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A cross-sectional prospective study on the relationship between serum liver enzymes and hypertension in patients accessing health care services at Nebbi General Hospital, Nebbi District.

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Abstract

Background

Hypertension is associated with cardiovascular disease (CVD) and has a relationship to liver health. The objective of the study was to establish the relationship between serum liver enzymes and hypertension among patients accessing health care services at Nebbi General Hospital.

Method

A cross-sectional prospective study was carried out to evaluate the relationship between liver enzymes and hypertension in Nebbi general hospital between December 2022 and May 2023. Data was collected by performing laboratory analysis of liver enzymes and interviewing the patient about their biodata. The data was sorted and analyzed using SPSS for Windows version 25. The data analyzed was presented by using charts, figures, tables, graphs, and useful conclusions were made.

Results

The study analyzed data from 108 individuals and observed varying prevalence rates of elevated liver enzymes, ranging from 0.9% to 46.3%, based on different liver enzymes (ALP 0.9%, ALT 7.4%, AST 27.8%, and GGT 46.3%). The analysis of the data further revealed that all liver enzymes, except ALT, were elevated in females (P>0.05). Additionally, certain liver enzymes, such as ALT and ALP, were elevated in the age group 50-59 years, while AST and GGT were elevated in the age group of 60-69 years (P>0.05).

Conclusions

The current research findings align with previous studies indicating a relationship between elevated liver enzymes and hypertension. This current study suggests a potential link between hypertension and liver dysfunction, as indicated by elevated liver enzymes.

Recommendations

The study underscores the importance of monitoring liver health in individuals with hypertension and raises awareness of potential liver-related complications. Further research is needed to elucidate the underlying mechanisms and clarify the clinical implications of these associations.

Keywords: *Hypertension, Liver enzymes (GGT, AST, ALT, ALP), Nebbi General Hospital, Nebbi District.*
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Introduction

The global burden of non-communicable diseases (NCDs) is immense and growing (Joseph et al., 2020). The disease has now emerged as a major global health concern, posing significant challenges to healthcare systems worldwide (Omotayo et al., 2024). Hypertension is a major contributing factor to cardiovascular disease (CVD) and one of the leading causes of death in the world. The world prevalence of hypertension was 26% in 2000 and is projected to increase by 29.2% in 2025 (Rahman et al., 2020). The incidence of hypertension is increasing in developing and developed countries. In the Asian region, hypertension has become a significant concern affecting over 35% of adults, and particularly Southeast Asia is facing an increasing

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burden of hypertension (Rahman et al., 2020). Unfortunately, hypertension is one of the major causes of premature death globally (Khalili et al., 2022). Moreso, the highest prevalence of adult hypertension globally is in the WHO's African region (35-38%), with the mean age of hypertensives in the West being late 30s to 40s (Joseph et al., 2020). Although the relationship between serum liver enzymes' levels and hypertension has been reported in limited studies (Khalili et al., 2022), the interrelationship between liver dysfunction and the development of hypertension is increasingly recognized (Cleveland Clinic, 2021). This study aimed to establish the relationship between serum liver enzymes and hypertension among patients accessing health care services at Nebbi General Hospital.

Materials and methods

Study design and site

The study was cross-sectional and prospective, carried out from December 2022 to May 2023 at Nebbi General Hospital, Nebbi district, Uganda. The Hospital is located 300 metres from Nebbi Town along Paidha Road. It is a government-run health facility providing many services, not limited to a chronic care clinic, laboratory, OPD, maternity, emergency, supervision of lower health units, and an ophthalmic clinic. The health unit serves the communities of Nebbi, Pakwach, Maddi Okollo, and Zombo districts. The health unit was chosen due to high patient turnover and the researcher's familiarity.

Study population

The study population was hypertension patients seeking health care services at Nebbi general hospital OPD and the chronic care clinic of all age groups.

Inclusion criteria

The study only included patients with confirmed hypertension who were sent to the chronic care clinic to be started on treatment.

