

Seroprevalence of Epstein-Barr Virus Antibodies and Complement C3/C4 Levels in Immunocompromised (Malignant Tumors and Organ Transplant Recipients) Patients

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Article Info

Article history:

Received: 15, 05, 2025

Revised: 17, 08, 2025

Accepted: 05, 09, 2025

Published: 30, 09, 2025

Keywords:

EBV IgG,
EBV IgM,
Complement C3/C4,
Tumors,
Organ Transplant

ABSTRACT

This cross-sectional study (4 Oct 2024–5Mar 2025) assessed Epstein-Barr virus (EBV) seroprevalence and complement activity in 100 immunocompromised patients (80 cancers and 20 kidney transplant) versus 50 healthy blood donors at Baqubah Teaching Hospital. Serum IgG/IgM antibodies were quantified by ELISA, alongside hematologic indices and complement components C3 and C4. EBV exposure was substantially higher in the patient group: 17% were IgG-positive and 4% IgM-positive, compared with only 3% IgG-positivity and 0% IgM-positivity in controls, underscoring greater past and recent infection in immunocompromised hosts. Hematologic profiles reflected this vulnerability. Patients exhibited significantly lower haemoglobin (11.57 ± 0.19 g/dL vs. 12.75 ± 0.16 g/dL; $p = 0.001$) and lymphocyte counts ($1.54 \pm 0.07 \times 10^3 \mu\text{L}^{-1}$ vs. $1.89 \pm 0.13 \times 10^3 \mu\text{L}^{-1}$; $p = 0.02$), alongside markedly depressed total white blood cell counts ($4.90 \pm 0.18 \times 10^3 \mu\text{L}^{-1}$ vs. $9.90 \pm 0.29 \times 10^3 \mu\text{L}^{-1}$; $p = 0.001$). Red blood cell counts were paradoxically higher in patients ($4.11 \pm 0.10 \times 10^6 \mu\text{L}^{-1}$ vs. $3.65 \pm 0.10 \times 10^6 \mu\text{L}^{-1}$; $p = 0.001$), while platelet numbers did not differ. Complement analysis revealed a pronounced rise in C3 among patients (116.68 ± 2.17 mg/dL) relative to controls (91.26 ± 3.63 mg/dL; $p = 0.001$), suggesting enhanced innate immune activation; C4 levels remained comparable (31.46 ± 0.89 mg/dL vs. 31.27 ± 1.11 mg/dL; $p = 0.801$). In conclusion, the data highlight a significantly greater EBV burden in tumour and transplant recipients, accompanied by characteristic shifts in blood counts and elevated C3.

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1. INTRODUCTION

The Epstein-Barr virus (EBV), also known as human herpesvirus 4 (HHV-4), belongs to the family of γ -herpesviruses. This virus has made history by being the first known human tumorigenic virus. Up to 95% of the world's adult population is infected with this highly efficient virus, which causes asymptomatic infection of the B-lymphocyte reservoir throughout life [1-3]. A large percentage of the population naturally has an EBV infection [2, 4]. Infectious mononucleosis (IM) [2, 5], immune dysfunction disorders (MS) [6], systemic autoimmune diseases (SADs) [7], a number of malignancies (haematological malignancies, epithelial cancers) [8], and EBV-associated hemophagocytic lymphohistiocytosis (EBVHLH) are among the many diseases that have been linked to it by research [3]. A gammaherpesvirus, Epstein-Barr virus (EBV)

has a genome that encodes approximately 85 genes and is linear and double-stranded in nature, with a size ranging from 170 to 185 kilobases.

Internal repeat sequences divide the EBV genome into long and short domains encoding proteins, and a series of 0.5-kb terminal direct repeats at both ends of the genome complete the organisation [9]. A viral membrane derived from the host membrane encases 162 capsomeres in the nucleocapsid of EBV. The term "tegument" describes the area that lies between the envelope and the nucleocapsid. The spike-like projections are made by surface glycoproteins found in the outer membrane [10], [11]. Since infected epithelial cells are normally transported by saliva, the mouth is the principal site of EBV transmission [12]. Additionally, it can disseminate via the bloodstream, through blood transfusions and organ transplants [13][14][15][16]. Infected epithelial cells may also be present in the uterine cervix or semen, indicating the potential for EBV transmission via sexual contact [12]. You can spread EBV more easily if you kiss, share intimate things like toothbrushes or tools for eating, or eat or drink from someone who is sick.

