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INFLUENCE OF AGING AND HYPOPROTEINEMIA ON RENAL FUNCTION DECLINE IN ELDERLY INDIVIDUALS IN WESTERN CAMEROON

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Abstract

Background: Chronic kidney disease (CKD) is a major public health concern, particularly in aging populations. Physiological aging is associated with a progressive decline in renal function, exacerbated by nutritional imbalances such as hypoproteinemia. In resource-limited settings, where access to a balanced diet and healthcare services is restricted, these factors become critical for CKD prevention. This study aims to demonstrate how the interaction between advanced age and hypoproteinemia contributes to the deterioration of glomerular filtration rate (GFR) across various regions in Cameroon.

Objective: To analyze the synergistic effect of aging and hypoproteinemia on renal function in five localities of Western Cameroon, identifying high-risk populations and proposing targeted recommendations.

Methods: A cross-sectional study was conducted on a representative sample of 768 adults aged 50 and above, categorized into four age groups (50–59, 60–69, 70–79, and ≥80 years). Renal function was assessed using the MDRD equation to estimate GFR, and total protein levels were measured via spectrophotometry. Statistical analysis focused on correlations between age, plasma protein levels, and CKD prevalence across different localities.

Results: The findings revealed a significant relationship between aging, hypoproteinemia, and renal function decline. CKD prevalence increased exponentially in individuals over 60 years, with higher rates observed in the Dschang and Baham localities. Additionally, hypoproteinemia was identified as an independent aggravating factor, increasing the risk of renal dysfunction by 2.3 times (95% CI: 1.8–2.9).

Conclusions: These results underscore the need for enhanced nutritional and nephrological surveillance among elderly populations, particularly in regions with high malnutrition prevalence. A combined approach

integrating nutritional strategies and early monitoring of renal biomarkers could help mitigate the CKD burden in these vulnerable populations.

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Introduction:

The intricate physiological process of aging is linked to significant metabolic and biomolecular alterations, including a steady deterioration in renal function. As people age, the frequency of chronic kidney disease (CKD) rises, and demographic forecasts indicate that the number of cases will climb exponentially over the next several decades, especially in middle-income nations like Cameroon.

Reduced total plasma protein levels, or hypoproteinemia, are a major contributor to renal impairment and an indirect indicator of inadequate nutritional condition. According to recent research, nutritional deficiencies might affect renal hemodynamics and hasten glomerular fibrosis, raising the risk of chronic kidney disease. In sub-Saharan Africa, where nutritional inequalities and restricted access to healthcare worsen these problems, however, not much research has been done on this association.

The purpose of this study is to investigate how hypoproteinemia and aging affect renal function in five different Western Cameroonian regions. This study aims to develop focused preventive strategies to reduce the prevalence of CKD in these areas by identifying high-risk people and assessing the relationships between these variables.

Methods:-

Study Design:

This cross-sectional study was conducted between January and June 2023 in five localities of Western Cameroon: Bafang, Bafoussam, Baham, Bandjoun, and Dschang. These sites were selected for their sociodemographic diversity and varying levels of healthcare access. The primary objective was to investigate the relationship between aging, hypoproteinemia, and renal function to identify predictive risk factors for CKD in this aging population.

Study Population:

The study included a sample of 768 participants aged 50 years and older, categorized into four age groups: 50–59, 60–69, 70–79, and ≥80 years. These age brackets were established based on clinically recognized thresholds to assess the impact of aging on renal function.

Biochemical Parameter Measurement:

Blood samples were collected and analyzed to determine serum total protein and serum creatinine concentrations. Glomerular filtration rate (GFR) was estimated using the Modification of Diet in Renal Disease (MDRD) equation, which is a critical tool for assessing renal function. The formula used is as follows:

The estimation of the Glomerular Filtration Rate (GFR):

The Modification of Diet in Renal Disease (MDRD) equation was used to determine the estimated glomerular filtration rate (eGFR), which was as follows:

$$\text{DFG (mL/min/1.73 m}^2) = 186 \times (\text{serum creatinine in mg/dL})^{-154} \times (\text{age in years})^{-0203} \times (0.742 \text{ if female}) \times (1.210 \text{ if Black}).$$

Variables:

- **Serum creatinine:** Measurement of creatinine levels in the blood.
- **Age:** Expressed in years.
- **Sex:** A correction factor is applied for females and Black individuals.

This method is widely validated for assessing renal function in elderly populations. Participants were categorized based on their protein status into three distinct groups:

- **Hypoproteinemia** (<60 g/L)
- **Normoproteinemia** (60-80 g/L)
- **Hyperproteinemia** (>80 g/L)

Renal Function Assessment:
Participants were classified according to the stages of renal insufficiency based on eGFR:

- **Normal renal function** (>90 mL/min/1.73 m²)
- **Mild renal impairment** (60-89 mL/min/1.73 m²)
- **Moderate chronic kidney disease** (30-59 mL/min/1.73 m²)
- **Severe renal impairment** (15-29 mL/min/1.73 m²)
- **End-stage renal disease (ESRD)** (<15 mL/min/1.73 m²)

Data Analysis
Data analysis was conducted using SPSS and XLSTAT software. The following analytical approaches were employed :

1. Pearson Correlation Tests:
Associations between electrolyte levels, age, gender, and localities were assessed using Pearson correlation coefficients. À significance threshold of $p < 0.05$ was applied.

