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Medical Nutrition Therapy with a Plant-Based Diet in Pregnant Women with Chronic Kidney Disease: A Case Series

Terapia médica y nutricia con una dieta basada en plantas en mujeres embarazadas con Enfermedad Renal Crónica: Serie de casos

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ABSTRACT

Background: Chronic kidney disease (CKD) is a global health problem. Pregnancies in women with CKD face an increased risk of adverse perinatal outcomes. Despite limited data, nutritional care remains a crucial component of multidisciplinary treatment for these women. The aim was to describe clinical and metabolic status and perinatal outcomes in pregnant women with CKD receiving intensive medical and nutritional care, including the recommendation of a plant-based diet (PBD).

Methods: Retrospective analysis of 7 CKD-pregnancies. Participants received care from a perinatal nephrologist, routine obstetric follow-up, and medical nutrition therapy comprising a PBD, micronutrient supplementation, counseling, and education. Renal, nutritional and metabolic status were obtained from institutional records. Perinatal outcomes assessed included preeclampsia, gestational diabetes (GDM), preterm, hospitalization, hemodialysis (HD), intrauterine growth restriction, fetal loss, and neonatal nutritional status.

Results: Six women had stage 4 CKD. Most (n=5) received outpatient care; none required HD. Glomerular filtration rate and proteinuria remained stable in all women. Five women maintained or improved baseline creatinine (peak ≤3.0mg/dL). Third-trimester urea nitrogen was 31.3±11.3mg/dl, and albumin 2.97±0.09g/dl. No cases of GDM or fetal loss were observed, and one woman developed preeclampsia. All neonates were born alive. Neonatal outcomes reflected the high-risk nature of CKD pregnancies: three (42%) were preterm and four (57%) presented wasting. Newborn nutritional indices considering length and head circumference were normal.

Conclusion: In this case series of women with CKD receiving intensive medical and nutritional care, complications consistent with CKD pregnancies were observed, although with a low frequency of GDM, preeclampsia, fetal loss, and neonatal stunting. None of the women required initiation of HD, and renal function remained stable.

Keywords: Prenatal nutrition; traditional diet; pregnancy complications; infant-newborn; renal insufficiency; case series

RESUMEN

Introducción: La enfermedad renal crónica (ERC) es un problema de salud mundial que puede complicar la gestación. Las mujeres embarazas con ERC presentan un mayor riesgo de resultados perinatales adversos. Aún con datos limitados, la atención nutricional es un componente crucial del tratamiento multidisciplinario. El objetivo fue describir el estado clínico-metabólico y los resultados perinatales en embarazadas con ERC que recibieron atención médica y nutricia intensiva incluyendo la recomendación de una dieta basada en plantas (DBP).

Métodos: Análisis retrospectivo de 7 embarazos con ERC. Las participantes recibieron atención por un nefrólogo perinatal, seguimiento obstétrico habitual y una terapia médica nutricional (TMN) que incluyó una DBP, suplementación con micronutrientes, consejería y educación. El estado renal, nutricio y metabólico se obtuvo de registros institucionales. Los desenlaces perinatales evaluados incluyeron preeclampsia, diabetes gestacional (DMG), parto pretérmino, hospitalización, hemodiálisis, restricción del crecimiento intrauterino, pérdida fetal y estado nutricio neonatal.

Resultados: Seis mujeres presentaron ERC estadio 4. La mayoría (n=5) recibió manejo ambulatorio; ninguna requirió hemodiálisis. La tasa de filtración glomerular y la proteinuria se mantuvieron estables. Cinco mujeres mantuvieron o mejoraron su creatinina basal (pico ≤3.0mg/dL). El nitrógeno ureico en el tercer trimestre fue de 31.3±11.3mg/dL y la albúmina de 2.9±0.09g/dL. No se observaron casos de DMG ni pérdidas fetales; solo una mujer desarrolló preeclampsia. Todos los recién nacidos nacieron vivos. Los resultados neonatales reflejaron el alto riesgo de los embarazos con ERC: tres (42%) fueron prematuros, y cuatro (57%) presentaron emaciación. Los índices nutricios de longitud y perímetro cefálico fueron adecuados.

Conclusión: En esta serie de casos en mujeres con ERC recibiendo tratamiento intensivo médico y nutricio, se observaron complicaciones consistentes con el embarazo con ERC, pero con baja frecuencia en DMG, preeclampsia, pérdidas fetales y desmedro al nacer. Ninguna mujer requirió iniciar tratamiento con hemodiálisis, manteniendo estable la función renal.

