

Augsburg University

Idun

Theses and Graduate Projects

8-16-2021

Rise in Mesoamerican endemic Nephropathy (MeN) in Migrant Population in Exchange for Work; Is it Worth the Trade-Off?

Katie Schmitz

Follow this and additional works at: <https://idun.augsburg.edu/etd>



Part of the [Occupational Health and Industrial Hygiene Commons](#)

Rise in Mesoamerican endemic Nephropathy (MeN) in Migrant Population in Exchange for
Work; Is it Worth the Trade-Off?

By

Katie Schmitz

Alicia Quella

Paper Submitted in Partial Fulfillment

Of the Requirements for the Degree Of Master of Science

Physician Assistant Studies Augsburg University

August 16, 2021

Background

History of Sugarcane in Mesoamerica

Historically, the production and cultivation of the sugarcane crop in Central America has been a reliable and vital component of economic stability. Sugarcane is a highly profitable crop due to increased demand and thus, generates an abundance of occupational opportunities for Central American populations. The tropical climate within this region also provides optimal growth to support the sugarcane agriculture. Regions lacking tropical climates rely on Central American countries for sugarcane importation, further increasing the demand and occupational opportunities. However, an increased crop demand and desire for profitable margin by large sugarcane harvesting companies often requires decreased investment in worker wages and suboptimal working conditions.

Sugarcane is harvested manually in Central American countries with the use of a machete and other hand-held tools. An average workday for a Central American sugarcane worker is approximately ten to twelve hours daily, six to seven days per week, with little time allotted for breaks and rest. Pay is determined on an individual basis and is dependent on the quantity of sugarcane harvested rather than hours worked. Adequate personal protective equipment is not often provided for sugarcane workers, despite exposure to harsh working conditions.

Although sugarcane plantations do offer some personal financial stability for seasonal migrants, stimulate regional economy, and are a historical component of Central America, a deeper investigation of occupationally-motivated migration, working conditions, and health implications and disparities is warranted.

Migration to Costa Rica

Although working conditions and wages within sugarcane plantations are suboptimal for many native Costa Ricans, some Central Americans are drawn to the occupation, as it allows for greater economic opportunity and a sense of personal financial stability. For example, the most common reasons for citizens of Nicaragua to migrate to Costa Rica are motivated by job opportunities and increased wages. The paucity of job opportunities and extremely low wages offered by Nicaraguan occupations motivate Nicaraguan citizens to migrate to countries, such as Costa Rica, who offer an abundance of intensive manual-labor jobs, such as sugarcane cultivation. Although these occupations are not favorable and pay very little, migrants experience seasonal job security and increased wages relative to what is offered in their homeland. For this reason, Costa Rica is known to encompass the highest Nicaraguan immigrant population in all of Central America.

Rise in Renal Pathology & Recognition of MeN

The prevalence and recognition of Chronic Kidney Disease (CKD) is increasing in Central American countries, namely, El Salvador, Nicaragua, Costa Rica, and Guatemala. Within the last decade, CKD in this region has accounted for over 20,000 deaths [7]. While the precise etiology has not yet been identified, various factors have been suggested to contribute to the acquisition of CKD of undetermined cause (CKDu), particularly in the Mesoamerican population. For example, a common presentation of CKDu affected individuals includes young men with low income status who are employed as sugarcane workers in warm zones. In this context, Mesoamerica refers to Southeast Mexico, Guatemala, El Salvador, Western Nicaragua, and North-western Costa Rica.

The manifestation of CKD in the absence of CKD risk factors, such as hypertension and diabetes, are required for the diagnosis of CKDu. CKDu in the Mesoamerican population has become so prevalent that it is often referred to as Mesoamerican endemic Nephropathy (MeN). For some regions of Central America, the dramatic incidence and prevalence of this particular renal pathology has truly become a severe endemic.

In examining these commonalities between affected individuals, various explanations have been suggested to identify the etiology of MeN. The most widely accepted explanations include chronic exposure to heat stress within working conditions, excessive exertional efforts, environmental pollutants, and the frequent experience of dehydration due to the strenuous nature of sugarcane cultivation. With increased death rates, prevalence, and recognition of MeN in migrant populations employed in sugarcane plantations, an exploration of healthcare accessibility and healthcare disparities of this population is vital.

