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RESEARCH ARTICLE

PREVALENCE OF ADVANCED-STAGE RENAL DISEASE ON THE ISLAND OF CHIOS: ASSESSMENT AND ANALYSIS

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Abstract

Background: Renal Disease is a progressive and often asymptomatic condition that significantly contributes to both morbidity and mortality. The aim of this study is to evaluate the prevalence of Chronic Kidney Disease among the island's population over a seven-month period, a task of particular relevance given that all patients were exclusively monitored at the General Hospital given the lack of private nephrology care.

Method and Material: A cross-sectional descriptive study was conducted with a sample of patients from the outpatient nephrology clinic and Dialysis Unit of the General Hospital of Chios "Skylitsio" for the period from October 2023 to April 2024.

Results: The majority of patients were men and exhibited higher rates of advanced stages of Chronic Kidney Disease compared to women. The age distribution showed that older patients primarily visited the clinic, accounting for 56.67% of total patients. Stage 3 was the most prevalent (38.65% of total patients). The prevalence of patients undergoing hemodialysis in Chios was identical to the national prevalence (0.12%). The majority of patients were men (72.5%), with the most affected age group being 71–80 years (37.1%). Most had been receiving hemodialysis for 1 to 7 years (80.65%). The leading cause of end-stage renal disease requiring hemodialysis was nephropathy of unknown etiology (37.1%).

Conclusions: The prevalence of chronic kidney disease in Chios was generally higher compared to both the national average and global prevalence.

Keywords: Chronic kidney disease, renal disease, complications, Chios Island.

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INTRODUCTION

Chronic Kidney Disease (CKD) is recognized in the literature as a "global epidemic" characterized by a rapid increase over time.[1] Recent data estimate that approximately 10% of the global population is affected by CKD, with 20% of individuals aged over 65 years being affected.[2] Specifically, according to Cockwell and Fisher[3], the global prevalence of CKD in 2017 was 9.1%. It has been reported a global median prevalence of CKD of 9.5%, underscoring the persistent upward trend in the burden of CKD globally over time.[4]

This "epidemic" is estimated to have an annual growth rate of approximately 7%.[5] According to data from the cross-sectional study by the International Society of Nephrology's Global Kidney Health Atlas, the global average incidence of newly diagnosed end-stage kidney disease cases reached 144 per million population.[6]

The ISN Global Kidney Health Atlas reports that the prevalence of CKD in Greece (all stages G1–5) is approximately 14.7% of the population[7], with the highest concentration of patients observed in stage 3. This population is anticipated to increase to approximately 1,249,475 patients by 2032.[8] Finally, Greece is among the countries with the highest prevalence of kidney replacement therapy (KRT), alongside Portugal and France, with a rate of 1,319 per million population.[9]

A literature review revealed no corresponding studies for the island of Chios. Therefore, the present research study was undertaken to estimate the prevalence of Chronic Kidney Disease on the island.

METHODOLOGY

Aim

The aim of the present study was to investigate the prevalence of Chronic Kidney Disease (CKD) on the island of Chios and to compare it with national and international data, considering that all CKD patients were followed up at the General Hospital of Chios. Additionally, the following factors were investigated:

- Among patients visiting the outpatient nephrology clinic—i.e., patients with CKD stages 1 to 5 who did not require renal replacement therapy—gender, age and the CKD stage.
- Among hemodialysis patients of the Dialysis Unit: gender, age, cause of end-stage renal disease, total duration of treatment.

Finally, correlations among these factors were assessed.

Design of the study

This research study is a descriptive cross-sectional study. No exclusion criteria were applied.

Research Approval

The research protocol of this study was approved by the Scientific Council Committee of the General Hospital of Chios "Skylitsio" (approval number 4821/30-03-2024). The study was conducted in accordance with ethical standards, ensuring that patient confidentiality was strictly maintained. Participation was entirely voluntary, and anonymity was preserved throughout the data collection and analysis process.

Study Population

The study sample consisted of outpatients who visited the nephrology outpatient clinic of the General Hospital of Chios "Skylitsio," as well as hemodialysis patients from the Dialysis Unit of the same hospital. The study lasted from October 2023 to April 2024.

Data Collection

The first group consisted of patients from the nephrology outpatient clinic. Data collection was initially conducted using the clinic's handwritten case logbook and was later supplemented with information from the digital appointment system and the patients' electronic medical records. In the second group, which included hemodialysis patients, data collection was performed through the patients' handwritten medical records maintained by the Dialysis Unit.

Duplicates and Repeat Patients

All duplicate or repeatedly recorded patient entries were identified and removed using Microsoft Word 2010.

Data Collection Tool

A digital spreadsheet was used to record demographic data and laboratory values in order to estimate the prevalence of kidney

disease and related factors. In the first study group, consisting of patients from the outpatient nephrology clinic, data included demographic information (gender, age) and laboratory values relevant to the study (complete blood count, urinalysis, glycated hemoglobin, creatinine). In the second study group, comprising all hemodialysis patients, data included demographic information (gender, age), the cause of end-stage renal disease, and the year of initiation of hemodialysis treatment.

eGFR Estimation Tool

The CKD-EPI Creatinine Equation was used to estimate the glomerular filtration rate.[10]

Statistical Analysis

Descriptive Statistics

Quantitative data were presented as absolute and relative frequencies (%), accompanied by graphical representations illustrating trends. The study sample was drawn from the population of the island of Chios. Therefore, the observed results may be subject to sampling error.

