ISSN (P): 3105-7071
ISSN (O): 3105-708X
INNOV STEAM RES EDU
WWW.TUFSTEAM.COM
HTTPS://DOI.ORG/10.63793/ISRE

INNOVATIONS IN STEAM: RESEARCH & EDUCATION

An International Journal

VOLUME 1 ISSUE 2 2023

ARTICLES: 23010201-23010205

Innovations in STEAM: Research & Education

ABOUT

Innovations in STEAM: Research and Education (acronym ISRE; abbreviated Innov STEAM Res Edu) publishes peer reviewed papers on all facets of STEAM (Science, Technology, Engineering, Arts, Management). The journal publishes reviews (submitted as well as solicited), full-length research articles, short communications, case studies, extension articles, product registration etc. Submissions made for consideration by ISRE must be original and must not be considered for publication elsewhere simultaneously.

AIMS AND SCOPE

The aim of the Innovations in STEAM: Research and Education (ISRE) is to advance knowledge and promote innovation in the fields of on all facets of STEAM (Science, Technology, Engineering, Arts, Management). By providing a comprehensive platform for the dissemination of high-quality, peer-reviewed research, the journal seeks to foster innovation and knowledge sharing across all aspects of STEAM research and education, as well as allied disciplines, making it a multidisciplinary journal. The ISRE aspires to be a leading source of cutting-edge research and insights that address critical challenges, promote sustainable practices, and enhance productivity and resilience in arts, science and technology systems worldwide. Through this, ISRE aims to contribute significantly to the advancement in arts, science and technological disciplines. ISRE considers specific areas of research and education in STEAM but are not limited to:

- Arts and Social Sciences
- Basic and Applied Sciences
- Computational Sciences
- Engineering and Technological Sciences
- Food and Nutritional Sciences
- Languages and Literature
- Law and Legal Studies
- Management Sciences
- Medical and Allied Health Sciences
- Pharmaceutical Sciences
- Trans-religion Studies

By encompassing these diverse areas, ISRE aims to be a leading platform for researchers and practitioners, to share their findings and contribute to the advancement of arts and social science, business, medical, pharmaceutical, computational, fundamental sciences disciplines.

Innovations in STEAM: Research & Education

Innovations in STEAM: Research & Education
Volume 1, Issue 2, December 2023

Table of Contents

www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN (print): 3105-7071; ISSN (online): 3105-708X
Volume 1; Issue 2; Article No. 23010201
https://doi.org/10.63793/ISRE/0006

CASE REPORT

Case Report on Multi-Drug Resistance Urosepsis in 19-Year-Old Female

Noor Ul Ain[1], Aqsa Shakoor[2], Razzia Tehreem[2], Eman Aftab[2], Javeria Akhtar[1], Eman Fatima[1], Seerat Iftikhar[1]
[1]Department of Pharmacology, Government College University Faisalabad, Pakistan
[2]Department of Pharmacy, The University of Faisalabad, Pakistan

METADATA

Paper history
Received: 20 February 2023
Revised: 21 May 2023
Accepted: 15 August 2023
Published online: 28 September 2023

Corresponding author
Email: ananoorkhan105@gmail.com
(Noor Ul Ain)

Keywords
Colistin
UTI
MDR
Urine culture
Bacteria

Citation
Noor Ul Ain, Shakoor A, Tehreem R, Aftab E, Akhtar J, Fatima E, Iftikhar S (2023) Case report on multi-drug resistance urosepsis in 19-year-old female. *Innovations in STEAM: Research & Education* 1: 23010201.
https://doi.org/10.63793/ISRE/0006

ABSTRACT

Background: Multiple drug resistance (MDR) has emerged as a serious consequence of the overuse of antibiotics. Kidney stone disease results from the formation of crystalline aggregates of urinary solutes within the kidney or urinary tract. In some cases, the stone moves into the ureter, requiring a ureteral stent replacement procedure for management. However, the use of unsterilized equipment during such procedures can lead to urinary tract infections (UTIs).
Objective: This case study highlights the development of MDR *Pseudomonas aeruginosa* following the treatment of a UTI in a patient undergoing ureteral stent replacement.
Method: The patient developed a UTI post-procedure, confirmed through urine culture, which identified Pseudomonas aeruginosa as the causative agent. Multiple antibiotics were administered to control the infection.
Results: Despite antibiotic therapy, the patient's condition did not improve. A subsequent urine culture revealed the development of MDR due to the excessive use of antibiotics. Most antibiotics tested showed resistance, with only colistin remaining effective. Treatment with colistin was initiated and continued for 14 days. Follow-up results indicated complete bacterial inhibition and no further infection progression, leading to the patient's stable condition.
Conclusion: This case underscores the importance of rational antibiotic use and proper sterilization techniques to prevent MDR infections, especially in patients undergoing invasive procedures such as ureteral stent placement.

INTRODUCTION

The emergence of multidrug-resistant (MDR) bacterial infections has become a critical global health concern, posing serious challenges to healthcare systems. MDR infections are associated with prolonged hospital stays, increased healthcare costs, and higher mortality rates (Wartu *et al*. 2019). Of particular concern is MDR urosepsis, a life-threatening condition that originates in the urinary tract and spreads into the bloodstream (Porat *et al.* 2023). This condition is difficult to manage due to the resistance of causative bacteria to multiple antibiotics, leaving limited treatment options. Although carbapenems remain the cornerstone of current treatment strategies, their overuse has resulted in growing resistance. Alternative therapeutic options such as beta-lactam/beta-lactamase inhibitor combinations, cefiderocol, polymyxins, aminoglycosides, and fosfomycin have been explored as potential treatments (Kunz Coyne *et al*. 2022).

The rise of antibiotic-resistant microorganisms represents one of the greatest threats to modern medicine. The overuse and misuse of antibiotics, combined with the rapid spread of resistance genes among bacterial populations, have significantly contributed to the global burden of MDR infections. Previously, antibiotic-resistant strains were largely confined to nosocomial (hospital-acquired) infections; however, these resistant strains have now become widespread in both community and healthcare settings, infection control measures to prevent the spread of resistant pathogens affecting both Gram-positive and Gram-negative bacterial species (McKinnon *et al*. 2018; Walker *et al*. 2022).

Kidney stone disease, also known as nephrolithiasis or

urolithiasis, is a common urological disorder characterized by the formation of crystalline aggregates of urinary solutes within the kidney or urinary tract. The pathogenesis, risk factors, and management options for kidney stones vary considerably. They may put a stent into one or both ureters, depending on the reason for the stenting. Allow urine to bypass a kidney stone (renal calculi) that slows or stops urine flow (Guliciuc *et al*. 2021). This stenting procedure prevents development of new blockage after kidney stone treatment. It also prevents blockage from postoperative swelling after the removal of kidney stone. Due to non-stroke instruments used during procedure may lead to MDR urosepsis. It is caused by multidrug-resistant bacteria, is a very serious medical condition where a urinary tract infection (UTI) spreads to the bloodstream. MDR bacteria are resistant to multiple antibiotics, making treatment more challenging and potentially increasing the risk of severe complications like organ failure, sepsis-induced shock, and death. It poses a significant Danger due to the difficulty in finding effective antibiotics to treat the infection. Treatment options may involve using a combination of antibiotics or newer antimicrobial agents. Diagnosis was made in 2107 (7.7%) cases amongst 27,542 patients screened. Microbiological proof of infection was available in 1606 (5.8%) cases. In total, 408 patients had microbiologically proven urosepsis (Petrosillo *et al*. 2020).

Cases were registered from Europe (n: 311–76%), Asia (n: 66–16.1%), Africa (n: 21–5.1%) and USA (n: 10–2.4%). Type of hospital cases were registered from university (n: 228–56%), teaching (n: 107–26%), district (n: 69–17%) and others (n: 4–1%). Mean age of patients with urosepsis was 63 ± 17 years, and the female-to-male ratio was 3:7. An intervention prior to the episode of urosepsis was reported in 324 (79%) cases (clean: n: 77–24%, clean contaminated: n: 99–31%, clean contaminated with bowel segments opened: n: 57–18%, contaminated: n: 28–9%, infected: n: 63–19%, missing: n: 2). A urinary catheter at the time of diagnosis was present in 287 (70%) cases, and urinary tract obstruction was reported in 234 (57%) cases. Urolithiasis was reported in 20% (n: 76, missing n: 21) of cases (Rozwadowski and Gawel 2022).

Given the growing burden of MDR urosepsis, particularly among patients with underlying urological conditions such as kidney stones, there is an urgent need to promote rational antibiotic use and implement stringent.

