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Research Article

Follow up Study on Sri Lankan Traditional Medicine Treatment on Diagnosed Chronic Kidney Disease of Unknown Etiology Patients in Kebithigollewa, North Central Province (NCP), Sri Lanka

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ABSTRACT

Background: The study focuses on 75 diagnosed CKDu patients in the NCP of Sri Lanka who have been visiting a selected Ayurveda clinic in Kebithigollewa. Biochemical parameters such as serum creatinine and micro-albumin were analyzed over a period of six months among patients undergoing Sri Lanka traditional medicine treatment.

Methods: The patients undergoing Sri Lankan traditional medication for a period of one year were selected for the study. Descriptive data analysis was carried out for a further six-month period on samples of 75 patients diagnosed with CKDu. The patients age, gender, serum creatinine, micro-albumin, blood pressure and ankle edema were taken into consideration. Pearson correlation test was carried out on all patient data to assess patient prognosis.

Results: A sample of 75 (n=75) patients were selected for the study of which 52 were males and 23 were females in the age range 40-60. The average e-GFR for the first month (m=1) follow up was 35.44 and sixth month (m=6) was 40.16. The average serum creatinine level declined from 2.59 to 2.48 over the six-month study period, accounting to a 5% reduction. The average blood pressure for the six-month period was 123/77. The average ACR measured for a four-month period was 304.85 mg/g and had a correlation value of 0.328 at 95% confidence and a p value of 0.04 was obtained when correlated with e-GFR.

Conclusion: A significant improvement in both biochemical and quality of life parameters were observed among the selected patient population who underwent Sri Lankan traditional medicine treatment.

KEYWORDS: Chronic kidney disease of unknown aetiology; Chronic kidney disease; Chronic kidney disease epidemiology collaboration; World Health Organization; Ministry of Health; Albumin to creatinine ratio

ABBREVIATIONS: ACR: Albumin to Creatinine Ratio; BUN: Blood Urea Nitrogen; CKD: Chronic Kidney Disease; CKD-EPI: Chronic Kidney Disease Epidemiology Collaboration; CKDu: Chronic kidney Disease of Unknown Aetiology; COPCORD: Community Acquired Program for the Control of Rheumatic Disease; E-GFR: Estimated Glomerular Filtration Rate; ESRD: End Stage Renal Disease; MDRD: Modification of Diet in Renal Disease; MOH: Ministry of Health; NCD: Non Communicable Diseases; NCP: North Central Province; NSAID's: Non-Steroidal Anti-Inflammatory Drugs; NWP: North Western Province; WHO: World Health Organization.

INTRODUCTION

Chronic kidney disease of unknown origin is a disease that is prominent in farming communities, especially in the North Central Province (NCP) Sri Lanka. Most commonly the disease

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is evidently found in Sri Lanka, India and Central American countries such as Guatemala and Nicaragua. CKDu is a unique kidney disease since it has no symptoms or signs that rectify the presence of kidney disease during early stages [1] and it generally carries a poor prognosis. Unlike CKD with identified predisposing factors such as diabetes mellitus, high blood pressure and hypertension, CKDu lacks identified predisposing factor hampering early diagnosis [2]. An estimated 3.2 million people are suffering from end stage renal disease (ESRD) each year caused by different forms of kidney disease [1] out of which only 14% are able to undergo renal replacement therapy making CKD's one of the most devastating non-communicable diseases [3]. Due to economic constraints and the disease being more prevalent in low or middle income countries, alternative options have been explored as a part of the disease management. Following the recommendations of WHO the usage of traditional medicines has been considered as an alternative approach in improving quality of life of these patients [4]. The treatment cost for CKDu is relatively high, with dialysis costing an estimate of ten thousand (LKR) or above for a period of four hours. The mean income per month for the local farmers also range around the above estimated cost for dialysis making treatment unaffordable for a majority of those affected [4]. Complimentary or Alternative medicine (CAM) is widely used in Asian countries such as India, China and Sri Lanka to treat numerous medical conditions serving both a cost effective and a successful approach in managing the conditions. The WHO action plan on CKDu in Sri Lanka released in 2016 identifies Sri Lankan traditional medicine as a cost effective management modality. The study focuses on a follow-up of 75 patients who have been diagnosed with CKDu and undergoing traditional treatment remedy for a period of 6 months. A descriptive study was carried out to analyze and assess their biochemical, clinical, anthropometric and quality of life data of the selected CKDu patient population.