Migrant Healthcare Disparities in Costa Rica

With an increase in MeN-associated fatalities, particularly in the migrant sugarcane-worker population, it is important to understand the barriers this population faces in accessing proper treatment. While CKD is a serious health condition, with proper treatment and management, health preservation and life-prolonging efforts, such as Kidney Replacement Therapy (KRT), are possible.

Costa Rica's healthcare system is publicly financed and is provided by the Caja Costarricense del Seguro Social (CCSS). CCSS is the Costa Rican social security program which manages, promotes, and provides public health for the country. For Costa Rican natives, this system has many benefits, including access to health insurance and healthcare for nearly all Costa Rican citizens. However, there are some discrepancies with this program as well.

Because the public healthcare system provided by the CCSS is intended for Costa Rican citizens, it is of little use to migrants. As previously mentioned, it is not uncommon for Nicaraguan natives to migrate to Costa Rica seasonally for sugarcane agriculture and harvestation. Therein lies a major flaw; those at highest risk for chronic health conditions, specifically MeN, do not have adequate access to healthcare. Further exploration of contributing factors to these components of healthcare and disparities, including immigration policies, will be discussed further.

Summary

As the demand for sugarcane in Costa Rica increases, Nicaraguan migrants are offered opportunities of financial stability and increased wages in sugarcane plantations. However, it does not come without its trade-offs; As more Nicaraguan natives occupy these labor-intensive jobs, they experience increased exposure to various conditions that may contribute to detrimental health conditions, such as MeN and its progression to ESKD. While this condition can be managed with proper care, barriers to healthcare access and health disparities prevent migrants in Costa Rica from receiving necessary treatment. As an increase in fatalities results from the acquisition and progression of untreated MeN, it is essential to recognize the importance of sugarcane agriculture in Mesoamerica, populations at highest risk, the disease itself, as well as the healthcare disparities preventing proper treatment of the condition.

Each of these components will be explored further in conjunction with the pathophysiology and proposed etiologies of MeN, an interview with a Nicaraguan citizen, and proposition of management strategies and practices to promote the health of sugarcane workers.

Materials and Methods

This research was conducted in July 2021, in the settings of San Jose, Costa Rica and the United States. Background and preliminary research was gathered through Google Scholar searches, as well as various interviews and touring experiences in Costa Rica. Such experiences consisted an interview with Nicaraguan citizens traveling to Costa Rica, a guided coffee tour at Doka Estate, a personal reflection from a visit to Longo Mai (a self-sustaining rural Costa Rican community), an interview with two agricultural PhD students at the University of Minnesota on safety of agricultural practices, and the utilization of updated primary literature of credible origin. Key words in the primary literature search included Chronic Kidney Disease, Mesoamerica, Mesoamerican Endemic Nephropathy, Central America, sugarcane, migration, Nicaraguan migrants, healthcare, and heat stress. Primary literature was accessed through Google Scholar, PubMed, and Mendeley which included articles from the following journals: *International Journal of Environmental Research and Public Health*, *World Development*, *International Journal of Nephrology and Renovascular Disease*, *Pan American Journal of Public Health*, *Kidney International Reports*, *Seminars in Nephrology*, *AJDK*, *BMJ*, and *Global Health Action*. Each of the primary literature sources utilized for the discussion component of this research were published between the years of 2017-2021.

Discussion

Migration to Costa Rica

Migration to Costa Rica has, historically, been a popular route for many Central Americans for various reasons. As previously mentioned, Costa Rica accounts for the largest Nicaraguan immigrant population in all of Central America, accounting for nearly 75% of the migrant population and 7% of the total population [8]. There are a few characteristics of the country that make it a favorable migration destination, each of which will be discussed based on results from a survey including data from participants who have migrated from Nicaragua to Costa Rica. Some of the most commonly reported reasons for migration include the conceptualization of Costa Rica as a progressive country with the strongest social policy regimes in the South, low cost of living, occupational opportunity, and family ties.

