Research Article

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Journal of Nursing and Health Studies
ISSN 2574-2825

2025
Vol.10 No.1:132

The Utilization of Renal Dialysis in Saudi Arabia: A Comprehensive Study in Saudi Arabia

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Received date: January 13, 2024, Manuscript No. IPJNHS-24-18549; **Editor assigned date:** January 16, 2024, PreQC No. IPJNHS-24-18549 (PQ); **Reviewed date:** January 30, 2024, QC No. IPJNHS-24-18549; **Revised date:** February 14, 2025, Manuscript No. IPJNHS-24-18549 (R); **Published date:** February 21, 2025, DOI: 10.36648/2574-2825.10.1.132

Citation: Alonazi W, Alghamdi LS (2025) The Utilization of Renal Dialysis in Saudi Arabia: A Comprehensive Study in Saudi Arabia. J Nurs Health Stud Vol:10 No:1

Abstract

Background: Understanding the trend of utilization of renal dialysis in Saudi Arabia is fundamental as it provides a general overview of renal care. As a result, it assists in identifying challenges, opportunities, and potential areas for improvement in the provision of renal dialysis services, justifying the significance of the present study, which focused on the utilization of renal dialysis services in Saudi Arabia in 2021.

Objectives: This research investigated the utilization of renal dialysis services in Saudi Arabia by focusing on the number of renal dialysis centers, hemodialysis machines, and hemodialysis and peritoneodialysis patients.

Methods: The data from the general authority of Saudi Arabia and the Ministry of Health (MoH) indicators for renal dialysis centers and patients by health sectors in 2021 using MS Excel 365 and SPSS Version 29. As a result, the number of renal dialysis centers was considered a dependent variable, and the number of HD machines, HD, and peritoneodialyis patients were the independent variables to determine the relationship between the variables.

Results: The findings revealed a positive relationship between the number of renal dialysis centers, the number of HD machines, and HD and peritoneodialysis patients, as demonstrated by $p<0.05$ in these three healthcare sectors.

Conclusion: The number of renal dialysis centers influences the availability of HD machines, affecting the number of HD and peritoneodialyis patients. Most patients (Saudi Arabians) preferred MoH over other governmental sectors and private sectors, while this is vice versa in the case of non-Saudi Arabians.

Keywords: Renal dialysis; Quality of care; Chronic renal failure; Saudi Arabia

Introduction

The concept of renal dialysis was first defined and utilized in 1854. Hemodialysis (HD) began in the Netherlands during WWII when it was performed for patients suffering from acute renal failure. It was then introduced in the USA in 1948. However, renal dialysis for chronic renal failure commenced in 1960 after the successful development of HD. Consequently, improving the HD technique to develop sufficient arteriovenous fistula, which occurred in 1972, allowed for faster expansion of dialysis services. After 1972, HD equipment was fully developed to provide long-lasting ambulatory peritoneal dialysis and home-care hemodialysis. The improvement in renal replacement therapy encompassed the presence of recombinant human erythropoietin, effective antihypertensive drugs, and calcitriol. Furthermore, technical development in HD included using biocompatible membranes, ultrafiltration, and membranes of higher porosity [1].

Dialysis services were first introduced in Saudi Arabia in the early 1970's. Since then, dialysis centers have expanded across different regions of the country, with growth influenced by service capacity and geographical coverage. The overall economic development of Saudi Arabia has played a pivotal role in the nationwide expansion of these services. Many units have upgraded to advanced hemodialysis machines, allowing for the adoption of bicarbonate dialysis, controlled ultrafiltration, and sodium profile modeling. Additionally, in the last two decades, a more comprehensive range of biocompatible dialyzers has become available [2].

As reported by Shaheen et al., there has been a rise in the number of dialysis centers in Saudi Arabia. Among these, 55% are associated with MOH-affiliated hospitals. Government non-MOH hospitals contribute 9%, while 13% result from outsourced dialysis initiatives. Charitable and private hospitals comprise 21%, and the King Abdullah hemodialysis project accounts for 2%. In 2019, there were 243 dialysis centers in the country, but this number has since increased. The distribution of these centers is uneven, with the central region having the highest share at 30%, followed by the western region at 27%, the Southern region at 19%, the eastern region at 11%, and the northern region at 11%. Furthermore, Shaheen et al., noted an

annual increase of 6.2% in dialysis patients, projected to reach 22,000 by 2020 [3]. In 2021, the actual number surpassed 20,000 and 9,810 sick people were undergoing medication following kidney transplantation [4]. The demand for renal replacement treatment in Saudi Arabia was estimated to involve 294.3 million people in 2021 [5].

