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## The relationship between sodium, potassium, and hypothyroidism in Chronic Kidney Disease (CKD) patients



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### ABSTRACT

**Introduction:** The thyroid hormone itself carries out a variety of metabolic functions including the regulation of lipids, carbohydrates, proteins and electrolytes, and mineral metabolism, which will affect electrolyte balance. The objective of this study was to look at the relationship between sodium and potassium, and hypothyroidism.

**Methods:** A cross-sectional study on subject data were taken retrospectively by looking at medical records of patients treated at Dr. Kariadi Hospital Semarang from 1 June 2017 to 1 June 2018 to see the relationship between serum sodium and potassium, and hypothyroidism.

**Results:** Sodium did not show significant correlation with thyroid-stimulating hormone (TSH) and thyroxine (T4) ( $p = .985$  and  $p = .705$ ). Correlation test between potassium and urea showed a significant relationship ( $p = .005$  and  $r = .441$ ). Likewise, regarding the relationship with creatinine, sodium did not show a significant correlation ( $p = .890$  and  $r = .023$ ), while potassium showed significant correlation ( $p = .003$  and  $r = .466$ ).

**Conclusions:** There was no significant relationship between serum sodium and potassium and thyroid hormone (TSH and T4). There is a significant positive correlation between ureum creatinine and potassium.

**Keywords:** Chronic renal disease, hypothyroid, potassium, sodium

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### INTRODUCTION

Hypothyroidism is an endocrine disease that can cause a variety of clinical situations, including congestive heart failure, electrolyte disorders, and coma. It is a clinical condition that is often found in the general population, which is the manifestation of a lack of thyroid hormone as a result of reduced hormone activity.<sup>1,2</sup> Hypothyroidism is ten times more common in women than men.<sup>3</sup> The thyroid hormone itself carries out a variety of metabolic functions including the regulation of lipids, carbohydrates, proteins and electrolytes, and mineral metabolism.<sup>4</sup>

The effects of thyroid hormone on electrolytes and minerals are not well-known, and the underlying mechanism is not well-understood.<sup>5</sup> Thus, this study was conducted to assess the changes in serum electrolyte levels (sodium, potassium, and chloride) in patients with hypothyroidism. This study aimed to see whether there was a relationship between hypothyroidism and serum levels of electrolytes (sodium, potassium, chloride) in chronic kidney disease patients.

### MATERIAL AND METHODS

This study was a cross-sectional study conducted from July 2018 to September 2018 at Dr. Kariadi

Hospital Semarang. Research data were taken from medical records of patients treated at Dr. Kariadi Hospital Semarang between 1 June 2017 and 1 June 2018. This study was approved by the ethics committee of the medical school of Diponegoro University and Dr. Kariadi Hospital Semarang.

The inclusion criteria of this study were patients in Dr. Kariadi Hospital Semarang who were diagnosed with hypothyroidism. Their sodium, potassium, and chloride were also measured. The exclusion criteria of this study were patients who had undergone chemotherapy or surgical therapy. Patients with complications of other diseases such as cardiovascular disorders were also excluded.

### RESULTS

Of the 67 patients selected by the inclusion and exclusion criteria, the total sample of our study was 40 samples. The normality of data was tested using the Shapiro-Wilk test. The result showed that the data were not normally distributed, as shown in Table 1.

As shown in Table 2, the Spearman's TSH correlation test on sodium and potassium electrolytes resulted in positive correlation but not statistically significant ( $p = .678$ ,  $r = .069$  and  $p = .909$ ,  $r = .019$  respectively). The results of the Spearman's

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**Table 1** Descriptive of TSH, T4, ureum, creatinine, and Shapiro-Wilk data normality test

