TABLE OF CONTENTS

Editorial

Original Articles

Editorial

Artificial Intelligence in Medical Research: "The Paradox of a better tomorrow"

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Introduction

In this arena of medical research there is convergence of technological innovation and scientific ambition. With exceptional technological capabilities, researchers confront the dual challenge of leveraging these tools while maintaining a clear focus on their dominant scientific goals. This fragile balance personifies a significant paradox. While technology offers revolutionary potential, it also introduces complexities that must be navigated carefully to ensure that the ultimate aims of research are not compromised or overshadowed.

Artificial intelligence's (AI) impact on medical research is already evident in areas such as drug discovery, personalized medicine, and diagnostic imaging. Machine learning algorithms can analyze complex datasets far more quickly and accurately than humans, leading to faster identification of potential treatments and more precise tailoring of therapies to individual patients. For instance, AI-driven models can predict how a patient might respond to a particular drug based on their genetic makeup, lifestyle, and environmental factors, paving the way for truly personalized medicine.[1]

With AI's ability to process vast amounts of data, identify patterns, and make predictions, the field of medicine is primed for breakthroughs that could dramatically improve patient outcomes and healthcare systems worldwide. However, alongside this optimism lies a puzzle — the very technology that holds the potential to create a better tomorrow also brings with it challenges and risks that must be carefully steered.[2] Similarly, AI has transformed diagnostic practices, with algorithms now capable of detecting diseases in medical images, often with accuracy levels surpassing those of human experts. This has the potential to reduce diagnostic errors, speed up the diagnostic process, and make healthcare more accessible in regions with a shortage of medical professionals.[3]

Yet, the contradiction emerges when we consider the challenges and ethical dilemmas that accompany these advancements. AI might be seen as flawless, potentially fostering blind trust in its results overlooking the need for careful evaluation within the broader medical context. One of the most significant concerns is the potential for over-reliance on AI, where the technology could overshadow human judgment and expertise. While AI can process data and provide recommendations, it lacks the subtle understanding, ethical reasoning and empathy that human doctors bring to their practice.[4] For instance, AI can recommend treatment based on algorithms, but it cannot consider the moral implications of a particular intervention, the patient's preferences, or emotional comfort. It cannot offer the compassion that patients often seek from their doctors during difficult diagnoses or treatments.

Another concern is that AI systems are trained on existing datasets, which may not always reflect the diversity of patient populations or account for rare medical conditions. This makes it essential for doctors to critically evaluate AI-generated recommendations and apply their expertise and ethical judgment to ensure the best patient outcomes.

The rapid integration of AI into medical research also raises questions about data privacy and security. AI systems require vast amounts of data to function effectively, often including sensitive patient information. Collecting, storing, and using this data responsibly is paramount. Medical data is among the most sensitive types of personal information, and its mishandling can lead to significant harm. Ensuring that this data is stored and used in ways that protect patient privacy and comply

with ethical standards is a significant challenge. One of the key issues is the risk of data breaches. Medical institutions are increasingly targeted by cyberattacks, and the integration of AI may amplify this risk by creating more access points for malicious actors. A breach could expose personal health records, leading to privacy violations, identity theft, or even insurance fraud. In addition, the misuse of data by entities with unethical intentions could further jeopardize patient confidentiality. This potential information misuse poses a risk to both individuals and the trust that is essential to the patient-doctor relationship.

Another facet of this contradiction is the potential for AI to exacerbate existing inequalities in healthcare. While AI has the capacity to broaden access to high-quality medical care, its benefits may not be evenly distributed. Populations in low-resource settings or those with limited access to technology may not reap the same advantages, potentially widening the gap between different socio-economic groups. Additionally, biases inherent in the data used to train AI models can lead to skewed outcomes, unequally serving marginalized groups.[5]

To address these contradictions, it is crucial that the integration of AI into medical research is approached with a robust ethical foundation, caution and transparency. Collaboration between technologists, medical professionals, ethicists, editors and policymakers is essential to ensure that AI is used in ways that enhance, rather than to diminish the quality of healthcare. This includes rigorous testing and validation of AI systems, ongoing oversight to detect and correct biases, and the creation of comprehensive guidelines to regulate the use of AI in medicine and research. By doing so, we can ensure that the promise of AI is realized in ways that truly benefit all of humanity, creating a future that is not only better but also just and equitable.

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Original Article

Relation between Serum Uric Acid and Anthropometric Measures in Diabetic Nephropathy Patients

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Abstract

Background: Diabetic nephropathy is a major challenge of diabetes mellitus, leading to significant morbidity and mortality. Raised serum uric acid (SUA) tier is a potential cause of deterioration of kidney disease, such as diabetic nephropathy. Anthropometric measures for instance Body Mass Index (BMI) and waist circumference (WC) are crucial markers of adiposity, which is intimately linked to both progression of diabetic nephropathy and hyperuricemia.

Objective: To evaluate the relation between SUA and anthropometric measures in diabetic nephropathy.

Methods: A cross-sectional study was executed involving 150 patients by convenience sampling diagnosed with diabetic nephropathy at the Diabetic Clinic of Tertiary care Hospital in Lahore. SUA levels were measured using enzymatic methods, while anthropometric measures, including BMI and waist circumference, were recorded. The relation between SUA and these anthropometric measures was analyzed using Spearman correlation coefficient.

Results: The median (IQR) SUA in diabetic nephropathy patients was 6.9 (5.4-8.6) mg/dl and in healthy group was 5.2 (4.6-6.2) mg/dl. In diabetic nephropathy group, a significant direct relation of SUA was found with BMI (rho = 0.296, p < 0.001) and also with waist circumference (rho = 0.435, p < 0.001). In healthy group, significant direct relation was found with waist circumference only (rho = 0.212, p = 0.001). SUA, Waist circumference and BMI were higher considerably in diabetic nephropathy when measured against the control.

Conclusion: The study demonstrates a significant relationship between elevated SUA levels and adverse anthropometric measures in diabetic nephropathy patients. These findings suggest that managing obesity through lifestyle modifications and pharmacotherapy could play a critical role in controlling SUA and potentially slowing the progression of diabetic nephropathy.

Key words: Uric acid, waist circumference, diabetic nephropathy.

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Introduction

Diabetic nephropathy is a foremost cause of terminal kidney disease universally, posing a major challenge in diabetes management. With the increasing burden of diabetes mellitus, especially type 2 diabetes, the need to comprehend the mechanisms driving the progression

of diabetic nephropathy is very much required for developing effective interventions.[1]

Serum uric acid (SUA) has emerged as a prime factor in this context. Traditionally considered a marker of renal dysfunction, recent research suggests that elevated SUA levels may play a leading role in the pathology of diabetic nephropathy.[2] Hyperuricemia can induce reactive oxidative stress, inflammation, and vascular dysfunction, all of which contribute to the progression of kidney damage.[3] SUA has been associated with glomerular hypertension, promoting glomerulosclerosis and interstitial fibrosis—hallmarks of diabetic nephropathy. Furthermore, it can impair renal autoregulation, exacerbating damage in individuals with compromised kidney function due to diabetes.[4]

Anthropometric adiposity markers, as Body Mass Index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), body fat percentage, are closely linked to both diabetes mellitus and diabetic nephropathy. Obesity, particularly central (visceral) obesity has a prime role in the pathogenesis of insulin impediment, type 2 diabetes and metabolc syndrome, which are main risk factors for diabetic renal disease.[5,6]

Elevated serum uric acid (SUA) levels are increasingly recognized as both a marker and a potential contributor to the advancement of diabetic nephropathy, particularly in the context of adiposity-related diabetes. The interplay between obesity, uric acid, and diabetic nephropathy can be described through several key mechanisms mediated through insulin resistance.[7] Insulin resistance leads to decreased renal uric acid clearance, resulting in hyperuricemia. Higher uric acid exacerbates insulin resistance by impairing endothelial function and promoting oxidative stress, creating a vicious cycle that contributes to hyperglycemia and accelerates the onset of diabetic nephropathy.[8]

Understanding SUA's role in diabetic nephropathy offers potential therapeutic avenues, such as using urate-lowering agents, to slow disease progression and improve renal outcomes in diabetic patients.[5,6,8]

Current study aims to evaluate the relation between SUA and anthropometric measures in patients with diabetic nephropathy, with the goal of providing insights into potential strategies for slowing disease progression.

Methods

This was cross-sectional observational study, executed at the University of Health Sciences, Lahore over a span of 1 year from March 2010 to February 2011. Approval was taken from Ethical Board of the University of Health Sciences (No: UHS Education/126-091228/20-10-2009). A total 150 patients of diabetic nephropathy were included in the study. Sample size was determined by WHO calculator using the formulation for study design. Convenience sampling technique was employed, and patients were recruited from Services Institute of Medical Sciences, Lahore.[9]

Inclusion criteria were as follows: age between 30-60 years, diagnosed with type 1 or 2 diabetes mellitus, and evidence of nephropathy (microalbuminuria or proteinuria, with or without reduced glomerular filtration rate). Exclusion criteria included patients with gout, chronic inflammatory diseases, or those on urate-lowering therapy.

Paticipants provided written informed consent before recruitment. Demographics, as age, gender, duration of diabetes, and medication history, were gathered through structured questionnaire and previous records.

BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a flexible measuring tape.[5]

Blood samples were collected after an overnight fast. Serum uric acid levels were measured using an enymatic calorimetric method on an automated analyzer. Serum creatinine and glucose levels were also measured to assess renal function and glycemic control.[10]

Data were scrutinized with SPSS version 22. As data distribution was not normal Mann Whitney U statistical test was employed for comparing the Medians of quantitative variables between diabetic nephropathy and healthy groups. Spearman's correlation coefficient was used to evaluate the relationship between SUA levels and anthropometric measures. A p-value <0.05 was of statistical significance.