2. Cross-Tabulation Analysis:
Dynamic cross-tabulation tables were used to explore associations between categorical variables, such as electrolyte status, age groups, gender, and geographical localities.

These combined methods ensured a robust and comprehensive analysis of the relationships between the measured parameters and the demographic characteristics of the study population.

Results:-

Study Population Characteristics
A total of **768 participants** were included in the study (**451 women, 317 men**), with a **female dominance of 58.7%**.

Geographical Distribution

- **Bafang**: High female participation, particularly in the **50-59 age group**.
- **Bafoussam**: Balanced age distribution with a slight female predominance.
- **Baham**: Strong presence in the **50-59 age group**.
- **Bandjoun**: Female dominance, especially among those aged **60-69 years**.
- **Dschang**: High participation, notably among **older women**.

Prevalence Trends

- Women represented the majority of participants across all localities.
- Age distribution varied significantly depending on the region.

Table 1:- Distribution of the Study Population by Sex, Age, and Locality.

Localities	**Villages**	**50-59**	**60-69**	**70-79**	**≥80**	**Total**
		F	**M**	**F**	**M**	**F**
Bafang	Bana	15	4	22	8	10
	Banka	12	21	8	17	2
Bafoussam	Kamkop	20	15	14	12	11
	Tamdja	5	13	12	12	4
Baham	Demgo	25	17	11	6	7
	Medjo	18	9	24	8	6
Bandjoun	Semtôh	8	17	6	19	8
	Tsélâh	17	13	12	14	9
Dschang	Fotetsa	25	7	23	5	12
	Johnny Baleng	22	5	24	5	23

Total: 768 participants (F: 451 [58.7%]; M: 317 [41.3%])
F: Female; M: Male

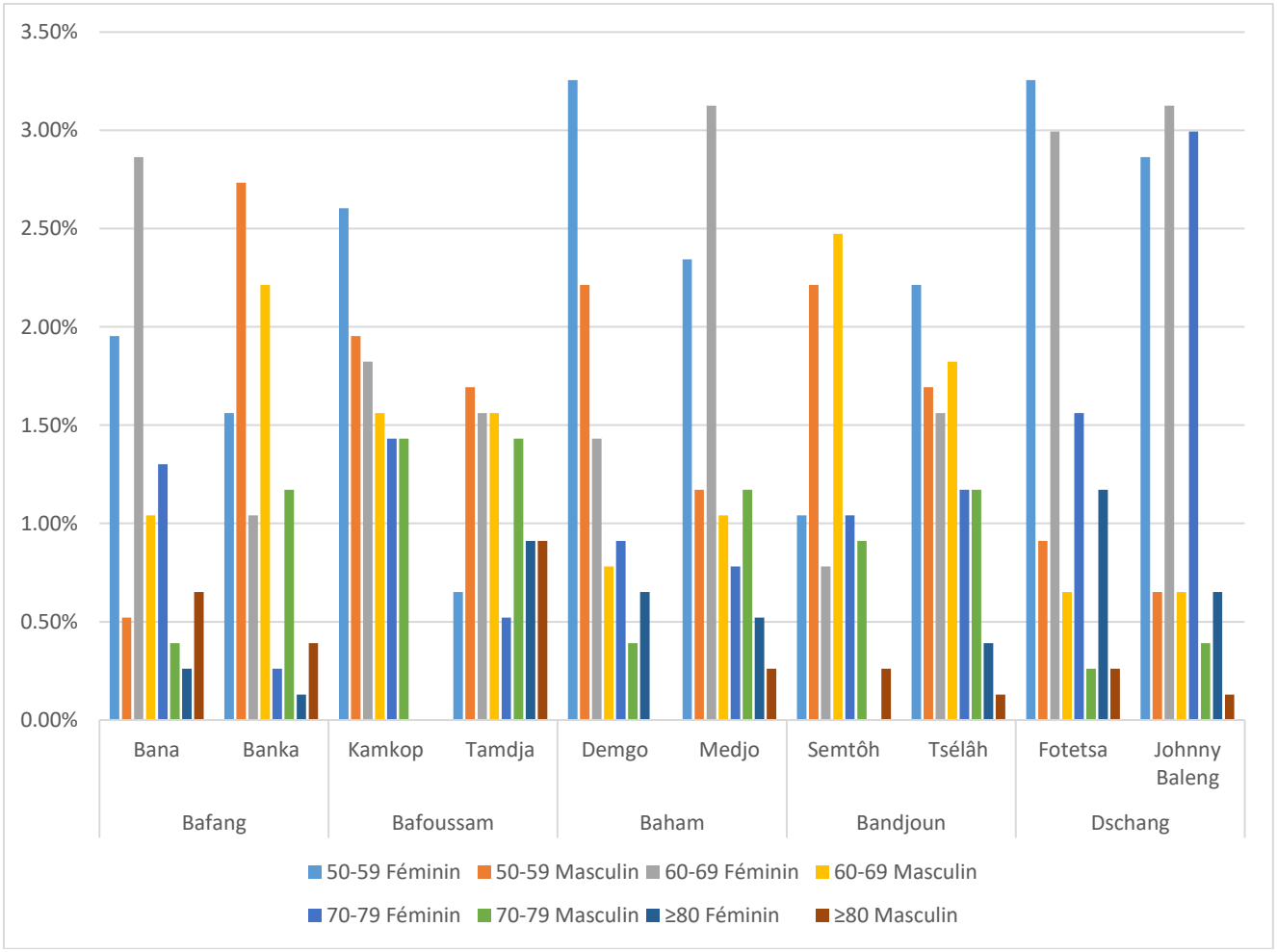

Figure 1:- Percentage Distribution of the Population by Sex and Age Group in Various Localities of Western Cameroon.

