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Original Research Article

Assessment of nutrition status of chronic kidney disease patients "on dialysis" and "not on dialysis": a diet-based analysis

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ABSTRACT

Background: Nutritional status and micronutrient levels of CKD patients are very critical aspects of their overall health. CKD patients with T2DM face additional challenges in managing their nutritional status. This is because of the correlation between T2DM-related dietary considerations and CKD. CKD patients with T2DM require management of both conditions simultaneously. This needs a careful balance of dietary restrictions and recommendations. Thus, the focus of present research was to assess nutrition status of CKD patients suffering with T2DM on dialysis and not on dialysis.
Methods: Total 80 patients were considered in this research, 40 patients of T2DM related CKD on dialysis and 40 patients of T2DM related CKD not on dialysis. Central tendency tests have been conducted here.
Results: For T2DM CKD patients not on dialysis, vegetarians consumed maximum water followed by eggetarian. Non vegetarians consumed minimum water in comparison to other two. Maximum vegetarians don't have hypertension, all eggetarians have hypertension, and more than half non vegetarians have hypertension. All vegetarians were males, more than half females were non vegetarians, equal number of males and females were eggetarian.
Conclusions: The type of diet that is vegetarian, non-vegetarian or eggetarian also decides the type and quantity of nutrition being consumed. Thus it is critical to assess the nutrition based on diet type for T2DM CKD patients on dialysis and not on dialysis.

Keywords: Chronic kidney disease, Kidney disease, Nutrition, T2DM

INTRODUCTION

Chronic kidney disease (CKD) patients who are undergoing maintenance dialysis are prone to many nutrition related disorders. The prevention and management of such nutrition related disorders is possible through dietary counselling. If dietary counselling fails to meet the recommended energy and protein requirements, the addition of oral nutrition supplements (ONSs) is necessary. When both of these measures fail, the next option is to provide nutritional support through enteral tube feeding or parenteral nutrition (PN). Partial PN comprises of intra-peritoneal PN (IPPN) and intra-dialytic PN (IDPN) therapies.[1]

Nutritional status and micronutrient levels of CKD patients are very critical aspects of their overall health. This is because such patients face dietary restrictions, loss of appetite, metabolic abnormalities, and complications such as malnutrition and cachexia. It varies between patients who are on hemodialysis, peritoneal dialysis (PD) and renal transplantation (RT). To understand the nutritional status and micronutrient levels of such patients, regular monitoring and management is required.[2]

The 2020 kidney disease outcome quality initiative (KDOQI) issued a clinical practices guideline for CKD patients that strict protein restriction should be imposed

on patients affected by stage 3 to 5 CKD patients who are not on dialysis. Low protein diets are considered as effective therapies to delay the beginning of dialysis and to gain additional benefits by promoting better dietary quality.[3] On the other hand, nutritional intake has been described to have a positive impact on peritoneal dialyzed patients. Protein intake is an important factor to stratify malnutrition. Though, inadequate intake of protein could lead to PEW.[4]

Prognostic nutritional index (PNI) has been identified as a composite indicator of inflammation and nutritional status among CKD patients. PNI has been recognised as an independent prognostic marker for CKD. It is also an important predictor of mortality among CKD-D and CKD-ND patients.[5]

As a result, it is observed that proper nutritional diet is of utmost importance for CKD-D patients on while protein restriction has been suggested for CKD-ND patients. Consumption of ONS has been found beneficial for both categories of CKD patients. Fatigue is the most common symptom among CKD patients and PNI is a useful indicator of mortality.

CKD patients with T2DM face additional challenges in managing their nutritional status. This is because of the correlation between T2DM-related dietary considerations and CKD. CKD patients with T2DM require management of both conditions simultaneously. This needs a careful balance of dietary restrictions and recommendations. Balancing the dietary restrictions and ensuring accurate nutritional intake is essential for CKD patients with T2DM. Thus, the focus of present research was to assess nutrition status of CKD patients suffering with T2DM on dialysis and not on dialysis.

Thus, the objectives of present research were to assess diet-based differentiation for T2DM related CKD who were not on dialysis and to assess diet-based differentiation for T2DM related CKD who are on dialysis.

METHODS

The present study was cross-sectional research. The sampling method used is non probabilistic sampling. Under non probabilistic sampling, convenience sampling has been used. The study was conducted in the OPD/IPD and dialysis unit of the nephrology and medicine department, King George's Medical University, Lucknow. The duration of research was one year that is 2022-23. The study has been approved by institutional ethics committee King George's Medical University, Lucknow (Ref.Code-104th ECM II B-Ph.D / P4).