Upon entering host cells, EBV fuses its envelope with their membranes, allowing the virus to penetrate epithelial cells and lymphocytes via the interaction of viral glycoproteins with cellular receptors. The circular viral genome is formed after entry when the terminal direct repeats at both ends of the linear DNA fuse, resulting in a transformation from a linear genome [17]. The EBV genome is maintained as an extrachromosomal episome within the replicated cell [18]. In situ hybridisation (ISH) of Epstein-Barr virus-encoded RNA (EBER) in biopsy specimens is the preferred method for detecting Epstein-Barr virus. Techniques like heterogeneous antibody testing, fluorescence immunoassays, enzyme immunoassays, Western blot assays, and polymerase chain reaction (PCR) are employed to identify Epstein-Barr virus in many sample types [18]. ELISA is an immunological biochemical assay used to detect and measure antibodies, antigens, peptides, proteins, glycoproteins, and hormones in biological samples. [19, 20] The method is based on the principle of detecting the antigen-antibody interaction and the enzymatic activity linked to the antibodies. [19, 21] In the ELISA test, the antigen or antibody being targeted adheres to plastic surfaces, referred to as the 'sorbent.' The antigen recognized by the specific antibody (such as the immunoglobulin (Ig) G fraction of serum or monoclonal antibodies) is called the 'immunogen.' When this antibody binds to a second antibody (also 'immuno'), it becomes 'enzyme linked.' The enzyme then reacts with a substrate, producing a measurable coloured product. [19], [21],[22].

Both of the adaptive and innate immune systems rely on the complement system. A complex regulatory mechanism governs the presence of complement, which comprises around 30 different protein types and is ubiquitous in serum, tissue fluids, and membranes of cell interfaces. The innate immune response system relies on it to activate through three separate pathways: the classical, lectin, and alternative pathways. C3 is pivotal in tumour occurrence, progression, and the immune response to it. The dysregulation of the complement system may significantly influence the initiation and progression of tumours [23]. Prior studies indicate that varying concentrations of C3a may exert distinct effects on tumour cells, implying that complement C3 could be significant in tumorigenesis and may be concentration-dependent [24]. Currently, only a limited number of clinical investigations highlight the functional significance of complement resistance in tumour cell survival and disease development [25]. Therefore, this study aims to assess the seroprevalence of Epstein-Barr virus (EBV) antibodies (IgM and IgG) and to measure the levels of complement proteins C3 and C4 in immunocompromised patients, specifically those with cancer and kidney transplants, compared to healthy controls.

2. Experimental Methodology

2.1 Study design and patient selection

The present study employed an observational cross-sectional design, conducted during a period spanning from 4th October 2024 to 5th March 2025. Each case provided a thorough medical history, which included demographic data such as name, age, and gender. One hundred and fifty individuals from Iraq, divided into two groups: patients and controls. The patient group comprised 100 immunocompromised individual, including 80 patients diagnosed with various malignant Tumors (breast carcinoma, Lung carcinoma ,colorectal carcinoma, lymphoma, ovarian carcinoma, Rectal carcinoma , soft tissue sarcoma ,melanoma, pancreatic adenocarcinoma ,gastric carcinoma, urothelial carcinoma osteosarcoma, pharyngeal carcinoma, small intestinal adenocarcinoma, testicular cancer, cholangiocarcinoma, hepatocellular carcinoma, and brain cancer) who were undergoing chemotherapy, radiation, or both. Additionally, there were 20 kidney transplant recipient. The control group consisted of 50 healthy individuals. Samples were collected from the Ibn Sina Dialysis Centre, the Oncology Centre, and the main blood bank/Baqubah Teaching Hospital.

The study was conducted by the Virus Laboratory, which is part of the Educational Laboratories Division at Baqubah Teaching Hospital. Individuals who had other chronic debilitating diseases or chronic disorders or were pregnant were excluded from the study.

2.2 Blood collection and preparation

Five ml of venous blood was collected from each participant and prepared. Blood was placed in gel tubes and allowed to clot at room temperature (20–25°C) for 15 minutes. The clotted blood was then centrifuged for ten minutes at 3,000 rpm to obtain serum samples. Serum samples were divided between the study groups in Eppendorf tubes and stored at -20°C until needed for Epstein-Barr virus (EBV) ELISA diagnostic testing.

2.3 Measurement of complement proteins (C3, C4)

The serum levels of the complement components C3 and C4 were measured by radial immunodiffusion (RID) [26, 27].

2.4 Measurement of Immunoglobulin M (IgM) and Immunoglobulin G (IgG)

Detection of human EBV antibodies (IgM, IgG) by ELISA procedure according to SUNLONG Company (china) and on principle of Sandwich-ELISA method as well as the analytical procedure.

2.5 Ethical approval

The study was carried out by the ethical principles outlined in the Declaration of Helsinki. The study was performed following the acquisition of both verbal and written consent from the patients before collecting the samples, this case-control study was approved by the University of Diyala, as well as the study was approved by the Ministry of Health and Environment of Iraq 38216 in dated 17/09/2024.

