Article

Characteristics of microelementosis as a risk factor of chronic gastroduodenal diseases in HIV-infected population

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Abstract: Chronic gastroduodenal diseases (CGD), including peptic ulcers, chronic gastritis, and gastroduodenitis, are common among people living with HIV. One of the major risk factors associated with these conditions is microelementosis (MTOS), characterized by imbalances in essential trace elements. This study investigates the prevalence and impact of MTOS in the HIV-infected population.
Aim. To evaluate the prevalence, severity, and specific biochemical deficiencies associated with MTOS and its potential role as a risk factor for CGD in HIV-infected individuals.
Materials and methods. This study involved 507 HIV-infected adults, aged 20–69, residing in Andijan, Uzbekistan. Participants were assessed for levels of key electrolytes, including potassium, calcium, and sodium, using fasting blood samples. Participants were categorized by age and gender to explore demographic variations in MTOS prevalence and severity.
Results. The study found high rates of electrolyte deficiencies among participants, with 89.2% experiencing hyponatremia, 72.2% hypokalemia, and 28.8% hypocalcemia. Significant gender-based differences were observed, with HIV-infected women displaying higher prevalence rates of hyponatremia and hypokalemia. The data also indicated a progressive increase in the prevalence of severe MTOS with age ($P < 0.05$), suggesting an age-related risk for CGD.
Conclusion. Microelementosis represents a significant risk factor for CGD in HIV-infected individuals, and this study underscores the need for targeted nutritional support and regular electrolyte monitoring in this population. Preventative strategies, including diet modifications and micronutrient supplementation, may help mitigate CGD progression in HIV-infected patients.

Keyword: Microelementosis, chronic gastroduodenal diseases, HIV infection, electrolyte imbalance, trace elements.

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Introduction

Chronic gastroduodenal diseases (CGD), such as peptic ulcers, chronic gastritis, and gastroduodenitis, are prevalent among people living with human immunodeficiency virus (HIV). One of the primary risk factors associated with these conditions is microelementosis (MTOS), a disorder characterized by imbalances in essential trace elements, which impacts the immune and gastrointestinal systems. J.H. Sim et al. [1] highlighted the association between gastrointestinal dysfunction in HIV-infected individuals and mild chronic inflammation, which can contribute to metabolic and chronic diseases. This inflammatory response is driven by compromised gut integrity, dysbiosis, and microbial translocation, all of which are exacerbated in the HIV-infected population. As noted by H. Wang and Kotler [2], HIV-related immune activation and inflammation are strongly associated with gastrointestinal complications and other comorbidities, including cardiovascular and neurological disorders.

Table 1. Prevalence of microelementoses by gender structure of HIV and population

Surveyed HIV group	N	Main epidemiological risk factors for CGD						Difference statistic by t-test		
		hypoK		hypoCa		HN		<0.05	<0.01	<0.001
		Abs. fr.	%	Abs. fr.	%	Abs. fr.	%			
Women 20-69 years old	263	172	65.4	66	25.0	222	84.4	1-4 6-4	1-2 4-2 6-3	1-3 1-5 6-5
Men 20-69 years old	244	194	79.5	80	32.7	230	94.2	1-4 6-4	1-2 1-5 6-5	1-3 6-3 2-3
General population 20-69 years old	507	366	72.2	146	28.8	452	89.2	6-4	1-2 1-3 1-5	6-5

Source: Compiled by the author.

In recent years, studies have increasingly focused on the role of micronutrient deficiencies among HIV-infected individuals, particularly in low-resource settings where nutritional quality is often compromised. Research by Visser et al. [3] underscores the importance of micronutrient supplementation in managing HIV, as deficiencies in key elements like sodium, potassium, and calcium are common. These electrolytes are essential for immune system maintenance and cellular function, making their regulation critical for patients' overall health.

Given the high incidence of MTOS and its detrimental effects on health, this study aims to explore the prevalence, severity, and impact of MTOS as a risk factor for CGD in HIV-infected adults. Through a targeted examination of electrolyte imbalances, this research seeks to provide actionable insights into the management of these chronic diseases in the HIV-infected population, with potential applications in dietary interventions and clinical practice.