Palabras clave: Nutrición prenatal; dieta tradicional; complicaciones del embarazo; recién nacido; insuficiencia renal; serie de casos

KEY MESSAGES

- Intensive medical nutrition therapy, including a plant-based diet, in this group of pregnant women with CKD (3-5), was associated with stable renal function and no requirement for dialysis in this case series.
- Close multidisciplinary care was associated with stable metabolic, electrolyte, and blood pressure control, and no cases of gestational diabetes or fetal loss, and a low frequency of preeclampsia.
- Neonatal outcomes reflected the high-risk nature of CKD pregnancies, with a high frequency of prematurity and wasting, although most newborns had preserved head circumference and length.
- Culturally adapted plant-based dietary strategies may represent a potentially feasible nutritional approach for high-risk CKD pregnancies, particularly in low-resource or dialysis-limited settings.

INTRODUCTION

Chronic kidney disease (CKD) is a significant global health problem affecting around 10% of the population, with higher numbers in low- and middle-income countries (LMIC) and among women[1]. The prevalence of CKD in pregnancy has risen to approximately 1-3%[2].

CKD during pregnancy increases the risk of adverse perinatal outcomes, including preeclampsia, preterm birth, intrauterine growth restriction (IUGR), neonatal death, low birthweight, small for gestational age (SGA) newborns, increased neonatal intensive care unit admission and complications associated with prematurity[3,4]. These risks rise with advancing CKD stage[4]. Despite limited data on nutrition care in these women, it’s a crucial component of multidisciplinary treatment[5]. Medical nutrition therapy (MNT) is recommended for adults with CKD (stages 1-5) and should be offered by a clinical nutritionist with close collaboration with a physician[6]. Nutrition therapy is associated with an improvement in nutrition and metabolic status, a reduction in complications, the preservation of residual kidney function, and the promotion of fluid and electrolyte balance, among others[6,7]. Adequate energy, protein consumption, and

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optimal micronutrient intake are important nutritional goals in these patients. Protein restriction (0.55-0.60 g/kg/d) in stages 3-5 CKD is advised, associated with reduced disease progression, death prevention, and improved quality of life[6], however, some controversy exists[8] about the benefits of low protein diets since these could be the result from a combination of additional strategies, such as the type of protein. KDIGO 2012 guideline states that dietary protein intake <0.8 g/kg/day did not offer any advantage and recommends 0.8 g/kg per day when glomerular filtration rate (GFR) <30 mL/min per 1.73m2 in non-diabetic metabolically stable patients with pre-dialysis CKD[9]. This recommendation is considered a safer option to prevent protein-energy malnutrition when alpha-keto analog supplementation is not used. Different dietary interventions have generally been associated with reduced systolic and diastolic blood pressure, and higher GFR and albumin level in CKD patients[10]. Plant-based diets (PBD) are nutrient-dense, high-fiber, and lower in protein. Recently, PBD have been recognized as an effective dietary strategy where improvements in nitrogen balance, acid-base metabolism, metabolic control (glucose, lipid profile, insulin resistance), bone mineral metabolism disorders, and proteinuria have been reported[9,11].

In a retrospective study, a group of pregnant women who received a PBD as intervention showed a lower risk of preterm birth and SGA newborns[12]. In a previous case report, nutrition care with a controlled, unprocessed, healthy diet successfully avoided hemodialysis (HD) in a CKD (stage 5) pregnant woman[13].

This case series aims to describe clinical and metabolic status, renal function during pregnancy, and the incidence of adverse perinatal outcomes in a group of pregnant women with CKD (stages 3-5) who received intensive medical and nutrition care, including a PBD and individualized micronutrient supplementation. Only single case studies exist describing outcomes in CKD pregnant women receiving a nutrition intervention.

METHODS

Case series presentation

We performed a retrospective chart review of pregnant women with CKD who received medical and nutrition treatment. This report adheres to the confidentiality guidelines of our institution's Ethics Committee and National regulation on data privacy.

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Case identification and eligibility

Cases were identified through institutional medical records of pregnant women attended between August 2019 and November 2021. Eligible cases were defined according to the following criteria: women aged ≥18 years with a confirmed diagnosis of CKD stages 3–5 who had been referred to the Nutrition Coordination for Medical Nutrition Therapy (MNT). From the available records, cases were included if they had completed at least three specialized nutrition visits and had complete perinatal follow-up data. Records with incomplete follow-up or corresponding to patients who initiated dialysis prior to the nutritional intervention were excluded. CKD was defined as an estimated glomerular filtration rate (eGFR) <60mL/min/1.73m2 or the presence of markers of kidney damage persisting for >3 months[9].