Diagnosis of CKDu

CKDu is asymptomatic and no symptoms are visible in the patients until the later stages as mentioned above. Ultrasound images of the kidneys shows most commonly tissue scaring during the end stages and evidence of primary nephritis in most cases observed. Proteinuria is detected in these patients allowing biomarkers such as albumin and creatinine to be used in estimating GFR as an indicator of kidney function [6].

Despite the fact that renal biopsies serves as gold standard in diagnosing CKDuthe invasive nature of the procedure and the costs involved has lead to a minimum data availability with regard to histopathological changes in the renal tissue [2].

Risk population of CKDu

The most common group affected by CKDu are the farming population where the people involved in agricultural activities are more liable to get the disease and cannot undergo treatment options as they are relatively poor and in their mid-40's finding income difficulties. This is a common feature presented in India as well as Nicaragua which highlights the main way of CKDu presented in patients [7]. Most commonly in Sri Lanka the elderly population is increasing gradually which increases the risks of the body tissues wearing out and unable to function normally. This also causes hypertension which a risk factor that is associated with CKDu..

CKDu in Sri Lanka

The government of Sri Lanka recognized CKDu as a national health burden and a Presidential Task Force was appointed in 2015 with the main objective of analyzing and reducing the number of CKDu patients and a vision of eradicating CKDu and ensuring well-being of patients allowing them to return to normal lifestyle. The same year, WHO carried out a detailed analysis on 5000 CKDu affected patients identifying CKDu as a disease among agricultural communities mainly in the North Central Province of the country. According to Weaver et al. [8], the male population in Sri Lanka is more liable to get the disease compared to the females. Further, poverty has been identified as a limiting factor in providing treatment for CKDu. Although the number of females affected by CKDu is higher greater proportion of males are observed in the later stages of the disease [8,9].

A recent study carried out by Rajapaske et al. [2] show that 15-23% of the population is affected by CKDu in NCP. The other common findings in the study were the presence of hypertension in the patients after stage 2. While many factors have been identified as causative agents for CKDu there have been no significant findings that has been established to support them so far [9]. Agrochemicals and use of contaminated water are the major source of CKDu in farming population as stated by Wijkström et al. [5]. Most CKDu patients affected in Sri Lanka do not exhibit the patterns of Mesoamerican nephritis causing it to be a unique type of CKDu with the most common histological findings being the presence of interstitial fibrosis and glomerulosclerosis [10].

The presence of two distinguishable weather patterns in the country makes the farming community more prone to dehydration compared to that of other CKDu affected nations, where three or four weather patterns are present and thus leading to a shorter dry period [11].

Endemic regions of CKDu

According to studies carried out in North Central Province (NCP) the area is reported endemic to CKDu with mainly the agricultural communities with low socioeconomic status being commonly affected. Medawachchiya, Giradurukotte, Medirigiriya, Kebithigollewa, and Nikawewa are some endemic areas of CKDu located in NCP [12]. This condition is identified in both males, and females who are in the range of 17-70 years with family history also serving a risk factor. However, ESRD is mostly common in men where the mortality increases without kidney transplantation. According to medical statistics in Anuradhapura General Hospital, an annual increase of 227% of ESRD patients has been observed. Out of the patients treated by the Nephrology Unit of Kandy Teaching Hospital, 50-69% of the patients were from NCP with kidney disease caused due to an unknown aetiology [12]. Due to the increase in the incidents of CKDu within the country, 4% of the public health budget is used for the treatment of this renal disease [13]. Dialysis is an expensive treatment which cannot be afforded by the low income patients. This causes patients to travel a long distance to reach government hospitals which provide this facility for free, consequently causing a burden to both the individual

and the family. Hence, strategies for the treatment of these CKDu patients in rural areas should be rearranged accordingly. The domestic economic burden is further intensified by the presence of several affected individuals within the family including the males around the age range of 40 who serve as the main income generator through agriculture. Lack of education leading to an inability to be engaged in an alternative less labor intensive job further hampers their family economy opting them to receive traditional medicine treatment as an affordable alternative source [14].

Alternative treatment for CKDu

The global report on alternative and traditional medicines released by WHO has recommended the use of traditional medicine methods specially those of South Asian countries can be utilized to treat NCD's and some infectious disease such as HIV to which successful allopathic medical treatments are not available [15]. Further, the WHO action plan on CKDu in Sri Lanka released in 2016 identifies Sri Lankan traditional medicine as a cost effective management modality which improves the normal day-to-day activities. In places like China, where healthcare facilities are ranked among the world's best 20% of the healthcare sector relies on traditional medicines for a period of more than 200 years that has reduced their health budget by a substantial amount [16]. The history of use of traditional medicine in Sri Lanka spans for over 2500 years and it has been proven to be a cost effective approach in controlling CKD [5]. Numerous studies conducted have shown the effectiveness of traditional medicine via clinical as well as biochemical assessments in the settings of CKDu in Sri Lanka [17]. Blood pressure, height, weight and ankle edema have been used as the most common clinical parameters while serum creatinine, urine creatinine, urine micro-albumin, ACR and e-GFR have been used to monitor the disease progression in addition to the quality of life of the patients [18].