The concept and perception of Costa Rica as the most progressive country in the South with the strongest social policy is thought to be a large influence for many to migrate. The publicly financed healthcare system, Caja Costarricense del Seguro Social (CCSS), as well as the ability of the country to provide social services to all sectors of the population, regardless of socioeconomic status, provides a sense of safety and security for many. The CCSS currently provides healthcare coverage and insurance to over 87% of the Costa Rican population. This may seem like a major draw for the migrant population, however, survey results reveal access to Costa Rican social services and educational opportunities were not of primary importance in choosing the country as their migration destination [8]. This concept will be further addressed in *Migrant Healthcare Disparities in Costa Rica*. The survey further explored strongest motivators for Nicaraguan migrants to Costa Rica.

One popular explanation for migration is the relative living expense in Costa Rica. Migration to the United States was reported to be preferred by the migrating Nicaraguan population, however, settlement in Costa Rica is a more financially suitable option for many. A migration of closer proximity is not only less expensive, but Costa Rica also has a lower associated cost of living when compared with the United States [8]. Although the destination of migration to the United States was reported to be favored, financial burdens and constraints restrict the Nicaraguan population to settle more reasonably with greater financial stability.

When asked for other motivating factors for migration to Costa Rica from Nicaragua, many participants expressed family ties and connections with individuals already in Costa Rica as a significant contributing component. Over 70% of those surveyed who had migrated from Nicaragua to Costa Rica reported at least one preexisting personal connection to an individual in Costa Rica prior to migration. For 36% of these individuals, the connection(s) established prior to migration was one of the three major influencing factors on their decision. When asked about methods and significance of support from these preestablished connections with individuals in Costa Rica, 73% reported receiving financial support upon arrival. The majority of this financial support, 92.5%, was gifted to migrants by friends [8]. This influence of personal and financial support from those already migrated significantly contributes to Nicaraguans' motivation to relocate.

Perhaps the most popular explanation for Nicaraguan migration to Costa Rica, as revealed by the previously mentioned survey, is work-related. More specifically, participants expressed the lack of jobs in Nicaragua, as well as low wages, were the single most motivating work-related factors. The survey reveals that 61% of individuals migrating from Nicaragua to Costa Rica named job opportunity and/or work-related matters as their number one influencing factor [8]. A

greater explanation and description of job opportunities offered in Costa Rica will be discussed further. Above all, the opportunities for employment and economic stability provided by Costa Rica was revealed to be the largest contributor in the decision for individuals to migrate.

With an explanation of occupation-related opportunity as the primary influencing factor for migration to Costa Rica, it is also important to understand the occupations available to migrants. According to an interview conducted with a Nicaraguan Native, Juan Carlos, the factors of job opportunity and increased wages in Costa Rica are reiterated to be the most contributory migration motivators. Labor-intensive occupations, such as sugarcane work, is one of the most commonly pursued occupations following migration. In the interview he explains, “Sugarcane work is one of the most difficult jobs there is. Workers are under the sun all day, usually in very hot weather, and they must cut the sugarcane manually with a machete. Then, they must then carry the cut stalks on their backs.” It should also be noted that sugarcane workers are paid by piece, rather than by hours worked. Because of this, workers decrease duration and frequency of breaks and time to rehydrate in order to make ends meet [5]. Such labor-intensive occupations are available for migrants because natives no longer wish to occupy these areas, and employers are able to pay migrant populations less than minimum wage due to their, often undocumented, immigration status.

As Juan Carlos describes, the decision to migrate for sugarcane work is not one that is made without considerations, as there are various risks associated with the migration process. The vast majority of individuals cross the border undocumented through “blind spots”, paying a coyote, and/or bribing authorities on both ends of the border. He also explains that most migrant workers are aware of the health risks, specifically for renal pathology, associated with sugarcane work. Often times, they personally know someone or may even have a relative who is already suffering

from MeN. Another consideration made by migrants is payment below minimum wage. By crossing the border undocumented or with only a tourist visa, employers are able to take advantage and pay migrant workers below minimum wage without fear of being reported. However, due to the lack of employment opportunities in their homeland and sense of responsibility to support their family, they are obligated to occupy such positions.

