






Original article

# Direct cost of hemodialysis in a public hospital in the Dominican Republic

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## Abstract

**Introduction:** Hemodialysis represents a high expense for patients with end-stage renal disease, the family budget, and the per capita health expenditure of the Dominican Republic government.

**Objective:** To estimate the direct costs of hemodialysis among patients with end-stage renal disease (ESRD) at Salvador B. Gautier Hospital.

**Methodology:** A descriptive cross-sectional study was conducted among 59 ESRD patients undergoing hemodialysis therapy in a tertiary public hospital in the Dominican Republic from July 26th to August 23rd, 2021. Data were collected through interviews with the participants and a review of clinical records. A total of 718 hemodialysis sessions were studied and direct costs were estimated using the bottom-up method.

**Results:** The mean cost per hemodialysis session was DOP 4,880.51 (USD 85.91) and the mean annual cost was DOP 761,359.56 (USD 13,401.86). Direct medical costs represented 50.06 % and direct non-medical costs 49.94 %. Medical supplies and transportation represented 40.86 % and 24.79 % of total costs, respectively.

**Conclusions:** Hemodialysis imposes a considerable economic burden for the Dominican Republic. The income of the families is not sufficient to cover hemodialysis treatment. To reduce the economic impact of hemodialysis, strategies should be implemented to prevent the progression of chronic kidney disease to the end stage.

**Keywords:** Direct costs, hemodialysis, chronic kidney disease, public hospital, end-stage renal disease, Dominican Republic.

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# Costos directos de la hemodiálisis en un hospital público en la República Dominicana

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## Resumen

**Introducción:** la hemodiálisis representa un gasto elevado para los pacientes con enfermedad renal terminal, el presupuesto familiar y el gasto sanitario per cápita del gobierno de la República Dominicana.

**Objetivo:** estimar los costos directos de la hemodiálisis en pacientes con enfermedad renal en etapa terminal (ESRD) en el Hospital Salvador B. Gautier.

**Material y Métodos:** se realizó un estudio descriptivo de corte transversal con 59 pacientes con enfermedad renal en etapa terminal que recibieron terapia de hemodiálisis en un hospital público de la República Dominicana en el período 26 de julio al 23 de agosto de 2021. Los datos se recolectaron mediante entrevistas a los participantes y revisión de los expedientes clínicos. Se estudiaron 718 sesiones de hemodiálisis y se estimaron los costos directos usando el método *bottom-up*.

**Resultados:** el costo promedio por sesión de hemodiálisis fue DOP 4,880.51 (USD 85.91) y el costo anual DOP 761,359.56 (USD 13,401.86). Los costos directos médicos representaron un 50,06 % y los costos directos no médicos el 49,94 %. Los insumos médicos y el transporte representaron el 40,86 % y 24,79 % de los costos totales, respectivamente.

**Conclusión:** la hemodiálisis constituye una carga económica considerable para la República Dominicana. Los ingresos de las familias no son suficientes para cubrir la terapia de hemodiálisis. Para reducir el impacto económico de la hemodiálisis se deben implementar estrategias para prevenir la progresión de la enfermedad renal crónica a la etapa terminal.

**Palabras clave:** costos directos, hemodiálisis, enfermedad renal crónica, enfermedad renal en etapa terminal, República Dominicana.

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## Introduction

Chronic kidney disease (CKD) is a worldwide public health problem. The global increase in this disease is mainly driven by the rising prevalence of diabetes mellitus, arterial hypertension, obesity, and aging. In 2017 9.1 % of the world population had CKD and approximately 1.2 million people died from direct causes of this illness. Moreover, 1.4 million deaths were attributed to cardiovascular conditions, and 25.3 million disability-adjusted life-years were attributed to the effect of kidney failure. The CKD mortality rate increased by 41.5 % from 1990 to 2017 [1].