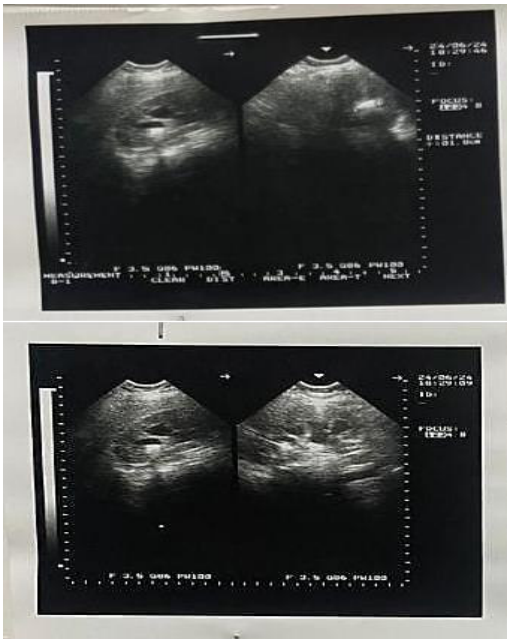
CASE PRESENTATION

A 20 year old female presented in emergency department of private setup with symptoms of high-grade fever, chill, nausea, vomiting. And difficulty in urinating and from last 3 days there is moderate obstruction in urinating. Also, she had Right flank pain radiating to the groin from last 4 days. Patients' past history has shown that the patient is suffering from kidney stones from the last 4 years. According to the physical examination the patient's blood pressure is 140/90 mmHg, pulse 112 bpm, and body temperature is more than 37.5ºC. A ureteral stent was placed to relieve the obstruction of urine and allow the urine to pass from the kidney to the bladder. The stone is removed, and the discomfort of the patient was reduced. But after 3 days of ureteral stent placement the patient had high grade fever, and also have symptoms includes: nausea chill and vomiting. She was again presented to the same setup and was admitted to hospital again due to her severe condition. Empirically she was treated with paracetamol (infusion 1 g/100 mL) and some other antibiotics. After few days when she was not recovered Ultrasound and X-ray imaging examination again perform and show that infection begin in the ureter where the ureter stent placement performs. The reason behind is that during stent placement the equipment are not fully sterilized. So, due to no sterility of the equipment the UTI infection begins. According to the abdominal examination there is tenderness in the right flank and costovertebral angle. Ultrasound and X-ray imaging examinations show that there is a 13mm stone in her right kidney and in left kidney there is 11mmstone at start she was treated with the pain management and hydration. Alpha blockers were prescribed to facilitate the stone passage. The patient was subsequently treated with Cefixime 400 mg, paracetamol (1 g/100 mL infusion), diclofenac, amikacin sulfate, ceftriaxone sodium, meropenem, multivitamins, antiemetics, and moxifloxacin. She showed partial improvement and was discharged home. However, a few months later, she presented it to the emergency department again in a worsened state.

A urine culture was performed, which after 48 h of incubation, identified Pseudomonas species (Fig. 1–2). Her condition had significantly deteriorated, and due to the excessive and prolonged use of antibiotics, she had developed multiple drug resistance (MDR). Only a limited number of antibiotics showed susceptibility. Her treatment was adjusted based on the antibiotic susceptibility results, which initially produced some improvement. However, a repeat urine culture revealed that only Colistin remained effective against the isolated bacterial strain. The patient started on colistin, and iron supplementation (Sangobian) was prescribed to support her overall health. Despite this, her condition remained suboptimal.

Investigations

Laboratory investigations confirmed complete resistance to several antibiotics, including Amikacin, Aztreonam, Ciprofloxacin, Imipenem, Meropenem, Ceftazidime, and Levofloxacin. The urine culture indicated that Colistin was the only remaining effective option. To further assess the extent of the infection, a CT-KUB (Kidney, Ureter, and Bladder) scan was performed (Fig 3). The scan revealed the presence of infectious material and pus accumulation, prompting the recommendation for another ureteral stent placement to relieve the obstruction. Additional laboratory results showed a significantly elevated serum parathyroid hormone (PTH) (Fig. 4) level of 649 pg/mL. A parathyroid



Aiima

RENAL ULTRASOUND

RIGHT KIDNEY:

. Right kidney shows 13mm stone upper pole .No hydronephrosis is seen. Renal cortex & medulla is well appreciated. No cystic disease of the kidney is seen. No signs of back pressure changes noted in the pelvicalyceal system of the kidney.

LEFT KIDNEY.

Shows 11 mm stone upper pole mild hydronephrosis And dilatation of upper ureter.

Dilated ureter shows 8 mm stone mid and 9 mm stone distal ureter Good cortical thickness and CMD.

URINARY BLADDER is full , no stone or any other abnormality.

Liver . Spleen, Pancreas & Gall Bladder are seen normal.

Fig. 1: Ultrasound reports of renal calculi

Culture And Sensitivity Report

Specimen: Left DJ Stunt For c/s

Morphology / Gram's Staining: Gram -ve Negative rods have been seen

Microorganism Identified: Pseudomonas species is obtained after 48 hours of incubation at 37°C.

Catalase Test: Positive

Coagulase Test:

Oxidase Test: Positive

Drugs	Sensitivity	Drugs	Sensitivity
Ampicillin	R	Fosfomycin	S
Amoxycillin		Gentamycin	
Amikacin (Gracil)	S	Gemifloxacin	
Azithromycin	R	Imipenem	S
Avelox		Levofloxacin	
Augmentin	R	Linzolide	
Aztreonam		Meropenem (Merosol)	S
Cefaclor		Nalidixic acid	
Cefixime	R	Neomycin	
Cefepime	R	Oxacillin	
Cefotaxime		Piperacillin/Tazobuctum	R
Ceftriaxone	R	Terivid	
Chloramphenicol		Septran	R
Ciprofloxacin	R	Sparfloxacin	
Clindamycin		Velosef	R
Ertapenem	S	Zincef	
Fortum		Tetracyclin	
Erythromycin		Urixin	
Klaycid		Vancomycin	
CBA-150 (Colistin)	S	Vibramycin	
Sulzone	S	Nitrofurintoin	S
Doripenem	S	Teicoplanin	
Doxycycline	R	Colistimethate Sodium 1Mlu (Colistin)	

Specimen: URINE

Culture: Growth obtained after 24 hours of incubation at 37°C.

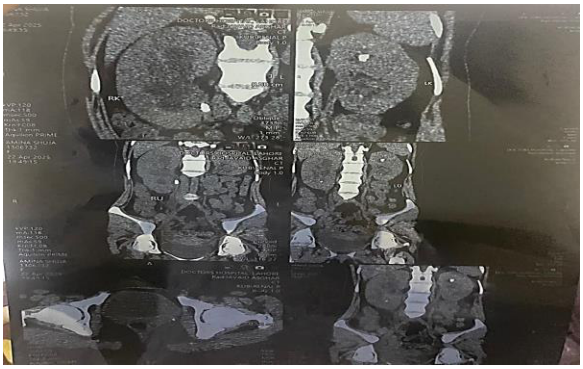
Isolate1: Pseudomonas aeruginosa

Colony Count: 10 ^ 4 - 10 ^5 CFU / ML

	Pseudomonas aeruginosa	
	MIC	Result
B-lactam/B-lactamase Inhibitor Combinations		
Piperacillin-Tazobactam		R
Ceftazidime-Avibactam		R
Cephems & Cephalosporins		
Cefepime		R
Ceftazidime		R
Carbapenems		
Imipenem		R
Meropenem		R
Aminoglycosides		
Amikacin		R
Gentamicin		R
Fluoroquinolones		
Ciprofloxacin		R
Miscellaneous		
Colistin	1	I ✓

S = Sensitive I = Intermediate R = Resistant MIC = Minimum Inhibitory Concentration (ug/mL)

Fig. 2: Culture report and repeated antibiotic sensitivity for *P. aeruginosa*



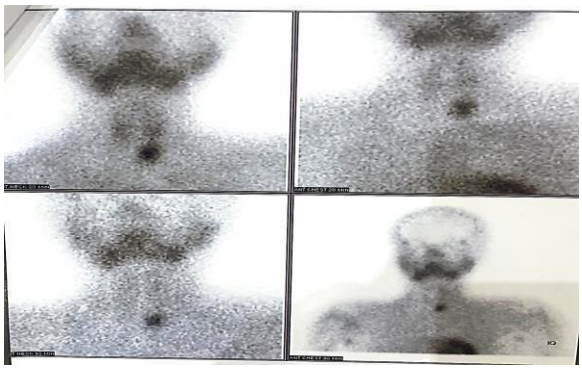
Intact PTH	649	pg/mL	15-65 pg/mL
Calcium	11.1	mg/dL	Adult: 8.4 - 10.2 mg/dL
			Newborn: 0 - 10 Days: 7.6 - 10.4 mg/dL; 10 Days-24 Months: 9 -11 mg/dl
			Children: 2-12 years: 8.8 -10.8mg/dl
Troponin-I High Sensitivity	2.7	pg/mL	Male Upto 34.2 pg/mL; Female Upto 15.6 pg/mL

Comments :

Note:

1. ≥ 50 % increase in hs Troponin-I result between the first sample and sample after 3 hrs is considered significant.
2. Studies have shown in general population or patient with stable cardiovascular disease that elevated troponin levels are associated with structural heart disease, risk of future cardiovascular events, and mortality.

Fig. 3: Report of CT-KUB and serum PTH (649)



PARATHYROID SCAN

Clinical Features

Recurrent renal calculi, right sided DJ stent insitu
Serum PTH= 640 ng/ml
Parathyroid adenoma??