MATERIALS AND METHODS

Design

This study is a community based continuous follow-up study carried out for a period of six months from June to January.

Setting

The study was carried out in the Kebithigollewa Ayurvedic Community Health Centre, NCR, Sri Lanka.

Study population This study involves 75 CKDu patients having serum creatinine above 1.2 mg/dL for a period of more than six months (age range 35-80) regularly visiting the clinic from 2015 onwards.

Data collection methods

Socio-demographic, anthropometric and biochemical data of the CKDu clinic attendees were collected for a period of six consecutive months (July 2018-January 2019).

Socio demographic data

Patient age, gender, occupation and family history of CKDu were taken.

Anthropometric measurements

Patient weight, height, blood pressure, ankle edema was taken as physical measurements.

(Ankle edema figure of eight measurement reference)

Biochemical parameters

Blood and urine samples were collected to analyze the serum creatinine and urine albumin markers respectively. A 3 mL venous blood sample was collected to plain tubes under universal precautions by a qualified phlebotomist. The serum was separated by using bench-top centrifuge (model number and model) at rpm 3200 for five minutes and serum was stored in 1.5 mL Eppendorf tubes and transported to laboratory at 4°C. The samples were analyzed using the TECOM TC-220 fully automated blood analyzer by a qualified laboratory technician. A 5-10 mL of urine was collected from the patients into clean urine containers and sealed and stored in temperature lower than 4°C. Patients were instructed to collect the mid-stream urine samples with minimum contamination. Samples were analyzed using MALB-KIT and QR-100 specific protein analyzer by a qualified laboratory technician. The e-GFR values were calculated using the CKD-EPI equation established by the WHO for South Asian region [19].

Data analysis

In applying descriptive statistics, the socio-demographic data were categorized and examined, using variable analysis. Then the data were differentiated based on the changes in standard ordinal

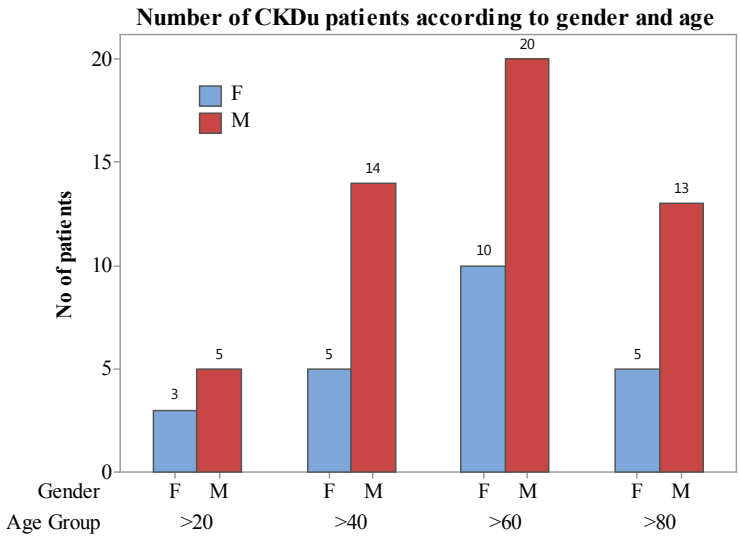

Figure 1: Count of CKDu patients by gender and age category. Age was categorized in to 4 groups (21-40, 41-60, 61-80 and above 80 years).