Inferential Statistics

The comparison between observed and expected frequencies was performed using the Chi-square (χ^2) test:

$$X^2 = \sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

P-values obtained from the statistical tests were used to evaluate the statistical significance of the results, with a significance level set at $p < 0.05$. If the p-value is less than the significance level (0.05), it is concluded that the observed data are more likely to reflect a true effect rather than the null hypothesis. If the p-value is greater than 0.05, no statistically significant difference exists between the compared data, and the null hypothesis is not rejected.

RESULTS

I) Nephrology outpatient clinic, General Hospital of Chios

During the period from October 1, 2023, to April 30, 2024, a total of 915 appointments were recorded at the Nephrology Outpatient Clinic of the General Hospital of Chios "Skylitsio." After removing duplicate entries and repeated visits by the same individuals, the final sample size comprised 517 distinct patients. The demographic characteristics of this sample are presented below.

The distribution of patients across age groups was as follows: 0.97% (n=5) were between 5 and 20 years old, 3.48% (n=18) were aged 21–30 years, 3.09% (n=16) fell within the 31–40 year range, 5.61% (n=29) were aged 41–50 years, 12.57% (n=65) were between 51 and 60 years old. In addition, 17.60% (n=91) were aged 61–70 years, 31.53% (n=163) were in the 71–80 year group, and 25.15% (n=130) were older than 80 years (Figure 1).

Using the eGFR estimation tool, CKD-EPI Creatinine Equation (2021), and based on patients' laboratory findings, it was determined that among the 517 patients, 101 (19.54%) had normal renal function or were classified as stage 1 CKD, 95 (18.38%) were at stage 2, 181 (35.01%) at stage 3, 94 (18.18%) at stage 4, and 34 (6.58%) at stage 5. For 12 patients (2.31%), renal function could not be assessed due to incomplete data.

From the sample of 517 patients, 12 (2.31%) were unilateral nephrectomy patients, while 11 (2.12%) were kidney transplant recipients. (Figure 2)

Prevalence of Stage 3, 4, and 5 Chronic Kidney Disease (CKD) on the Island of Chios

Based on the aforementioned data, and given that during the study period all patients with Chronic Kidney Disease (CKD) were exclusively followed up at the Nephrology Outpatient Clinic of the General Hospital of Chios, it was possible to estimate disease prevalence. Specifically, the prevalence of stages 3, 4, and 5 CKD on the island was determined for this timeframe. Conversely, estimating the prevalence of stages 1 and 2 CKD was deemed unnecessary, as CKD is a "silent" disease, often remaining undiagnosed in early stages due to many patients not seeking medical care. The reference population of Chios was estimated at 50,361 inhabitants based on the 2021 Census data.[11]

The prevalence of stage 3 CKD was 0.30% (181 cases per 50,361 inhabitants; 95% CI: 0.25–0.35%, SE ≈ 0.00024). The prevalence of stage 4 CKD was 0.19% (94 cases per 50,361 inhabitants; 95% CI: 0.152-0.228%, SE ≈ 0.000194). The prevalence of stage 5 CKD,

for patients not yet requiring renal replacement therapy, was 0.0675% (34 cases per 50,361 inhabitants; 95% CI: 0.0448-0.0902%, SE ≈ 0.000116).

Gender and CKD Stage

Among female patients attending the Nephrology Outpatient Clinic, the majority were classified as being in Stage 3 of Chronic Kidney Disease (CKD), accounting for 30.64% (n=72) of cases. This was followed by normal renal function or Stage 1 in 25.96% (n=61), Stage 2 in 19.57% (n=46), Stage 4 in 17.02% (n=40), and Stage 5 in 4.68% (n=11). Due to the absence of complete data, renal function could not be assessed in 2.13% of the cases (n=5). Similarly, the largest proportion of male patients were also classified in Stage 3 CKD, representing 38.65% (n=109). This was followed by Stage 4 in 19.15% (n=54), Stage 2 in 17.38%, normal renal function or Stage 1 in 14.18%, and Stage 5 in 8.16% of cases. Renal function assessment was not feasible in 2.48% of male patients due to insufficient data. (Figure 3)

Age Group and CKD Stage

In the 5–20 years age group (N=5), four individuals exhibited normal renal function or were classified in Stage 1 of CKD, while one individual was in Stage 2. In the 21–30 years age group (N=18), sixteen individuals (88.89%) had normal renal function or were classified in Stage 1 CKD, whereas in two cases (11.11%) renal function could not be assessed due to incomplete data. In the 31–40 years age group (N=16), six individuals (37.5%) were found to have normal renal function or Stage 1 CKD, one (6.25%) was in Stage 2, four (25%) were in Stage 3, two (12.5%) were in Stage 4, and one (6.25%) was in Stage 5. In two individuals (12.5%), renal function could not be evaluated due to insufficient data.