Procedure

Parathyroid scanning was done employing Dual Phase 99mTc-MIBI 99mTc-Tetrofosmin scintigraphy. 300 MBq of tracer was injected and anterior static imaging of neck was acquired every 20 minutes till 90 minutes.

Findings

The early-delayed imaging reveal suspicious area of tracer accumulation/retention in the region of lower pole of left lobe of thyroid gland.
USG showed iso to hypoechoic lesion in the region of lower pole of left lobe of thyroid gland.

Opinion

Scintigraphic evidence of parathyroid adenoma in the region of lower pole of left lobe of thyroid gland.

Advice

Fig.4: Parathyroid scan

TEST	RESULTS		HISTORY			REFERENCE RANGE
HM23-CBC Diff Profile (CS11)	**14/05/25**		12/05/25	05/05/25	04/05/25	
WBC Total	9960	/µL	11740	8100	10100	(4000/µL-10500/µL)
RBC, Total	5.24	m/µL	5.15	4.69	4.30	(3.8 - 5.8)m/µL
Hemoglobin	13.0	g/dL	12.8	11.9	10.8	12.5 - 16.0)g/dL
HCT	41.3	%	39.9	36.8	34.0	(37 - 47)%
MCV	78.8	fL	77.5	78.5		(78 - 100)fL
MCH	24.8	pg	24.9	25.4	25.1	(27 - 31)pg
MCHC	31.5	g/dL	32.1	32.3	31.8	(32 - 36)g/dL
Platelet Count	336000	/µL	392000	598000	631000	(150,000 - 400,000)/µL
Neutrophils	68	%	65	76	76	(54 - 62)%
Lymphocytes	20	%	24	15	16	(25 - 33)%
Monocytes	5	%	6	7	7	(1 - 4)%
Eosinophils	6	%	5	2	1	(1 - 3)%
Basophil	1	%	0	0	0	(0 - 0.75)%
RDW	15.7	%	15.4	16.0	15.9	(11.5 - 14.0)%

Fig. 5: Pre-operative CBC reports

Microbiology

Received in Lab.: 18/05/2025 23:19
Verified On..... : 19/05/2025 00:58

TEST	RESULTS	HISTORY	REFERENCE RANGE
MU01-Urine R/E	**19/05/25**		
Color	YELLOW		Pale Yellow - Yellow
Appearance	Turbid		Clear
Specific Gravity	<=1.005		1.005 - 1.025
pH	6.0		5 - 8
Protein	+++		Negative
Glucose	Negative		Negative
Ketone	Negative		Negative
Urobilinogen	Normal		Negative
Bilirubin	Negative		Negative
Blood	+++		Negative
Nitrite	Negative		Negative
Red Blood Cells	30-40		0 -2 /HPF
Leukocytes-Estrases	+++		Negative
Epithelial Cells	1-2		Nil /HPF
Yeast	NIL		Nil
Cast	NIL		Nil
Crystals	Nil		Nil
WBC	NUMEROUS		1 - 2 /HPF

Fig. 6: Post-operative urine report

Service Nephrology

Medication(s) on Discharge:

Drug			Dose	Frequency	Route	Duration
COLICRAFT (4.5) 4.5-MIU	INJECTION	(COLISTIMETHATE-SODIUM)	2 MIU	12 Hourly	INTRAVENOUS	For 7 Day(s)
MYFOL	TABLET 400-MCG	(L-METHYLFOLATE)	400 MCG	Once a Day	Orally	Continue
PROVAS-N (450+35) 485-MG	TABLET	(ORPHENADRINE+PARACETAMOL)	485 MG	12 Hourly (Two times a day)	Orally	For 3 Day(s)
ONDACE (TAB) MG	TABLET 8-	(ONDANSETRON)	8 MG	12 Hourly (Two times a day)	Orally	Continue
FEFOL-VIT MG	CAPSULE 150-	(FERROUS-SULPHATE+VITS(B1+B2+NIACIN+C)+F.A)	150 MG	Once a Day	Orally	Continue
MIMCIPAR	TABLET 30-MG	(CINACALCET)	30 MG	Once Daily	Orally	Continue
ZOPENT(OPP) MG	TABLET 40-	(PANTOPRAZOLE)	40 MG	Once Daily	Orally	Continue
MAXFLOW	CAPSULE 0.4-MG	(TAMSULOSIN)	.4 MG	Before Sleep	Orally	Continue

This prescription is vaild till 08-MAY-25

Discharge Instructions :

1. **Diet :** AVOID DAIRY PRODUCTS
2. **Activity :** AS PER TOLERATED

Fig. 7: Post-operative urine report

Service Nephrology

Medication(s) on Discharge:

Drug			Dose	Frequency	Route	Duration
COLICRAFT (4.5) 4.5-MIU	INJECTION	(COLISTIMETHATE-SODIUM)	2 MIU	12 Hourly	INTRAVENOUS	For 7 Day(s)
MYFOL	TABLET 400-MCG	(L-METHYLFOLATE)	400 MCG	Once a Day	Orally	Continue
PROVAS-N (450+35) 485-MG	TABLET	(ORPHENADRINE+PARACETAMOL)	485 MG	12 Hourly (Two times a day)	Orally	For 3 Day(s)
ONDACE (TAB) MG	TABLET 8-	(ONDANSETRON)	8 MG	12 Hourly (Two times a day)	Orally	Continue
FEFOL-VIT MG	CAPSULE 150-	(FERROUS-SULPHATE+VITS(B1+B2+NIACIN+C)+F.A)	150 MG	Once a Day	Orally	Continue
MIMCIPAR	TABLET 30-MG	(CINACALCET)	30 MG	Once Daily	Orally	Continue
ZOPENT(OPP) MG	TABLET 40-	(PANTOPRAZOLE)	40 MG	Once Daily	Orally	Continue
MAXFLOW	CAPSULE 0.4-MG	(TAMSULOSIN)	.4 MG	Before Sleep	Orally	Continue

This prescription is vaild till 08-MAY-25

Discharge Instructions :

1. **Diet :** AVOID DAIRY PRODUCTS
2. **Activity :** AS PER TOLERATED

Fig. 8: Post-operative medications

Fig. 9: Culture report for *Pseudomonas aeruginosa* after medication alteration

scan confirmed parathyroid dysfunction

Treatment

During her hospital stay, the patient received Colistin (2 mg) twice daily for 14 days. Follow-up laboratory tests showed significant improvement, with bacterial growth successfully inhibited. Renal function improved, as reflected by normalization of creatinine levels and estimated glomerular filtration rate (eGFR). Her white blood cell (WBC) count decreased from 17,000 to 9,000. The treatment plan was continued, and based on her laboratory and imaging results, a multidisciplinary approach was adopted. A stepwise treatment protocol was implemented, which included surgical removal of the overactive parathyroid gland, responsible for hypercalcemia and recurrent kidney stone formation. In the same surgical session, laser lithotripsy was performed to remove the kidney stones, both procedures were conducted under a single anesthesia. Following surgery, the patient showed gradual clinical improvement (Fig. 5–9).

DISCUSSION

Multi drug resistance is a sever condition in which the patient develops resistance to the antibiotic because of excessive use. Multidrug resistance (MDR) is a kind of acquired resistance of microorganisms and cancer cells to chemotherapeutic drugs that are characterized by different chemical structures and different mechanisms of action (Linhares *et al*. 2015). Urolithiasis is a disorder that is characterized by the development of solid crystalline aggregates of urinary solutes within the urinary space of the kidney. Her are the number of treatments to treat the kidney stone. For the ureteral obstruction the ureteral stent placement is used now day other procedures are also used to treat ureteral obstruction (Parajuli *et al*. 2017). Here we discuss the case report of a patient who had ureteral obstruction. Ureteral stent placement is used for treatment but due to non-sterile conditions of the equipment's the patient develops Urosepsis. And due to excessive use of the antibiotics the patient develops antibiotic resistance. Patient is badly affected and in critical condition. From this case presentation we can assure that the effect of colistin has shown to the bacteria without any severe adverse effects leading to a progressive treatment (Babar *et al*. 2021).

Overall, this case illustrates the growing threat of MDR in urological settings and highlights the significance of infection control practices and antibiotic stewardship in preventing such complications.

CONCLUSIONS

This case highlights the serious complications that can arise from inadequate sterilization and excessive antibiotic use, leading to multidrug-resistant urosepsis. Strict aseptic techniques and rational antibiotic use are essential to prevent such infections. Colistin proved effective in managing the MDR infection, demonstrating its potential as a last-resort treatment option in similar cases.

AUTHOR CONTRIBUTIONS

All the authors contributed equally to the write up.

CONFLICTS OF INTEREST

The authors affirm that they possess no conflicts of interest.

DATA AVAILABILITY

Not applicable

ETHICS APPROVAL

Informed consent was obtained from patient.

FUNDING SOURCE

No funding was acquired for this work.