	Total	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
	(n=75)	(n=1)	(n=12)	(n=37)	(n=16)	(n=9)
Age in years (mean ± SEM)	59 ± 1.07	73 ±*	57 ± 2.42	59 ± 1.67	59 ± 2.35	61 ± 1.98
Age category(Count)						
>20	8	0	1	5	2	0
>40	19	0	6	8	3	2
>60	30	0	3	15	8	4
>80	18	1	2	9	3	3
Gender [Number(percentage)]						
Male	52 (69%)	1	11	23	11	6
Female	23 (31%)	0	1	14	5	3
Weight	58.18 ± 1.15	53 ±*	58.67 ± 1.77	58.15 ± 1.85	5938 ± 2.78	56.11 ± 2.3
Blood Pressure						
Systolic	102.7 ± 1.81	114.83 ±*	98.22 ± 3.67	102.78 ± 2.44	104.31 ± 4.85	104.12 ± 5.78
Diastolic	77.62 ± 1.32	83.0 ±*	73.97 ± 2.16	76.73 ± 1.56	80.64 ± 3.81	80.17 ± 5.25
Ankle edema	23.86 ± 0.823	25 ±*	22.205 ± 0.601	24.67 ± 1.48	24.91 ± 1.60	21.056 ± 0.903
Serum Creatinine	2.57 ± 0.169	1.683 ±*	1.39 ± 0.038	1.96 ± 0.064	3.23 ± 0.187	5.56 ± 0.606
Micro Albumin	60.47 ± 3.45	40.083 ±*	45.76 ± 6.38	58.70 ± 4.83	66.06 ± 8.47	79.65 ± 8.74
e-GFR(mL/min/1.73 m^2)	37.11 ± 2.0	51.167 ±*	65.167 ± 2.69	39.98 ± 1.21	22.57 ± 1.22	12.2 ± 1.07
ACR (mg/g)	203.2 ± 12.1	167.98 ±*	240.9 ± 27.7	228.0 ± 17.8	164.4 ± 24.2	124.5 ± 191

Note: Significant at *P value=0.05

Table 1: Average Characteristics of the study population by CKDu stages for six months.

No of clinics	Serum Creatinine		eGFR		Blood Pressure (SP/DP)	
(months)	(mean ± SEM)		(mean ± SEM)		(mean ± SEM)	
	Male	Female	Male	Female	Male	Female
1	2.817 ± 0.218	2.087 ± 0.158	36.23 ± 2.49	33.65 ± 2.45	124.71 ± 2.99/77.83 ± 2.09	121.57 ± 2.787/76.70 ± 2.62
2	2.715 ± 0.212	2.109 ± 0.174	37.62 ± 2.46	35.09 ± 3.20	121.79 ± 2.29/78.31 ± 1.97	129.43 ± 3.99/ 78.00 ± 2.73
3	2.779 ± 0.234	2.213 ± 0.179	38.13 ± 2.71	32.52 ± 2.92	124.92 ± 3.28/79.88 ± 1.95	120.78 ± 3.77/ 75.96 ± 2.54
4	2.868 ± 0.262	2.183 ± 0.206	37.40 ± 2.81	34.57 ± 3.27	123.37 ± 3.28/77.44 ± 2.12	119.83 ± 6.75/ 80.39 ± 2.34
5	2.752 ± 0.233	2.113 ± 0.186	38.00 ± 2.61	35.70 ± 3.53	125.60 ± 3.09/77.06 ± 1.91	124.96 ± 4.71/ 78.04 ± 3.51
6	2.663 ± 0.239	2.061 ± 0.186	42.10 ± 3.23	35.78 ± 2.96	121.62 ± 3.32/75.96 ± 1.76	119.09 ± 4.08/74.91 ± 2.52

Table 2: Descriptive characteristics of the some of the bio-chemical and anthropometric measurements.

measures such as count, percentage, mean and standard error of mean (SEM). Values for demographic variables, anthropometric measurements and bio chemical data in the study participants are presented as means with standard error of mean (SEM). Anthropometric analysis was carried out on the BMI, blood pressure and ankle edema using mean comparison test. CKD-EPI based e-GFR was used to categorize CKDu stages. Disease progression was determined according to the advance of CKDu stages over the monitoring period and changing pattern of monthly averages of variables. The association between serum creatinine & micro albumin and e-GFR & micro albumin over consecutive 6-month period was assessed by scatter plots. The best fitted line gives the projective forecast of the variation of assessed biomarkers over time. Biochemical parameters were analyzed using Pearson correlation test and the p values were obtained for the correlations carried out. The level of significance for all statistical tests was considered as $p<0.05$. Minitab version 17 was used for the analysis.

RESULTS AND DISCUSSION

The total number of 75 CKDu patients were included in this study: (52 males (M) and 23 females (F)). Figure 1 shows distribution of the study population according to the gender and age category. The prevalence of CKDu was higher in Males than in females. In both males and females, the prevalence increased with increasing age. The characteristics of the study population are summarized in Table 1. The average weight of CKDu patients was 58.18 ± 1.15 kg. The average blood pressure (systolic/diastolic) by CKDu stage which are categorized according to the e-GFR is presented in Table 1. Most patients diagnosed with CKDu were present in stage 3 of the disease. In our study, men (69%) were at higher risk of CKDu than women (31%). The average values of serum creatinine and e-GFR of the early stage CKDu (stage 2) were 1.39 ± 0.038 and 65.167 ± 2.6, and late stage of CKDu (stage 5) were 5.56 ± 0.606 and 12.2 ± 1.07, respectively. Descriptive characteristics of some of the bio-chemical and anthropometric measurements are presented in Table 2. It shows the data obtained for the patients over a period of six months and the average for males and females. The difference between current e-GFR value and initial reading is about 5.87 mL/min/1.73 m^2 in males and 2.13 mL/min/1.73 m^2 in females. The study was monitored for 6 months for disease progression with the treatments. According to the Figure 2, it was found that the average values of ACR, systolic and diastolic blood pressure, micro albumin and serum creatinine showed a decline over six-month period.