2.6 Statistical analysis

The data was analysed using version 26 of the Statistical Package for Social Sciences (SPSS) software. Mean $\pm$ standard error (M $\pm$ SE) was the way the data was presented. To determine if immuno-compromised individuals with healthy controls differed significantly on study parameters, an independent-samples T test was used. Any changes with a p-value less than 0.05 were considered statistically significance.

3. RESULTS AND DISCUSSION

3.1 Demographic characteristics of study groups

The study included 100 immunocompromised patients and 50 healthy controls. Among the patient group, 36% were male and 64% were female, with mean ages of 54.30 ± 2.91 years and 55.37 ± 1.77 years, respectively ($p = 0.74$). The overall mean age of the patient group was 54.99 ± 1.53 years (95% CI: 51.89–57.99). In the control group, 86% were male and 14% were female, with mean ages of 32.44 ± 1.85 years for males and 23.71 ± 2.44 years for females ($p = 0.71$). The overall mean age of controls was 31.22 ± 1.68 years (95% CI: 28.11–34.54). The difference in mean age between patients and controls was statistically significant ($p = 0.001$) (Table 1).

Table 1: Demographic Characteristics of the Patient and healthy control Groups.

Group		Gender	No. (%)	*(Mean ± SE)	95% *CI for Mean Age	P-value (Male Vs. Female)	P-value (Patients Vs. controls)	
Age Gender	Patients	Male	36 (36%)	54.30±2.91	51.89–57.98	0.74	0.001	
		Female	64 (64%)	55.37±1.77				
		Total	100 (100%)	54.990±1.53				
	Controls	Male	43 (86%)	32.44±1.85	28.11–34.54	0.71		
		Female	7 (14%)	23.71±2.44				
		Total	50 (100%)	31.22±1.68				
P value < 0.05 * Values are expressed as mean ± standard error (SE) * %95 Confidence Intervals				* Independent-samples T test				

3.2 Distribution of Cancer and Kidney Transplant Cases in the Study Population

This study reports the distribution of cancer types and kidney transplant cases among the study participants. The most common malignancy was breast carcinoma, observed in 42% of patients ($n=42$). Kidney transplant recipients comprised 20% of the study population ($n=20$). Lung carcinoma was diagnosed in 5% ($n=5$), while colorectal carcinoma, lymphoma, and ovarian carcinoma each accounted for 4% ($n=4$) of cases. Rectal carcinoma and soft tissue sarcoma were identified in 3% ($n=3$) of patients. Other malignancies, including melanoma, pancreatic adenocarcinoma, gastric carcinoma, and urothelial carcinoma, were each observed in 2% ($n=2$). Less frequent cancers—each representing 1% ($n=1$)—included osteosarcoma, pharyngeal carcinoma, small intestinal adenocarcinoma, testicular cancer, cholangiocarcinoma, hepatocellular carcinoma, and brain cancer (Fig. 1).