In the 41–50 years age cohort (N=29), nineteen subjects (65.52%) demonstrated normal renal function or were classified as Stage 1 of Chronic Kidney Disease (CKD). Five subjects (17.24%) were classified as Stage 2, three subjects (10.34%) as Stage 3, one subject (3.45%) as Stage 4, and none (0%) as Stage 5. Renal function assessment was not feasible in one subject (3.45%) due to incomplete data.

Within the 51–60 years age cohort (N=65), eighteen subjects (27.69%) were observed to have normal renal function or were to Stage 1 CKD. Twenty-two subjects (33.85%) were classified as Stage 2, fifteen subjects (23.08%) as Stage 3, six subjects (9.23%) as Stage 4, and three subjects (4.62%) as Stage 5. Renal function evaluation was precluded in one subject (1.53%) owing to insufficient data.

In the 61–70 years age cohort (N=91), twenty-two subjects (24.18%) demonstrated normal renal function or were classified within Stage 1 of Chronic Kidney Disease (CKD), twenty-one subjects (23.08%) were classified as Stage 2, twenty-eight subjects (30.77%) as Stage 3, fifteen subjects (16.48%) as Stage 4, and two subjects (2.2%) as Stage 5. In the 61–70 years age cohort (N=91), twenty-two subjects (24.18%) demonstrated normal renal function or were classified within Stage 1 of Chronic Kidney Disease (CKD), while twenty-one subjects (23.08%) were classified as Stage 2. Furthermore, twenty-eight subjects (30.77%) were classified as Stage 3, fifteen (16.48%) as Stage 4, and two (2.2%) as Stage 5. Renal function assessment was precluded in three subjects (3.29%) due to incomplete data.

Within the 71–80 years age cohort (N=163), sixteen subjects (9.81%) had normal renal function or were classified as Stage 1 CKD, while twenty-five subjects (15.34%) were classified as Stage 2. Seventy-three subjects (44.79%) were classified as Stage 3, thirty-four (20.86%) as Stage 4, and thirteen (7.97%) as Stage 5. Renal function evaluation was not feasible in two subjects (1.23%) owing to insufficient data.

In the age cohort over 80 years (N=130), no subjects exhibited normal renal function or were classified in Stage 1 CKD. Twenty subjects were classified as Stage 2, fifty-eight subjects as Stage 3, thirty-six subjects as Stage 4, and fifteen subjects as Stage 5. Renal function assessment was precluded in one subject due to incomplete data.

II) Dialysis unit, General Hospital of Chios

During the study period, a total of 62 patients underwent hemodialysis, of whom 45 (72.58%) were male and 17 (27.42%) were female. The prevalence of patients receiving hemodialysis in Chios during this period was estimated at 0.12% (62 out of 50,361 residents on the island). The 95% confidence interval for the calculated prevalence ranged from 0.0898% to 0.1502%, while the standard error (SE) was estimated at 0.00015.

The predominant age group among patients undergoing hemodialysis was the 71–80 years cohort, comprising 37.1% of the total population (n=23). This was followed by the 61–70 years age group, representing 25.81% (n=16), while the group over 80 years accounted for 19.35% (n=12). Patients aged 51–60 years constituted 8.06% (n=5), followed by the 41–50 years group at 6.45% (n=4) and the 30–40 years group at 3.23% (n=2) (Figure 4).

The most frequent cause of end-stage renal disease (ESRD) was recorded as "unknown etiology," accounting for 23 patients (37.1%). This was followed by type II diabetic nephropathy, identified in 16 patients (25.81%). Nephropathy secondary to polycystic kidney disease was detected in 5 patients (8.06%), while renal failure due to renal malignancy was observed in 4 patients (6.45%). Hypertensive nephropathy and IgA nephropathy were each found in 3 patients (4.84%), whereas renal failure secondary to vesicoureteral reflux was diagnosed in 2 patients (3.23%). Less common causes included type I diabetic nephropathy, nephropathy due to nonsteroidal anti-inflammatory drug (NSAID) abuse, and antiphospholipid syndrome, each affecting one patient (1.61%). Finally, in 3 patients (4.84%), end-stage renal disease was attributed to various other unspecified causes.

The p-value estimation for the Chi-Square test revealed that the expected frequency was calculated as 5.64 (62/11 ≈ 5.64). The computed Chi-Square statistic was 90.58, with a corresponding p-value of 4.11×10^{-15}. The exceedingly low p-value indicates the presence of a statistically significant difference in the frequencies of the causes, suggesting that the etiologies of end-stage renal disease do not follow a uniform distribution.

The overall duration of hemodialysis therapy among patients within the studied cohort ranged from a few months to over two decades. The largest proportion of patients, specifically 40.32% (n=25), had been undergoing this modality of renal replacement therapy for a period of 2 to 4 years. The second most prevalent category comprised patients who had received hemodialysis for up to one year, accounting for 22.58% (n=14) of the sample. Patients undergoing treatment for 5 to 7 years constituted 17.74% (n=11), while those with a treatment duration of 8 to 10 years represented 9.68% (n=6) of the population. A smaller proportion of patients, namely 4.84% (n=3), had been on hemodialysis for 11 to 15 years, as well as for more than 20 years. Notably, no patients were recorded with a total duration of hemodialysis treatment between 16 and 20 years.