End-stage renal disease is the last stage of CKD and requires dialysis or a kidney transplant to sustain the patient's life. In 2010 2.6 million people received renal replacement therapy (RRT) worldwide. It is estimated that 4.9 to 9.7 million people needed RRT, suggesting that at

least 2.3 million people may have died prematurely because they did not have access to RRT. The largest gap occurs in low-income countries, particularly in Asia and Africa, where 1.9 million people and 432 thousand people need RRT respectively, but do not receive it [2].

CKD has a major impact on the global economy, and it is estimated that in the United States, medicare expenditures for CKD treatment exceed USD 51 billion per year [3]. On the other hand, in Uruguay 30 % of the budget of the National Fund for specialized therapies is allocated for renal diseases [4].

The cost of CKD to the National Health System (NHS) in England was estimated at GBP 1.44 to 1.45 billion, equivalent to roughly 1.3 % of all NHS spending in the period 2009-2010; more than half of that amount was spent on RRT, which was provided to only 2 % of the population with CKD (5). In middle-income countries, treatment with dialysis or kidney transplantation creates an enormous financial burden for most patients. In other 112 countries with a combined population of more than 600 million people, patients with CKD cannot afford to pay any RRT, resulting in the deaths of nearly a million people for untreated kidney failure [6].

In the Dominican Republic, there are no studies on the cost of hemodialysis therapy in end-stage renal disease (ESRD). This research set the precedent for estimating the direct costs of ESRD treatment in hemodialysis in the country, describing the socioeconomic characteristics of the population studied to be of use to all actors involved.

## Methods and materials

### Study design

A descriptive, cross-sectional, prospective study was conducted at Salvador B. Gautier Hospital nephrology department. This community hospital is in Santo Domingo, the capital of the Dominican Republic, it provides multiple specialties, consultations services, and receives patients from all around the country. The study's primary objective was to describe the direct and indirect costs of hemodialysis per session, and the secondary objective was to describe the socioeconomic and sociodemographic characteristics of the patients attending the hemodialysis unit. The study was conducted between July 26<sup>th</sup>, 2021, and August 23<sup>rd</sup>, 2021, with an estimate of 28 days. The Salvador B. Gautier Hospital Ethics Committee approved the research protocol. The data was collected by the data collection team and was analyzed and interpreted by the authors.

The study has a quantitative approach, whose perspectives measure the costs for the health care system and the participants and their families. Table 1 reflects the cost categories included in each perspective.

**Table 1.** Cost categories included in each perspective

<b>Perspective</b>	<b>Direct medical costs</b>	<b>Direct non-medical costs</b>
<b>Health care system</b>	All costs: <i>Expendable material</i> <i>Care staff</i>	-
<b>Participants and families</b>	Out-of-pocket costs: <i>Outpatient medications</i> <i>Lab tests</i>	Out-of-pocket costs: Transportation <i>Alimentation</i> <i>Additional care</i>

**Source:** Own elaboration.

## Participants

The population consisted of patients who received hemodialysis therapy at the hospital's hemodialysis unit. A total of 106 patients were identified. The inclusion criteria was the following: all patient's receiving hemodialysis on an outpatient basis, who were over 18 years old, had been receiving hemodialysis for at least 3 months, and agreed to participate in the study by signing the consent form. The exclusion criteria were patients who provided insufficient data to complete the survey.

## Data collection

The sociodemographic and economic data were obtained through direct interviews with the patients. In addition, the clinical record was reviewed to obtain clinical data (drug use, comorbidities, complications) and the resources used in each hemodialysis session.

The data collection form consisted of six sections made up of open and closed questions, which addressed the general data of each case (name and code of the patient as well as the name of the collector), causes of chronic kidney disease, frequency of hemodialysis, employment information of nursing and medical personnel, complications during dialysis and direct costs of medications, expendable material, laboratories, images, and procedures according to the invoice delivered by the patient or the price established by PromeseCal.

