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Research Article

Impact of Age on the Trace Elements Levels in Human Immunodeficiency Virus Patients on Highly Active Antiretroviral Therapy (AART) Attending Federal Medical Centre Owerri, Imo State, Nigeria

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ABSTRACT

Advancing age is characterized by impaired pharmacodynamic and pharmacokinetic changes. Therefore, this study aimed to assess the impact of age on trace element levels in Human Immunodeficiency Virus patients on Highly Active Antiretroviral Therapy (HAART). A total of 196 HIV-positive patients in the age ranges of 20-29, 30-39, 40-49, 50-59, 60-69, and 70-79 years old who are on HAART were recruited for the study. Determinations of HIV status and plasma trace element levels of the participants were performed using standard procedures. Results obtained from the study showed that zinc, selenium, and iron levels were most pronounced among HAART subjects in the age ranges of 20-29 and 30-39 years old, but declined in HAART subjects in the age ranges of 60-69 and 70-79 years old. In conclusion, it can be deduced from this study that HAART is most effective in younger individuals.

Keywords: Anti-retroviral; Human Immunodeficiency Virus; Selenium; Therapy; Zinc

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INTRODUCTION

According to Fischer *et al*. (2014), the Human Immunodeficiency Virus (HIV) is a type of virus that causes a significant drop in CD4+ counts after invading the host and compromising host immunity, which then

opens the door for the formation of opportunistic infections. WHO report states that 40.4 million people have died from AIDS-related illnesses, and at least 86.6 million people are infected. Recent data predicts that 39 million people will have HIV in 2030, with approximately 1.3 million new cases (UNAIDS, 2023).

It is essential to assess the levels of trace elements in HIV patients receiving highly active antiretroviral therapy (HAART), a combination of several antiretroviral medications used to slow down the replication of HIV in a host and ideally improve critical metabolic functions and developmental processes hindered by HIV infection (UNAIDS/WHO, 2013).

Biological aging is characterized by a decline in physiological activities. Changes in the structure and activities of cells, tissues, and organs associated with aging can directly or indirectly compromise the pharmacokinetics and/or pharmacodynamics of certain drugs, affecting their therapeutic effects, metabolism, and utilization (Ji *et al*., 2021). Therefore, it is crucial to evaluate the effectiveness of this important medication concerning age to identify any potential needs for advancements in its development and ensure optimal delivery of highly active antiretroviral therapy (HAART).

MATERIALS AND METHODS

Study Site

A cross-sectional research study was conducted at the Federal Medical Centre (FMC) in Owerri, Imo State, located in the South-East region of Nigeria. According to the 2006 census, Imo State has an estimated population of approximately 3.9 million, with Owerri being its largest city. The population consists of 62,990 males and 64,223 females, predominantly from the Igbo ethnic group, as well as other tribes. The city is situated between latitudes 29 and 30°E. FMC Owerri plays a vital role as a public health facility in Imo State, offering HIV-related services.

Sample Size

Out of the 196 participants in the trial, using a sample calculator, the sample size was calculated, taking into account a confidence level of 95%, a margin of error of 0.05%, and a population proportion of 9%.

Study population

The study comprised of 126 HIV-positive individuals who are receiving highly active antiretroviral therapy (HAART), 35 were HIV-positive but not receiving HAART, and the remaining 35 tested negative for the virus.

Collection and Preparation of Test Samples

A sterile syringe was used to draw precisely 5 mL of blood from the individuals' antecubital vein, which was then placed in a dry plain plastic tube and allowed to clot. The clotted blood sample was then centrifuged at 1500 rpm for 5 minutes, and the resultant serum was separated into a plain container, carefully labeled, and refrigerated at 2°C before use.

