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Factors associated with chronic kidney disease of non-traditional causes among children in Guatemala

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ABSTRACT

Objective. To identify factors associated with chronic kidney disease of non-traditional causes among children in Guatemala.

Methods. A cross-sectional survey was conducted. The study population was all pediatric patients with stage 5 chronic kidney disease active in FUNDANIER's pediatric nephrology unit (*N* = 156). Simple random sampling led to a total of 100 participants. Data collection consisted of a questionnaire addressing individual and household characteristics, access and utilization of health care, and place of residence when the disease began. Chronic kidney disease etiology was obtained from medical records. Municipality-level secondary data were collected. Descriptive statistics were estimated. Logistic regression was used for bivariate and multivariate analysis.

Results. The odds ratio (OR) for almost all variables approached 1. Notable exceptions in household characteristics were mother's education level up to primary school (OR 2.2727) and living in an urban setting when symptoms began (OR 0.4035). Exceptions in municipal characteristics are zones with intensive small-scale agriculture (OR 3.8923) and those with intensive large-scale agriculture (OR 0.3338). *P*-values and confidence intervals show that the sample was not big enough to capture statistically significant associations between variables.

Conclusions. Study findings suggest that factors associated with chronic kidney disease of non-traditional causes among children in Guatemala are intensive agricultural practices in their municipality of residence, and mother's level of education. Future research in children could use case-control designs or population-based studies in agricultural communities. Public health interventions that involve kidney function screening among children are recommended.

Keywords Renal insufficiency, chronic; kidney failure, chronic; risk factors; child health; epidemiology; Guatemala.

In the past four decades, chronic kidney disease (CKD) has increased worldwide so extensively that some consider it a pandemic (1). CKD can lead to renal failure that is treatable only by peritoneal dialysis, hemodialysis, or renal transplantation, all of which come with important financial burdens and social impacts. The worldwide rise in CKD cases is attributable to the increased number of people living with diabetes and high blood pressure. Other, less common causes such as infection, injury, and exposure to toxins from drugs, herbal supplements, or environmental pollution are on the rise and affect primarily male agricultural workers between their 20s and 50s (2, 3). There is documentation that these less common causes may affect women, children, and men who do not directly work in agriculture (3, 4), a trend documented mainly in Central America and Sri Lanka, with additional reports from Egypt, India, Mexico, and Sudan (1, 2, 4). Although the disease has been given different names, such as CKD of unknown cause, Central American nephropathy, Sri Lankan nephropathy,

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Uddanam nephropathy (India), chronic interstitial nephritis in agricultural communities, and El Salvador nephropathy (1–5), the Pan American Health Organization (PAHO) has recommended to consider them all as possibly the same disease, and to call it CKD of non-traditional causes (CKDnT) (3). In Central America, CKDnT is a public health priority because it has reached epidemic proportions (3). The cause of CKDnT remains unknown, although available evidence shows that its main driver is occupational heat stress (5). Possible causes under study include heat exposure, exposure to pesticides, consumption of water containing heavy metals, overconsumption of anti-inflammatory medications, tobacco use, inadequate hydration, infections (leptospirosis, hantavirus, malaria), low birthweight, and genetic predisposition (3, 4). Most researchers attribute CKDnT to multifactorial causes, with an interplay of repeated heat exposure and poor hydration working in synergy with exposure to toxins and infectious agents to damage the kidneys (1–3). In adults, signs and symptoms may include fatigue, fainting, cramps, joint pain, polyuria, dysuria, foamy urine, hypotension, normal fundoscopy, vascular irregularities of lower limbs, altered neurological reflexes, and hearing loss. Characteristic laboratory findings are absence of severe proteinuria and markers of tubular damage. Renal histology shows evidence of chronic tubulointerstitial nephritis with glomerulosclerosis and mild chronic vascular changes (1–5).

Although the number of studies on CKDnT has been increasing in recent years, the information related to pediatric population is scarce. At the largest pediatric nephrology center in Guatemala, 43% of CKD cases were attributed to undetermined causes, the majority of which patients came from regions with documented cases of CKDnT in adults (6). In El Salvador, a descriptive epidemiologic study (7) among children under 18 years in three agricultural regions with known high prevalence of CKDnT identified a CKD prevalence of 3.9%. In Nicaragua, a cross-sectional study (8) of teenagers from four schools compared regions hypothesized to have different levels of environmental exposures leading to kidney injury at a young age. The four schools were located in communities that differed in overall CKD mortality, types of predominant agricultural activity, and altitude. Levels of kidney injury were significantly higher among participants who came from the school located in a community where adults primarily work in sugar cane plantations. No additional studies focusing on risk factors of CKDnT have been identified in the literature (1–5).