The information on the prices of supplies used in the dialysis unit was obtained from the PromeseCal price catalog, the entity that provides medicines, sanitary supplies, and laboratory reagents to the National public system. For the prices of laboratory tests, the price catalog for

uninsured people of the Amadita National Reference Laboratory was used, as it is the most common laboratory used by the patients of our institution. The price of the globular blood package was consulted for patients affiliated with the SeNaSa subsidized insurance at the blood bank of the Dominican Red Cross which is the most used blood bank by our institution's patients.

## Variables

The study's dependent variables were the cost of the hemodialysis session as measured by the direct medical and non-medical costs [7]. The bottom-up method was used to estimate the cost of the hemodialysis session.

The independent variables were sociodemographic factors (age, sex, education level, family size, and marital status) and socioeconomic factors, such as poverty (defined as patients with a family monthly income of less than DOP 36,584., that according to the national poverty line were classified as poor) [8]. Additionally, the type of vascular access (tunneled and non-tunneled catheter, arteriovenous fistula, and related arteriovenous fistula) and related complications (hypertension, hypotension, infections, and others), and reported comorbidities by the patients.

The direct medical cost corresponds to the cost of the dialysis session including the drugs used in each session, the outpatient medications related to kidney disease, in addition to consumables, laboratory tests, procedures used (fistula placement), and the fees of the assisting personnel. The non-medical cost corresponds to the cost of transportation, food, and other factors that add to the total cost of therapy, such as additional care.

## Data processing and analysis

A dataset was created in Google Sheets and exported as comma-separated values (.csv) file and imported into the Pandas statistical analysis package in Pandas version 1.4.0. and Python version 3.10.0 for analysis. Descriptive statistics such as percentages, measures of central tendency such as the arithmetic mean, and measures of dispersion such as the standard deviation were used to describe the variables of the study.

## Ethical considerations

The study was approved by the ethics committee of the hospital. Participants were informed of the objectives of the study, and the right to opt out or leave at any time. Written consent

was obtained from each participant before the initiation of data collection. The confidentiality and anonymity of participants were preserved by using non-personal identifiers.

## Results

A total of 106 patients were identified, of whom 88 who met the research criteria consented to participate. In addition, 29 patients were excluded due to incomplete data, therefore the final sample consisted of 59 patients.

### Sociodemographic and economic characteristics

A total of 59 patients with end-stage renal disease (ESRD) receiving hemodialysis therapy participated, for a total of 718 hemodialysis sessions in the study period, 63 % of the participants were male (Table 2) and the mean age was  $51.42 \pm 15.26$  years, with a range of 22 to 87 years.

**Table 2.** Sociodemographic and economic characteristics of the participants in the unit of hemodialysis at the Hospital de Salvador B. Gautier, Dominican Republic 2021

Variables	Frequency (n)	Percentage (%)
<b>Sex (n = 59)</b>		
Male	37	63
Female	22	37
<b>Age (n = 59)</b>		
18 - 35 age	7	11,86
36 - 55 age	34	57,63
56 - 65 age	9	15,25
>65 age	9	15,25
<b>Marital status (n = 59)</b>		
Single	23	39
Common law marriage	17	29
Married	15	25
Widower	4	7
<b>Residence (n = 49)</b>		
Urban	29	59
Rural	20	41
<b>Education level (n = 59)</b>		
Elementary school	28	47

High School	24	41
College	5	8
Preschool	1	2
None	1	2
<b>Working status (n = 58)</b>		
Employed	46	79
Unemployed	12	21
<b>Family size (average 4.24) (n = 55)</b>		
>4.24	21	38,18
<4.24	34	61,82
<b>Dialysis frequency (n = 59)</b>		
3 sessions per week	58	98,30
2 sessions per week	1	1,70
<b>Economic status (n = 52)</b>		
Poor	50	96
Not poor	2	4
<b>Vascular access (n = 54)</b>		
Tunneled catheter	24	44
Arteriovenous fistula	19	35
No Tunneled catheter	11	20
<b>Health risk insurer (n = 59)</b>		
SeNaSa Subsidized	53	90
SeNaSa Contributive	5	8
SEMMA	1	2
<b>Coping strategies*</b>		
Financial support from neighbors, family, and friends	47	79,66
Money loans	12	20,34
Sale of assets or goods	9	25,25
Stay at home until having resources	6	10,17
None	5	8,47
Minimize frequency per week	3	5,08
Healers or natural remedies	2	3,39
Others	5	8,45
<b>Comorbidities*</b>		
Arterial hypertension	39	66,10