Results

The population of current study consisted 150 male patients of diabetic nephropathy and 75 healthy male controls. Median (IQR) age of Group 1 subjects was 49.01 (43-55) years and that of the other was 38.5 (35-45) years. The Median (IQR) SUA in diabetic nephropathy patients was 6.7 (5.6-8) mg/dl and in healthy group was 5.2 (4.6-6.2) mg/dl. SUA, Waist circumference and BMI were higher considerably in diabetic nephro-

pathy group as compared to the healthy one (Table- I). In the group with diabetic nephropathy, a significant direct relation was found between SUA and BMI (rho = 0.296, p < 0.0001) also waist circumference (rho = 0.435, p < 0.0001). In healthy group, significant direct/ positive correlation was found with waist circumference only (rho = 0.212, p = 00.001), (Table-II, Figures I & II).

Table I: *Comparison of variables between study groups.*

Variables	Diabetic Nephropathy (N=150)	Healthy Group (N=75)	p-value
Age in years	49.01 (43-55)	38.5 (35-45)	0.000*
Systolic blood pressure	130 (110-140)	115 (90-130)	0.000
Diastolic blood pressure	80 (70-90)	75 (70-80)	0.000
Waist circumference in cm	102 (95-106)	88.5 (72-90)	0.000
Body mass index in kg/m^2	28.72 (25.91-31.67)	27.86 (22.97-30.56)	0.55
Uric acid	6.9 (5.4-8.8)	5.2 (4.6-6.2)	0.000

Mann Whitney U stats is employed to compare study groups. A p-value less than 0.05 is of statistical significance.

Table II: *Correlation of Study variables.*

Correlation of variables by Spearman Test		Waist circumference (cm)	Body mass index (Kg/meter square)
Diabetic nephropathy	Serum uric acid	0.435 0.000*	0.296 0.000*
Healthy group		0.212 0.001*	0.31 0.285

Spearman stats is employed to determine correlation between the variables in each group. A p-value less than 0.05 is of statistical significance.
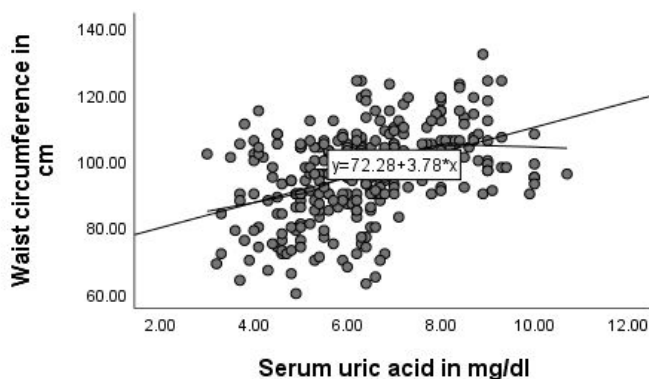
Figure-I: *Scatter plot showing significant relationship between waist circumference and serum uric acid in*

diabetic nephropathy group.
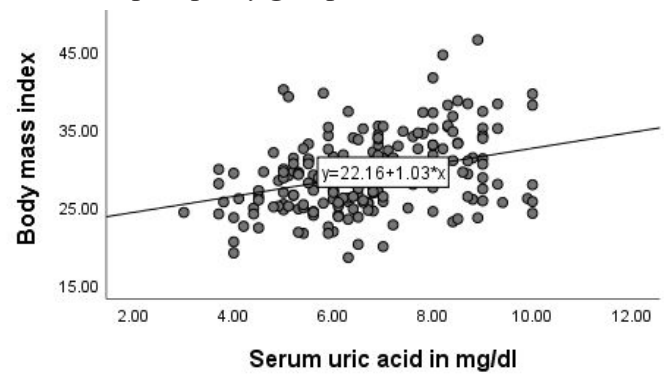
Figure-II: *Scatter plot showing significant relationship between serum uric acid and body mass in diabetic nephropathy group.*

Discussion

The current study evaluated the relationship between serum uric acid (SUA), anthropometric measures of obesity, and diabetic nephropathy in male patients of diabetic nephropathy and healthy male controls. A key observation from the study is the significantly higher median SUA in diabetic nephropathy patients as compared to the healthy subjects. The median level of SUA1 in the diabetic nephropathy group was 6.8 mg/dl, while in the control healthy group was 5.2 mg/dl. This observation is in harmony with previous studies that have pinned hyperuricemia as not only a marker but also a contributor to the pathophysiology of diabetic nephropathy.[10-12] Elevated SUA levels are thought to promote renal injury by inducing oxidizing stress, inflammation, vascular dysfunction, and fibrosis, all of which contribute to the worsening of kidney function in diabetic patients.[13-15] The significantly higher levels of SUA in the nephropathy group highlights the importance of managing uric acid levels in this population to slow down the progression of renal damage.[16]

The study also found that waist circumference and BMI were higher significantly in the group with diabetic nephropathy as to healthy ones, suggesting a strong link between obesity and diabetic nephropathy.[17,18] Obesity, particularly central or visceral obesity is crucial in the evolution of insulin resitance and related states, either of which are closely linked with the onset and progress of type 2 diabetes mellitus and nephropathy.[19] Increased waist circumference and BMI are markers of excess adiposity, which promotes chronic low-pace inflammation, oxidation stress, and dysregulated lipid metabolism.[15] These factors contribute to kidney damage, further

exacerbating diabetic nephropathy in individuals with obesity.

A key finding of this study is the significant direct relation between SUA levels and anthropometric obesity measures, particularly in the diabetic nephropathy group. SUA showed a strong direct relation with waist circumference (rho = 0.435, p < 0.001) and a moderate correlation with BMI (rho = 0.296, p < 0.001). This suggests that individuals with higher levels of central obesity are likely to have elevated SUA tier, further increasing their risk of renal complications.[20] Central obesity, measured by waist circumference, predicts metabolic risk more than BMI alone, as it reflects the accumulation of visceral fat, which is metabolically active and secretes pro-inflammatory cytokines that promote both insulin resistance and kidney damage.[21]

The bridge between SUA and adiposity is well-documented in the literature. Adipose tissue, especially visceral fat, contributes to uric acid production through increased breakdown of purines. Additionally, insulin resistance associated with obesity impairs renal excretion of uric acid, leading to hyperuricemia.[21,22] This creates a bidirectional relationship in which obesity contributes to elevated SUA levels, and hyperuricemia, in turn, exacerbates the metabolic and inflammatory burden of obesity, further promoting renal dysfunction.[22]

Interestingly, in the healthy control group, SUA levels showed a considerable direct correlation with waist circumference (rho = 0.212, p = 0.001) but not with BMI. This finding suggests that even in individuals without diabetic nephropathy, central obesity is a more important determinant of SUA levels than overall body mass. It highlights the potential importance of waist circumference as a risk factor for hyperuricemia and its associated complications, even in seemingly healthy individuals.[23]

Overall, the findings of this study emphasize the complex interplay between SUA, obesity, and diabetic nephropathy. Elevated SUA levels, particularly in the context of obesity, may serve as an early indicator of kidney dysfunction in patients with diabetes. The strong correlation between SUA and central obesity (waist circumference) highlights the need for targeted interventions aimed at reducing visceral fat and managing hyperuricemia to mitigate the risk of diabetic nephropathy.[22-24]

The positive correlations between SUA and anthropometric measures of obesity underscore the potential role of hyperuricemia as a modifiable risk factor in the progress of diabetic nephropathy. These findings suggest that managing both obesity and SUA levels may be key strategies in prevention or postponement of renal complications in diabetic patients.[24]

Conclusion

There is a significant relation between elevated SUA levels and adverse anthropometric measures, particularly BMI and waist circumference, in diabetic nephropathy patients. These indicate that addressing obesity may be a key target in controlling SUA levels and slowing the progression of diabetic nephropathy. Further studies are required to explore the causal relationships and to evaluate the effect of weight management strategies on SUA levels and renal outcomes in this patient population.

Authors Contribution

All the authors contributed equally in accordance with ICMJE guidelines and are accountable for the integrity of the study.

MI: Study design and concept, Acquisition of data and final approval

TT: Data Collection, analysis and final revision

AA: Data Collection, statistical analysis and final revision

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Original Article

Effects of Core Stability Training on Lumbar Flexibility in Postpartum Females with Hyperlordosis: A Quasi-Experimental Study

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Abstract

Background: Lordosis is the natural curve of lumbar spine which is essential for proper posture and spinal alignment. When this angle increases then that is hyperlordosis & when it decreases called hypolordosis. Many postpartum women experience an increase in lumbar lordosis, which can cause discomfort, pain, and postural imbalances, potentially leading to long-term musculature issues. Core stability exercises effectively strengthen the abdominal and spinal muscles, addressing these postural problems and enhancing overall stability, which is crucial for recovery and preventing future complications.

Objective: The current study was designed to assess the effect of core stability training on lumbar flexibility in hyperlordotic postpartum females.

Methods: In this Quasi Experimental study, a Non-Probability-Convenience sampling technique was used to collect the data. The total duration of treatment was 12 weeks. Pre-treatment Modified-Modified Schober Test (MMST) value was measured before and after the treatment of twelve weeks to check the efficiency of the core stability exercises in hyperlordotic postpartum females. Data was analyzed on SPSS 25.

Results: In this study, core stability training significantly decreased lumbar lordosis (p value = 0.000) with mean values of 8.21 ± 0.22 and 7.68 ± 0.37 for Pre-Exercise MMST (Mean ± SD) and Post-Exercise MMST (Mean ± SD) respectively.

Conclusion: Core stability training is a good approach for correcting lumbar lordosis and back pain after childbirth. This means core stability exercises played an important role in correcting hyperlordosis and in gaining the spine's normal curvature hence alleviating symptoms.