REFERENCES

Babar ZU, Dodani SK, Nasim A (2021) Treatment outcome and adverse effects of colistin in adult patients with carbapenem-resistant Gram-negative bacteremia from Pakistan. *International Journal of Infectious Diseases* 106: 171–175. https://doi.org/10.1016/j.ijid.2021.03.004.

Guliciuc M, Maier AC, Maier IM, Kraft A, Cucuruzac RR, Marinescu M, Şerban C, Rebegea L, Constantin GB, Firescu D (2021) The urosepsis—a literature review. *Medicina* 57: 872. https://doi.org/10.3390/medicina57090872.

Kunz Coyne AJ, El Ghali A, Holger D, Rebold N, Rybak MJ (2022) Therapeutic strategies for emerging multidrug-resistant *Pseudomonas aeruginosa*. *Infectious Diseases and Therapy* 11: 661–682. https://doi.org/10.1007/s40121-022-00591-2.

Linhares I, Raposo T, Rodrigues A, Almeida A (2015) Incidence and diversity of antimicrobial multidrug resistance profiles of uropathogenic bacteria. *BioMed Research International* 2015: 354084. https://doi.org/10.1155/2015/354084.

McKinnon J, Chowdhury PR, Djordjevic SP (2018) Genomic analysis of multidrug-resistant *Escherichia coli* ST58 causing urosepsis. *International Journal of Antimicrobial Agents* 52: 430–435. https://doi.org/10.1016/j.ijantimicag.2018.06.017.

Parajuli NP, Maharjan P, Parajuli H, Joshi G, Paudel D, Sayami S, Khanal PR (2017) High rates of multidrug resistance among uropathogenic *Escherichia coli* in children and analyses of ESBL producers from Nepal. *Antimicrobial Resistance & Infection Control* 6: 9. https://doi.org/10.1186/s13756-016-0168-6.

Petrosillo N, Granata G, Boyle B, Doyle MM, Pinchera B, Taglietti F (2020) Preventing sepsis development in complicated urinary tract infections. *Expert Review of Anti-infective Therapy* 18: 47–61. https://doi.org/10.1080/14787210.2020.1700794.

Porat A, Bhutta BS, Kesler S (2023) Urosepsis. In: *StatPearls [Internet]*. Treasure Island, FL: StatPearls Publishing. https://doi.org/10.1186/s13756-016-0168-6.

Rozwadowski M, Gawel D (2022) Molecular factors and mechanisms driving multidrug resistance in uropathogenic *Escherichia coli*—an update. *Genes* 13: 1397. https://doi.org/10.3390/genes13081397.

Walker MM, Roberts JA, Rogers BA, Harris PN, Sime FB (2022) Current and emerging treatment options for multidrug resistant *Escherichia coli* urosepsis: A review. *Antibiotics* 11: 1821. https://doi.org/10.3390/antibiotics11121821.

Wartu JR, Butt AQ, Suleiman U, Adeke M, Tayaza FB, Musa BJ, Baba J (2019) Multidrug resistance by microorganisms: A review. *Science World Journal* 14: 49–56.

www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN (print): 3105-7071; ISSN (online): 3105-708X
Volume 1; Issue 1; Article No. 23010202
https://doi.org/10.63793/ISRE/0007

RESEARCH ARTICLE

Use of Iris Mini Software in Reducing Asthenopia and Sleep Cycle

Ammara Affi, Atiqa Mumtaz, Tehreem Irshad, Saiqa Nasir, Mufassara Iftikhar
Department of Optometry, The University of Faisalabad, Faisalabad 38000, Pakistan

METADATA

Paper history
Received: 26 March 2023
Revised: 15 June 2023
Accepted: 24 August 2023
Published: 02 October 2023

Corresponding author
Email: ammaraaffi.OPT@tuf.edu.pk
(Ammara Affi)

Keywords
Asthenopia
Blue light
Melatonin
Sleep-wake cycle

Citation
Affi A, Mumtaz A, Irshad T, Nasir S, Iftikhar M (2023) Use of Iris Mini software in reducing asthenopia and sleep cycle. *Innovations in STEAM: Research & Education* 1: 23010202. https://doi.org/10.63793/ISRE/0007.

ABSTRACT

Background: Excessive use of digital screens is leading a number of eye disorders and other adverse effects like sleeplessness, insomnia, ocular discomfort. It is important to evaluate different methods to combat the severity of such eye disorders. The use of Iris Mini Software could be an effective solution to reduce the extent of eye defects.
Objective: The objective of this study was to evaluate the effect of Iris Mini Software on asthenopic symptoms and Sleep cycle in screen users.
Methodology: A longitudinal study was conducted from September 2021 to May 2022 at The University of Faisalabad, involving 30 emmetropic individuals aged between 18 to 30 years and this sample was taken by non-probability convenient sampling technique. All participants had screen time of 5–6 h, with a history of asthenopia and disturbed sleep cycle, excluding those with ocular pathologies, refractive errors, associated problems like migraine, insomnia were excluded. The study assessed asthenopia and sleep cycle before and after introducing them to Iris Mini Software in their devices, followed by a month's follow up with an interval of one week by using self-designed questionnaire.
Results: Iris Mini Software significantly improved asthenopia over the time period of one month significantly ($P < 0.001$) in screen users and also improvement in their sleep duration ($P < 0.0001$). The device was also effective in reducing symptoms of eye strain caused by long exposure of screen and enhancing sleep quality by reducing blue light exposure, which positively influenced melatonin production.
Conclusion: The use of Iris Mini Software illustrates a positive impact on relieving the asthenopic symptoms and improving sleep duration. This research suggests that Iris Mini Software can be an effective solution for the mitigation of poor sleep quality and ocular discomfort.

INTRODUCTION

Human eyes operate much like a sophisticated camera design to focus light onto the retina facilitating day and night vision clear. The retina contains two types of photoreceptors: rods and cons. Rods account for approximately 95% of photoreceptors cells, which are primarily responsible for low light conditions, enabling individuals to perceive at night. In contrast there are three types of cones, each sensitive to different wavelengths of light (red, green and blue); together these are responsible for day vision and enabling color perception and vision under daylight conditions. In 1998, neuroscientist Ignacio Provencio made a groundbreaking discovery by identifying a novel photoreceptor in the human eye known as melanopsin. Unlike the rods and cones melanopsin is involved in conventional vision and is specifically sensitive to blue light and plays a crucial role in regulating the circadian rhythm (Provencio *et al*. 1998). When exposed to blue light, melanopsin sends signals to the brain indicating that it is daylight, suppressing the production of melatonin, a hormone responsible for regulating sleep (Daniel 2014).

Blue light is a high energy light in the visible electromagnetic spectrum, with wavelength ranging from 380–500 nm (Lin *et al*. 2017). It plays a crucial role in the physiology of human beings as it is important for regulation of sleep cycle or circadian rhythm and the response is mediated by melanopsin, a photo pigment found in

specialized retinal ganglion cells (Rosenfield *et al*. 2020). During daylight hours, the natural blue light is good for shortening the time of reflex reaction. For boosting the mood, increasing alertness and supporting our overall wellbeing. While on the other hand, the artificial blue light from the screen causes discomfort or ocular fatigue. It also affects pupil and ciliary muscles causing dryness and uneasiness that can overtime lead to headaches and blurred vision (Guarana *et al*. 2021). Prolonged exposure to short wavelength blue light causes the phototoxicity of retinal light sensitivity cells. Overtime this damage can lead to development of disease like Age Related Macular Degeneration (AMD), a leading cause of vision loss (Silvani *et al*. 2022).

Optical radiation encompasses ultraviolet light (100–400 nm), infrared light (750–10000 nm) and visible light (400–750 nm). Mostly, the cornea is naturally equipped to eliminate and act as a barrier from harmful ultraviolet radiations particularly wavelength below 295 nm. However, the wavelength shorter than 400 nm does penetrate to the retina, which may lead to retinal damage more susceptible for retinal pigment epithelium damage and termination toward retinal disorders or evoke photodynamic retinal damage. Over time, prolonged exposure to high intensity light falls on the visible spectrum (400–500 nm). This is mentioned as "blue light hazard" (Ishizawa *et al*. 2021). Overtime repeated exposure to blue light can contribute to development of conditions like AMD.

In the current era, digital screens are most frequently used in workplaces like schools and offices. Around 35.6% of the total population smartphone users have increased globally, and it is increasing because of engaging features and entertainment. Although screen time is high due to engagement and productivity, it also has its adverse effects like sleep deprivation or insomnia and ocular discomfort or dry eye (Heo *et al*. 2017). People under the age of 40 have more ocular symptoms that constitute tiredness, ocular suffer from irritation, dryness, burning eye, redness, blurred vision and diplopia. Actually, the screen emits wavelength of 400–490 nm of blue light that is forefront for Digital Eye Strain (Algvere *et al*. 2006).

