# "ASSESSMENT OF PREVALENCE AND RISK FACTORS OF DELIRIUM IN KIDNEY DISEASE PATIENTS UNDERGOING RENAL DIALYSIS- A PROSPECTIVE OBSERVATIONAL STUDY"

**BY**

**REG NO. BQ0119002**

# Dissertation

**Submitted to the**

**KLE Academy of Higher Education and Research,**

**Belagavi, Karnataka.**

**In partial fulfilment of the requirements for the degree of**

**DOCTOR OF MEDICINE**

**IN**

**PSYCHIATRY**

**JAWAHARLAL NEHRU MEDICAL COLLEGE**

**KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH**

**BELAGAVI- 590010, KARNATAKA, INDIA**

**APRIL - 2022**

**KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH, BELAGAVI, KARNATAKA.**

# Endorsement by the Head Of Department, Principal/ Head of the Institution

This is to certify that the dissertation entitled **"ASSESSMENT OF PREVALENCE AND RISK FACTORS OF DELIRIUM IN KIDNEY DISEASE PATIENTS UNDERGOING RENAL DIALYSIS- A PROSPECTIVE OBSERVATIONAL STUDY"** is a bonafide research work done by **Registration No. BQ0119002.**

**Seal & Signature of the HOD**

**Dr. N. M. Patil** M.D.
Professor & Head,
Department of Psychiatry,
J.N. Medical College,
Belagavi – 590010.
Karnataka, India.

**Date :**

**Place :** Belagavi

**Seal & Signature of the Principal**

**Dr. (Mrs.) N. S. Mahantashetti** M.D.(Paed)
Principal,
J. N. Medical College,
Nehru Nagar,
Belagavi - 590010.
Karnataka, India.

**Date :**

**Place :** Belagavi

# ANTI-PLAGIARISM CHECK – ACCEPTANCE LETTER

KLE

## JAWAHARLAL NEHRU MEDICAL COLLEGE

(Recognized by Medical Council of India, New Delhi)

Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

*Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA*

0831 - 2471350 0831 - 2470759 www.jnmc.edu principal@jnmc.edu

Ref No: MDC/PG/ Date: 19-11-2021

### ACCEPTANCE LETTER

The softcopy of thesis entitled: **"ASSESSMENT OF PREVALENCE AND RISK FACTORS OF DELIRIUM IN KIDNEY DISEASE PATIENTS UNDERGOING RENAL DIALYSIS- A PROSPECTIVE OBSERVATIONAL STUDY"** has been submitted for Anti-Plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of **01%** which is within the acceptable limits of **10%** as per the guidelines given by UGC.

Guide.

KAHER BELAGAVI J.N. MEDICAL COLLEGE

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
**Reg. No. BQ0119002.**
Postgraduate Student,
2019-20 Batch,
Department of Psychiatry,
J. N. Medical College, Belagavi.

# ACKNOWLEDGEMENT

First and foremost I would like to thank God for his blessing bestowed upon me, for giving me teachers and parents who have been forever helpful and forever kind.

I express my deep sense of gratitude and sincere regards to my guide and mentor, **Dr. S. S. Chate**, Professor, Department of Psychiatry, J. N. Medical College for his valuable time, esteemed guidance, and motivation in every step of preparation of my dissertation. Without his constant support, this study would not have been possible.

I consider it to be my privilege to have worked under **Dr. N. M. Patil**, Professor and Head of Department of Psychiatry, J. N. Medical College, who has been my inspiration. His warmth, kindness and support has been invaluable in this journey.

I extend my gratitude and sincerest regards to **Dr. M S Karishetti,** Professor and Chief Consultant, Department of Nephrology, J.N. Medical College for his valuable time and constant dedication towards helping improve the project by his knowledge and experience.

I would also like to express my immense gratitude towards **Dr. Bheemsain Tekkalaki,** Associate Professor, Department of Psychiatry, J.N. Medical College, **Dr. Sandeep Patil**, Assistant Professor, Department of Psychiatry, J.N. Medical College and **Dr. Vinayak Koparde**, Assistant Professor, Department of Psychiatry, J.N. Medical College and **Dr. Vishwash Yadwad**, Assistant Professor, Department of Psychiatry, J.N. Mediccal college who have all been instrumental by playing a key role in my dissertation. A special thanks to **Dr. Punit Mutalik**, Senior Resident, Department of Psychiatry, J.N. Medical College for always being available and playing a key role in the completion of my dissertation

I would like to sincerely thank **Dr. (Mrs.) N.S. Mahantashetti**, Principal, J. N. Medical College for permitting me to carry out this study and for being a source of motivation to the entire institution.

I wish to offer my thanks to the Department of Medical Education for their valuable information and support.

I would like to thank each one of my dear seniors, friends and colleagues- **Dr. Akshay Naik, Dr. Ramkrishna Vignesh, Dr Druhin Grover, Dr. Shreyas Patil, Dr. Astha, Dr. Prabhbani Bindra, Dr. Avnika Bansal, Dr. Akanksha A. Singh, Dr. Raiza Mohammed, Dr. Nishi V. , Dr. Soumya Ande, Dr. Ajinkya Jadhav, Dr. Preetham DS, Dr. Dhanananjay Patil, Dr. Ruthshee Suresh, Dr. Sudharani and Dr. Lavanya Reddy** for always being next to me, for supporting and helping me in all possible ways. A special thanks to Dr. Saloni Garg for her immense help throught the journey of my dissertation.

There are no words to express my love and respect for my family- my late mother **Mrs. Seema Prakash**, my father, **Mr. Alok Prakash Yadav**, my brother **Dr. Aditya Prakash** and my sister in law **Dr. Preeti Singh** who have always cared and loved me, and to whom I am forever indebted.

Last but not the least, I would like to thank all the patients who have participated in the study and have made the study complete.

**Date:** **Dr. Divya Prakash**

**Place:** Belagavi

# ACRONYMS

| | |
|---|---|
| APACHE-II | Acute Physiology and Chronic Health Evaluation - II |
| AKI | Acute Kidney Injury |
| CAM | Confusion Assessment Method |
| CAM-ICU | Confusion Assessment Method-Intensive Care Unit |
| CNS | Central Nervous System |
| COVID-19 | Coronavirusdisease-19 |
| CSF | Cerebro-spinal Fluid |
| CVA | Cerebrovascular Accident |
| CKD | Chronic Kidney Disease |
| DALY | Disability Adjusted Life Years |
| DDS | Dialysis Disequilibrium Syndrome |
| DSM-III-R | Diagnostic and Statistical Manual of Mental Disorders-3rd Edition Revised |
| EEG | Electroencephalogram |
| ESRD | End Stage Renal Disease |

| | |
|---|---|
| GBD | Global Burden of Diseases |
| GFR | Glomerular Filtration Rate |
| HCW | Health Care Worker |
| ICD-10 | International Classification of diseases 10th Revision |
| ICDSC | Intensive Care Delirium Screening Checklist |
| ICU | Intensive Care Unit |
| LFT | Liver Function Test |
| NSAID | Nonsteroidal Anti-inflammatory Drugs |
| NT | Neurotransmitters |
| SGOT | Serum glutamic oxaloacetic transaminase |
| SGPT | Serum glutamic oxaloacetic transaminase |
| TB | Total Bilirubin |
| TLC | Total Leukocyte Count |
| UTI | Urinary Tract Infections |

# ABSTRACT

**Background**: Studies have shown that delirium is common in ICU settings, post surgery and in elderly. There are various predisposing risk factors for same. There is evidence of delirium occurring after dialysis.

**Aim**: To assess prevalence and risk factor of delirium in kidney disease (both acute and chronic) patients undergoing dialysis.

**Methods**: A one year prospective observational study of admitted patients of kidney disease (acute and chronic) requiring dialysis, aged 18 years or more. All patients who were already in delirium prior to dialysis were excluded. Mental status Examination (MSE) was done and Confusion assessment method scale (CAM) scale was applied on the included patients to make a diagnosis of delirium. For risk factors, sociodemographic data, past history of delirium, number of dialysis received and blood investigations were collected. P value for all parameters were calculated using chi-square, fisher's exact and unpaired t test.

**Results**: We found that prevalence of delirium was 20 % after dialysis. Risk factors identified were past history of delirium, >3 dialysis received, presence of Hypertension, increased urea, creatinine, hemoglobin, WBC levels, increased LFT's(significant p-value).

**Conclusion:** Prevalence of delirium in dialysis group patients is high. There are multiple risk factors for same and can be predicted and taken care of to reduce the long term consequences of delirium.

**Keywords**: delirium, prevalence, dialysis, risk factors.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ANNEXURE

# INTRODUCTION

Diseases of the renal system are a globally increasing cause of life impairment and death. Global Burden of Disease (GBD) conducted a study in 2015 that found out that 1.2million deaths, 19 million disability adjusted life years (DALYs) and 18 million years of life lost due to diseases of cardiovascular system are directly because of decreased Glomerular Filtration Rate (GFR). Hence, it is associated with a tremendous economic burden.[1] Most of the people with kidney disease will undergo dialysis. The process of dialysis itself predisposes for delirium either by leading to enormous, fast changes in fluids and urea which is known as Dialysis Disequilibrium Syndrome or by bringing about intradialytic cerebral hypoperfusion and hypoxia related to differences in circulating volume. A lot of the features of DDS are actually due to occurrence of brain swelling that occurs as a result of the procedure of dialysis.[2]

The typical features of delirium are acute alteration in both, the level of consciousness and cognition with specific decline in attention. It is dangerous and fatal but still a reversible condition of the CNS.[3] Symptoms include disturbance in level of consciousness along with ameliorated capacity of focusing, sustaining, or shifting attention, cognitive changes or emergence of disturbance in perception not better explained by previously present / evolving dementia. It ensues in a matter of hours to days & changes in severity.[4]

Delirium in ICU is not uncommon during critical diseases and can lead to adverse short and long term events. Although delirious state is one of the independent predictor of high levels of mortality and elongated Intensive Care Unit (ICU) and

hospital stay in severely ill individuals getting mechanical ventilation; it continues to be an unrecognized condition because of deficiency in regular monitoring and misdiagnosis.[5] Many staffs of ICU consider delirious state as a regular and dangerous ICU problem.[6,7] The Pain, Agitation, and Delirium Clinical Practice Guidelines developed by the American College of Critical Care Medicine focussed on early and immediate prevention of delirious state. Even though the need of assessment, prevention, and treatment of delirious state has been identified by Health Care Worker (HCW), the implementation continues to be difficult, and the occurrence of delirious state in ICU stays high[8,9] Multiple factors like drug use, period of ICU hospitalization, substance use, physical restraining are independent risk factors for delirious state.[10]

Patients who are having kidney disease (both acute or chronic) are also at risk for developing delirium due to various factors. Damage to the kidney is an under-evaluated risk factor that is vital in the development of delirious and comatose state during critically diseased conditions. Patients suffering from Acute Kidney Injury (AKI) are at a higher risk of delirium. This has been shown by studies done in the past.[11]

Yasui-Furukori N et al. (2017) showed in their study that occurrence of delirium in hemodialysis is 15% and it increases the risk of mortality. It may be due to disbalances in electrolyte levels which occur post dialysis, and can be a cause of a phenomenon called Dialysis Disequilibrium Syndrome (DDS), or due to surgical/medical factors. However, there aren't many studies about prevalence of delirium in patients undergoing dialysis & the possible risk factors causing it.[12]

Hence it is important to evaluate the prevalence of delirium and risk factors for delirium among patients undergoing hemodialysis so that preventive measures can

be taken to overcome the problems of morbidity and mortality associated. To our knowledge there are no studies conducted for evaluation of delirium in kidney disease patients receiving dialysis in India or outside. This makes this study even more important.

# OBJECTIVES

1. To estimate the prevalence of delirium in patients of kidney disease (both acute and chronic) undergoing renal dialysis.

2. To identify risk factors associated with causation of delirium in patients of kidney disease (acute and chronic) undergoing renal dialysis

# REVIEW OF LITERATURE

**Delirium: types, clinical features and mechanism.**

Delirium is a frequently and commonly occurring phenomenon leading to behavioral disturbances in medically ill individuals and is usually not diagnosed. It's a problem which does not belong completely either to medicine or psychiatry. Although multiple terminologies have come up to explain it like acute organic reaction, acute brain syndrome, acute confusional state, the term delirium is most reliably and commonly used. Acute brain failure is another used term , as it encompasses its multiple causes, settings, and also the significant morbidity and mortality it can cause.[13] Delirium may develop within hours to days. Commonly, the features keep changing and it is worst during night time. The fluctuation of the symptoms can lead to great difficulty in diagnosis, because the nursing staffs or relatives may report that patients were having altered and disturbed behaviour during night time while the doctors see those patients completely normal subsequently during daytime.[4]

According to the differences in psychomotor behaviour and activity, delirium can be divided into 3 types namely, 1)hyperactive 2) hypoactive and 3) mixed delirium. Large percentage of severely ill individuals undergo hypoactive delirium which mainly has symptoms of flat affect, apathy and unalertness. This type has the worst prognosis and can cause delayed impairment in cognition.[11] The second type is hyperactive delirium which presents with restless and agitated behaviour. The last one which is the mixed-type delirium is known to have fluctuations in psychomotor activity between high and low. Delirium usually means that there is an acute failure of

cerebral functioning. Its pathophysiology is quite complex and it results from both inflammatory and non-inflammatory process.[14]

Hallucinations in visual modality are typical and strongly indicate a delirious state. However, hallucinations of other modalities can also be present. Delusional thinking are usually transient, commonly of the persecutory type and are related to the disoriented state. Delusions can lead to aggression and agitated behavior. Delirium may also cause disturbance on affect and mood of the patient. The affect of the patient can range from apathetic and disinterested to anxious, perplexed, and fearful. Consequently, a casual assessment can lead to diagnosing depression and anxiety which would be incorrect. Disturbed cycles of sleep and wakefulness are frequent. An individual with altered behaviour and agitation at night who is roaming around in the ward and looks confused would be easy to recognise. However, an individual with hypoalertness and lethargy may go unrecognised.[4]

Delirium is thought to be caused by abnormal regulation of the normal activities of neurons which in turn can be caused due to abnormalities of other organ systems.[15] Multiple hypothesis like neuroinflammatory, neuronal aging, oxidative stress, neurotransmitter deficiency, neuroendocrine, diurnal dysregulation and network dysconnectivity have been postulated in the occurrence of delirium.[16] The theory of "global" cerebral impairment hypothesises that certain specific disruptions of neurological pathways and NT systems may result in delirious state. Due to the complicated mechanism of the attention system of our brain, it is not surprising that dysfunction of multiple different neurotransmitters like acetylcholine, serotonin, dopamine, cytokines and interleukins should be involved. However, clinically, there are a few pathophysiologic mechanisms that would be more common than the others.

