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# Serum albumin levels and fluid overload in patients with hemodialysis: study in a private hospital in Zacatecas

# Niveles de albumina sérica y sobrecarga hídrica en pacientes con hemodiálisis: estudio en hospital privado de Zacatecas

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**Abstract**

One of the markers to evaluate health in patients with hemodialysis is the level of serum albumin, water overload is a common complication in this type of people that can affect albumin, the objective in this work was to know the levels of serum albumin and its relationship with fluid overload in patients with chronic renal failure on hemodialysis. A descriptive, cross-sectional and analytical study was carried out in a renal therapy unit of a private hospital in the city of Zacatecas, the sample consisted of 50 patients of both sexes. The variables considered were serum albumin, body mass index (BMI), water overload, anthropometry and sociodemographic factors. An intermediate negative correlation (-0.382) was found with a p of 0.003, which suggests a significant association between the two variables. These results are of clinical relevance, since maintaining adequate levels of serum albumin can contribute to the prevention or control of fluid overload in these patients, which in turn can positively impact their health and quality of life.

**Serum albumin, fluid overload, hemodialysis**

**Resumen**

Uno de los marcadores para evaluar la salud en pacientes con hemodiálisis es el nivel de albumina sérica, la sobrecarga hídrica es una complicación común en este tipo de personas que puede afectar la albúmina, el objetivo en este trabajo fue conocer los niveles de albumina sérica y su relación con la sobrecarga hídrica en pacientes con insuficiencia renal crónica en hemodiálisis. Se realizó un estudio descriptivo, transversal y analítico en una unidad de terapia renal de un hospital privado en la ciudad de Zacatecas, la muestra se conformó con 50 pacientes ambos sexos. Las variables consideradas fueron la albumina sérica, el índice de masa corporal (IMC), la sobrecarga hídrica, la antropometría y los factores sociodemográficos. Se encontró una correlación negativa intermedia (-0.382) con una p de 0.003, lo cual sugiere una asociación significativa entre las dos variables. Estos resultados son de relevancia clínica, ya que el mantenimiento de niveles adecuados de albúmina sérica puede contribuir a la prevención o control de la sobrecarga hídrica en estos pacientes, lo que a su vez puede impactar positivamente en su salud y calidad de vida.

**Albúmina sérica, Sobrecarga hídrica, Hemodiálisis**

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## Introduction

Chronic renal failure (CKD) is a progressive disease in which the kidneys lose their ability to filter waste and excess fluid from the blood (Paucar, Asencio & Vera, 2019). Haemodialysis is a common treatment in CKD, which allows the removal of these waste products and excess fluid through an external filter (Fernández-Lucas et al., 2012).

Serum albumin is a key parameter used to assess renal function and nutritional status in haemodialysis patients. It is a protein produced by the liver that helps maintain fluid balance in the body and is also essential for the transport of nutrients and other compounds in the blood (Suárez-Llanos, 2023).

In haemodialysis patients, fluid overload is a common problem as they may have difficulty eliminating excess fluid during haemodialysis, which can negatively affect the nutritional status and kidneys of patients. This is why it is a priority to understand the effect of serum albumin levels on fluid overload in CKD patients on haemodialysis.

## Pathophysiology of chronic renal failure (CRF)

The pathophysiology of CKD can be caused by various pathologies such as: diabetes mellitus; arterial hypertension; chronic glomerulonephritis; polycystic kidney disease; urinary obstruction and congenital kidney disease. These can gradually damage the nephrons (functional units of the kidneys), and as damage occurs, the ability of the kidneys to filter and remove wastes from the blood can be progressively reduced.

As the disease progresses, the kidneys become less efficient in the production of hormones and regulation of water balance and electrolytes, when this happens it can become more complicated and can lead to anaemia, electrolyte imbalances, accumulation of toxins in the blood, increased blood pressure and problems in the skeletal system (Martos & Villalba, 2021).