Table 2 shows that:
Normal Renal Function or Hyperfiltration:
Among the 768 participants, 185 (24.1%) exhibited normal renal function or hyperfiltration. This group was predominantly composed of individuals aged 50-59 years, suggesting the presence of compensatory mechanisms that temporarily maintain normal eGFR, consistent with the findings of **Levey et al. (2003**).

Mild Renal Impairment:
A significant proportion (34.1%) of participants fell into this category, primarily composed of individuals aged 60-79 years. Hypoproteinemia was frequently observed, supporting the hypotheses of **Brenner & Rector (2020**) on the impact of malnutrition in the progression of chronic kidney disease (CKD).

Moderate Chronic Kidney Disease:
This stage accounted for 31.4% of participants, with a marked geographical distribution (higher prevalence in Bafoussam, Baham, and Dschang). These findings align with those of **Kovesdy et al. (2017**) regarding the influence of socioeconomic conditions on CKD progression.

Severe and End-Stage Renal Disease (ESRD):

Although rare, these cases were predominantly observed in individuals aged ≥80 years, confirming aging as a major risk factor **(Johnson et al., 2018**).

Table 2:- Glomerular Filtration Rate in the Study Localities Based on Total Protein Levels and Age.

Classes de débit de filtration glomérulaire	Localités	Hypoprotéinémie				Normale				Hyperprotéinémie				Total général
		50-59	60-69	70-79	≥ 80	50-59	60-69	70-79	≥ 80	50-59	60-69	70-79	≥ 80	
Normal ou hyperfiltration	Bafang	4	1	0	0	15	6	5	0	1	6	2	0	40
	Bafoussam	6	7	2	0	5	1	1	0	0	0	1	0	23
	Baham	10	1	1	0	9	6	0	0	1	0	0	0	28
	Bandjoun	3	2	1	0	15	12	7	0	5	2	1	0	48
	Dschang	4	2	0	0	20	10	3	0	2	5	0	0	46
Insuffisance rénale débutante	Bafang	3	4	1	1	10	21	5	2	2	1	2	0	52
	Bafoussam	14	10	4	2	8	10	7	0	1	2	0	0	58
	Baham	12	10	9	0	20	10	0	0	2	0	0	0	63
	Bandjoun	1	6	3	1	14	13	5	0	2	1	0	0	46
	Dschang	5	8	1	0	16	11	15	6	6	6	1	1	76
Insuffisance rénale chronique modérée	Bafang	4	2	1	0	6	8	5	6	2	2	2	2	40
	Bafoussam	9	7	6	8	6	9	11	3	0	0	1	0	60
	Baham	4	14	7	2	3	7	2	5	2	0	0	0	46
	Bandjoun	2	2	0	1	7	12	12	0	3	0	4	1	44
	Dschang	0	1	3	1	5	12	15	9	1	2	2	0	51
Insuffisance rénale chronique sévère	Bafang	0	1	1	0	5	0	0	0	0	3	0	0	10
	Bafoussam	0	2	0	1	2	2	3	0	1	0	0	0	11
	Baham	1	0	1	2	4	0	4	0	0	0	1	2	15
	Bandjoun	0	0	0	0	2	0	0	1	1	1	0	0	5
Insuffisance rénale chronique terminale	Bafoussam	0	0	0	0	0	0	1	0	1	0	0	0	2
	Baham	0	0	0	0	0	1	0	0	1	0	0	0	2
	Bandjoun	0	0	0	0	0	0	0	2	0	0	0	0	2
	Total général	82	80	41	19	172	151	101	34	34	31	17	6	768

The analysis of Figure 2 shows the distribution of total protein classes (hypoproteinemia, normal, hyperproteinemia) across age groups in the different study locations (Barang, Baroussam, Bandjoun, Dschang).

Key Observations:-

- Hypoproteinemia: The 60-69 and 70-79 age groups show higher levels of hypoproteinemia, especially in Barang and Baroussam. This trend suggests an increased risk of low protein levels among older individuals.
- Normal: The normal protein class is more prevalent in the 50-59 age group, with notable values across all locations. This could indicate better nutritional health in this age range.

- Hyperproteinemia: Hyperproteinemia levels remain relatively low in all locations, but there is a slight increase observed in the 80 and older age group, particularly in Dschang.