Clinical Timeline and Intervention

Medical care was provided by a dedicated obstetric nephrologist, while MNT was administered by a clinical dietitian following a standardized protocol: 1) Initial nephrology and nutrition assessment (baseline) at diagnosis; 2) regular MNT follow-up visits every 2-4 weeks for dietary adjustment and metabolic monitoring; 3) Hospitalization for intensive monitoring in specific cases; 4) Delivery with neonatal anthropometric assessment.

Medical Nutrition Therapy

Medical nutrition therapy consisted of intensive counseling, including dietary recommendations (plant-based diet), micronutrient supplementation, and education delivered through a behavioral approach (goal-setting and problem-solving). Energy and protein requirements were estimated based on pregestational weight, using 25–35 kcal/kg/day and adding the energy cost of pregnancy (+340kcal/d in the second, and +452kcal/d in the third trimester)[5,6]. Protein intake was estimated at 0.6–0.8 g/kg/day, with additional requirements for pregnancy (+9g/d and +31g/d in the second and third trimesters, respectively)[5]. All patients were supplemented with folic acid, iron, calcium, vitamin D3, and other nutrients through a multivitamin. Any additional individual micronutrient supplementation was prescribed in consultation with the nephrologist.

An individualized plant-based dietary (PBD) pattern was recommended, defined as a dietary approach emphasizing a high proportion of foods derived from plant sources—such as whole grains, legumes, fruits, vegetables, nuts, seeds, and plant oils—while limiting animal-derived

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products. Plant-based diets represent a spectrum of dietary patterns (e.g., Mediterranean, DASH), characterized by the predominance of minimally processed plant foods rather than the complete exclusion of animal products[11,14]. In the context of chronic kidney disease (CKD), this approach was adapted to achieve moderate protein restriction, with a reduced contribution of animal protein and an emphasis on nutrient-dense, fiber-rich foods. This dietary pattern was tailored to a traditional Mexican dietary context, promoting the use of locally available foods and customary dishes (e.g., corn-based products, legumes, fruits, vegetables, seeds, oils, and avocado), in order to enhance cultural acceptability and feasibility.

Individual energy and protein prescriptions were calculated for each patient based on pregestational weight and gestational stage, and portion sizes were accordingly individualized. Animal-derived foods were limited to a maximum of two servings per day of dairy products and/or eggs, while oily fish was recommended up to twice per week as an alternative protein source. Red and processed meats were discouraged. Patients were advised to avoid sugar-sweetened beverages and soft drinks. Added sugars were restricted to <25g/day. The overall dietary approach emphasized whole, minimally processed foods and discouraged ultra-processed products.

This dietary pattern was recommended as part of the intervention; however, actual intake could not be objectively verified. At each visit, usual intake was qualitatively explored, and perceived adherence to recommendations was self-reported on a 0–100% scale. No standardized dietary assessment tools (e.g., 24-hour dietary recalls or food records) were available, precluding objective quantification of dietary intake and adherence. Barriers and facilitators, including socioeconomic and cultural factors, were addressed to tailor recommendations throughout follow-up.

Maternal CKD assessment

Renal function, clinical, nutritional, and metabolic status during pregnancy were obtained from medical records. We present sociodemographic characteristics, clinical data (diagnosis, blood pressure), renal function status (serum creatinine–SCr–, albumin, serum urea nitrogen-SUN, proteinuria), and weight status (pregestational body mass index–pBMI–, gestational weight gain) at baseline and follow-up. The need for HD was registered as a primary outcomes.

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Perinatal outcomes

Maternal gestational conditions, such as preeclampsia (ACOG criteria[15]), gestational diabetes mellitus (GDM) (International criteria[16]), preterm birth (deliveries <37weeks), and hospitalization, were extracted from institutional records. Fetal outcomes documented included IUGR (Fetal weight/gestational age <3 percentile or <10 percentile with placental blood flow alterations[17]) and fetal loss. Neonatal outcomes included low birth weight (LBW), small for gestational age (SGA), wasting, stunting, low head circumference for age (HC/A), and NICU admission.