Exclusion criteria

The study excluded patients who were severely ill and in emergency conditions.

Sample size determination

Sample size was determined using the formula, Kish and Leslie 1965.

$N = PQZ2/E2$

Where, P = population estimate, taken at 50% (0.5) because the population size was unknown.

$Q = 1-P=1-0.5=0.5$

Z = confidence level, 95% (1.96) is taken.

E = error level (precision), taken at 10%=0.1.

$N=0.5X0.5(1.96)2/ (0.10)2$

$N=96.04=97$

Adjustment for non-response rate: We expected a 10% non-response rate and adjusted the sample size. That is, adjusted sample size = 106.7. Therefore, a sample size of 108 was considered.

Study tool design

The researchers designed a simple questionnaire, a laboratory report form, and a simple data entry form to collect data.

Sampling technique

The purposive sampling technique was used, and it targeted only hypertensive patients accessing health care services at Nebbi General Hospital at the time of the study. Only those who consented were enrolled in the study.

Minimizing bias

The prospective patients were purposefully selected. Standardized data collection tools were designed. Standard operating procedure was strictly followed for determining liver enzyme levels and blood pressure measurements. Clear inclusion and exclusion criteria were followed and used. Control samples were included while running tests for liver enzymes. Reagents' expiry dates were checked before their use. Appropriate statistical software, such as SPSS version 25, was used to determine the association between variables.

Study procedure

Researcher-guided questionnaire administration

The researchers guided the respondents to answer a simple questionnaire seeking information on possible risk factors attributed to hypertension.

Blood sample collection

Venous blood samples were taken from the respondents following a standard operating procedure. The blood samples were dispensed into a plain tube and allowed to clot. The specimens were then centrifuged, and the serum was separated, ready for enzyme analysis.

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Liver enzyme testing

The liver enzymes were tested using a Fully Automatic Automated Analyzer Humastar 200 For Hospital Use, Assays - Clinical Chemistry. The analyzer offers precise and rapid testing for a wide range of biochemical assays, including liver function, kidney function, glucose, and lipid profiles.

Data analysis

Data was analyzed using SPSS for Windows version 25. The analyzed data were presented as charts, tables, and figures, with narratives.

Ethics

Ethical approval for the research was granted by Mengo Hospital Research Ethics Committee (MHREC) on 20th March 2023 under the ethical clearance number MH/REC/31/02-2023. An introductory letter was obtained from the principal tutor, Mengo Hospital Medical Laboratory Training school, and submitted to the medical superintendent, Nebbi Hospital. The authority to carry out the study was obtained from the medical superintendent, Nebbi Hospital, and the Laboratory Manager. Written informed consent was obtained from the study participants, ensuring privacy and confidentiality by not including the patients' names and other personal identification details. Laboratory identification criteria were developed and used. Participant information was kept confidential.

Results

Figure 1: Number of study participants enrolled and studied

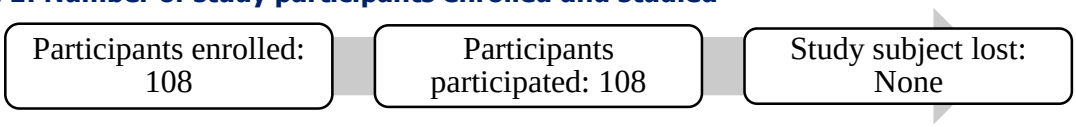

Table 1: The social demographic characteristics of the respondents

Variables		Frequency(f)	Percent (%)
Sex	Female	59	54.6
	Male	49	45.4
	Total	**108**	**100.0**
Age group (years)	20-29	6	5.6
	30-39	13	12.0
	40-49	18	16.7
	50-59	17	15.7
	60-69	24	22.2
	70-79	16	14.8
	80-89	12	11.1
	90-99	2	1.9
	Total	**108**	**100.0**

Table 1 illustrates the social demographic characteristics of the respondents. Findings revealed that the majority of them were females (54.6%) compared to males (45.4%) [n = 108]. Findings also showed that the majority of the patients were in the age group 60-69 years, accounting for 22.2%, and the average age was 58 years (standard deviation 17.0) with a range of 25-90 years (65 years).