Keywords: Postpartum, Core Stability, Lumber Flexibility, Hyperlordotic

Introduction

Pregnancy triggers various physiological adaptations, driven primarily by hormonal shifts, increased weight, and expanded blood volume.[1] These changes often lead to alterations in the spine's curvature, especially in the thoracic and lumbar regions, as well as discomfort in the lower back and pelvic areas. They also affect balance and gait patterns.[2,3] Postpartum, addressing hyperlordosis can benefit from enhanced lumbar flexibility and strengthened core stability, both essential in restoring alignment and alleviating discomfort. Low back pain related to pregnancy is a frequent issue, affecting around 50.9% of pregnant women. Additionally,

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49% report experiencing pelvic pain for more than three months during pregnancy, while 10% continue to have pelvic pain throughout the entire pregnancy. In the first year postpartum, 72% of women suffer from pain in the lumbar and pelvic areas, with some continuing to experience this discomfort for up to three years after giving birth.[4] Some of the musculoskeletal changes in pregnancy include the forward neck flexion, hyperlordosis of the lower back, and laxity of ligaments & joints, increasing the movement of the pubic symphysis and sacroiliac joint.[5] The hormone released in pregnancy softens the ligaments & tendons, leading to the hypermobility of the joints and preparing the body for the delivery phase.[6] Backache is one of the common problems in pregnant females, pain can be of the facet joint and pelvic girdle or combined, 76% of the pain is mainly in the lower back. Even the increased lordotic curvature during pregnancy remains the same after delivery to some extent. Abdominal muscles start separating in later stages of pregnancy which affects the stability of the lower back spine, this, in turn, tightens the hip flexors & lower back muscles to stabilize the spine. Because of all musculoskeletal changes the normal gait pattern of pregnant females gets disturbed and mostly adapts to the waddling gait. These musculature and postural changes cause many musculoskeletal symptoms & pains.[7]

Lumbar Flexibility pertains to the range of motion and ability to move the lower back (lumbar spine) through various motions such as bending forward, backward, and side-to-side. The pelvic floor muscles, diaphragm, and transverse abdominis, as well as superficial muscles like the rectus abdominis, obliques, and erector spinae are among the structures that provide lumbar flexibility and mechanical stability of the spine. Core stability refers to the strength, endurance, and control of these muscles. Postural changes during pregnancy, such as the shortening of the para-spinal muscles, increase in pelvic tilt, and overstretching of the abdominal muscles together with reduced muscle stamina, compromise the strength and stability of the lumbopelvic region.[8] An anterior pelvic tilt increases lumbar lordosis and compensatory thoracic kyphosis, with lumbar hyperlordosis being the most prevalent postural change.

Pregnancy-related lumbar and pelvic girdle pain is a prevalent issue, impacting many women both during pregnancy and postpartum, often leading to functional impairment and reduced quality of life. Studies indicate that stabilizing exercises can enhance physical function and reduce disability in this population, highlighting the potential value of targeted motor control and stability exercises.[9,10] Specific exercises for motor control and stability have been recommended for lumbar and pelvic postpartum pain.[11,12] The level of evidence is, however, limited, as few randomized controlled trials have been performed. Despite limited evidence of effect, core stabilization exercises have grown in popularity and different core stabilization approaches are practiced because of increasing awareness of postpartum issues as well as recommendations by healthcare providers. Investigating the effectiveness of these exercises is essential to establish evidence-based practices for managing postpartum lumbar and pelvic pain, supporting better recovery and long-term well-being for affected women.

In this study, core stability training was used to maintain lumber extensibility to correct the lumber curve from lordosis in hyperlordotic postpartum females. The objective was to assess the effect of core stability training on lumber flexibility in hyperlordotic postpartum females.

Methods

This was a quasi-experimental study, conducted in Jinnah Hospital, Lahore, and was completed within the time duration of six months (July 2021-January 2022). There was only one study group in which core stability exercises were performed. Non-Probability-Convenience sampling technique was used to collect the data as it allows easier recruitment of participants, as the access to postpartum groups is limited in our settings.

After approval from the ethical review board (NO. REC/RCR/AHS/21/0520), informed written consent was collected from all the participants. The sample size was 17, calculated by the online EPITOOL sample size calculator.[13] The sample included postpartum females of 3 months to 6 months, with history of single-ton pregnancy regardless of their delivery history i.e. both females with a history of normal delivery (11) & c-section delivery (6) were included. Age of these females were between 18 to 35years and all participants had a measured Modified-Modified Schober's test (MMST) reading more than 6.85±1.18cm. The participants were matched for BMI and physical activity level. Those with pre-existing musculoskeletal conditions were excluded. Pregnant females or those with a history of complications after or during delivery e.g. infection, accident, or trauma were excluded from this study.

The Modified-Modified Schober Test (MMST) was the tool used to assess the range of motion for the lumbar spine. In MMST, the patient should be in a standing position, the examiner marks both posterior superior iliac spine (PSIS) and then draws a horizontal line at the center of both marks. The second line was marked 5 cm below the first line. The third line was marked 10 cm above the first Line. The patient was then instructed to flex forward as if attempting to touch his/her toes, The examiner measured the distance between the top and bottom line again. If the measurement was less than 5cm, it was hypo lordosis while the normal flexion value was 6.85±1.18cm for the age group of 18 – 35 years, which was in our inclusion criteria.[14]

During the 1st visit of the patients, history was taken along with complete physical examination and Modified-Modified Schober Reading was measured, and treatment was given to the participants. The core stability exercises that were suggested to the patients were toe-tapping, back isometrics, and superman exercises. In this study, three sessions per week were given for twelve weeks. In all sessions, core stability training was performed for all patients. Post-treatment MMST values were measured after the treatment of twelve weeks to check the efficiency of the core stability exercises in hyperlordotic postpartum females. The total treatment was for a period of 12 weeks. All participants followed the same regimen i.e.Toe tapping, Back Isometrics and Superman, the duration of each session same three sets of each 10 repetitions. Data was analyzed on SPSS 25. Comparison between the pre-exercise and post exercise MMST score was done by paired t test as the data was normally distributed (checked by Shapiro wilk test) and a p value < 0.05 was considered significant.

Results

The study involved 17 postpartum females, aged 18 to 35, who underwent 12 weeks of core stability training. The demographic information of the study participants along with pre- and post-intervention MMST score is given in table I. The results showed a reduction in hyperlordosis as shown by pre- and post-treatment MMST scores, with 14 out of 17 participants experiencing improvement. The paired t test confirmed the intervention's effectiveness, with a highly significant p-value of 0.000, indicating a clear impact of the training on postpartum hyperlordosis as shown in Table II. The partici-

Table I: *Demographic information of the study participants*

n = 17	17
	Mean ± SD
Age	25.00 ± 2.34
BMI	23.8 ± 1.6
Pre. Treatment MMST Score	8.211 8±. 21
Post. MMST Score	7.6829 ± .36

n = number of study participants, mean ± SD: Mean ± standard deviation, MMST Value (cm): Modified - Modified Schober's test

Table III: *Comparison of Pre- and Post-Core Stability Exercises MMST score between normal delivery and C section group*

Group	n	C section	Normal delivery	p value
Pre-Exercise MMST **Mean ± SD**	6	8.01 ± 0.12	8.33 ± 0.15	0.12
Post-Exercise MMST **Mean ± SD**	11	7.66 ± 0.17	7.71 ± 0.23	0.18

n = sample size, MMST Value (cm): Modified - Modified Schober's test, mean ± SD: Mean ± standard deviation, p-value calculated by Independent samples t test. p value <0.05 was considered statistically significant.

pants with improved scores had decreased pain as well as improved mobility as described by the participants. The comparison between C-section and normal delivery groups, as shown in Table III, did not yield statistically significant differences. This lack of difference is noteworthy as it suggests that the mode of delivery may not substantially impact the specific outcomes measured in this study.

Discussion

The increased curvature of the lumbar spine observed during pregnancy tends to partially revert after delivery. However, some females experience hyperlordosis post-

Table II: *Comparison of Pre- and Post-Core Stability Exercises MMST score*

n = 17	Pre-Exercise MMST (Mean ± SD)	Post-Exercise MMST (Mean ± SD)	Mean Difference	t-value	p-Value	95% CI
MMST Value (cm)	8.21 ± 0.22	7.68 ± 0.37	0.52 ± 0 .44	4.90	0.000*	(0.30-0.75)

*n = number of study participants, MMST Value (cm): Modified - Modified Schober's test, mean ± SD: Mean ± standard deviation, 95% CI: 95% Confidence Interval, *statistically significant p-value < 0.05 calculated by paired t test.*

partum, which disrupts the anatomical structure of the body and may worsen with subsequent pregnancies. This progression can lead to various musculoskeletal issues and exacerbate symptoms such as pain. Hyperlordosis is primarily driven by the weakening of abdominal muscles and the tightening of lower back muscles and hip flexors.[15] In this study, core stability training was employed to enhance lumbar extensibility and correct the lumbar curve associated with lordosis.[15] The intervention demonstrated statistically significant improvement in MMST scores, underscoring its effectiveness in managing post-pregnancy lordosis. These findings align with evidence suggesting that therapeutic exercises, such as static back, pelvic bridging, crunches, planks, and single-leg pelvic bridging, contribute to core strengthening and help address hyperlordosis.[16] Supporting the results of current study are the findings of Olsson et al. (2019), they compared the effects of physical therapy techniques, including pelvic floor muscle exercises and core stability exercises, on postpartum females suffering from back pain. Their study concluded that core stability exercises yielded more favorable outcomes in reducing lumbar pain and improving abdominal muscle endurance in postpartum females.[17] By synthesizing the findings from this study and prior research, it is evident that core stability exercises play a critical role in managing postpartum hyperlordosis, mitigating associated musculoskeletal issues, and improving overall physical well-being.