Most likely, there is no final common pathway to the state of delirium; rather, delirious state should be viewed as a last common symptom of a number of situation-specific NT abnormalities.[17] The lack of one similar/common pathway or a uniform NT abnormality can explain why it is so difficult to prevent and treat delirium.[16]

**Burden of delirium**

Delirium, which is a sudden decline of the overall cognition (and its functioning), is a frequent, dangerous, and expensive complication of hospitalisation in elderly individuals, post-surgery patients, severely medically ill. While previous researches on delirium has mainly concentrated on medical aspects of preventing and treating it, newer studies have talked about its human burden, mainly on the individuals suffering from it and their caregivers and family.[18] Delirium burden, defined as patient's and family member's subjective experience about delirious state, includes symptom (of delirium) awareness, situational stress, and emotional response. Delirious state causes significant distress for the patient and their caregiver, and the burden of delirium can have an impact on emotional, psychological, and physical well-being long after the delirious episode has passed. Further and better understanding of burden of delirium may help in quantifying these significant problems of the experience of delirium and development of useful strategies to extend better support to patient and also to their family caregiver during and after a delirious episode.[19]

**Delirium: prevalence and risk factors.**

Delirium is never the result of one single factor.[20] Severely ill individuals may experience a variety of risk factors that can cause delirious episodes. These can be classified as predisposing and precipitating factors. Predisposing factors are also

referred to as "host factors" because they exist since before and are rarely modifiable, whereas on the other hand precipitating factors are usually modifiable through preventive interventions and are mostly iatrogenic or associated with the severity of the disease. We can reduce the impact of modifiable factors on patient outcomes if they are identified and prevented early. Furthermore, the current treatment strategy for delirium episodes in severely ill patients is more about prevention and mobilisation rather than treating it after its onset.[14,21]

Most of the factors responsible for a delirious state are potentially fatal, so delirium needs to be treated as an emergency medical condition. As it is established that a patient can suffer from delirium due to multiple causes, doctor should hence consider several factors while deciding about diagnosis and management. Drug intoxication, withdrawal syndromes, metabolic causes, infections, head injury, epilepsy (ictal/interictal/post-ictal), neoplasms, vascular and cerebrovascular diseases, disorders of cardiovascular system can all be causes of delirium.[4]

Dubois et al. (2001) discovered that hypertension, cigarette smoking, alcohol abuse, bilirubin abnormality, sodium abnormality, glucose abnormality, use of opiates as analgesics were all an important predicting factors for developing delirious state in ICU.[22] Higher Glasgow Coma Score, abnormal alkaline transferase levels, presence of acidosis, APACHE-II score; use of mechanical ventilation, steroids, sedatives and insulin and higher number of medications and smoking were all found to be predictors of delirium in ICU by the study done in PGI, Chandigarh by Sharma et al (2012).[23] Another study done by Aldemir et al (2001) showed that respiratory infections, fever, infections, anemia, hypotension, hypocalcemia, hyponatremia, azotemia, elevated liver enzymes, hyperbilirubinemia, acidosis were strongly related with the onset of

delirium whereas hypertension, hypo/hyperpotassemia, hypernatremia, hypoalbuminemia, hypo/hyperglycemia, cardiac disease, emergency admission, age and gender were not a predictor.[24]

Trauma, infection, sedation, urgent admission, and increased urea concentration were found to increase the chances of delirious state in ICU by Francesco et al (2021).[25] Factors like use of restraints and length of ICU hospitalization were also discovered to be causing significant risk for delirium in a study done by Yanbin et al (2019).[10]

**Diagnosis of delirium**

**Diagnostic guidelines (ICD-10):**

According to ICD-10, symptoms (mild or severe), must be present in each one of the given domains:

(a) impairment in attention and consciousness

(b) overall disturbed cognition including distorted perception, illusions and hallucinations, impaired memory (immediate and recent) , disorientation (time, place and person);

(c) disturbances in psychomotor activity

(d) alterations of the sleep - wake cycle including insomnia, complete loss of sleep or alteration of the sleep wake cycle, drowsy state during day; nighttime worsening of symptom; nightmares (which may continue as hallucinations after getting up);

(e) emotional disturbance including symptoms of anxiety, depression, apathy, euphoria and irritability.

Even though there are few diagnostic criteria devised for diagnosis of delirium, it still remains a clinical condition with no laboratory parameters specific for its diagnosis.[14] A standard clinical evaluation doesn't provide an accurate diagnosis. Keeping this in mind, many methods for diagnosis of delirium in ICU patients have been devised and validated, but the Confusion Assessment Method for the ICU (CAM-ICU) and the Intensive Care Delirium Screening Checklist (ICDSC) are the ones which are widely used. These tools have been especially designed to use in those people who are at a higher risk of going into delirium.[26,27]

**CKD**

Larger than 20 million US citizens have CKD, and over 500 000 have ESRD. Hypertension and diabetes mellitus are the most frequent etiologies of CKD. CKD can in turn result in diseases of the cardiovascular system, cognitive problems, frequent hospitalisation, and all-cause mortality. In old CKD patients, risk of cardiovascular diseases and all-cause mortality depends upon kidney functioning, age and protein levels in urine. Occurrence of these are more likely than progression to ESRD. Other CKD complications include metabolic abnormalities like anaemia, secondary hyperparathyroidism, and electrolyte imbalances. The main aims of treatment are to slow down the reduction in kidney function, prevention of cardiovascular disease, treatment of complications, and to facilitate the transition to renal replacement therapy when indicated. Collaboration between primary care providers and nephrologists is the most effective way to manage these difficult patients. Other risk factors include autoimmunity, systemic infections, UTI, kidney stones, lower urinary tract obstruction, increased uric acid, AKI, a family history of CKD, and sociodemographic factors such as old age and black race. Heavy

consumption of alcohol and tobacco, obesity, and NSAIDs are all risk factors. Patients over the age of 55 and those with presence of hypertension or diabetes, should be screened.[28] Estimation of GFR and test for markers of kidney damage should be done in screening.[29]

In India, true burden of CKD is difficult to determine. The CKD prevalence is approximately 800 parts per million population (pmp), with an incidence of ESRD of 150–200 pmp. The most common etiology of CKD is diabetic nephropathy according to population-based studies. As CKD is now realised as a significant problem in India, the government has started establishing stand alone hemodialysis units which can be utilised at a cost which can be afforded. The National Organ Transplant Program has also been started to make transplantation on a national scale easier. The hemodialysis programme is about halfway through its implementation. Hence it's still a long journey. With increase in patients of hypertension and diabetes, the burden of CKD is also going to increase in India. Hence, a cost effective CKD prevention program is required in long run.[30] Also a multi sectoral approach is required for the same.[1] 2/3$^{rd}$ of dialysis patients have moderate to severe cognitive impairment.[31]

Chronic renal failure is the last and last common path of multiple disease of the renal system. When a patient's kidney functioning is not sufficient to sustain bodily requirements, options available are continuous renal dialysis (which includes both hemodialysis and peritoneal dialysis) or renal transplant. There are numerous physiologic derangements associated with renal failure due to any cause. Water and mineral homeostasis (sodium, potassium, chloride, calcium, phosphorus, magnesium, sulphate) are no longer possible, and elimination of day to day metabolic load of fixed $H^+$ ions is also not possible. Harmful by-products of nitrogen metabolism (such as

creatinine, urea and uric acid) accumulate in circulation and tissues. Ultimately, the kidneys can no longer work as endocrine organs (production of erythropoietin).[32]

The procedure of dialysis is aimed at removal of the nitrogenous by-products of catabolism and correcting the salt-water and acid-base imbalances related to kidney failure.[33] Even then dialysis is an ineffective remedy for the multiple disruptions that take place in renal failure because it cannot improve kidney's endocrinological functions.[34]

The indications for initiating dialysis procedure for chronic renal failure vary from physician to physician. A few of them start dialysis when the residual glomerular filtration rate (GFR) falls under 10 mL/min/1.73 $m^2$ body surface area (15 mL/min/1.73 $m^2$ in diabetics) whereas others begin the procedure when the patients have lost the stamina and energy to perform usual day to day tasks and activities. Most agree that dialysis treatments are urgently needed in the presence of symptoms of uremia (nausea, vomiting, anorexia, fatigability, diminished sensorium) and signs (pericardial friction rub, refractory pulmonary edema, metabolic acidosis, foot or wrist drop, asterixis).[35]

**CKD and Psychiatry**

Chronic kidney disease elevates the risk of death in affected patients by a factor of 2–4 when compared to unaffected patients. Dialysis patients who have stage V CKD have a disproportionately high symptom burden. These patients, in particular, suffer from fatigue, symptoms of anxiety and depression, as well as sleep disturbances and itching.[12]

Dementia, depression and delirium, all of these conditions are common in patients with early CKD and those who are undergoing dialysis for ESRD. Even though dementia, delirium, and depression are separate disorders, dementia-like symptoms may be present in depression, dementia can later cause delirium, and delirium can predict future dementia. The full spectrum of CKD's neuropsychiatric complications are not very clear. Cognitive function, which can deteriorate very early in the course of kidney diseases, is known to be impaired in nearly 90% of patients receiving dialysis, and impaired cognitive function further leads to elevated risks of mortality.[36] Haemodialysis is not a complete cure, while it may correct metabolic and toxic disturbances in CKD patients, it also leads to cerebral perfusion, which results in repeated cerebral oedema and hypotension. Added measures are required to limit delirium, detect and minimise the impact of dementia on daily activities, and aggressively treat depression. The degree of kidney function is inversely related to both the prevalence of cognitive dysfunction and also the rate of deterioration of cognitive functioning. 2/3$^{rd}$ of patients receiving dialysis have moderately to severely impaired cognition.[31] Due to the decreased clearance of frequently prescribed medicines and the elongated hospitalisation which is experienced by these individuals, patients with CKD and those undergoing dialysis procedure are at a

higher risk of delirium. Depression is most likely underdiagnosed and remains untreated in CKD populations and those receiving dialysis.[37] AKI is also a major predicting parameter for delirious state in critically ill individuals.[38]

The mildest form of the more serious brain affections associated with renal disease seems to be a tendency to fall into a state of silent stupor, which can vary in severity from mere inactivity of manners and sluggishness of intellect to complete lack of sensibility to one's own environment. Despite the fact that severe uremia is uncommon now due to the widely available dialysis procedure, there is still a link between early stages of CKD and cognitive dysfunction, depressive episodes, and vulnerability to acute confusional state. These associations are important from clinical point of view because neuro-psychiatric disorders have been linked to increased patients mortality, higher incidences of hospitalisation, and poor treatment compliance.[37]

Delirium is a frequent symptom in patients receiving dialysis. Reason for this has been linked to electrolyte imbalances which occur after the procedure of dialysis, resulting in a condition which is aka DDS, or to surgical/medical complications. Uremia, anaemia, and hyperparathyroidism can all cause delirium.[12]

In a study done by Norio et al. which was aimed at finding association between delirium after hemodialysis and mortality rate, they found that prevalence of dialysis after delirium was 15 % among 338 patients and was more common in older age groups. They also concluded that patients who developed delirium after hemodialysis had higher mortality rate in next 1 year.[12] Not many studies have been done about prevalence of delirium after dialysis but delirium has been extensively studied in other settings like ICU, post-op settings and in elderly. Another study done

in Italy by Francesco et al (2021) estimated 55.8 % incidence of delirium among 165 patients admitted in ICU.[25] A study done in PGI, Chandigarh India by Sharma et al (2012) estimated prevalence and incidence of delirious state in ICU as 24.4% & and 53% respectively, among 140 patients.[23] Aldemir et al. (2001) states that 30 % of patients in surgical ICU develop delirium whereas 25 % delirium prevalence was reported in geriatrics medicine unit in the study done by Sharon et al (2014).[24,39]

Older age group patients with CKD are more likely to need dialysis as evidenced by the study done by Beddhu et al. (2001) in which mean age of patients receiving dialysis was 53 years.[40] Older age has also been implicated as one of the risk factor of delirium as shown in studies done by Norio et al. (2017) and Sharma et al. (2012) who found that mean age of patients in delirium were significantly higher than non-delirious patients.[12,23]

According to the National Health and Nutrition Examination Survey (NHANES), among the US population, CKD with no ESRD is more common in women than males. However, less number of females received dialysis than males.[41] The exact reason is not known but there are several hypothesis regarding this which states that men progress to ESRD more rapidly than females. Another hypothesis states that lower awareness among women can be the reason.[42] As far as gender is concerned, studies done by Sharma et al. (2012) and Norio et al (2017) did not find any specific gender to be at higher risk of delirium.[12,23]

Urea and creatinine have been a good pointers of the normal functions of kidney. According to the study done by Azra et al.(2014) an increase in these parameters is indicative of renal dysfunction.[43] Deranged levels of these can also be a cause of delirium. In a study done by O'Keeffe et al. (1996) elevated urea levels was

found to be a risk factor of delirium in elderly while Francesco et al. (2021) concluded that increased urea levels was a predictor of delirium in ICU.[25,44] Increased creatinine level was also found to be a predictor of delirium after cardiac surgery in the study done by Bakker et al (2012).[45] However increased urea and creatinine was not a significant risk factor in the study done by Sharma e al (2012). [23]

Anemia is a common condition which occurs in CKD and has bad outcome. There could be various reasons for this like reduction in erythropoietin, reduced life of erythropoietin, uremia induced inhibitors of erythropoiesis.[46] Anemia is likely to be present in patients receiving dialysis. In the study by Aldemir et al. anemia was proven to be a strong risk factor of causing a delirious state in surgical ICU.[24] However, in the study by Sharma et al. (2012) anemia was not a predicting factor of delirious state in ICU.[23] As anemia is common in CKD patients, its role in causing delirium becomes important for evaluation. Along with anemia, high WBC count is also an important risk factor for CKD.[47] Francesco et al. (2021) and Aldemir et al. (2001) concluded in their study that infections which leads to high WBC count predisposes to delirious state.[24,25] Some studies like the one done by Sharma et al (2012) found opposite results.[23]

Sharma et al. (2012) in their study also concluded that hypocalcemia can lead to delirious state while Aldemir et al. (2001) showed that hypoalbuminemia also has the same fate for the patient.[23,24] Dialysis procedures also lead to other changes in electrolytes like that of sodium and potassium.[35] Sharma et al. (2012) did not find changes in sodium and potassium to have a significant role in causing delirium.[23] However, Yıldızeli et al (2005) found abnormal potassium levels to have a relation with causation of delirium.[48] Aldemir et al. (2001) and Wolf et al (2016) further found

role of abnormal sodium levels in predisposing to delirium.[24,49] Moreover, Aldemir et al. (2001) who found that hyperbilirubinemia and elevated liver enzymes are risk factor of delirium in ICU patients.[24]

Hypertension and Diabetes are both important causes of CKD.[30,38] Dubois et al. mentioned in their study strong relation of hypertension and delirious state in ICU setting.[22] However diabetes was not found to be a risk factor for delirious state by Bakker et al. (2012) and Yanbin et al (2019).[45,50]

The above mentioned parameters have all been shown to play some role in causation of delirium in ICU settings or post-surgery state. These parameters are also shown to be deranged in CKD patients on dialysis. Hence, there is a pressing need to further evaluate their role as a predisposing factor for delirium in groups of patients receiving dialysis.