In Guatemala, the estimated prevalence and incidence of CKD among children are 4.9 and 4.6 per million age-related population, respectively (6). The country's capacity to comprehensively treat children with CKD through its public health care system was solidified in 2003, when parents of children with CKD created the Fundación para el Niño Enfermo Renal (Foundation for Children with Kidney Disease, FUNDANIER) (9, 10). Since its inception, FUNDANIER has supported a pediatric nephrology unit at one of the country's tertiary-level referral hospitals in Guatemala City, and it has helped found the country's only pediatric kidney replacement therapy program. FUNDANIER's pediatric nephrology unit receives patients from all over the country, accepts walk-ins and referrals by any health care provider, does not charge patients for any medical fees for services or donated products, and sometimes covers lodging costs for families in need. Given its location in Guatemala City, patients from rural areas may face geographic and associated financial barriers to access. While pediatricians and general practitioners see common renal problems, it can be assumed that the great majority of pediatric patients with advanced CKD are eventually seen in FUNDANIER's pediatric nephrology unit.

The goal of this study was to identify factors associated with CKDnT among children in Guatemala at the individual, household, and community levels, with a special emphasis on elucidating the role of access to health care services and environmental factors suggested by previous research (6).

MATERIALS AND METHODS

Research design

A cross-sectional survey was designed to determine factors associated with CKDnT. Independent variables were defined using a conceptual model based on three complementary sources. First, causal models derived from reviews of literature on CKDnT, which emphasize certain environmental exposures related to temperature, altitude, and exposure to agrochemicals (1–4). Second, the behavioral model of health services use, which categorizes predisposing, enabling, and need factors associated with access and utilization of health care services (11, 12). Third, published sources that describe factors which affect access to health care in Guatemala (13). Independent variables identified through these sources were organized in a conceptual framework with factors at the individual, household, and municipal levels.

Population and sample

The study population was the total of pediatric patients with stage 5 CKD who were active at the end of July 2015 in the clinical database of FUNDANIER's pediatric nephrology unit (N = 156). The population included patients identified in the FUNDANIER database classified as stage 5 CKD, using the guidelines of the National Kidney Foundation's Kidney Disease Outcome Quality Initiative (KDOQI), if they showed an estimated glomerular filtration rate (eGFR) of <15 mL/min/1.73m^2, or were on renal replacement therapy (14), with a documented etiology for CKD, and who were accompanied by a parent or guardian. A sample size of 90 was estimated through simple random sampling, with an alpha of 0.05 and a proportion of CKDnT cases in the population of 84% based on FUNDANIER's database. A decision was made to aim at recruiting 105 participants, with the goal to account for incomplete information in patient medical records.

Data collection

Participants were recruited after their appointments in FUNDANIER's pediatric nephrology unit. Interviews were conducted between September 2015 and April 2016, in Spanish, in a private space, and consisted of a questionnaire that took between 20 and 30 minutes to administer by author LPMA. The questionnaire had been previously validated in five FUNDANIER patients with stage 4 CKD for comprehension, internal consistency, and duration. The questionnaire (available from authors upon request) consisted of 70 questions, addressing individual (e.g., age, sex, ethnicity, level of education) and household (e.g., income, parental level of education, primary

language) characteristics, access and utilization of health care (e.g., time to diagnosis, access to the clinic, home care), treatment adherence (for a separate analysis reported elsewhere) (15), and place of residence when the disease began. Additionally, data collected from medical records included CKD etiology (used for classifying the dependent variable), and KDOQI classification (used to confirm inclusion criteria).