The abdominal musculature of the female body weakens in pregnancy because of the continuous stretch & hormonal change. The results obtained through literature show the effects of core muscle training on the trunk muscles' endurance, disability, lower backache, and pain in postpartum.[18] Because of various musculoskeletal changes in pregnancy, the musculature of pregnant females needs to be corrected, and strengthening the lumber portion is necessary to decrease all these symptoms. The Musculature of pregnant females is under the high influence of hormones during pregnancy and because of the continuous increase in the fetus size, the musculoskeletal of pregnant females disturbs and changes the tone and structure resulting in abnormal curvature of the body.[19] Another study reported that the effect of core stability exercises on the sacroiliac joint were amazing, and these exercises can be used as a treatment of the sacroiliac joint in females in the postpartum. Hormonal changes and fetus size affects the sacroiliac joint and leads to disturbance, raising various symptoms

& discomfort. Authors have also discussed that the flexibility and range of the lumber spine can also be increased with the help of core stability exercises, and it improves the movement & position of the joints.[20] The results of the current study are further supported by findings from a randomized controlled trial conducted by Thabet and Alshehri (2019), which examined the effects of a core training program on 40 postpartum women with diastasis recti. Their study demonstrated that core stability exercises were effective not only in reducing the size of diastasis recti but also in alleviating low back pain and improving the quality of life. These findings are particularly relevant to the current study's focus on hyperlordosis and lumbar flexibility, as diastasis recti and postpartum hyperlordosis share common contributing factors, including weakened core muscles and altered spinal alignment. Strengthening the deep core muscles through targeted exercises, as highlighted in both studies, is crucial for restoring anatomical balance, reducing lumbar strain, and improving overall musculoskeletal health in postpartum women. By initiating core stability exercises in the early postpartum stages, as suggested by Thabet and Alshehri, women may not only address diastasis recti but also mitigate the progression of hyperlordosis, thereby enhancing lumbar extensibility and reducing associated symptoms like low back pain. This integration underscores the broader applicability of core training interventions in addressing postpartum musculoskeletal issues.[21] The effects of core strengthening are evident in this study as well, suggesting that every postpartum female should be advised to engage in core stability training to help restore musculature after pregnancy. In support of the current study are the results of Smrcina Z et al., 2022, who performed a systematic review and suggested core stabilization exercises as an effective intervention to improve low back pain.[22] The study has the limitation of a small sample size plus prior activity levels of the participants might influence outcomes. Future studies with larger sample size and taking into consideration the prior activity level could explore the long-term effects of core stability training on lumbar flexibility and functionality.

Conclusion

The effects of core stability training on lumbar flexibility were evident in hyperlordotic postpartum females. Significant improvements were observed in this study, highlighting the important role core stability exercises play in managing hyperlordosis and aiding in the resto-

ration of normal or near-normal spinal curvature.

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SR: Study design and concept, Acquisition and analysis of data and final approval

SA: Study design, interpretation of data and analysis, revision

EA: Study design and concept, Acquisition and analysis of data and final approval

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Original Article

Knowledge, Attitude, and Practices Regarding the Prevention and Control of Malaria in Khyber Pakhtunkhwa: An Observational Study

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Abstract

Background: This Knowledge, Attitudes, and Practices (KAP) study aims to assess local awareness and preventive behaviors concerning malaria in high-risk areas like Karak District. By evaluating understanding transmission, symptom recognition, and treatment-seeking behaviors, the study seeks to inform and enhance malaria control strategies as malaria is one of the most serious global public health challenges, contributing significantly to illness and mortality. The insights gained will aid in developing targeted interventions and improving the effectiveness of malaria control programs.

Objective: To assess knowledge, attitude, and practices regarding the prevention and control of malaria in local population of District Karak.

Methods: This cross-sectional study was conducted in Tehsil Takht-e-Nasrati, Karak district, Khyber Pakhtunkhwa (KPK), using convenience sampling to survey 372 household heads. Data was collected through structured interviews, and only respondents who understood Urdu or Pashto were included. Descriptive statistics and Fisher's exact tests were used for analysis, with a significance level of $p \leq 0.05$. SPSS version 19 was utilized for analysis.

Results: The study found that individuals aged 26-35 years were most affected by malaria. Additionally, 72.31% of participants were employed and awareness and preventive practices showed that 56.45% of participants deemed avoiding outdoor sleeping important, 43.28% advocated for insecticide use and mosquito control, and 42.20% used protective measures, with 42.47% employing bed nets or indoor spraying.

Conclusion: The study reveals a solid understanding of malaria prevention among the population yet emphasizes the need for improved implementation of protective measures and targeted government actions to enhance malaria control.

Keywords: Malaria, Knowledge, Attitude, Prevention, Education

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Introduction

Malaria continues to be a leading cause of illness and death in tropical and subtropical regions, despite ongoing control efforts. Each year, it causes around 300–500 million cases and nearly one million deaths globally, with over 90% of the burden occurring

in sub-Saharan Africa and Asia.[1] Though, the COVID-19 pandemic has hindered malaria control efforts, jeopardizing the progress made against the disease.[2] As a result, malaria cases and deaths rose in 2020, with an estimated 241 million infections and 627,000 fatalities globally.[3,4]

Malaria control depends on timely and accurate diagnosis, treatment and preventive strategies such as using long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS), and intermittent preventive treatment for pregnant women and children. Proportional morbidity dropped from 4.9% in 2015 to 3.3% in 2019, while proportional mortality fell from 3.5% to 1.7% over the same period. However, in 2020, the malaria burden increased again, with morbidity and mortality rising to levels similar to those seen in 2015, reaching 3.8% and 2.1%, respectively.[5] In 2015, malaria cases and deaths significantly dropped, but large populations remain at high risk, especially in Nigeria.[6] Ethiopia is scaling up various malaria control measures to improve access to prevention and treatment, including insecticide-treated nets, indoor residual spraying, and epidemic control. Though malaria mainly affects rural areas, urban transmission is rising due to rapid urbanization and poor sanitation.[7]

The latest world malaria report indicates that nearly half of the global population is at risk, with around 247 million cases and 619,000 deaths reported in 2021.[8] Preventing malaria through improved knowledge and awareness is key to staying healthy. Research on knowledge, attitudes, and practices highlights the importance of direct community engagement in tackling malaria. Community beliefs, perceptions, and attitudes toward symptom recognition, treatment, prevention, and control significantly impact malaria interventions, yet these factors are often overlooked in control efforts. Studies have proven the effectiveness of long-lasting insecticidal nets (LLINs) and indoor residual spraying (IRS), in reducing malaria, leading prevention programs to prioritize these methods for controlling transmission.[9]

Various studies emphasized the role of socioeconomic disparities, pointing to the need for targeted interventions for at-risk populations. KP province has faced a significant rise in malaria cases recently. To address this surge, it's crucial to understand current trends to predict future outbreaks and develop effective interventions.[10]

Malaria is prevalent in District Karak and affects people with low socioeconomic status. Effective prevention depends on local knowledge, attitudes, and practices, but there is a gap in understanding these factors in Karak. This study aims to address this gap and inform targeted awareness interventions in the karak district timely to decrease malaria cases.

Methods

The ethical approval of the study was taken from the ethical review board of Gandhara University Peshawar (No GU/2021/112). The cross-sectional study design was conducted in the Tehsil Takht-e-Nasrati, Karak district, KPK from 1st June 2021 to 20th January 2022. The data was gathered through structured interviews using a questionnaire by the convenience sampling technique. Participation in the malaria study was voluntary, and informed consent was obtained from all participants beforehand. A prevalidated questionnaire was used for the data collection and Cronbach's alpha for this questionnaire was determined to be 0.81 for knowledge, 0.86 for attitude, and 0.91 for practices, respectively. A sample size of 372 was calculated using the open epi sample size calculator, with a 95% confidence level, a 5% margin of error, and a prevalence of 59.5% was used.[11] Inclusion criteria were age (16-55 years), both genders and those who would understand Urdu and Pashto were included. Those who did not consent to participate and individuals who could not understand Pashto or Urdu were excluded from the study and ages below 16 and above 55 were excluded. Older adults may face cognitive challenges, affecting the accuracy of their KAP responses.

The statistical analysis was conducted using SPSS version 19. Descriptive statistics, including frequencies and percentages, were used for variables such as the age of the respondent, monthly income, and employment status, as well as knowledge, attitude, and practice (KAP) variables. For quantitative variables like age, knowledge score, attitude score, and practice score, frequency, and percentages were calculated, and Fisher exact tests were calculated. A significance level (p-value) of ≤ 0.05 was considered statistically significant.

Results

Most respondents are aged 26-35 (53.49%), with 72.31% being employed. Over half (51.61%) hold a BA/BSc degree, and most earn between 21,000-40,000 (62.90%). Overall, the respondents are young, educated, employed, and have moderate income levels.

The results show significant awareness about malaria,

Table I: *Frequency and Percentage of the Participants (n = 372)*

Age of the respondent	ƒ	(%)
16-25	103	27.69
26-35	199	53.49
36-45	67	18.01
46-55	03	0.81
Education level	**ƒ**	**(%)**
FA/FSc	29	7.80
BA/BSc	192	51.61
MA/MSc	94	25.27
Not Affected	57	15.32
Monthly income	**ƒ**	**(%)**
Less than 20,000	52	13.98
Between 21,000-40,000	234	62.90
Between 41,000-60,000	66	17.74
Between 61,000-80,000	12	3.23
Above 80,000	08	2.15
Employment status	**ƒ**	**(%)**
Employed	269	72.31
Unemployed	103	27.69

Percentages (%) and f=Frequency

with 57.26% recognizing it as a deadly communicable disease and 56.45% understanding that mosquito nets prevent it. Additionally, 45.97% know delayed treatment can be fatal, while 43.55% acknowledge the role of personal hygiene in prevention.

A majority (56.45%) believe in avoiding outdoor sleep to prevent malaria, with highly significant results (p = 0.00). Additionally, 53.49 believe that there should be an awareness session regarding the prevention of malaria. (p = 0.02)

The results suggest significant associations between malaria prevention practices and specific behaviors, with Fisher's exact test showing highly significant values (p < 0.05) for several items, such as bed net usage, protective measures, and seeking treatment.