**Dialysis Disequilibrium Syndrome**

DDS is a hemodialysis related acute CNS complication characterised by symptoms of fatiguability, headache, nauseous feeling, vomiting, blurring of vision, tremors, muscle cramps, impaired consciousness, seizures, and comatose state. Because of cerebral edema, it can result in death. CNS symptoms are more frequent towards the end of a dialysis treatment, which is characterised by rapid clearance of urea, emphasising the plasma CSF-urea concentration gradient. It has been termed disequilibrium as this syndrome usually happens when parameters of blood biochemistry start improving. Cerebral edema in DDS occurs as a result of rapid and fast haemodialysis and the development of an osmotic gradient between plasma and the brain, according to animal studies. The gradient is caused by the differing urea concentrations between the two spaces.[51] CT scan of head in patients of CKD receiving initial/intermittent procedure of haemodialysis revealed decreased density of brain parenchyma, indicating increased content of brain water. Diffusion-weighted MRI has recently revealed that there is interstitial edema of the cerebral cortex in nephrectomized humans and animals following the initial treatment of hemodialysis.[2,52]

Symptoms are mostly mild, transient, and self-limiting, but DDS may lead to fatality in rare cases. Symptoms are much more common in patients who have significantly high plasma urea levels, in patients of CKD (rather than AKI), and in patients who receive aggressive urea removal as part of their initial haemodialysis treatment. It is more frequent in children and adolescents, patients who have a history of head trauma, subdural haematoma, CVA, and malignant hypertension, and patients with risk factors for cerebral edema, such as hyponatremia. DDS is a clinical

diagnosis that occurs in individuals who are about to initiate haemodialysis. There is no laboratory parameter or any biological marker which can diagnose the condition of DDS, so it is mostly an exclusion diagnosis. Uremic, hyponatremic, hypoglycemic state, CVA, and subdural haematoma are all examples of processes that can cause similar symptoms. EEG has been investigated as a test to help in diagnosing DDS, although its clinical utility is restricted. [52] The occurrence of delirious state impacts significantly and negatively on the mortality among patients who are receiving haemodialysis procedure.[12] DDS is now recognised as a separate clinical condition that is decreasing and becoming uncommon as technology of dialysis is improving, mainly in terms of reduced flow rates for both blood and dialysate, lesser dialysate volume, and more regular and dialysis. Brain edema is the cause of most of the features of DDS. As a result, individuals who have previously existing conditions characterised by brain edema (CVA, malignant hypertension, hyponatremic state, head injury, hypoglycemic state) are way more vulnerable to the complications of DDS. This could be a problem for individuals who require dialysis and have acute renal failure as well as many other medical and surgical issues.[2]

Silent lesions of cerebral white matter have been seen using conventional MR imaging in 1/3$^{rd}$ of individuals with CKD who have a GFR ranging from 15 and 60 mL/min. These lesions are associated with vascular risk factors, mainly hypertensive state, and are indicative of brain damage due to ischemia caused by generalised damage to vessels. The severity and frequency of these lesions in patients are extreme, that could be explained by the extent of impairment in renal functioning in patients who require renal replacement therapy to survive.[53]

As the clinical understanding of predisposing and precipitating factors grows, strategies to prevent and manage delirious state will become immensely important. While provision of good nursing care and medical care are the primary methods of preventing delirium development, the importance of drugs in both triggering and correcting delirium is becoming more apparent. Preadmission clinics, for example, that plan perioperative and post-operative care before elective surgical procedures should be more aware of these concepts.[54] Pharmacologically active agents may be contributing to the etiology of delirium by influencing a number of neurotransmitter systems. Anticholinergic activity is found in a surprising number of drugs, with varying degrees of potency. Pharmacodynamic and pharmacokinetic changes, such as renal failure, increase the potential for drug toxicity. In order to decrease the risk of delirious condition as much as possible, a critical medication review is required. Patients who are thought to be at a higher risk of having delirium due to a combination of susceptibility and/or predictable stress may receive some help by the use of antipsychotic medication or cholinesterase inhibitors as a preventative measure.[55]

A major chunk of individuals have hypoactive type delirium, which means that even though they don't have agitated behavior or restlessness, they can still be going through not so pleasant symptoms such as hallucinations and delusional state. The multifactorial nature of risk factors that lead to delirious state adds to the difficulty of determining the efficacy of specific drug related therapy as well as the prospects for successful application clinically. Scarcity of knowledge of any potentially significant differences in the mechanisms of delirious state in various groups such as dementia, post-operative, septic conditions, haemodialysis patients, or terminally diseased patients also restricts drug-related therapy guidelines. Evidently

there is a requirement to increase our knowledge of the pathophysiology, phenomenology, and efficacy of specific drug-related therapy in subgroups and subtypes of delirium. [54,56]

# METHODOLOGY

**Type of study**: The study was a cross-sectional study.

**Study period and duration**: One year study done from 1st January 2020 to 31st December 2020.

**Place of study**: KLE's Dr. Prabhakar Kore Charitable Hospital and Research Centre, Belagavi.

**Study population**: All patients with kidney disease (both acute and chronic) admitted and undergoing dialysis in KLE's Prabhakar Kore Charitable Hospital and Research Centre, Belagavi over a period of one year.

**Sample size**: Calculated by formula $4pq/d^2$

P= 15%[12] , q=85% and d = 5 %

Sample size= 100

The prevalence(P) was taken from a study done by Yasui-Furukori et al (2017).[12] However, due to COVID-19 pandemic, only 75 samples could be included in the study.

**Ethical clearance**:

Prior to commencement of the study, the ethical clearance was obtained from Institute of Ethics committee, Jawaharlal Nehru Medical College, Belagavi. Ref. No. MDC/DOME/297 (Annexure I)

**Inclusion criteria**:

- All patients of age 18 years and above who are diagnosed with Kidney disease (acute and chronic) and require renal dialysis in dialysis unit of KLEs Prabhakar Kore Charitable Hospital and Research Centre, Belagavi.

**Exclusion criteria**:

- Patient already in delirium prior to dialysis.

**Instruments used**:

**Confusion assessment method (CAM):**

This assessment tool was applied twice within 48 hours to detect delirium. The CAM instrument, that takes lesser than five minutes to finish, is made up of 9 operationalized parameters from the Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R). 4 criterias is established: acute onset and fluctuating course, in-attention, disorganised thinking, and altered level of consciousness. The presence of both the 1st and 2nd criteria, as well as either the 3rd or 4th criterion, was needed by the CAM algorithm for the diagnosiing delirium.[26,27] (Annexure IV)

**Procedure:**

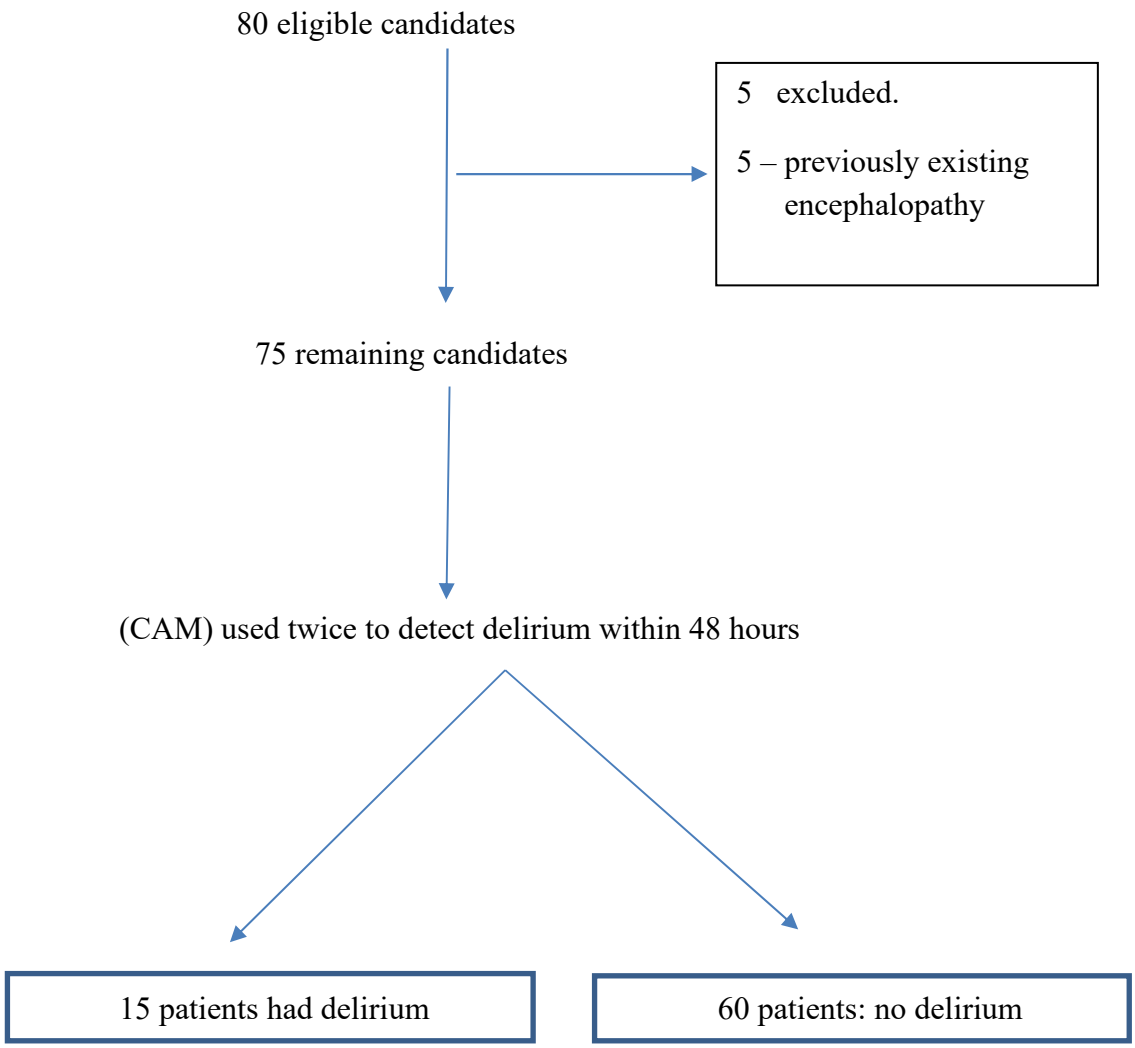
Patients with the diagnosis of Kidney Disease (both acute or chronic) who were admitted for the procedure of dialysis and who met the inclusion and exclusion criteria were included in the study. Informed consent was taken from all these participants or from their relatives where required.(Annexure II) Sociodemographic data was recorded on a specially designed proforma.(Annexure III) Other history including presence of hypertension/diabetes, number of dialysis received in the past, past h/o delirium were also obtained. Along with this, blood investigations were

recorded which were already done prior to dialysis by the primary clincian under whom the admission was made. General physical examination was done. Patients were examined for delirium twice within 48 hours after they had undergone dialysis. Based on mental status examination and application of CAM, diagnosis of delirium was made.

**Data analysis:**

After collecting all the samples, the data obtained was tabulated in Microsoft excel sheet and subjected to appropriate statistical analyses. Descriptive data were presented as percentages and mean and standard deviation was calculated. The strength of association (p value) was calculated using chi-square and fisher's exact test for qualitative data, and using unpaired t test for quantitative data. Statistical significance was set at p value less than 0.05. All tests were 2-tailed.

**Selection of patients**:



# RESULTS

## Table 1: Sociodemographic details of the study sample. (N=75)

| Sociodemographic variables | | |
|---|---|---|
| | **No. of cases** | **Percentage (%)** |
| **Age in years (MEAN +/- SD)** | 55.413 +/- 12.9 | |
| 21-40 | 12 | 16 |
| 41-60 | 34 | 47 |
| >60 | 29 | 37 |
| **Gender** | | |
| Male | 51 | 68 |
| Female | 24 | 32 |
| **Occupation** | | |
| Unemployed | 14 | 19 |
| Homemaker | 15 | 20 |
| Farmer | 13 | 17 |
| Self-employed | 13 | 17 |
| Unskilled | 7 | 9 |
| Skilled | 8 | 11 |
| Professional | 5 | 7 |
| **Religion** | | |
| Hindu | 65 | 87 |
| Muslim | 10 | 13 |

Table 1 shows description of the sociodemographic variables of the study sample. 47 % of the sample were in the age group 41-60 years (Figure 1a). The mean age was 55.413(SD 12.9). The majority of the patients were males constituting 68% while 32 % were females (Figure 1b). Employment status showed that 20 % were homemakers while 19% were unemployed. 17 % were farmer while another 17 % were self-employed. 11% were skilled while 9% had an unskilled job. Only 7% of the sample had professional employment. 87 % of the sample was constituted by Hindu and rest were Muslim.

**Figure 1a: Age (years) distribution in patients on dialysis**

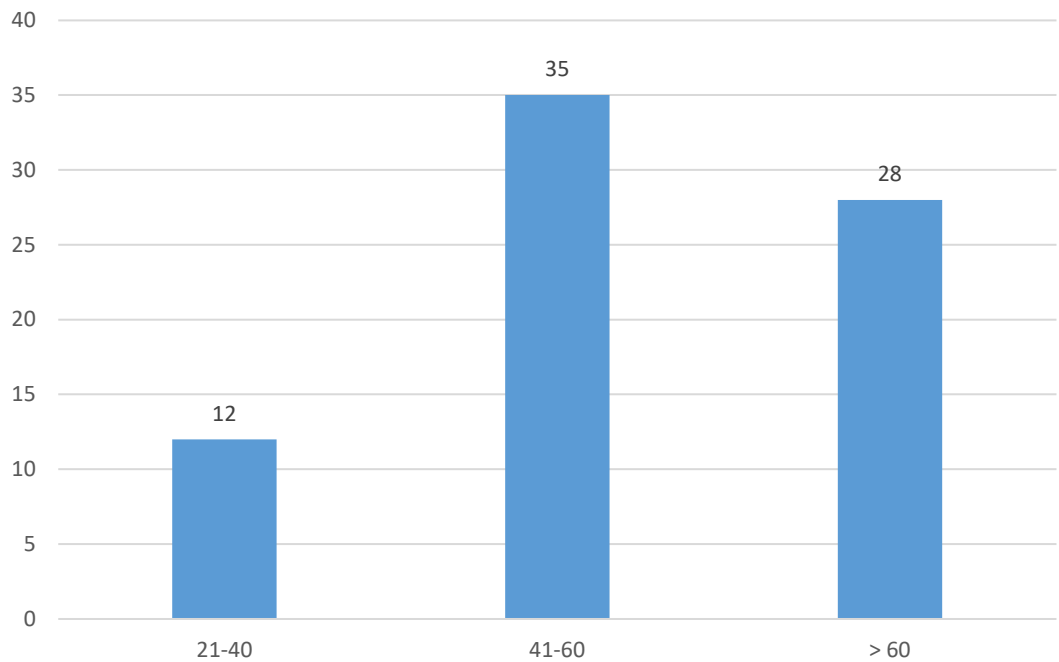


**Figure 1b: Gender Distribution in Patients on Dialysis**

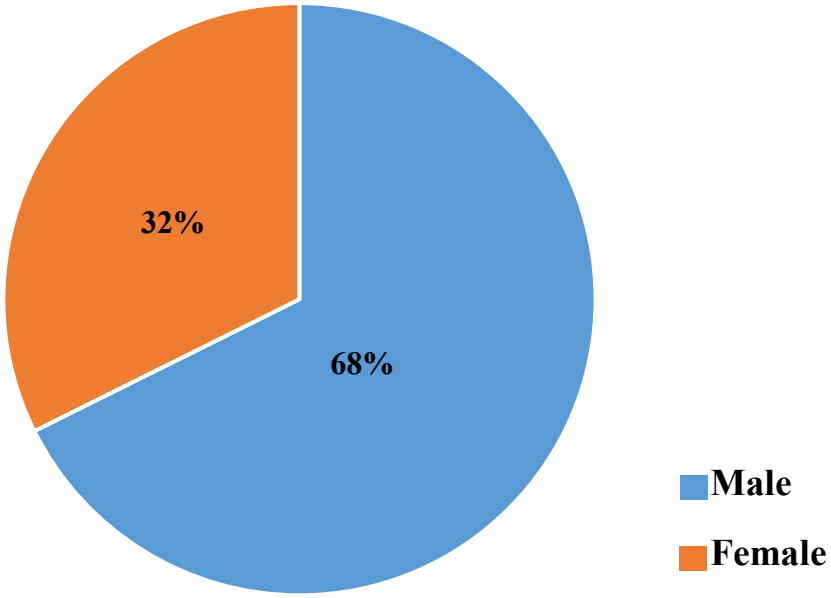


**Table 2: Prevalence of Delirium in patients on Dialysis.**

| | No. of patients | Percentage |
|---|---|---|
| Delirium | 15 | 20% |
| No Delirium | 60 | 80% |

In the present study, as shown in Table 2, 15 out of 75 patients developed delirium that is the prevalence of delirium was 20 % and 60 patients while 80% did not have delirium. Same is shown in Figure 2.

**Figure 2: Prevalence of delirium in patients on dialysis.**

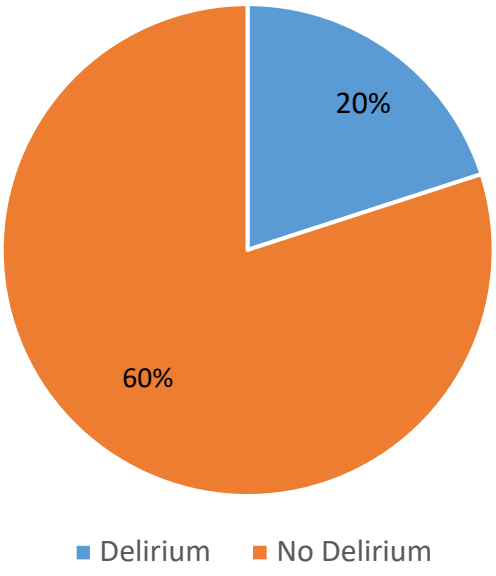


**Table 3: Comparison of Prevalence of Delirium across age groups. (N=75)**

| Age(years) (55.413 +/- 12.9) | Delirium n (%) | No Delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **21-40** | 2(16.6) | 10(83.4) | 12 | 0.774 |
| **41-60** | 6(17.6) | 28(82.4) | 34 | |
| **> 60** | 7 (24.1) | 22(75.9) | 29 | |
| **Total** | 15 | 60 | 75 | |

p value < 0.05 is significant

In our sample, 24.1 % of individuals who developed delirium were in the age group >60 years. 16.6 % were in age group of 21-40 years, while 17.6 % were in age group 41-60 years. This was found to be statistically non significant. (p value=0.774)

**Table 4: Comparison of Prevalence of Delirium across both genders. (N=75)**

| Gender | Delirium n (%) | No Delirium n (%) | Total | p value |
|---|---|---|---|---|
| Male | 10 (19.6) | 41 (80.4) | 51 | 0.9015 |
| Female | 5 (20.83) | 19 (79.17) | 24 | |
| **TOTAL** | 15 | 60 | 75 | |

P value < 0.05 is significant

Table 4 describes that 19.6 % of males developed delirium while 20.83 % of the females developed delirium. (p value = 0.9015 ). This was not significant.