Age Group and Etiology of End-Stage Renal disease (ESRD)

An analysis of etiological factors across age groups showed that end-stage renal disease of unknown origin was the predominant cause of renal failure in several cohorts. Specifically, it accounted for 100% (n=2) of cases among patients aged 30–40 years, 80% (n=4) among those aged 51–60 years, and 43.48% (n=10) among those aged 71–80 years. In the 41–50 years age group, the leading etiology was vesicoureteral reflux, accounting for 50% (n=2) of cases. In contrast, among patients aged 61–70 years and those over 80 years, the most frequently identified cause of ESCKD was type II diabetic nephropathy, with respective prevalence rates of 31.25% (n=5) and 41.67% (n=5).

Based on the analyzed data, the computed Chi-square (χ^2) test statistic was 62.64, with an associated p-value of 0.108. Given that the p-value exceeds the conventional threshold for statistical significance ($\alpha = 0.05$), the null hypothesis cannot be rejected. Consequently, no statistically significant association was identified between patient age group and the underlying etiology of end-stage chronic kidney disease within the study population.

Gender and Principal Etiologies of End-Stage Renal disease (ESRD)

In the male subset of the study population, the leading cause of end-stage renal disease was chronic kidney disease of unknown etiology, observed in 37.78% of cases (n=17), followed by type II diabetic nephropathy in 22.22% (n=10) and renal carcinoma in 8.89% (n=4). Hypertensive nephropathy and polycystic kidney disease each accounted for 6.67% of cases (n=3). Among female patients, the most prevalent etiologies were equally distributed between chronic kidney disease of unknown origin and type II diabetic nephropathy, each contributing to 35.29% (n=6) of cases. Polycystic kidney disease was recorded as a less frequent etiology in this group, with a prevalence of 11.76% (n=2).

The Chi-square test statistic (χ^2) was calculated at 3.88, with a corresponding p-value of 0.423. Given that this p-value exceeds

the conventional threshold for statistical significance (α = 0.05), the analysis does not support the presence of a statistically significant association between patient sex and the underlying etiology of end-stage renal disease.

DISCUSSION

The investigation into the prevalence of Chronic Kidney Disease and associated risk factors in the population of Chios yielded significant epidemiological findings. These results demonstrate that the proportion of individuals affected by this disease exceeds the reported national average. Such findings raise important public health concerns and underscore the need for further in-depth research aimed at elucidating the underlying causes and guiding targeted interventions.

Chronic Kidney Disease affects more than 700 million individuals globally, while the total burden of kidney disease, including Acute Kidney Failure, is estimated at approximately 850 million people.[12] The global incidence rate of Chronic Kidney Disease (CKD) is estimated at approximately 10%, with 674 million confirmed cases reported in 2021. During the same year, there were 11.13 million new diagnoses, 1.53 million deaths, and 44.45 million disability-adjusted life years (DALYs) attributed to CKD.

The global prevalence of Chronic Kidney Disease increased by 29.3% between 1990 and 20173. From 1990 to 2021, the number of CKD cases worldwide rose by 92%, from approximately 350 million to nearly 674 million.[13,14] Over the same period, CKD-related deaths increased by 156%, while disability-adjusted life years (DALYs) associated with the disease rose by 114%.[13]

According to Bradley et al.[15], CKD rose from the 17th to the 12th leading cause of death between 1990 and 2017. As of 2021, Chronic Kidney Disease ranked as the ninth most common cause of death worldwide, with projections indicating it may rise to the fifth leading cause by the year 2040.[12]

In certain parts of the world, such as Oceania, sub-Saharan Africa, and Latin America, the impact of Chronic Kidney Disease has been significantly greater than what would typically be predicted given their socio-demographic development. Conversely, regions including Western, Eastern, and Central sub-Saharan Africa, along with areas like East and South Asia, Central and Eastern Europe, Australasia, and Western Europe, have experienced a lower-than-expected CKD burden relative to their developmental status.[16] The global rise in end-stage kidney disease is likely a reflection of the worldwide epidemic of type II diabetes and the aging population in developed countries, where incidence rates are notably higher among older adults.[17]

In Europe, the annual incidence of chronic kidney failure is estimated at approximately 0.76 per 100,000 population, with an overall prevalence of 2.53 per 10,000.[18] In Western Europe, the mean prevalence of Chronic Kidney Disease is reported at around 10.1%, although substantial variation exists between countries. Within this regional context, Greece is identified as a country with a disproportionately high CKD burden.[19]

The most recent published data regarding the global stage-specific prevalence of chronic kidney disease date back to 2017.[20] Data for Greece, also, remain limited, with the latest figures reported by the Hellenic Society of Nephrology in a presentation by Fragkidis in 2016.[21] Based on these data, the estimated prevalence of stage 3 Chronic Kidney Disease (CKD) in Chios during the study period was considerably lower than the global average, yet exceeded the national one. In contrast, the prevalence of stage 4 CKD in Chios was found to exceed both global and national estimates. The prevalence of end-stage kidney disease in Chios, including patients receiving renal replacement therapy as well as those who had not yet initiated treatment, was approximately twice the global average. However, the national prevalence of patients undergoing hemodialysis appeared to align with the corresponding rate observed in Chios.