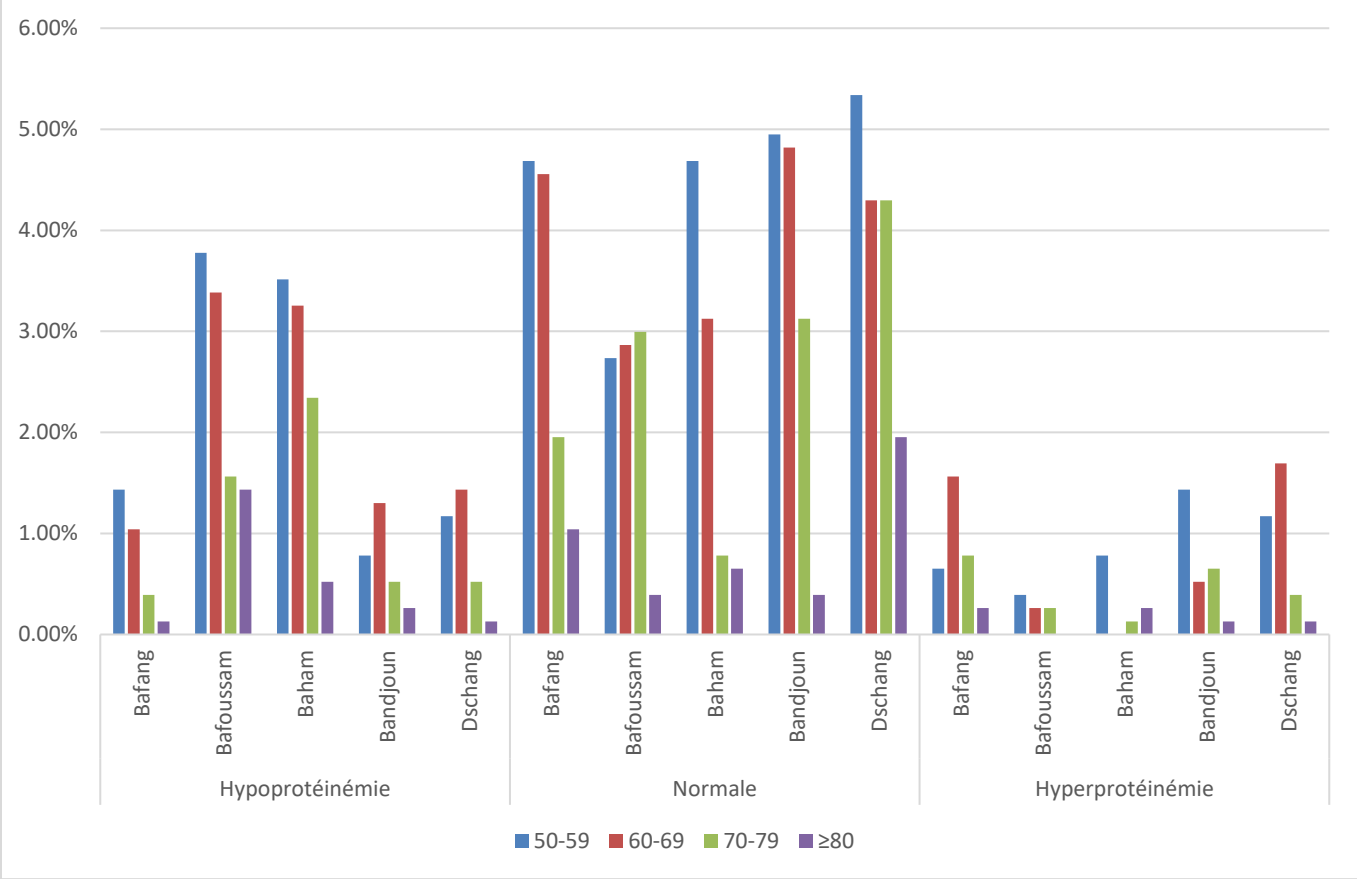

Figure 2:- Distribution of Total Protein Classes by Age Groups in the Study Locations.

The analysis of this graph highlights the distribution of total protein levels (hypoproteinemia, normal, hyperproteinemia) by sex (female and male) in the different study locations.

Key Observations:

- Hypoproteinemia: Hypoproteinemia levels are generally higher in women compared to men in most locations, though the differences are not extremely pronounced. Barang and Baroussam show a similar trend, indicating an increased risk of low protein levels among women.
- Normal: The normal protein class shows significantly higher levels in Dschang, especially in women. This may suggest a difference in nutritional health or access to food resources between sexes in this location.
- Hyperproteinemia: Hyperproteinemia levels are relatively low, but a slight prevalence is observed in men in certain locations, particularly in Barang.

The analysis of this figure illustrates the distribution of Glomerular Filtration Rate (GFR) classes by age groups (50-59 years, 60-69 years, 70-79 years, and 80 years and older) across different locations (Barang, Baroussam, Bandjoun, Dschang).

Key Observations: Normal or Hyperfiltration: Normal or hyperfiltration GFR levels are most common in the 50-59 age group, with a gradual decrease observed in the older age groups. This indicates a decline in kidney function with age.

Early-stage Kidney Failure: This class shows a notable increase in the 60-69 and 70-79 age groups, particularly in Dschang. This suggests that kidney function begins to deteriorate significantly from the age of sixty.