**Table 5: Association of Prevalence of Delirium with Hypertension and Diabetes. (N=75)**

| | Delirium n (%) | No delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **Hypertension** | | | | |
| **yes** | 12(27.9) | 31(72.1) | 43 | 0.0472* |
| **no** | 3(9.4) | 29(90.6) | 32 | |
| **TOTAL** | 15 | 60 | 75 | |
| **Diabetes** | | | | |
| **yes** | 8(33.33) | 26(66.67) | 34 | 0.4865 |
| **no** | 7(17.0) | 34(83) | 41 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

Table 5 describes association of delirium with hypertension and diabetes. 27.9 % of patient with hypertension had delirium while only 9.4 % without hypertension had delirium. This was statistically significant. (p value=0.0472). On considering diabetes mellitus, 33.3 % with diabetes and 17% without diabetes had delirium. This was not significant. (p value= 0.4865)

**Table 6: Association of Prevalence of Delirium with Serum Urea and Serum Creatinine levels. (N=75)**

| | Delirium n (%) | No delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **S. urea (mg/dl)** | | | | |
| **<50** | 2 (11.1) | 16 (88.9) | 18 | 0.2795 |
| **≥ 50** | 13 (22.8) | 44 (77.2) | 57 | |
| **TOTAL** | 15 | 60 | 75 | |
| **S. Creatinine (mg/dl)** | | | | |
| **<5** | 0 (0) | 31 (100) | 31 | <0.0001* |
| **5-10** | 6 (20) | 24 (80) | 30 | |
| **≥ 10** | 9 (64) | 5 (36) | 14 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value < 0.05 is significant

Table 6 describes association of prevalence of delirium with serum urea and creatinine levels. 22. 8% of people who had serum urea ≥ 50 developed delirium while 11.1 % of those who had serum urea<50 developed delirium. This was not significant.(p value=0.2795). 64 % of sample who had serum creatinine ≥ 10 developed delirium while only 20 % with serum creatinine 5-10 had delirium. This was statistically significant (p value <0.0001).

**Figure 3: Association of delirium with serum creatinine levels.**

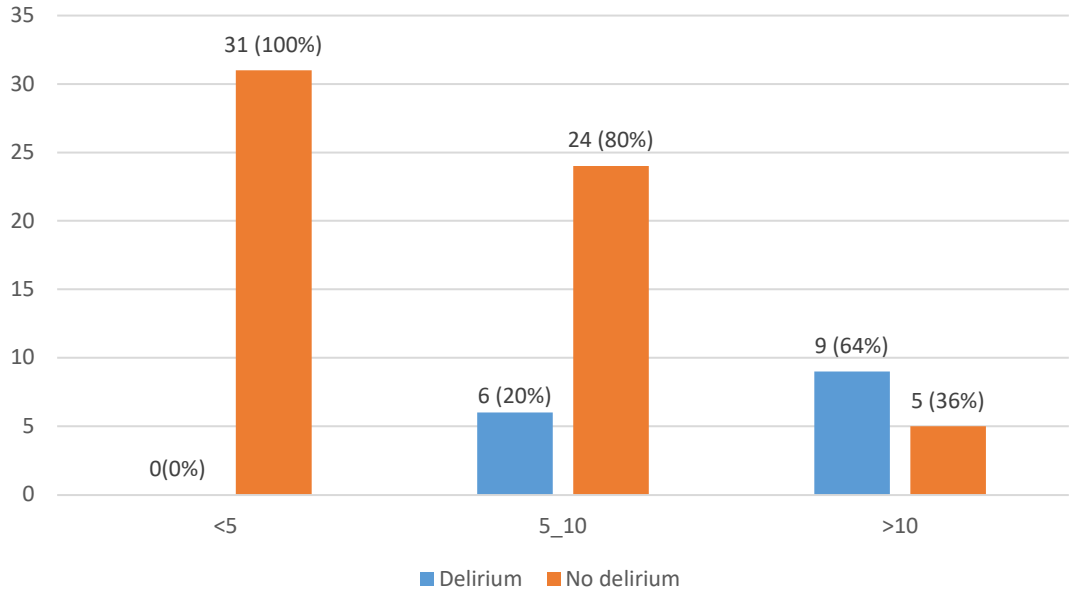


**Table 7: Association of Prevalence of Delirium with Haemoglobin levels . (N=75)**

| Haemoglobin (mg/dl) | Delirium n (%) | No Delirium n (%) | Total | p Value |
|---|---|---|---|---|
| **< 8** | 5 (71) | 2 (29) | 7 | 0.0002* |
| **8 - 9.9** | 6(38) | 10 (62) | 16 | |
| **10 - 11.9** | 2(10) | 18(90) | 20 | |
| **12 – 15** | 2(6) | 30(94) | 32 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value < 0.05 is significant

<8-severe anemia

8-9.9- moderate anemia

10-11.9- mild anemia

Table 7 describes association of delirium with Haemoglobin levels of patients. 71% of patients with severe anemia developed delirium, 38 % with moderate anemia, 10 % with mild anema and only 6% with no anemia developed delirium. This difference was statistically significant (p value =0.0002).

**Figure 4: Association of Prevalence of Delirium with Hemoglobin levels .**

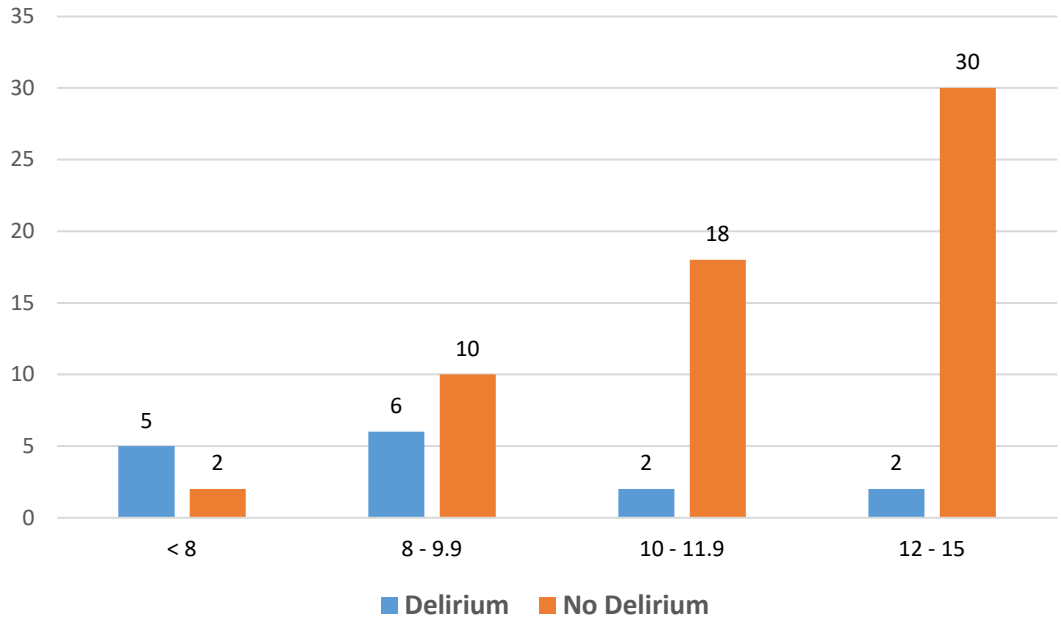


**Table 8: Association of Prevalence of Delirium with Total Leukocyte Count (TLC levels). (N=75)**

| TLC ($x10^9$/L) | Delirium n (%) | No Delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **4 -10** | 5 (9.4) | 48 (90.6) | 53 | 0.0004* |
| **≥ 10** | 10 (45.4) | 12 (54.6) | 22 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

≥ 10- leukocytosis

Table 8 describes association of delirium with Total Leukocyte Count. 45.4% of patients with leukocytosis (TLC> 10) developed delirium while only 9.4 % with normal TLC developed delirium. This was found to be significant (p value=0.0004.

**Figure 5:Association of Prevalence of Delirium with TLC levels.**

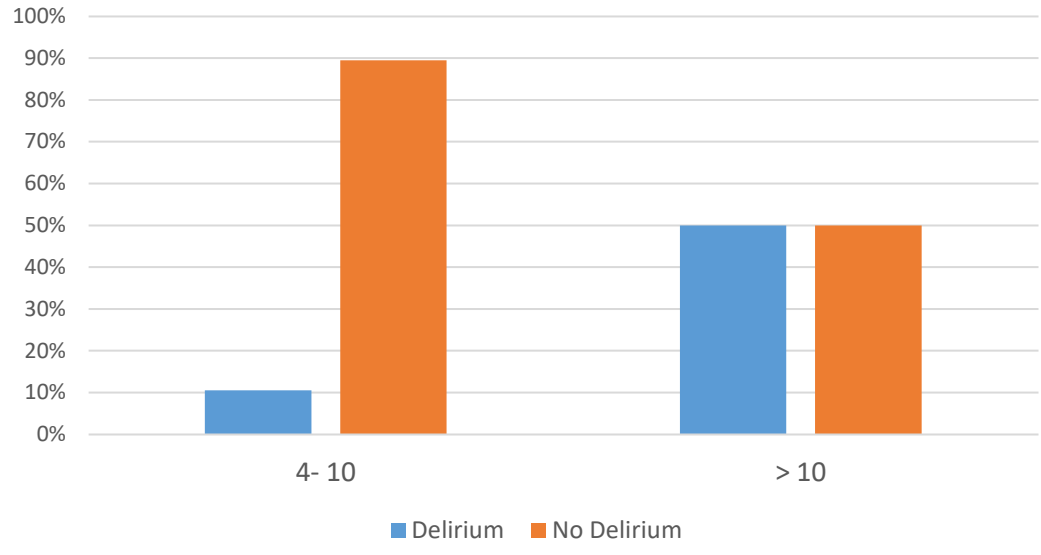


**Table 9: Association of Prevalence of Delirium with Serum Albumin levels. (N=75)**

| Albumin (g/dl) | Delirium n (%) | No Delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **3.5-5.2** | 2 (11.11) | 16 (88.88) | 18 | 0.2795 |
| **<3.5** | 13 (22.80) | 44 (77.20) | 57 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

3.5-5.2- normal albumin level

<3.5- hypoalbuminemia

Table 9 describes association of delirium with albumin levels. 22.8 % of patients with hypoalbuminemia developed delirium while 11.11 % of patients with normal albumin levels developed delirium. This was found to be non significant (p value= 0.2795)

**Table 10: Association of Prevalence of Delirium with Serum Calcium levels. (N=75)**

| Calcium (mg/dl) | Delirium n (%) | No Delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **8.6-10.2** | 3 (10.71) | 25 (91.29) | 28 | |
| **<8.6** | 12 (25.53) | 35 (74.47) | 47 | |
| **TOTAL** | 15 | 60 | 75 | 0.1207 |

*p value<0.05 is significant
8.6-10.2-normal calcium levels
<8.6- hypocalcemia

Table 10 describes association of prevalence of delirium with serum calcium levels. In this study 10.71 % of patients who had normal calcium levels developed delirium whereas 25.53 % of patients with hypocalcemia developed delirium. This was found to be non significant (p value=0.1207).

**Table 11: Association of Prevalence of Delirium with Serum Potassium and Serum Sodium levels . (N=75)**

| | Delirium n (%) | No delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **S. Potassium (mEq/L)** | | | | |
| **<3.5** | 2 (15.38) | 11 (84.62) | 13 | 0.6557 |
| **3.5-5.1** | 11 (19.64) | 45 (80.36) | 56 | |
| **>5.1** | 2(33.33) | 4(66.66) | 6 | |
| **TOTAL** | 15 | 60 | 75 | |
| **S. Sodium (mEq/L)** | | | | |
| **<135** | 6(14.28) | 36(85.72) | 42 | 0.1628 |
| **135-145** | 9(27.27) | 24(72.73) | 33 | |
| **>145** | 0(0) | 0(0) | 0 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

For potassium, <3.5- hypokalemia and >5.1- hyperkalemia

For sodium, <135- hyponatremia, >145- hypernatremia

Table 11 describes the association of prevalence of delirium with serum potassium and sodium levels. In this study, 2 out 13 (15.38%) patients who had hypokalemia, 11 out of 56 patients (19.64%) who had normal potassium levels while 2 out of 6 patients (33.33%) who had hyperkalemia developed delirium. This was statistically non significant (p value =0.6557).6 out of 42 patients(14.28%) with hyponatremia developed delirium while 9 out of 33 patients (27.27%) who had normal sodium levels developed delirium. There were no patients with hypernatremia. This was not statistically significant (p value= 0.1628).

**Table 12: Association of Prevalence of Delirium with LFTs (Liver Function Test). (N=75)**

| | Delirium n (%) | No delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **Total Bilirubin (TB) (mg/dl)** | | | | |
| **<2** | 9(14.5) | 53 (85.5) | 62 | 0.0095* |
| **≥ 2** | 6(46.1) | 7(53.9) | 13 | |
| **TOTAL** | 15 | 60 | 75 | |
| **SGOT (units/L)** | | | | |
| **<120** | 11(16.4) | 56(83.6) | 67 | 0.0248* |
| **≥120** | 4(50) | 4(50) | 8 | |
| **TOTAL** | 15 | 60 | 75 | |
| **SGPT (units/L)** | | | | |
| **<120** | 11(16.4) | 56(83.6) | 67 | 0.0248* |
| **≥120** | 4(50) | 4(50) | 8 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

Table 12 describes association of prevalence of delirium with LFT's. In this study, 6 out of 13 (46.1%) people who had bilirubin levels more than or equal to 2 mg/dl developed delirium whereas only 9 out of 62 with bilirubin levels <2 mg/dl had delirium. This was found to be statistically significant (p value=0.0095). Table 12 shows that 50 % of patients who had the levels of these enzymes ≥ 120 (3 times the normal value) developed delirium while only16.4 % with enzyme level <120 had delirium. This was also statistically significant (p value=0.0248).