Information about place of residence when symptoms began was used as a proxy for investigating the environmental and health care access factors in the conceptual model. Municipality-level data were collected on average temperature, average humidity, average evapotranspiration (16), total population, percentage of people dedicated to agriculture (17), number of health care facilities (18), and predominant use of land (19). Predominant use of land classifies municipalities into six agrarian zones: *zone 1* corresponds to intensive small-scale agriculture linked to distribution systems; *zone 2* refers to small-scale agriculture within regions dedicated to large-scale exports; *zone 3* describes marginal use of agriculture combined with seasonal work in other industries; *zone 4* refers to small-scale industries combined with multiple informal activities; *zone 5* corresponds to growing small-scale agriculture restricted by large-scale industries; and *zone 0* refers to metropolitan urban areas. As a general pattern (19), municipalities in agrarian zone 1 use intensive agriculture to compete in local and regional markets, while municipalities in agrarian zone 3 use agriculture for self-consumption. Municipalities in agrarian zone 2 have large plantations dedicated to export crops and surrounding communities dedicated to agriculture for self-consumption. Small-scale agricultural workers from zones 1 and 3 are often seasonal workers in plantations located in zone 2.

Data analysis

The dependent variable was classified as CKDnT if the medical records showed that etiological investigation had classified the final diagnosis as "CKD of undetermined cause," which FUNDANIER has been classifying for several years as those patients with renal ultrasound without hydronephrosis, cystography free of reflux, and no history suggesting nephritic or nephrotic syndrome. No data about biopsy diagnosis were collected. This definition is compatible with the PAHO definition for suspect case of CKDnT, defined as a person under 60 years of age with one abnormal result that meets the Kidney Disease Improving Global Outcomes (KDIGO) CKD criteria, and who has no history of type 1 diabetes, no history of hypertensive disease, and no history of other known causes of CKD (20). A database (available from authors upon request) was built with the questionnaire results and the additional municipality-level variables. Statistical analysis used STATA® 12.1 (StataCorp LP, College Station, Texas, United States of America). For each variable, descriptive statistics were estimated. Logistic regression was used for bivariate and multivariate analysis, using a 0.05 threshold to assess if associations were statistically significant.

Research ethics

Ethics approval was obtained from the Institutional Review Board at the University of Denver, and the ad-hoc research ethics committee at FUNDANIER. Written informed consent was obtained from parents or guardians accompanying minors who participated in this study, and written informed assent was obtained from minors between the ages of 7 and 17 years old. Consent, assent, and the interview were carried out in a private space. To guarantee participants' anonymity, personal identifiers, including names and clinical record identification, were not collected.

RESULTS

We approached every patient who arrived for clinic appointments until we recruited 105 participants. Five patients were excluded because they did not have a completed etiological investigation in their medical records. The remaining 100 patients were included in the study, of which 76 (76%) were classified as CKD of undetermined cause, and 24 (24%) had an identified etiology as follows: 14 (14%) congenital anomalies of the kidney and urinary tract—CAKUT (6 neurogenic bladder, 7 vesicoureteral reflux, 1 prune belly syndrome); 7 (7%) glomerulopathies (6 idiopathic glomerulopathies, 1 lupus nephritis); 1 (1%) tubulopathy; 1 (1%) hereditary nephritis (branchio-oto-renal syndrome); and 1 (1%) nephrolithiasis. All patients were receiving renal replacement therapy, including 40 (40%) on peritoneal dialysis, 25 (25%) on hemodialysis, while 35 (35%) patients had a transplant.

Fifty-four participants were female. Median age was 14 years, with 12 (12%) participants aged 6–9 years, 42 (42%) aged 10–14, and 46 (46%) aged 15–18 (mean age 13.66, minimum 6, maximum 18, standard deviation 3.09). Thirty-nine (39%) self-identified as indigenous, all participants (100%) spoke Spanish as their first language, although five (5%) also spoke an indigenous language. Sixty-six (66%) patients had attended up to primary school, 19 (19%) had attended secondary school, and 5 (5%) had attended high school or vocational school. Fifty-nine (59%) were attending school regularly.

Table 1 presents the household- and municipality-level variables most relevant to the analysis and discussion. Mothers were the primary caregiver for 72 (72%) patients, 11 (11%) had rotating care between relatives, 7 (7%) were taken care of by another member of the nuclear family, and 10 (10%) by aunts, grandparents, or neighbors. Eighty-five (85%) mothers spoke Spanish to the child participant, 10 (10%) spoke combined Spanish and an indigenous language, 1 (1%) spoke an indigenous language, and 4 (4%) did not respond to this question. Twenty-two (22%) participants lived less than 2 hours from the clinic, 47 (47%) 2–4 hours, 21 (21%) 4–6 hours, and 3 (3%) patients lived more than 6 hours away. Sixty-six (66%) participants used the public bus system for transport to clinic appointments, 13 (13%) used their family vehicle, and the rest (21%) used a combination of bus, taxi, and private vehicle. Sixty-seven (67%) participants lived in urban areas at the time of questionnaire administration. Twenty-three (23%) participants reported having moved their hometown due to their illness, to be closer to health care facilities, or to improve household sanitary conditions.