Newborn assessment

Newborn weight, length, and head circumference were measured by attending neonatologists and obtained from institutional records. LBW was defined as birthweight <2500g. Nutrition indices were assessed using World Health Organization (WHO) criteria for term infants and Intergrowth-21st criteria for preterms[18]. SGA was classified as a weight for age <-2 z-scores, wasting as weight for length (W/L) <-2 z-scores, stunting as length for age (L/A) <-2 z-scores, and a high risk of neurodevelopment delay as HC/A <-2 z-scores.

Medical Management

An initial exhaustive medical history and physical examination were conducted. Women were inquired about their pregestational SCr or renal function assessment; none knew their previous status. Detailed physical examination and blood pressure (BP) measurements were performed at each visit. Additionally, self-monitoring of BP at home was requested and evaluated at each visit, with a BP goal <140/90 mmHg, ideally <135/85mmHg[9].

Laboratory tests were requested biweekly approximately, including a complete blood count, metabolic and lipid panel, 24-hour proteinuria, and other individualized parameters (e.g., parathyroid hormone, vitamin D). Based on laboratory results, iron deficiency was corrected, with variable doses of erythropoietin initiated to maintain hemoglobin (Hb) levels above 11mg/dL[9]. Individualized iron supplementation doses were prescribed. Acid-base evaluation with CO_2 was monitored every 3-4 weeks to adjust individual oral sodium bicarbonate doses.

During the consultation, edema was clinically evaluated, and a low-dose loop diuretic was started when required, always considering the amniotic fluid index (AFI). In specific cases (cases 1 and

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3), cation exchange resins were added to diuretics for potassium management. Our interdisciplinary team closely monitored all patients, maintaining effective communication in case of any change in clinical evolution.

RESULTS

Case series presentation.

Overall, three key patterns emerged from the data: (1) maternal renal function remained stable without the need for dialysis, (2) metabolic parameters were generally maintained within target ranges, and (3) neonatal outcomes reflected the high-risk profile of CKD pregnancies, including low birth weight and prematurity, but with all live births and relative preservation of length-for-age and head circumference-for-age in most newborns.

<u>*Maternal description*</u>

We included 7 women in this analysis. Overall, maternal clinical evolution was characterized by stable renal function and relatively controlled metabolic parameters despite advanced CKD. Table 1 presents sociodemographic data and clinical diagnoses of the studied women. Most women were classified with stage 4-CKD (n=6) and one woman with stage 3-CKD. Mean age was 32.14±4.14 years (range: 28-39 years). Most were housewives (n=6) residing in areas close to Mexico City (Estado de México and Hidalgo) (n=5). Three women completed high school, while the remaining had lower education level. Multiparity was common (n=6). The mean p-BMI was 24.78±3.62kg/m2; with four women classified as normal weight (57.1%), and three as overweight.

<u>*Clinical course of pregnant women with CKD*</u>

The mean gestational age at the first MNT visit (baseline) was 23.70±5.09weeks (range: 15.4-30.5). MNT visits range from 3 to 7; 85% (n=6) of women assisted to at least four visits. Self-reported adherence to MNT recommendations was 85.7%; based on participants' subjective estimates. The institutional records lacked documentation of dietary recalls, therefore, assessing these women's quantitative/qualitative dietary intake data was not possible.

Nutritional management included individualized micronutrient supplementation. Folic acid doses ranged from 400mcg/d to 6mg/d; three women received ≥5mg/d. Four women received 20-

60mg/d of iron; one required 300mg of IV iron in the second trimester. The other three women received >100mg/d of supplemental iron. Only two women received <1000mg of calcium supplementation (440-1750mg/d). Three women received ≤400IU/d of vitamin D, most doses ranged from 800-1600IU/d. Omega-3 supplementation was prescribed in four women (300mg/d to 2g/d).

Most women received ambulatory treatment. Two women required prolonged hospitalization (65 and 66 days) due to clinical severity and were initially considered candidates for HD. However, HD was not initiated, and both were managed with intensive dietary intervention and close medical monitoring, taking into account clinical judgment as well as contextual factors, including socioeconomic and housing conditions.

Renal and metabolic parameters remained relatively stable throughout pregnancy. No women required HD treatment. Table 2 shows eGFR values for women at their first and last visits. Five women maintained or decreased bicarbonate doses. BP remained within target range in most women except one with a peak of 145/95mmHg (Table 3). Respecting renal function markers, five women (71%) decreased or maintained baseline SCr, and five (71%) had a peak SCr ≤3.0mg/dL during pregnancy. Mean SUN in the third trimester was 31.30±11.34mg/dL (19.0-52.60mg/dL); a peak SUN <35mg/dL were observed in 4/7 women, while 6/7 had a peak SUN <50mg/dL. Highest albumin ranged from 2.9-3.6g/dL; mean serum albumin in the third trimester was 2.97±0.09g/dL. All women presented proteinuria at the first MNT visit; peak proteinuria during pregnancy ranged from 2168 to 8250mg/24h (Table 4).

