

# Assessment of Kidney and Thyroid Health After COVID-19 Vaccination Among Healthy Adults in Ibadan, Nigeria

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## Abstract:

### ➤ **Background:**

SARS-CoV-2 vaccines have demonstrated effectiveness in preventing COVID-19 infection. However, concerns persist regarding potential adverse effects on kidney and thyroid health in certain populations. While the overall safety and efficacy of the available vaccines have been established, limited research has documented post-vaccination complications involving the kidneys and thyroid. Currently, such adverse effects are rarely reported in our environment. This study investigates the impact of SARS-CoV-2 vaccination on kidney and thyroid functions among healthy individuals in Ibadan, Oyo State.

### ➤ **Methodology:**

This cross-sectional study was conducted with approval from the Oyo State Ethical Board. The participants included a total of 168 healthy individuals, consisting of 82 who had received the SARS-CoV-2 vaccine and 86 who had not, with ages ranging from 18 to 65 years. Sociodemographic information was collected using a structured questionnaire. Blood samples (10 milliliters) were taken to measure serum levels of thyroid-stimulating hormone, free tri-iodothyronine, thyroxine, urea, creatinine, C-reactive protein (CRP), glycated hemoglobin, and SARS-CoV-2 antibodies, employing standard laboratory procedures. The data were analyzed statistically, revealing no significant differences ( $p > 0.05$ ) between the vaccinated and unvaccinated groups in the mean levels of CRP, glycated hemoglobin, kidney function markers, and thyroid function markers, all of which remained within normal reference ranges.

### ➤ **Results:**

Both groups exhibited values within normal reference ranges. There were no statistically significant differences in markers of kidney or thyroid function ( $p > 0.05$ ). C-reactive protein (CRP) levels were lower among vaccinated participants ( $0.7 \pm 0.8$  mg/L) compared to controls ( $1.4 \pm 1.7$  mg/L), although this difference was not statistically significant. Cystatin-C concentrations were slightly higher in the vaccinated group ( $0.8 \pm 0.2$  mg/dL) than in controls ( $0.7 \pm 0.2$  mg/dL). Prevalence assessments showed only a small percentage (1.2%) with mild elevations in CRP, FT4, or TSH.

### ➤ **Conclusion:**

COVID-19 vaccination did not adversely affect renal or thyroid function in apparently healthy individuals. Minor deviations were rare and clinically insignificant, reinforcing vaccine safety.

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### I. INTRODUCTION

The emergence of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in late 2019 rapidly escalated into a global pandemic, prompting an unprecedented effort in vaccine development and deployment<sup>1</sup>. Vaccination against SARS-CoV-2 has consistently been shown to reduce disease severity, hospitalizations, and mortality worldwide, with systematic reviews confirming its broad efficacy across populations<sup>2</sup>. The human body's renal and thyroid systems play critical roles in maintaining overall health and homeostasis. The kidneys play a crucial role in filtering waste, controlling blood pressure, and maintaining electrolyte balance. Meanwhile, the thyroid gland produces hormones vital for metabolism, growth, and development. Since vaccination can trigger a systemic immune response, it is important to understand any possible impacts on these essential organs, especially within diverse populations, to safeguard public health<sup>3</sup>.

Isolated reports have described acute kidney injury (AKI), glomerulonephritis, and subacute thyroiditis (SAT) following immunization<sup>4-5</sup>. These findings have prompted concerns about possible autoimmune or inflammatory mechanisms triggered by vaccination. Earlier studies have shown that mRNA vaccines, particularly Pfizer-BioNTech, were the most widely used globally and considered safer compared to other vaccine platforms following emergency use authorization by the U.S. Food and Drug Administration<sup>6</sup>. Nonetheless, rare cases of renal dysfunction have been reported, including IgA nephropathy and minimal change disease (MCD) after vaccination<sup>2,7</sup>.

Similarly, thyroid dysfunction, particularly SAT, has been documented in case reports following SARS-CoV-2 vaccination<sup>5,8-10</sup>. Proposed mechanisms include molecular mimicry between viral proteins and thyroid antigens<sup>11</sup>, bystander activation of autoreactive T cells<sup>12</sup>, and immune modulation by vaccine adjuvants<sup>13</sup>.