**Figure 6: Association of Prevalence of Delirium with LFTs**

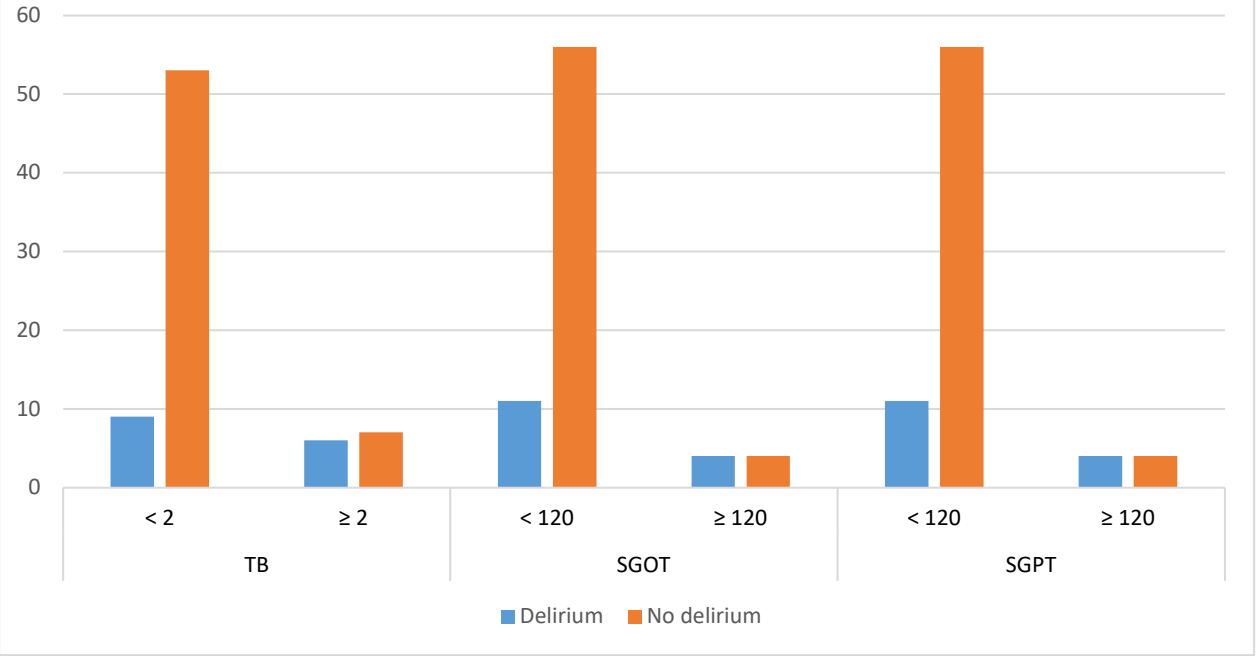


**Table 13: Association of Prevalence of Delirium with number of Dialysis received. (N=75)**

| No. of Dialysis received | Delirium n (%) | No delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **<3** | 8(12.6) | 55(87.4) | 63 | 0.0003* |
| **≥3** | 7(58.3) | 5(41.7) | 12 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

Table 13 describes association of prevalence of delirium with no. of dialysis received. Among patients who had received ≥ 3 dialysis, 58.3 % developed delirium while only 12.6 % who received <3 dialysis developed delirium. This was statistically significant (p value= 0.0003).

**Figure 7: Association of Prevalence of Delirium with number of Dialysis received.**

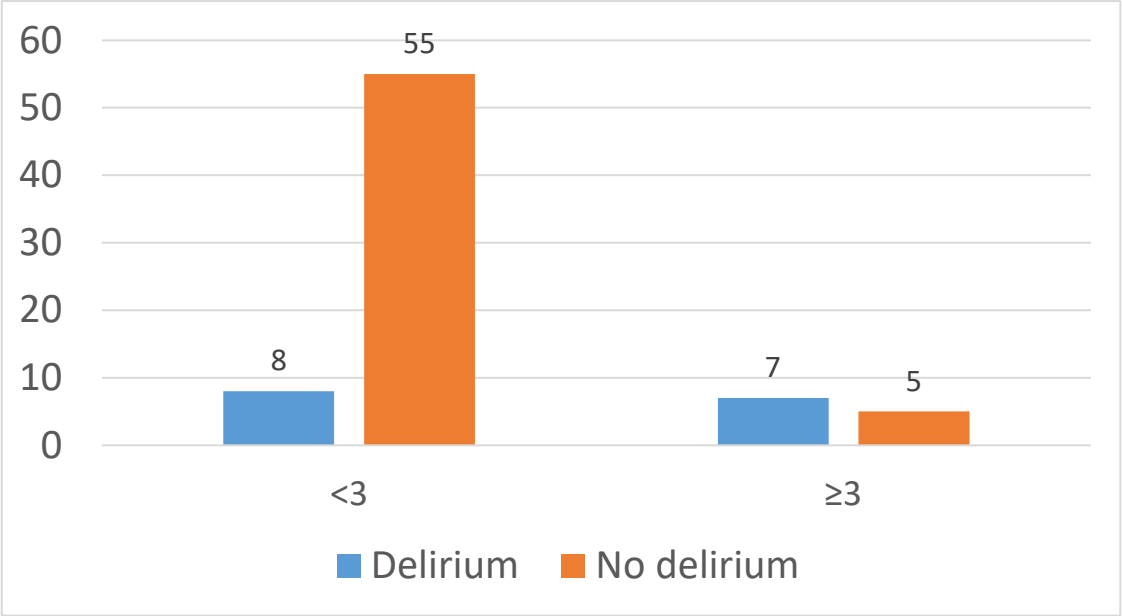


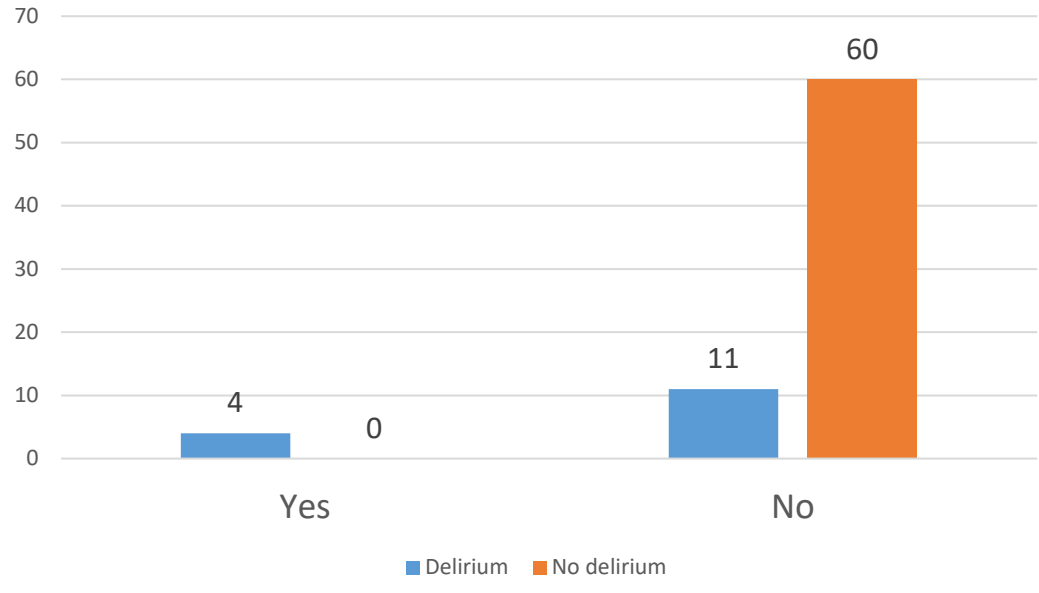
**Table 14: Association of Prevalence of Delirium and past history of Delirium. (N=75)**

| Past history of Delirium | Delirium n (%) | No delirium n (%) | TOTAL | p value |
|---|---|---|---|---|
| **yes** | 4(100) | 0(0) | 4 | <0.0001* |
| **no** | 11(15.5) | 60(84.5) | 71 | |
| **TOTAL** | 15 | 60 | 75 | |

*p value<0.05 is significant

Table 14 describes association of prevalence of delirium past h/o delirium. 100% of patient with past h/o delirium after dialysis developed delirium in the study while only 15.4 % who did not have past history had developed delirium. This was statistically significant (p value <0.0001).

**Figure 8: Association of past history of delirium with current delirium**



# DISCUSSION

Main objective of this study was to find out the prevalence of delirium in the patients undergoing dialysis for kidney diseases and to assess the risk factors for the causation of same. Out of 75 patients that were assessed on CAM twice within 48 hours after dialysis, 15 were found to have delirium. Factors like age, sex, presence of diabetes/hypertension, serum urea, serum creatinine, h/o delirium in past were assessed to see if they have a role in increasing the risks of delirium after dialysis.

Table 1 shows the sociodemographic details of our sample. The mean age of the individuals receiving dialysis was noted to be 55.413 with an SD of 12.90. 34 (47%) out of 75 belonged to the age group of 41-60 years, 29 (37%) out of 75 belonged to age group >60 years while rest 12 (16%) out of 75 were from the age group <40. Same has been shown in Figure 1a. This was in accordance to a study done in Italy by Francesco et al. (2021) in which mean age of the sample was 57.6 with an SD of 18.3.[25] Another study done by Beddhu et al (2002) in which mean age was 53 with SD of 16 in patients receiving dialysis.[40]

Male population constituted 68 % of the sample while female population constituted 32 % of the sample (Table 1, Figure 1b). This was consistent with the study done by Francesco et al. (2021) in which 65% belonged to male population and 35 % belonged to female population. A study done by Cobo et al (2016) concluded that although kidney diseases are more common in females but they are less likely to be started on dialysis.[41]

According to Table 1, employment status showed that 15 (20%) out of 75 were homemakers while 14 (19%) were unemployed. 13 (17%) were farmer while another 13 (17%) were self-employed. 8 (11%) were skilled while 7 (9%) had an

unskilled job. Only 5 (7%) out of 75 had professional employment. Out of 75 65 (87%) were Hindu and rest 10 (13%) were Muslim.

Table 2 shows the prevalence of delirium in our sample. Out of 75 patient who were assessed on the Confusion Assessment Method (CAM), 15 of them were found to have delirium. Overall, the prevalence of delirium in this study was found to be 20 % of the 75 patients receiving dialysis (Figure 2). In the study done by Yasui-Furukori et al. in Japan the prevalence of delirium after dialysis was found to be 15.4 % among 338 patients undergoing dialysis which is comparable to our results.[12] Another study done in Italy by Francesco et al (2021) estimated 55.8 % incidence of delirium among 165 patients admitted in ICU.[25] A study done in PGI, Chandigarh India by Sharma et al (2012) estimated incidence and prevalence of delirium as 24.4% & and 53.6% respectively, among 140 patients.[23] This difference could be because different causes of admission in ICU like trauma, surgical procedures, requirement of ventilator support etc.

Table 3 shows comparison of prevalence of delirium across age groups. In this study, among the 15 patients who developed delirium, 2 (16.6%) belonged to the age group of 21-40 years, 6 (17.6%) belonged to age group of 41-60 years and 7 (24.1%) to >60 years age group as shown in Table 3. The highest percentage was in the age group of >60 years. However on comparing this data, the difference was not statistically significant (P value= 0.9952). In the study done by A. Sharma et al (2012), it was concluded that older patient had more risk of developing delirium (>65 years). The lack of statistically significant result regarding age in our study could be explained by the smaller sample size as compared to other studies.

Table 4 shows the comparison of prevalence of delirium across both genders. In our study 10 (19.6%) out of 51 men and 5 (20.83%) out of 24 women developed delirium. Although this difference is not statistically significant (p value=0.9015). Similar result was found in the study done by Sharma et al (2012).[23]

Table 5 shows the association of prevalence of delirium with Hypertension and Diabetes. It was found that 12 (27.9%) out of 43 patients who had hypertension developed delirium whereas only 3 (9.4%) out of 32 patients who did not have hypertension developed delirium. This difference was found to be statistically significant (p-value of 0.0472). It can be inferred that hypertension increases the risk of delirium after dialysis. This finding was in consistent with the study done by Dubois et al. (2001) who concluded that hypertension is strongly linked with development of delirium.[22]

8 (33.33%) out of 34 diabetic patients develop delirium while only 7 (17%) out of 41 non diabetic patients developed delirium. Even though prevalence of delirium was more in diabetic than non-diabetic patients (Table 5), the difference was statistically insignificant (p-value=0.4865). Similar results were found in studies done by Bakker et al. (2012) and Yanbin et al (2019).[10,45]Although these were studies done in ICU and post operative patients respectively. Further studies are needed to evaluate for risk of delirium in patients with diabetes and receiving dialysis.

Table 6 show association of prevalence of delirium with serum urea levels. It was found that 13 (22.8 %) out of 57 patients with serum urea more than 50 mg/dl developed delirium while only 2 (11.1%) out of 18 patients with serum urea level <50 mg/dl developed delirium. Although prevalence of delirium was more in patients who had higher serum urea levels but the difference was found to be statistically non-

significant (p-value=0.2795). This was in accordance with the study done by Sharma et al (2012) where serum urea levels was not found to be a risk factor for ICU delirium.[23] However, a study done by S. T. O'Keeffe et al (1996) about risk factors of delirious state in older age group found that elevated serum urea levels was found to be a predicting risk factor of delirium.[44] Similar result regarding increased levels of urea was also seen in the previous study done by Francesco et al (2021).[25] There is no study which evaluates serum urea levels as a risk factor for delirium particularly in patients undergoing dialysis.

Table 6 also shows association of prevalence of delirium with serum creatinine levels. Among the patients who were assessed for delirium, none of the patients who had urea levels < 5 mg/dl developed delirium. 6 (20%) out of 30 patients who had serum creatinine levels between 5-10 mg/ dl developed delirium while 9 (64%) out of 14 patients who had serum creatinine levels >10 developed delirium (Figure 3). The difference was noted to be statistically significant (p-value<0.0001). Hence, establishing increased serum creatinine levels as a potential risk factor for delirium from our study results. Increased creatinine level was found to be one of the independent risk factor for delirium after cardiac surgery according to a study done by Bakker et al (2012).[45] However, risk of delirium in ICU due to increased creatinine levels was not found to be statistically significant according to the study done by Sharma et al (2012).[23] This difference could be due to the fact that our study included only patients with kidney diseases receiving dialysis.

Table 7 shows association of prevalence of delirium with hemoglobin levels. 5 (71 %) out of 7 patients who had severe anemia developed delirium and 6 (38%) out of 16 patients who had moderate anemia developed delirium (Figure 4). Only 2 (10%)

out of 20 patients with mild anemia and 2 (6%) out of 32 with no anemia developed delirium. This difference of Haemoglobin levels among patient who developed delirium was statistically significant (p-value= 0.0002). This was in accordance with the study done by Aldemir et al (2001) in which anemia was found to be a predisposing risk factor for delirium.[24]

Table 8 shows association of prevalence of delirium with total leukocyte count (TLC). Among the 75 patients included in sample, 53 patients had normal TLC levels. 22 patients had leukocytosis whereas none of the patients had leukopenia (Table 8 and Figure 5). We found that only 5 (9.4%) out of 53 patients who had normal TLC levels developed delirium whereas, 10 (45.4%) out of 22 patients with leukocytosis developed delirium (Figure 5). This difference was statistically significant (p-value=0.0004). This means that most of the people who had some foci of infection had more chances of developing delirium. In the study done by Francesco et al (2021) it was discovered that infections are a risk factor for causing delirium in ICU.[25] Similar results were found in the study done by Keeffe et al (1996).[44] Our findings were consistent with these 2 studies.

Table 9 shows association of prevalence of delirium with serum albumin levels. In our study we found that 13 (22.8%) out of 57 patients who had hypoalbuminemia developed delirium whereas only 2 (11.11%) out of 18 patients with normal albumin levels developed delirium. There were no patients in our sample with hyperalbuminemia. Although there were more patients with hypoalbuminemia who developed delirium, this difference between 2 group was not found to be statistically significant (p value=0.2795). This result differs from the study done previously by Sharma et al. (2012) where hypoalbuminemia was found to be a

predisposing factor for occurrence of delirium.[23] This difference could be due to the fact that dialysis improves albumin levels temporarily.

Table 10 shows the association of prevalence of delirium with serum calcium levels. Our study recorded that 12 (25.53%) out of 47 patients with hypocalcemia developed delirium but only 3 (10.7%) out of 28 patients with normal calcium levels developed delirium. But this result was not found to be significant (p-value =0.1207). This was not consistent with the study done by Aldemir et al. (2001) where it was deduced that hypocalcemia is a predicting factor for delirium.[24] The reason for this difference could be that hypocalcemia although a risk factor but is a rare cause of delirium as stated by the study done by Armağan et al (2011).[57]

Table 11 shows the association of prevalence of delirium with potassium levels. We found that 2 (33.3%) out of 6 patients having hyperkalemia developed delirium. Only 2 (15.38 %) out of 13 patients with hypokalemia and 11 (19.64%) out of 56 patients with normal potassium levels developed delirium. Hence, the data collected showed higher chances of delirium in hyperkalemic patients. Although this wasn't found to be statistically significant (p-value=0.657). This finding was consistent with the study done by Sharma et al. which did not find abnormal potassium level as a risk factor of delirium in ICU. However a study done by Yıldızeli et al. (2005) about post operative delirium, abnormal potassium levels post surgery was found to be an important risk factor for delirium.[48] This difference in findings must be because of the difference in the type of patients under study as potassium levels are likely to change immensely after a major surgery. However, there is a need to further evaluate and study the role of potassium in delirium in different groups (including dialysis group) of patients.

