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MANAGEMENT OF WATER FOR HUMAN CONSUMPTION AND IMPACT ON PUBLIC HEALTH

Fadil Kryeziu*[1,2], Sami Gashi1[1], Violeta Kryeziu[2], Butrin Bytyqi[2], Sejran Abdushi[3]

[1]UBT College.

[2]National Institute of Public Health of Kosova.

[3]Policlinic 'Shëndeti' Prizren.

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***Corresponding Author: Fadil Kryeziu**

UBT College National Institute of Public Health of Kosova.

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Improving access to safe drinking water can result in tangible health benefits. Every effort should be made to achieve the safest possible drinking water quality. Diseases associated with drinking water contamination constitute a major burden on human health. Interventions to improve drinking water quality offer significant health benefits. People at greatest risk for waterborne diseases are infants and young children, people who are debilitated or live in unsanitary conditions, and the elderly. Safe drinking water is suitable for all common household purposes, including personal hygiene. However, higher quality water may be required for some special purposes, such as renal dialysis and cleaning contact lenses, or for certain purposes in food production and pharmaceutical use. People with severely compromised immune systems may need to take additional steps, such as boiling their drinking water, due to their susceptibility to organisms that would not normally be a concern through drinking water.

The Guidelines are intended to support the development and implementation of risk management strategies that will ensure the safety of drinking-water supplies through the control of hazardous water constituents. These strategies may include national or regional standards developed from the scientific basis provided in the Guidelines. The Guidelines describe reasonable minimum requirements for safe practice to protect the health of consumers and/or derive numerical "guideline values" for water constituents or water quality indicators. The guidelines provide a scientific starting point for national authorities to develop drinking water regulations and standards appropriate to the national situation (WHO, 2011).

Water safe for human consumption and domestic use is safe when it is free from pathogenic agents, harmful physical and chemical substances (Cabelli, 1983). Ensuring sufficient quality drinking water is of great importance for public well-being and prosperity (Gunnarsdottir, et al., 2016). The quality of drinking water is one of the biggest factors affecting human health. However, the quality of drinking water in many countries, especially in developing countries, is not desirable and sufficient, and this poor quality has led to many water-borne diseases (Li, 2019).

Approximately 11% of child deaths worldwide are attributed to diarrheal diseases, and of these cases, 88% are caused by unsafe water or inadequate sanitation. Therefore, the quality of drinking water cannot be overlooked when assessing the role of water in public health. The most common diseases that can be transmitted through water are diarrheal diseases such as: *bacillary dysentery, typhoid, paratyphoid, cholera, salmonellosis, colibacillosis, amebiasis, giardiasis, and cryptosporidiosis.* Diarrhea alone kills more children than malaria and tuberculosis combined worldwide. Therefore, water quality is a critical issue for ensuring public health. Since water is closely linked to daily human activities, ensuring safe and clean drinking water is one of the most important public health priorities. Regular monitoring of drinking water for various infectious agents should be implemented, as it will ensure and reduce the incidence of waterborne diseases. (Pal M, 2018)

The purpose of the research is to assess and analyze the importance of managing and monitoring water for human consumption, as a key factor in protecting and promoting public health, showing the importance of the direct connection between the quality of drinking water and the occurrence of various water-related diseases, the impact on the quality of life and economic development.

The objectives are to assess the importance of providing clean and safe drinking water for human life and health. To analyze the impact of polluted/unsafe water on the spread of infectious diseases and other health problems, as well as to assess the role of public institutions in guaranteeing water quality for the population.

METHODS OF STUDY

This study was conducted using a qualitative method, based on data analysis using a retrospective study method. This method is based on the analysis of available data that were provided from official reports and documents of the Regional Center for Public Health in Prizren, respectively from the Human Ecology Division that deals with water quality control.

The collected data were analyzed using comparative and statistical methods. These data include laboratory water analyses and information on the treatment and distribution of water for human consumption, to assess the relationship between water management and water-related morbidity.

The data we have provided has been entered into the system and statistically processed in the SPSS program (Statistical Package for the Social Sciences).

RESULTS END ANALYSIS

For the analysis of the data, some of the data from the report databases for the first six months of 2024 were taken into consideration. The results present the reports of the months of July, August, September, October, November and December, where of these, the months of July, August, September and October have data from the processed and unprocessed report while the months of November and December have data only from the processed reports. Some of the most important parameters were tested such as: pH, Conductivity, Turbidity, Nitrite, Nitrate, Iron, THM, KMNO4 consumption index, E.coli and Enterococcus. The tested units include: mg/l, µg/l, number/100, NTU, µs/cm and x. The analysis included the month and type of processing, the arrhythmic average of all tests as well as the number of suitable and unsuitable tests.