Regarding gender, according to the Global Burden of Disease 2021 database, the global prevalence of Chronic Kidney Disease from 1990 to 2021 was higher in women than in men.[13] Contrary to global trends, in Chios, most patients attending the nephrology outpatient clinic were male, although the difference compared to females was minor. Despite the overall gender balance, males presented with higher rates of advanced CKD stages than females. Similarly, data from the Hemodialysis Unit also showed a predominance of male patients. This finding is consistent with international literature, which indicates that men tend to have a worse prognosis regarding the progression of kidney failure compared to women.[22]

The findings of the present study are in line with those of Balasis

et al.[23] conducted at a private nephrology center in Crete to assess the quality of life among hemodialysis patients. In that study, 75.4% of patients undergoing dialysis were male, compared to 72.58% in Chios. The percentage of women was 24.6% in Crete, similar to the 27.42% in Chios.

The increased incidence of CKD in Chios may be attributed to a combination of environmental, dietary, and socio-cultural factors. Specifically, according to the analysis by Nakou[24], the island's drinking water is characterized by high hardness and elevated chloride levels compared to other Mediterranean regions. These factors have been associated in the literature with an increased prevalence of kidney disease of unknown etiology.[25]

Furthermore, the local diet, characterized by high salt intake and saturated animal fats, contributes to the development of risk factors such as hypertension and type II diabetes, which are primary causes of Chronic Kidney Disease.[26]. A study by Grivetti[27], the only published investigation on the dietary habits of the inhabitants of Chios, examined regional differences in consumption patterns. It revealed that residents of urban and southern areas consumed meat and alcoholic beverages more frequently than those in northern regions. Simultaneously, olive oil and foods rich in complex carbohydrates, such as bread and pasta, were less commonly used by individuals living in the urban and rural southern sectors. Although a traditional dietary pattern characterized by olive oil, vegetables, and cheese remains present on the island, a westernized dietary pattern has become widespread. This pattern, marked by high consumption of red and processed meats and animal fats, is associated with increased intake of saturated fats.

Furthermore, contemporary dietary habits in Greece, including those in Chios, are characterized by a high intake of salt primarily through processed foods and ready-made meals, which are often salt-rich. A nationwide study conducted in 2014 by the Hellenic Food Authority identified the systematic use of salt, particularly during cooking. The study also highlighted that many Greeks are not fully aware of the main dietary sources of excessive salt consumption.[28]

Notably, in a population-based cohort study involving 1,110 Swedish men, Huang et al.[29] reported that individuals with moderate adherence to the Mediterranean diet had 23% reduced odds of developing Chronic Kidney Disease. Those with high adherence demonstrated a 42% reduction in odds compared to individuals with low adherence. In patients with established CKD, adherence to healthy dietary patterns is associated with a reduced risk of mortality; however, it does not appear to halt the progressive decline of residual kidney function.[30]

Finally, delayed access to nephrology care can adversely affect prognosis and delay diagnosis, particularly in remote areas such as many villages in Chios, where healthcare accessibility is limited. Chronic Kidney Disease disproportionately affects countries with low to middle Socio-Demographic Index, with aging populations and healthcare disparities further accelerating disease progression.[14]

The PRESTAR study (2009–2010), which included 1,501 patients across nine nephrology centers in Greece, revealed notable delays in CKD diagnosis. Furthermore, the same multicenter study, published in 2014 by Sombolos et al.[31], highlighted that Greece ranks among the developed countries with the highest incidence of end-stage renal disease. This finding underscores the persistent challenges in the early detection and management of chronic kidney disease.

Overall, these findings highlight the need for targeted preventive interventions, such as improving water quality, promoting dietary modifications, and enhancing timely medical monitoring to reduce disease burden and improve the quality of life of Chios residents.

In this context, the implementation of telenephrology represents an innovative and practical approach for monitoring and supporting patients with Chronic Kidney Disease, particularly during the early stages where preventive measures are crucial. Telenephrology has been successfully applied in remote regions of Australia and Canada, demonstrating documented reductions in hospitalizations, delays in progression to end-stage renal disease[32] and enhanced adherence to renal clinic appointments.[33] However, it presents certain limitations, such as the inability to manage acute conditions and potential connectivity issues.[34] In countries with insular geography like Greece, integrating telemedicine protocols into primary healthcare has been recognized as an essential strategy to overcome disparities in healthcare access.[35]

Chios possesses adequate technological infrastructure, including its integration into the National Telemedicine Network, which can be leveraged for the routine remote monitoring of CKD patients by nephrologists based in larger medical centers. This approach is particularly beneficial for residents of remote villages, eliminating the need for frequent travel to urban healthcare facilities. Such practices have the potential to improve treatment adherence, reduce healthcare costs, and enhance the prevention of disease-related complications, as supported by recent meta-analyses.[36]

Limitations of the study

Major limitations of the study included the short duration of the research period, the sample size and limited access to patients' medical records, all of which may impact the generalizability of the findings.