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Table 2: The prevalence of elevated liver enzymes in hypertensive patients at Nebbi General Hospital

Variables		Frequency(f)	Percent (%)
ALT	0-45 U/L (Normal)	100	92.6
	>45 U/L (High)	8	7.4
	Total	**108**	**100.0**
AST	0-35 U/L (Normal)	78	72.2
	> 35 U/L (High)	30	27.8
	Total	**108**	**100.0**
GGT	0-30 U/L (Normal)	58	53.7
	>30 U/L (High)	50	46.3
	Total	**108**	**100.0**
ALP	< 44 U/L (Low)	11	10.2
	44-147 U/L (Normal)	96	88.9
	>147 U/L/ (High)	1	0.9
	Total	**108**	**100.0**

Table 2 shows the prevalence of elevated liver enzymes in hypertensives at Nebbi General Hospital. Findings revealed that the prevalence of elevated liver enzymes ranged from 0.9% to 46.3% (ALP 0.9%, ALT 7.4%, AST 27.8% and GGT 46.3%; n = 108). The study findings also revealed that the most elevated liver enzyme was GGT at 46.3%.

Table 3: Elevated liver enzyme levels in hypertensive patients by sex distribution at Nebbi General Hospital

Variables		Sex		Total	p-value
		Female	Male		
ALT	0-45 U/L (normal)	56	44	100	0.312
	>45 U/L (High)	3	5	8	
Total		59	49	108	
AST	0-35 U/L (normal)	42	36	78	0.792
	> 35 U/L (High)	17	13	30	
Total		59	49	108	
GGT	0-30 U/L (Normal)	30	28	58	0.514
	>30 U/L (High)	29	21	50	
Total		59	49	108	
ALP	<=43 U/L (Low)	6	5	11	0.657
	44-147 U/L (Normal)	52	44	96	
	>147 U/L/ (High)	1	0	1	
Total		59	49	108	

Table 3 shows the elevated liver enzyme levels by sex. Findings showed slight variations between females and males but were not statistically significant (all p-values > 0.05). Although all the liver enzyme levels except ALT were elevated in females (AST, GGT, and ALP), sex does not appear to significantly influence liver enzyme elevations in this sample. GGT had the highest proportion of elevations, followed by AST, ALT, and ALP.

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Table 4: The age group more prone to elevated liver enzymes in hypertensive patients at Nebbi General Hospital

Variables		Age group (years)								Total	p-value
		20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99		
ALT	0-45 U/L (normal)	5	13	16	13	23	16	12	2	100	0.124
	>45 U/L (High)	1	0	2	4	1	0	0	0	8	
Total		**6**	**13**	**18**	**17**	**24**	**16**	**12**	**2**	**108**	
AST	0-35 U/L (normal)	4	10	13	11	16	14	9	1	78	0.837
	> 35 U/L (High)	2	3	5	6	8	2	3	1	30	
Total		**6**	**13**	**18**	**17**	**24**	**16**	**12**	**2**	**108**	
GGT	0-30 U/L (Normal)	4	7	10	9	13	6	9	0	58	0.468
	>30 U/L (High)	2	6	8	8	11	10	3	2	50	
Total		**6**	**13**	**18**	**17**	**24**	**16**	**12**	**2**	**108**	
ALP	<=43 U/L (Low)	0	1	3	1	3	2	1	0	11	0.901
	44-147 U/L (Normal)	6	12	15	15	21	14	11	2	96	
	>147 U/L/ (High)	0	0	0	1	0	0	0	0	1	
Total		**6**	**13**	**18**	**17**	**24**	**16**	**12**	**2**	**108**	