When the nephrons do not do their job, there are consequences in other systems of the organism, since when the levels of toxins in the blood rise, it can cause neuronal problems and thus affect brain function (de Mier et al., 2019). Likewise, electrolyte imbalances can affect the cardiac system and increase the risk of developing cardiovascular disease (Parra-Pérez & Gómez-González, 2022).

The pathophysiology of CKD also involves the activation of several compensatory and pathological mechanisms, an activation of the renin-angiotensin-aldosterone system can occur, leading to vasoconstriction and sodium and water retention, which further exacerbates renal failure, and research also mentions that chronic inflammatory processes and oxidative stress play a role in the pathophysiology of CKD (Raucoules-Aimé & Ouattara, 2023).

## Treatment of chronic renal failure: haemodialysis

Treatment of CKD attempts to control risk factors and associated complications, here you can find: Converting enzyme inhibitors (ACE inhibitors) and angiotensin II receptor blockers; Hypotensives; Diuretics; Phosphorus chelators; Calcium and vitamin D supplementation; Erythropoietin; Diabetes and blood pressure control; and Dialysis and kidney transplantation (Muñoz, Fernández, Doyágüez & Magro, 2023).

Dialysis is the process that carries out the normal functions of the kidneys when they have CKD, and there are two types: haemodialysis and peritoneal dialysis. In the case of haemodialysis, the patient's blood is extracted through a catheter and filtered out of the body through a machine, which allows toxins, wastes and excess fluid to be eliminated, which helps to maintain optimal levels of electrolytes and chemicals in the blood (Jáuregui-González et al., 2023).

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**Function and role of serum albumin in the body**

Serum albumin is a protein produced by the liver, it plays a crucial role in the body for the multiple functions it performs, one of the main ones being the regulation of osmotic pressure in the circulatory system, due to its size and negative electrical charge, albumin has the ability to retain water in the blood vessels and prevent it from leaking into the surrounding tissues. This helps to maintain adequate volume and pressure in the circulatory system, ensuring good tissue perfusion.

Albumin is also actively involved in the transport of various molecules in the blood, binding to substances such as hormones, vitamins, bilirubin, fatty acids and drugs, and transporting them through the bloodstream to different tissues and organs within the body, thus facilitating the delivery of essential nutrients and the elimination of waste products (Navarro, Alvarez & Martell, 2020).

Serum albumin is essential in the body's defence against infection and disease, as it is a protein that can act as a protective barrier against pathogens and toxins. In addition, it also binds to other immune system compounds, such as immunoglobulins, to aid the immune response and the elimination of invading microorganisms (Rugeles et al., 2023).

Another important function of serum albumin is its ability to regulate acid-base balance in the body. As a protein that can accept and release protons, it helps to maintain the proper pH in body fluids (Ferreiro, 2021).

**Water overload in haemodialysis patients: causes and consequences**

Water overload is a common complication in patients undergoing haemodialysis, difficulties in maintaining the proper balance of water and sodium in the body can occur, which can lead to water overload (Hurst, 2013).

There are several factors that can contribute to the development of water overload in haemodialysis patients, one of which is excessive fluid intake, either through food or drink. The consumption of sodium-rich foods can also aggravate this condition, as sodium promotes water retention in the body. Some patients may also have problems eliminating excess water and sodium due to decreased urine production (Ayús & Musso, 2008).

There are serious consequences of water overload in haemodialysis patients, one of the main ones is the risk of arterial hypertension, as excess fluid in the body can increase blood pressure, this endangers cardiovascular health or can cause strokes, this overload can also affect the lungs, leading to congenital heart failure, as fluid accumulation in the lungs hinders the ability to breathe properly and can cause coughing, shortness of breath and fatigue (Henriquez-Palop et al., 2013).

Another negative effect of fluid overload is increased stress on the kidneys. Already compromised, excess fluid can lead to kidney damage, which can worsen kidney function and make it even more difficult to eliminate waste from the body (Ayús & Musso, 2008).