Moderate and Severe Chronic Kidney Disease: The frequency of moderate and severe chronic kidney disease increases considerably in the older age groups (70-79 years and 80 years and older). Dschang and Baroussam show particularly high rates, which may indicate public health issues related to age and kidney function in these regions.

End-stage Chronic Kidney Disease: Although less frequent, end-stage chronic kidney disease predominantly occurs in individuals aged 70 and older, highlighting the urgent need for renal care for this population.

This figure highlights the relationship between age and kidney function, showing a progressive decline in GFR with increasing age. Localities such as Dschang and Baroussam appear to be particularly affected, suggesting a need for targeted public health interventions for the prevention and management of kidney diseases, especially among the elderly. Education on kidney care and regular medical follow-ups may be beneficial for these populations.

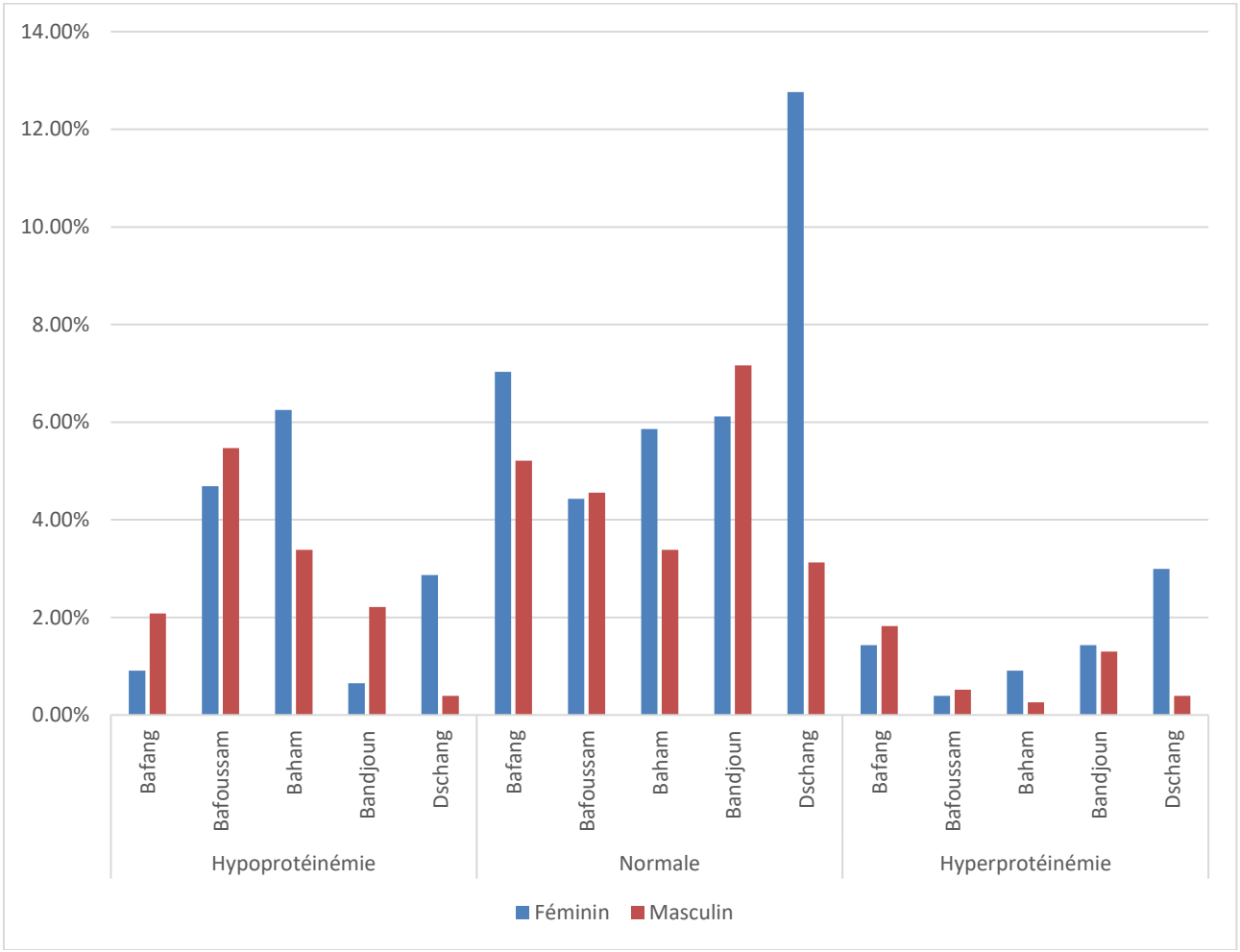

Figure 3:- Distribution of Total Protein Class by Sex in the Study Locations.