Table 4 shows the age group more prone to elevated liver enzymes in hypertensive patients at Nebbi General Hospital. All liver enzymes (ALT, AST, GGT, ALP) showed no statistically significant differences across age groups ($p > 0.05$). Elevated values were present in all age groups and concentrated in middle-aged and older people, peaking at 60-69 years, but no specific group strongly enough to show significance ($p>0.05$). GGT and AST had the highest numbers of elevated results, especially in middle-aged and older participants. The findings also showed that the liver enzyme levels increased with increasing age, peaking at 60-69 years, and thereafter decreased with increasing age ($p>0.05$).

Discussions

The study analyzed data from 108 hypertensive individuals and obtained varying prevalence rates of elevated liver enzymes, ranging from 0.9% to 46.3%, based on different liver enzymes (ALP 0.9%, ALT 7.4%, AST 27.8%, and GGT 46.3%). Notably, GGT was identified as the most elevated liver enzyme. These liver enzymes, such as ALP, ALT, AST, and GGT, are commonly used markers for assessing liver health. Their elevated levels may suggest liver inflammation, injury, or impaired liver function.

This current study highlights a potential link between hypertension and liver dysfunction, as indicated by elevated liver enzymes. This finding was not different from a similar study in Bangladesh, which revealed a prevalence of elevated liver enzymes in hypertension of 49.2% (Rahman et al., 2020).

The current study findings highlight the high prevalence of elevated liver enzymes in hypertensive patients. It underscores the importance of monitoring liver health in individuals with hypertension and raises awareness of potential liver-related complications. This finding also necessitates efforts to address this silent killer and reduce its prevalence, as outlined by the WHO targets.

These findings are supported by previous studies that have explored the association between liver function tests (LFTs) and hypertension. For instance, a study conducted in Chennai examined LFTs in hypertensive patients and reported a significant increase in serum AST and ALT levels. The study concluded that hypertensive patients have a higher risk of diseases associated with abnormal LFT levels (Sathiyamoorthy et al., 2016). Another study found a positive association between increased levels of ALT, GGT, and ALP with hypertension. The study concluded that LFTs could be useful in the early detection of cardiometabolic disorders. (Gaeini Z. et al., 2020). While the specific liver

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enzymes and their associations with hypertension may vary, the overall findings suggest that elevated liver enzymes, such as ALT and GGT, may serve as potential markers for cardiovascular risk in hypertensive individuals.

The current study findings further revealed that all liver enzymes, except ALT, were elevated in females. Although all the liver enzyme levels except ALT were elevated in females (AST, GGT, and ALP), sex does not appear to significantly influence liver enzyme elevations in this sample ($p>0.05$).

This current study further revealed that the liver enzyme levels increased with increasing age, peaking at 60-69 years, and thereafter decreased with increasing age. However, there was no specific age group strongly enough to show significance ($p>0.05$). These findings are different from a similar study in a Chinese population, which found that higher serum gamma-glutamyl transferase (GGT) levels were associated with a high risk of hypertension. They observed a positive association between serum GGT level and the incidence of hypertension, with a stronger association observed in females compared to males (Wu et al., 2021). Similarly, Khalili et al. (2022) also found positive associations between liver enzymes (ALT, AST, GGT) and blood pressure in both genders. Their results indicated that ALT and AST were positively associated with systolic, diastolic, and mean blood pressures in both genders, while ALP was positively associated with systolic and mean blood pressures in females. Thus, certain liver enzymes, particularly GGT, ALT, AST, and ALP, may be associated with hypertension and blood pressure across different age groups. The associations between liver enzymes and hypertension can vary between genders, and the strength of these associations may also differ. The findings of the current study demonstrated the potential role of liver enzymes as markers for hypertension and highlighted the importance of considering age- and gender-specific associations.

Generalizability

Although the current study findings provide valuable insights into the link between elevated liver enzyme levels and hypertension, local variations in patient demographics should be considered.