Gestational weight gain in the last visit (third trimester) ranged from 6.4 to 12.9kg (Table 3). Most women (n=5) maintained glucose <100mg/dL throughout pregnancy; in the third trimester, one woman had 109 mg/dL, and another had 144mg/dL. Peak triglycerides were 349-627mg/dL in the second or third trimester (Table 3). Peak serum sodium ranged from 132 to 139mEq/L and peak potassium from 4.9 to 5.6mEq/L (Table 4). Four of six women had Hb<10mg/dL in the second trimester. All women showed an increase in Hb values in the third trimester.

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Table 1. Clinical and sociodemographic data of included women.

Case No.	Age (years)	Educational Level	Place of Residence	Occupation	Parity	CKD classification (KDIGO)	Etiology	Other comorbidities
1	39	None	Oaxaca	Housewife	Multiparous	4 A3	Unknown	Chronic systemic hypertension, anemia
2	36	Elementary School	Hidalgo	Housewife	Multiparous	4 A3	Advanced global glomerulosclerosis, (kidney biopsy during pregnancy). Unknown	Chronic systemic hypertension, anemia
3	33	Junior High	Oaxaca	Housewife	Multiparous	4 A3	Unknown	Secondary hyperparathyroidism, history of right cephalic vein thrombosis
4	31	High school	Estado de México	Employee	Multiparous	4 A3	Unknown	Chronic systemic hypertension, anemia
5	28	Junior High	Hidalgo	Housewife	Multiparous	4 A3	Unknown	Chronic systemic hypertension
6	28	High school	Hidalgo	Housewife	Multiparous	3 A2	Unknown + Nephrectomy	History of preeclampsia, anemia
7	30	High school	Estado de México	Housewife	Multiparous	4 A3	Unknown	Chronic systemic hypertension

CKD: Chronic kidney disease
KDIGO: Kidney Disease: Improving Global Outcomes

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Table 2. Estimated renal disease progression according to serum creatinine values in studied women.

Case No.	SCr (first visit) mg/dL	eGFR (first visit) mL/min/1.73 m^2	SCr (last visit) mg/dL	eGFR (last visit) mL/min/1.73 m^2
1	3.41	17	3.8	15
2	2.2	29	3.06	20
3	2.6	24	2.2	30
4	2.38	27	2.46	26
5	3.25	19	2.63	25
6	2.1	32	1.9	36
7	2.7	24	2.6	25

SCr: serum creatinine; eGFR: estimated glomerular filtration rate
Note: Conversion factors for units: SCr in mg/dL to µmol/L, ×88.4

Table 3. Weight status, blood pressure and metabolic markers in studied women.

		Gestational weight gain		Blood pressure		Glucose		Triglycerides	
Case No.	Pregestational BMI (Weight status)	2nd trimester kg	3rd trimester kg	1st visit mmHg	Peak mmHg	1st visit mg/dL	Peak mg/dL	1st visit mg/dL	Peak mg/dL
1	Normal weight	2	6.4	115/67	118/84	69	141	304	369
2	Normal weight	2.8	5.4	116/77	136/86	68	76	645	627
3	Normal weight	6	7.4	110/70	120/60	86	120	413	387
4	Overweight	3.4	2.8	128/85	-	87	79	402	371
5	Overweight	-	8.8	116/77	145/95	109	95	566	554
6	Normal weight	9.8	12.9	137/80	137/87	72	92	194	349
7	Overweight	5.3	4.7 k	114/76	129/85	78	85	310	422

BMI: Body mass index
Note: Conversion factors for units: Glucose in mg/dL to mmol/L, ×0.05551; Triglycerides in mg/dL to mmol/L, ×0.01129

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Table 4. Renal and clinical outcomes of women with chronic kidney disease.