Digital eye strain, also known as computer vision syndrome, occurs after prolonged use of digital devices like computers, phones and tablets. It can lead to a range of symptoms including eye discomfort, such as dryness, irritation, or a gritty feeling, as well as blurred vision, particularly after staring at a screen for an extended period (Munsamy *et al*. 2022). People may also experience headaches, often around the forehead or temples, and neck or shoulder pain due to poor posture, sensitivity to light, difficulty to focus and ocular fatigue. Computer vision syndrome affects in two ways. Psychological components stimulate the effect of media at bedtime, which delays sleep. Physiological components concern artificial light exposure that delays the circadian system by suppressing melatonin secretion, that is pivotal for sleep maintenance and institution in humans. The blue light information is met up by photoreceptors, present in retina and then retinal ganglion cells (Wiryawan *et al*. 2021). Further, it is transmitted to suprachiasmatic nucleus (SCN), which in turn transmits to the pineal gland where secretion of melatonin occurs in evening and suppressed in light exposure. The short wavelength light and artificial light suppress melatonin secretion that delay sleep onset (Silvani *et al*. 2022).

Iris mini is software that contains a blue blocking filter but appears red in color which prevents eyes from strain, reduces eye pain and improves sleep. It reduces the brightness of the screen without changing the backlight flickering frequency or current and pulse width modulation (Cheng *et al*. 2014). It gives a large amount of reduction in brightness. The brain is less fast than eyes, so cannot perceive this flicker but in eyes iris start the process of open and close (contract and dilate) like this flicker. However, if the frequency of flickers is lower, iris contraction is greater, the eyes feel tired and painful. So, the best way to overcome this problem is to use software that can change the color and brightness without more blue light (Lee *et al*. 2021). This study evaluated the effect of Iris Mini Software on asthenopic symptoms and Sleep cycle in screen users.

MATERIALS AND METHODS

This longitudinal study was conducted at The University of Faisalabad between September 2021 and May 2022, with a sample of 30 emmetropic participants. The participants were selected using a non-probability convenient sampling method. Eligible participants were individuals aged between 18 and 30 years who reported using screens for 5–6 h on average daily and experienced symptoms of asthenopia, as well as disrupted sleep patterns. Those with ocular conditions, refractive errors, or associated health issues such as migraines or insomnia were excluded from the study.

Prior to participation, informed consent was obtained from each individual. Data collection was carried out using a self-designed proforma and questionnaire. Ocular examinations were performed with a pen torch, and visual acuity was measured using the Log Mar chart. Participants were followed up weekly for a period of three to four weeks. The purpose of the follow-ups was to assess the effects of the Iris Mini software on improving both asthenopia and sleep duration. A comprehensive, self-designed questionnaire was used to monitor changes in participants' symptoms related to asthenopia and their sleep patterns.

To evaluate the data, a Chi-square test was employed to determine that there were significant improvements in asthenopia and sleep duration following the use of the Iris Mini software. The statistical analysis was performed by using SPSS version 20.

RESULTS

In this study 30 emmetropic participants with age range 18-

Table 1: Asthenopia before and after usage of Iris Mini Software

Asthenopia	**Software**	Base line findings	1 week	2 week	3 week	4 week	*P*-value
Watering	After use	18	6	2	0	0	0.000
	Before use	12	24	28	30	30	
Headache	After use	18	9	2	0	0	0.000
	Before use	12	21	28	30	30	
Eye fatigue	After use	22	7	1	0	0	0.000
	Before use	8	23	29	30	30	
Burning sensation	After use	13	7	2	0	0	0.000
	Before use	17	23	28	30	30	
Redness	After use	14	4	2	0	0	0.000
	Before use	16	26	28	30	30	
Itching	After use	19	9	4	1	0	0.000
	Before use	11	21	26	29	30	
Double vision	After use	10	3	0	0	0	0.000
	Before use	20	27	30	30	30	

Table 2: Sleep duration before and after usage of Iris Mini Software

Sleep duration (h)	Base line findings	1 week	2 week	3 week	4 week	*P*-value
3-4 h	6	1	0	0	0	0.000
5-6 h	19	17	7	2	1	
7-8 h	3	10	21	26	25	
> 8 h	2	2	2	2	4	

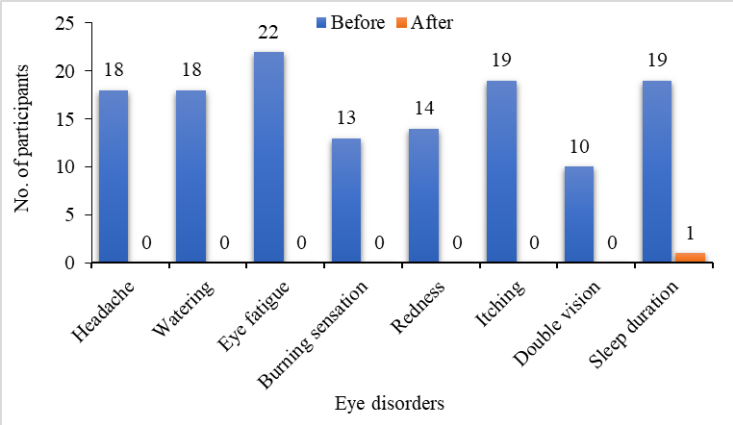


Fig. 1: Frequency distribution of asthenopic symptoms and sleep duration before and after usage of Iris Mini Software

30 years were included. Asthenopia and sleep duration were assessed by using questionnaire proforma from all subjects. Out of 30 participants before usage of Iris Mini software, 18 had complaints of watering and headache, 22 had eye fatigue, 13 had burning sensation, 14 had redness, 19 had itching, 10 had double vision. Six patients had in-sleep duration of 3–4 h, 19 patients have 5–6 h, 3 patients had 7–8 h and 2 patients had more than 8 h. Then after the usage of Iris Mini software for one month, no respondent was left with the problem of asthenopia (Table 1). The in-sleep duration improvements were significant ($P < 0.0001$). Patients of 3–4 h in-sleep duration were 0, 5–6 h were 1, 7–8 h were 25 and more than 8 h were 4 (Table 2). This study gives us an innovative idea if the Iris Mini Software remained in highly inactive mode during usage of screen, with a significant reduction in different eye disorders (Fig. 1).

DISCUSSION

Excessive screen work and blue light exposure cause muscle fatigue, asthenopic symptoms and also disturb sleep cycle because it suppresses melatonin hormone that regulate the sleep cycle. Iris Mini software filters the blue light, which consequently prevents the occurrence of these symptoms. A pilot study by Knufinke *et al*. (2019) evaluated the effect of blue blocking filters on 15 clients of the age range of 18–32 years in Europe and reported improved sleep-in athletes by blocking blue light in the evening. Their study supported this notion as the results were revealed that blue blocking filters were significant in athletes to improve sleep quality. In this study Iris Mini software was introduced to a total of 30 participants that were able to show the positive response to this software.

Another observational study was conducted by Palavets and Rosenfield (2019) to see the effects of blue blocking filters on asthenopic symptoms of 24 emmetropic participants, ageing 22 to 27 years. The subjects were given a task to read a paragraph for 30 min on a computer having a blue light filter with 90% contrast. They concluded that the blue light filter had the minimum effect to vanish the asthenopic symptoms that occurred at near due to screen because their participants were using the blue light filter only for 30 min. In contrast the results of this study proved that the blue filters improved the asthenopia significantly.

CONCLUSIONS

Asthenopia and disturbed sleep was present in 30 screen users. Iris Mini Software was effective in improving symptoms of asthenopia and disturbance of sleep cycle, signifying its use on a wider scale.

ACKNOWLEDGMENTS

All the authors express their sincere gratitude to the Institute of Agronomy, Bahauddin Zakariya University, Multan for their invaluable assistance in soil sampling and soil analysis.

AUTHOR CONTRIBUTIONS

AA: data analysis, final review, overall supervision; AM, TI, SN and MI: concept, study design, data collection, literature search, data analysis.

CONFLICTS OF INTEREST

The authors declare that they possess no conflicts of interest.

DATA AVAILABILITY

The data will be made available on a fair request to the corresponding author.

ETHICS APPROVAL

Approved by Institutional Ethical Review Board at its meeting held on February 23, 2022.

FUNDING SOURCE

This project is self-funded.

REFERENCES

Algvere PV, Marshall J, Seregard S (2006) Age-related maculopathy and the impact of blue light hazard. *Acta Ophthalmologica Scandinavica* 84: 4–15. https://doi.org/10.1111/j.1600-0420.2005.00627.x.

Cheng HM, Chen ST, Hsiang-Jui L, Cheng CY (2014) Does blue light filter improve computer vision syndrome in patients with dry eye. *Life Science Journal* 11: 612–615.

Daniel G (2014) *The Iris blue light filter and eye protection software*. Iristech. 15 August. Available at: https://iristech.co/ (Accessed: January 24 2023).

Guarana CL, Barnes CM, Ong WJ (2021) The effects of blue-light filtration on sleep and work outcomes. *Journal of Applied Psychology* 106: 784–796. https://doi.org/10.1037/apl0000806.