The government of Saudi Arabia has dedicated resources to the construction and enhancement of healthcare infrastructure, incorporating hospitals and medical facilities that feature cutting-edge technologies for diagnosis and treatment [6]. Notably, several government-launched initiatives contribute to the enhancement of healthcare services nationwide. These initiatives include Saudi Vision 2030, the National Transformation Program (NTP), compulsory health insurance, and the Saudi Center for Organ Transplantation (SCOT). These efforts play a significant role in advancing dialysis services in Saudi Arabia [7]. Therefore, examining how people utilize renal dialysis in MoH, other governmental sector hospitals and private healthcare sectors is essential. For this reason, the following hypotheses were tested:

H_0: There is a negative relationship between the number of renal dialysis centers, HD and peritoneodialysis patients, and HD machines.

H_1: There is a positive correlation between renal dialysis centers, HD, periotoneodialysis patients, and HD machines.

Materials and Methods

Research design

This study aimed to comprehend patient outcomes and diverse practices of renal dialysis in various healthcare settings in Saudi Arabia using a quantitative research design. A descriptive research design was utilized as one of the quantitative research types, focusing on providing a detailed account of a phenomenon or population. This design involves the collection and analysis of data without manipulating variables. The primary objective of descriptive research is to observe, record, and report on what is happening or existing without attempting to establish cause-and-effect relationships, which is suitable for the current study. Furthermore, a quantitative observational study was conducted, wherein the research analyzed and extracted valuable information about renal dialysis practices by examining data from the General Authority for Statistics (GaStat) of Saudi Arabia and the Ministry of Health (MoH) indicators for Renal Dialysis Centers and Patients across Health Sectors in the year 2021.

Sampling strategy

The research objectives were achieved using secondary data from the general authority of Saudi Arabia and the Ministry of Health (MoH) indicators for renal dialysis centers and patients by health sectors in 2021. The inclusion and exclusion criteria considered variations in the healthcare sector (comprising the Ministry of Health, other government sectors, and the private sector) and patient demographics. This approach incorporated a comprehensive and diverse dataset for subsequent analysis. Additionally, purposive sampling was employed, involving selecting data based on criteria that align with the research objectives.

Data collection

Structured observation was employed to gather data from the General Authority for Statistics (GaStat) of Saudi Arabia and the Ministry of Health (MoH) indicators for renal dialysis centers and patients by health sectors in the year 2021. This data was then transferred to MS Excel 365 for subsequent analysis. The data underwent coding based on various factors, including health sectors, gender, nationality, hemodialysis by the health sector, renal dialysis by the health sector, number of dialysis centers, number of hemodialysis machines, number of hemodialysis patients, and number of peritoneodialysis patients.

Variables and measures

The dependent variable in this study was the healthcare sector. Conversely, the independent variables included hemodialysis patients categorized by the health sector, gender, and nationality, as well as renal dialysis centers and patients categorized by the health sector. Additionally, the measures employed encompassed age, gender, nationality, the number of renal dialysis centers, the number of hemodialysis machines, the number of hemodialysis patients, and the number of peritoneodialysis patients.

Procedure

Information was acquired from the General Authority for Statistics (GaStat) of Saudi Arabia and the Ministry of Health (MoH) indicators for renal dialysis centers and patients by health sectors in 2021. Subsequently, the data underwent coding and appropriate formatting within MS Excel 365. The organized data was then utilized to generate pertinent tables and graphs using MS Excel 365. However, the interrelationship between dependent and independent variables was analyzed through SPSS Version 29.

Data analysis

Data analysis was conducted using MS Excel 365 and SPSS Version 29. The data was scrutinized based on the distribution of machines and patients across health sectors, the presence of renal dialysis centers within health sectors, trends related to gender, and correlations. Additionally, the analysis delved into aspects such as nationality, renal dialysis centers, and patients distributed across health sectors.