Arterial hypertension and diabetes mellitus	16	27,12
Heart Failure	4	6,78
Human Immunodeficiency virus	3	5,08
None	2	3,39
Glomerulonephritis	2	3,39
Others	9	15,21
<b>Complications*</b>		
Hypotension	67	9,33
Hypertension	57	7,94
Pain	7	0,98
Infection	5	0,70
Pruritus	4	0,56
Paresthesia	3	0,42
Nausea	3	0,42
Others	4	0,56

\*Not exclusive.

Source: Own elaboration.

More than half of the participants were in a relationship (54%), and 49% had at least a secondary level of education, 79% of the participants were unemployed and 59% resided in the urban area. The average family size was  $4.24 \pm 2.04$  and 96% lived in poverty. Almost 80% of the participants received help from relatives, neighbors, and friends, and only less than 10% could afford therapy.

## Clinical features

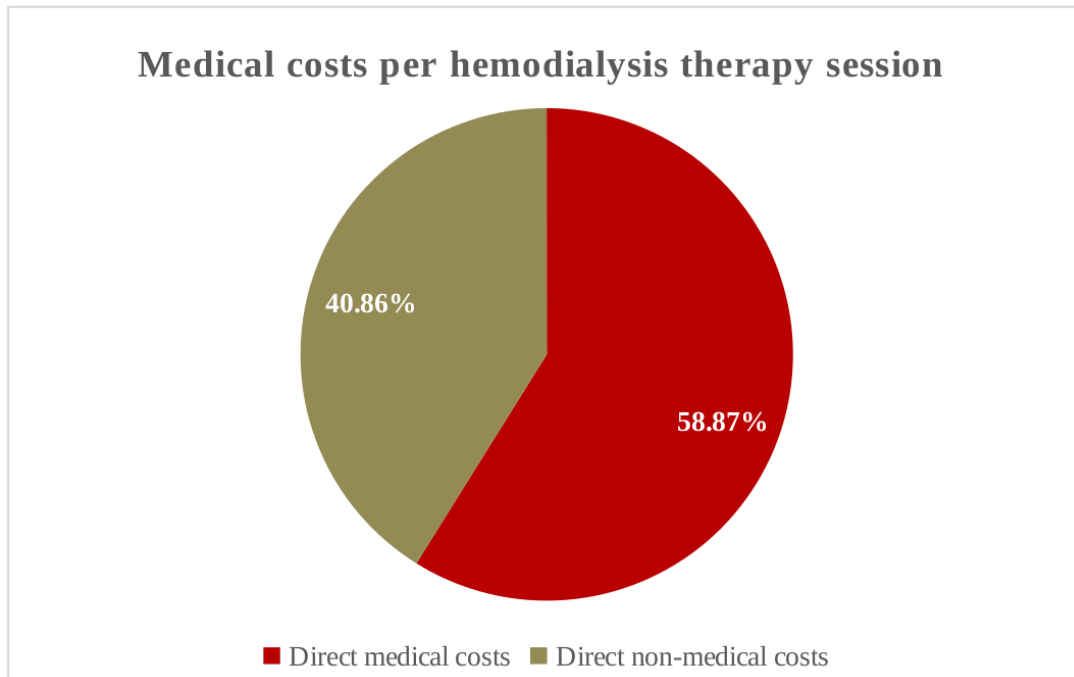
Virtually 100% of the participants received therapy three times a week. Approximately 2/3 of the patients had hypertension as a comorbidity, and almost 1/3 had hypertension and diabetes mellitus.