The Rise in Renal Pathology & Recognition of MeN

Mesoamerican endemic Nephropathy (MeN) is an increasingly prevalent chronic health condition, which is seldom recognized in a timely manner. Although it has been present for decades, the increased incidence and prevalence of progressed renal pathology amongst this population has allowed for further investigation. While MeN in Central America is a recently recognized issue, its history and presence can be traced throughout the continent, specifically to Costa Rica when it appeared in the 1970's [6, 9]. However, the first recognition of the condition was recorded in the 1990's in Nicaragua, El Salvador, and Costa Rica [9]. Although the impact of renal pathology is only starting to be understood, figures suggest MeN is a heavy burden for the Central American population. In fact, MeN is reported to be the number one cause of premature death of young adult men in several Central American Countries [1]. A description for risk factors, signs, and symptoms of the disease will be further discussed.

MeN is a form of Chronic Kidney Disease (CKD) that primarily affects young adult and middle aged (20-40 year old) Central American male farm and agricultural workers employed in labor-intensive occupations who are consistently exposed to high temperatures [1, 3, 4, 6, 9, 10] with the greatest prevalence among sugarcane workers and sugarcane cutters [1, 3]. Individuals affected by MeN experience disease in the absence of CKD risk factors, including hypertension and diabetes. This disease has become of vital importance to recognize due to the severe health

implications associated with the progressive nature of the condition and its increased incidence and prevalence.

Although the exact etiology of MeN is unknown, the most widely accepted explanation is due to the combination of chronic heat stress, prolonged dehydration, and labor-intensive occupations. Sugarcane workers, particularly sugarcane cutters, are the most commonly affected population [10]. The gold standard diagnostic method for MeN is kidney biopsy, which reveals chronic tubulointerstitial nephritis [6, 7, 10]. Ultrasound may also be used as a primary method of screening to evaluate clinical suspicion. Evidence of MeN with ultrasonography will display normal kidney size, however, there will be evidence of excess parenchymal echogenicity [6].

The onset of disease is often unrecognized, as patients are initially asymptomatic [6]. It has been proposed that this asymptomatic phase of disease may be the onset of an Acute Kidney Injury (AKI). Laboratory values during this time reveal increased serum sodium and serum creatinine. With repeated exposure to heat, dehydration, and intensive manual labor, the likelihood of subsequent AKI increases. With each AKI occurrence, the kidneys become increasingly fibrotic and scarred, and their function continues to decrease [4]. This is the widely accepted explanation for the progression of AKI to MeN. The pathophysiological processes will be described in detail in *Etiology and Pathophysiology of MeN*.

In the failure of clinical intervention and disease recognition, MeN progresses to End Stage Kidney Disease (ESKD) and death [4]. Unfortunately, most migrants who do present to the emergency department (ED) in Costa Rica with symptoms such as fever, aseptic dysuria, nocturia, cramps/muscle weakness, and electrolyte abnormalities have already progressed to ESKD and experience high rates of fatality as a result if they are not treated promptly with dialysis [1, 6].

Another study reveals the most common chief complaints upon Nicaraguan migrant presentation to the ED in Costa Rica. In comparing uninsured citizens of Costa Rica and uninsured migrants from Nicaragua, data shows genitourinary complaints as the most common ED presentation for migrants, following emergencies associated with pregnancy. In comparison, genitourinary complaints rank as the tenth most common cause for Costa Rican utilization of ED facilities [8]. The incidence of genitourinary complaints, including MeN and ESKD, of the Nicaraguan migrant populations who present to Costa Rican ED settings is significantly greater compared to that of their Costa Rican counterparts.

One prospective study follows 326 Nicaraguan sugarcane workers who presented initially with normal renal function, as measured by serum creatinine (Scr). Over the course of the harvesting season, 34 of these workers developed Acute Kidney Injury (AKI). All participants were followed prospectively for a year after the harvesting season and were monitored at six and twelve month intervals. Half of those who developed AKI during the harvesting season progressed to MeN within that year, and one third of those individuals experienced a prolonged decrease in kidney function with a $GFR \leq 30\%$, placing them in stages 3B and 4 CKD. Many of those who were discovered to have an AKI were asymptomatic and reported they would not have otherwise presented for medical attention [4]. The initial asymptomatic presentation of an AKI in the MeN disease progression makes proper timing of medical intervention difficult, yet vital.