Subjects

The study subjects encompassed hemodialysis patients categorized by nationality, gender, and health sectors, along with renal dialysis centers classified by healthcare sectors and peritoneodialysis patients.

Ethical considerations

The study relied on pre-existing data, eliminating ethical concerns in this context. Nevertheless, the researcher made a point of upholding the fundamental principles of research conduct.

Reliability and validity

As secondary data was utilized, the reliability and validity of the information were contingent on the primary data source. Consequently, the analysis relied on the reliability and validity approach employed in the original data collection.

Statistical analysis (Interpretation)

As previously stated, MS Excel 365 and SPSS Version 29 were statistical software for data analysis, specifically in descriptive statistics. This analytical process yielded responses to the research inquiries.

Results

This section provides the outcomes of the analyses. The results are presented in tables. According to the data, by mid-June 2021. In Table 1, MoH had the highest number of renal dialysis centers (70.18%), followed by the private sector (18.55%) and then other government sectors (11.27%). Furthermore, MoH had the highest Number of Hemodialysis Machines (NHM) (67.13%) compared to other governmental sector (19.61%) and private sector (13.26%). Non-Saudi (NS) Arabians received more of their renal dialysis services (NRC) from the private sector (63.52%) than from another governmental sector (8.65%) and MoH (7.2%) (Figure 1). Contrary to Non-Saudi (NS) Arabians, Saudi (S) Arabians preferred MoH (64%) for the majority of their Renal Dialysis Services (RDS) over other governmental sectors (21%) and the private sector (14.93%). Across the three healthcare sectors, the number of Males (M) (55.21% for MoH, 54.28% for other governmental sector, and 60.94% for private sector) seeking renal dialysis services was more than the number of females (44.79% for MoH, 45.72% for other governmental sector, and 39.053% for private sector) (Figure 2). Surprisingly, peritoneodialysis patients (NPP) only sought renal dialysis services from MoH and other governmental sectors-most visited other governmental sectors (56.69%) than MoH (43.3%).

Table 1: Descriptive statistics for the number of renal dialysis centers, number of HD machines, number of HD patients (in terms of nationality and sex), and number of peritoneodialyis patients.

	NRDC		NHM	NHP											NPP	
	No.	%	No.	%	NS		S		Total		M		F		Total		No.	%
					No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
MoH	193	70.18	5,437	67.13	946	7.2	12,190	92.8	13,136	64	7253	55.21	5883	44.785	13,136	64	806	43.31
Other gov. sector	31	11.27	1,588	19.6	375	8.7	3958	91.35	4,333	21	2352	54.28	1981	45.71	4,333	21.11	1,055	56.66
Private sector	51	18.545	1,074	13.26	1947	63.2	1118	36.48	3065	14.93	1868	60.95	1197	39.05	3065	14.93	0	0
Total	275	100	8,099	100	3,268	79.37	17,266	73.54	20523	100	11,473	56.81	9,061	43.18	20523	100. 0536	1,861	100

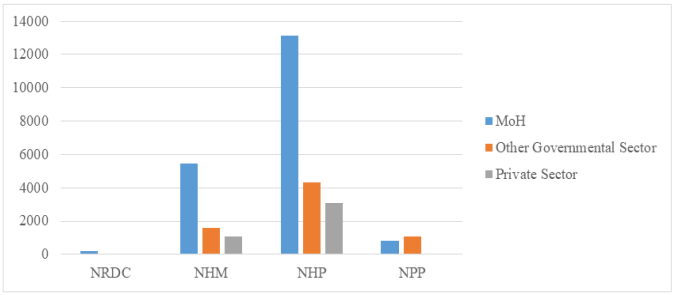

Figure 1: The distribution of renal dialysis centers, number of hemodialysis machines, number of hemodialysis patients, and the number of peritoneodialysis in three healthcare sectors.