An analysis was performed for each variable for frequency of month, water type, parameter, unit, arrhythmic average, number of suitable tests, and number of unsuitable tests.

Table 1 Frequency analysis of reports across months.

Month of measurement	**Frequency**	**Percent**	**Valid percentage**	**Cumulative percentage**
July	20	20.0%	20.4 %	20.4 %
August	20	20.0%	20.4 %	40.8 %
September	20	20.0%	20.4 %	61.2 %
October	20	20.0%	20.4 %	81.6 %
November	9	9.0 %	9.2 %	90.8 %
December	9	9.0 %	9.2 %	100.0 %
Total	98	98.0 %	100.0 %	

Data missing from the system: 2 cases (2.0%)

From the table we see that from July to October, of the same data that we have analyzed with other months, there are 20 that constitute the majority of the data with 81%. This suggests a decrease in activity in recent months and good coverage at the beginning of the monitoring period. From the database of data for the same measurements from other months, 2 or 2.0% were missing which should be taken into account for the final analysis.

In the table 2 shows a stronger focus on the quality control of water provided for consumption, as the majority of the data (59.2%) relate to treated water. However, meaningful comparisons between the two types are made possible by the significant inclusion of untreated water (40.8%). The two missing data from the database have little effect on the final analyses.

Table 2 Frequency analysis for water type.

Type of water	Frequency	Percent	Valid percentage	Cumulative percentage
Processed	58	58.0 5	59.2 %	59.2 %
Unprocessed	40	40.0%	40.8 %	100.0 %
Totali	98	98.0 %	100.0 %	

Data missing from the system: 2 cases (2.0%)

From the table 3 we see the distribution of measurements based on the parameters under analysis. With the exception of pH (9 measurements), Turbidity (11 measurements) and Enterococcus (only 7 measurements), most metrics had 10 measurements each. This shows that the main water quality measurements are covered in a fairly balanced way. The inclusion of microbiological characteristics (E. coli and Enterococcus) emphasizes the importance of sanitary control and cleanliness. There are three missing cases (3%), which is a low amount of missingness and should not have a major impact on the statistical analysis.

Table 3 Frequency analysis for physical, chemical and microbiological parameters of water.

Parameter name	Frequency	Percent	Valid percentage	Cumulative percentage
pH	9	9.0 %	9.3%	9.3%
Conductivity	10	10.0%	10.3%	19.6%
Turbidity	11	11.0%	11.3%	30.9%
Nitrite	10	10.0%	10.3%	41.2%
Nitrate	10	10.0%	10.3%	51.5%
Iron	10	10.0%	10.3%	61.9%
THM	10	10.0%	10.3%	72.2%
KMNO4 Index	10	10.0%	10.3%	82.5%
E. coli	10	10.0%	10.3%	92.8%
Enterococcus	7	7.05	7.2 %	100.0%
Total	97	97.0%	100.0%	

Data missing from the system: 3 cases (3.0%)

Table 4 Frequency analysis for the unit of measurement.

Unit of measurement	Frequency	Percent	Valid percentage	Cumulative percentage
mg/l	51	51.0%	53.1%	53.1%
µg/l	6	6.0%	6.3%	59.4%
Number 100 ml	10	10.0%	10.4%	69.8%
NTU	9	9.0%	9.4%	79.2%
µs/cm	10	10.0%	10.4%	89.6%
X	10	10.0%	10.4%	100.0%
Totali	96	96.0%	100.0%	

The distribution of measurements based on the units of analysis is presented in Table 4. The most widely used unit for chemical composition in water, mg/l (53.1%) is used to express most of the data. Units such as µg/l were used for heavy metals and number/100ml for microbiological parameters. In addition, turbidity (NTU), pH (x) and conductivity (µs/cm) are all balanced. There are 4 missing data points but these do not affect the validity of the statistical analysis.

DISCUSSION

The results of this study provide an important insight into the quality of water monitored over a six-month period. From the frequency analysis, it is seen that reporting is more complete and concentrated in the months of July-October, while in the months of November and December there is a decrease in monitoring activity. This may be related to seasonal factors or to the water monitoring capacities in this period.