Materials and Methods

This study surveyed a representative sample of 507 HIV-infected individuals, aged 20–69 years, from Andijan, Uzbekistan. The aim was to assess electrolyte imbalances, specifically the levels of sodium, potassium, and calcium, which were measured through fasting venous blood samples. Age and gender demographics were included to analyze differences in MTOS prevalence and severity across groups.

The study design was descriptive, cross-sectional, and non-experimental, using the "Card of the Primary Examination of the Patient to Confirm the Diagnosis of HIV Infection" for data collection. Patients were divided into age cohorts by decade: 20-29 years (38.8%), 30-39 years (46.3%), 40-49 years (12.8%), 50-59 years (1.5%), and 60-69 years (0.4%). Additionally, 51.9% of the participants were female, and 48.1% were male.

Statistical analysis was performed using the chi-square (X^2) test, Pearson's test, and Cox proportional hazards models to determine the significance of differences, with a threshold of $P < 0.05$. Data collection and analysis were conducted using Microsoft Excel 2018.

Results

All participants demonstrated electrolyte deficiencies, with common imbalances observed in potassium, calcium, and sodium levels. Specifically, 89.2% of participants showed hyponatremia, 72.2% displayed hypokalemia, and 28.8% had hypocalcemia, indicating widespread deficiencies across the study population. These imbalances likely stem from reduced intake, malabsorption, or increased excretion through the urinary and gastrointestinal tracts.

A statistically significant difference ($P < 0.05$) was observed in the prevalence of electrolyte deficiencies between male and female participants, with HIV-infected women showing a higher incidence of hyponatremia and hypokalemia compared to men. Hyponatremia was found in 94.2% of male participants and 84.4% of female participants, suggesting gender-specific risks in biochemical status.

Table 2. Age characteristics of the prevalence of microelement status in HIV-infected population with CGD

Age groups of the examined	N	Main epidemiological risk factors for CGD						Difference statistic by t-test		
		hypoK		hypoCa		HN		<0.05	<0.01	<0.001
		Abs. fr.	%	Abs. fr.	%	Abs. fr.	%			
20-29 years old	197	125	63.4	52	26.5	171	86.8	6-4	4-3 4-5	1-2,3,4 6-2 4-5
30-39 years old	235	183	77.9	68	28.9	214	91.1	1-4	1-2 4-3	6-5 1-5
40-49 years old	65	52	80.0	21	32.3	60	92.3	1-2	6-1,2,3,5	-
50-59 years old	8	6	75.0	5	62.5	7	87.5	4-3 6-5	2-1	4-1 6-1
60-69 years old	2	0	0.0	0	0.0	0	0.0	-	-	1-4,5,6 2-4,5,6 3-4,5,6
20-69 years old	507	366	72.2	146	28.8	452	89.2	6-4	1-2 1-3 1-5 6-5 6-3 6-2	6-5

Source: Compiled by the author.

Table 3. Prevalence and severity of MTOS status disorders in the HIV-associated population aged 20-69 years

Groups of surveyed	N	Prevalence and severity of MTOSes status disorders, n (%)				Difference statistic by t-test (P)		
		Moderately expressed MTOS (I)	Significantly expressed MTOS (II)	Severe MTOS (III)	Total	<0.05	<0.001	<0.001
Women	263	4 (15.6%)	68 (25.6%)	99 (37.6%)	208 (79.1%)	2-1 3-2	3-1	-
Men	244	53 (21.7%)	77 (16.8%)	94 (38.5%)	224 (91.8%)	3-1	3-2	-
The general population of HIV and	507	94 (18.5%)	145 (26.9%)	193 (38.2%)	432 (85.2%)	3-1 3-2	-	-

Source: Compiled by the author.