In this type of patient, it is essential to monitor fluid intake and follow a balanced, low-sodium diet, and it is also important to constantly monitor for signs and symptoms of fluid overload, such as sudden weight gain, swelling in the extremities and shortness of breath (Henríquez-Palop et al., 2013) (Henríquez-Palop et al., 2013).

**Previous studies: serum albumin levels and water overload in patients with chronic renal failure on haemodialysis**

Yuya et al. (2023) published an article mentioning that the post-dialysis plasma level of human atrial natriuretic peptide (HANP) reflects fluid volume in haemodialysis patients. This study included 156 haemodialysis patients without atrial fibrillation and examined the usefulness of HANP level (100 pg/ml) in predicting hypoxaemia due to congestion. Patients with a HANP level ≥100 pg/ml developed hypoxaemia due to congestion.

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In a 5-year follow-up, patients with a HANP level ≥100 pg/ml were found to have significantly higher rates of hospitalisation for acute heart failure (AHF), development of cardiovascular disease (CVD) and all-cause death.

In addition, a significant association was found between cardiac dysfunction and high HANP level. In conclusion, the HANP level is indicative of both fluid volume and cardiac dysfunction. A threshold HANP level of 100 pg/ml may be a predictive marker of AHF and a practical indicator for volume control in haemodialysis patients.

Also Yu et al. (2023) in their published research examined the impact of seasonal variation in peritoneal dialysis and patient outcomes. They considered peritoneal balance and peritoneal dialysis efficacy test data from all patients followed in one centre over a period of one year. In addition, information was collected on monthly deliveries from the entire centre over a five-year period.

The results showed that plasma albumin and phosphate levels were higher in summer and correlated positively with the average monthly temperature. No seasonal differences were found in peritoneal dialysis ultrafiltration or urine volume, but more use of low glucose concentration was observed in summer and less in winter. The authors concluded that albumin and plasma phosphate levels are higher in summer in peritoneal dialysis patients, and a lower glucose peritoneal dialysis solution is more widely used in summer. This may be useful for individualised treatments.

Another paper examined the effects of oral sodium bicarbonate on protein metabolism and markers of inflammation in haemodialysis patients with metabolic acidosis. 66 adult haemodialysis patients participated in the study, which was divided into two groups, one receiving daily oral sodium bicarbonate for 12 weeks and the other not given, with variables measured before and after intake.

The results showed that serum bicarbonate and pH increased significantly in the group that consumed the oral sodium, serum albumin levels and in this case serum potassium and muscle strength decreased, in the case of IL-6 levels, were lower. The authors concluded that correcting metabolic acidosis in haemodialysis patients improved serum albumin levels and the rate of protein catabolism, without causing hypokalaemia or a significant increase in interdialysis weight. These effects were more evident in patients with low IL-6 levels, suggesting that inflammation may be associated with treatment response (Rasheed, Al-Hashemi & Ali, 2023).

Authors Elías-Viramontes, Casique-Casique & Rodríguez-Loreto conducted a study in Madrid with the aim of analysing the theoretical and methodological aspects used in the design and implementation of health interventions for people with kidney disease. To do so, they conducted a systematic review using databases of publications in specialised journals. In their research, they focused on the psychological aspect, and in particular on the motivational area, as a fundamental element in achieving behavioural change in these people. As a theoretical reference, they took into account Bandura's approaches, which resulted in significant improvements in the health behaviours of patients with renal disease (Elías-Viramontes, Casique-Casique & Rodríguez-Loreto, 2020).

In the city of Majugua, during 2018, in a cross-sectional descriptive study involving people over 18 years of age. The main objective was to identify markers of kidney damage in patients with risk factors for chronic kidney disease. The indicators considered were age, sex, smoking, obesity, use of anti-inflammatory drugs, history of diabetes mellitus, arterial hypertension, and renal indicators: renal damage, haematuria, glomerular filtration rate, proteinuria, leukocyturia, cylindruria and elevated creatinine. As a result, it was found that the average age of patients who presented markers of renal disease was 64.3 years, while in those who did not present them was 62.4 years. The minimum age recorded was 49 and 46 years, respectively, while the maximum age was 74 and 73 years, respectively (Castellanos et al., 2018).