Etiology and Pathophysiology of MeN

Continuous heat stress exposure, intensive manual labor, and chronic dehydration are the most widely accepted mechanisms in which an AKI manifests as MeN and progress to ESKD. There are a few other conditions and exposures that have been proposed as potentially significant contributors to the acquisition of the disease. Some of these include exposure to particulate

matter, silica, nickel, arsenic, cadmium, toxins, and glyphosate [7]. For the sake of this paper, the combination of heat stress, intensive manual labor, and chronic states of dehydration will be the main foci contributing to the pathophysiological processes of MeN. The processes of activating vasopressin (Anti-diuretic hormone; ADH) and the Renin-Angiotensin Aldosterone System (RAAS), muscular cell breakdown (Rhabdomyolysis) and its byproducts, as well as hyperuricemia will be discussed.

One of the proposed mechanisms by which heat stress, intensive manual labor, and chronic states of dehydration contribute to the development of MeN is through the secretion of vasopressin and activation of RAAS. Vasopressin secretion occurs during the detection of increased plasma osmolality and/or decreased blood volume. These states of insufficiency present in the settings of heat, exertion, and dehydration experienced by sugarcane workers. Vasopressin is produced in the hypothalamus and stored, where it is later secreted, from the posterior pituitary gland. It then acts upon the distal convoluted tubule to increase water reabsorption. Meanwhile, Aldosterone is also being secreted from the adrenal cortex further increasing water retention, blood pressure, and serum sodium while also decreasing serum potassium. In these sugarcane workers, it is not uncommon for vasopressin levels to remain consistently elevated or for the RAAS to be chronically active. In workers examined with the diagnosis of MeN after the harvesting season, 42% showed a retained elevation in plasma renin. The presence of plasma renin in this case is significant because plasma renin is a surrogate marker for the activation of RAAS.

In a study conducted on risk factors of CKD, increased vasopressin was found to be an independent contributor to disease progression. Associated with this increase in vasopressin and activation of RAAS, sugarcane cutters examined before and after their work shift showed a

markedly increased urine osmolality, relatively increased serum sodium concentration, and a statistically significant rise in serum creatinine [5]. Elevations in serum sodium and creatine are known to cause renal artery vasoconstriction and increase renal energy requirements and oxygen demand. The associated compensatory hypokalemia may also contribute to tubulointerstitial inflammation. The result of these phenomenon is renal hypoxia and tubulointerstitial and medullary inflammation [3]. These clinical findings are indicative of primary AKI acquisition, at minimum, and suggest development of, and progression to, MeN with subsequent occurrences.

The pathophysiologic process of muscle breakdown and Rhabdomyolysis, occurs in states of excessive exertional efforts in conjunction with chronic exposure to heat and humidity. The serum marker utilized to detect and follow the progression of muscle breakdown and Rhabdomyolysis is elevation of serum Creatinine Phosphokinase (CPK). An experimentation measured the fluctuation of CPK and its association with strenuous exercise in a high temperature setting. Although no diagnoses of frank Rhabdomyolysis presented, the observance of muscle loss is apparent, suggesting the level of strenuous activity of these sugarcane workers may be contributing to a sub-clinical Rhabdomyolysis that ultimately results in tubulointerstitial inflammation: the histological finding consistent with MeN. It was later revealed that even slight increases of CPK in such a setting is a major risk factor to the development of an AKI [3]. Another risk factor for the development of sub-clinical or clinical Rhabdomyolysis is hypokalemia. As noted previously, this is a common finding in sugarcane workers.

Another set of studies was conducted to examine the role of Rhabdomyolysis-like mechanisms in development in MeN measured serum CPK of sugarcane workers before and after the harvest season, as well as before and after work shifts. In both studies, pre and post-season as well as pre and post-shift, CPK levels were significantly elevated [9]. This study may

also suggest that even sub-clinical elevations of CPK may be a large contributing factor to the development of an AKI and progression to MeN and/or ESKD.

A rise in CPK is one of the surrogate markers for muscle degradation, as well as an increase in uric acid. Hyperuricemia is another common laboratory abnormality found in sugarcane cutters. When muscle is broken down during strenuous activity, exertion, and heat exposure, patients exhibit a trending decrease in eGFR, and a proportional increase in serum uric acid can be seen [5]. This is of clinical significance due to the high propensity and possibility of AKI and MeN development as a result of uric acid-mediated renal damage.