The mean number of complications was  $0.21 (\pm 0.48)$  per session, with hypotension (9.33%) and hypertension (7.94%) being the most frequent. Tunneled catheters (44%) and arteriovenous fistula (35%) were the most frequent vascular accesses.

## Hemodialysis costs

The average cost per hemodialysis session was DOP  $4,880.51 \pm 4,517.55$  (USD  $85.91 \pm 79.52$ ). Of this, direct medical costs accounted for 50.06% and direct non-medical costs accounted for





**Figura 1.** Medical costs per hemodialysis therapy session in patients in the hemodialysis unit of the Salvador B. Gautier Hospital, Dominican Republic 2021 (Table 3)

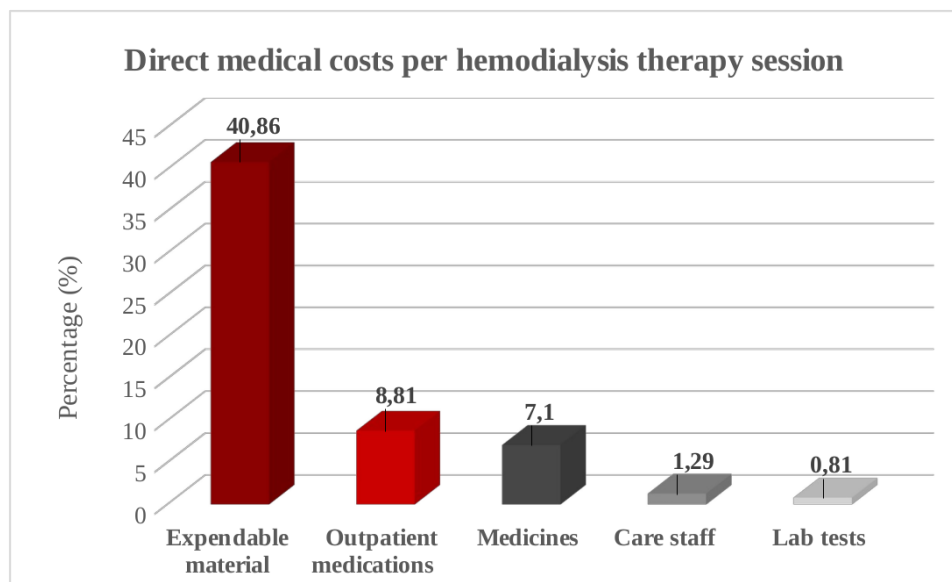
**Source:** Own elaboration.

the remaining 49.94 %. The annual cost of hemodialysis therapy is DOP 761,359.56 ± 704,737.80 (USD 13,401.86 ± 12,405.17) (Table 3).

**Table 3.** Average cost per hemodialysis therapy session in patients in the hemodialysis unit of the Salvador B. Gautier Hospital, Dominican Republic 2021