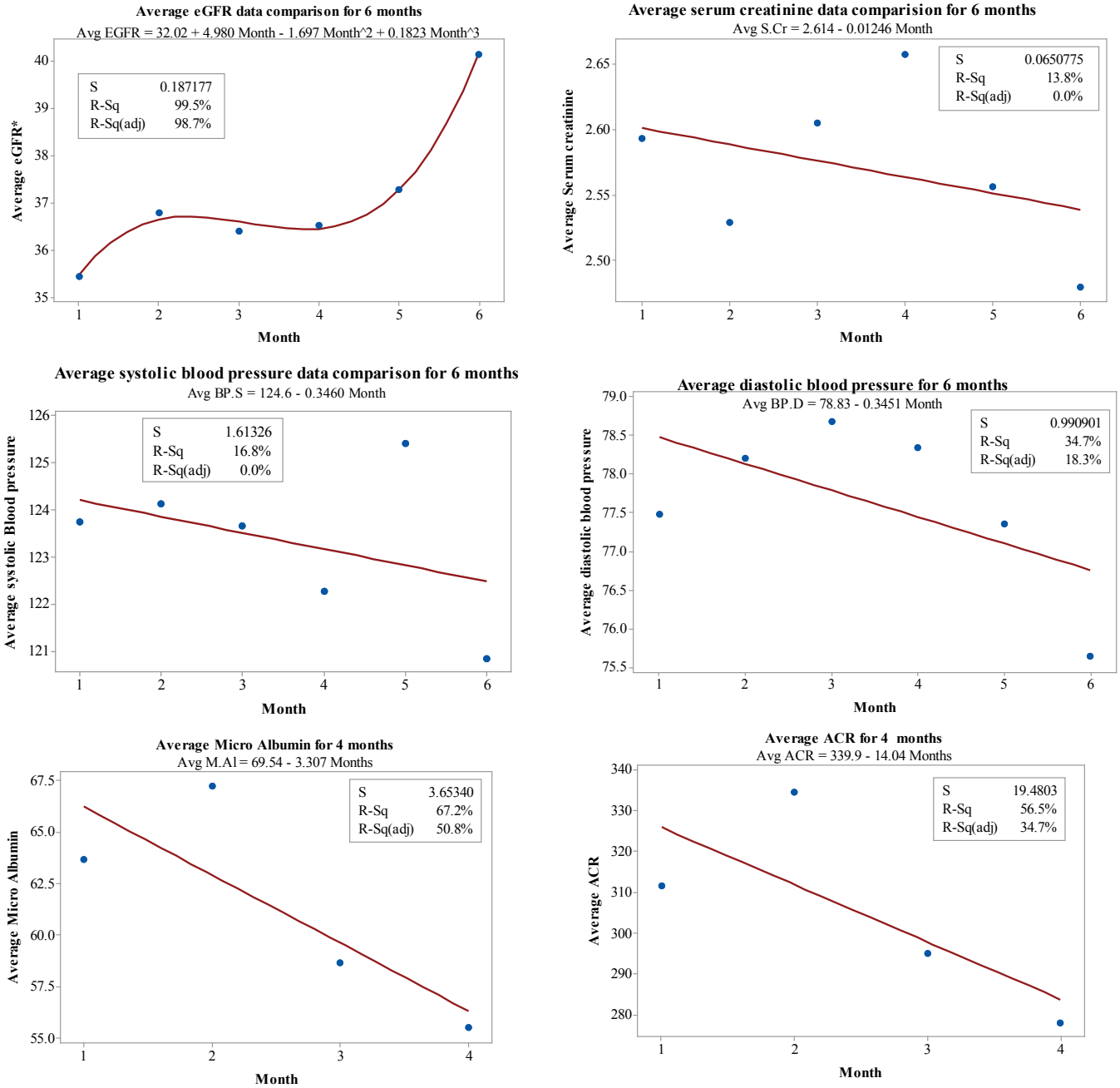

Figure 2: Fitted linear or cubic* models showing the changes of average biochemical and clinical parameters of the selected study subjects over the six month study period. Higher percentage of R squared values shows that fitted model is significant.