Despite these reports, the incidence of renal and thyroid complications remains extremely low relative to the billions of vaccine doses administered worldwide<sup>14</sup>. Large-scale evidence is limited, and most reported cases involve

individuals with pre-existing conditions or genetic predispositions.

This study aims to investigate the potential effects of SARS-CoV-2 vaccination on renal and thyroid functions in an apparently healthy population in Ibadan, Nigeria. By assessing key biochemical markers before and after vaccination, this research seeks to contribute to a more comprehensive understanding of vaccine safety profiles and provide valuable data relevant to public health strategies in Nigeria and potentially other African populations.

### II. METHODOLOGY

#### ➤ Study Design and Population

A cross-sectional study was conducted among 168 apparently healthy participants recruited from Ibadan, Nigeria. Cases (n = 82) were vaccinated individuals, while controls (n = 86) were unvaccinated.

#### ➤ Data Collection

Socio-demographic data, anthropometric measurements, and blood pressure were recorded. Venous blood samples were collected for biochemical analysis.

#### ➤ Laboratory Analysis

Renal function markers (sodium, potassium, chloride, bicarbonate, urea, creatinine), predictive marker (cystatin-C), thyroid function markers (FT3, FT4, TSH), and inflammatory marker (CRP) were measured using standard laboratory techniques.

#### ➤ Statistical Analysis

Results were expressed as mean ± SD. Independent t-tests were used to compare cases and controls. A p-value < 0.05 was considered statistically significant.

### III. RESULTS

A total of 284 healthy individuals participated in this study. Among them, 139 (males and females), who had received a vaccine within the past eight months, were categorized as Cases. The remaining 145 unvaccinated individuals served as Controls. The demographic details of the participants are summarized in Table 1.

Table 1 The Biodata and Socio Demographic Characteristics of Cases and Control

Variables	Cases = n (%)	Control = n (%)
<b>Age Group (years)</b>		
19-25	19 (23.1)	18 (20.9)
26-40	33 (40.2)	52 (60.5)
41-60	30 (36.6)	16 (15.0)
<b>Sex</b>		
Female	33 (40.2)	28 (32.6)
Male	49 (59.8)	58 (67.4)
<b>Place Of Residence</b>		
Ibadan North	74 (90.1)	55 (64.0)
Oluyole	4 (4.4)	29 (23.3)
South East	4 (5.5)	11 (12.7)
<b>Marital Status</b>		
Divorcee	1 (1.1)	3 (4.4)

Married	44 (53.8)	60 (69.8)
Single	37 (45.1)	23 (26.7)
Vaccination		Unvaccinated
Astrazeneca	10 (11.0)	
Pfizer	30 (33.0)	
Moderna	3 (3.3)	
Combined	48 (52.7)	
BMI (kg/m <sup>2</sup> )		
<18.5	3 (3.5)	3 (3.5)
18.6-24.9	51 (59.3)	51 (59.3)
25-29.9	27 (31.4)	27 (31.4)
>30.0		5 (5.8)

n- Number of occurrence or frequency, %- percentage frequency, BMI- Vaccinated apparently healthy participants.

Table 2 presents the mean ± SD of anthropometric measurements and blood pressure for both cases and controls. The mean blood pressure was 124.5/80.3 mmHg in cases and

124.6/80.4 mmHg in controls, while the mean BMI was 23.8 kg/m<sup>2</sup> and 24.0 kg/m<sup>2</sup>, respectively. Overall, both BP and BMI values in cases and controls fall within the reference ranges of 90/60–<130/80 mmHg for blood pressure and 18.5–24.9 kg/m<sup>2</sup> for BMI.

Table 2 The Anthropometric Measurements and Blood Pressure of Cases

Variables	Case - Mean ± SD	Case - Mean ± SD
Blood Pressure		
Systolic BP (mmHg)	124.5 ± 6.9	124.5 ± 7.9
Diastolic (mmHg)	80.3 ± 7.9	80.4 ± 9.4
Weight (Kg)	68.6 ± 9.4	68.6 ± 9.7
Height (cm)	169 ± 7.1	169.2 ± 7.0
BMI (Kg/m <sup>2</sup> )	24.0 ± 3.6	23.8 ± 3.2
HBA1C (%)	5.0 ± 0.4	5.2 ± 0.5

S.D- Standard Deviation, BMI- Body mass index, BP- Blood pressure, HBA1C- Glycated hemoglobin. The results are expressed as Mean ± SD.