Inclusion criteria

Patients giving written informed consent were taken. Age group 18-65 years. CKD patients' stage III-V (ND) and V (HD).

Exclusion criteria

Patients not giving consent. Pregnant or lactating women. Active infection/malignant condition at time of enrollment.

Total 80 patients were considered in this research, 40 patients of T2DM related CKD on dialysis and 40 patients of T2DM related CKD not on dialysis.

The collected data was analysed using SPSS 23.0 software. Central tendency tests have been conducted here. Further, p value has been used for assessment of statistical significance. Here level of significance has been taken to be 5%. The ethical approval was approved by the college.

RESULTS

The eating habits of the T2DM patients suffering from CKD have been categorized as vegetarians, non-vegetarians and eggetarians.

When analysed on the basis of lifestyle, more patients are living a moderate lifestyle which includes 66.7% vegetarians and 58.3% non-vegetarians. Among eggetarians, a ratio of 1:1 was seen between sedentary and moderate lifestyles. Though, sedentary lifestyle has slightly lower patient count as compared to moderate lifestyle among vegetarians and non-vegetarians.

When analysed on the basis of hypertension, it was found that there is a statistically significant difference (p value =0.005) between vegetarians, non-vegetarians and eggetarian. More patients among non-vegetarians (58.3%) and eggetarian (100%) are possessing hypertension. While among vegetarians, the higher patient count (83.3%) was found towards not possessing hypertension. These means that T2DM CKD patients who were vegetarians have lower rate of possessing hypertension as compared to non-vegetarians and eggetarians.

When analysed on the basis of alcohol intake, most of the vegetarian (83.3%) and non-vegetarian (75.0%) T2DM CKD patients are found to not indulge in any sort of alcohol consumption. Eggetarian T2DM CKD patients possessed equal ratio between consumption and non-consumption of alcohol.

Table 1: Comparison of eating habits of T2DM CKD patients "not on dialysis".

		Vegetarians		Non-vegetarians		Eggetarians		P value
		N	%	N	%	N	%	
Lifestyle	Sedentary	4	33.3	10	41.7	2	50.0	0.824
	Moderate	8	66.7	14	58.3	2	50.0	
Hypertension	No	10	83.3	10	41.7	0	0	0.005
	Yes	2	16.7	14	58.3	4	100.0	
Alcohol	No	10	83.3	18	75.0	2	50.0	0.431
	Yes	2	16.7	6	25.0	2	50.0	
Smoking	No	10	83.3	14	58.3	4	100.0	0.123
	Yes	2	16.7	10	41.7	0	0	
Tobacco	No	6	50.0	16	66.7	2	50.0	0.594
	Yes	6	50.0	8	33.3	2	50.0	
Sex	Male	12	100.0	6	25	2	50.0	0.000
	Female	0	0	18	75	2	50.0	

Table 2: Comparison of parameters for T2DM CKD patients "not on dialysis".

	Vegetarians		Non-vegetarians		Eggitarian		P value
	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	
Water consumed (ml)	1000-4000	2300.00±1000.000	1000-3000	1558.33±607.859	2000-2000	2000.00±0.000	0.021
Energy consumed (kcal)	1200-1900	1383.33±265.718	1000-1900	1550.00±284.376	1200-1500	1350.00±173.205	0.147
Protein consumed (gm)	20-40	31.67±6.513	20-35	28.75±4.235	30-30	30.00±0.000	0.250
Fat consumed (gm)	15-30	21.67±5.774	15-35	23.33±6.370	25-30	27.50±2.887	0.252
Weight (kg)	56-71	64.00±5.560	40-83	58.54±11.846	61-71	66.00±5.774	0.183
Height (cm)	156-171	165.33±5.382	154-168	160.42±3.599	158-165	161.50±4.041	0.009
BMI (kg/m^2)	21-27	23.50±2.236	16-30	22.67±4.114	24-26	25.00±1.155	0.433
Age (years)	45-63	53.17±7.469	20-65	46.67±15.364	62-65	63.50±1.732	0.044

Table 3: Comparison of eating habits of T2DM CKD patients "on dialysis".