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In Spain, Martínez, García & Torres (2017) conducted a monthly analysis of 52 prevalent haemodialysis patients with the aim of improving the nutritional status of patients. For this, they conducted a retrospective descriptive study where serum albumin measurements were performed and levels below 3.8 g/dl were evaluated, as well as other biochemical determinations: total protein, C-reactive protein (CRP), total cholesterol and leukocytes. In addition, variables such as age, sex, vascular access, aetiology of renal disease, time on renal replacement therapy (RRT), hypertension (HT) and diabetes mellitus (DM) were considered. The results obtained revealed that 32.6% of the sample had a mean albumin level of less than 3.8 g/dl, which placed them at risk of DPE syndrome (malnutrition, inflammation and accelerated atherosclerosis).

In 2017, in Madrid, a cross-sectional study was carried out in which 74 patients were analysed in order to evaluate the diet of a group of individuals with advanced chronic kidney disease, comparing it with the established recommendations, and its relationship with markers of nutritional status. During the study, intake, biochemical and anthropometric variables were analysed, such as the three-day dietary record. The results revealed a positive correlation between albumin levels, body mass index (BMI), and creatinine clearance (Pérez-Torres et al., 2017).

In Cuba, in a cross-sectional descriptive study, the aim of which was to identify the condition and its characteristics in people aged 18 years or older. The age, sex and skin colour of the participants were analysed, as well as the history of diseases considered risk factors for chronic kidney disease (CKD). In addition, alterations in renal damage markers such as microalbuminuria test (with pathological results) and/or pathological Addis count were assessed. The presence of functional renal damage was also determined by decreasing glomerular filtration rate. As a result of the study, CKD was diagnosed in 23.7% of the non-dispensed at-risk population, representing a quarter of that population (Martínez et al., 2016).

In the city of Granada, Spain, a study was conducted in which 90 male and female patients with CKD in a haemodialysis unit were evaluated. The aim of the study was to assess nutritional status by evaluating biochemical parameters, such as albumin, and anthropometric parameters, such as muscle mass index. For this purpose, quarterly measurements of plasma albumin and other biochemical determinations were performed, as well as anthropometric measurements of weight, height and body mass index. The result after 10 years of follow-up was that all patients experienced a significant decrease in biochemical parameters and albumin levels. However, no significant changes were observed in relation to malnutrition in terms of body mass index (Quero et al., 2015).

In Mexico City, Velarde, Pacora & Llajaruna, conducted a study in haemodialysis patients. The aim of the study was to determine the association between hypoalbuminaemia and hypophosphataemia with the VGS type C scale in patients with chronic kidney disease on haemodialysis. An analytical cross-sectional study was carried out. The Kruskal-Wallis test and the multiple comparisons test were used to analyse the data. Regarding the categorical variables of hypoalbuminaemia (≤3.5 g/dl) and hypophosphataemia, it was found that there is an association between type C GSV and hypoalbuminaemia and hypophosphataemia in patients with chronic kidney disease on haemodialysis (Velarde, Pacora & Llajaruna, 2020).

Balderas-Vargas et al. (2020) conducted a cross-sectional study in Mexico City. The aim of the research was to identify the prevalence and factors associated with occult renal failure in patients with type 2 diabetes mellitus and systemic arterial hypertension, two common chronic diseases. For this purpose, a measurement instrument was used with questions related to various associated factors, such as osteoarthritis, chronic disease treatment, smoking, analgesic intake, alcoholism, body mass index, physical activity and serum levels of glucose, cholesterol and triglycerides.

