Analysis of ground water samples in Polonnaruwa district to identify the possible contributors of CKDu

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Introduction

According to the 2012 census report, the total population of Sri Lanka was 20.3 million and about 85% of them live in rural and peri-urban areas of the country and agriculture is a major component of the economy [1]. Until the Covid 19 become the pandemic issue in the year 2019/2020, the chronic kidney disease of Unknown aetiology (CKDu) was one of the significant medical problems, caught the consideration of Sri Lankan society at all levels. A large and developing number of rural Sri Lankans experience the effects of CKDu since the mid-1990s. Most of the CKDu patients were found in the dry zone of Sri Lanka, where farming is the primary earning for those inhabitants [2,3]. Polonnaruwa, in the north-central province, is one of the important districts, where the CKDu is prevailing significantly, in Sri Lanka.4 Paddy and chena cultivation are common livelihood in these destitution-stricken regions. The paddy farmers always work with pesticides and composts and thus become definitive casualties of CKDu.

Many studies have been conducted to find a possible aetiological cause for the disease and several hypotheses were generated. These include pesticides, fluoride [4,5], heavy metals such as cadmium and arsenic, and hardness of groundwater, but none have brought forth convincing evidence regarding an aetiological factor.

Because of the wide discrepancy of the causes stipulated, the objective of this study was to find any correlation of drinking water quality with no. of cases, prevalence, and trend of CKDu in four divisional secretariat divisions, namely Elahera, Lankapura, Medirigiriya, and Hingurakgoda DS divisions in Polonnruwa district of North Central Province of Sri Lanka, which was the first province in which the disease was identified.

Methodology

Six water samples were collected from each of the Elahera, Lankapura, and Medirigiriya and Hingurakgoda DS divisions of the Polonnaruwa district. Wherever possible, those six samples within a DS Division were collected at six different locations, such as an isolated location, upstream of tank, within a paddy field, a moderate location, a somewhat hilly area, and a downstream of an irrigation channel. The collected samples were analyzed at the national water supply and drainage board laboratory, Polonnaruwa by standard methods. Results were statically analyzed by 2 sample t – test using Minitab 17 software at 95% confidence level. Results of the Elahera (Divisional Secretariat) DS division was taken as the reference due to the relatively no cases among the areas under study. But, 15 patients from Lankapura DS division, 2 patients from Medirigiriya DS division, 1 patient from Hingurakgoda DS division were reported in our study area.

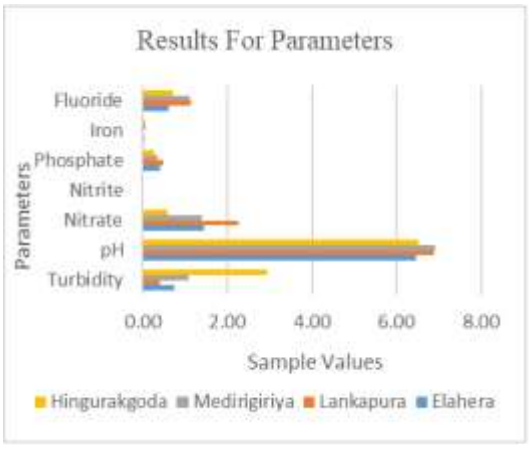
Results and Discussion

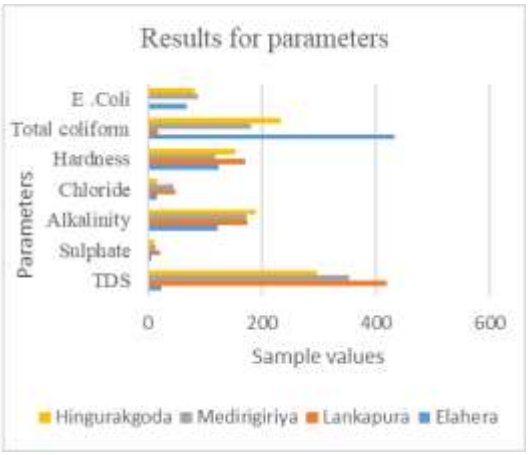
When we compare the data of the Elahera DS division as the reference location, we can see that the values of the sample results are higher in the location of the CKDu patients we have identified. Accordingly, we can see that the number of parameters contained in water has some effect on the CKDu.t-test performed for parameters revealed that these locations show no significant difference.