Heo JY, Kim K, Fava M, Mischoulon D, Papakostas GI, Kim MJ, Kim DJ, Chang KA, Oh Y, Yu BH, Jeon HJ (2017) Effects of smartphone use with and without blue light at night in healthy adults: A randomized, double-blind, cross-over, placebo-controlled comparison. *Journal of Psychiatric Research* 87: 61–70. https://doi.org/10.1016/j.jpsychires.2016.12.010Get rights and content.

Ishizawa M, Uchiumi T, Takahata M, Yamaki M, Sato T (2021) Effects of pre-bedtime blue-light exposure on ratio of deep sleep in healthy young men. *Sleep Medicine* 84: 303–307. https://doi.org/10.1016/j.sleep.2021.05.046.

Knufinke M, Fittkau-Koch L, Møst EI, Kompier MA, Nieuwenhuys A (2019) Restricting short-wavelength light in the evening to improve sleep in recreational athletes–A pilot study. *European Journal of Sport Science* 19: 728–735. https://doi.org/10.1080/17461391.2018.1544278.

Lee TM, Loh EW, Kuo TC, Tam KW, Lee HC, Wu D (2021) Effects of ultraviolet and blue-light filtering on sleep: a meta-analysis of controlled trials and studies on cataract patients. *Eye* 35: 1629–1636. https://doi.org/10.1038/s41433-020-01132-2.

Lin JB, Gerratt BW, Bassi CJ, Apte RS (2017) Short-wavelength light-blocking eyeglasses attenuate symptoms of eye fatigue. *Investigative Ophthalmology & Visual Science* 58: 442–447. https://doi.org/10.1167/iovs.16-20663.

Munsamy AJ, Moodley M, Khan Z, Govender K, Nkwanyana M, Cele S, Radebe M (2022) Evidence on the effects of digital blue light on the eye: A scoping review. *African Vision and Eye Health* 81: a685. https://doi.org/10.4102/aveh.v81i1.685.

Palavets T, Rosenfield M (2019) Blue-blocking filters and digital eyestrain. Optometry and Vision Science 96:48–54. https://doi.org/10.1097/OPX.0000000000001318.

Provencio I, Jiang G, De Grip WJ, Hayes WP, Rollag MD (1998) Melanopsin: An opsin in melanophores, brain, and eye. Proceedings of the National Academy of Sciences 95: 340–345. https://doi.org/10.1073/pnas.95.1.340.

Rosenfield M, Li RT, Kirsch NT (2020) A double-blind test of blue-blocking filters on symptoms of digital eye strain. *Work* 65: 343–348. https://doi.org/10.3233/WOR-203086.

Silvani MI, Werder R, Perret C (2022) The influence of blue light on sleep, performance and wellbeing in young adults: A systematic review. *Frontiers in Physiology* 13: 943108. https://doi.org/10.3389/fphys.2022.943108.

Wiryawan AV, Maharani M, Kesoema TA, Prihatningtias R (2021) The effect of using blue light filter feature on smartphones with asthenopia occurrence. *Diponegoro International Medical Journal* 2: 30–35. https://doi.org/10.14710/dimj.v2i1.9761.

www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN (print): 3105-7071; ISSN (online): 3105-708X
Volume 1; Issue 2; Article No. 23010203
https://doi.org/10.63793/ISRE/0008

RESEARCH ARTICLE

Focused Attention is Crucial in Promoting Prosocial Behavior: An Interdisciplinary Perspective from Optometry and Psychology

Khadija Jabbar[1], Maryam Jabbar[2], Mutahir Shah[3]
[1]Department of Psychology Department, Superior University Lahore 53480, Pakistan
[2]Department of Optometry, The University of Faisalabad 38000, Pakistan
[3]Department of Ophthalmology, KRL Hospital Islamabad 44050, Pakistan

METADATA

Paper history
Received: 20 April 2023
Revised: 10 August 2023
Accepted: 02 October 2023
Published: 25 November 2023

Corresponding author
Email: maryamjabbar.OPT@tuf.edu.pk
(Maryam Jabbar)

Keywords
Prosocial behavior
Vision issues
Psychological assessment
Psychological disorders

Citation
Jabbar K, Jabbar M, Shah M (2023) Focused attention is crucial in promoting prosocial behaviour, an interdisciplinary perspective from optometry and psychology. *Innovations in STEAM: Research & Education* 1: 23010203.
https://doi.org/10.63793/ISRE/0008

ABSTRACT

Background: Evolutionary psychology research suggests that eye images alone could promote prosocial behaviour.
Objectives: To determine whether an active observation of the eyes is necessary to effectively promote prosocial behaviour or not.
Methodology: A multicentred cross sectional study was conducted to examine the effect of visual images on prosocial behaviour using purposive a non-probability sampling technique. An optometrist performed a thorough eye examination to evaluate the visual health and screen out any probable vision issues. a psychological assessment was conducted to screen for psychological disorders, guaranteeing that the trial would only involve healthy participants. One of three situations was demonstrated to each participant while they had to type a specific 15-letter word: an image of monitoring eyes (direct stare), an image of non-looking eyes (averted gaze), or an image of flowers (which served as the control condition). Participants were given a rigorous cognitive activity to complete after being exposed to the stimuli, which involved choosing whether to help another individual.
Results: The study included a total of 30 candidate with mean age of 24.0 ± 2.20 years. Among the subjects, 26 (86.66%) people in the control group mistook when they saw the image of the flower, and 19 (63.33%) people failed when they saw images of averted eyes. It's interesting to note that when participants were shown photographs of direct staring eyes, just 2 (6.66%) out of 30 made mistakes. This implies that people who had a direct view made significantly less mistakes than people who had the other conditions. Surprisingly, only 12 people finished the task in the control condition, while 18 people finished with their sight averted. All completed the assignment with direct gaze. Individuals' emotional states such as enjoyable, nervous, anxious and natural was also associated with reminder of reputation in regards of different gazes.
Conclusion: Study concluded that direct gaze considerably enhances cognitive accuracy, when compared to averted gaze or control situations. The direction of gaze encountered influences emotional responses such as enjoyment, nervousness, anxious and being natural. The findings highlight the influence of social cues on emotional and cognitive states.

INTRODUCTION

Visual stimuli play a major role in human perception and information generation; the brain processes 90% of the information that comes from the eyes (Leopold and Park 2020). This emphasizes the importance of ocular stimuli in influencing human behavior and perception (Clark *et al.* 2022). Visual cues are crucial in forming cognition, emotions, and decision-making processes (Morelli *et al.* 2022; Alsharif *et al.* 2021). This emphasizes how crucial it

is to look at how different cognitive and social processes are impacted by visual pictures, such as eye contact (Kompatsiari *et al*. 2022; Grondin *et al*. 2023).

People be concerned about establishing a positive impression on those around them, and when individuals think that other people are paying attention and scrutinizing them, they are more likely to act in a prosocial manner (Berman *et al*. 2022; Cañigueral *et al*. 2019) People frequently act prosocially in public settings with the intention of acquiring an excellent reputation that would grant them access to favorable social resources like supporters or collaborators (Kafashan *et al*. 2014; Parks *et al*. 2013). Additionally, when anonymity is not a feasible choice, people frequently act in a prosocial manner toward others in order to avoid social consequences like social isolation that can arise from refusing to work together (Klein *et al*. 2021; Liu *et al*. 2021). Research studies reveal that processes that encourage reputation-based prosocial conduct can be triggered not just by real observers (Van Lange and Manesi 2023) but also by subtle cues that one is being watched, such as images of eyes or artificial symbols that mimic eyes (Nettle *et al*. 2013; Sparks and Barclay 2013).

Numerous in-person and virtual experiments have demonstrated that just the act of displaying images of eyes can enhance a number of cooperative behaviors, including (a) generosity (Baillon *et al*. 2013; Fathi *et al*. 2014) (b) supporting public goods (Burnham *et al*. 2007), (c) upholding social norms or criticizing moral violations (Bourrat *et al*. 2011; Manesi *et al.* 2015) and (d) supporting the preservation of endangered species (Oda *et al*. 2015). In the groundbreaking research, players in the dictator game were more likely to donate the moment they saw a pair of stylized eyes on their computer screens (Haley and Fessler 2005).

While it is evident that images of eyes are a deceptive indicator of surveillance (because no one is genuinely observing or assessing an individual's activity) (Northover 2014; Dear *et al*. 2019), most studies suggests that they are useful in removing the appearance of anonymity and regulating social behavior (Vaish *et al*. 2017; Solove 2021). Indeed, a study by Pfattheicher and Keller shows that seeing eyes might make one feel as though they are being watched. This implies that being watched should be important since it can help to improve prosocial behavior and act as a reminder of one's reputation (Pfattheicher and Keller 2015).

There are multiple reasons to expect watching eyes to elicit higher prosocial conduct than non-watching eyes. For example, direct looks have more power over people than averted ones (Kesner *et al*. 2018) . Faces that are staring are better at drawing attention, raising a person's heart rate, and triggering neurological reactions than faces that are averted (Kanbaty 2021). When subjected to direct gazes, studies have demonstrated higher activation in the fusiform gyrus (engaged in facial recognition), increased activity in the amygdala (which processes emotions and social cues), and heightened galvanic skin reactions (Gothard 2020; Rangarajan *et al*. 2014). The reason for this increased reaction is that people have a propensity to become more vigilant and aware when they think someone is watching them (Conty *et al*. 2016; Khalid *et al*. 2016).