	Month	Correlation Coefficient	p value	Correlation Coefficient	p value	Correlation Coefficient	p value
e-GFR	1	-0.79	<0.001	-0.377	0.001	0.273	0.018
	2	-0.81	<0.001	-0.371	0.001	0.286	13
	3	-0.769	<0.001	-0.241	0.039	0.357	0.002
	4	-0.74	<0.001	-0.312	0.007	0.484	<0.001
	5	-0.768	<0.001	-	-	-	-
	6	-0.76	<0.001	-	-	-	-

Table 3: Person correlation coefficient between variables.

The study focuses on the approaches used to evaluate the diagnosis of CKDu [20,21]. A total of 75 patients fulfilled the inclusion criteria of which 52 were males and 23 were females with a mean age of 59 ± 1.07. Further 75% males were above stage 3 depicting the severity of the disease and plausible economic impact of the affected communities. An estimated 75% of the patients were symptomatic with common symptoms of backache, body pain and frequent urination. Prevalence of CKDu in NCP is relatively high [22], the prevalence is nearly four times compared to other provinces in Sri Lanka. Males generally tend to have a higher risk and the study carried out also shows nearly 2/3rd of the population chosen for the study were males. In 2016, WHO and PTF with the help of international consultation identified a suitable method for addressing and evaluating the prevalence of CKDu in Sri Lanka.

The framework designed for the study focused on e-GFR values as an indirect marker for observing the patients affected with CKD's. This action plan was implemented throughout the country from 2016 onwards and expected to finish by 2020 [23]. WHO has recommended the use of CKD-EPI which is based on age, gender and ethnicity as a standard equation in staging CKDu patients. In this study serum creatinine was used as a biomarker in evaluating e-GFR based on the CKD-EPI equation [24]. The patients were categorized into five stages based on the estimated GFR values. Our results demonstrate the average of serum creatinine and e-GFR constantly having changes at different months. The frequently presented stage in the study was stage 3 (S.Cr 1.958 ± 0.064 and e-GFR 39.98 ± 1.21) and this was significantly lower compared to previously published data [24]. Stage 2 (S.Cr 1.39 ± 0.038, e-GFR 65.167 ± 2.6) to stage 5 (5.56 ± 0.606 and 12.2 ± 1.07) showed a steep increase in serum creatinine of nearly 300% indicating severe damage to kidneys. Hence, this supports the hypothesis developed by the KDIGO guidelines that state creatinine levels and CKD's