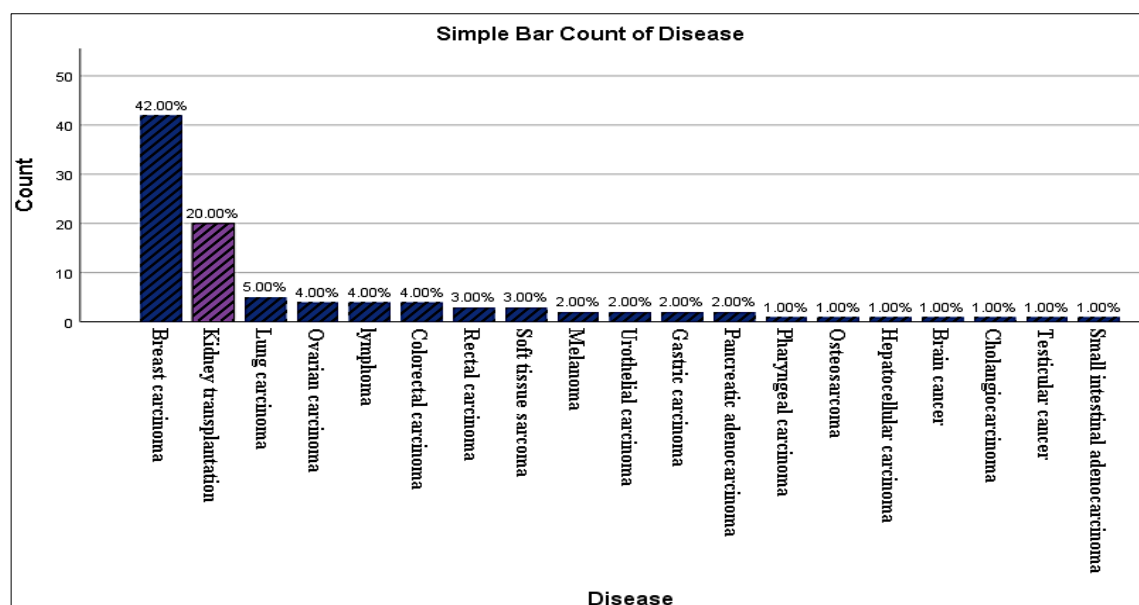


Figure 1: Distribution of Cancer Diseases and Kidney Transplant Cases in the Study Population.

3.3 Prevalence of Epstein-Barr Virus Antibodies (IgG and IgM) Across Study Cohorts

The results of this study showed that among 100 patients (including various cancer types and kidney transplant recipients), 17% were IgG positive, while 83% were IgG negative. In contrast, only 4% of patients were IgM positive, and 96% were IgM negative. The highest IgG positivity was observed in patients with breast carcinoma (7 cases), followed by colorectal carcinoma (2 cases) and several cancer types including osteosarcoma, lung carcinoma, lymphoma, melanoma, ovarian carcinoma, brain cancer, and urothelial carcinoma, each with one positive case. IgM positivity was limited to only four cases: one case each in breast carcinoma, lung carcinoma, colorectal carcinoma, and kidney transplantation. All other disease categories showed no IgM positivity (Table 2).

In control group ($n=50$), IgG antibodies were detected in only 3 individuals (6%), while no IgM antibodies were detected. This indicates a higher seroprevalence of EBV-specific IgG and IgM antibodies among patients compared to healthy controls. Figure 2 and Figure 3 show the Seroprevalence of EBV IgG and IgM Among each of the study groups: Cancer Patients, Kidney Transplant Recipients, and Healthy Controls.

Table 2: Comparison of EBV Antibody prevalence Between Patients and Healthy Controls.

Group	Disease	IgG		IgM		Total
		Positive	Negative	Positive	Negative	
	Breast carcinoma	7	35	1	41	42
	Osteosarcoma	1	0	0	1	1
	Lung carcinoma	1	4	1	4	5
	Colorectal carcinoma	2	2	1	3	4
	Rectal carcinoma	0	3	0	3	3
	Pharyngeal carcinoma	0	1	0	1	1
	lymphoma	1	3	0	4	4
	Melanoma	1	1	0	2	2

Patients (No. 100)	Ovarian carcinoma	1	3	0	4	4
	Pancreatic adenocarcinoma	0	2	0	2	2
	Soft tissue sarcoma	0	3	0	3	3
	Small intestinal adenocarcinoma	0	1	0	1	1
	Gastric carcinoma	0	2	0	2	2
	Testicular cancer	0	1	0	1	1
	Cholangiocarcinoma	0	1	0	1	1
	Brain cancer	1	0	0	1	1
	Urothelial carcinoma	1	1	0	2	2
	Hepatocellular carcinoma	0	1	0	1	1
	Kidney transplantation	1	19	1	19	20
Subtotal (Patients)		17 (17%)	83 (83%)	4 (4%)	96 (96%)	100 (100%)
Control (No. 50)	Healthy	3 (6%)	47 (94%)	0 (0%)	50 (100%)	50 (100%)