	SCr		Proteinuria		Serum Urea Nitrogen		Albumin		Potassium		Sodium	
Case No.	1st visit mg/dL	Peak mg/dL	1st visit mg/24h	Peak mg/24h	1st visit mg/dL	Peak mg/dL	1st visit g/dL	Peak g/dL	1st visit mEq/L	Peak mEq/L	1st visit mEq/L	Peak mEq/L
1	3.41	4.67	2178	2168	29.9	63.1	2.8	3.6	4.5	5.4	137	138
2	2.2	3.06	4850	5460	31.8	41.1	3.0	2.9	4.7	4.9	137	136
3	2.6	2.6	8688	-	41.1	32.7	3.2	3.0	4.7	5.6	138	138
4	2.38	2.81	8665	8250	29.4	33.2	3.0	3.1	4.9	5.2	134	136
5	3.25	3.16	4680	4653	34.1	36.9	3.1	3.4	4.7	5.0	135	133
6	2.1	2.2	2100	6440	24.3	33.6	3.3	3.5	4.2	5.0	136	140
7	2.7	3.0	635.6	5114	33.6	34.6	3.3	3.2	4.4	5.0	136	139

SCr: serum creatinine
Note: Conversion factors for units: SCr in mg/dL to μmol/L, ×88.4; serum urea nitrogen in mg/dL to mmol/L, ×0.357

Perinatal outcomes

Perinatal outcomes were characterized by a high frequency of prematurity and wasting at birth consistent with the high-risk profile of CKD pregnancies. One woman developed preeclampsia, and GDM was not present. Gestational age at birth averaged 37.0±1.86weeks. Three babies (42%) were preterm (<37weeks), including one early preterm (<34weeks). IUGR affected three fetuses; no fetal losses occurred. All babies were born alive; with mean birthweight of 2375.42±399.52g, mean length of 47.57±2.76cm, and mean HC of 32.71±0.69cm. Five babies (71%) were classified as LBW one as SGA, and four were malnourished (wasting). One baby presented stunting and none of them had low HC/A. Two babies required NICU hospitalization.

DISCUSSION

This case series describes stable renal function and perinatal outcomes within the expected spectrum for CKD pregnancies in women receiving intensive multidisciplinary care, which included the recommendation of a plant-based dietary pattern and individualized micronutrient supplementation**.** Renal function remained stable, with no requirement for hemodialysis, and no

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cases of gestational diabetes or fetal loss were observed; one woman developed preeclampsia. Neonatal outcomes reflected the high-risk nature of CKD pregnancies, with a high frequency of prematurity, low birth weight and wasting, although length-for-age and head circumference-for-age were preserved in most cases.

These findings should be interpreted in the context of the well-documented increased risk of adverse maternal and neonatal outcomes in CKD pregnancies, particularly in advanced stages. Although available evidence remains limited, previous studies have reported high rates of preeclampsia, preterm birth, and fetal growth restriction in this population [3,4]. Therefore, the outcomes observed in our series should not be interpreted as optimal, but rather as occurring within the expected clinical spectrum for this high-risk group. CKD during pregnancy, particularly stages 3-5, often leads to renal function decline and increases the risk of multiple adverse maternal, fetal, and neonatal outcomes. Preeclampsia prevalence in these women can exceed 40%, while gestational diabetes mellitus affects approximately 12%[19]. Preterm and early preterm birth rates may exceed 30% and reach up to 13%, respectively[4]. Preventing these complications is associated with a better intrauterine environment (better metabolic and hormone status, lower inflammation and oxidative stress, lower infection risk), which promotes optimal fetal growth and mitigates the risk of chronic diseases later in life[20].

One of the main objectives in managing CKD is to delay HD and sustain residual renal function by reducing urea generation[9]. HD poses significant health risks for CKD patients, and despite recent protocol improvements in pregnancy, it still carries notable risk (cervical shortening, incompetence, heightened preterm risk, mother-child morbidity)[21]. None of the studied women required HD, and their eGFR remained stable. The treatment target for CKD pregnancies is near-normal SUN levels (<40-42mg/d)[22]. Six women in our sample achieved this goal. Five women lowered or maintained their SCr from baseline to the end of pregnancy. Although proteinuria typically increases in pregnant women, especially those already proteinuric[23], it remained relatively stable in our sample. He et.al, identified higher creatinine and proteinuria as significant risk factors for adverse kidney outcomes, including renal failure, even up to 4 years post-pregnancy[24]. The clinical implications of maintaining stable renal function and avoiding HD in women with advanced CKD are clinically relevant. In our series, renal function remained stable

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and no patients required dialysis, in the context of close multidisciplinary management that included intensive medical monitoring and a plant-dominant dietary pattern. Although causality cannot be inferred, these findings are consistent with previous reports suggesting that, even in advanced CKD, carefully supervised nutritional interventions may contribute to delaying the initiation of renal replacement therapy. Avoiding dialysis during pregnancy may be clinically relevant, given the potential risks associated with intradialytic hemodynamic instability and electrolyte shifts that could affect fetal perfusion[23].