		Vegetarians		Non-vegetarians		Eggetarians		P value
		N	%	N	%	N	%	
Lifestyle	Sedentary	14	77.8	12	60.0	2	100.0	0.330
	Moderate	4	22.2	8	40.0	0	0.0	
Hypertension	No	16	88.9	14	70.0	2	100.0	0.283
	Yes	2	11.1	6	30.0	0	0.0	
Alcohol	No	12	66.7	10	50.0	2	100.0	0.171
	Yes	6	33.3	10	50.0	0	0.0	
Smoking	No	10	55.6	18	90.0	0	0.0	0.004
	Yes	8	44.4	2	10.0	2	100.0	
Tobacco	No	12	66.7	12	60.0	2	100.0	0.538
	Yes	6	33.3	8	40.0	0	0.0	
Sex	Males	16	88.9	12	60	2	100.0	0.088
	Females	2	11.1	8	40	0	0.0	

When analysed on the basis of smoking habits, the highest inclination is towards the non-smokers. Vegetarians (83.3%), non-vegetarians (58.3%) and eggetarian (100.0%) had the greatest number of T2DM CKD patients observed as non-smokers. Provenzano et al stated that smoking habits of CKD patients are highly associated with cardiovascular diseases and higher mortality rate.[6] Smoking is injurious to health even for a

fit human being. But, with T2DM CKD disorder, smoking can be a big risk

When analysed on the basis of tobacco intake, 66.7% of non-vegetarian CKD patients have been observed to be the non-consumers of tobacco. While both vegetarians and eggetarians were found to possess a 1:1 ratio of tobacco consumption.

For the patients suffering from T2DM CKD who were "not on dialysis", the mean age of vegetarians was 53.17 years, for non-vegetarians the mean age was 46.67 years and for eggetarian, it was 63.50 years. On the basis of age, these three dietary categories possessed statistically significant difference (p value=0.04<0.05).

The mean BMI for eggetarian (25.00 kg/m^2) was the highest among T2DM CKD patients "not on dialysis". The vegetarians possessed mean BMI of 23.50 kg/m^2 while non-vegetarians possessed 22.67 kg/m^2. This infers that T2DM CKD patients who consume egg possess the highest BMI.

When analysing the protein and fat consumption of T2DM CKD patients, both vegetarians and eggetarian possess nearly equal amount of protein with a mean of 31.67 gm among vegetarians and 30.00 gm among eggetarian. Non-vegetarians possess a mean of 28.75 gm of protein consumption which is less as compared to others.

Figure 1 presents the graphical representation of different nutritional parameters of T2DM CKD patients not on dialysis.

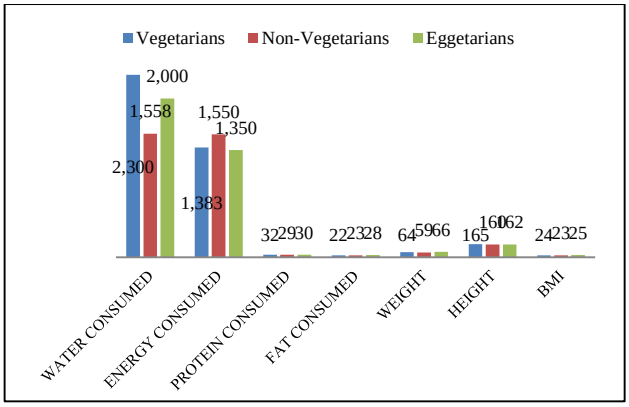

Figure 1: Graphical comparison of parameters for CKD patients "not on dialysis".

Next assessing the nutritional profile of T2DM CKD patients "on dialysis".

Out of the total 40 T2DM CKD patients who were "on dialysis", 18 were vegetarians, 20 were non-vegetarians and merely 2 were eggetarians (Table 3).

When analysed on the basis of lifestyle of these patients, more patients were living a sedentary lifestyle which includes 77.8% vegetarians, 60.0% non-vegetarians and 100.0% eggetarian. Though, moderate lifestyle has significantly less patient count as compared to sedentary lifestyle among four vegetarians, eight non-vegetarians and 0 eggetarian.

Table 4: Comparison of parameters for T2DM CKD patients "on dialysis".