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The results obtained in the multivariate analysis indicated that the factors associated with occult renal failure were: being older than 60 years (adjusted odds ratio (OR) = 1.96, 95% confidence interval (95% CI) = 1.22-2.49), being older than 60 years (adjusted odds ratio (OR) = 1.96, 95% confidence interval (95% CI) = 1. 22-2.49), being female (AOR = 2.17, 95% CI = 1.30-2.82), having systemic arterial hypertension (AOR = 1.96, 95% CI = 1.22-2.50) and not being overweight or obese (AOR = 0.49, 95% CI = 0.41-0.8).

During 2015, in the city of Guadalajara, Jalisco, Mexico, a study was conducted in patients with end-stage renal disease (ESRD) who started peritoneal dialysis. The aim of the study was to determine the association between serum albumin levels and subjective global assessment in these patients. A cross-sectional analytical approach was used to determine serum albumin levels and to perform a nutritional assessment using subjective global grading (GSV). The results showed that 34.8% of patients were well nourished, 40.6% were at risk or moderately impaired in their nutritional status, and 24.6% had severe nutritional impairment. No significant association (p=ns) was found between serum albumin levels and VGS (Yanowsky-Escatell et al., 2015).

## Methodology to be developed

A descriptive, cross-sectional and analytical study was carried out in a Renal Therapy Unit S. C. belonging to a private hospital located in the city of Zacatecas, using simple random probability sampling, including 50 patients of indistinct sex undergoing haemodialysis substitution treatment who came twice a week for treatment and who signed informed consent to participate in the study.

The following variables were considered: Serum albumin, body mass index (BMI), water overload, anthropometry and socio-demographic factors. To determine the socio-demographic variable, a survey was applied; for anthropometry, a SECA model 213 portable stadiometer was used with a precision of 1 mm, following the protocol established by the International Society for the Advancement of Kineanthropometry (ISAK).

For BMI, the formula weight in kg/height in metres squared proposed by the World Health Organisation (WHO) for adults aged 18-59 years was used. For water overload, a TANITA model BC533 bioimpedance scale was used, total body water was taken after haemodialysis and, finally, spectrophotometry was used to determine serum albumin.

*Ethical considerations*

The study complies with the principles set out in the Nuremberg Code of 1947, which requires the voluntary consent of the participant and ensures that they have the legal capacity to give consent. The results obtained in this study are intended to benefit society. Any unnecessary harm, whether physical or mental, will be avoided. Furthermore, the study adheres to the principles set forth in the Universal Declaration on Bioethics and Human Rights, which includes full respect for human dignity, human rights and fundamental freedoms as set forth in article 3. According to the General Health Law on Health Research of the United Mexican States, this study is considered low risk.

## Results

In this study, the main objective was to determine serum albumin levels and their relationship with water overload in patients with chronic renal failure on haemodialysis. 50 patients were analysed, 28 of whom were men and 12 women.

| | Frequency | Percentage% | Cumulative percentage |
|---|---|---|---|
| Female | 22 | 44.0 | 44.0 |
| Male | 28 | 56.0 | 100.0 |
| Total | 50 | 100.0 | |

**Table 1** Patients who participated in the study to draw percentages by sex
*Source: Own elaboration based on data collection*

As it is well known that serum albumin is a protein that is synthesised in the liver and plays a crucial role in maintaining water balance in the body, low levels of the protein may indicate a higher likelihood of water overload in patients. In relation to the gender of the patients, a significant difference between men and women can be observed, which may be related to the small sample size.

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It can be said that two main groups were also found in this study, one with age ranges between 18 and 59 years, which represents more than 53% of the total number of patients, and another group of adults older than 60 years, which represents 47.7%. It is a priority to highlight that the average age of the patients was 55.1 years, with a standard deviation of 15.3 (which indicates that there is some variability in the age distribution), it also reflects that the majority were found in the older age range, which indicates that not all patients are grouped in the average age, which shows that there is a wide range of ages considered within the sample used.