We found that 6 (14.28%) out of 42 hyponatremic patients developed delirium but 9 (27.27%) out of 33 individuals with normal Na levels also developed delirium as shown in Table 11. There were no patients with hypernatremia in sample. This result was found to be insignificant (p-value 0.1628). However, we expect hyponatremic patients to have higher prevalence of delirium but our results did not show so. This was inconsistent with earlier studies done by Aldemir et al. (2001) and Wolf et al. (2016) who found that hyponatremia does lead to delirium.[24,49]

Table 12 shows association of LFT's (Total Bilirubin (TB), SGOT, SGPT) with prevalence of delirium. Figure 6 shows that 6 (46.1 %) out of 13 patients with total bilirubin >2mg/dl developed delirium while only 9 (14.5%) out of 62 with total bilirubin <2 mg/dl developed delirium. Similarly 4 (50%) out of 8 patients with SGOT and SGPT >120 (three times higher the normal value) developed delirium while only 11 (16.4%) out of 67 patients with SGOT and SGPT <120 developed delirium. This was found to be statistically significant proving that increased total bilirubin and SGOT/SGPT are potential predictors of delirium. (p-value for TB=0.0095, p-Value for SGOT/SGPT=0.0248). This finding was consistent with the study done by Aldemir et al. (2001) who found that hyperbilirubinemia and elevated liver enzymes are risk factor of delirium.[24]

Table 13 shows the association of prevalence of delirium with number of dialysis received. 7 (58.3%) out of 12 patients who had received ≥3 dialysis in the admission developed delirium (p-value<0.0003) proving that increased no. of dialysis further increases risk of delirium. Only 8 (12.6%) out of 63 patients who received <3 dialysis in past developed delirium. Same has been shown in figure 7. There have been no studies which has assessed number of dialysis as a risk factor for delirium.

Table 14 shows the association of prevalence of delirium with past history of delirium. 4 patients had past history of delirium after dialysis. All these 4 patients developed delirium in our assessment. Hence, 100% of patients who had past history of delirium developed delirium again after dialysis. Whereas, only 11 (15.5%) out of 71 patients without past history of delirium developed delirium. Same has been shown in Figure 8. This result was found to be statistically significant (p-value =0.0001). In a study done by Chung et al. (2016) past history of delirium was not found to be a significant risk factor for delirium in surgical or medical patients.[58] Although there are not enough studies to assess past history of delirium as a risk factor. Further studies are needed to assess the same.

This study was conducted as there are no data about the prevalence of delirium after dialysis or about its risk factors. Delirium after dialysis is an important adverse event as it increases mortality, morbidity and hospital stay. Hence, if identified at the earliest and adequately addressed, the adverse consequences can be reduced.

Strengths of the study:

- To our best knowledge, this is the 1st study which evaluates the prevalence of delirium among patients on hemodialysis.
- The study evaluates role of multiple parameters including blood investigations, past h/o delirium etc. in causation of delirium which has not been done previously.

**Limitations of the study:**

- Sample size was less compared to other studies done for prevalence of delirium.
- Delirium is an acute and transient condition. Due to lack of efficient continuous monitoring, some cases might have been missed.

# CONCLUSION

CKD is a major cause of disability. End-Stage renal disease are mostly treated by Renal Replacement Therapy which includes Renal transplant and Dialysis. Hemodialysis has a major side-effect in the form of delirium which may increase mortality and lead to adverse neurocognitive disturbances in long term.

Our study showed that 20 % of the patients receiving dialysis were found to have delirium within 48 hours of receiving dialysis. The study established that delirium after dialysis is associated with hypertension, increased creatinine levels, increased Hemoglobin and TLC, increased LFT's, and other factors like past history of delirium and multiple dialysis received.

Due to the high possibility of delirium post dialysis, these patients should be frequently monitored and adequately treated to avoid long term consequences of cognitive deficits, increased hospital stay, morbidity and mortality.

# SUMMARY

The prevalence of delirium has widely differed in various studies done across various settings like ICU, post-op unit, elderly patients etc. Delirium has various adverse implications on the patients and caregivers as it causes great deal of distress and also increases mortality and neurocognitive deficits in long term. The studies regarding evaluation of delirium has been mainly done in ICU settings, post-surgical unit, in patients requiring ventilators and among the elderly. Hence this study was undertaken to estimate the prevalence of delirium in the individuals receiving dialysis.

75 patients who fulfilled the criteria were evaluated using CAM twice after they had received dialysis. It was noted that how many patients developed hypoactive delirium and how many developed hyperactive type.

The mean age of the sample was 55.413 with a SD of 12.9. There were 51 males in the sample (68%) whereas 24 were females (32%). 47% of the sample was constituted by the age group 41-60 years and 37 % by age group >60 years. The prevalence of delirium was found to be 20 % Presence of hypertension, increased serum creatinine, anemia and increased TLC levels, deranged LFT's showed statistically significant association with delirium. Other factors which were strongly associated with risk of delirium was ≥3 dialysis and past history of delirium. Factors which were found not significant as a risk factor foradelirium in this study were age, sex, levels of serum urea, sodium, potassium, calcium and albumin and presence of diabetes.

Our study hence reveals that delirium is a significant adverse effect after dialysis and can be associated with some important risk factors. Prevention and monitoring of these risk factors may hence help reduce the burden of delirium.

However, more studies are required to strengthen the results of this study and also to evaluate more risk factors which can cause increased risk of delirium.

# BIBLIOGRAPHY

1. Luyckx VA, Tonelli M, Stanifer JW. The global burden of kidney disease and the sustainable development goals. Bull World Health Organ. 2018 Jun 1;96(6):414-422C.

2. Arieff AI. Dialysis disequilibrium syndrome: Current concepts on pathogenesis and prevention. Kidney Int. 1994;45(3):629–35.

3. World Health Organisation. ICD-10 Classifications of Mental and Behavioural Disorder: Clinical Descriptions and Diagnostic Guidelines. Geneva: World Health Organization; 1992.

4. Brown TM, Boyle MF. Delirium Aetiology. Alcohol. 2002;325(September).

5. Kalabalik J, Brunetti L, El-Srougy R. Intensive care unit delirium: A review of the literature. J Pharm Pract. 2014;27(2):195–207.

6. Trogrlić Z, Ista E, Ponssen HH, Schoonderbeek JF, Schreiner F, Verbrugge SJ, et al. Attitudes, knowledge and practices concerning delirium: a survey among intensive care unit professionals. Nurs Crit Care. 2017;22(3):133–40.

7. Glynn L, Corry M. Intensive care nurses' opinions and current practice in relation to delirium in the intensive care setting. Intensive Crit Care Nurs [Internet]. 2015;31(5):269–75. Available from: http://dx.doi.org/10.1016/j.iccn.2015.05.001

8. Özsaban A, Acaroglu R. Delirium assessment in intensive care units: practices and perceptions of Turkish nurses. Nurs Crit Care. 2016;21(5):271–8.

9. Saller T, v. Dossow V, Hofmann-Kiefer K. Knowledge and implementation of

the S3 guideline on delirium management in Germany. Anaesthesist. 2016;65(10):755–62.

10. Pan Y, Yan J, Jiang Z, Luo J, Zhang J, Yang K. Incidence, risk factors, and cumulative risk of delirium among ICU patients: A case-control study. Int J Nurs Sci [Internet]. 2019;6(3):247–51. Available from: https://doi.org/10.1016/j.ijnss.2019.05.008

11. Siew ED, Fissell WH, Tripp CM, Blume JD, Wilson MD, Clark AJ, et al. Acute kidney injury as a risk factor for delirium and coma during critical illness. Am J Respir Crit Care Med. 2017;195(12):1597–607.

12. Yasui-Furukori N, Tarakita N, Uematsu W, Saito H, Nakamura K, Ohyama C, et al. Delirium in hemodialysis predicts mortality: A single-center, long-term observational study. Neuropsychiatr Dis Treat. 2017;13:3011–6.

13. Leigh H, Streltzer J. Handbook of Consultation-Liaison Psychiatry.

14. Kanova M, Sklienka P, Kula R, Burda M, Janoutova J. Incidence and risk factors for delirium development in ICU patients – A prospective observational study. Biomed Pap. 2017;161(2):187–96.

15. Maldonado JR, Kapinos G. Pathoetiological Model of Delirium: a Comprehensive Understanding of the Neurobiology of Delirium and an Evidence-Based Approach to Prevention and Treatment. Crit Care Clin. 2008;24(4):789–856.

16. Maldonado JR. Neuropathogenesis of delirium: Review of current etiologic theories and common pathways. Am J Geriatr Psychiatry. 2013;21(12):1190–222.

17. Flacker JM, Lipsitz LA. Neural mechanisms of delirium: Current hypotheses and evolving concepts. Journals Gerontol - Ser A Biol Sci Med Sci. 1999;54(6):239–46.

18. Partridge JSL, Martin FC, Harari D, Dhesi JK. The delirium experience: What is the effect on patients, relatives and staff and what can be done to modify this? Int J Geriatr Psychiatry. 2013;28(8):804–12.

19. Annie M, Aquila MD, Schmitt EM, Marcantonio ER, Jones RN, Inouye K, et al. Delirium Burden in Patients and Family Caregivers : Development and Testing of New Instruments. 2018;

20. Inouye SK, Bogardus ST, Charpentier PA, Leo-Summers L, Acampora D, Holford TR, et al. A Multicomponent Intervention to Prevent Delirium in Hospitalized Older Patients. N Engl J Med. 1999;340(9):669–76.

21. Schweickert WD, Pohlman MC, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, et al. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial. Lancet [Internet]. 2009;373(9678):1874–82. Available from: http://dx.doi.org/10.1016/S0140-6736(09)60658-9

22. Dubois MJ, Bergeron N, Dumont M, Dial S, Skrobik Y. Delirium in an intensive care unit: A study of risk factors. Intensive Care Med. 2001;27(8):1297–304.

23. Sharma A, Malhotra S, Grover S, Jindal SK. Incidence, prevalence, risk factor and outcome of delirium in intensive care unit: A study from India. Gen Hosp Psychiatry [Internet]. 2012;34(6):639–46. Available from:

http://dx.doi.org/10.1016/j.genhosppsych.2012.06.009

24. Aldemir M, Özen S, Kara IH, Sir A, Baç B. Predisposing factors for delirium in the surgical intensive care unit. Crit Care. 2001;5(5):265–70.

25. Gravante F, Giannarelli D, Pucci A, Gagliardi AM, Mitello L, Montagna A, et al. Prevalence and risk factors of delirium in the intensive care unit: An observational study. Nurs Crit Care. 2021;26(3):156–65.

26. Inouye SK, Van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: The confusion assessment method: A new method for detection of delirium. Ann Intern Med. 1990;113(12):941–8.

27. Ely EW, Margolin R, Francis J, May L, Truman B, Dittus R, et al. Evaluation of delirium in critically ill patients: Validation of the Confusion Assessment Method for the intensive care unit (CAM-ICU). Crit Care Med. 2001;29(7):1370–9.

28. Whaley-Connell AT, Sowers JR, Stevens LA, McFarlane SI, Shlipak MG, Norris KC, et al. CKD in the United States: Kidney Early Evaluation Program (KEEP) and National Health and Nutrition Examination Survey (NHANES) 1999-2004. Am J Kidney Dis. 2008;51(4 SUPPL. 2):1999–2004.

29. Lascano ME, Schreiber MJ, Nurko S. Chronic Kidney Disease. Curr Clin Med. 2010;853–6.

30. Agarwal SK, Srivastava RK. Chronic kidney disease in India: Challenges and solutions. Nephron - Clin Pract. 2009;111(3):197–203.

31. O'connor NR, Corcoran AM. End-stage renal disease: Symptom

management and advance care planning. Am Fam Physician. 2012;85(7):705–10.

32. Kerjaschki D. Lymphatic neoangiogenesis in human neoplasia and transplantation as experiments of nature. Kidney Int. 2005;68(5):1967–8.

33. Silver SM, Sterns RH, Halperin ML. Brain swelling after dialysis: Old urea or new osmoles? Am J Kidney Dis. 1996;28(1):1–13.

34. Force OO. Philosophical transactions. 1854;

35. Hamilton RW. Principles of dialysis: diffusion,convection and dialysis machines. In: Atlas of diseases of the kidney,Vol 5. p. 1–6.

36. Murray AM. Cognitive Impairment in the Aging Dialysis and Chronic Kidney Disease Populations: An Occult Burden. Adv Chronic Kidney Dis. 2008;15(2):123–32.

37. McQuillan R, Jassal S V. Neuropsychiatric complications of chronic kidney disease. Nat Rev Nephrol [Internet]. 2010;6(8):471–9. Available from: http://dx.doi.org/10.1038/nrneph.2010.83

38. Modi GK, Jha V. The incidence of end-stage renal disease in India: A population-based study. Kidney Int [Internet]. 2006;70(12):2131–3. Available from: http://dx.doi.org/10.1038/sj.ki.5001958

39. Inouye SK, Westendorp RGJ, Saczynski JS. Delirium in elderly people. Lancet [Internet]. 2014;383(9920):911–22. Available from: http://dx.doi.org/10.1016/S0140-6736(13)60688-1

40. Beddhu S, Zeidel ML, Saul M, Seddon P, Samore MH, Stoddard GJ, et al. The

effects of comorbid conditions on the outcomes of patients undergoing peritoneal dialysis. Am J Med. 2002;112(9):696–701.

41. Cobo G, Hecking M, Port FK, Exner I, Lindholm B, Stenvinkel P, et al. Sex and gender differences in chronic kidney disease: Progression to end-stage renal disease and haemodialysis. Clin Sci. 2016;130(14):1147–63.

42. Coresh J, Byrd-Holt D, Astor BC, Briggs JP, Eggers PW, Lacher DA, et al. Chronic kidney disease awareness, prevalence, and trends among U.S. adults, 1999 to 2000. J Am Soc Nephrol. 2005;16(1):180–8.

43. Azra K. Estimation of Blood Urea ( Bun ) and Serum Creatinine. Indian J Fundam Appl Life Sci [Internet]. 2014;4(4):199–202. Available from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1062.2480&rep=rep1&type=pdf%0Aglomerular

44. O'Keeffe ST, Lavan JN. Predicting delirium in elderly patients: Development and validation of a risk-stratification model. Age Ageing. 1996;25(4):317–21.

45. Bakker RC, Osse RJ, Tulen JHM, Kappetein AP, Bogers AJJC. Preoperative and operative predictors of delirium after cardiac surgery in elderly patients. Eur J Cardio-thoracic Surg. 2012;41(3):544–9.

46. Babitt JL, Lin HY. Mechanisms of anemia in CKD. J Am Soc Nephrol. 2012;23(10):1631–4.

47. Erlinger TP, Tarver-Carr ME, Powe NR, Appel LJ, Coresh J, Eberhardt MS, et al. Leukocytosis, hypoalbuminemia, and the risk for chronic kidney disease in US adults. Am J Kidney Dis. 2003;42(2):256–63.

48. Yildizeli B, Oğuzhan Özyurtkan M, Batirel HF, Kuşcu K, Bekiroğlu N, Yüksel M. Factors associated with postoperative delirium after thoracic surgery. Ann Thorac Surg. 2005;79(3):1004–9.

49. Zieschang T, Wolf M, Vellappallil T, Uhlmann L, Oster P, Kopf D. Assoziation von Hyponatriämie, Delirrisiko und Mortalität. Dtsch Arztebl Int. 2016;113(50):855–62.

50. McQuillan R, Jassal S V., Pan Y, Yan J, Jiang Z, Luo J, et al. Delirium Aetiology. Alcohol [Internet]. 2002;6(2):344–7. Available from: https://doi.org/10.1016/j.ijnss.2019.05.008

51. Hossmann KA, Takagi S. Osmolality of brain in cerebral ischemia. Exp Neurol. 1976;51(1):124–31.

52. Patel N, Dalal P, Panesar M. Dialysis disequilibrium syndrome: A narrative review. Semin Dial. 2008;21(5):493–8.

53. Chen CL, Lai PH, Chou KJ, Lee PT, Chung HM, Fang HC. A preliminary report of brain edema in patients with uremia at first hemodialysis: Evaluation by diffusion-weighted MR Imaging. Am J Neuroradiol. 2007;28(1):68–71.