	Vegetarians		Non-vegetarians		Eggitarian		
	Range	**Mean±SD**	**Range**	**Mean±SD**	**Range**	**Mean±SD**	**P value**
Water consumed (ml)	1500-4200	2477.78±831.410	1500-3000	1970.00±432.982	2000-2000	2000.00±0.000	0.059
Energy consumed (kcal)	1200-1800	1470.00±191.219	1000-2000	1585.00±300.920	1450-1450	1450.00±0.000	0.348
Protein consumed (gm)	20-45	30.00±8.402	20-40	30.00±6.070	25-25	25.00±0.000	0.633
Fat consumed (gm)	10-30	21.67±5.941	15-35	22.50±6.177	16-16	16.00±0.000	0.350
Weight (kg)	60-78	70.33±5.156	50-87	64.90±9.846	70-70	70.00±0.000	0.109
Height (cm)	158-172	165.56±4.422	160-170	165.40±3.979	156-156	156.00±0.000	0.012
BMI (kg/m^2)	22-28	25.56±1.947	18-30	23.60±3.347	29-29	29.00±0.000	0.012
Age (years)	19-54	43.22±11.133	40-62	50.60±7.287	42-42	42.00±0.000	0.046

When analysed on the basis of smoking habits, the highest inclination is towards the non-smokers. Vegetarians (55.6%) and non-vegetarians (90.0%) had the highest number of T2DM CKD patients observed as non-smokers which is a good habit based on the medical conditions of these patients and being on dialysis as well, while 100.0% of eggetarian were found to be smokers. This is not so good for them based on their condition.

Also, the difference between the three groups was found to be statistically significant. Lee et al in their research stated that potential harmful effects of degree of exposure to smoking can be seen on CKD patients.[7] Non-smokers show better progress in their treatment while the smokers face significant issues in their progress.

Table 5: Summary table.

	On dialysis			Interpretation	Not on dialysis			Interpretation
	Vegetarians	**Non-Vegetarians**	**Eggetarian**		**Vegetarians**	**Non-Vegetarians**	**Eggetarian**	
Water consumed	Statistically insignificant difference			There is no difference in the water consumed amount among three groups	Statistically significant difference. Vegetarians consume maximum water followed by Eggetarian. Non vegetarians consume minimum water			There is a difference in the water consumed amount among three groups
Energy consumed	Statistically insignificant difference			There is no difference in the energy consumed amount among three groups	Statistically insignificant difference			There is no difference in the energy consumed amount among three groups
Protein consumed	Statistically insignificant difference			There is no difference in the protein consumed amount among three groups	Statistically insignificant difference			There is no difference in the protein consumed amount among three groups
Fat consumed	Statistically insignificant difference			There is no difference in the fat consumed amount among three groups	Statistically insignificant difference			There is no difference in the fat consumed amount among three groups
Weight	Statistically insignificant difference			There is no difference in the weight of the three groups	Statistically Insignificant Difference			There is no difference in the weight of the three groups
Height	Statistically significant difference, height of vegetarians and non vegetarians is same. Eggetarian are shorter			There is difference in the height of the three groups	Statistically Significant Difference, Vegetarians are tallest followed by Eggitarian. Non vegetarians are shortest in comparison			There is difference in the height of the three groups
BMI	Statistically Significant Difference. BMI of Eggetarian is much higher followed by vegetarians. Non vegetarians presented lowest BMI			There is difference in the BMI of the three groups	Statistically insignificant difference			There is no difference in the BMI of the three groups
Age	Statistically Significant Difference, non vegetarians were older followed by vegetarians. Eggitarian are youngest			There is difference in the age of the three groups	Statistically Significant Difference. Eggitarian are oldest followed by vegetarians. Non vegetarians are youngest			There is difference in the age of the three groups
Lifestyle	Statistically insignificant difference			There is no difference in the lifestyle of the three groups	Statistically insignificant			There is no difference in the lifestyle of the three groupd
Hypertension	Statistically insignificant difference			There is no difference in the hypertension of the three groups	Statistically Significant Difference, maximum vegetarians don't have hypertension, all Eggitarian have hypertension, more than half non vegetarians have hypertension			There is a difference in the hypertension of the three groups
Alcohol	Statistically insignificant difference			There is no difference in the alcohol intake of the three groups	Statistically insignificant difference			There is no difference in the alcohol intake of the three groups
Smoking	Statistically Significant Difference, smokers are lesser than non smokers for vegetarians and non vegetarians. All Eggitarian were smokers			There is a difference in the smoking of the three groups	Statistically insignificant difference			There is a difference in the smoking of the three groups
Tobacco	Statistically insignificant difference			There is no difference in the lifestyle of the three groups	Statistically insignificant difference			There is no difference in the lifestyle of the three groups
Sex	Statistically insignificant difference			There is no difference in the gender three groups	Statistically Significant Difference, All vegetarians were males, more than half females were non vegetarians, equal number of males and females were Eggitarian			There is a difference in the gender three groups

For the patients suffering from T2DM CKD who were "on dialysis", the mean age of vegetarians was 43.22 years, for non-vegetarians the mean age was 50.60 years and for eggetarian, it was 42.00 years. This age difference was found to be statistically significant.