Discussion

In this study, most respondents (53.49%) were between 26-35 years old, with 27.69% falling in the 16-25 age group. More than half (51.61%) held a BA/BSc degree, while 25.27% had completed an MA/MSc, and a smaller group (7.80%) had an FA/FSc qualification. Most respondents (62.90%) earned between 21,000-40,000,

Table II: *Frequency and Percentage of Knowledge (n = 372)*

Knowledge of Malaria	Yes ƒ	Yes %	No ƒ	No %	Uncertain ƒ	Uncertain %	Fishers exact test χ^2	p value
You believe that malaria is a communicable and deadly disease?	213	57.26	84	22.58	75	20.16	12.01***	0.00
Is malaria spread through mosquito bites?	160	43.01	115	30.91	97	26.08	5.20*	0.02
Do you know that stagnant water is the main areas for mosquito breeding?	160	43.01	122	32.80	90	24.19	18.01	0.00
Does a mosquito net prevent malaria?	210	56.45	88	23.66	74	19.89	9.10***	0.00
Does personal hygiene prevent malaria?	162	43.55	119	31.99	91	24.46	5.20**	0.02
Does environmental hygiene prevent malaria?	154	41.40	117	31.45	101	27.15	13.43*	0.00
Do you know that malaria is a treatable disease?	161	43.28	116	31.18	95	25.54	5.19*	0.02
Do you know that delayed treatment seeking and inadequate treatment of malaria can lead to death or is equal?	171	45.97	110	29.57	91	24.46	9.18***	0.00

*n = sample size, p value calculated by Fisher-Exact Test, p value less than 0.05 considered significant, *p < 0.05. **p < 0.01, ***< 0.001.*

Table III: *Frequency and Percentage of Attitude (n= 372)*

Attitude of the participants	Yes ƒ	Yes %	No ƒ	No %	Uncertain ƒ	Uncertain %	Fishers exact test χ^2	p value
Do you use protective measures against malaria?	157	42.20	123	33.06	92	24.73	12.50***	0.00
Should environmental hygiene be promoted?	151	40.59	130	34.95	91	24.46	9.20***	0.00
Should we avoid sleeping outdoor?	210	56.45	88	23.66	74	19.89	19.03***	0.00
Should mosquito nets be used?	158	42.47	115	30.91	99	26.61	6.55**	0.01
Should there be awareness raising sessions for malaria prevention?	199	53.49	90	24.19	83	22.31	5.20*	0.02
Do you believe on using insecticide aerosol sprays, destruction of mosquito breeding and resting areas?	161	43.28	116	31.18	95	25.54	8.68*	0.03

*n = sample size, p value calculated by Fisher-Exact Test, p value less than 0.05 considered significant, *p < 0.05. **p < 0.01, p***< 0.001.*

Table IV: *Frequency and Percentage Distribution of Practices (n = 372)*

Practices against Malaria	Yes		No		Uncertain		Fishers exact test	
	f	%	f	%	f	%	χ2	p value
Do you use bed nets in the house for preventing malaria disease?	150	40.32	129	34.68	93	25.00	10.78	0.00***
Do you use indoor residual spraying of insecticides against mosquito?	158	42.47	120	32.26	94	25.27	5.10	0.02*
Do people in your house use short sleeves?	158	42.47	121	32.53	93	25.00	7.97	0.03*
Is your door and windows protected by mosquito nets?	160	43.01	125	33.60	87	23.39	21.02	0.00***
Is there any stagnant water in your surrounding?	160	43.01	120	32.26	92	24.73	5.20	0.02*
Do you consult a doctor when you or your family member suffers from malaria fever?	157	42.20	126	33.87	89	23.92	23.29	0.00***
Do you use protective measures against malaria fever?	161	43.28	121	32.53	90	24.19	18.01	0.00***
Do you preferred to seek treatment within 24 hours of presenting Malaria symptoms?	158	42.47	123	33.06	91	24.46	6.54	0.01**

n = sample size, p value calculated by Fisher-Exact Test, p value less than 0.05 considered significant, *p < 0.05, **p < 0.01, ***< 0.001.

and 72.31% were employed. Overall, the respondents were primarily young, moderately educated, employed, and earning a mid-range income. The previous studies showed that the age distribution of respondents was mostly between 19 and 45 years old (51.5% %), 19.5% had no education, while 24.5% completed primary education, people were mainly in business (28.5%) and farming (26%) and 8.1% of respondents lacked knowledge about malaria transmission, while 90% of respondents had comprehensive knowledge about malaria prevention measures.[12] According to previously published literature, 50.3% of participants reported an income of 5,000–10,000 Saudi riyals, while 26% earned below 5,000. Regarding education, most had attained secondary school (61.4%), while only 3.6% were uneducated while knowledge regarding malaria was generally high (87.9%).[13]

According to current study, the majority (57.26%) recognized malaria as a deadly disease and considered mosquito nets effective for its prevention. Previous studies support these findings, with around 90% of respondents identifying bed nets as the primary malaria prevention method. Of these, 64% were aware of insecticide-treated nets (ITNs). Mosquito coils were the second most recognized preventive measure, used by 37.8% of respondents. Additionally, 48.5% reported cleaning their surroundings, and 29% mentioned draining stagnant water to prevent mosquito breeding.[14] A high level of awareness about using bed nets for malaria prevention was reported in studies from Ethiopia and Malawi. Despite widespread knowledge of ITNs, only 31.9% of respondents actively used them.[15] In the survey, 71.2% of residents believed ITNs provided better protection than regular bed nets. The use of insecticide-treated nets

was considered an effective, low-cost method for reducing malaria and other vector-borne diseases in sub-Saharan Africa.[16] Eliminating mosquito habitats early on was emphasized as a key primary prevention strategy for malaria. The study demonstrated that respondents had a strong knowledge of environmental prevention methods, consistent with findings from other studies in Nigeria.[17] However, many people continued to rely on home remedies due to accessibility and other barriers to healthcare facilities, despite recommendations for hospital treatment.[18]

The current study revealed that the majority believed avoiding outdoor sleeping was an effective way to prevent malaria, with highly significant results (p value 0.00). Additionally, 53.49% of respondents supported the need for awareness sessions on malaria prevention. Bed nets were widely recognized as effective for protecting against mosquitoes, with numerous studies emphasizing the benefits of ITNs.[19] Similar results were also reported that mosquito bed nets were crucial in preventing malaria in African countries. Families without bed nets were more susceptible to infection compared to those who used them.[20]

Other methods used against mosquitoes included sleeping with windows closed (30.7%) and burning coils or grass as repellents (22.3%). IRS and burning coils and local plants were also noted as key precautionary measures for mosquito control in Atacora, Benin Republic.[21] A study in Zimbabwe revealed a significant connection between people's understanding of malaria causes and their preventive actions, with better knowledge of insecticide spraying correlating with higher compliance.[22]

The second most common preventive measure was mosquito coils, used by 17.5%. In a previous study, it was found that most parents visit government or private doctors immediately, with 16.2% opting for self-medication first. Common precautionary measures include using insect repellents, mosquito nets, closing windows and doors, wearing long sleeves, and burning cow dung[6], furthermore, the use of insecticide sprays, mosquito coils, and window screens for protection also protects the individual. However, studies suggest that insecticide sprays, particularly in agricultural areas, may increase mosquito resistance, reducing the effectiveness of LLINs.[23] Preventive strategies reported were 32.4% pesticide spraying, 26.1% preventing stagnant water, 14.1% wearing long-sleeved shirts, and 27% focusing on hygiene and education. Additionally, 45.2% use protective clothing.[6]

Conclusion

The survey results indicate a significant level of awareness regarding malaria as a contagious and deadly disease, with a majority understanding that mosquito nets and personal hygiene play important roles in prevention. While a considerable number of respondents recognize the importance of environmental hygiene and insecticide use, fewer actively engage in protective measures such as bed net usage, indoor residual spraying, and immediate consultation upon the onset of symptoms. The government should emphasize improving knowledge and practices related to consistent bed net usage, immediate medical consultation upon malaria symptoms, regular indoor residual spraying, and eliminating stagnant water sources.

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Original Article

Barriers in Seeking Dental Health Care Facilities by the Patients in Pakistan: A Cross-Sectional Study

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Abstract

Background: Patients in Pakistan face considerable obstacles due to limited access to oral health care services, which are exacerbated by socioeconomic factors such as income and education. Gaining an understanding of these obstacles is essential to improve the oral health system.

Objective: To determine the factors related to barriers to seeking dental health care facilities among patients in Pakistan and their association with education and monthly income.

Methods: A cross-sectional study with 400 patients used a non-probability convenience sampling method. Patients of both genders who were 25 years of age and older were included, and all participants gave written consent. The chi-square test found relationships between income, education, and obstacles to accessing dental care ($p < 0.05$).

Results: A total of 400 patients aged 25 and older participated in the data collection. Patients encountered various barriers when seeking dental healthcare facilities, including costly treatment (23.1%), fear of pain (13.7%), and time constraints (13.7%). Educated patients predominantly faced issues such as time shortages and appointment-related challenges, whereas illiterate individuals cited treatment costs and fear of pain as their primary barriers.

Conclusion: Costly treatment, time constraints, and dental procedure fears pose significant barriers to dental service utilization. These challenges are particularly acute among individuals with lower educational attainment and income levels.

Keywords: Dental Anxiety, Health Care Costs, Self-Medication, Patient Education, Cross-sectional study

Introduction

Health care access is increasingly acknowledged as vital to health outcomes, with dental care access as a complex yet essential part of the health care system. Although global oral health has improved in recent decades, dental disease rates remain high in developing nations, especially for dental caries and periodontal disease, where dental services are often underutilized.[1] Oral health is a crucial indicator of overall well-being and quality of life, with dental caries affecting approximately 3.58 billion people globally, making it the most prevalent medical condition.[2] In Pakistan, only 10.7% of adults visited a dentist for regular checkups in the past year, highlighting inadequate dental care utilization.[3] A 2013 study in Tehran by Bahadori et al. identified cost, inconvenience, fear, organizational factors, and patient-dentist relationships as barriers to dental service

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access, with cost being the most significant and patient-dentist relationships the least.[4]

According to Brown et al. (1999), dental service utilization is the proportion of the population accessing these services within a specific time frame. Regular dental visits enable early detection and treatment of oral health issues, support health promotion, provide oral health education, and help maintain overall oral health.[5] Preventive measures, including regular fluoride toothbrushing and professional guidance on oral health habits, can effectively reduce the risk of caries and periodontal disease.[6] Oral disease prevention is a longstanding goal in dentistry, now prioritized in primary care through National health services reforms and evidence-based practices..[7] Jain et al. identified knowledge, attitude, fear, cost, and transportation as barriers to utilizing oral healthcare services.[8]

Access to dental healthcare in Pakistan is crucial but hindered by significant barriers such as high treatment costs, fear of pain, and time constraints. These obstacles are particularly challenging for individuals with lower education and income levels, leading to disparities in dental care utilization. Previous studies have highlighted these barriers but have often overlooked the specific challenges faced by patients at dental hospitals. Therefore, this research paper aims to address this gap by observing the barriers to accessing dental hospital facilities among patients in Pakistan. By investigating the factors influencing individuals' ability to access these facilities and their implications for oral health outcomes, this study seeks to contribute to the development of contextually relevant interventions within the Pakistani healthcare system.