54. Bourne RS, Tahir TA, Borthwick M, Sampson EL. Drug treatment of delirium: Past, present and future. J Psychosom Res. 2008;65(3):273–82.

55. Tesar GE, Murray GB, Cassem NH. Use of high-dose intravenous haloperidol in the treatment of agitated cardiac patients. J Clin Psychopharmacol. 1985;5(6):344–7.

56. Seneff MG, Mathews RA. CASE REPORTS USE OF HALOPERIDOL INFUSIONS TO. 1995;29.

57. Kelimeler A. Isparta Devlet Hastanesi, Acil. 2011;3(2):29–31.

58. Kim H, Chung S, Joo YH, Lee JS. The major risk factors for delirium in a clinical setting. Neuropsychiatr Dis Treat. 2016;12:1787–93.

# ANNEXURE I. ETHICAL CLEARANCE LETTER

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to - be University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

**JAWAHARLAL NEHRU MEDICAL COLLEGE,**
**NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)**

Website: http\www.jnmc.edu
E-Mail : dome@jnmc.edu

Phone: (+ 91-0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 - 2470759

**Ref: MDC/DOME/**297. **Date: 24/12/2019**

To,

**REG NO. BO0119002**
PG student in Psychiatry,
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"ASSESSMENT OF PREVALENCE AND RISK FACTORS OF DELIRIUM IN KIDNEY DISEASE PATIENTS UNDERGOING RENAL DIALYSIS – A PROSPECTIVE OBSERVATIONAL STUDY"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

**(Dr. Anita Dalal)**
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

**(Dr. Roopa M Bellad)**
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

138

## ANNEXURE II. INFORMED CONSENT

Dear Mr./Mrs./Dr. _____, you are kindly requested to enrol yourself in a research study titled, **" ASSESSMENT OF PREVALENCE AND RISK FACTORS OF DELIRIUM IN KIDNEY DISEASE PATIENTS UNDERGOING RENAL DIALYSIS- A PROSPECTIVE OBSERVATIONAL STUDY"** being conducted by **REG NO. BQ0119002**, a post graduate student in M.D. Psychiatry and the study will be carried out under the direct supervision and guidance of Dr. _____, Professor Of Department of Psychiatry, Jawaharlal Nehru Medical College, Belagavi.

You have been requested to participate in this as you fit into the laid out criteria for a study 'subject'/participant.

Your participation in the study is voluntary. During the study you will be undergoing an interview session. Your decision whether to or not to participate in the study will not affect your treatment in any form. If you decide to participate you are free to withdraw at any time.

**TITLE OF THE STUDY:**

**ASSESSMENT OF PREVALENCE AND RISK FACTORS OF DELIRIUM IN KIDNEY DISEASE PATIENTS UNDERGOING RENAL DIALYSIS- A PROSPECTIVE OBSERVATIONAL STUDY**

**PROCEDURE INVOLVED:**

If you agree to enrol yourself in my study, you will be subjected to SCALE-CONFUSION ASESSMENT METHOD (CAM).

**RISK AND BENEFITS:**

There are no potential risks involved in the study.

**Benefits of taking part in this research:**

To determine the prevalence and risk factors of delirium in dialysis patients.

**VOLUNTARY PARTICIPATION / WITHDRAWAL FROM THE STUDY:**

**Taking part in the study is voluntary. You may choose not to enrol yourself in this study and may choose to leave the study anytime in between.**

**ALTERNATIVES:**

Your decision regarding participation in the study will not change present or future health cares services offered to you at KLES Dr. Prabhkar Kore Hospital and Medical Research Centre, Belagavi. You would simply be excluded from the study if you wish to, and all your details shall be kept confidential and you will get the routine line of management.

**PRIVACY AND CONFIDENTIALITY**:

All data collected or disclosed by you during the course of participation of the study will be kept fully confidential. If however during the course it becomes necessary for the progress of the course to disclose the identity, it would be done so only after your informed and written consent. The only people to know that you are a research subject are members of the research team. No information about you will be disclosed to other without your written permission except:

- in emergency to protect your rights and welfare.

- If required by law.

**AUTHORIZATION TO PUBLISH RESULT**:

The results of the study may be used to publish an article. When the results of research will be published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information obtained in connection with this study and that can be identifyied with you will remain confidential.

**FINANCIAL INCENTIVES FOR PARTICIPATION:**

No additional costs shall be incurred upon you for the purpose of this study. It is purely being done with the idea of research and all the cost of study will be borne by the investigators. There will not be any remuneration, reimbursement, compensation or free medical care.

**QUESTIONS/CONTACT DETAILS:**

You shall be free to contact the below mentioned name and addresses anytime during the study period for any clarification or help as you may desire for.

In case of queries during study or in the future, you may contact following persons,

1. Dr. Roopa M. Bellad, Chairman, J.N.M.C Ethical Committee for Human Research 9448113403
2. Dr. _____ Dept. Of Psychiatry JNMC, Belagavi.
3. Dr._____ Associate Professor Dept. Of Psychiatry JNMC, Belagavi.
4. **REG NO. BQ0119002** Investigator, PG in Psychiatry, JNMC, Belagavi

**STATEMENT OF CONSENT**

I/my relative have/has read and have/has completely understood the entire information given in the consent form, which explains all the details of the study, i.e, the purpose, procedure involved, risks & benefits, privacy & confidentiality, incentives and the authorization to publish the results of the study. My/my relative's signature in the space provided for signature below indicates that I/my relative have/has voluntarily agreed to participate in the study. I/my relative may withdraw my/my relative's participation for any reason or may be withdrawn by the investigator from the study for any reason at any time. I/my relative am/is not giving up any of my/my relative's legal rights by signing this consent form. I/my relative will be given a copy of this consent form.

Signature of the participant with date: _____

Name of the participant: _____

Signature of the authorized representative with date:_____

Name of the authorized representative: _____

Relationship of authorized person: _____

Signature of the witness with date: _____

Name of the witness:_____

Signature of the Investigator with date: _____

# ANNEXURE III. PROFORMA

IP NO:

INFORMANT:

NAME:

AGE:

SEX:

EDUCATION:

RELEGION:

OCCUPATION:

CONTACT ADDRESS:

CONTACT NUMBER:

DATE OF ADMISSION:

CHIEF COMPLAINTS:

-DURATION

-

PRECIPITATING FACTORS:

TREATMENT HISTORY:

-DRUGS RECEIVED

-NUMBER OF DIALYSIS:

-RENAL TRANSPLANT HISTORY

-HISTORY OF DELIRIUM
-HOSPITALIZATION

-ANY H/O PSYCHIATRIC ILLNESS:

-H/O SUBSTANCE ABUSE

FAMILY HISTORY:

-ANY H/O HYPERTENSION OR DIABETES OR KIDNEY DISEASE (ACUTE AND CHRONIC

-H/O DELIRIUM IN FAMILY

-H/O PSYCHIATRIC ILLNESS:

GENERAL PHYSICAL EXAMINATION:

-HT:

-WT:

-BMI:

-BP:

-PULSE:

SYSTEMIC EXAMINATION:

MENTAL STATUS EXAMINATION:

-PSYCHOMOTOR ACTIVITY

-CONSCIOUSNESS

-ORIENTATION

-ATTENTION AND CONCENTRATION:

-MEMORY

-INTELLIGENCE:

-ARITHMETIC:

-ABSTRACTION:

-COMPREHENSION:

-SPEECH

-THOUGHT:

-MOOD

-JUDGEMENT:

-INSIGHT:

INVESTIGATIONS:

-

CAM:

# ANNEXURE IV. CONFUSION ASSESSMENT METHOD (CAM)

(Adapted from Inouye et al., 1990)

Patient's Name:_____ Date: _____

***Instructions:*** Assess the following factors.

**Acute Onset**

1. Is there evidence of an acute change in mental status from the patient's baseline?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Inattention**

(*The questions listed under this topic are repeated for each topic where applicable.*)

2A. Did the patient have difficulty focusing attention (for example, being easily distractible or having difficultykeeping track of what was being said)?

_____ Not present at any time during interview

_____ Present at some time during interview, but in mild form

_____ Present at some time during interview, in marked form

_____ Uncertain

2B. (*If present or abnormal*) Did this behavior fluctuate during the interview (that is, tend to come and go orincrease and decrease in severity)?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

2C. (*If present or abnormal*) Please describe this behavior.

_____

_____

**Disorganized Thinking**

3. Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclearor illogical flow of ideas, or unpredictable, switching from subject to subject?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Altered Level of Consciousness**

4. Overall, how would you rate this patient's level of consciousness?

_____ Alert (*normal*)

_____ Vigilant (*hyperalert, overly sensitive to environmental stimuli, startled very easily*)

_____ Lethargic (*drowsy, easily aroused*)

_____ Stupor (*difficult to arouse*)

_____ Coma (*unarousable*)

_____ Uncertain

**Disorientation**

5. Was the patient disoriented at any time during the interview, such as thinking that he or she was somewhere other than the hospital, using the wrong bed, or misjudging the time of day?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Memory Impairment**

6. Did the patient demonstrate any memory problems during the interview, such as inability to remember events in the hospital or difficulty remembering instructions?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Perceptual Disturbances**

7. Did the patient have any evidence of perceptual disturbances, such as hallucinations, illusions, or misinterpretations (for example, thinking something was moving when it was not)?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Psychomotor Agitation**

8A. At any time during the interview, did the patient have an unusually increased level of motor activity, such as restlessness, picking at bedclothes, tapping fingers, or making frequent, sudden changes in position?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Psychomotor Retardation**

8B. At any time during the interview, did the patient have an unusually decreased level of motor activity, such as sluggishness, staring into space, staying in one position for a long time, or moving very slowly?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

**Altered Sleep-Wake Cycle**

9. Did the patient have evidence of disturbance of the sleep-wake cycle, such as excessive daytime sleepiness with insomnia at night?

___ YES ___ NO ___ UNCERTAIN ___ NOT APPLICABLE

***Scoring:***

For a diagnosis of delirium by CAM, the patient must display:

1. Presence of acute onset and fluctuating discourse

AND

2. Inattention

AND EITHER

3. Disorganized thinking

OR

4. Altered level of consciousness

***Source:***

Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med*. 1990;113(12):941-948.

**Confusion Assessment Method (CAM) Diagnostic Algorithm**

Feature 1: Acute Onset and Fluctuating Course

This feature is usually obtained from a family member or nurse and is shown by positive responses to the following questions: Is there evidence of an acute change in mental status from the patient's baseline? Did the (abnormal) behavior fluctuate during the day; that is, did ittend to come and go, or increase and decrease in severity?

Feature 2: Inattention

This feature is shown by a positive response to the following question: Did the patient have difficulty focusing attention; for example, being easily distractible, or having difficulty keepingtrack of what was being said?

Feature 3: Disorganized Thinking

This feature is shown by a positive response to the following question: Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject?

Feature 4: Altered Level of Consciousness

This feature is shown by any answer other than "alert" to the following question: Overall, how would you rate this patient's level of consciousness? (alert [normal], vigilant [hyperalert], lethargic [drowsy, easily aroused], stupor [difficult to arouse], or coma [unarousable])

***Source:***

Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med*. 1990;113(12):941-948.