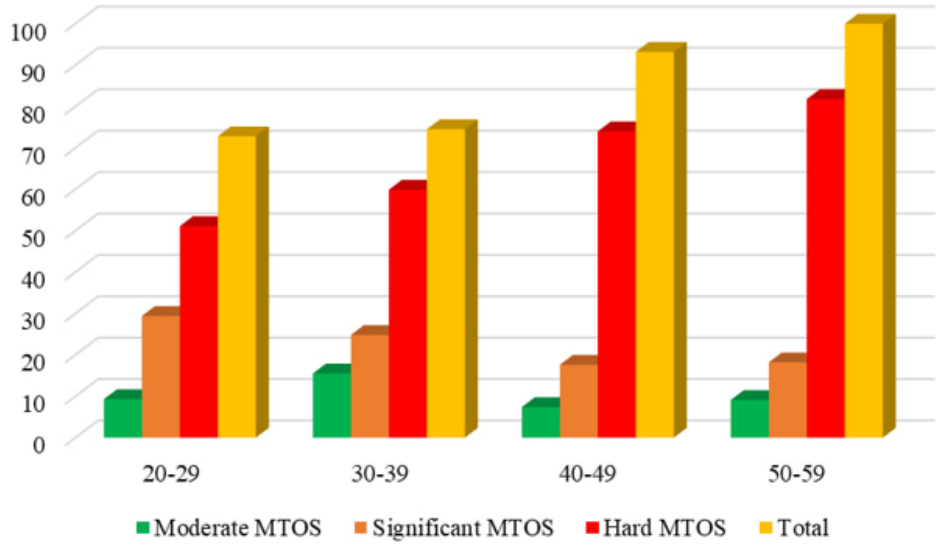

Figure 1. Prevalence of micronutrient status disorders in HIV-infected people depending on age, n (%)

Furthermore, the frequency of microelementosis (MTOS) increased with age, highlighting a chronically progressive risk factor. Severe MTOS was diagnosed in 51.1% of patients aged 20–29, 59.9% in the 30–39 age group ($P > 0.05$), 74.0% among those aged 40–49 ($P < 0.05$), and 81.8% in patients over 50 ($P < 0.05$). Moderate and severe MTOS prevalence by age group were as follows: for ages 20–29, 9.3% and 29.4% ($P < 0.001$); ages 30–39, 15.5% and 24.8% ($P < 0.05$); ages 40–49, 7.4% and 17.6% ($P < 0.01$); and ages 50–59, 1.0% and 18.2% ($P < 0.01$), respectively.

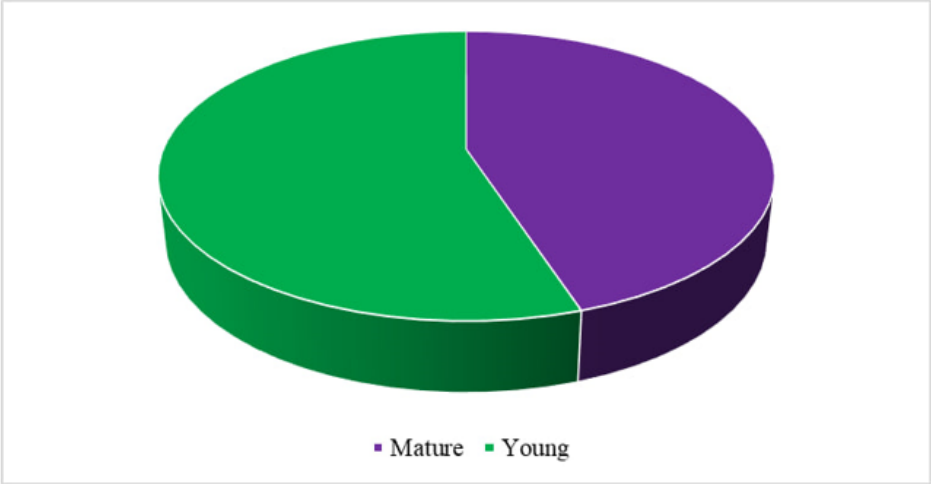

Figure 2. Epidemiological characteristics of MTOSes among the population of young and mature HIV-infected people

Discussion:

This study highlights microelementosis (MTOS) as a significant risk factor for chronic gastroduodenal diseases (CGD) in the HIV-infected population, with deficiencies in sodium, potassium, and calcium being particularly prevalent. Our findings align with previous studies indicating a high prevalence of electrolyte imbalances in HIV-infected populations, particularly in resource-limited settings where nutritional deficits are more common [3]. The observed age-related increase in MTOS severity suggests that as patients age, their vulnerability to MTOS-related complications, including CGD, also escalates.