Methods

At Lahore Medical and Dental College's OPD Dental Hospital, a cross-sectional study was conducted from 10th May 2024 till 12th November 2024. A pre-validated questionnaire was used.[9] The questionnaire was piloted with 40 patients, representing 10% of the sample with a 0.72 Cronbach's alpha value, indicating a good internal consistency level. 400 patients were interviewed for data collection using the convenience sampling technique. Patients 25 years and older and those who were making their first visit to the hospital were included in this study. This study did not include patients who were recalled for follow-up or who had received prior treatment. This study did not include patients who declined to participate and those who couldn't communicate in

Saraiki, Punjabi, Urdu, or English. The Ethics Review Committee of Lahore Medical and Dental College (Ref. No. LMDC/FD/1971/24) in Lahore fully approved the study. Using an online open epi sample size calculator, version 3.01, the calculated sample size was 384 by using a 5% margin of error, the 95% confidence interval.[10] The chi-square test was used to determine the association between the sociodemographic characteristics of the population (education, and monthly household income). It was decided to use a significant threshold (p-value) of less than 0.05.

Results

Table I depicts participant demographics in which age was divided into 25-35 years (33.6%), 36-46 years

Table I: *Demographic outline of the patients (n=400)*

	Frequency	Percentage
Age		
25-35 years	135	33.6%
36-46 years	135	33.6%
47 and above	130	32.3%
Gender		
Male	180	44.8%
Female	220	54.7%
Education		
literate	143	35.6%
illiterate	257	63.9%
Monthly income		
Less than 40000	185	46.0%
40000-50000	121	30.1%
above 50000	94	23.4%

Table II: *Barriers in seeking dental health care facilities by the patients (n = 400)*

Barriers	Frequency	Percentage %
Fear of Pain	55	13.7%
Time shortage	55	13.7%
Costly treatment	93	23.1%
Appointments related issues	42	10.4%
Distance/Difficulty in access	34	8.5%
Avoid treatment	37	9.2%
Lack of awareness regarding dental treatment	32	8%
Rely on home remedies	24	6%
Self-medication	28	7%

(33.6%), 47 and above (32.3%); while gender in which males (44.8%) and females (54.7%) reported to OPD of dental college. 35.6% were literate and 63.9% were illiterate. The majority report monthly income below 40,000 PKR.

The data in Table II demonstrate various barriers faced by patients seeking dental healthcare facilities which were costly treatment (23.1%) and fear of Pain (13.7%).

Table III presents that literate patient predominantly faced time shortages and appointment-related issues, while illiterate individuals encountered cost and fear of pain as the primary barriers to access. For incomes less than 40000 PKR, the major barriers were costly treatment (63.4%) and time shortage (54.5%).

Discussion

Our study showed that females (54.7%) visited more than the males (44.8%). The majority were illiterate (63.9%), and most participants had an income below 40,000 per month (46%). The study results aligned with earlier research by the ajayi in which female 222 (55.5%) participated more than the male 78 (44.5%).[11] The expense of treatment posed a significant obstacle to receiving dental care, as reported by 23.1% of patients in our study. The results were consistent with a previous study in India, revealing that the main barrier to accessing dental treatment was the elevated cost of dental services.[12] The study findings are consistent with previous research in India found that cost and perceived need significantly influence dental visits.[13]

The fear of pain (13.7%) was another barrier in our study, and it emerged as a prominent barrier to accessing dental healthcare services among patients. This emphasizes the importance of addressing patients' fears about dental procedures to improve access to dental care, as seen in Karachi, Pakistan, where females displayed heightened dental fear, aligning with our findings on barriers to access.[14] The constraint of time (13.7%) and distance from dental services (8.5%) emerged as a significant barrier to accessing dental healthcare. This finding underscores the importance of addressing time management and scheduling issues to improve the accessibility and convenience of dental services for patients. Most patients, accounting for 38.4%, mentioned the cost of dental services as their primary challenge, followed by 26.5% with busy schedules, and 19.1% facing distance-related difficulties.[15] This issue is more in females and older males who rely on companions for conveyance to hospitals, as shown by the Indian studies.[16] Appointment-related issues (10.4%), presented as a notable barrier to accessing dental healthcare. These findings reflected on the study conducted in Jordan.[17]

Table III: *Association between education and monthly income and barriers in seeking dental health care facilities.*

	Fear of Pain	Time shortage	Costly treatment	Appointments related issues	Distance/ Difficulty in access	Avoid treatment	Lack of awareness regarding dental treatment	Rely on home remedies	Self-medication	P Value
Education										
Literate	20 (36.4%)	30 (54.5%)	21 (22.6%)	25 (59.5%)	14 (41.2%)	10 (27.0%)	8 (25.0%)	7 (29.2%)	8 (28.6%)	<0.001*
Illiterate	35 (63.6%)	25 (45.5%)	72 (77.4%)	17 (40.5%)	20 (58.8%)	27 (73.0%)	24 (75.0%)	17 (70.8%)	20 (71.4%)	
Monthly income										
Less than 40000	18 (32.7%)	30 (54.5%)	59 (63.4%)	17 (40.5%)	15 (44.1%)	14 (37.8%)	13 (40.6%)	9 (37.5%)	10 (35.7%)	0.021*
40000-50000	27 (49.1%)	13 23.6%)	22 23.7%)	12 28.6%)	9 26.5%)	11 (29.7%)	10 31.3%)	8 33.3%)	9 (32.1%)	
above 50000	10 (18.2%)	12 (21.8%)	12 (12.9%)	13 (31.0%)	10 (29.4%)	12 (32.4%)	9 (28.1%)	7 (29.2%)	9 (32.1%)	

*p value calculated by chi-square test, *p value < 0.05 considered significant*

The inclination to avoid treatment was reported by 9.2%, lack of awareness regarding dental treatment (8%), reliance on home remedies (6%), and self-medication (7%) were reported by the patients as barriers in our study. The low literacy level in developing countries like Pakistan contributes to a lack of awareness regarding the importance of seeking timely dental care.[18] Another barrier was self-medication and reliance on home remedies, which was similarly observed in studies conducted in India and Nigeria.[19]

Our study reported that illiterate participants reported higher percentages of the causes of barriers such as costly treatment (77.4%), fear of pain (63.6%), time shortages (45.5%), difficulty accessing care (58.8%)%), avoiding treatment (73.0%), lack of awareness regarding dental treatment (75%), rely on home remedies (70.8%) and Self-medication (71.4%). Similar results were reported by a systematic review also indicated that individuals with lower educational status utilize dental services less frequently compared to those with higher educational status, which may be due to differences in their knowledge about the benefits of dental visits and their attitudes toward utilizing them.[20] Around 17.3% of respondents avoided seeing a dental professional due to cost in the past year, and 16.5% declined recommended dental treatment for the same reason.[21] Another study found that the primary barriers to accessing dental care were cost (39.1%) and lack of time (28.7%).[22] This finding was consistent with El Bcheraoui et al., who reported that the likelihood of utilizing dental services increases with higher education levels.[23] This contrasts with Obeidat et al.'s study, which found no significant impact of age, gender, income, education, employment, health, insurance, or transportation on dental service utilization and regularity.[17]

Our study reported that low income was associated with various barriers like cost (63.4%), time shortage (54.5%), and difficulty to access (44.1%). Kakatkar et al. found that higher-income individuals had better access to dental care compared to those with lower incomes.[16] According to another study, lower-income patients earning below 40,000 had limited access to dental care, whereas higher-income individuals above 50,000 enjoyed significantly better access.[24] The results are emphasized by a similar study where it was reported that individuals with low income (P < 0.001) and those lacking dental insurance (P < 0.001) were most likely to experience financial barriers to accessing dental care.[25]

Conclusion

Costly treatment, time constraints, and dental procedure fears pose significant barriers to dental service utilization. These challenges are particularly acute among individuals with lower educational attainment and income levels. Addressing these issues through targeted interventions—such as cost-reduction strategies and enhanced patient education—will be essential for improving dental care accessibility and ensuring equitable service provision across different demographic groups.

Additionally, access to dental care correlates with patient education and monthly income. Tackling barriers, considering education and income, is crucial for dental service access.

Conflict of Interest: None

Funding Disclosure: None

Ethical Consideration: The study was approved by the ethical review board. Informed written consent was obtained from the participants, and the confidentiality of their data was clearly explained.

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Authors Contribution: All the authors contributed equally in accordance with ICMJE guidelines and are accountable for the integrity of the study.

SLSS: Study design and concept, Acquisition and analysis of data and final approval

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Original Article

Comparison of Left Ventricular Hypertrophy Regression on Echocardiography in Hypertensive Patients with and without Diabetes Mellitus Treated with a Candesartan-Based Regimen

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Abstract

Background: Hypertension is 2-3 times more common in type 2 diabetes (T2DM) patients than in non-diabetics. For hypertensive diabetics, maintaining blood pressure below 130/80 mm Hg is crucial to reduce LVH risk. Angiotensin receptor blockers are particularly effective, as antihypertensive drugs differ in their ability to reverse LVH.

Objective: To compare the regression of Left Ventricular Hypertrophy (LVH) on echocardiography in hypertensive patients with and without diabetes mellitus using Candesartan based regimen.