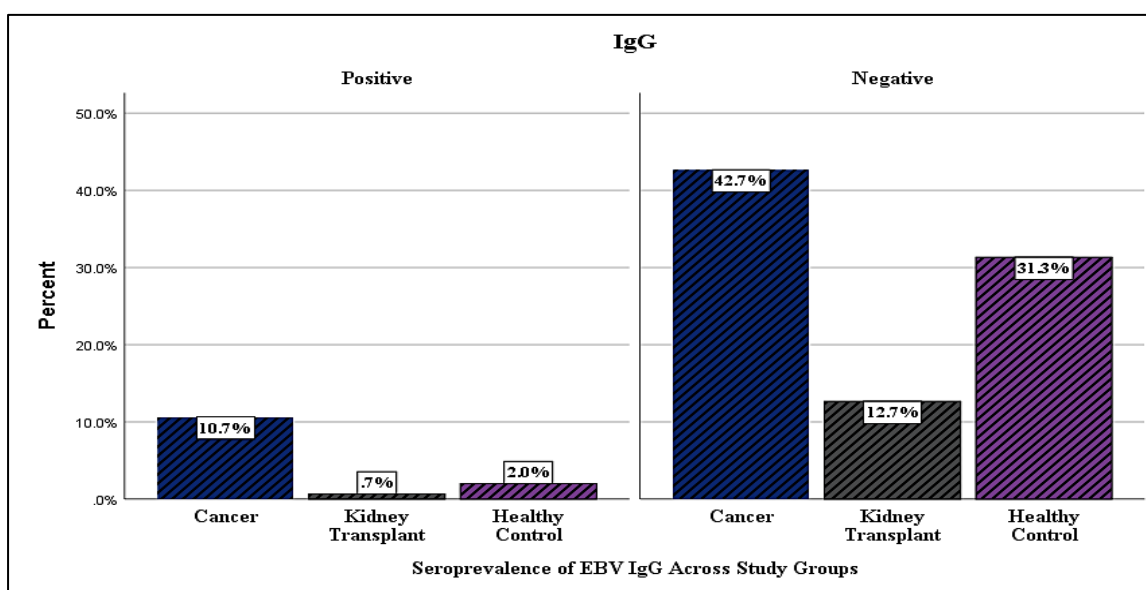


Figure 2: Prevalence of EBV IgG Among Cancer Patients, Kidney Transplant Recipients, and Healthy Controls

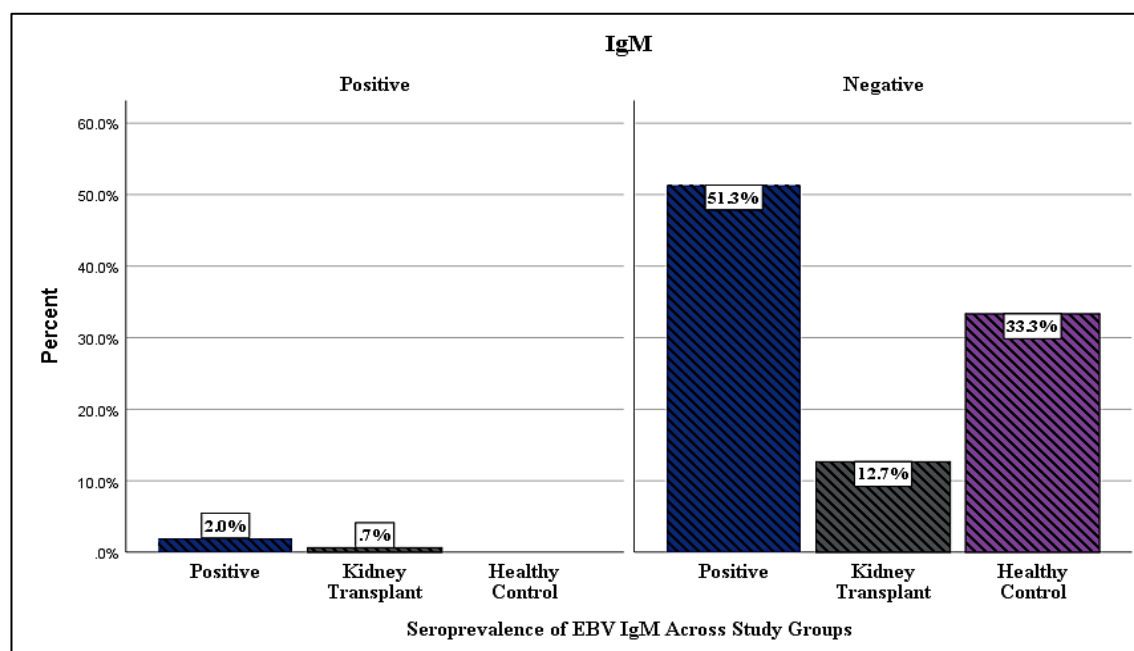


Figure 3: Prevalence of EBV IgM Among Cancer Patients, Kidney Transplant Recipients, and Healthy Controls

3.4 Hematological parameters Among Study Groups

The results show that hemoglobin (HGB) levels were significantly lower in patients (11.57 ± 0.19 g/dL) compared to controls (12.75 ± 0.16 g/dL; $p = 0.001$). Conversely, red blood cell (RBC) counts were significantly higher in patients ($4.11 \pm 0.10 \times 10^6/\mu\text{L}$) than in controls ($3.65 \pm 0.10 \times 10^6/\mu\text{L}$; $p = 0.001$). Lymphocyte counts were significantly reduced in patients ($1.54 \pm 0.07 \times 10^3/\mu\text{L}$) relative to controls ($1.89 \pm 0.13 \times 10^3/\mu\text{L}$; $p = 0.02$). Total white blood cell (WBC) counts were markedly lower in patients ($4.90 \pm 0.18 \times 10^3/\mu\text{L}$) compared to controls ($9.90 \pm 0.29 \times 10^3/\mu\text{L}$; $p = 0.001$). However, no statistically significant difference was observed in platelet (PLT) counts between the two groups ($p = 0.433$) (Table 3). These findings highlight significant alterations in hematological parameters in immunocompromised patients compared to healthy controls.