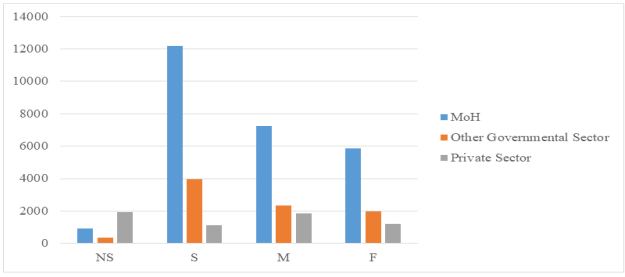

Figure 2: The distribution of non-Saudi Arabians, Saudi Arabians, males, and females in three healthcare centers.

In Table 2, HS characterizes the health sector (three healthcare sectors), NRDC defines the number of renal dialysis centers, NHM denotes the number of hemodialysis machines, NS signifies non-Saudi Arabians, S represents Saudi Arabians, and M is the number of males. At the same time, F describes the number of females. Moreover, NPP is the number of peritoneodialysis. The Healthcare Sector (HS) negatively correlated with the variables except NS (non-Saudi Arabians), demonstrating renal dialysis services in these healthcare sectors are not the same. Nonetheless, in the case of non-Saudi Arabians, it shows a positive trend. Furthermore, there is a strong relationship between NRDC and NHM, S, M, and F. There is a weak correlation (0.181) between NRDC and NPP and a weak negative relationship (0.043) between NRDC and NS. There is a weak negative correlation between non-Saudi Arabians and the number of hemodialysis machines. Moreover, NRM and NPP have a weak positive association. On the other hand, NRM is strongly associated with the number of Saudi Arabians (0.990), males (1) and females (0.999). NS is moderately related to the healthcare sector (0.629) and weakly associated with NRDC (-0.43), NHM (-0.262), S (-0.395), M (-0.236), and F (-0.308) but strongly related to NPP (-0.990). As demonstrated by a strong negative correlation between S and HS, MoH and other governmental and private sectors provide different renal dialysis services to patients. Furthermore, NRDC, NHM, M, and F positively associate with S. On the other hand, there is a positive relationship between NPP and a weak negative association with NS. Additionally, M and F positively associate with NRDC and NHM, with a weak association between NPP and NRDC and NHM. Furthermore, these correlations between the number of renal dialysis centers and the number of HD machines, HD, and peritoneodialysis patients are significant at p=0.05.

Table 2: The relationship between the number of renal dialysis centers and HD machines, renal, number of HD patients, and number of peritoneodialysis patients across three healthcare sectors.

		HS	NRDC	NHM	NS	S	M	F	NPP
HS	Pearson correlation	1	-0.804	-0.915	0.629	-0.963	-0.904	-0.933	-0.731
	Sig. (2-tailed)		0.406	0.265	0.567	0.174	0.282	0.233	0.478
	N	3	3	3	3	3	3	3	3
NRDC	Pearson correlation	-0.804	1	0.976	-0.043	0.935	0.981	0.964	0.181
	Sig. (2-tailed)	0.406		0.141	0.973	0.231	0.124	0.172	0.884
	N	3	3	3	3	3	3	3	3
NHM	Pearson correlation	-0.915	0.976	1	-0.262	0.99	1.000*	.999*	0.393
	Sig. (2-tailed)	0.265	0.141		0.832	0.09	0.017	0.031	0.743
	N	3	3	3	3	3	3	3	3
NS	Pearson correlation	0.629	-0.043	-0.262	1	-0.395	-0.236	-0.308	-0.99
	Sig. (2-tailed)	0.567	0.973	0.832		0.741	0.849	0.8	0.089
	N	3	3	3	3	3	3	3	3
S	Pearson correlation	-0.963	0.935	0.99	-0.395	1	0.986	0.996	0.519
	Sig. (2-tailed)	0.174	0.231	0.09	0.741		0.107	0.059	0.653

	N	3	3	3	3	3	3	3	3
M	Pearson correlation	-0.904	0.981	1.000*	-0.236	0.986	1	.997*	0.368
	Sig. (2-tailed)	0.282	0.124	0.017	0.849	0.107		0.048	0.76
	N	3	3	3	3	3	3	3	3
F	Pearson correlation	-0.933	0.964	.999*	-0.308	0.996	.997*	1	0.437
	Sig. (2-tailed)	0.233	0.172	0.031	0.8	0.059	0.048		0.712
	N	3	3	3	3	3	3	3	3
NPP	Pearson correlation	-0.731	0.181	0.393	-0.99	0.519	0.368	0.437	1
	Sig. (2-tailed)	0.478	0.884	0.743	0.089	0.653	0.76	0.712	
	N	3	3	3	3	3	3	3	3