Municipalities where participants lived when symptoms started represent 44 out of the country's 340 municipalities, distributed in 15 departments (provinces) out of the country's 22 departments (Figure 1). Average annual rainfall in these municipalities ranges from 15 to 27.5 inches. Fifty-six (56%) participants came from municipalities with 20 inches of average

TABLE 1. Selected household- and municipality-level characteristics of research participants, Guatemala, September 2015–April 2016

Variables	Total (n = 100)	%
Household characteristics		
Lives in a city currently	**100**	**100**
No	33	33
Yes	67	67
Time to referral (days since first symptoms to referral to FUNDANIER)	**100**	**100**
1 week or less	14	14
Between 1 week and 1 month	38	38
Between 1 and 6 months	23	23
Between 6 months and 1 year	6	6
More than 1 year	19	19
Mother's level of education	**100**	**100**
No formal education	9	9
Attended up to primary school	53	53
Attended up to secondary school	14	14
Attended up to higher education	20	20
No answer	4	4
Household monthly income (US$)[a]	**100**	**100**
Less than $80	8	8
$80–200	29	29
$201–670	45	45
More than $670	11	11
No answer	7	7
Municipal characteristics		
Average temperature (ºC)	**100**	**100**
15–17.5	8	8
20	56	56
22.5–25	20	20
26–27.5	16	16
Primary health care facilities (per 100 000 population)	**100**	**100**
3 or fewer facilities	40	40
3–10	21	21
10.1–20	25	25
20.1–55	14	14
Percentage of EAP in agriculture (%)	**100**	**100**
20 or less	52	52
21–40	12	12
41–60	25	25
Over 60	11	11

Source: Prepared by the authors from study data.
EAP: economically active population
[a] Converted at 7.50 quetzals per 1 US dollar, rate for 13 August 2016 (www.banguat.gob.gt)

rainfall. While relative humidity in these municipalities was in the range 70%–85%, 94 (94%) participants originated from municipalities with relative humidity of 70%–75%.

From the time when symptoms started, participants reported waiting a median of 30 days to be referred to FUNDANIER (range 0–5 000 days, mean 421 days, standard deviation 92). Primary health care facilities in these municipalities ranged from 2 to 55 per 100 000 population.

The percentage of economically active population (EAP) dedicated to agriculture ranged between 2% and 88% in the municipalities where participants lived in when symptoms began. Participants lived in municipalities that fall under four out of the six agrarian zones described in the methods section (Table 2).

Bivariate analysis

Table 3 shows the results of the bivariate analysis. The odds ratios (OR) for all individual-level, most household-level, and most municipal-level characteristics approach 1. Exceptions to the category of household characteristics were mother's education level up to primary school (OR 2.2727), the type of place of residence (rural or urban), when participants' symptoms began (OR 0.4035), currently living in a city (OR 0.3241), and presence of several caregivers (OR 0.3304). Exceptions in municipal characteristics are agrarian zone 1 (OR 3.8923) and agrarian zone 2 (OR 0.3338). *P*-values and confidence intervals show that the sample was not big enough to capture statistically significant associations between variables.