Table 1. The results for parameters.

Parameters and SI Units	Elahera		Lankapura		Medirigiriya		Hingurakgoda	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
Turbidity (NTU)	0.75	0.91	0.41	0.30	1.09	0.71	2.95	4.03
TDS (mg/l)	22.50	114.30	419.20	220.10	352.80	100.70	295.80	152.60
pH	6.47	0.36	6.88	0.17	6.91	0.50	6.51	0.24
Nitrate(mg/l)	1.46	1.17	2.27	0.85	1.39	1.13	0.59	0.36
Nitrite(mg/l)	0.01	0.00	0.02	0.02	0.02	0.01	0.01	0.01
Sulphate(mg/l)	5.50	4.42	21.80	27.50	13.00	11.95	12.33	12.18
Phosphate (mg/l)	0.40	0.33	0.48	0.72	0.36	0.48	0.27	0.65
Alkalinity (mg/l)	121.70	60.10	175.00	106.50	173.30	78.10	190.00	114.50
Chloride(mg/l)	15.67	6.50	47.67	42.00	43.67	25.20	15.67	21.78
Hardness(mg/l)	125.00	84.10	170.00	66.90	118.30	64.90	153.30	76.10
Iron(mg/l)	0.03	0.03	0.02	0.07	0.06	0.06	0.07	0.02
Fluoride(mg/l)	0.61	0.18	1.15	0.17	1.11	0.16	0.73	0.07
Total coliform	433.00	432.00	17.00	40.80	180.00	238.30	232.00	259.00
E .Coli	68.00	117.00	0.00	0.00	87.00	160.80	82.00	98.10

all parameters were analysed through two-sample t-test by using Minitab 17 software at 95% confidence level**.**





Figures 1 & 2. The results for parameters.

Table 2. *t* and *p* values of the analysed parameters.

Parameters	Elahera – Lankapura			Elahera – Medirigiriya			Elahera – Hingurakgoda		
	t value	*p* value	significant difference	*t* value	*p* value	significant difference	*t* value	*p* value	significant difference
Turbidity	-0.28	0.985	absent	-0.28	0.985	absent	1.81	0.985	Absent
TDS	2.18	0.102	absent	1.44	0.363	absent	0.8	0.767	Absent
pH	2.12	0.114	absent	2.21	0.096	absent	0.24	0.99	Absent
Nitrate	1.38	0.395	absent	-0.12	0.999	absent	-1.5	0.329	Absent
Nitrite	1.58	0.291	absent	0.6	0.879	absent	0.38	0.963	Absent
Phosphate	0.92	0.68	absent	-0.42	0.952	absent	-1.49	0.335	Absent
Iron	-0.23	0.991	absent	1.09	0.573	absent	1.49	0.335	Absent
Fluoride	1.68	0.249	absent	1.55	0.304	absent	0.38	0.965	Absent
Sulphate	1.73	0.229	absent	0.79	0.768	absent	0.72	0.811	Absent
Alkalinity	1.00	0.633	absent	0.97	0.654	absent	1.28	0.452	Absent
Chloride	2.05	0.13	absent	1.8	0.13	absent	1.16	0.53	Absent
Hardness	1.06	0.591	absent	-0.16	0.997	absent	0.67	0.843	Absent
Total coliform	2.58	0.04	present	-1.57	0.297	absent	-1.25	0.47	Absent
E .Coli	-1.07	0.058	absent	0.29	0.984	absent	0.21	0.994	Absent

Conclusion

Although the values of the analytical results seem to be contributing to the no. of cases of CKDu in the study area, the statistical analysis doesn't show any significant relationship between the water quality parameters and CKDu in the areas of our study. This could be due to other factors, such as small sample size, less no. of times repeating the analyses, and/or other causes such as agricultural irrigation water sources, chena cultivation, and food habits, etc.

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