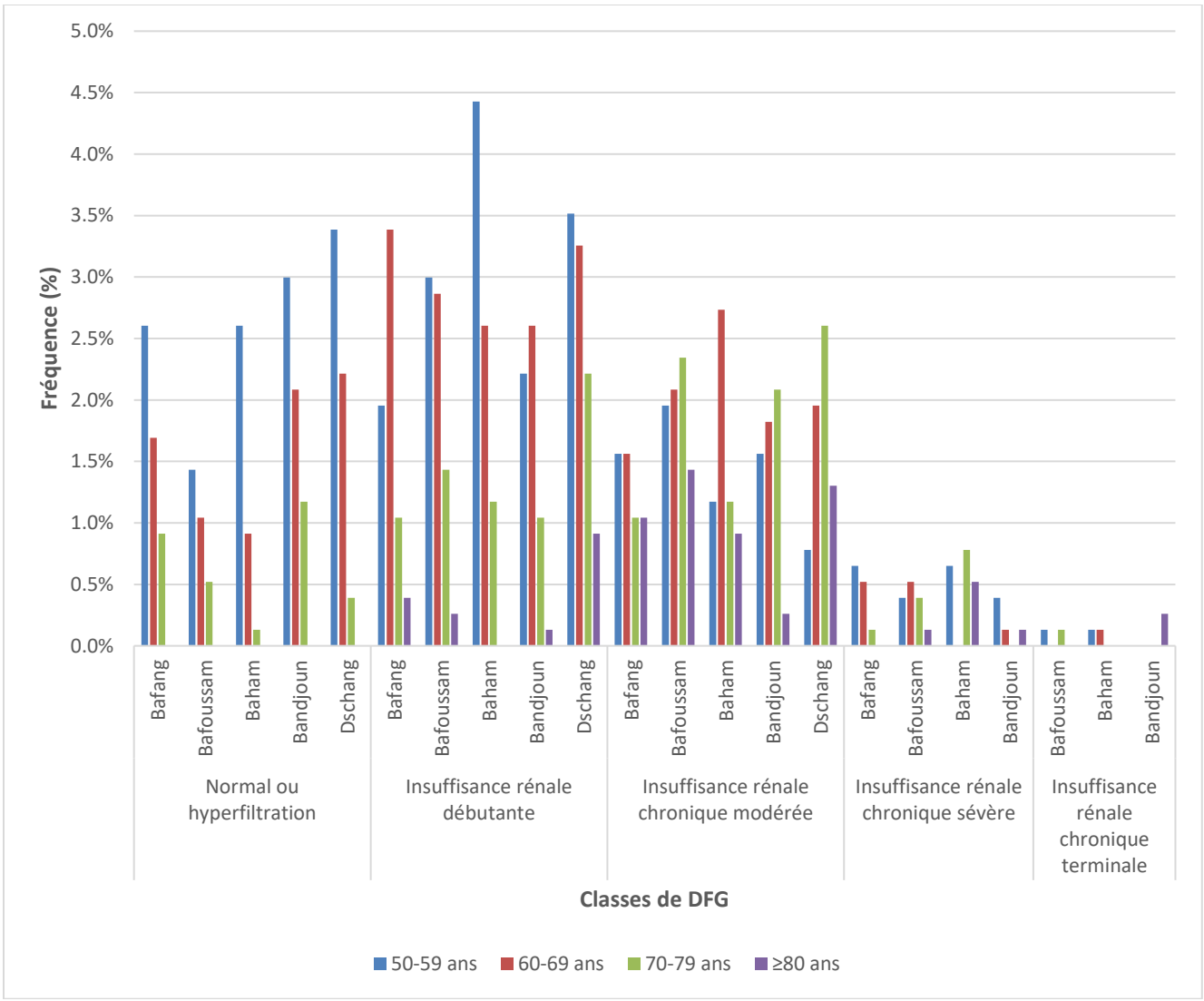

Figure 4:- Distribution of GFR Classes by Age Groups in the Study Localities.

The analysis of this figure shows the distribution of Glomerular Filtration Rate (GFR) classes by sex (female and male) in different localities (Barang, Baroussam, Bandjoun, Dschang).

Key observations:

- Normal or hyperfiltration: The frequency of normal or hyperfiltration GFR is generally higher in men than in women across most localities, indicating that men tend to maintain better kidney function at this stage.
- Early-stage renal insufficiency: Women show higher levels of early-stage renal insufficiency, especially in Dschang and Baroussam, which may suggest increased vulnerability among women at this early stage of kidney function decline.
- Moderate and severe chronic renal insufficiency: Rates of both moderate and severe chronic renal insufficiency are more pronounced in women. This could reflect differences in susceptibility to chronic kidney diseases or gender-specific health factors.
- End-stage chronic renal insufficiency: Although cases of end-stage chronic renal insufficiency are rare, they appear to be more frequent in women in certain localities, raising concerns about healthcare and interventions needed for this population.