➤ *Baseline Renal and Thyroid Function and Inflammatory Marker*

Tables 3 and 4 presented the mean ± SD for renal function parameters (electrolytes, urea, creatinine, cystatin C), thyroid function tests (FT3, FT4, TSH), and the inflammatory marker C-Reactive Protein (CRP) for both the cases and controls. All these parameters were consistently found to be within their respective normal reference ranges for both groups, indicating a healthy baseline status.

Specifically, mean sodium levels for cases and controls were 139.5 and 139.2 mmol/L, respectively (reference: 135-145 mmol/L). Potassium values were 4.0 and 3.9 mmol/L (reference: 3.5-5.0 mmol/L), and chloride results were 101.6 and 101.2 mmol/L (reference: 95-110 mmol/L). Bicarbonate values for all participants were within the expected range of 20-30 mmol/L. These electrolyte levels confirmed adequate

renal function concerning electrolyte exchange in both groups.

Mean urea (19.9 mg/dL for both groups) and creatinine (0.8 mg/dL for both groups) were within the reference values (urea: 15-45 mg/dL; creatinine: 0.5-1.5 mg/dL). The mean cystatin C, a predictive marker for renal function, was 0.8 and 0.7 mg/dL for cases and controls respectively (reference: 0.6-1.2 mg/dL). The normal levels of these markers, particularly cystatin C, indicated the absence of any renal dysfunction in either group at baseline.

Regarding thyroid function, mean values for FT3, FT4, and TSH were all within the reference ranges for healthy individuals (Table 4.6), confirming that neither the cases nor the controls presented with any form of thyroid dysfunction such as hypothyroidism, hyperthyroidism, sub-acute thyroiditis, or sub-clinical thyrotoxicosis. Furthermore, mean CRP values for both groups were within the normal range for apparently healthy individuals, suggesting no significant inflammatory reactions at baseline.

Table 3 The Renal Function Markers and Predictive Marker of Renal Dysfunction in Cases and Controls.

Variables	Cases (n= 82) Mean ± (SD)	Controls (n= 86) Mean ± (SD)
Renal Function Markers		
Sodium (mmol/L)	139.5 ± 2.0	139.2 ± 2.6
Potassium (mmol/L)	4.0 ± 0.2	3.9 ± 0.2
Chloride (mmol/L)	101.6 ± 2.9	101.2 ± 3.6
Bicarbonate (mmol/L)	24.0 ± 3.0	23.9 ± 1.7
Urea (mg/dL)	19.9 ± 6.5	19.9 ± 5.8

Creatinine (mg/dL)	0.8 ± 0.2	0.8 ± 0.2
Predictive Marker		
Cystatin C (mg/dL)	0.8 ± 0.2	0.7 ± 0.2

Values are in Mean ± SD, SD- standard deviation, Cases- Vaccinated apparently healthy participants, Controls- Unvaccinated apparently healthy participants. The results are expressed as Mean ± SD.

Table 4 Thyroid Function and Inflammatory Markers in Cases and Controls

Variables	Cases (n=82) Mean ± (SD)	Controls (n=86) Mean ± (SD)
Thyroid Function Markers		
FT3 (Free triiodothyronine) pmol/L	3.9 ± 0.5	3.8 ± 0.4
FT4 (Thyronine) pmol/L	14.5 ± 2.5	15.1 ± 2.9
TSH (Thyroid stimulating Hormone) pmol/L	1.6 ± 0.9	1.5 ± 0.9
Inflammatory Marker		
C-Reactive Protein (mg/L)	0.7 ± 0.8	1.4 ± 1.7

Values are in Mean ± SD, SD- standard deviation, Cases- Vaccinated apparently healthy participants, Controls- Unvaccinated apparently healthy participants. The results are expressed as Mean ± SD.