Two women in the study (cases #1 and #3) were hospitalized after being referred from Oaxaca (southeast state in Mexico and one of the most economically marginalized). Despite being candidates for ambulatory HD, their very low socioeconomic and inadequate housing conditions, lead the medical team to opt for conservative management. They continued a PBD with full adherence during hospitalization. Both women maintained a reasonably good clinical status and renal function throughout pregnancy. This highlights the potential need for alternative strategies in low and middle-income countries where poverty, food insecurity, and poor housing conditions prevail. Efforts to improve medical intervention are crucial, requiring an interdisciplinary approach involving nephrologists, high-risk obstetricians, nutritionists, and neonatologists, particularly in situations where the body's physiological and compensatory mechanisms allow for avoidance of HD during pregnancy.

Since we delivered a multi-component nutrition and medical treatment, we cannot relate the outcomes to a specific component. Our descriptive design precluded evaluating the isolated effect of the moderate protein-restricted PBD. Nevertheless, previous evidence in CKD pregnancies suggests that moderate protein restriction may have beneficial effects. Low-protein diets have been associated with improved control of hyperfiltration and proteinuria, potentially delaying the need for HD[23]. A case reported by Nava et.al. showed that a low protein diet supplemented with alpha-keto analogs postponed HD initiation during pregnancy[25]. Similarly, moderate protein-restricted PBDs have been associated with stable or reduced creatinine levels and lower urea concentrations without apparent detrimental effects on fetal growth[23]. A large dietary intervention study in CKD pregnancies receiving moderate protein-restricted PBD

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reported a lower incidence of preterm and SGA babies compared to controls (combined outcome: 61.54% versus 80.77%; p=0.03)[12].

In addition, evidence from non-pregnant CKD populations provides mechanistic plausibility for these findings. Plant-based diets have been associated with reduced generation of uremic toxins, improved acid–base balance, decreased intestinal phosphorus absorption, and potential preservation of glomerular filtration rate through reductions in inflammation, oxidative stress, and proteinuria. The higher fiber content of PBDs may also promote a more favorable gut microbiota profile, contributing to lower production of gut-derived uremic compounds[11]. However, protein restriction during pregnancy remains a topic of ongoing debate. Concerns persist regarding its potential impact on fetal growth, particularly in the absence of rigorous nutritional monitoring[26,27]. Therefore, the balance between maternal metabolic control and adequate fetal nutrient supply requires careful, individualized assessment, especially in high-risk populations such as women with advanced CKD.

Neonatal outcomes in this case series reflected the high-risk profile of pregnancies complicated by CKD. A high frequency of low birth weight, prematurity, and wasting was observed, consistent with previous reports in this population[3,4], and suggestive of fetal growth restriction, a well-recognized complication in CKD pregnancies. Importantly, all pregnancies resulted in live births, although this finding should be interpreted cautiously given the small sample size and descriptive nature of the study. While birthweight is commonly used to assess neonatal nutritional status, it does not provide information on body composition or proportional growth. In this context, additional anthropometric indicators such as weight-for-length and length-for-age are important to characterize growth quality, as they reflect different biological responses to suboptimal nutrient supply[28,29]. In our study, although wasting was frequent, length-for-age and head circumference-for-age were preserved in most newborns, suggesting variability in growth patterns. Head circumference-for-age is a particularly relevant indicator, as it reflects early brain growth and neurodevelopmental potential. Despite the high-risk profile, no cases of low head circumference were observed. In addition, only one newborn presented stunting at birth. Stunting reflects impaired longitudinal growth, and suggests poor maternal nutrition or health throughout a significant portion of pregnancy, which is consistent with the underlying maternal

CKD. Stunting is a relevant nutritional status indicator, considering it has been associated with adverse developmental outcomes and increased risk of metabolic dysfunction later in life[30]. Previous reports have described adequate neonatal anthropometric outcomes in selected cases receiving intensive multidisciplinary care[31]. It should be noted that data on wasting and stunting in CKD pregnancies remain scarce, highlighting the relevance of reporting these indicators beyond birthweight alone.