As for total body water levels, the information is shown in figure 1, which shows that 63% of patients have normal levels, indicating that they are well hydrated and maintain a healthy balance of water in their bodies, also here it can be seen that 37% have high levels of total body water, of which 16.7% are female and 20% are male. This gender difference could be the result of different factors, such as differences in body composition or physical activity levels.

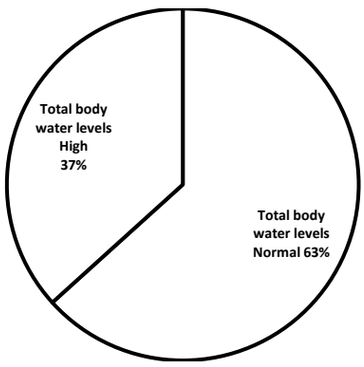


**Figure 1** Total body water level
*Source: Own elaboration based on data collection.*

It is important to monitor total body water levels in patients, as maintaining an adequate balance is necessary for good health. In table 2, it can be seen that when analysing the BMI in patients, 46% are within the normal range, this information shows that a large majority have a BMI according to their weight and height, which is good for their health, it can also be seen that 48% of patients are overweight or obese, It should be noted that overweight and obesity are related to various chronic diseases such as diabetes, hypertension and cardiovascular diseases, and that the majority of patients have a BMI in accordance with their weight and height, which is good for their health.

| | Frequency | Percentage % |
|---|---|---|
| Underweight | 3 | 6 |
| Normal | 23 | 46 |
| Overweight | 13 | 26 |
| Obesity 1 | 10 | 20 |
| Obesity 2 | 1 | 2 |

**Table 2** Body Mass Index in patients who participated in the study
*Source: Own elaboration based on data collection*

On the other hand, Table 2 also shows that 6% are underweight, which is bad for health, since it is associated with malnutrition and a weak immune system.

When analyzing serum albumin, it was found that 55% of the population has normal levels, which implies that most people have values within an acceptable range, on the other hand, 25% have a slight depletion of albumin, which indicates low levels of this protein in the body, this could be talking about a lesser capacity to transport and store nutrients, likewise it is mentioned that 15% have moderate depletion of albumin.

When an association was made between serum albumin levels and water overload, an intermediate negative correlation was found (-0.382) (see table 3) supported by a p of 0.003, which suggests a significant association between the two variables, corroborated by the correlation coefficient (r=-0.382) which indicates that there is a significant association between the two variables. 382) which indicates that there is a linear relationship between serum albumin levels and water overload in these patients, the negative relationship means that as serum albumin values increase water overload levels decrease. This relationship could be due to the fact that an increase in serum albumin may indicate an improvement in hepatic and renal function, resulting in a better ability to eliminate excess fluids from the body.

| | | Albumin | Water |
|---|---|---|---|
| Albumin | arson correlation | 1 | -.382** |
| | Sig. (bilateral) | | .003 |
| | N | 60 | 60 |
| Water | Pearson correlation | -.382** | 1 |
| | Sig. (bilateral) | .003 | |
| | N | 50 | 50 |
| ** The correlation is significant at the 0.01 level (2-tailed). | | | |

**Table 3** Correlation between serum albumin levels and water overload in patients
*Source: Own elaboration based on data collection.*

Serum albumin levels and BMI did not present a significant correlation, this is deduced because the Pearson correlation value is 0.226, which means a weak correlation, since the BMI of the patients cannot be used as a reliable indicator when considering only albumin levels for this study (see table 4).

| | | IMC | Albumin |
|---|---|---|---|
| IMC | Pearson correlation | 1 | .226 |
| | Sig. (bilateral) | | .082 |
| | N | 50 | 50 |
| Albumin | Pearson correlation | .226 | 1 |
| | Sig. (bilateral) | .082 | |
| | N | 50 | 50 |