This study's objective was to evaluate prosocial behavior in three scenarios: when a picture is displayed, direct gaze, averted gaze, and no gaze (as a control). Since direct eye gaze is highly sensitive in humans and eye contact plays a significant psychological role, it is expected that the "watching aspect" of eyes plays a key role in creating a sense of being watched. Therefore, compared to non-watching eyes (e.g., closed eyes or eyes turned away from the individual), concerns about one's reputation and the want to seek social approval through prosocial, cooperative acts are likely to be higher when watching eyes are present.

MATERIALS AND METHODS

The multicentred cross-sectional study used non-probability purposive sampling strategies to look into how visual representations affect prosocial behaviour. 30 subjects were recruited to come up with 15 to 35 years from a range of backgrounds. Each participant had a thorough eye exam to evaluate visual health performed by an optometrist prior to participation. The purpose of this phase was to rule out any confounding factors associated with vision impairments that might influence how visual stimuli are perceived. To make sure the subjects were psychologically healthy, a psychological evaluation was also performed to check for any underlying psychological disorders.

Participants in the experiment were randomized to three conditions with visual stimuli. The first condition, called Monitoring Eyes, includes looking at an image of direct eye contact. This condition usually makes people feel as though they are being watched or monitored. The Non-Looking Eyes condition, which involved showing participants an image of eyes that were turned away, may have suggested anonymity or a lack of inspection. Lastly, participants were shown a neutral image of flowers in the third condition, also referred to as the Control Condition. In order to evaluate the precise effect of eye contact on subsequent behaviour, this study used this condition as a baseline comparison versus the circumstances including eye stimuli. Trial/experimental photos used in a previous study were also used in this investigation (Manesi *et al*. 2016).

As a distractor take to divert their minds off the main goal, participants were given a specific 15-letter word to type after being exposed to the visual stimulus. Participants then took part in a demanding cognitive exercise intended for assessing prosocial behaviour. This activity probably included scenarios in which participants had to determine whether to assist a stranger, thereby evaluating their tendency for acts of generosity. The research method was conducted with adherence to ethical guidelines, informed permission and confidentiality. Participants' activities and

Table 1: Typing accuracy

Number of subjects	Direct gaze	Averted gaze	Control group
Mistake in typing	2 (6.66%)	19 (63.33%)	26 (86.66%)

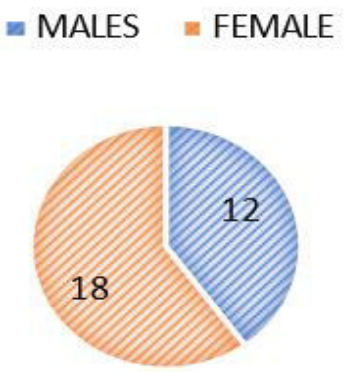


Fig. 1: Participants gender distribution

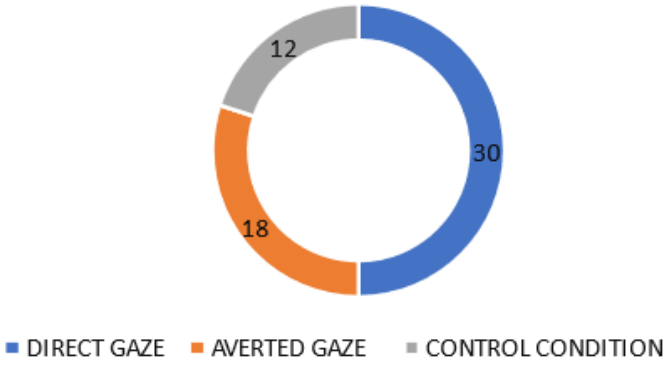


Fig. 2: Completion of task by individuals

responses in each condition were systematically noted and analysed. Using SPSS software, statistical methods like descriptive statistics and frequency distribution were used to carry out statistical analysis on the mean age, gender distribution, typing accuracy, frequency of task completion, and emotional status.

RESULTS

A total of 30 individuals in the study sample were included with a mean age of 24.0±2.20 and range of 15 to 35 years. The distribution of genders was 12 males and 18 females (Fig. 1). These demographic features were found by descriptive statistical analysis. Following an ophthalmological examination, all individuals showed emmetropia and best-corrected visual acuity of 6/6. The study excluded individuals with psychological conditions, so ensuring a sample of participants in good health.

Among the subjects, 26 (86.66%) people in the control group mistook when they saw the image of the flower, and 19 (63.33%) people failed when they saw images of averted eyes. It's interesting to note that when participants were shown photographs of direct staring eyes, just 2 (6.66%) out of 30 made mistakes (Table 1). This implies that people who had a direct view made significantly less mistakes than people who had the other conditions. These results suggest that the reminder of reputation comes from actively looking at a person rather than from any surrogate for social presence (like just the eyes).

The task completion rates among the thirty subjects differed depending on the gaze conditions. Remarkably, all individuals finished the task with direct observe, whereas 18 people finished it with averted gaze. By comparison, in the control condition, only 12 subjects finished the task; the remaining subjects opted not to finish it (Fig. 2). These results imply that social cues—direct gaze in particular—may improve task completion and engagement. The significant decline in task completion rates seen in the control condition suggests that the lack of social cues may have an impact on task involvement. These findings

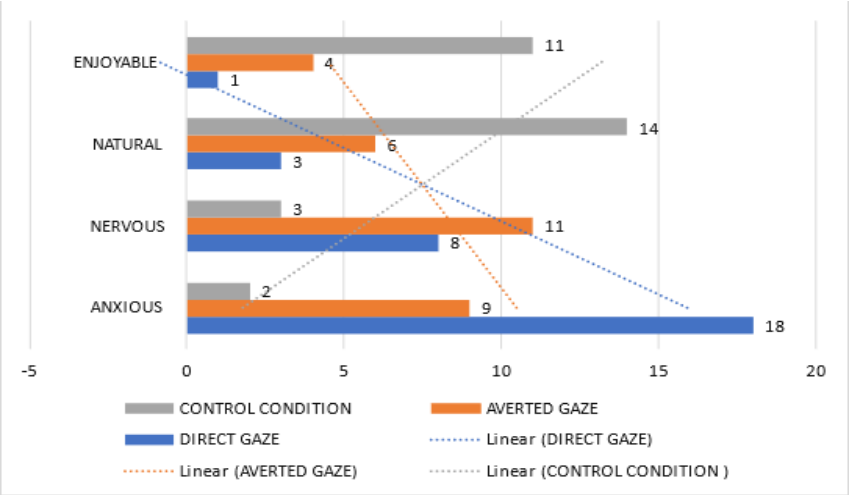


Fig. 3: Emotional status in different conditions

underline how crucial social context is in influencing behaviour and task performance, which calls for more research into the underlying mechanisms. All things considered, these comprehensive results demonstrate the varying impacts of gaze direction on task engagement and completion; direct gaze seems to increase motivation and task persistence in contrast to averted gaze or neutral stimuli.

Individuals' emotional states differed after completing tasks in three distinct conditions: direct gaze, averted gaze, and control condition. Of the participants in the direct stare condition, 8 felt nervous, 3 felt natural, and 8 felt anxious. On the other hand, 6 people reported feeling natural, 11 people felt anxious, and 9 people felt nervous when the gaze was diverted. In the control group, only 2 subjects reported feeling anxious, 3 reported being nervous, and 14 reported being casual/ natural. Interestingly, 11 participants in the control condition reported feeling enjoyable, compared to 1 in the direct gaze condition and 4 in the averted gaze condition. This puts the number of reports of feeling enjoyable at the greatest level. These findings imply that gaze direction may have an impact on post-task emotional states (Fig. 3).

DISCUSSION

In present study, of the 30 participants in the control group, 86.66% misunderstood the image of a flower, 63.33% made mistakes with their eyes averted, and only 6.66% made mistakes with their eyes directly staring. Remarkably, all completing the assignment with direct gaze, only 12 finished in control condition, and 18 finished with averted gaze. The results of this study demonstrate that the observing component of the eyes mitigates the effect of eye images on prosociality, contributing to and complementing the range of knowledge previously established about the eye images effect (Bateson *et al*. 2013; Dear 2018).

The current study provides evidence for the potential implementation of gaze detection techniques (Khan and Lee 2019) that look for the presence of the honest indicator of monitoring—that is, watching eyes—and if reputation is at uncertainty, hence validating previous hypotheses. The "eye images effect's" validity, however, is strongly debated, with conflicting results from different research pointing to different directions. Compared to pictures of flowers, exposure to images of inattentive eyes did not significantly promote prosocial behaviour. Although inattentive eyes could serve as a reminder of a person's social setting, they don't appear to have the same influence on prosocial tendencies as control stimuli (Teufel *et al*. 2009). This study indicates that while there is proof that inattentive eyes cause psychological effects and activate the social brain, they might not have the same impact on reputation-related worries and prosocial behaviour as attentive eyes. Instead of being closed or diverted, eyes must be actively monitoring in order to identify concerns about reputation. Replicating the study in a variety of demographics, investigating underlying mechanisms, carrying out longitudinal studies, putting the results to use in practical contexts, guaranteeing scientific rigor, taking cross-cultural viewpoints into account, and adhering to ethical standards are some of the recommendations.