CONCLUSIONS

The objective of this study was to provide insight into the prevalence and clinical characteristics of Chronic Kidney Disease (CKD) on the island of Chios for the period October 2023-April 2024. Stage 3 emerged as the most commonly observed stage of CKD. The majority of patients attending the nephrology outpatient clinic were male and exhibited more advanced stages of the disease compared to females. Older individuals, particularly those over the age of 71, were more frequently represented and tended to present with more severe forms of CKD. The data indicate a clear association between advancing age and disease severity. Regarding end-stage renal disease, most patients undergoing hemodialysis were male and belonged to older age groups. The majority had been receiving dialysis treatment for 1–7 years. The predominant cause of ESRD requiring hemodialysis was kidney disease of unknown etiology, followed by type II diabetic and hypertensive nephropathy, with no significant gender-based variation in etiology distribution.

REFERENCES

1. De Nicola L, Minutolo R. Worldwide growing epidemic of CKD: fact or fiction? Kidney Int. 2016 Sep;90(3):482–4. doi:10.1016/j.kint.2016.05.001.
2. Chevalier R. Evolution, kidney development, and chronic kidney disease. 2019.
3. Cockwell P, Fisher L. The global burden of chronic kidney disease. Lancet. 2020;395(10225):662–4.
4. Jadoul M, Aoun M, Masimango Imani M. The major global burden of chronic kidney disease. Lancet Glob Health. 2024;12(3):e342–3.
5. Kidney Health Initiative. KRT Roadmap – Kidney Diseases [Internet]. Kidney Health Initiative. Available from: https://www.kidneyhealthinitiative.org
6. Lee YC, Lin CW, Ho LC, Hung SY, Wang HK, Chang MY, et al. All-cause standardized mortality ratio in hemodialysis and peritoneal dialysis patients: A nationwide population-based cohort study. 2023.
7. Pippias M, Alfano G, Kelly DM, Soler MJ, De Chiara L, Olanrewaju TO, et al. Capacity for the management of kidney failure in the International Society of Nephrology Western Europe region: report from the 2023 ISN Global Kidney Health Atlas (ISN-GKHA). Kidney Int Suppl (2011). 2024 Apr;13(1):136–51. doi:10.1016/j.kisu.2024.01.008.
8. Stafylas P, Sarafidis P, Tychala C, Pella E, Karaiskou M, Valsami R, et al. The clinical and economic burden of chronic kidney disease in Greece. Nephrol Dial Transplant. 2023;38(1):gfad063c_5632. doi:10.1093/ndt/gfad063c_5632.
9. Smyth B, O'Keeffe L, O'Donoghue D, Jager KJ. Kidney replacement therapy and nephrology workforce statistics for the 21 countries in Western Europe: A study by the ISN Global Kidney Health Atlas. Kidney Int Suppl. 2021;11(2):e41–e52. doi:10.1016/j.kisu.2021.02.004.
10. National Kidney Foundation. Cockcroft-Gault Formula. 2021.
11. Hellenic Statistical Authority. Results of the 2021 Population-Housing Census concerning the Permanent Population of Greece [Internet]. 2023. Available from: https://tvpatrida.gr/wp-content/uploads/2023/04/apografi_elstat_2021_episima-1.pdf