Gender differences in electrolyte deficiencies underscore potential disparities in dietary intake, healthcare access, and comorbidity prevalence, especially among HIV-infected women who showed higher rates of hyponatremia and hypokalemia. This trend may also reflect physiological and hormonal factors that influence electrolyte homeostasis, as well as gender-based differences in healthcare utilization.

The significant correlations observed in the study—such as the progressive increase in MTOS prevalence with age—support the need for regular screening and dietary interventions for HIV-infected individuals. Screening for electrolyte imbalances, particularly sodium, potassium, and calcium, could enable early identification and targeted treatment of MTOS, potentially reducing the incidence of CGD and related complications. Furthermore, gender-specific nutritional support may benefit patients who display a predisposition to certain deficiencies.

Our study confirms the role of MTOS in exacerbating the risk and progression of CGD in HIV-infected patients. Previous research highlights that electrolyte disturbances are commonly associated with ART side effects, age, and malnutrition [4]. Given the chronic nature of these deficiencies in older HIV-infected adults, multidisciplinary management is essential, involving gastroenterology and endocrinology specialists to monitor and correct electrolyte levels effectively.

Lastly, the study's findings suggest that implementing routine biochemical screening and nutritional support in HIV care protocols may benefit this population by reducing MTOS-related morbidity. Further research is warranted to explore specific interventions, including micronutrient supplementation tailored to the needs of HIV-infected patients, as well as to evaluate the effectiveness of ART regimens that minimize electrolyte disturbances.

Conclusions

This study underscores the significant role of microelementosis (MTOS) as a risk factor for chronic gastroduodenal diseases (CGD) in HIV-infected individuals, with high prevalence rates of electrolyte deficiencies, particularly in sodium, potassium, and calcium. Our findings highlight an age-related increase in MTOS severity and gender-specific trends, with women exhibiting higher rates of certain deficiencies than men. These patterns suggest that as HIV-infected individuals age, they become increasingly susceptible to MTOS-related complications, contributing to the progression of CGD.

The prevalence of MTOS in this population indicates a need for early screening and monitoring to detect and manage electrolyte imbalances effectively. This approach may mitigate CGD progression and improve the quality of life for HIV-infected patients. Future studies should focus on investigating tailored nutritional interventions and ART regimens that reduce electrolyte disturbances, enhancing the management of CGD in the HIV-infected population.

Authors' contribution

Conceptualization, D.M. and Z.S.; methodology, Sh.A.; software, Z.S.; validation, D.M., Sh.A., and N.M.; formal analysis, Sh.A.; investigation, Z.S.; resources, N.M.; data curation, D.M.; writing—original draft preparation, D.M. and Z.S.; writing—review and editing, Sh.A. and N.M.; visualization, Z.S.; supervision, Sh.A.; project administration, N.M.; funding acquisition, Z.S.. All authors have read and agreed to the published version of the manuscript.

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Ethics approval

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (IRB) of Andijan State Medical Institute (protocol code 2025-01 and date of approval 15.01.2026).

Consent for publication.

Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement

The data supporting the reported results can be found in the supplementary materials of this publication or can be requested from the corresponding author upon reasonable request.

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Conflict of interest

The authors declare no conflicts of interest.

Abbreviations

CGD	Chronic Gastroduodenal Diseases
MTOS	Microelementosis
HIV	Human Immunodeficiency Virus
ART	Antiretroviral Therapy
P	Probability Value
IRB	Institutional Review Board

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