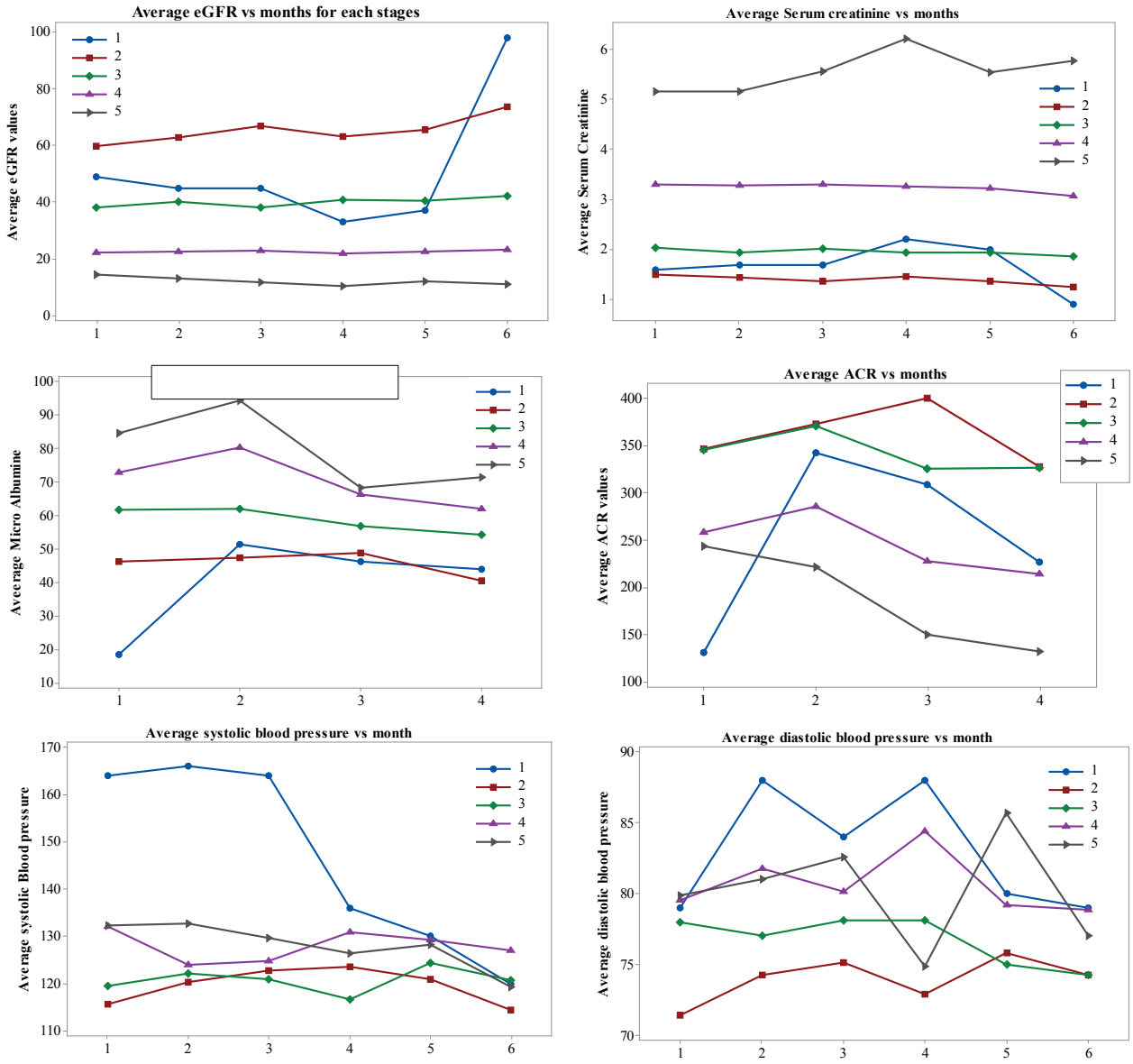

Figure 3: Plot of averages of variables over consecutive six months categorized by CKDu stages. The legend box shows the 5 CKDu stages categorized according to the estimated glomerular filtration rate (eGFR) (90 – 60 mL/min/1.73 m^2 stage 1, 60-89 mL/min/1.73 m^2 stage 2, 59 - 30mL/min/1.73 m^2 stage 3, 29 - 15 mL/min/1.73 m^2 stage 4, Less than 15 Stage 5 (end stage renal disease).

	Serum Creatinine		e-GFR		Micro Albumin		ACR		Systolic Blood pressure		Diastolic Blood pressure	
Month	Mean difference	p value	Mean difference	p value	Mean difference	p value	Mean difference	p value	Mean difference	p value	Mean difference	p value
2	-0.064	0.089	1.4	0.049	3.56	0.859	22.9	0.887	0.39	0.577	0.73	0.714
3	0.012	0.592	0.973	0.133	-5.03	0.07	-16.7	0.195	-0.09	0.481	1.2	0.795
4	0.0643	0.792	1.09	0.185	-8.59	0.007	-33.6	0.027	-1.47	0.258	0.87	0.709
5	-0.0373	0.31	1.85	0.045	-	-	-	-	1.65	0.8	-0.12	0.47
6	-0.1147	0.049	4.72	0	-	-	-	-	-2.91	0.045	-1.84	0.113

Table 4: Paired sample T test –Comparison of each month's averages of selected biochemical and clinical parameters with 1st month.

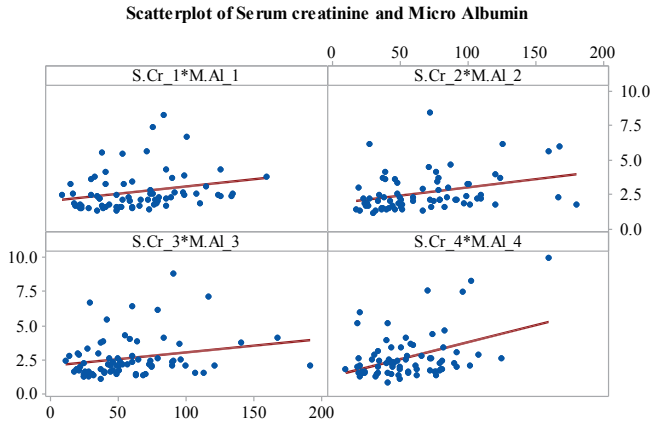

Figure 4: Serum creatinine and micro-albumin relationship using Pearson R correlation.