Methods: The study was conducted at Mayo Hospital, Lahore. Non-probability convenience sampling technique was used to collect data of 45 hypertensive patients with diabetes and 45 hypertensive patients without diabetes. Blood pressure was measured at baseline and during all follow ups by the researcher himself. The patients received candesartan-based treatment for six months. Patients were treated with an initial dose of 8 mg Candesartan once a day. Left ventricular mass index was calculated by echocardiography and follow ups were done on the 1st, 3rd and 6th months.

Results: The average age of patients was 52.81 years (range: 35–65). There were 40 men (44.44%) and 50 women (55.56%). Based on BMI, 33.33% had normal weight, 42.22% were overweight, and 24.44% were obese. After six months, LVH regression was observed in 57.8% of diabetic patients and 35.6% of non-diabetic patients, showing significantly better outcomes in the diabetic group ($p < 0.05$).

Conclusion: This study concludes that a candesartan-based regimen effectively regresses left ventricular hypertrophy in diabetic hypertensive patients, highlighting the importance of tailored treatment strategies to optimize cardiovascular outcomes.

Keywords: Hypertension, Diabetes Mellitus, Echocardiography, Left Ventricular Hypertrophy.

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Introduction

Left ventricular hypertrophy (LVH), a critical target organ damage in hypertension, increases the risk of atrial fibrillation, heart failure, coronary artery disease, and mortality.[1] Hypertension is 2–3 times more common in patients with type 2 diabetes mellitus (T2DM), and

the coexistence of these conditions significantly heightens the risk of both microvascular and macrovascular complications.[2,3] LVH is a preclinical marker of cardiovascular diseases and an independent risk factor for adverse outcomes, especially in hypertensive diabetic patients.[4,5] The pathogenesis of LVH in diabetes involves complex interactions between hyperglycemia, insulin resistance, obesity, dyslipidemia, and hypertension. These factors contribute to cardiomyocyte growth and extracellular matrix remodeling, leading to increased left ventricular mass.[6] Systemic hypertension, the most significant risk factor for LVH, exacerbates myocardial hypertrophy and fibrosis, altering left ventricular geometry and function. Hypertension leads to Extracellular Matrix (ECM) remodeling of cardiomyocytes through mechano-transduction, fibroblast activation, and dysregulated ECM turnover, contributing to myocardial fibrosis and stiffness. Candesartan inhibits LVH directly by blocking AT1 receptor-mediated hypertrophic signaling in cardiomyocytes and indirectly by reducing fibroblast-mediated fibrosis, oxidative stress, and inflammation. These combined effects help restore normal cardiac structure and function. Effective blood pressure control below 130/80 mm Hg and optimal glucose regulation are critical in managing hypertensive diabetic patients.[6]

Regression of LVH is a critical objective in managing hypertension due to its association with adverse cardiovascular outcomes. Among antihypertensive medications, angiotensin receptor blockers (ARBs), such as Candesartan, have shown significant efficacy in promoting LVH regression.[7-9] Factors such as the duration of diabetes and patient age influence the effectiveness of Candesartan-based regimens in reducing echocardiographic LVH (ECH-LVH) in hypertensive patients.[10] While other antihypertensive drugs, such as Amlodipine, have demonstrated some benefits—such as reducing left ventricular mass index and posterior wall thickness — they show limited effects on other parameters like the LV end-diastolic diameter.[11] This underscores the need for effective medications that can comprehensively regress LVH in diabetic hypertensive patients, thereby preventing complications. Although research has been done in this field results from previous studies vary with some reporting improvement in both groups while others report no significant difference.[12,13] Echocardiography, being more sensitive and reliable than electrocardiography, is the preferred method for detecting and monitoring LVH regression.[9] This study aims to compare the regression of echocardiographic LVH in hypertensive patients with and without diabetes mellitus using a Candesartan-based regimen.

Methods

This Quasi experimental interventional study was done at Medical Outdoor and Indoor departments of Mayo Hospital, Lahore (Jan 2015-Jan2016). The study was approved by King Edward Medical University's institutional review board(No. 51/PEC/RC/KEMU). The sample size was calculated using the prevalence of LVH as 72% in hypertensive patients with diabetes and 32% in hypertensive non-diabetic patients. The expected difference in LVH regre-ssion between diabetic and non-diabetic hypertensive patients was also considered. The calculation was per-formed with 99% study power, a 95% level of significance, and a 5% margin for Type I error using the WHO sample size calculator.[14] After taking informed consent, all patients were enrolled who were fulfilling the inclusion and exclusion criteria in this study from outpatient department and indoor medical department, Mayo hospital Lahore by non-probability convenience sampling. The study included patients aged 25 to 65 years of either gender with a known history of hypertension for a minimum of three years or those diagnosed with left ventricular hypertrophy on echocardiography and hypertensive patients diagnosed with Diabetes Mellites for at least three years. Patients with triggered atrial fibrillation, heart blocks, or a prior diagnosis of heart failure were excluded. Other exclusion criteria included a known malignancy, concurrent renal disease, or any other significant comorbid condition. Furthermore, patients with contraindications to angiotensin receptor blockers, renal artery stenosis, a history of stroke, or those already on angiotensin-converting enzyme inhibitors or angiotensin receptor blockers were not included. Individuals with valvular or congenital heart disease and pregnant female patients were also excluded from the study. Basic demographical information (age, gender, occupation, etc.) was obtained. The presence of cardiovascular risk factors, target organ dysfunction and associated clinical ailments including diabetes mellitus, was noted from the clinical history and investigation. Hypertensive patients with diabetes were enrolled in group A and hypertensive patients without diabetes was enrolled in group B. Blood pressure was measured at baseline and during all follow ups. At a single occasion 3 different readings were taken 10 minutes apart and their average was taken. The patients received treatment

for six months using a regimen based on candesartan. Left ventricular mass index was calculated. Tablet Candesartan 8 mg once day (OD) was the initial dose given to the patients.

They were followed at 1st, 3rd and 6th months. Candesartan was titrated up to a maximum of 16 mg OD at the end of the first month if the desired blood pressure objective was not reached. Diabetic patients were given appropriate anti-diabetic therapy and their HbA1c was monitored. Metformin and Glimipride or Metformin and injection Humulin 70/30 can be used. Dose can be modified to keep HbA1c below 6.5. Frequent monitoring of renal function tests was conducted, and individuals were excluded from the research if their renal profiles worsened.

All data was entered and analyzed using computerized software i.e. SPSS version 20. Qualitative data like gender and Occupation was presented in form of fre-

quency (%). Shapiro Wilk test was applied to check the distribution of data. Quantitative data like age, onset of disease, blood pressure and ECH-LVH were presented in form of Mean ± S.D. Independent sample t test was applied to compare mean (BP, ECH-LVH) in both study groups (diabetic and non-diabetic groups), at each follow up. Paired T test was used to check the difference in each parameter at 1st, 3rd and 6-month values. The Chi-square test was applied to compare the qualitative attributes (like status of hypertension) in both groups. P-value < 0.05 was considered as significant.

Results

The mean age of patients was 52.81 ± 7.85 years with minimum and maximum age of 35 and 65 years. The mean age in diabetic and non-diabetic group was 54.44 ±8.04 and 51.18 ± 7.38 years. The mean age of diabetic

TableI: *Comparison of blood pressure in both study groups at different follow-ups*

| | | Mean ± SD | | | | **p-value** |
	Study groups	Baseline	1st	3rd	6th	Baseline vs. 6th months
Systolic	Diabetic	147.44±6.79	136.67±7.07	130.22±12.52	133.56±10.48	<0.001
	Non-Diabetic	150.11±5.06	141.33±5.48	135.78±8.39	137.78±5.99	< 0.001
*p-value		0.037	0.001	0.0105	0.021	
Diastolic	Diabetic	95.67±6.09	86.00±6.18	85.84±9.32	86.00±5.39	< 0.001
	Non-Diabetic	97.00±6.61	89.78±6.57	87.56±7.73	88.89±10.71	< 0.001
*p-value		0.332	0.006	0.346	0.110	

*p value 0.05 considered significant, **p value calculated by paired t test, *p value calculated by independent sample t test*

Table II: *Comparison of different measurements in both study groups*

| | | Mean ± SD | | | | **p-value** |
	Study groups	Baseline	1st	3rd	6th	Baseline vs. 6th months
Ejection fraction	Diabetic	61.51±7.76	61.51±7.76	58.93±9.11	61.44±6.22	0.963
	Non-Diabetic	61.44±7.59	61.47±7.28	62.51±7.29	61.47±5.83	0.987
*p-value		0.967	0.978	0.043	0.986	
LVEDD	Diabetic	44.60±6.22	44.38±6.52	46.93±10.09	45.02±5.24	0.712
	Non-Diabetic	45.02±7.01	45.16±6.94	45.24±6.80	46.47±8.09	0.347
*p-value		0.763	0.585	0.354	0.317	
IVSd	Diabetic	13.44±1.60	13.44±1.60	12.71±1.74	12.49±1.25	0.002
	Non-Diabetic	12.38±1.17	12.36±1.15	11.91±0.97	11.91±0.92	0.026
*p-value		0.001	<0.001	0.009	0.015	
PWd	Diabetic	11.82±3.15	11.82±3.15	12.00±3.09	11.53±1.47	0.598
	Non-Diabetic	11.24±1.93	11.27±1.95	11.33±1.41	11.84±2.26	0.182
*p-value		0.297	0.317	0.192	0.440	

*LVEDD=Left ventricular end diastolic volume, IVSd=interventricular septum thickness in diastole, PWd=Pulse Wave Doppler, LVMI=Left ventricular Mass Index, p value ≤ 0.05 considered significant, **p value calculated by paired t test, *p value calculated by independent sample t test*