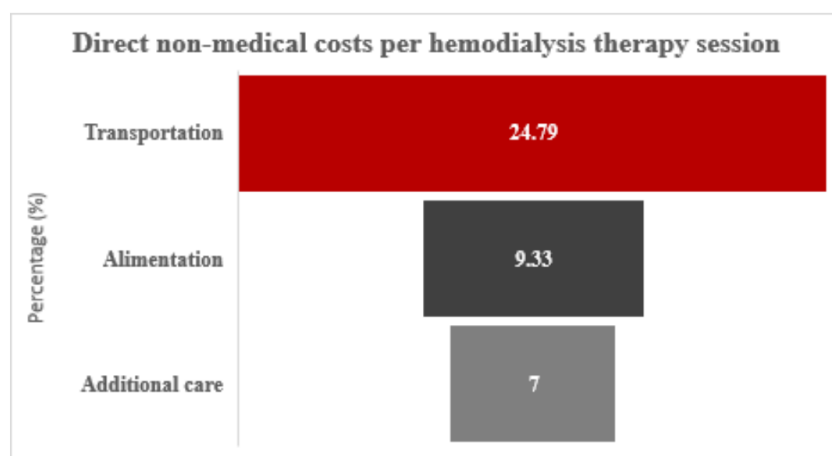
Variable	DOP	USD	% of the total cost
<b>Direct medical costs</b>	<b>2,873.52 ± 1,338.85</b>	<b>50.58 ± 23.57</b>	<b>58,87</b>
Expendable material	1,994.18 ± 529.41	35.10 ± 9.32	40,86
Medicines	346.28 ± 126.07	6.10 ± 2.22	7,10
Outpatient medications	430.17 ± 334.55	7.57 ± 5.89	8,81
Lab tests	39.75 ± 348.82	0.70 ± 6.14	0,81
Care staff	63,14	1,11	1,29
<b>Direct non-medical costs</b>	<b>2,006.99 ± 3,178.70</b>	<b>35.33 ± 55.95</b>	<b>41,12</b>
Transportation	1,209.82 ± 1,606.20	21.30 ± 28.27	24,79
Alimentation	455.50 ± 682.01	8.02 ± 12.01	9,33
Additional care	341.67 ± 890.49	6.01 ± 15.67	7,00
<b>Total</b>	<b>4,880.51 ± 4,517.55</b>	<b>85.91 ± 79.52</b>	<b>100</b>
Monthly Total*	58,566.12 ± 54,210.60	1,030.91 ± 954.24	
Annual Total†	761,359,56	±13,401,86	
	704,737,80	12,405,17	

1 USD = DOP 56.81 at the time of the study [9].



**Figura 2.** Direct medical costs per hemodialysis therapy session in patients in the hemodialysis unit of the Salvador B. Gautier Hospital, Dominican Republic 2021 (Table 3)

**Source:** Own elaboration.



**Figura 3.** Direct non-medical costs per hemodialysis therapy session in patients in the hemodialysis unit of the Salvador B. Gautier Hospital, Dominican Republic 2021 (Table 3)

**Source:** Own elaboration.

## Discussion

By the year 2021 in the Dominican Republic, approximately 10 suffering from some degree of kidney disease and more than 5,000 patients required dialysis therapy (10). However, the cost imposed by renal replacement therapy (RRT) in its different modalities had not been studied to date. This research was carried out in the dialysis unit of Salvador B. Gautier

Hospital, a third-level public center of national reference, which is attended by a low-income population and is mostly affiliated with the National Health Insurance of the subsidized regime.

Indirect and intangible costs were not estimated thus, the results obtained underestimate the real cost of treating end-stage renal disease (ESRD) on hemodialysis in the Dominican Republic. Nevertheless, it presents a general idea of the magnitude of the problem in economic terms.

The study revealed that the average cost per hemodialysis session was DOP 4,880.51 ± 4,517.55 (USD 85.91 ± 79.52), equivalent to an annual cost of DOP 761,359.56 ± 704,737.80 (USD 13,401.86 ± 12,405.17) per patient, of which direct medical costs accounted for 50.06 % and direct non-medical costs 49.94 %. The result obtained is higher than that estimated by Villarreal-Ríos et al in Mexico in 2019 (USD 10,535.06 per year) [11], Kassa et al in Ethiopia in 2020 (USD 4,466.59 ± 1,226.29 per year) [12], Fathima et al in India in 2018 (USD 1,638.6 per year) [13], Suja et al in India in 2012 (USD 58 per session) [14], Ranashinghe *et al* in Sri Lanka in 2011 (USD 8,804 per year) [15], Elsharif et al in Sudan in 2010 (USD 6,846 per year) [16], and Mahdavi-Mazdeh et al in Iran in 2008 (USD 78.87 per session) [17] (Table 3, Figure 1, Figure 2).