12. Francis A, Harhay MN, Ong ACM, et al. Chronic kidney disease and the global public health agenda: an international consensus. Nat Rev Nephrol. 2024;20:473–85. doi:10.1038/s41581-024-00820-6.
13. Guo J, Liu Z, Wang P, Wu H, Fan K, Jin J, et al. Global, regional, and national burden inequality of chronic kidney disease, 1990–2021: A systematic analysis for the Global Burden of Disease Study 2021. Front Med (Lausanne). 2025;11:1501175. doi:10.3389/fmed.2024.1501175.
14. Deng L, Guo S, Liu Y, Zhou Y, Liu Y, Zheng X, et al. Global, regional, and national burden of chronic kidney disease and its underlying etiologies from 1990 to 2021: a systematic analysis for the Global Burden of Disease Study 2021. BMC Public Health. 2025 Feb 17;25(1):636. doi:10.1186/s12889-025-21851-z.
15. Bradley M, Land D, Thompson DA, Cwiertny DM. A critical review of a hidden epidemic: examining the occupational and environmental risk factors of chronic kidney disease of unknown etiology (CKDu). Environ Sci Adv. 2025;4:57–76. doi:10.1039/D4VA00304G
16. Bikbov B, Purcell CA, Levey AS, Smith M, Abdoli A, Abebe M, et al. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020;395(10225):709–33.
17. Hamer RA, El Nahas AM. The burden of chronic kidney disease. BMJ. 2006 Mar 11;332(7541):563–4. doi:10.1136/bmj.332.7541.563.
18. Willey CJ, Coppo R, Schaefer F, Mizerska-Wasiak M, Mathur M, Schultz MJ. The incidence and prevalence of IgA nephropathy in Europe. Nephrol Dial Transplant. 2023 Sep 29;38(10):2340–9. doi:10.1093/ndt/gfad082.
19. International Society of Nephrology (ISN). Global Kidney Health Atlas – 3rd Edition. 2021.
20. Persaud N. CKD a leading cause of morbidity and mortality worldwide [Internet]. Renal & Urology News. 2020 Feb 18. Available from: https://www.renalandurologynews.com/view/ckd-a-leading-cause-of-morbidity-and-mortality-worldwide
21. Fragidis S. Chronic kidney disease: Epidemiology, staging, and risk factors [Internet]. 2023. Available from: https://www.ene.gr/wp-content/uploads/2024/01/01-St-Fragidis.pdf
22. García GG, Iyengar A, Kaze F, Kierans C, Padilla-Altamira C, Luyckx VA. Sex and gender differences in chronic kidney disease and access to care around the globe. Semin Nephrol. 2022;42(2):101–13. doi:10.1016/j.semnephrol.2022.04.001.
23. Balasi R, Vlasiadis K, Patelarou E, Patelarou A. Quality of life assessment in hemodialysis patients at a private nephrology center in Crete. Arch Hellen Med. 2020;7(6):765–72.
24. Nakou K. Total Hardness and Chlorides in Water in Island Areas [Master's thesis on the Internet]. Mytilene: HELLANICUS Institutional Repository; 2014. Available from: https://hellanicus.lib.aegean.gr/bitstream/handle/11610/8465/file1.pdf
25. Botheju WSM, Liyanage SA. The role of fluoride, cadmium and water hardness in drinking water: A critical study of potential factors of chronic kidney disease of unknown etiology (CKDu) in the prevalence area, Sri Lanka. In: Proceedings of the 20th International Postgraduate Conference (IPRC 2019); Colombo, Sri Lanka. 2019. Vol. 30.
26. He LQ, Wu XH, Huang YQ, et al. Dietary patterns and chronic kidney disease risk: a systematic review and updated meta-analysis of observational studies. Nutr J. 2021;20:4. doi:10.1186/s12937-020-00661-6.
27. Grivetti L. Comparative study of diet and disease prevalence in Greek Chians part I rural and urban residents of Chios. Ecol Food Nutr. 1999; doi:10.1080/03670244.1999.9991585.
28. Marakis G, Tsigarida E, Mila S, Panagiotakos DB. Knowledge, attitudes and behavior of Greek adults towards salt consumption: a Hellenic Food Authority project. Public Health Nutr. 2014 Aug;17(8):1877–93. doi:10.1017/S1368980013002255.
29. Huang X, Jiménez-Moleón JJ, Lindholm B, Cederholm T, Ärnlöv J, Risérus U, et al. Mediterranean diet, kidney

function, and mortality in men with CKD. Clin J Am Soc Nephrol. 2013;8(9):1548–55. doi:10.2215/CJN.01780213.

30. D'Alessandro C, Giannese D, Panichi V, Cupisti A. Mediterranean dietary pattern adjusted for CKD patients: The MedRen Diet. Nutrients. 2023;15(5):1256. doi:10.3390/nu15051256.
31. Sombolos K, Tsakiris D, Boletis J, Vlahakos D, Siamopoulos KC, Vargemezis V, et al. Multicenter epidemiological study to assess the population of CKD patients in Greece: results from the PRESTAR study. PLoS One. 2014 Nov 18;9(11):e112767. doi:10.1371/journal.pone.0112767.
32. Rohatgi R, Wang I, Swaminathan S, Lo JC, Williams WW, Kasiske BL, et al. Telenephrology: current perspectives and future directions. Kidney Int. 2017;92(6):1328–33.
33. Jan J, Mehrotra A, Nadkarni GN, He JC, Langhoff E, Post J, Galvao-Sobrinho C, Thode HC Jr, Rohatgi R. Telenephrology: Providing Healthcare to Remotely Located Patients with Chronic Kidney Disease. Am J Nephrol. 2018;47(3):200–7. doi:10.1159/000488004.
34. Narva AS, Romancito G, Faber T, Steele ME, Kempner KM. Managing CKD by Telemedicine: The Zuni Telenephrology Clinic. Adv Chronic Kidney Dis. 2017 Jan;24(1):6–11. doi:10.1053/j.ackd.2016.11.019.
35. World Health Organization. Telemedicine: Opportunities and developments in Member States: Report on the second global survey on eHealth [Internet]. Geneva: World Health Organization; 2021. Available from: https://www.who.int/publications/i/item/9789240029200
36. Almeida OAE, Lima MEF, Santos WS, Silva BLM. Telehealth strategies in the care of people with chronic kidney disease: integrative review. Rev Lat Am Enfermagem. 2023;31:e4049. doi:10.1590/1518-8345.6824.4049.