The mean BMI for eggetarian (29.00 kg/m^2) was the highest among CKD patients with varied eating habits. The vegetarians possessed mean BMI of 25.56 while non-vegetarians possessed 23.60 kg/m^2. This BMI based difference was found to be statistically significant (p value =0.012). This infers that T2DM CKD patients who consume egg possess the highest BMI.

When analysing the height and weight of T2DM CKD patients on dialysis, the highest height was observed among vegetarians which was a mean of 165.56 cm. While non-vegetarians also possessed 165.40 cm that was not much of a difference between vegetarians and non-vegetarians. Though, eggetarian possessed a mean height of 156.00 cm. There wasn't much of a difference observed among vegetarians and non-vegetarians. But it can be inferred that vegetarians gain better height than patients with other sorts of eating habits followed by non-vegetarians. This result was also found to be statistically significant (p value =0.012).

When weight of these T2DM CKD patients was observed, vegetarians possessed the most weight with a mean of 70.33 kg. Though there wasn't much difference among eggetarian as well. Eggetarian possessed a mean weight of 70.00 kg while non-vegetarians possessed 64.90 kg. Thus, it can be stated that consumption of vegetarian diet is a major source of weight gain among T2DM CKD patients. But this difference was found to be statistically significant (p value =0.109).

Figure 2 below presents the graphical representation of different nutritional parameters of T2DM CKD patients on dialysis.

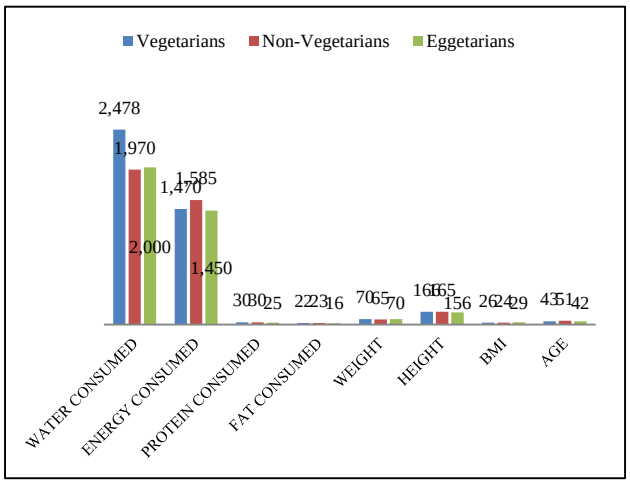

Figure 2: Graphical comparison of parameters for CKD patients "on dialysis".

Based on the above discussion, following is a summary Table 5 of the findings.

DISCUSSION

Managing T2DM CKD is a very critical condition. It requires constant monitoring and management. It involves management of multiple parameters like controlling blood sugar levels, managing blood pressure and cholesterol. This can be done via medication, nutrition, diet and changes in lifestyle. When the medical condition progresses, patients become dialysis dependent. In such condition, nutrition plays even more crucial role. The type of diet i.e. vegetarian, non-vegetarian or eggetarian also decides the type and quantity of nutrition being consumed. Thus, it is critical to assess the nutrition based on diet type for T2DM CKD patients on dialysis and not on dialysis.

Nutrition based on diet type plays a critical role in managing T2DM CKD, be it with dialysis or without dialysis. While protein is important for overall health, too much protein consumption can stress the kidneys in patients with CKD. Thus, moderating protein intake is crucial. It was found in the present research that there is no difference in the protein consumed amount among three groups both for patients on dialysis and not on dialysis.

Correct hydration is vital for kidney wellbeing, but patients with T2DM CKD may need to screen their water consumption closely, particularly if subjected to fluid retention or swelling. It is significant for these patients to determine correct water intake quantity. The present research concluded that for patients who are on dialysis, have no difference in water consumption quantity among the three diets. This can be attributed to the fact that patients who are on dialysis are regularly monitored for fluid intake and its management. But for the patients who are not on dialysis, a significant difference was found to exist between three groups. It was found that vegetarians consume maximum water followed by eggetarian. Non vegetarians consume minimum water.

Keeping a healthy weight is significant for treatment of both T2DM and CKD. A well-adjusted diet that concentrates on portion control and nutrient-dense foods can facilitate in achieving and maintain a healthy weight. It was found in the present research that there is no difference in the weight among three groups both for patients on dialysis and not on dialysis.