Multivariate analysis

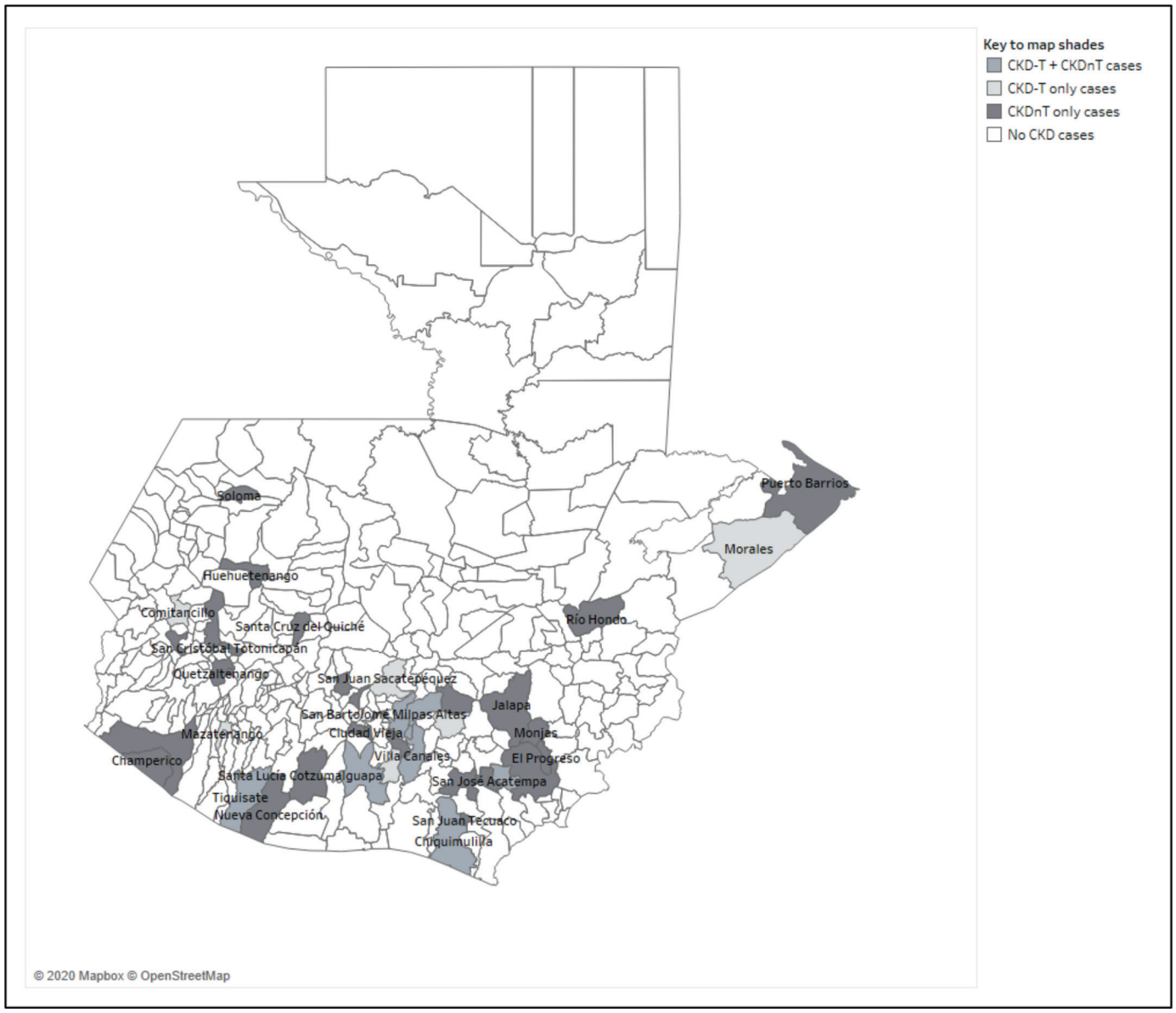
Table 4 presents results from the multivariate analysis where odds ratios are consistent with reported values from the bivariate analysis for patients with mothers who have education up to primary school, living in a city, and agrarian zones 1 and 2.

DISCUSSION

Results from this study are insufficient to conclude that any of the studied factors are associated with increased or decreased odds of having CKDnT at a statistically significant level. It is, however, important to offer an interpretation of non-significant results, in light of the research question, conceptual model, and current knowledge about CKDnT. While factors showing narrow confidence intervals point to more precise estimates, and factors showing wide confidence intervals point to more potential for random error, point estimates showing a tendency are worth examining further, keeping in mind that this study compared participants who already had stage 5 CKD and is not representative of the population as a whole.