Table 3: Comparison of Complete Blood Count (CBC) Tests between Cancer and Kidney Transplant Patients and Healthy Controls.

CBC Tests	Group	N	Mean	Std. Deviation	Std. Error Mean	P-value
(Normal Range)						
PLT (100-300)	Patients	100	235.7500	112.29789	11.22979	0.433
	Controls	50	246.3800	53.26518	7.53283	
HGB (11.0-16.0 g/dL)	Patients	100	11.5660	1.92853	.19285	0.001
	Controls	50	12.7500	1.09828	.15532	
RBC (3.50-5.50)	Patients	100	4.1116	.98781	.09878	0.001
	Controls	50	3.6508	.67323	.09521	
Lymph. (0.8-4.0)	Patients	100	1.5414	.70562	.07056	0.02
	Controls	50	1.8940	.92701	.13110	
WBC (4.0-10.0)	Patients	100	4.8959	1.75651	.17565	0.001
	Controls	50	9.8980	2.06758	.29240	
P value < 0.05				* Independent-samples T test		
* Values are expressed as mean ± standard error (SE)						

3.5 Complement protein Levels (C3 and C4) Among Study Groups

The results indicate a significant increase in C3 levels among patients (116.682 ± 2.169 mg/dL) compared to controls (91.260 ± 3.625 mg/dL), with a highly significant p-value ($p = 0.001$). Conversely, C4 levels showed no significant difference between patients (31.455 ± 0.888 mg/dL) and controls (31.272 ± 1.108 mg/dL), with a p-value of 0.801. This elevation in C3 levels suggests an altered immune response in the patient group (Table 4 and Fig. 4).

Table 4: Comparison of Complement protein Levels (C3 and C4) Between Cancer and Kidney Transplant Patients and Healthy Controls

Complement proteins	Group	N	Mean	Std. Deviation	Std. Error Mean	P-value
(Normal Range)						
C3 (91–156 mg/dl)	Patients	100	116.6820	21.69040	2.16904	0.001
	Controls	50	91.2600	25.63124	3.62480	
C4 (20–50 mg/dl)	Patients	100	31.4550	8.87770	.88777	0.801
	Controls	50	31.2720	7.83222	1.10764	
P value < 0.05 * Values are expressed as mean ± standard error (SE)				* Independent-samples T test		

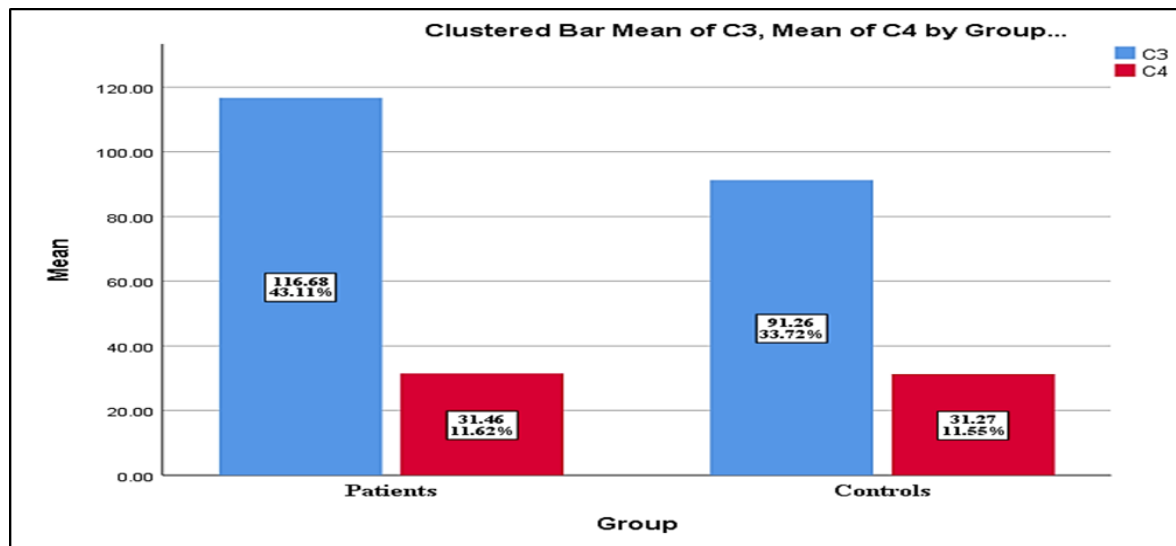


Figure 4: Comparison of Complement protein Levels (C3 and C4) Between Cancer and Kidney Transplant Patients and Healthy Controls.