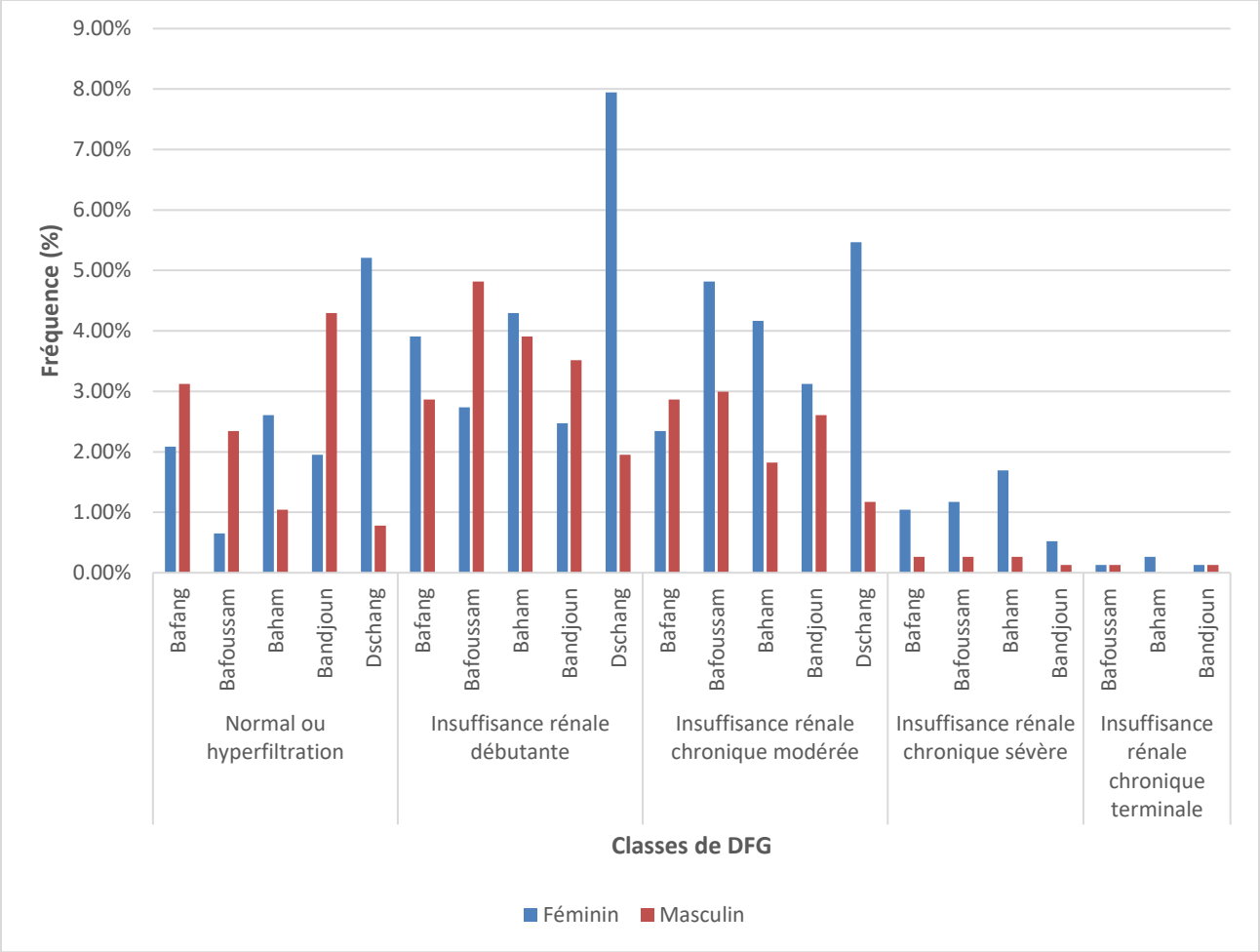

Figure 5:- Distribution of GFR Classes by Gender in the Study Localities.

Discussion:-

The findings of this study align with previous research highlighting the complex relationship between aging, nutrition, and renal function deterioration. A detailed analysis of the data reveals multiple pathophysiological interactions involving renal functional reserve, nephron loss, and the socioeconomic determinants of kidney health.

Hypoproteinemia and Kidney Dysfunction

In line with the groundbreaking research of Levey et al. (2003), who demonstrated that insufficient protein intake lowers renal functional reserve and speeds up the development of chronic kidney disease (CKD), our results show a significant correlation between hypoproteinemia and the prevalence of kidney disease. Furthermore, Brenner and Rector (2020) stress that functional nephron loss in older adults with hypoproteinemia is exacerbated by reduced compensatory mechanisms, increasing vulnerability to hemodynamic and metabolic disorders. These findings highlight the therapeutic significance of regular dietary evaluation in the elderly as a possible preventative measure against the advancement of chronic kidney disease.

Aging and Renal Decline

One physiological component that is unavoidable in the slow fall of glomerular filtration rate (GFR) is aging. In keeping with the findings of Johnson et al. (2018), who reported increasing nephron atrophy and interstitial fibrosis with age, our study demonstrates a notable acceleration in the decrease of renal function among people over 70. Furthermore, our data reveals a harmful synergy between aging and hypoproteinemia in renal degeneration. Although this balance needs to be carefully regulated to prevent aggravating the renal metabolic burden, this link implies that increasing protein consumption could be a crucial nutritional strategy in reducing the decline of GFR.

Geographical and Nutritional Disparities

Significant disparities in the incidence of CKD are shown by a locality-stratified study, with higher rates of moderate-to-severe forms reported in Dschang and Baham. According to Kovesdy et al. (2017), who showed that delayed diagnoses, restricted access to healthcare, and malnutrition all contribute to the worsening of chronic kidney disease (CKD) in vulnerable groups, these discrepancies can be explained by socioeconomic and nutritional determinants. Furthermore, our findings point to a gradient of healthcare management disparity that may be lessened in these areas by better integrating health education initiatives with nutritional monitoring.