Patients coming from agrarian zone 1 demonstrated an increased odds of CKDnT while zones 2 and 0 showed reduced odds of CKDnT. Evidence derived from research carried out in adults shows that working in plantations, similar to those defined in agrarian zone 2, is the main driver of CKDnT. Contrary to findings in adult patients, we show decreased odds of CKDnT in this zone. There is no clear insight into what may explain cases among children (4, 5). In adults, although some analyses point to a potential role of agrochemicals (1, 2) or heavy metals in water sources (3), results have been inconclusive. The role of agricultural work-related heat stress has been more thoroughly investigated and shows a clearer association with CKDnT (4, 5), opening up the question of whether its presence in children may signal that they also have been exposed to heat stress in working conditions (5). Contrary to our assumptions based on previous research on the topic (6), none of the variables measuring availability and utilization of health care services showed an association with CKDnT. Similarly, at the municipal level, the majority of environmental factors, such as temperature, humidity, and altitude, which are part of

FIGURE 1. Municipalities with chronic kidney disease of traditional (CKD-T) and non-traditional (CKDnT) causes in children, Guatemala, September 2015–April 2016



Source: Prepared by the authors from study data.

TABLE 2. Municipalities of residence of research participants when symptoms began, by agrarian zone and chronic kidney disease of non-traditional causes (CKDnT), Guatemala, September 2015–April 2016

Agrarian zone	Description	CKDnT (*n* = 100)			
		No	%	Yes	%
0	Metropolitan urban areas	4	4	8	8
1	Intensive small-scale agriculture linked to distribution systems	1	1	11	11
2	Small-scale agriculture within regions dedicated to large-scale exports	9	9	22	22
3	Marginal use of agriculture combined with seasonal work in other industries	10	10	35	35
4	Small-scale industries combined with multiple informal activities	0	0	0	0
5	Small-scale agriculture restricted by large-scale industries	0	0	0	0
	Totals	24	24	76	76

Source: Prepared by the authors from study data.

TABLE 3. Bivariate analysis of variables associated with chronic kidney disease of non-traditional causes in children, Guatemala, September 2015–April 2016 (*n* = 100)

Characteristics	Odds ratio	*p*-value[b]	95% confidence interval
Individual characteristics			
Age	1.0281	0.713	0.8870–1.1917
Female	0.9912	0.985	0.3946–2.4896
Indigenous	0.8395	0.727	0.3140–2.2441
Attends school	1.3713	0.504	0.5428–3.4645
Household characteristics			
Type of place, current residency	1.0057	0.135	0.9982–1.0131
Lives in a city	0.3241	0.059	0.1007–1.0433
Changed residency due to disease	1.1138	0.851	0.3621–3.4262
Type of place, residency when sick	0.4035	0.102	0.1360–1.1968
Mother studied up to primary school	2.2727	0.088	0.8840–5.8431
Mother studied up to secondary school	1.3809	0.563	0.4630–4.1189
Mother studied up to tertiary school	0.7391	0.792	0.0785–6.9549
Monthly income below US$ 80[a]	0.5469	0.435	0.1203–2.4850
Monthly income below US$ 200[a]	1.1382	0.791	0.4376–2.9606
Monthly income below US$ 670[a]	1.0893	0.906	0.2642–4.4909
Mother speaks only Spanish	1.1429	0.853	0.2775–4.7068
Mother is primary caregiver	1.1323	0.811	0.4091–3.1344
Several caregivers	0.3304	0.093	0.0909–1.2014
Time to referral	0.9996	0.127	0.9992–1.0000
Time to diagnosis	0.9826	0.495	0.9344–1.0333
Municipal characteristics			
Average temperature	1.0038	0.957	0.8743–1.1524
Relative humidity	0.9975	0.975	0.8541–1.1649
Evapotranspiration	0.9992	0.645	0.9960–1.0024
Percentage of EAP in agriculture	1.0096	0.334	0.9901–1.0295
Agrarian zone	1.0621	0.790	0.6813–1.6557
Agrarian zone 1	3.8923	0.205	0.4759–31.8367
Agrarian zone 2	0.3338	0.431	0.2590–1.7799
Agrarian zone 3	1.1951	0.707	0.4723–3.0243
Agrarian zone 0	0.5882	0.424	0.1604–2.1577
Agrarian zones 1 and 3	1.8121	0.208	0.7183–4.5715
Agrarian zones 1, 2, and 3	1.7000	0.424	0.4634–6.2357
Health care facilities, per capita	1.0086	0.724	0.9616–1.0580
Primary health care facilities, per capita	1.0122	0.624	0.9642–1.0626
Secondary health care facilities, per capita	0.8632	0.336	0.6396–1.1649

Source: Prepared by the authors from study data.
EAP: economically active population
[a] Converted at 7.50 quetzals per 1 US dollar, rate for 13 August 2016 (www.banguat.gob.gt)
[b] Logistic regression