Discussion

The study examined the utilization of renal dialysis in 2021 in different healthcare sectors (MoH, another governmental sector, and the private sector). As a result, the present research focused on the number of renal dialysis centers, the number of HD machines, the number of HD patients, measured according to nationality and sex, and the number of peritoneodialysis patients to determine how people utilize renal dialysis in MoH, other governmental sector, and private sector. Descriptive and inferential statistics were conducted to determine the relationship between these variables. Descriptive statistics revealed the characteristics of the samples. On the other hand, inferential statistics (correlation) tested the hypotheses to assess if a relationship exists between the number of renal dialysis centers (renal dialysis services), the number of HD machines, and the number of HD and peritoneodialysis.

Utilization of renal dialysis services based on percentage (%)

In 2021, MoH (70.18%) had the highest number of renal dialysis centers compared to the other governmental sector (11.27%) and the private sector (18.55%). Additionally, more HD machines were available at MoH (67.13%) than in other governmental sectors (19.61%) and private sectors (13.26%). Based on these findings, more patients were seeking renal dialysis services from MoH (64%) than from Other Governmental Sector (21%) and private sector hospitals (14.93%), demonstrating the availability of HD machines and renal dialysis centers influenced patients' preference on specific healthcare sectors.

The results showed that a majority of Saudi Arabians (92.80%) favored the Ministry of Health (MoH) for renal dialysis services compared to other governmental (91.34%) and private sector (36.48%) hospitals. There are several reasons underlying this preference for MoH over alternative healthcare providers. One key factor is that MoH facilities are government-funded, allowing them to offer renal dialysis services at a more affordable cost or even free charge. In contrast, private sector hospitals may impose higher fees for their services, making MoH hospitals a more cost-effective choice for individuals. Additionally, many residents in Saudi Arabia may possess health insurance plans that cover services offered by MoH hospitals [8-10]. When private sector hospitals lack coverage or have limited benefits, individuals may choose MoH hospitals to minimize their out-of-pocket expenses. Trust also plays a pivotal role in the decision-making process for Saudi Arabian citizens seeking renal dialysis services. Some individuals may place greater trust in the quality and reliability of healthcare services provided by government-related institutions [11,12]. MoH hospitals are often perceived as having standardized procedures and protocols, fostering a sense of security among patients. Public perception is another factor contributing to the significant volume of patients utilizing dialysis services in Saudi Arabia. Public hospitals are occasionally viewed as having healthcare professionals with more excellent expertise and better-equipped facilities [13-15]. This perception might influence individuals to opt for MoH or other governmental sector hospitals for renal dialysis services instead of private-sector hospitals. Alhamad et al. found that patients consider transportation means, family, and social support when selecting dialysis centers, aligning with the current findings [16-18]. In line with Friberg et al.,'s research, patients showed a greater inclination toward home dialysis when they received

comprehensive and high-quality information about predialysis from three or more sources [19].

The findings established that more non-Saudi Arabia (63.52%) sought renal dialysis services from private sector hospitals than other governmental sector hospitals (8.65%) and MoH (7.2%). Factors such as insurance policies and preference coverage might have contributed to non-Saudis' preference for private sector hospitals over other governmental sector hospitals and MoH. Moreover, the number of hemodialysis patients (91.69%) surpassed that of peritoneodialysis patients (8.31%). This discrepancy can be attributed to the broader availability and accessibility of hemodialysis as a form of renal replacement therapy across various healthcare settings. The infrastructure necessary for hemodialysis, including dialysis units and adequately trained staff, may also be more prevalent than peritoneal dialysis. Additionally, not all patients are viable candidates for peritoneal dialysis, with factors such as overall health, abdominal condition, and willingness to engage in self-care at home influencing the preference between hemodialysis and peritoneal dialysis. Certain patients may have medical conditions or lifestyle considerations that make hemodialysis more suitable.