Recommendations for CKD Management:-

A primary and secondary prevention program targeting at-risk populations could be a key action lever in reducing CKD prevalence in resource-limited regions. Franceschi et al. (2019) showed that integrative approaches combining tailored nutritional strategies and regular renal function monitoring can slow CKD progression and improve the quality of life of elderly patients. Based on the combined impact of aging, hypoproteinemia, and geographic disparities on CKD progression, it is imperative to develop targeted interventions adapted to local specificities.

Conclusion:-

These findings underscore the need for preventive strategies that focus on improving nutritional intake and ensuring regular renal function monitoring, especially in regions with limited healthcare access. The implementation of context-specific public health policies could play a crucial role in reducing the prevalence of chronic kidney disease (CKD) and promoting better renal aging in African settings. This study emphasizes the critical influence of aging and hypoproteinemia on the progression of chronic kidney disease, while also highlighting the impact of geographical and socioeconomic disparities on disease outcomes.

Recommendations:-

1. **Nutritional Assessment and Intervention Programs** Establishing routine nutritional assessments as part of standard geriatric treatment is crucial because hypoproteinemia plays a critical role in the course of chronic kidney disease (CKD), particularly in the elderly. Protein supplements are one type of targeted nutritional intervention that should be used to decrease the progression of chronic kidney disease (CKD) and minimize renal deterioration. To address the faster renal deterioration seen in this group, this should be done in conjunction with renal function monitoring, especially in those over 70 years.
2. **Context-Specific Nutritional and Healthcare Strategies** The study's findings highlight substantial geographical disparities in CKD prevalence. To address these, health policies should integrate region-specific strategies, focusing on local dietary patterns, healthcare access, and socioeconomic determinants of health. Expanding access to essential health services, including renal function tests and nutritional counseling, can reduce the incidence of moderate-to-severe CKD in regions like Dschang and Baham, where higher rates were observed.
3. **Primary and Secondary Prevention Programs** It is crucial to implement both primary and secondary prevention programs to target at-risk populations. These programs should focus on early detection of CKD through regular screening of elderly populations, with a particular emphasis on those with hypoproteinemia. Public health campaigns should also educate individuals on the importance of maintaining a balanced diet, regular exercise, and proper medical care to prevent the onset or worsening of CKD.
4. **Increased Access to Renal Function Monitoring** Regular renal function monitoring is critical to identifying early signs of kidney decline, especially in elderly individuals who are more prone to CKD. Health services should prioritize renal health by incorporating regular kidney function tests in routine check-ups, especially for populations at higher risk, such as those with malnutrition, older age, or pre-existing conditions.
5. **Healthcare Infrastructure Enhancement** Addressing the challenges posed by limited healthcare infrastructure is vital, particularly in resource-limited settings. Strengthening healthcare facilities, providing mobile health units, and increasing healthcare workforce training on CKD and geriatrics can significantly improve early diagnosis and timely intervention. Expanding access to diagnostic services, especially in rural areas, would support better management of CKD and prevent further progression.
6. **Educational Campaigns on Nutritional Health** Public health education campaigns should be launched to raise awareness of the importance of proper nutrition in maintaining renal health. Such campaigns can educate elderly individuals and their caregivers about the risks of malnutrition and how it can affect kidney function. This education should include information about the importance of protein intake, the potential impact of dietary imbalances, and strategies to improve overall nutritional health.
7. **Integration of Nutritional Monitoring into National Aging Policies** Governments and policymakers should integrate regular nutritional assessments and renal function monitoring into national aging and public health

policies. By prioritizing these practices, governments can proactively address the aging-related challenges of CKD. The inclusion of these services in public health policies would ensure the elderly population receives comprehensive care aimed at preventing and managing CKD.

Declarations

Ethical Approval and Consent to Participate:

This study was approved by the Ethical Committee of the Bafoussam Regional Hospital. Written informed consent was obtained from all participants.

Availability of Data and Materials:

The datasets used and analyzed during this study are available upon reasonable request from the corresponding author.

Competing Interests:

The authors declare no competing interests.

Funding Statement:

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Authors' Contributions:

- **Claude Alain NGNOTUE MBOBDA : Study design, data collection, statistical analysis, manuscript drafting.**
- **Dieudonné ADIOGO : Supervision, methodology validation, manuscript review.**
- **Arnold TIOFACK ZEBAZE, Rollin Mitterrand KAMGA, Christelle Laure MAGUIPA T, Cédric KENDINE VEPOWO : Data analysis, manuscript editing, and critical revision.**

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References:-

1. Levey, A. S., Coresh, J., Balk, E., Kausz, A. T., Levin, A., Steffes, M. W., Hogg, R. J., Perrone, R. D., Lau, J., & Eknoyan, G. (2003). National Kidney Foundation practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. Annals of Internal Medicine, 139(2), 137-147. https://doi.org/XXXX
2. Brenner, B. M., & Rector, F. C. (2020). The Kidney (10th ed.). Elsevier.
3. Johnson, R. J., Feehally, J., & Floege, J. (2018). Comprehensive Clinical Nephrology (6th ed.). Elsevier.
4. Kovesdy, C. P., Kalantar-Zadeh, K., & Mehrotra, R. (2017). Nutritional status and chronic kidney disease. Advances in Chronic Kidney Disease, 24(4), 276-283. https://doi.org/XXXX.