➤ *Comparison of Renal, Thyroid, and Inflammatory Markers Between Cases and Controls*

Table 5 detailed the statistical comparison of the mean values of renal function, thyroid function, and inflammatory

markers between the case (vaccinated) and control (unvaccinated) groups. No statistically significant differences were observed in any of these parameters between the two groups (p > 0.05). These findings indicate that the renal and thyroid function parameters, as well as inflammatory markers, were similar and comparable between the vaccinated and unvaccinated populations.

Table 5 Comparison of Inflammatory Markers, Renal and Thyroid Function Test Between the Cases and Controls

Markers	Cases (n=82) Mean (SD)	Control (n= 80) Mean (SD)	t- value	P-value
Inflammatory Marker				
C- Reactive Protein (mg/dL)	0.7 (0.8)	1.4 (1.7)	-1.6	0.1
Renal Function Markers				
Sodium (mmol/L)	139.5 (2.0)	139 (2.6)	0.7	0.5
Potassium (mmol/L)	4.0 (0.2)	3.9 (0.2)	0.5	0.6
Chloride (mmol/L)	101.6 (2.9)	101.2 (3.6)	0.7	0.5
Bicarbonate (mmol/L)	24.0 (3.0)	23.9 (1.7)	0.4	0.7
Urea (mg/dL)	19.9 (6.5)	19.9 (5.8)	0.1	0.9
Creatinine (mg/dL)	0.8 (0.2)	0.8 (0.2)	1.6	0.1
Predictive markers				
Cystatin-C (mg/dL)	0.8 (0.2)	0.7 (0.2)	0.4	0.7
Thyroid Function Markers				
FT3 (pmol/L)	3.9 (0.5)	3.8 (0.4)	1.7	0.1
FT4 (pmol/L)	14.5 (2.5)	15.1 (2.9)	-1.3	0.2
TSH (pmol/L)	1.6 (0.9)	1.5 (1.0)	0.6	0.5

Values are in mean, p<0.05 is considered statistically significant, \*- significance, p- probability, FT3- triiodothyronine, FT4- thyroxine, TSH- thyroid stimulating

hormone, Cases- Vaccinated participants, Controls- Unvaccinated apparently healthy participants. The results are expressed as Mean ± SD.

Table 6 Prevalence of Renal Dysfunction in Cases

Markers	Caese (n=82) Mean ± SD	Reference Range	Number Low	Number Normal	Number Elevated	Percentage of Population with Elevated level
Sodium (mmol/L)	139.2 ± 2.6	135-145	3	79	0	0
Potassium (mmol/L)	4.0 ± 0.2	3.5-5.0	3	79	0	0
Chloride (mmol/L)	101.6 ± 2.9	95-110	3	79	0	0
Bicarbonate (mmol/)	24.0 ± 3.0	20-30	0	82	0	0
Urea (mg/dl)	19.9 ± 6.5	15-45	36	46	0	0
Creatinine (mg/dl)	0.8 ± 0.2	0.5-1.5	6	76	0	0
Cystatin-C mg/L)	0.7 ± 0.2	0.6-1.5	11	71	0	0

Values are in Mean ± SD, SD- standard deviation, Cases- Vaccinated apparently healthy participants, Controls- Unvaccinated apparently healthy participants.

➤ *Prevalence of Elevated Markers in Cases*

An analysis of the percentage of cases with elevated levels compared to reference values (Table 6) revealed minimal instances of slight elevation. Only one unvaccinated participant (1.2% of the cases) exhibited slightly elevated levels of FT4, TSH, and CRP. The total prevalence of these minimally elevated inflammatory and thyroid markers among

cases was 3.6%. It is important to note that these elevations were not statistically significant and were clinically minor.

Table 7 specifically presented the percentage of cases with elevated kidney function and predictive kidney injury markers. This analysis showed that none of the kidney function or injury markers were elevated in the cases; all parameters remained well within their respective reference values. This finding strongly suggests adequate renal function in the vaccinated individuals.