Peritoneodialysis patients were notably absent in private-sector hospitals, a circumstance attributed to resource and infrastructure limitations. This limitation arises from the specific requirements associated with establishing and sustaining a peritoneal dialysis program, including the need for trained staff, specialized equipment, and infrastructure to support home-based care. Private sector hospitals may allocate resources based on services with higher demand or those more commonly sought by their patient population. Additionally, the absence of peritoneodialysis in private-sector hospitals may be influenced by insurance coverage considerations. In Saudi Arabia, insurance coverage tends to be more favorable for hemodialysis than peritoneal dialysis, prompting patients to choose the financially more viable option.

The relationship between NRDC and NHM, the number of HD patients (in terms of sex and nationality), and NPP

The study tested the correlation between the number of renal dialysis centers, the number of HD patients (measured in terms of nationality), and the number of peritoneodialysis patients. According to the present findings, $p<0.05$, leading to the rejection of the null hypothesis (H_0), indicating that there is a positive relationship between the number of renal dialysis centers and the number of HD, and peritoneodialysis patients and HD machines. Therefore, the number of renal dialysis centers positively influences the number of HD machines, which in turn affects the number of patients seeking HD and peritoneodialysis services.

According to the findings, it is crucial to adopt a comprehensive strategy to improve the quality and accessibility of renal dialysis services in Saudi Arabia. One aspect of this approach involves the government restructuring its healthcare policies to extend the same benefits to non-Saudi Arabian residents as those enjoyed by Saudi Arabian citizens. This can be achieved through the formulation and enforcement of policies that advocate for fair and equal access to renal dialysis services, regardless of geographical location or individual background.

Conclusion

The study assessed the utilization of renal dialysis services across different healthcare sectors in Saudi Arabia, focusing on the number of renal dialysis centers, HD machines, and HD and peritoneodialysis patients. The prevailing healthcare policies favor Saudi Arabian citizens for renal dialysis services within the Ministry of Health (MoH) sector and its affiliated hospitals over private sector facilities. This preference is supported by a higher attendance of hemodialysis patients in the MoH sector and its associated hospitals. Moreover, substantial investments in MoH sector hospitals in Saudi Arabia have resulted in a more significant number of dialysis machines and the provision of superior, more affordable healthcare services compared to private-sector hospitals. Notably, discernible variations in the quality of care and patient outcomes exist across these three healthcare sectors.

The government funding assists MoH sector hospitals and affiliated hospitals in offering high-quality renal dialysis at a reasonable cost. In contrast, private sector hospitals provide quality renal dialysis services but at a higher expense. The current healthcare policies in Saudi Arabia need to be more favorable for non-Saudi residents to access renal dialysis services from the MoH sector and its affiliated hospitals. The key factors contributing to the disparities in effectiveness and efficiency among these healthcare sectors are Saudi Arabia's healthcare policies, including insurance coverage policies, which are disadvantageous for non-Saudi residents.

Limitations

This study relied on secondary data sources, which are subject to several limitations. For instance, certain facets of the research question might have yet to be covered during the initial data collection, resulting in information gaps. Moreover, the data may be aggregated at a level that aligns differently from the specific details required for the present study. Additionally, the primary data might not have included procedures for obtaining informed consent, necessitating the researcher to carefully consider ethical implications.

Authors' Contributions

LS conceptualized the study, designed the analytic plan, conducted the statistical analysis, drafted sections of the manuscript, conducted the policy analysis, drafted study tables, critically reviewed the manuscript, and approved the final manuscript as submitted. WA reviewed and revised the study protocol, critically reviewed the manuscript, and approved the final manuscript as submitted.

Funding

Not applicable.

Availability of Data and Materials

The dataset and the accompanying files are available from the General Authority for Statistics (GaStat) of Saudi Arabia and the Ministry of Health (MoH) indicators for renal dialysis centers and patients by health sectors in the year 2021.

Ethics Approval and Consent to Participate

Not applicable as this is an analysis of the secondary dataset. All methods were carried out by relevant guidelines and regulations.

Consent for Publication

Not applicable as this is an analysis of the secondary dataset.

Competing Interests

Not applicable.

Acknowledgment

Researchers supporting project number (RSP2024R332), King Saud University, Riyadh, Saudi Arabia.

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