177595/2025-6).

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