TABLE 4. Multivariate analysis of variables associated with chronic kidney disease of non-traditional causes in children, Guatemala, September 2015–April 2016 (*n* = 100)

Characteristics	Odds ratio	*p*-value[a]	95% confidence interval
Lives in a city	0.4993	0.314	0.1292–1.9291
Time to diagnosis	0.9996	0.114	0.9991–1.0001
Mother studied up to primary school	2.2332	0.129	0.7929–6.2971
Average temperature	1.1269	0.358	0.8733–1.4540
Primary health care facilities, per capita	0.9755	0.571	0.8955–1.0628
Agrarian zone 1	3.7015	0.339	0.2525–54.2603
Agrarian zone 2	0.3263	0.387	0.0258–4.1252
Agrarian zone 3	1.7951	0.449	0.3942–8.1751
Percentage of EAP in agriculture	1.0193	0.427	0.9723–1.0686

Source: Prepared by the authors from study data.
EAP: economically active population
[a] Logistic regression

conceptual models of CKDnT, did not show an association in this sample. A closer look at people, families, and communities and their dynamics in relation to agriculture, agricultural practices, and agricultural products may help get closer to an explanation. For instance, Krisher et al. found distinct levels of kidney damage among sugar cane workers depending on where they seasonally migrate from (21), Ramirez et al. found that altitude and type of agricultural practices are associated with higher prevalence of tubular renal damage in adolescents (8), while Herrera-Ruiz showed that labor flexibilization has shaped workers' seasonal migration and agricultural practices (22). Since available evidence on CKDnT in adults (1–5) shows that they are usually diagnosed between the third and fifth decades of life, when the disease has already progressed, and available data in children (7, 8) show that renal damage starts early in life in areas with high CKD mortality, it is reasonable to hypothesize that exposure during childhood may find clinical expression in early adulthood. This hypothesis should be tested in future studies, and kidney function screening in children living in high-risk areas may lead to early detection and treatment of CKD. An important finding is that factors commonly associated with health inequities in Guatemala, like ethnicity, sex, and income, did not show an association with CKDnT in this sample. Although CKD more generally disproportionally affects people with lower incomes, CKDnT does not seem to be more deeply affected. It should be noted that 89 participants' household income was below the officially estimated average market basket of consumer goods and services (known as the *canasta básica*) (23). Additionally, while CKDnT in adults disproportionally affects males, in this sample sex was not an associated factor. Participants who had mothers with a lower level of formal education showed increased odds of CKDnT. The mother's level of education is commonly found to be a significant risk factor for many health problems, such as immunization rates, child survival, child nutrition, and health care utilization. It has most commonly been interpreted as a variable that summarizes a constellation of social and economic factors at play, like financial security, access to social support, cultural capital, and access to information (24–26).

Limitations

Limitations of this study are the known ones for cross-sectional surveys based on self-reporting. In addition, the municipality-level analysis by definition may insert the ecological fallacy into the analysis. The statistical significance was affected by the number of research participants and the study duration, in turn affected by the number of actual pediatric patients with CKDnT. Finally, the dependent variable, CKDnT, and the municipal-level variables come from secondary data. The main strength of this study is that it is the first one to focus on risk factors of CKDnT in children.

Conclusion

The results from this study suggest that factors associated with CKDnT among children in Guatemala are agricultural practices in their municipality of residence, and mother's level of education. Other variables derived from the conceptual model at the individual, household, and community level did not show an association with CKDnT. This study's emphasis was on elucidating the role of access to health care services and environmental factors suggested by previous research (6).

Future research in children could use case-control designs, but it may prove more fruitful to design population-based studies in agricultural communities, focused on early detection and a life-cycle approach. Conducting similar studies in other affected countries, or multi-country studies, is needed for testing hypotheses in different contexts. Public health interventions that involve kidney function screening among children, especially in high CKD mortality areas, are recommended.

Author contributions. All authors conceived the original idea and designed the research project. LPMA collected the data. BMR and AC processed and analyzed the data. All authors contributed to the interpretation of results. AC and BMR outlined the paper, AC wrote the initial draft, and BMR edited and commented the draft. All authors reviewed and approved the final version.

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Conflict of interest. None declared.