| Age | Sex | Religion | Occupation | Dialysis No. | H/o of renal transplant | H/o delirium | H/o alcohol abuse | Hypertension | Diabetes | Indication for dialysis | Psychomotor activity | S. Creatinine | S. Urea | hb | TLC | Na | K | TB | DB | SGOT | SGPT | ALP | Calcium | albumin | Delirium | Acute Onset | Inattention | Disorganized Thinking | Altered Level of Consciousness | Disorientation | Memory Impairment | Perceptual Disturbances | Psychomotor Agitation | Psychomotor Retardation | Altered Sleep-Wake Cycle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85 | Male | Hindu | Unemployed | 1 | No | No | No | Yes | Yes | Acute on CKD | Increased | 7.47 | 51.2 | 7.6 | 8.9 | 144 | 4.35 | 3.2 | 0.04 | 230 | 220 | 54 | 7.5 | 1.8 | Yes | Yes | Yes | Yes | No | Yes | Uncertain | No | Yes | No | Yes |
| 38 | Female | Muslim | Housewife | 1 | No | No | No | Yes | No | AKI | Increased | 11.11 | 123 | 9.2 | 8.49 | 133 | 6.29 | 0.1 | 0.04 | 30 | 32 | 55 | 8.2 | 2.9 | Yes | Yes | Yes | Uncertain | Yes | Yes | Uncertain | Yes | Yes | No | Yes |
| 45 | Male | Hindu | Daily wage worker | 2 | No | Yes | No | No | No | AKI | Increased | 8.9 | 67 | 15.3 | 4.5 | 130 | 4.27 | 0.55 | 0.24 | 193 | 132 | 59 | 7 | 3 | Yes | Yes | Yes | Uncertain | Yes | Yes | Uncertain | Uncertain | Yes | No | Yes |
| 64 | Male | Hindu | Unemployed | 1 | No | No | Yes | Yes | No | Acute Renal Failure | Increased | 18.88 | 245 | 5.6 | 14.6 | 126 | 5.95 | 4.2 | 0.11 | 84 | 42 | 109 | 7.1 | 3 | Yes | Yes | Yes | Yes | Yes | Yes | Uncertain | Uncertain | Yes | No | Yes |
| 60 | Female | Hindu | Housewife | 7 | No | Yes | No | Yes | No | CKD | Increased | 14.1 | 132 | 9.9 | 17.9 | 132 | 3.97 | 0.45 | 0.05 | 37 | 34 | 99 | 6.9 | 2.6 | Yes | Yes | Yes | Yes | No | No | Uncertain | Yes | yes | No | Yes |
| 59 | Male | Hindu | Police service | 6 | No | No | No | Yes | Yes | CKD | Normal | 12.4 | 105 | 11.7 | 11.4 | 124 | 4.41 | 0.51 | 0.27 | 14 | 10 | 48 | 9.5 | 3.7 | Yes | Yes | Yes | Yes | Yes | Yes | Uncertain | No | yes | No | Yes |
| 70 | Male | Muslim | Retired clerk | 3 | No | No | No | Yes | Yes | CKD | Increased | 18.2 | 172 | 9.2 | 10 | 136 | 4.9 | 1.17 | 0.99 | 498 | 871 | 160 | 9.2 | 3.1 | Yes | Yes | Yes | Yes | Yes | Yes | Uncertain | No | Yes | No | Yes |
| 55 | Female | Hindu | Housewife | 3 | No | No | No | Yes | Yes | CKD | Decreased | 5.3 | 42 | 6.5 | 8.2 | 141 | 3.47 | 0.24 | 0.13 | 13 | 12 | 82 | 7.5 | 2.7 | Yes | Yes | Yes | Uncertain | Yes | Yes | Uncertain | No | No | Yes | Yes |
| 73 | Male | Muslim | Ex-army | 1 | No | No | No | Yes | Yes | AKI on CKD | Increased | 17.6 | 190 | 9 | 10.9 | 135 | 4 | 0.6 | 0.02 | 40 | 33 | 101 | 8.9 | 2.1 | Yes | Yes | Yes | Yes | Yes | Yes | Uncertain | No | Yes | No | Yes |
| 64 | Male | Hindu | Retired | 1 | No | No | No | Yes | Yes | CKD | Normal | 6.2 | 35 | 10.9 | 9.3 | 134 | 4.02 | 1.3 | 0.04 | 35 | 32 | 87 | 8 | 3.1 | No | NA | No | No | No | No | No | No | No | No | No |
| 43 | Male | Hindu | Farmer | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.24 | 66 | 12.5 | 8 | 137 | 4.29 | 5.48 | 4.89 | 41 | 33 | 102 | 8.6 | 2.8 | No | No | No | No | No | No | No | No | No | No | No | No |
| 55 | Male | Hindu | Farmer | 1 | No | No | No | yes | Yes | Chronic kidney disease | Normal | 6.68 | 106 | 13 | 7.2 | 136 | 4.1 | 1.02 | 0.1 | 28 | 35 | 88 | 8.9 | 4.2 | No | No | No | No | No | No | No | No | No | No | No | No |
| 87 | Male | Hindu | Unemployed | 1 | No | No | No | Yes | Yes | Acute on CKD | Increased | 7.47 | 51.2 | 7.7 | 9.9 | 143 | 4.36 | 1.1 | 0.06 | 31 | 24 | 67 | 7.1 | 2 | Yes | Yes | Yes | Yes | No | Yes | Uncertain | No | Yes | No | Yes |
| 43 | Male | Hindu | Daily wage worker | 2 | No | Yes | No | No | No | AKI | Increased | 8.9 | 67 | 10.6 | 11.6 | 130 | 4.48 | 3.9 | 0.06 | 189 | 170 | 92 | 7.7 | 2.8 | Yes | Yes | Yes | Uncertain | Yes | Yes | Uncertain | Uncertain | Yes | No | Yes |
| 54 | Female | Hindu | Housewife | 7 | No | Yes | No | Yes | No | CKD | Increased | 14.1 | 132 | 9.6 | 17.9 | 137 | 4.2 | 2.9 | 0.06 | 22 | 27 | 87 | 7.9 | 3.5 | Yes | Yes | Yes | Yes | No | No | Uncertain | Yes | yes | No | Yes |
| 71 | Female | Hindu | Housewife | 3 | No | No | No | Yes | Yes | CKD | Decreased | 5.3 | 42 | 6.8 | 10.2 | 132 | 3.5 | 1.16 | 0.99 | 21 | 25 | 67 | 8.2 | 2.9 | Yes | Yes | Yes | Uncertain | Yes | Yes | Uncertain | No | yes | no | Yes |
| 56 | Male | Muslim | Ex-army | 1 | No | No | No | Yes | Yes | AKI on CKD | Increased | 17.6 | 190 | 9.9 | 14 | 132 | 3 | 2.5 | 0.08 | 40 | 38 | 95 | 6.8 | 3 | Yes | Yes | Yes | Yes | Yes | Yes | Uncertain | No | Yes | No | Yes |
| 67 | Male | Hindu | Retired | 1 | No | No | No | Yes | No | CKD | Normal | 5.9 | 55 | 11 | 9.4 | 140 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No |
| 49 | Female | Hindu | Farmer | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 4.3 | 86 | 12.2 | 5.1 | 135 | 5.56 | 1 | 0.1 | 12 | 10 | 68 | 8.9 | 3.4 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 55 | Male | Hindu | labourer | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 6 | 96 | 12.5 | 7.6 | 134 | 4.7 | 1.3 | 0.6 | 15 | 16 | 57 | 9.2 | 3.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 66 | Male | Hindu | retired | 1 | No | No | No | yes | Yes | CKD | Normal | 6.5 | 51 | 9.8 | 10 | 132 | 4 | 1 | 0.03 | 31 | 34 | 92 | 7.8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 50 | Male | Hindu | Farmer | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.6 | 73 | 13 | 6.7 | 137 | 5.1 | 0.98 | 0.1 | 19 | 18 | 97 | 8.5 | 2.9 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 51 | Male | Hindu | business | 1 | No | No | No | No | No | Chronic kidney disease | Normal | 6.2 | 95 | 13.1 | 6.2 | 132 | 4.2 | 1.5 | 0.6 | 16 | 12 | 65 | 7.8 | 3 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 66 | Female | muslim | homemaker | 3 | No | No | No | yes | yes | CKD | Normal | 6 | 44 | 11.5 | 12.6 | 139 | 3.5 | 1.2 | 0.02 | 31 | 32 | 98 | 7.7 | 3.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 44 | Female | Hindu | clerk | 1 | No | No | No | Yes | yes | Chronic kidney disease | Normal | 3.8 | 78 | 12.5 | 8 | 137 | 4.29 | 5.48 | 4.89 | 128 | 124 | 102 | 8.6 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 59 | Male | Hindu | business | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 5.3 | 88 | 12.2 | 5.1 | 135 | 4.98 | 1 | 0.1 | 32 | 18 | 55 | 8.8 | 3.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 69 | Male | Hindu | Retired | 1 | No | No | No | yes | Yes | CKD | Normal | 5.8 | 47 | 11 | 9.4 | 135 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 37 | Male | Hindu | shopkeeper | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 4.5 | 62 | 7.6 | 10.3 | 135 | 4.13 | 0.4 | 0.28 | 30 | 16 | 56 | 9 | 3.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 67 | Female | Hindu | homemaker | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 4.2 | 77 | 11.2 | 8.7 | 130 | 2.9 | 0.8 | 0.07 | 54 | 55 | 102 | 6.5 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 72 | female | Hindu | homemaker | 2 | No | No | No | Yes | No | aki | Normal | 11 | 126 | 8.4 | 14.9 | 136 | 4.68 | 1.4 | 0.4 | 31 | 24 | 72 | 7.1 | 2.9 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 50 | Male | Hindu | Farmer | 1 | No | No | No | Yes | yes | Chronic kidney disease | Normal | 5.6 | 77 | 12.7 | 5.8 | 135 | 4.87 | 1.2 | 0.3 | 20 | 17 | 68 | 8.8 | 3.3 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 56 | Male | Hindu | Farmer | 1 | No | No | yes | Yes | No | Chronic kidney disease | Normal | 6.5 | 87 | 12.8 | 7.2 | 138 | 4.2 | 1.1 | 0.1 | 34 | 39 | 67 | 8.8 | 3.5 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 76 | female | hindu | homemaker | 1 | No | No | No | No | Yes | CKD | Normal | 4 | 65 | 9.5 | 10 | 133 | 3.7 | 1.2 | 0.1 | 23 | 27 | 56 | 7.8 | 3.4 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 41 | Male | Hindu | shopkeeper | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.7 | 43 | 9.8 | 9.4 | 131 | 3.93 | 1.59 | 1.47 | 138 | 127 | 235 | 7.1 | 3.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 53 | Female | Hindu | homemaker | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 4.7 | 93 | 11.8 | 5.9 | 139 | 4.7 | 1 | 0.1 | 19 | 18 | 70 | 8.9 | 3.2 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 69 | Male | Hindu | unemployed | 5 | No | No | No | No | Yes | acute on ckd | Normal | 6.5 | 72 | 11.2 | 8.7 | 130 | 2.9 | 0.8 | 0.07 | 54 | 55 | 102 | 6.5 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 47 | Male | Hindu | daily wage worker | 1 | No | No | yes | Yes | No | acute renal failure | Normal | 18 | 176 | 8.3 | 14.9 | 130 | 4 | 1 | 0.09 | 28 | 34 | 68 | 8.1 | 3.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 54 | Male | muslim | business | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 4.2 | 68 | 12.5 | 8.7 | 133 | 3.5 | 1 | 0.1 | 26 | 19 | 45 | 8.8 | 3.4 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 65 | Male | Hindu | shopowner | 1 | No | No | No | No | Yes | CKD | Normal | 6 | 46 | 9.1 | 22.2 | 131 | 3 | 0.51 | 0.32 | 12 | 10 | 83 | 7 | 2.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 39 | Male | Hindu | hotel waiter | 1 | No | No | yes | Yes | No | Chronic kidney disease | Normal | 3.3 | 63 | 12.5 | 8 | 137 | 4.29 | 5.48 | 4.89 | 160 | 164 | 102 | 8.6 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 68 | Female | Hindu | Farmer | 3 | No | No | yes | No | Yes | Chronic kidney disease | Normal | 5.3 | 79 | 9.5 | 6.2 | 135 | 3.09 | 0.1 | 0.06 | 16 | 10 | 65 | 8.5 | 2.9 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 65 | Male | Hindu | Unemployed | 1 | No | No | No | No | Yes | CKD | Normal | 4.1 | 97 | 11 | 9.4 | 135 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 47 | Female | Hindu | clerk | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.9 | 55 | 12.5 | 8 | 137 | 4.29 | 2.9 | 1.3 | 158 | 150 | 102 | 8.6 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 51 | Male | Hindu | business | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 5.9 | 49 | 12.2 | 4.8 | 137 | 3.8 | 1.3 | 0.33 | 28 | 19 | 79 | 8.5 | 3.9 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 61 | Female | Muslim | teacher | 1 | No | No | No | No | Yes | CKD | Normal | 6.4 | 76 | 11.2 | 8.7 | 130 | 2.9 | 0.8 | 0.07 | 54 | 55 | 102 | 6.5 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 48 | Male | Hindu | manager | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.8 | 87 | 12.5 | 8 | 137 | 4.29 | 2.3 | 4.89 | 41 | 33 | 57 | 8.6 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 62 | Female | Hindu | homemaker | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 5.8 | 99 | 11.2 | 8.7 | 130 | 2.9 | 0.8 | 0.07 | 54 | 55 | 60 | 6.5 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 79 | Male | Hindu | Retired | 1 | No | No | No | No | Yes | CKD | Normal | 4.9 | 100 | 9.5 | 10 | 133 | 3.7 | 1.2 | 0.1 | 23 | 27 | 56 | 7.8 | 3.4 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 39 | Male | Hindu | clerk | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.9 | 76 | 12.5 | 8 | 137 | 4.29 | 1.07 | 0.06 | 41 | 33 | 97 | 8.6 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 63 | Male | Hindu | Farmer | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 5.7 | 89 | 11.2 | 8.7 | 130 | 2.9 | 0.8 | 0.07 | 54 | 55 | 56 | 6.5 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 67 | Male | muslim | Retired | 1 | No | No | No | No | Yes | CKD | Normal | 4.6 | 59 | 11 | 9.4 | 135 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 56 | Female | Hindu | Farmer | 2 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.8 | 65 | 12.8 | 6.8 | 135 | 5.1 | 1.1 | 0.3 | 27 | 23 | 72 | 8.8 | 3.3 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 69 | Male | Hindu | Farmer | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 5.8 | 82 | 11 | 9.4 | 135 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 33 | Male | Hindu | clerk | 10 | no | no | no | no | no | Chronic kidney disease | Decreased | 12.87 | 96 | 12.5 | 26.8 | 126 | 4.42 | 15.02 | 14.17 | 21 | 38 | 177 | 7.9 | 2.7 | Yes | yes | uncertain | Uncertain | yes | uncertain | uncertain | no | yes | no | yes |
| 47 | Female | Hindu | daily wage worker | 1 | No | No | yes | Yes | No | acute renal failure | Normal | 18 | 176 | 12.5 | 8 | 137 | 4.29 | 1.1 | 0.6 | 41 | 33 | 102 | 8.6 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 39 | Male | Hindu | hotel waiter | 2 | No | No | yes | Yes | No | Chronic kidney disease | Normal | 3.3 | 63 | 12.9 | 6.3 | 139 | 4.56 | 2.1 | 1.2 | 30 | 32 | 97 | 8.9 | 3.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 47 | Male | Hindu | clerk | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.9 | 55 | 11.9 | 5.7 | 139 | 3.8 | 1.2 | 0.02 | 31 | 23 | 67 | 8.6 | 2.9 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 48 | Female | Hindu | homemaker | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 3.8 | 87 | 13.2 | 5 | 140 | 3.4 | 1.1 | 0.6 | 34 | 22 | 76 | 7.9 | 2.7 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 56 | Male | Hindu | Farmer | 4 | No | No | yes | No | Yes | Chronic kidney disease | Normal | 6.5 | 87 | 12.3 | 6.9 | 132 | 3.5 | 1.3 | 0.5 | 20 | 17 | 78 | 8.3 | 3.2 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 34 | Male | Hindu | business | 1 | No | No | No | no | No | Chronic kidney disease | Normal | 3.24 | 66 | 7 | 12.4 | 133 | 3.7 | 0.49 | 0.28 | 23 | 22 | 108 | 8.5 | 3.7 | No | No | No | No | No | No | No | No | No | No | No | No |
| 67 | Male | Hindu | Retired | 1 | No | No | No | No | Yes | CKD | Normal | 5.9 | 55 | 11 | 9.4 | 135 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 55 | Male | Hindu | labourer | 1 | No | No | No | No | Yes | Chronic kidney disease | Normal | 6 | 96 | 13.4 | 5.4 | 138 | 4.7 | 1.2 | 0.2 | 39 | 39 | 86 | 8.3 | 3.9 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 50 | Female | Hindu | homemaker | 1 | No | No | yes | Yes | No | Chronic kidney disease | Normal | 3.6 | 73 | 13 | 4.5 | 139 | 4.2 | 1.7 | 0.8 | 34 | 29 | 77 | 8.7 | 3.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 66 | Male | muslim | Retired | 3 | No | No | No | No | No | CKD | Normal | 6 | 44 | 11.2 | 8.7 | 130 | 2.9 | 0.8 | 0.07 | 54 | 55 | 102 | 6.5 | 2.8 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 69 | Female | Hindu | homemaker | 1 | No | No | No | No | Yes | CKD | Normal | 5.8 | 47 | 11 | 9.4 | 135 | 4.3 | 1.6 | 0.04 | 35 | 32 | 90 | 8 | 2.1 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 37 | Male | Hindu | shopkeeper | 1 | No | No | No | Yes | No | Chronic kidney disease | Normal | 4.5 | 62 | 11.5 | 8.3 | 140 | 4.7 | 1.4 | 0.7 | 19 | 33 | 100 | 8.8 | 2.7 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 72 | female | Hindu | homemaker | 2 | No | No | No | No | Yes | aki | Normal | 11 | 126 | 8.3 | 13.6 | 144 | 2.48 | 1.6 | 0.5 | 40 | 42 | 56 | 8.3 | 3.5 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 41 | Male | Hindu | shopkeeper | 1 | No | No | yes | Yes | No | Chronic kidney disease | Normal | 3.7 | 43 | 13 | 9 | 134 | 4 | 2.6 | 1.3 | 40 | 33 | 97 | 8.9 | 2.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 37 | Male | Hindu | shopkeeper | 2 | No | No | No | No | No | Chronic kidney disease | Normal | 4.5 | 49 | 13.2 | 7.7 | 135 | 3.8 | 1.3 | 0.2 | 38 | 27 | 78 | 8.1 | 3.6 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 39 | Female | Hindu | farmer | 1 | No | No | yes | No | No | Chronic kidney disease | Normal | 3.3 | 35 | 13.1 | 7.1 | 134 | 3.4 | 1.2 | 0.2 | 31 | 27 | 98 | 8.4 | 3.3 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 35 | Male | Hindu | hotel waiter | 2 | No | No | yes | No | No | Chronic kidney disease | Normal | 3.3 | 28 | 12.2 | 16.3 | 134 | 4.57 | 0.67 | 0.3 | 17 | 10 | 43 | 9.7 | 4.4 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 34 | Male | Hindu | business | 1 | No | No | No | no | No | Chronic kidney disease | Normal | 3.24 | 41 | 12.5 | 8 | 132 | 4.9 | 1.8 | 0.9 | 40 | 28 | 97 | 9.1 | 3.9 | No | No | No | No | No | No | No | No | No | No | No | No |
| 50 | Male | Hindu | Farmer | 1 | No | No | No | No | No | Chronic kidney disease | Normal | 3.6 | 29 | 12.2 | 5.8 | 136 | 4.7 | 1.1 | 0.6 | 14 | 19 | 48 | 8.8 | 3.4 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 54 | Male | muslim | business | 1 | No | No | No | No | No | Chronic kidney disease | Normal | 4.2 | 34 | 8.4 | 13.6 | 130 | 6.05 | 0.3 | 0.1 | 15 | 14 | 86 | 8.4 | 3.3 | No | NA | No | No | No | No | No | No | No | No | No | No |
| 47 | Female | Hindu | daily wage worker | 2 | No | No | yes | No | No | acute renal failure | Normal | 18 | 46 | 13.6 | 7.1 | 132 | 4.29 | 0.39 | 0.22 | 14 | 17 | 57 | 8.2 | 4 | No | NA | No | No | No | No | No | No | No | No | No | No |