Data regarding electrolyte status and metabolic parameters (glucose, lipids) in CKD pregnancies are limited[31]. This group showed relatively stable electrolytes, glucose, and triglycerides. All women had adequate control of hyperkalemia. While there's no data on the impact of a PBD on electrolytes during pregnancy, our population exhibited benefits observed in non-pregnant adults with CKD stages 3-5 without dialysis, maintaining stable electrolyte concentrations without dietary potassium or phosphorus restriction[32].

Effective dietary interventions require patient commitment for adherence. In these women, self-reported diet adherence was high (85.7%); with most reporting ≥90%. Following a CKD diet may be challenging; a PBD offers flexibility, enhancing acceptance and commitment. Recommending culturally accepted foods and traditional dishes likely positively influenced adherence due familiar flavors, easy preparations, and affordability. Our proposed diet emphasizes whole grains, legumes, fruits, vegetables, seeds, oils, and avocado, with some dairy, eggs, and oily fish. Traditional PBD aligns with public health priorities for sustainable, environmentally conscious dietary practices, essential for global food system transformation.

Intensive nutritional counseling and education are essential for promoting dietary adherence as well as supporting and accompanying women through behavioral change. All cases received intensive counseling focusing on addressing individual barriers and developing skills. Common barriers include insufficient nutrition education/guidance, restricted time during medical appointments, concerns about non-compliance, and potential relapse. All medical team members should receive training on CKD-specific dietary challenges, with dietitians ideally integrated into the multidisciplinary team[33]. MNT holds a secondary position vs the medical/pharmaceutical treatment. However, given its role in treating, preventing, or mitigating symptoms, MNT should be a fundamental element in CKD management[34].

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From a clinical perspective, these findings highlight the potential role of structured, multidisciplinary care in the management of high-risk pregnancies complicated by CKD. Although causality cannot be inferred, the observation of stable renal function without the need for dialysis suggests that, in selected patients, close monitoring combined with individualized nutritional strategies may contribute to maintaining metabolic stability during pregnancy. Importantly, neonatal outcomes in our series—particularly the high prevalence of LBW and prematurity—are consistent with previous reports in CKD pregnancies, reinforcing that fetal growth restriction remains a central clinical challenge in this population. These findings underscore the need for careful fetal surveillance and individualized nutritional and medical management to balance maternal and fetal risks.

This study has several limitations that should be considered when interpreting the findings. First, the small sample size (n=7) limits the generalizability of the results and precludes any statistical inference, restricting the conclusions to descriptive observations within this specific cohort. In addition, most women had stage 4 CKD, which may have influenced the clinical course and the urgency of decisions regarding dialysis initiation. Second, the retrospective design introduces the possibility of information bias and limits the ability to control for potential confounders that may have affected both maternal and neonatal outcomes. A key limitation of this study is the lack of objective dietary assessment. No standardized methods (e.g., 24-hour dietary recalls or food records) were available, which precludes the precise quantification of actual dietary intake, including protein and micronutrient consumption (e.g., potassium, phosphorus). Additionally, adherence was based on self-reported estimates, which is subject to recall bias and social desirability bias. Therefore, the outcomes should be interpreted as results of the recommendation of a plant-based diet within an intensive care model, rather than a strictly measured intake. Finally, economic constraints resulted in incomplete laboratory data in some cases, limiting a more comprehensive metabolic and nutritional evaluation. These limitations underscore the need for prospective studies with larger sample sizes and rigorous dietary assessment to better understand the role of nutritional interventions in CKD pregnancies.

CONCLUSION

In this case series of women with CKD stages 3–4, stable renal function and perinatal outcomes within the expected range for this high-risk population were observed in the context of intensive multidisciplinary care delivered by perinatal nutritionists, nephrologists, and obstetricians. A culturally adapted plant-based dietary pattern with individualized micronutrient supplementation may represent a feasible nutritional strategy for this high-risk group. More studies are needed to assess this type of intervention in this selected group, reporting clinical, biochemical and relevant newborn nutritional status outcomes.

AUTHORS' CONTRIBUTIONS

O.P-P conceptualized and designed the study, coordinated the project, supervised methodological development, participated in data analysis and interpretation, and led manuscript validation. L.I-G and M.F-R provided nutritional care and supported data collection. A.O-G was responsible for medical care and contributed to manuscript drafting. J.H-C and L.H-H contributed to data curation and analysis, as well as to results visualization. M.R-B provided clinical resources and critically reviewed the manuscript. A.M.R-C participated in data curation and visualization, contributed to manuscript drafting and editing, and supported data interpretation. All authors critically reviewed and approved the final version of the manuscript.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest in the preparation of this manuscript.

DATA AVAILABILITY

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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