3.6 Hematological Correlation between Cancer and Kidney Transplant Patients

This study compared hematological parameters between cancer patients and kidney transplant recipients. The analysis revealed significant differences in several blood test values. Platelet (PLT) counts were significantly higher in cancer patients ($254.69 \pm 11.88 \times 10^3/\mu\text{L}$) compared to kidney transplant recipients ($160.00 \pm 23.67 \times 10^3/\mu\text{L}$; $p = 0.01$). Hemoglobin (HGB) levels were significantly lower in cancer patients ($11.15 \pm 0.20 \text{ g/dL}$) than in kidney transplant recipients ($13.22 \pm 0.32 \text{ g/dL}$; $p = 0.001$). Similarly, red blood cell (RBC) counts were significantly lower in cancer patients ($3.89 \pm 0.08 \times 10^6/\mu\text{L}$) compared to kidney transplant recipients ($5.01 \pm 0.30 \times 10^6/\mu\text{L}$; $p = 0.001$). In contrast, no statistically significant differences were observed between the two groups in lymphocyte (Lymph.) counts ($p = 0.106$) or white blood cell (WBC) counts ($p = 0.618$) (Table 6).

Table 6: Correlation of Blood Test Levels Between Cancer Patients and Kidney Transplant Recipients.

CBC Tests	Group	N	Mean	Std. Deviation	Std. Error Mean	P-value
(Normal Range)						
PLT (100-300)	Cancer	80	254.6875	106.26723	11.88104	0.01
	Kidney Transplant	20	160.0000	105.85342	23.66955	
HGB (11.0-16.0 g/dL)	Cancer	80	11.1525	1.81617	.20305	0.001
	Kidney Transplant	20	13.2200	1.43696	.32131	
RBC (3.50-5.50)	Cancer	80	3.8859	.73228	.08187	0.001
	Kidney Transplant	20	5.0145	1.33491	.29849	
Lymph. (0.8-4.0)	Cancer	80	1.4843	.63945	.07149	0.106
	Kidney Transplant	20	1.7700	.90850	.20315	
WBC (4.0-10.0)	Cancer	80	4.9349	1.82670	.20423	0.618
	Kidney Transplant	20	4.7400	1.47306	.32939	
P value < 0.05				* Independent-samples T test		
* Values are expressed as mean + standard error (SE)						

Epstein-Barr Virus (EBV) has a prevalence of infection of about 95% and infects nearly all individuals by maturity. In individuals with malignancies, malignant cells contain EBV DNA, resulting in higher quantities of EBV DNA circulating in the plasma. The present investigation aimed to ascertain the seroprevalence of EBV across various age groups with immunodeficiency, as well as to quantify viral load using PCR in positive patients. Epstein-Barr virus types occur worldwide, but they differ in their geographic distribution. For instance, The prevalence of Epstein-Barr Virus (EBV) among cancer patients in Iraq has been the subject of various studies, highlighting its significant association with different cancer types, particularly lymphomas and breast cancer.

In study conducted in Sulaimani Governorate of Iraqi Kurdistan between 2010-2020 years, it involved 515 Burkitt's lymphoma patients were tested for IgG and IgM antibodies to EBV viral capsid antigen. [28] revealed that EBV seropositivity increases progressively throughout childhood, reaching approximately 92% by midadolescence. In other study preform in Najaf AL-Ashraf Governorate/Iraq[29] found that out of 40 women analyzed, a notable presence of EBV was detected. This underscores the potential role of EBV in breast cancer pathology within the Iraqi population. The virus predominantly transmits by oral secretions and persists as a latent infection within human B-cells. However, it can be transmitted through organ donations and blood transfusions [30]. The enzyme immunosorbent assay (ELISA) was employed in this investigation utilising two distinct types of antibodies. The results indicated positive sera of 4% for anti-EBV IgM capsid antigen and 17% for anti-EBV capsid antigen IgG, respectively. Numerous diagnostic assays for EBV infection employ various methodologies, however exhibit significant disparities in performance [31].