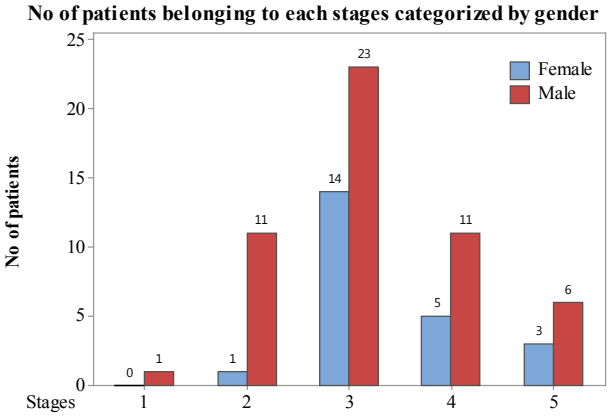

Figure 5: The above figure demonstrates the CKDu affected patient over a period of six months at different stages.

have a direct impact on patient prognosis. In general, during the 6 months' treatment for the patients a decline was observed in stage 1 (43.75%), stage 2 (17.3%), stage 3 (9.09%) and stage 4 (7.51%) where the serum creatinine ranges from (average value for 1st month) dropped down to (average value for 6th month). The only increment was observed in stage 5 patients where the serum creatinine increased from 5.156 to 5.756 (Table 3). This is demonstrated above in Table 1. Micro-albumin was obtained from the urine samples from patients for a continuous follow-up period of four months. This biochemical parameter was used to calculate the ACR which reflects patient prognosis [19]. As stated in Table 1, the average value dropped from the 63.68 to 55.52 over a period of four months. At high e-GFR values the micro-albumin value showed a negative correlation of -0.33 reflecting a considerable interdependency (Figure 3).

The continuous follow up study showed a decline in serum creatinine and micro-albumin over a period of 6 months. This indicates that traditional medicine does have a significant effect in controlling the progression of CKDu.

As evidence, a study carried out by Alok et al. [23] suggests kidney diseases can be cured by giving traditional medicine over a long period of time without causing much damage. A reported 80% of the Asian population relies on traditional therapy as the "undesirable effect of modern medicine" has developed urgency towards herbal medications. Furthermore, the inexpensive cost effective treatment options are preferable in low or middle income countries such as Sri Lanka, India and China commonly that contains a vast range of natural plants and history of producing natural products for healthcare systems [14]. As stated by Yuan et al. [24], traditional medications within Asian countries can enhance the possibility of "multi drugs-multi target" mechanism which can be used as a combinational therapy rather than one target-one drug modern approach. With significant findings presented above in CKDu patients, the use of traditional Sri Lankan medicines can provide a break-through for the government as well as healthcare sectors in establishing a common goal of eradicating the disease with cost effective and efficient treatment provided [25]. Thus, the treatment therapies can be expanded and closely monitored to understand the mechanism of traditional medicines and the effect on the kidneys which helps the prognosis of patients affected with CKD's (Table 4; Figures 4 and 5).

CONCLUSION

As evident from the above discussion, the study shows a positive impact on the traditional medicine treatment provided to the patients. The biomarkers such as creatinine and micro-albumin showed an overall decline and the assessment of e-GFR and micro albumin showed a strong negative correlation reflecting improved patient prognosis.

LIMITATIONS

The sample size is relatively small (75), a larger sample size can help better understand the different trends in CKDu and identify the components that needs to be measured to give a better prognosis. Further, renal biopsies obtained from these patients would give sufficient details that help understanding the pathology of the CKDu affected patients.

DECLARATION

Ethics approval and consent to participate

The ethical approval was obtained from Institute of Biology, Sri Lanka where the analysis of patient results was given approval. The consent forms were given to patients' involved in the study where they signed reading to all conditions of the research. The patients had the right to leave the study at any time willingly if they needed to.

Consent for publication

All the personal involved in the research gave their consent and agreed upon publishing this article with no conflicts of interest.

Availability of data and material

The data is available only to the researchers involved in the study and doctors who are part of the study in the CKDu-Care unit. Results will not be shared under circumstances the confidentiality of the results will be kept safely.

Competing interests

None of the researchers have relationships with organizations that have interest over the manuscript data available.

Authors contribution

Dr. Nishantha Kumarasinghe initiated the idea of carrying out the project, in which CKDu-Care is an organization that helps the people who have been suffering CKDu with free medical check-ups provided. With the help of several doctors who have specialized in Ayurveda Medicine this project was carried out. All the authors involved in the project read and approved the manuscript.

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CKDu-Care research members: Dr. Nishantha Kumarasinghe, Isuru Abeykoon, Fahim Aslam, Navodi Mekhala, Lahiru Galgamuwa, Dr. Vindika Suriyakumara, Dr. Aloka Lankeshwari, Dr. Madushani, Captain Buddhadasa.

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