Conclusions

The findings of the current study suggest that hypertensive individuals commonly have hidden liver enzyme abnormalities, even though these were not strongly linked to specific age groups and gender.

Study limitations

Not all patients who met the criteria consented to participate in the study; low turn-up of patients to the facility due to bad weather during data collection affected the quick realization of the sample, as it was too hot from December 2022 to April 2023.

Recommendations

The study underscores the importance of monitoring liver health in individuals with hypertension and raises awareness of potential liver-related complications. Further research with a large sample size is needed to elucidate the underlying mechanisms and clarify the clinical implications of these associations.

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List of abbreviations

ALP:	Alkaline phosphatase
ALT:	Alanine aminotransferase
AST:	Aspartate aminotransferase
CVD:	Cardiovascular disease
DBP:	Diastolic blood pressure.
GGT:	Gamma glutamyl transferase
HTN:	Hypertension
LFTs:	Liver function tests.
MHREC:	Mengo Hospital Research Ethics Committee.
NAFLD:	Nonalcoholic fatty liver disease.
NCDs:	Non-communicable diseases.
NGHL:	Nebbi General Hospital Laboratory.
NGH:	Nebbi General Hospital.

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OPD: Outpatient department.
SBP: Systolic blood pressure.
SGOT: Serum glutamate oxaloacetate transaminase.
SGPT: Serum glutamate pyruvate transaminase.
SOPs: Standard operating procedures.
UAHEB: Uganda Allied Health Examinations Board.
UNCSTG: Uganda National Council for Science and Technology Guidelines.
WHO: World Health Organization.

Source of funding
The study did not receive external funding

Conflict of Interest
There was no conflict of interest declared.

Author Biography
1. Oyungrwoth Edimond: Born on 14 July 1992, is a dedicated Ugandan medical laboratory professional from Congambe Village in Jangokoro Subcounty, Zombo District. With a strong passion for healthcare and scientific excellence, he has steadily built a career grounded in professionalism, competence, and service to the community. He holds a Diploma in Medical Laboratory Techniques from Mengo Hospital Laboratory Training School and a Certificate in Medical Laboratory Techniques from St. Martin Institute of Health Sciences, Munteme. He is currently advancing his academic career as a Bachelor of Medical Laboratory Science student at Muni University, where he is committed to deepening his knowledge in laboratory diagnostics, research, quality systems, and biosafety. His professional experience spans both public and private health institutions. He served as a Laboratory Technician trainee at Mengo Hospital for three years, a Lab Assistant at Nebbi General Hospital for two years, and a Quality and Safety Officer at Goli Health Centre IV for two years. He has also volunteered at Holy Family Hospital, Nyapea, and trained at Hoima Regional Referral Hospital. These roles have strengthened his expertise in clinical diagnostics and laboratory operations, biosafety, and quality assurance. He has supplemented his hands-on experience with additional training in medical logistics and supply chain management, biosafety and biorisk management, and laboratory quality management systems. His commitment to high laboratory standards and safe practices reflects his dedication to improving patient care. Beyond academic and professional work, Edimond is a humble, spiritually grounded individual who enjoys reading the Bible, preaching, singing, and playing football. These interests reflect his strong values, discipline, and community engagement. With a clear long-term vision, Edimond aspires to progress through academia and ultimately become a Professor in Medical Laboratory Science, contributing to research, training future laboratory professionals, and advancing laboratory medicine in Uganda and beyond. He can be contacted on Tel: +256 (0) 786115612.
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Author contributions

1. Oyungrwoth, Edimond – Conceptualization, Investigation, Methodology,
2. Salamu, Geofrey – Investigation, Supervision.
3. Akullo Mirriam – Review and editing of the manuscript.
4. Mabonga Habert – Review and editing, data analysis.
5. Oromcan, Benjamin Wathum – Original draft, Formal analysis, Writing - review & editing

Data availability

Data was readily available and accessible.

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