Our result is lower than in the United States in 2019 (USD 94,608 per year) [3], Kaur *et al.* in India in 2018 (USD 108 per session) [18], Aoun *et al* in Lebanon in 2020 (USD 2,804.30 per month) [19], Sanchez-Escuredo *et al* in Spain in 2015 (EUR 43,000.88 per year) [20], Mendes de Abreu et al in Brazil in 2013 (USD 28,570 per year) [21], Kerr *et al* in England in 2012 (GBP 24,043 per year) [5], Saran *et al* in Saudi Arabia in 2012 (USD 46,332 per year) [22], and Pacheco *et al* in Chile in 2007 (USD 20,803 per year) [23] (see table 4 for a table comparing the annual medical cost of hemodialysis in the Dominican Republic vs other countries).

The differences in the costs reported by the different studies are very marked. This is explained by the combination of different factors used in other studies, such as the types of costs considered (direct, indirect, intangible), the variation in the costs of medical supplies in different countries, the fees of health care personnel, the accessibility of health care services, per capita health spending by governments, the category of hospitals (public or private), the perspective used (patient, health system, health risk insurers), inflation, among others. For example, in the Dominican Republic and other developing countries, direct non-medical costs can represent up to 50 % of the costs, but in developed countries such as Spain, they tend to represent less than 20 % [20]. Even in the same country, in the same year, there can be a

**Table 4.** Total annual medical costs comparison for hemodialysis therapy in the Dominican Republic vs. other countries

Country	Mean Annual Cost (USD)
USA (2019) [3]	94.608
Spain (2015) [20]	47,730.97*
Saudi Arabia (2012) [22]	46.332
England (2012) [5]	37,987.94*
Lebanon (2020) [19]	33.651,60
Brazil (2013) [21]	28.570
Chile (2007) [23]	20.803
<b>Dominican Republic (our study)</b>	13.401,86
Mexico (2019) [11]	10.535,06
Sri Lanka (2011) [15]	8.804
Sudan (2010) [16]	6.846
Ethiopia (2020) [12]	4.466,59
India (2018) [13]	1.638,60

\*Average annual conversion rates for the specific year were used.

**Source:** Own elaboration.

great deal of variability, as is the case in India with the costs reported by Kaur *et al* [18] and Fathima *et al* [13] in 2018 (Figure 3).

The cost of the family basket in the Dominican Republic was DOP 38,625.29 at the time of the study [24]. In contrast, the monthly cost of hemodialysis therapy was PDO 58,566, almost 12,50 % higher than the cost of the household basket. This is in addition to the fact that 79 % of the participants were economically inactive and more than 90 % lived in poverty. This imposes a significant economic burden on families. Even though the state subsidizes the direct medical cost of therapy, more than 90 % of families have to resort to different strategies to meet the direct non-medical cost.

The annual cost of hemodialysis therapy per patient is almost 50 % higher than the GDP per capita of the Dominican Republic in 2021 [25], which represents a significant economic burden for the country. To reduce the economic impact of hemodialysis therapy, strategies should be implemented to prevent the progression of chronic kidney disease (CKD) to the end-stage, and above all to prevent people with hypertension and diabetes mellitus from developing CKD.

The present findings should be interpreted in the context of possible limitations. First, the study was conducted in the hemodialysis unit of a tertiary hospital in the capital city, which may not be a representative hospital for the whole country. Although, it is a government hospital and the findings in this type of hospital could be consistent across

the country. Second, direct nonmedical costs are not exempt from recall bias on the part of participants. Indirect and intangible costs, such as water and electricity consumption, equipment maintenance, cleaning, administration, loss of productivity, and others, were not estimated in this study and increased the total cost of therapy.

Future studies should take a more representative sample that includes patients from both public and private services and measure indirect and intangible costs to obtain a more accurate ESRD treatment and hemodialysis treatment.

## Conclusions

The annual cost of hemodialysis therapy for patients with end-stage renal disease was high compared to the Dominican Republic's GDP per capita of the Dominican Republic. The income of families is not sufficient to cover the treatment. To reduce the economic impact of hemodialysis therapy, strategies should be implemented to prevent the progression of chronic kidney disease to the terminal stage [26].

## Author's contributions

All authors participated equally in the conception of the research idea, the collection and analysis of information, and the final writing of the manuscript for publication.

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## Conflicts of interest

None declared by the authors.

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