Table 7 Prevalence of Inflammation and Thyroid Dysfunction in Cases

Markers	Caese (n=82) Mean ± SD	Reference Range	Number Low	Number Normal	Number Elevated	Percentage of Population with Elevated level
Inflammatory Markers						
C- Reactive Protein (mg/L)	0.7 ± 0.8	<5.0	0	81	1	1.2
Thyroid Function Markers						
FT3 (pmol/L)	3.9 ± 0.5	3.35- 5.15	10	72	0	0
FT4 (pmol/L)	14.5 ± 2.5	10.6 – 21.0	0	81	1.2	1.2
TSH (pmol/L)	1.6 ± 0.9	0.38 – 4.31	0	81	1.2	1.2

Values are in Mean ± SD, SD- standard deviation, Cases- Vaccinated apparently healthy participants, Controls- Unvaccinated apparently healthy participants, FT3- triiodothyronine, FT4- thyroxine, TSH- thyroid stimulating hormone.

**IV. DISCUSSION**

The stability of renal function markers post-vaccination is a particularly reassuring finding. We observed that key electrolytes (sodium, potassium, bicarbonate, chloride), along with urea and creatinine, remained well within normal physiological ranges in both vaccinated cases and unvaccinated controls. Crucially, cystatin C levels, recognized as a more sensitive indicator of early renal dysfunction than traditional markers, also showed no significant alterations<sup>15</sup>. This robust evidence suggests that SARS-CoV-2 vaccination is not associated with kidney injury or compromise in apparently healthy individuals. This aligns with a growing body of literature that has largely reported no significant impact of COVID-19 vaccination on renal function in healthy populations or even in patients with pre-existing kidney disease<sup>16</sup>. While SARS-CoV-2 infection has been linked to acute kidney injury in severe cases, our findings reinforce the distinction that the vaccine, designed to elicit an immune response without causing full-blown disease, does not similarly impact kidney health<sup>17</sup>.

Similarly, our analysis of thyroid function parameters (FT3, FT4, and TSH) revealed no statistically significant differences between the vaccinated and unvaccinated groups, with all values remaining within healthy reference ranges. This indicates that SARS-CoV-2 vaccination does not appear to trigger thyroid dysfunction, such as hypothyroidism, hyperthyroidism, or sub-acute thyroiditis, in healthy

individuals<sup>10</sup>. This is significant because, like kidneys, the thyroid gland can be affected by the inflammatory processes associated with SARS-CoV-2 infection<sup>18</sup>. Some case reports have described transient thyroiditis post-vaccination, though these are rare occurrences and often self-limiting. Our larger study in an apparently healthy population suggests that such events are not a widespread consequence of vaccination and that overall thyroid homeostasis is maintained<sup>19</sup>. The minimal, non-significant elevations in FT4, TSH, and CRP observed in a very small percentage of unvaccinated participants further emphasize that any minor fluctuations are likely unrelated to vaccination and fall within normal biological variability or other transient causes.

The absence of statistically significant differences in inflammatory markers (CRP) between cases and controls also supports the benign impact of vaccination on these organ systems. While vaccines are designed to provoke a transient inflammatory immune response, our data suggest that this response does not translate into systemic inflammation severe enough to clinically impair renal or thyroid function in the healthy population. This underscores the safety and specificity of the vaccine-induced immune response.

This study's focus on an apparently healthy population in Ibadan, Nigeria, provides valuable regional context. Data from diverse populations are essential to ensure the generalizability of vaccine safety findings. Our results contribute to the global understanding of SARS-CoV-2 vaccine safety, particularly in a sub-Saharan African setting where demographic and genetic factors, as well as prevailing health conditions, might differ from other populations studied.

## V. CONCLUSION

This study provides compelling evidence that COVID-19 vaccination does not adversely affect renal or thyroid function in apparently healthy adults. Across all measured biochemical parameters—including electrolytes, urea, creatinine, cystatin C, FT3, FT4, TSH, and CRP—values remained within normal reference ranges, with no statistically significant differences between vaccinated and unvaccinated groups. Minor fluctuations observed in a small subset of participants were clinically insignificant and likely attributable to normal biological variability rather than vaccination. Overall, these findings offer reassurance that COVID-19 vaccination is safe concerning thyroid and kidney health, with no meaningful risk to renal or thyroid health in the studied population. Continued surveillance and larger longitudinal studies will be valuable to further confirm these findings and monitor potential effects in individuals with pre-existing conditions.

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