Age was one parameter which was found to be significantly different for all the three diet, both for patients on dialysis and not on dialysis. For patients on dialysis, non-vegetarians were older followed by vegetarians. Eggetarian were youngest. This means that eggetarian suffering from T2DM CKD are more prone to be on dialysis at an early stage of life when compared to vegetarians and non-vegetarians. Based on this, it can be

stated that non vegetarians have better chances of not being on dialysis at early stage in life. For T2DM CKD patients not on dialysis, it was found that eggetarian were oldest followed by vegetarians. Non-vegetarians were youngest. This means non-vegetarians develop T2DM CKD at an early stage in comparison to vegetarians and Eggetarian

The research found that vegetarian food contains the most amount of protein and is beneficial for T2DM CKD patients. But, the difference on the basis of protein consumption was found to be statistically insignificant. The research conducted by Świątek et al stated that vegetarian diet and egg, both are rich sources of protein.[8] Thus, the consumption of vegetarian diet and eggs help the T2DM CKD patients to increase their protein intake which can then support in their CKD treatment.

A good chunk of non-vegetarian T2DM CKD patients was found to be living a sedentary lifestyle which means that these patients do not indulge in physical activity and spend most of their time in sitting chores. In a research conducted by Beetham et al it was stated that CKD patients who lead a sedentary lifestyle have higher chances of cardiovascular mortality.[9]

Eggetarian T2DM CKD patients possessed equal ratio between consumption and non-consumption of alcohol. The research conducted by Li et al stated that alcohol possesses a U-shaped relation with CKD.[10] Moderate drinkers exhibited lower disease prevalence compared to non-drinkers and heavy drinkers. Therefore, patients who are non-drinkers tend to show better progress in their CKD treatment.

The research found vegetarians and non-vegetarians to have the greatest number of T2DM CKD patients as non-smokers which is a good habit based on the medical conditions of these patients and being on dialysis as well, while 100.0% of eggetarian were found to be smokers. This is not so good for them based on their condition. Also, the difference between the three groups was found to be statistically significant. Lee et al in their research stated that potential harmful effects of degree of exposure to smoking can be seen on CKD patients.[7] Non-smokers show better progress in their treatment while the smokers face significant issues in their progress.

Though, the water intake of non-vegetarians is the least among all. This means that vegetarian diet requires more amount of water consumption than the other two. Xu et al in their research stated that vegetarian diet is considered a healthy diet.[11] This also because lots of water intake is associated with vegetarian diet. This also helps T2DM CKD patients who are not on dialysis as larger water intake helps in clearing out the impurities from kidney. This in turn benefits the renal function among CKD patients. The difference between the three groups was found to be statistically insignificant

It was found that the non-vegetarian diet holds the most amount of energy and benefits the T2DM CKD patients. Though, the difference was found to be statistically insignificant. The research conducted by Hou et al stated that enhanced consumption of grains might accompany hyperphosphatemia.[12] But, the calories from these grains trade off energy. Therefore, vegetarian diet holds less energy than non-vegetarian diet.

Non-vegetarian T2DM CKD patients possess a 1:1 ratio among consumption and non-consumption of alcohol. But this difference was found to be statistically insignificant. The research conducted by Joo et al states that heavy alcohol consumption among non-vegetarians is associated with faster progression of CKD.[13] This is not advisable for even healthy individuals. But with CKD condition, it can be fatal.

The mean BMI for eggetarian is the highest among CKD patients with varied eating habits. It was found that that T2DM CKD patients who consume egg possess the highest BMI. The research conducted by Narasaki et al stated that the consumption of plant-based foods are associated with numerous health benefits.[14] This includes improved blood pressure, glycaemic control, lipid levels, BMI and acid based parameters. Thus, the findings of this research are in sync with the findings of the present research.

The research found that the non-vegetarian diet holds the most amount of energy and benefits the CKD patients on dialysis. But this difference was found to be statistically insignificant (p value=0.348). González-Ortiz et al stated that CKD patients on hemodialysis are less likely to meet their daily protein intake goal.[15] It is important for CKD dialysis patients to focus on a healthy plant based diet to improve their energy and water consumption which will in turn benefit the CKD patients with improved renal function.

The biggest and the most significant limitation of the present research is the small sample size.

CONCLUSION

Largely, nutrition plays a vital role in handling T2DM CKD for both patients on dialysis and not on dialysis. A proper diet can help improve quality of life, slow disease progression, and reduce the risk of complications.

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Conflict of interest: None declared
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