The current investigation found a 4% positivity rate for EBV capsid antigen (IgM), indicating the effects of immunosuppression caused by immunosuppressive therapy, which is used to prevent organ rejection. This immunosuppression hampers the immune system's ability to respond to infections, resulting in insufficient production of IgM. The result aligns with the findings of Cookey et al. (2023)[32] in Port Harcourt, Nigeria, where IgM antibodies were identified in 3.2% of cases. Additionally, an agreement with EBV IgM was seen in Ogbomosho, where IgM antibodies were identified in 4% [33] according to Kolawole et al. (2017). The present study contradicts the findings of a study conducted by Patel et al. (2021) [34] in North India, which reported only 56.1% IgM. The present study demonstrated that 17% of patients—including those with various cancer types and kidney transplant recipients—tested positive for EBV viral capsid antigen (VCA) IgG antibodies. This finding is consistent with studies from Nigeria and Ghana, where EBV IgG seropositivity was reported at 20.3% and 20%, respectively[35],[36]. However, the current result is markedly lower than findings from other regions, such as Pakistan, where Amjad et al. [37] reported a seroprevalence of 79.8%, and Tehran, Iran, where Sharifipour and Davoodi [38] found an EBV IgG prevalence of 81.4%.

These discrepancies among studies may be explained by geographical variations [39], population demographics[40], Chronic diseases [41]. In addition, methodological differences, such as serological assay sensitivity, sample selection, and population health status, contribute to the wide range of reported prevalence rates. Socioeconomic factors, environmental exposures, and healthcare access also likely influence the epidemiology of EBV infection across regions. Cancer patients and kidney transplant recipients are at particularly high risk of EBV infection or reactivation due to their compromised immune systems[42],[43]. In cancer patients, especially those undergoing chemotherapy or radiation, immunosuppression weakens the host's ability to control latent viral infections, allowing EBV to reactivate [44],[45],[46]. Similarly, kidney transplant recipients receive long-term immunosuppressive therapy to prevent organ rejection, which suppresses T-cell mediated immunity that is critical for controlling EBV [47]. In such immunocompromised hosts, EBV not only persists but may also contribute to the development of EBV-associated malignancies, such as post-transplant lymphoproliferative disorders (PTLD) and certain types of lymphomas [48], [49]. The observed EBV IgG seropositivity among these patients in this study highlights the need for monitoring EBV status in high-risk groups to prevent complications arising from viral reactivation. Comparison of complete blood count (CBC) tests in this study Red blood cell (RBC) counts were found to be elevated in patients with compromised immune systems compared to controls. This increase may be due to dehydration, which can cause hemoconcentration, leading to a higher concentration of blood cells due to reduced plasma volume.

Complement activation can occur via the classical, alternative, or lectin routes. No matter which of these pathways is first triggered, the main complement proteins C4 and C3 are proteolytically activated and deposited during complement activity. This promotes phagocytosis and the creation of the membrane assault complex, which lyses the invading microbes. There are pros and cons to complement activation; while it is necessary for eliminating germs and clearing apoptotic cells, too much activation can harm the host by causing inflammation and exacerbating tissue damage [50]. The present investigation measured C4 and C3 concentrations in the blood of individuals with impaired immune systems. Because it is involved in either the classical or lectin pathway of complement activation, C4 was chosen for testing, as it is the most straightforward to quantify. In immunocompromised individuals, there may be an increased demand for C3 to combat infections or manage inflammation, leading to its elevation while C4 remains stable. Our findings demonstrated that C3 levels were considerably elevated in immunocompromised patients. This increase suggests enhanced innate immune activation, which may be a compensatory mechanism due to the patients' compromised immune systems.

The elevation in C3 could also reflect the body's attempt to manage infections or inflammation associated with their underlying conditions. This study comprised cancer patients with C3 concentration agreements from the Affiliated Hospital of Medical College, Qingdao University, Wendeng Municipal Hospital, and Weihai People's Hospital, located in Qingdao and Weihai, China. The current study contradicts the findings of a study that reported a decrease in C3 concentrations [51]. Our results proved that C4 were no significantly in immunocompromised patients. this was agreement with C4 concentrations of Baltimore, MD, USA. Plasma C4 levels did not differ in patients with rheumatoid arthritis [52]. In contrast to previous research that indicated elevated C4 levels in cancer patients, the current investigation did not find such an increase [53][54].

4. CONCLUSION

These findings underscore the role of EBV infection in immunocompromised patients, particularly those with tumors and organ transplants. The results demonstrated a high prevalence of anti-EBV IgG capsid antigen and a low prevalence of anti-EBV IgM capsid antigen in patients, suggesting past or reactivated infection rather than acute primary infection. Hematological analysis revealed significantly lower levels of hemoglobin (HGB), lymphocytes, and white blood cells (WBC) in immunocompromised patients compared to the control group, while red blood cell (RBC) counts were significantly higher. Platelet (PLT) counts did not differ significantly between groups. Complement analysis indicated a significant increase in C3 levels among patients, whereas C4 levels showed no significant difference compared to controls.

ACKNOWLEDGEMENTS

The authors appreciate the College of Sciences - University of Diyala - for using laboratories with the necessary equipment to carry out the experiment.

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