Human Immunodeficiency Virus (HIV) Testing

The subjects' HIV status was determined using a serial testing technique. A drop of serum was collected and tested for HIV with a rapid test kit (Alere Determine HIV-1/2 Ag/Ab Combo). HIV positive results were verified with a second HIV rapid test kit (the Uni-Gold Recombigen HIV kit). In a scenario where the Alere Determine HIV-1/2 Ag/Ab Combo kit produced a positive result but the Uni-Gold Recombigen HIV kit produced a negative result, a tie-breaker (HIV 1/2 Stat-Pak Assay Kit) was utilized to break the tie and determine the subject's HIV status.

Determination of Trace Elements

Collected samples were centrifuged at 500 g for 10 minutes, after which the resulting plasma was stored at −70 °C until analysis. Concentrations of zinc, selenium, and iron were determined using a 7500 CE inductively coupled plasma mass spectrometer (ICP-MS; Agilent, Cheadle, Staffordshire, England) operated in reaction cell mode. Prior to analysis, plasma samples were diluted 1:10 with a solution containing 2% butan-1-ol, 0.05% EDTA, 0.05% Triton X-100, 1% ammonia, and 25 µg/L germanium, which served as the internal standard. The dried samples were digested in 500 µL of 60% ultrapure nitric acid at 70 °C for 4 hours, followed by dilution with 4.5 mL of 1% nitric acid containing 25 µg/L germanium. Plasma internal quality controls (Seronorm, Billingstad, Norway) and external controls (TEQAS, Guildford, UK) were analyzed alongside the test samples to ensure accuracy and reliability.

Data Analysis

The results of this investigation were analyzed using the SPSS software program version 20. The results were presented as mean ± standard deviation. The student's t-test was used to assess the relationship between variables. P-values < 0.05 were considered statistically significant.

RESULTS

The levels of trace elements by age of HIV on HAART patients are displayed in Table 1, indicating that the zinc, selenium and iron levels reported for HIV on HAART patients were lowest in patients within the the age range of 70-79 years and lowest in patients in the age range of 20-29 years.

Table 1: Trace Elements levels by Age Categories in Highly Active Anti-Retroviral Therapy (HARRT) Subjects

Parameter	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	70-79 years
Zinc (µg/dl)	90.77±18.46^{e}	89.14±18.46^{d}	87.77±18.46^{c}	86.43±18.46^{bc}	85.66±18.46^{b}	82.65± 18.46^{a}
Selenium (µg/dl)	87.51±14.01^{e}	85.65±17.97^{d}	82.34±12.43^{c}	80.07±18.04^{b}	78.80±17.22^{ab}	77.25± 9.80^{a}
Iron (µg/dl)	68.52±22.28^{d}	68.50±24.20^{d}	65.40±22.00^{c}	59.06±29.50^{b}	56.23±30.00^{ab}	55.37± 27.53^{a}

Results are expressed as mean ± standard deviation. Values with the different superscript in a row is significantly ($p<0.05$) different

DISCUSSION

Physiological decline characteristically defines biological aging, which involves the progressive accumulation of damage leading to structural and functional changes in cells, tissues, and organs, ultimately increasing the risk of diseases and death (Ji *et al*., 2021). The decrease in zinc, selenium, and iron levels observed with increasing age could be attributed to declining physiological functions and subsequent alterations in cell, tissue, and organ function, which may ultimately lead to impaired metabolism and utilization of these elements. This findings in this study is consistent with the results of Baudry *et al*. (2020), who reported decreased levels of manganese, zinc, and selenium in aged subjects. In a US survey, Quilhate *et al*. (2012) found that higher manganese levels were associated with younger age, while the highest manganese concentration was observed in individuals in the 30-39 years age range in a study conducted in Korea (Kim et al., 2011). A study carried out in Brazil among 947 adults aged 40 years and older revealed that blood manganese levels were significantly lower with higher age (Da Silva et al., 2017).

CONCLUSION

The study assessed the influence of age on the levels of trace elements in human immunodeficiency virus patients receiving highly active antiretroviral therapy (HAART). The findings suggest that the intake of HAART does not affect blood trace elements. However, age may play a significant role in this scenario.

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