The analysis of the type of water shows that processed water occupies a larger part of the analyses, suggesting a focus of the authorities to guarantee the quality of the water for consumption. Meanwhile, the inclusion of raw water indicates the need for continuous monitoring of this type as well, as a potential source of pollution.

Regarding the measurement parameters, most of them were tested equally, reflecting a comprehensive approach to quality control. The exceptions are some microbiological parameters such as Enterococcus, which have a smaller number of measurements. This may indicate challenges in testing these parameters or low priority in some months.

The analyses included a range of physical, chemical and microbiological indicators, which is in line with international water quality control standards recommended by the World Health Organization. The use of different measurement units according to the nature of the parameters (e.g., mg/l for chemical compounds, number/100 ml for microorganisms) ensured a standardized approach, as recommended in best laboratory practices.

Regarding the arithmetic means of all tests, most of the samples show low values, which suggests that water pollution is generally low. However, high values in some individual samples (e.g., over 200) raise concerns about localized contamination that requires special attention. This is consistent with similar studies in urban areas of developing countries, where poor management of the water supply network or accidental contamination can lead to high concentrations of contaminants.

Statistical analysis of variance shows that the number of suitable tests is significantly higher for treated water compared to raw water, confirming the positive role of water treatment in ensuring water quality. Statistically significant differences between months also suggest that water quality control practices may be influenced by seasonal or operational factors, which should be taken into account in improvement strategies.

The correlations revealed reinforce the above findings: a positive relationship between month and number of appropriate tests suggests possible improvement of monitoring processes over time, while negative relationships between parameters and measurement results indicate that some parameters are more sensitive to pollution.

Overall, the results confirm the importance of continuing comprehensive monitoring and investments in water treatment technology to guarantee safety standards. Despite low pollution values in most cases, high individual cases require specific interventions and emphasize the importance of rapid response to improve water quality.

While in Albania the surface water monitoring network includes monitoring of rivers and lakes, as well as coastal and bathing waters, while groundwater monitoring is carried out in porous Quaternary aquifers in 7 detention basins. Parameters to be monitored include: meteorological and hydrological indicators, pH, O_2, alkalinity, salinity, TOC, nutrients (N, P), heavy metals, and organic compounds, as well as indicators for bathing waters. (Baraj, et al., 2017)

Water quality assessments are the responsibility of the Department of Environmental Protection, and the evidence received by the committee. Some of these water quality problems are mainly related to the proximity of urbanization; others are common to predominantly rural counties. Furthermore, the resolution of water quality issues is influenced by other regional issues, such as transportation, land use, and metropolitan area governance (Dumi, 2012). In the Republic of North Macedonia, water quality is measured through indicators: oxygen-consuming substances in rivers (BOD_5 and total ammonium) and nutrients in freshwater (nitrates, nitrites, and orthophosphates). In North Macedonia, the quality of water streams is of poorer quality downstream of cities, mainly due to the lack of wastewater treatment. Regression analysis shows that there are some differences in the concentrations of the parameters. In the Crna and Vardar rivers, a moderate eutrophic status of the waters was recorded compared to the BOD5 level. These results reflect, above all, the low percentage of urban and industrial wastewater treatment, as well as the inadequate regime for the protection of river basins. (Dimitrovska, et al., 2020)

While Montenegro uses systematic water quality testing for water supply and bathing which must be carried out at water intake or bathing points, following an annual schedule prepared by the Ministry, in accordance with the opinion of the relevant Ministry for Environmental Protection and the relevant Ministry for Health. This testing can only be carried out by an authorized company with a valid contract signed by the owner or user of the water supply or recreational facilities. In addition to the above, for the purpose of using and protecting surface and groundwater, the Law provides for the obligation to follow the quantitative and qualitative parameters of water. These parameters are monitored by the authority responsible for hydrometeorological tasks, according to the annual program established by the government. (Radunovi & Lj, 2008)

CONCLUSIONS

The study showed that the majority of treated water samples met the quality standards, confirming the effectiveness of water treatment in ensuring consumer safety.

However, some raw water samples and some isolated cases of contamination (higher values) indicate the need for further improvement and more rigorous controls.

Statistically significant differences between water type and month of measurement indicate that climatic, seasonal conditions and operating practices affect the quality of the tested water. The correlations found indicate links between parameters and laboratory results, highlighting the importance of continuous and detailed monitoring for each parameter in each sample.

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