ANNEX

FIGURE 1. Age Distribution of Patients Attending the Nephrology Outpatient Clinic (N=517)

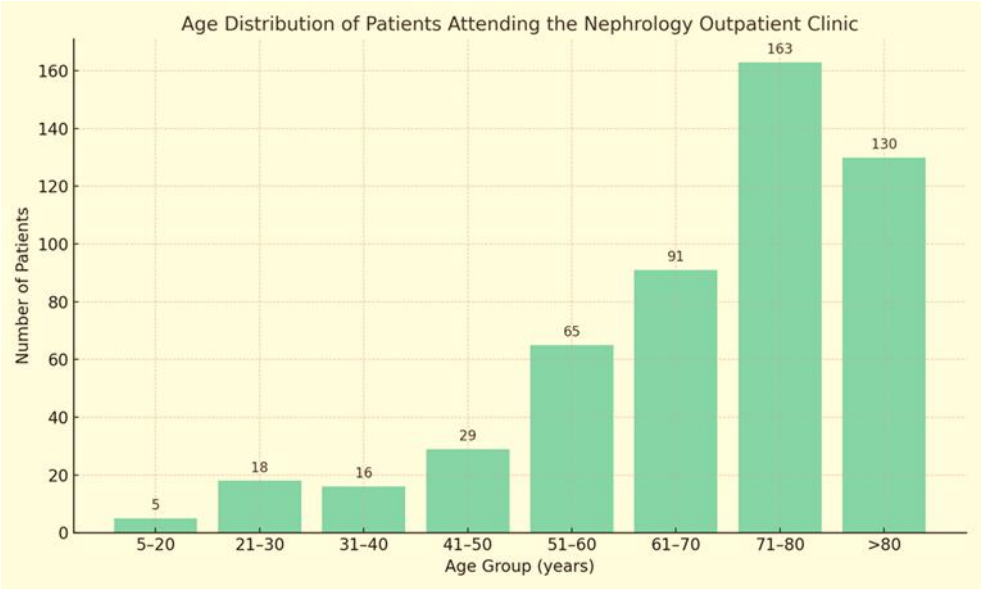


FIGURE 2. Classification of patients attending the Nephrology Outpatient Clinic (N=517)

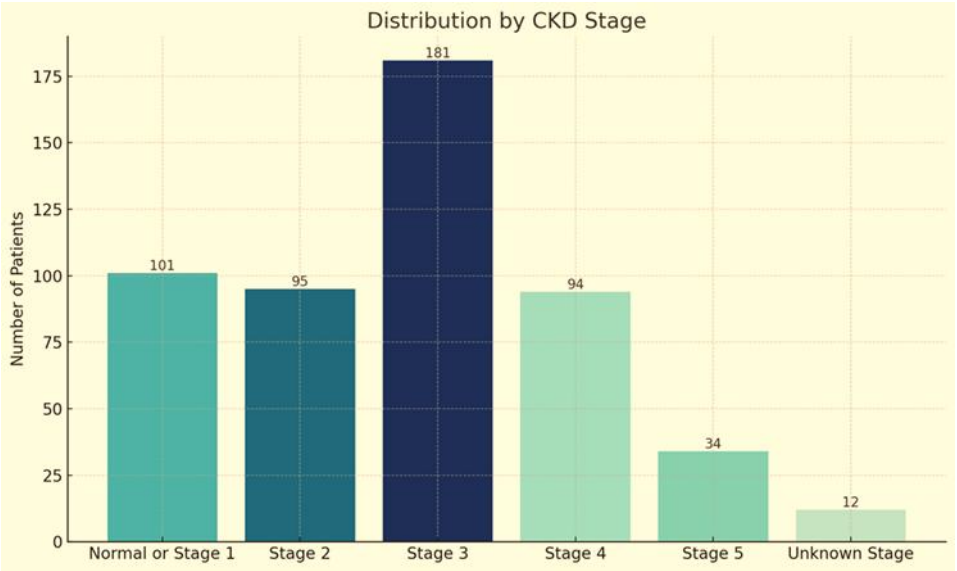
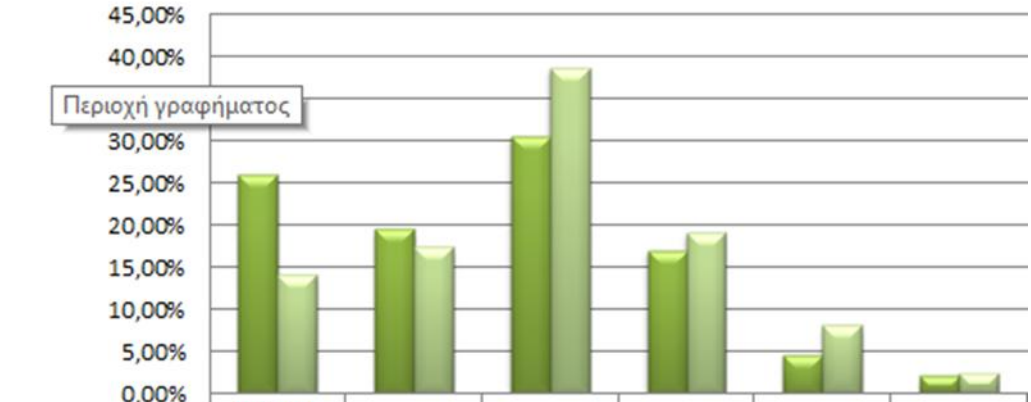


FIGURE 3. Association between gender and stage of CKD



	Normal renal function or Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Insufficient data
Female patients	25,96%	19,57%	30,64%	17,02%	4,68%	2,13%
Male patients	14,18%	17,38%	38,65%	19,15%	8,16%	2,48%

FIGURE 4. Hemodialysis Patients by Age Group