**Table 4** Correlation between BMI and serum albumin levels
*Source: Own elaboration based on data collection*

As for sex and albumin levels, no significant correlation was found since the data yielded a coefficient of 0.227, which is low with a p of 0.082 (see Table 5). This may mean that sex is not a determining factor in the variation of albumin levels in the population; it is possible that age, general health or diet may influence these levels.

| | | | Albumin | Sex |
|---|---|---|---|---|
| Rho de Spearman | Albumin | Correlation coefficient | 1.000 | .227 |
| | | Sig. (bilateral) | . | .082 |
| | | N | 50 | 50 |
| | Sexo | Correlation coefficient | .227 | 1.000 |
| | | Sig. (bilateral) | .082 | . |
| | | N | 50 | 50 |

**Table 5** Correlation Sex and serum albumin levels
*Source: Own elaboration based on data collection*

It can be argued that there is a positive correlation between serum albumin levels and body weight for this study, this may mean that as a person's weight increases so does the value of albumin in the blood. This correlation is supported by a Pearson correlation coefficient of 0.279, with a bilateral significance level of 0.031. This indicates that the relationship between serum albumin and weight is statistically significant, as the p value is less than the established level of 0.05 (see Table 6).

| | | Albumin | Weight |
|---|---|---|---|
| Albumin | Correlación de Pearson | 1 | .279* |
| | Sig. (bilateral) | | .031 |
| | N | 50 | 50 |
| weight | Pearson correlation | .279* | 1 |
| | Sig. (bilateral) | .031 | |
| | N | 50 | 50 |
| *. The correlation is significant at the 0.05 level (2-tailed). | | | |

***Table 6*** Correlation between weight and serum albumin levels
*Source: Own elaboration based on data collection.*

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**Conclusions**

In this study, when considering the sample of 50 patients with CKD on hemodialysis, it was found that serum albumin levels may be related to water overload; however, further studies are required to confirm these results, and a large discrepancy was found in the age of the participants, which can be considered as a study factor for future related research.

Likewise, the results obtained indicate that most of the patients presented normal levels of total body water, which reflects an adequate hydration and healthy balance in their bodies, but it should be noted that there were also patients with elevated levels of total body water, although in a lower percentage, presenting differences between sexes, so it would be interesting to consider the evaluation of sex as a possible cause of these levels.

In addition, it is evident that a significant percentage of patients have a normal BMI, which is good for health. However, it is also observed that a high percentage of patients are overweight or obese, which indicates a health risk due to possible associated chronic diseases. On the other hand, it was highlighted that a small percentage of patients are underweight, which can be detrimental to health and is associated with malnutrition and a weak immune system, it is necessary to work on promoting a healthy and balanced diet, as well as encouraging physical activity to prevent and control overweight and obesity, and to avoid underweight and its negative health consequences.

The results suggest that the majority of the population has normal serum albumin levels, but there is a significant proportion with mild and moderate depletion. In addition, a significant and negative association between serum albumin levels and water overload is evidenced in the patients analyzed.

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Likewise, the data collected indicate that BMI cannot be used as a reliable indicator of serum albumin levels in the context of this work, nor can whether they are male or female, the results of this study suggest that there is a positive correlation between serum albumin levels and body weight. This implies that as a person's weight increases, the value of albumin in the blood also increases. Furthermore, this correlation is supported by a Pearson correlation coefficient of 0.279, indicating a statistically significant relationship between serum albumin and weight. This finding is supported by a bilateral significance level of 0.031, which means that the p value is less than the established level of 0.05. These results support the idea that body weight may have an impact on blood albumin levels.

Finally, this study found a significant correlation between serum albumin levels and water overload in patients with chronic renal failure on hemodialysis. The results indicated an intermediate negative association between these two variables, suggesting that adequate serum albumin levels may contribute to the prevention or control of water overload in these patients. These findings are clinically relevant, since maintaining adequate serum albumin levels may have a positive impact on the health and quality of life of these patients.

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