Table III: *Comparison of LVMI in both study groups at different follow ups*

		Mean ± SD				*p-value Baseline vs. 6th months
	Study groups	**Baseline**	**1st**	**3rd**	**6th**	
LVMI	*Diabetic*	116.56±48.89	115.29±48.91	115.09±48.23	113.04±24.63	0.8
	Non-Diabetic	121.96±32.65	120.42±44.48	120.36±44.54	120.06±44.14	0.549
***p-value**		0.592	0.604	0.701	0.05	

LVMI=Left ventricular Mass Index, p value ≤ 0.05 considered significant, **p value calculated by paired t test, *p value calculated by independent sample t test

patients was higher than non-diabetic, p-value = 0.048. There were 40(44.44%) male and 50(55.56%) female patients with male to female ratio of 1:1.25. In diabetic group there were 19(42.2%) male and 26(56.8%) female patients while in non-diabetic group there were 21(46.7%) male and 24(53.3%) female patients. The gender distribution in both groups was similar, with no significant difference (p > 0.05). The mean BMI in the diabetic and non-diabetic groups was 28.08 ± 2.95 and 27.30 ± 3.60, respectively, with no statistically significant difference (p > 0.05). Based on BMI, 33.33% of patients were normal weight, 42.22% were overweight, and 24.44% were obese. In the diabetic group, 22.22% were normal weight, 51.1% were overweight, and 26.7% were obese, while in the non-diabetic group, 44.4% were normal weight, 33.3% were overweight, and 22.2% were obese. In the diabetic group, blood pressure decreased significantly (p value < 0.001) from 147.44 ± 6.79 / 95.67 ± 6.09 to 133.56 ± 10.48 / 86.00 ± 5.39. There was a significant reduction in the non-diabetic group as well as shown in Table I. A comparison of different

Table IV: *Comparison of Echocardiographic LVH regression (at 6th month) in both study groups*

		Study groups		Total
		Diabetic	**Non-Diabetic**	
Echocardiographic LVH regression (at 6th month)	**Yes**	26	16	42
		57.8%	35.6%	46.7%
	No	19	29	48
		42.2%	64.4%	53.3%
Total		45	45	90
		100.0%	100.0%	100.0%

LVH = Left ventricular Hypertrophy, Chi-square =4.46, p-value = 0.035, p value ≤ 0.05 considered significant, p value calculated by Chi-square

echocardiography parameters measurements in both groups is shown in Table II.

The difference in mean LVMI (Left ventricular Mass Index) was statistically same in both study groups till 3rd month but it was significantly lower in diabetic

group at 6th month (p-value = 0.05) as shown in Table III. The difference from baseline to 6th months was insignificant within the group in both study groups (Table III). In diabetic and non-diabetic groups, echocardiographic LVH regression at 6th month was observed in 26(57.8%) and 16(35.6%) of the patients, the regression in diabetic group was higher as compared to non-diabetic group at a significant level (p-value < 0.05) as shown in Table IV.

Discussion

A common harmful effect of hypertension is left ventricular hypertrophy (LVH), which significantly increases the risk of cardiovascular morbidity and mortality. Hypertension is diagnosed when systolic blood pressure exceeds 140 mm Hg or diastolic blood pressure exceeds 90 mm Hg, or if a person is already on antihypertensive medication.[15] Hypertension is classified into primary and secondary types, with primary (essential) hypertension accounting for 90-95% of adult cases, while secondary hypertension, caused by factors like vascular, renal, and endocrine issues, represents 2-10% of cases.[16] One independent predictor of poor cardiovascular outcomes is the onset of left ventricular hypertrophy (LVH) as a result of hypertension. On the other hand, LVH regression is linked to a better outcome.[17] In order to enhance patient outcomes, recent research has highlighted the significance of both reversing LVH and regulating blood pressure.

Research demonstrates that patients treated with candesartan have a significant reduction in left ventricular mass index (LVMI) compared to those on other antihypertensive agents, with diabetic patients showing particularly strong benefits. This is due to the exacerbated impact of hypertension in diabetic individuals, who often have additional complications like insulin resistance and altered neurohormonal activation.[18] LVH regression should be the prime objective in management of hypertension. Available antihypertensive drugs vary in their efficacy to cause LVH regression and the drugs which blocks Angiotensin receptor have been considered to

be very useful in this regard. Echocardiography is the more sensitive than electrocardiographic in early detection of LVH. Candesartan is widely used to manage hypertension, with doses ranging from 8–32 mg daily. It has been shown to reduce the risks associated with hypertension, including stroke, cardiovascular mortality, and renal failure.[19] Clinical evidence suggests that candesartan is as effective as other ARBs like valsartan and telmisartan and offers superior antihypertensive benefits over losartan.[20,21] The renin-angiotensin system is a target site for a number of antihypertensive medications and is essential for maintaining volume homeostasis and controlling blood pressure. It is a compound known for its prolonged duration and highly selective in mode of action.[22] According to Barrios V et al., the impact of a candesartan-based regimen on ECH-LVH in hypertensive patients is also influenced by the patient's age and the duration of diabetes mellitus.[23] The research has clearly demonstrated the advantages of blood pressure management, which lowers the risk of heart failure and stroke.

The current study also shows significant reductions in blood pressure in both diabetic and non-diabetic hypertensive patients after treatment with candesartan. However, while LVMI decreased in both groups, the change was not statistically significant, indicating a need for further investigation. Moreover, a significant decrease in blood pressure was observed in present study in the diabetic group, with values improving from baseline to the 6th month. This result indicates the effectiveness of the treatment regimen in managing hypertension in diabetic patients. Regarding LVMI, it decreased in both diabetic and non-diabetic patients from baseline to the 6th month. In diabetic patients, LVMI reduced from 115.09±48.23 to 113.04±24.63, while in non-diabetic patients, it decreased from 120.36±44.54 to 124.96 ± 32.65. However, the change in LVMI from baseline to 6 months was not statistically significant in either group. A study conducted in 2003 reported significant reductions in systolic and diastolic blood pressure following treatment with candesartan cilexetil, as well as a decrease in LVMI, measured both by MRI and echocardiography but the results were not compared in hypertensive patients with and without diabetes.[24]

A 2009 study by Barrios et al. on diabetic and non-diabetic hypertensive patients found that both groups experienced a significant reduction in blood pressure with candesartan treatment. The incidence of ECG-LVH also decreased in both groups, with a more pronounced reduction in diabetics. The relative risk reduction of ECG-LVH was higher in diabetic patients, especially when assessed using the Cor P (Cornell product) and Sok P (Sokolow-Lyon product) criteria, compared to non-diabetic patients.[23] The current study reported that echocardiography-based regression of LVH in patients using Candesartan regime is more useful for diabetic hypertensive patients. In support are the findings of the study by Cuspidi C et al., 2019 who reported similar findings. They showed that systolic/diastolic blood pressure was reduced by 19.3 ± 8/9.4±5 mmHg (p<0.001 for both) and left ventricular mass index (LVMI) declined to 17.01 g/m^2 (95%CI: -13.2 to -20.99; p<0.001) whereas LVMI-related echocardiographic parameters significantly decreased after therapeutic treatment with the candesartan-based drugs moreover, they demonstrated that diabetes (p < 0.05) was predictive of LVH regression.[25] LVH regression at 6th month was observed in the present study in 42(46.67%) patients. Moreover, the LVH regression at 6 months was significantly higher in diabetic patients (57.8%) compared to non-diabetic patients (35.6%). suggesting that candesartan may be particularly effective in diabetic hypertensive patients. The use of candesartan in a comprehensive management plan not only addresses blood pressure but also targets the structural changes in the heart. This is particularly relevant considering that LVH is often under-recognized in clinical practice. The goal of future studies should be to better understand the processes underlying the differential regression of LVH in people with and without diabetes who have hypertension. Longitudinal studies are required to evaluate the long-term outcomes of LVH regression on cardiovascular events in these populations. Additionally, exploring combination therapies that integrate ARBs with other classes of antihypertensive medications may enhance regression outcomes.

Conclusion

In conclusion, this study affirms that a candesartan-based regimen effectively promotes left ventricular hypertrophy (LVH) regression, particularly in diabetic hypertensive patients. The significant difference in LVH regression between diabetic and non-diabetic patients highlights the importance of personalized treatment plans for managing hypertension and its cardiovascular risks. This approach not only improves patient outcomes but also contributes to reducing long-term cardiovascular morbidity, underscoring the role of individualized therapeutic strategies in enhancing overall health.

Conflict of Interest: None

Funding Disclosure: None

Authors Contribution: All the authors contributed equally, in accordance with ICMJE guidelines and are accountable for the integrity of the study.

1. **NRR:** Conception, design, data analysis, and initial and final draft-making
2. **RR:** analysis and interpretation, initial and final draft making
3. **NF:** initial and final draft-making, analysis and design work
4. **HL:** Revising the initial and final draft, data collection and data analysis
5. **MA:** Data analysis, initial and final draft revision
6. **MA:** Initial and final draft-making, data analysis

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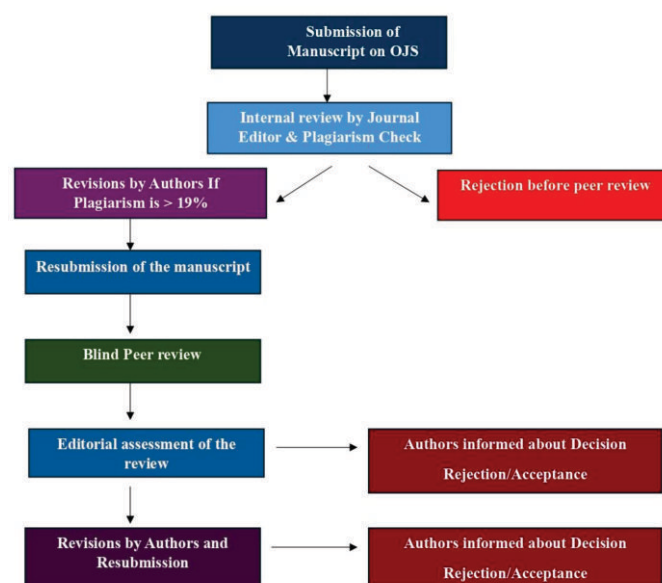
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