Migrant Healthcare Disparities in Costa Rica

As referred to in *Migration to Costa Rica* within the discussion section of this paper, access to social services and public healthcare opportunities were not named as motivating factors for Nicaraguan migrants. This is one of the many healthcare disparities currently experienced by the migrant population. Although the CCSS is of significant value to many Costa Rican citizens, it is often of little benefit to Nicaraguan migrants. Even after receiving proper immigration status, Nicaraguan-born individuals are 28% less likely (relative to Costa Rican counterparts) to receive health insurance [8]. For many, immigration status is one of the largest barriers to health insurance and access to healthcare.

Interviewee, Juan Carlos, explains that the process of obtaining health insurance for migrants often requires more resources than what are available to them. The expense associated with documentation is often much more than what Nicaraguan migrants are able to afford. Paying for a passport and visa decreases cost and helps migrants cross the Costa Rican border as a documented tourist, however, status as tourist does not qualify an individual for employment or public health insurance. Without adequate health insurance coverage, clinics are able to defer

patients care based on their inability to pay for services. As a result, it is not uncommon for this population to present to the ED in ESKD, as they cannot be turned away based on inability to pay in a medically emergent situation [7]. It should also be noted that due to the increase in incidence and prevalence of MeN and its progression to ESKD in conjunction with lack of accessible healthcare, out of pocket costs are increased. The result of increased out of pocket costs further perpetuates the poverty cycle for this population [6]. This is one of the major healthcare disparities Nicaraguan migrants face upon arrival to Costa Rica.

Although it has since been recognized, improper health records and inadequate access to healthcare for high-risk populations, little to no funding to support further research, poverty, and high demand of clinical work have been identified as main contributors to overlooking MeN on first presentation in the 1970's [6, 9]. Along with inadequate recognition and lack of early diagnosis of the condition, ESKD registries in Costa Rica do not exist. This limits treatment options, such as KRT and the possible chance of transplant for some patients. The lack of specialized nephrologists to diagnose, treat, and educate on MeN is also reported to contribute to the increasing incidence and prevalence [1]. Although the migrant population is at highest risk for MeN and early diagnosis and clinical intervention are essential, the healthcare disparities they face puts them at considerable risk for disease progression and associated fatality.

Proposed Solutions

In consideration of the increased incidence, prevalence, and associated risk factors of MeN within the Nicaraguan migrant population in Costa Rica, various solutions for prevention, timely diagnosis, and treatment will be proposed within this section.

With proper diagnosis and recognition of both AKI and progressed MeN, implementation of proper clinical treatment has been shown to significantly improve patient outcomes. When MeN

affected patients are given a Allopurinol and/or oral sodium bicarbonate, in combination with adequate hydration efforts, renal function can be significantly improved. This treatment has also been shown to be effective acutely following a labor-intensive work day after exposure to heat stress and dehydration. It is important to note that upon experimentation, rehydration and rest alone were not effective in restoring renal function and mitigating dysuria [1]. Further research on the implementation of Allopurinol and/or sodium bicarbonate in conjunction with rehydration efforts should be explored as a potential first line treatment for sugarcane workers at increased risk for MeN.

Although it is recently becoming more recognized as problematic, little research has been conducted on the methods of prevention of AKI and MeN in migrant sugarcane working populations. A scholarly article published in the Pan American Journal of Public Health refers to the condition as an, "...[an] occupational disease driven by work-related heat stress that warrants immediate preventative action," [9]. Utilization of Allopurinol and/or sodium bicarbonate in combination with adequate rehydration as a prophylactic measure in sugarcane workers should also be investigated to prevent disease.

Awareness and education of both sugarcane workers and production companies who employ migrant workers may also be helpful for those who are unaware. However, awareness of risk factors including chronic dehydration, excessive exertional efforts, and exposure to heat stress is often already known by both parties. It must be realized that modification to reduce risk is not simply resolved with a behavioral change, as this population has expressed they cannot financially afford taking breaks for rehydration and rest. Efforts and exploration in mitigating and/or interrupting these risk factors from a safety in the workplace perspective may be the most helpful and realistic avenue. Further research investigating the process of initiating,

implementing, and maintaining labor laws within these companies to protect migrant workers is a reasonable suggestion.