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Factores asociados a la enfermedad renal crónica por causas no tradicionales en niños en Guatemala

RESUMEN

Objetivo. Determinar los factores asociados a la enfermedad renal crónica por causas no tradicionales en niños en Guatemala.

Métodos. Se realizó una encuesta transversal. La población de estudio fue la totalidad de pacientes pediátricos con enfermedad renal crónica en fase 5 ingresados en la unidad de nefrología pediátrica de Fundanier (*N* = 156). Mediante el muestreo aleatorio simple se dispuso de un total de 100 participantes. La recopilación de datos consistió en un cuestionario que abordaba las características individuales y del hogar, el acceso y el uso de la atención de salud y el lugar de residencia al inicio de la enfermedad. La etiología de la enfermedad renal crónica se obtuvo a partir de los expedientes médicos y los datos secundarios se recopilaron a nivel municipal. Se calcularon las estadísticas descriptivas y se empleó el método de regresión logística para el análisis bifactorial y multifactorial.

Resultados. La razón de posibilidades (OR) se aproximó a 1 en casi todas las variables. Dos excepciones destacables en lo relativo a las características domésticas fueron el nivel de escolaridad de la madre hasta la educación primaria (OR 2,2727) y el lugar de residencia en un entorno urbano en la aparición de los síntomas (OR 0,4035). Las excepciones con respecto a las características municipales fueron las zonas de agricultura intensiva a pequeña escala (OR 3,8923) y las zonas de agricultura intensiva a gran escala (OR 0,3338). Los valores *P* y los intervalos de confianza indican que la muestra no fue lo suficientemente amplia para recoger las asociaciones estadísticamente significativas entre variables.

Conclusiones. Los resultados del estudio sugieren que los factores asociados a la enfermedad renal crónica por causas no tradicionales en niños en Guatemala son las prácticas agrícolas intensivas en el municipio de residencia y el nivel de escolaridad de la madre. Las futuras investigaciones con niños podrían incluir el diseño de casos o los estudios poblacionales en comunidades agrícolas. Se recomiendan intervenciones de salud pública que incorporen el tamizaje de la función renal en niños.

Palabras clave Insuficiencia renal crónica; fallo renal crónico; factores de riesgo; salud del niño; epidemiología; Guatemala.

Fatores associados a doença renal crônica de etiologia não tradicional em crianças na Guatemala

RESUMO

Objetivo. Identificar os fatores associados a doença renal crônica de etiologia não tradicional em crianças na Guatemala.

Métodos. Foi realizado um estudo transversal em uma população que consistiu de todos os pacientes pediátricos com doença renal crônica ativa em estágio 5 atendidos na unidade de nefrologia pediátrica da *Fundación para el Niño Enfermo Renal* (FUNDANIER) (*N* = 156). O processo de amostragem aleatória simples determinou a obtenção de uma amostra com 100 participantes. Um questionário foi usado para a coleta de dados sobre as características pessoais e familiares dos participantes, acesso à assistência de saúde e utilização de serviços e local de residência ao início da doença. Informação sobre a etiologia da doença renal crônica foi obtida dos prontuários médicos. Também foram coletados dados secundários ao nível da localidade. Estatísticas descritivas foram estimadas e um modelo de regressão logística foi usado nas análises bivariada e multivariada.

Resultados. As razões de chance (odds ratio, OR) de quase todas as variáveis se aproximaram de 1. As exceções nas variáveis relativas às características familiares foram escolaridade da mãe de nível fundamental (OR 2,2727) e residir em área urbana ao início dos sintomas (OR 0,4035). As exceções nas variáveis ao nível municipal foram áreas de agricultura intensiva em pequena escala (OR 3,8923) e em grande escala (OR 0,3338). Os valores de p e os intervalos de confiança indicam que o tamanho da amostra não foi grande o suficiente para detectar associações estatisticamente significativas entre as variáveis.

Conclusões. O estudo demonstrou que práticas agrícolas intensivas na localidade de residência e nível de escolaridade da mãe são fatores associados a doença renal crônica de etiologia não tradicional em crianças na Guatemala. Outros estudos em crianças devem ser realizados como estudos de caso-controle ou estudos populacionais em comunidades agrícolas. Recomendam-se também intervenções de saúde pública com a avaliação preventiva da função renal em crianças.

Palavras-chave Insuficiência renal crônica; falência renal crônica; fatores de risco; saúde da criança; epidemiologia; Guatemala.