Variable	Mean $\pm$ SD	Median (min – max)	p
TSH	20.63 $\pm$ 16.37	20 (0.01 – 66.89)	.000
T4	12.26 $\pm$ 13.50	8.9 (2.35 – 73.85)	.000
Ureum	89.26 $\pm$ 56.03	98 (10 – 215)	.028
Creatinine	7.16 $\pm$ 5.51	8.2 (0.5 – 17.8)	.002
Na	138.08 $\pm$ 4.78	137 (130 – 154)	.039
K	5.32 $\pm$ 7.05	4.2 (2.8 – 48)	.000

TSH: Thyroid stimulating hormone; Na: Sodium; K: Potassium; T4: Thyroxine

**Table 2** Test of Spearman's TSH and T4 correlation to Na and K

Variable	TSH / T4	p	r	Explanation
Na	TSH	.678	.069	NS
K	TSH	.909	.019	NS
Na	T4	.705	.063	NS
K	T4	.741	-.055	NS

NS: Not Significant; TSH: Thyroid Stimulating Hormone; Na: Sodium; K: Potassium; T4: Thyroxine

**Table 3** Test of Spearman's ureum and creatinine correlation for Na and K

Variable	Ureum / Creatinine	p	r	Explanation
Na	Ureum	.985	.003	NS
K	Ureum	.005	.441	S, Pos Moderate
Na	Creatinine	.890	.023	NS
K	Creatinine	.003	.466	S, Pos Moderate

NS : Not Significant; Na : Sodium; K : Potassium

T4 correlation test with sodium showed positive correlation but not statistically significant ( $p = .705$ ,  $r = .063$ ). Potassium showed negative correlation with T4 but not statistically significant ( $p = .741$ ,  $r = -.055$ ).

As shown in Table 3, The Spearman's ureum correlation test on sodium showed positive correlation but not statistically significant ( $p = .985$  and  $r = .003$ ). However, the correlation test between potassium and ureum showed positive and significant relationship ( $p = .005$  and  $r = .441$ ). Likewise, regarding the relationship with creatinine, sodium did not show a significant relationship ( $p = .890$  and  $r = .023$ ), while potassium showed positive and significant correlation ( $p = .003$  and  $r = .466$ ).

The results of this study showed an association between ureum and creatinine, and potassium serum levels, but both ureum and creatinine did not show a relationship with serum sodium. TSH and T4 did not have a significant relationship with sodium and potassium.

## DISCUSSION

Hyponatremia is the most common electrolyte abnormality encountered in clinical practice.<sup>6</sup> In

the case of hypothyroidism, serum sodium and potassium are negatively correlated with TSH,<sup>7</sup> but Murgod et al.<sup>1</sup> showed a significant negative correlation between TSH and serum sodium and potassium in hypothyroidism. As thyroid hormones are involved in controlling various metabolisms, the more important functions include the metabolism of lipids and various electrolytes, hypothyroid patients generally suffer from a slow metabolism that results in dyslipidemia and electrolyte disturbances.<sup>8</sup> Hypothyroidism is a very common condition and is seen more in women than in men.<sup>2</sup>

Thyroid hormone regulates sodium pumping activity in most tissues. In hypothyroidism, because of low potassium levels, and because of the lack of thyroid hormone, this enzyme is affected, resulting in the accumulation of water in the cell and causing edema. This is said to be one of the mechanisms responsible for the weight gain seen in hypothyroid patients.<sup>9,10</sup>

## CONCLUSIONS

There was no significant relationship between serum sodium and potassium and thyroid hormone (TSH and T4). There is a significant positive correlation

between ureum creatinine and potassium. Further research with larger sample sizes is needed to elucidate the effect of hypothyroidism on serum sodium and potassium in chronic kidney disease patients.

### CONFLICT OF INTEREST

The authors declare that they don't have any conflict of interest regarding manuscript

### ETHICAL APPROVAL

This study has been approved by the ethics committee of Diponegoro University prior to study was conducted.

### FUNDING

The author is responsible for the study funding without involvement of any grants or sponsorships.

### AUTHOR'S CONTRIBUTION

Indranila Kustarini Samsuria contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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