Another potential step in decreasing rates of MeN is through the recognition of non-occupational risk factors. While MeN is diagnosed in the absence of hypertension and diabetes, other modifiable health-related adjustments can be made to help prevent disease. Education provided to both sugarcane employers and migrant employees regarding the impacts of NSAID utilization, nicotine and illicit drug use, alcohol consumption, and family history of renal disease may be helpful as screening tools for identifying risk factors for renal compromise. The utilization of NSAIDs by sugarcane workers, for example, is a very common treatment for relief of musculoskeletal discomfort associated with intense physical labor. One study also reported a high prevalence of consistent tobacco smoking and alcohol consumption in sugarcane workers [9]. NSAID use, smoking, and alcohol consumption in the presence and absence of preexisting renal compromise can contribute to significant progression of renal pathology.

Conclusion

The increased demand of sugarcane in Costa Rica and the lack of occupational opportunities in Nicaragua has resulted in an increase in migrant sugarcane workers. Because many individuals cannot afford proper documentation for immigration, a significant number cross the border undocumented looking for financial stability. The vast availability of sugarcane work in Costa Rica provides Nicaraguan migrants with an opportunity for work, however, they are often paid less than minimum wage due to their undocumented immigration status. Migrant workers are subject to harsh working conditions including extreme physical exertion, dehydration, and heat exposure. The combination of this trifecta seen in the Nicaraguan migrant population employed in sugarcane harvestation is thought to be correlated with the significant

increase in incidence and prevalence of renal pathology, namely, MeN. Although those at highest risk for acquiring MeN are undocumented Nicaraguan migrant sugarcane workers, this population does not have access to the public health insurance or healthcare provided by Costa Rica. This has inhibited implementation of preventative measures, delayed diagnosis and treatment, and allowed for disease progression to ESKD and death. Some solutions to this multifactorial problem include further research on implementation and maintenance of labor laws to protect migrant workers; various assessment tools to identify and educate migrants on further contributing risk factors that may be behaviorally modifiable; the role of nicotine, NSAID, and alcohol use in MeN disease progression; and treatment and prophylactic options, such as the combination of Allopurinol and sodium bicarbonate.

References

1. Correa-Rotter, R., & García-Trabanino, R. (2019). Mesoamerican Nephropathy. In *Seminars in Nephrology* (Vol. 39, Issue 3, pp. 263–271). W.B. Saunders. <https://doi.org/10.1016/j.semnephrol.2019.02.004>
2. Crews, D. C., & Novick, T. K. (2019). Social Determinants of CKD Hotspots. In *Seminars in Nephrology* (Vol. 39, Issue 3, pp. 256–262). W.B. Saunders. <https://doi.org/10.1016/j.semnephrol.2019.02.003>
3. Hansson, E., Glaser, J., Jakobsson, K., Weiss, I., Wesseling, C., Lucas, R. A. I., Wei, J. L. K., Ekström, U., Wijkström, J., Bodin, T., Johnson, R. J., & Wegman, D. H. (2020). Pathophysiological mechanisms by which heat stress potentially induces kidney inflammation and chronic kidney disease in sugarcane workers. *Nutrients*, *12*(6). <https://doi.org/10.3390/nu12061639>
4. Kupferman, J., Ramírez-Rubio, O., Amador, J. J., López-Pilarte, D., Wilker, E. H., Laws, R. L., Sennett, C., Robles, N. V., Lau, J. L., Salinas, A. J., Kaufman, J. S., Weiner, D. E., Scammell, M. K., McClean, M. D., Brooks, D. R., & Friedman, D. J. (2018). Acute Kidney Injury in Sugarcane Workers at Risk for Mesoamerican Nephropathy. *American Journal of Kidney Diseases*, *72*(4), 475–482. <https://doi.org/10.1053/j.ajkd.2018.04.014>
5. Madero, M., García-Arroyo, F. E., & Sánchez-Lozada, L. G. (2017). Pathophysiologic insight into MesoAmerican nephropathy. In *Current Opinion in Nephrology and Hypertension* (Vol. 26, Issue 4, pp. 296–302). Lippincott Williams and Wilkins. <https://doi.org/10.1097/MNH.0000000000000331>
6. Polo, V. S., Garcia-Trabanino, R., Rodriguez, G., & Madero, M. (2020). Mesoamerican nephropathy (Men): What we know so far. In *International Journal of Nephrology and Renovascular Disease* (Vol. 13, pp. 261–272). Dove Medical Press Ltd. <https://doi.org/10.2147/IJNRD.S270709>
7. Schaeffer, J. W., Adgate, J. L., Reynolds, S. J., Butler-Dawson, J., Krisher, L., Dally, M., Johnson, R. J., James, K. A., Jaramillo, D., & Newman, L. S. (2020). A pilot study to assess inhalation exposures among sugarcane workers in Guatemala: Implications for chronic kidney disease of unknown origin. *International Journal of Environmental Research and Public Health*, *17*(16), 1–15. <https://doi.org/10.3390/ijerph17165708>
8. Voorend, K., Bedi, A. S., & Sura-Fonseca, R. (2021). Migrants and access to healthcare in Costa Rica. *World Development*, *144*. <https://doi.org/10.1016/j.worlddev.2021.105481>
9. Wesseling, C., Glaser, J., Rodríguez-Guzmán, J., Weiss, I., Lucas, R., Peraza, S., da Silva, A. S., Hansson, E., Johnson, R. J., Hogstedt, C., Wegman, D. H., & Jakobsson, K. (2020). Chronic kidney disease of non-traditional origin in Mesoamerica: A disease primarily driven by occupational heat stress. *Revista Panamericana de Salud Publica/Pan American Journal of Public Health*, *44*. <https://doi.org/10.26633/RPSP.2020.15>
10. Wesseling, C., Aragón, A., González, M., Weiss, I., Glaser, J., Rivard, C. J., Roncal-Jiménez, C., Correa-Rotter, R., & Johnson, R. J. (2016). Heat stress, hydration and uric acid: a cross-sectional study in workers of three occupations in a hotspot of Mesoamerican nephropathy in Nicaragua. *BMJ Open*, *6*, 11034. <https://doi.org/10.1136/bmjopen-2016>



Augsburg University Institutional Repository Deposit Agreement

By depositing this Content ("Content") in the Augsburg University Institutional Repository known as Idun, I agree that I am solely responsible for any consequences of uploading this Content to Idun and making it publicly available, and I represent and warrant that:

- I am either the sole creator or the owner of the copyrights in the Content; or, without obtaining another's permission, I have the right to deposit the Content in an archive such as Idun.
• To the extent that any portions of the Content are not my own creation, they are used with the copyright holder's expressed permission or as permitted by law. Additionally, the Content does not infringe the copyrights or other intellectual property rights of another, nor does the Content violate any laws or another's right of privacy or publicity.
• The Content contains no restricted, private, confidential, or otherwise protected data or information that should not be publicly shared.

I understand that Augsburg University will do its best to provide perpetual access to my Content. To support these efforts, I grant the Board of Regents of Augsburg University, through its library, the following non-exclusive, perpetual, royalty free, worldwide rights and licenses:

- To access, reproduce, distribute and publicly display the Content, in whole or in part, to secure, preserve and make it publicly available
• To make derivative works based upon the Content in order to migrate to other media or formats, or to preserve its public access.

These terms do not transfer ownership of the copyright(s) in the Content. These terms only grant to Augsburg University the limited license outlined above.

Initial one:

[Signature] I agree and I wish this Content to be Open Access.

___ I agree, but I wish to restrict access of this Content to the Augsburg University network.

Work (s) to be deposited

Title: Rise in Mesoamerican endemic Nephropathy (MeN) in Migrant Population in Exchange for Work; Is it Worth the Trade-Off?

Author(s) of Work(s): Katie Schmitz

Depositor's Name (Please Print): Katie Schmitz

Author's Signature: [Signature] Date: 08/16/2021

If the Deposit Agreement is executed by the Author's Representative, the Representative shall separately execute the following representation.

I represent that I am authorized by the Author to execute this Deposit Agreement on the behalf of the Author.

Author's Representative Signature: [Signature] Date: 08/16/2021