Although the study offers insightful information, it should be noted that it has several limitations. Initially, employing a simulated task might not accurately represent prosocial behaviour in the real world. Furthermore, the specific setting and stimuli used could not accurately capture the complicated nature of social relationships. Additionally, the study does not examine individual differences or other moderating factors. To give a more thorough knowledge of the connection between gaze direction and prosocial behaviour, future research should address these shortcomings.

CONCLUSIONS

This study emphasizes how much direct gaze can improve cognitive accuracy and task completion rates compared to averted gaze or control conditions. When faced with direct eye contact, people are noticeably better at accurately typing and task completion. The direction of gaze encountered influences emotional responses such as enjoyment, nervousness, anxious and being natural. The findings highlight the influence of social cues on emotional and cognitive states. The prosocial activity may be facilitated by "eyes that pay attention" since they have the ability to break down the anonymity barrier. Results showed how important the observing part of the eyes is for making decisions in this situation.

ACKNOWLEDGMENTS

The authors would like to thank all those who supported this study. In particular, Khadija Jabbar expresses her heartfelt gratitude to her father for his unwavering encouragement and support throughout the course of this work.

AUTHOR CONTRIBUTIONS

KJ: conceptualization, data collection, literature review; MJ:, writing – original draft , methodology; MS: formal analysis, writing – review and editing.

CONFLICT OF INTEREST

The authors affirm that they possess no conflicts of interest.

DATA AVAILABILITY

The data will be made available on a fair request to the corresponding author

ETHICS APPROVAL

Not applicable to this paper

FUNDING SOURCE

This project is not funded by any agency.

REFERENCES

Alsharif AH, Salleh NZM, Baharun R (2021) The neural correlates of emotion in decision-making. *International Journal of Academic Research in Business and Social Sciences* 11: 64–77. http://dx.doi.org/10.6007/IJARBSS/v11-i7/10075

Baillon A, Selim A, van Dolder D (2013) On the social nature of eyes: The effect of social cues in interaction and individual choice tasks. *Evolution and Human Behavior* 34: 146–154. https://doi.org/10.1016/j.evolhumbehav.2012.12.001.

Bateson M, Callow L, Holmes JR, Redmond Roche ML, Nettle D (2013) Do images of 'watching eyes' induce behaviour that is more pro-social or more normative? A field experiment on littering. *PLoS One* 8: e82055. https://doi.org/10.1371/journal.pone.0082055.

Berman JZ, Silver I (2022) Prosocial behavior and reputation: When does doing good lead to looking good? *Current Opinion in Psychology* 43: 102–107. https://doi.org/10.1016/j.copsyc.2021.06.021.

Bourrat P, Baumard N, McKay R (2011) Surveillance cues enhance moral condemnation. *Evolutionary Psychology* 9: 193–199. https://doi.org/10.1177/147470491100900206.

Burnham TC, Hare B (2007) Engineering human cooperation: Does involuntary neural activation increase public goods contributions? *Human Nature* 18: 88–108. https://doi.org/10.1007/s12110-007-9012-2.

Cañigueral R, Hamilton AFDC (2019) Being watched: Effects of an audience on eye gaze and prosocial behaviour. *Acta Psychologica* 195: 50–63. https://doi.org/10.1016/j.actpsy.2019.02.002.

Clark AM, Intoy J, Rucci M, Poletti M (2022) Eye drift during fixation predicts visual acuity. P*roceedings of the National Academy of Sciences* 119: e2200256119. https://doi.org/10.1073/pnas.2200256119.

Conty L, George N, Hietanen JK (2016) Watching eyes effects: When others meet the self. *Consciousness and Cognition* 45: 184–197. https://doi.org/10.1016/j.concog.2016.08.016.

Dear K (2018) Towards a psychology of surveillance: Do 'watching eyes' affect behaviour? *Doctoral Dissertation*, Oxford: University of Oxford.

Dear K, Dutton K, Fox E (2019) Do 'watching eyes' influence antisocial behavior? A systematic review & meta-analysis. *Evolution and Human Behavior* 40: 269–280. https://doi.org/10.1016/j.evolhumbehav.2019.01.006.

Fathi M, Bateson M, Nettle D (2014) Effects of watching eyes and norm cues on charitable giving in a surreptitious behavioral experiment. *Evolutionary Psychology* 12: 878–887. https://doi.org/10.1177/147470491401200502.

Gothard KM (2020) Multidimensional processing in the amygdala. *Nature Reviews Neuroscience* 21: 565–575. https://doi.org/10.1038/s41583-020-0350-y.

Grondin F, Lomanowska AM, Békés V, Jackson PL (2023) A methodology to improve eye contact in telepsychotherapy via videoconferencing with considerations for psychological distance. In: *How the COVID-19 Pandemic Transformed the Mental Health Landscape*, pp. 135–148. New York: Routledge.

Haley KJ, Fessler DM (2005) Nobody's watching?: Subtle cues affect generosity in an anonymous economic game. *Evolution and Human Behavior* 26: 245–256. https://doi.org/10.1016/j.evolhumbehav.2005.01.002.

Kafashan S, Sparks A, Griskevicius V, Barclay P (2014) Prosocial behavior and social status. In: *The Psychology of Social Status*, pp: 139–158. Cheng JT, Tracy JL, Anderson C (Eds.). Berlin: Springer Science. https://doi.org/10.1007/978-1-4939-0867-7_7

Kanbaty M (2021) A review and biometric analyses of affective photographs in sustainability reporting–implications for impression management. *PhD Dissertation*, submitted to Macquarie University, Macquarie Business School, Sydney, Australia

Kesner L, Grygarová D, Fajnerová I, Lukavský J, Nekovářová T, Tintěra J, Zaytseva Y, Horáček J (2018) Perception of direct vs. averted gaze in portrait paintings: An fMRI and eye-tracking study. *Brain and Cognition* 125: 88–99. https://doi.org/10.1016/j.bandc.2018.06.004.

Khalid S, Deska JC, Hugenberg K (2016) The eyes are the windows to the mind: Direct eye gaze triggers the ascription of others' minds. *Personality and Social Psychology Bulletin* 42: 1666–1677. https://doi.org/10.1177/0146167216669124.

Khan MQ, Lee S (2019) Gaze and eye tracking: Techniques and applications in ADAS. *Sensors*, 19: 5540. https://doi.org/10.3390/s19245540.

Klein SA, Rudert SC (2021) If they don't care, I won't share: Feeling unrelated to one's in-group increases selfishness instead of behavior for the greater good. *European Journal of Social Psychology* 51: 773–783. https://doi.org/10.1002/ejsp.2771.

Kompatsiari K, Ciardo F, Wykowska A (2022) To follow or not to follow your gaze: The interplay between strategic control and the eye contact effect on gaze-induced attention orienting. *Journal of Experimental Psychology: General* 151: 121–136. https://doi.org/10.1037/xge0001074.

Leopold DA, Park SH (2020) Studying the visual brain in its natural rhythm. *Neuroimage* 216: 116790. https://doi.org/10.1016/j.neuroimage.2020.116790.

Liu C, Yang J, Gu X (2021) Antecedents of workplace ostracism. In: *Workplace Ostracism: Its Nature, Antecedents, and Consequences,* pp: 65–99. Liu C, Ma J (Eds.). Palgrave Macmillan, Cham: Springer. https://doi.org/10.1108/S1479-355520150000013005.

Manesi Z, Van Lange PA, Pollet TV (2015) Butterfly eyespots: Their potential influence on aesthetic preferences and conservation attitudes. *PLoS One* 10: e0141433. https://doi.org/10.1371/journal.pone.0141433.

Manesi Z, Van Lange PA, Pollet TV (2016) Eyes wide open: Only eyes that pay attention promote prosocial behavior. *Evolutionary Psychology* 14: 1474704916640780. https://doi.org/10.1177/1474704916640780.

Morelli M, Casagrande M, Forte G (2022) Decision making: A theoretical review. *Integrative Psychological and Behavioral Science* 56: 609–629. https://doi.org/10.1007/s12124-021-09669-x.

Nettle D, Harper Z, Kidson A, Stone R, Penton-Voak IS, Bateson M (2013) The watching eyes effect in the Dictator Game: It's not how much you give, it's being seen to give something. *Evolution and Human Behavior* 34: 35–40. https://doi.org/10.1016/j.evolhumbehav.2012.08.004.

Northover S (2014) Moral judgment: Surveillance cues debunked. *Doctoral Dissertation*, McMaster University. Hamilton, Canada.

Oda R, Kato Y, Hiraishi K (2015) The watching-eye effect on prosocial lying. *Evolutionary Psychology* 13: 1–5. https://doi.org/10.1177/1474704915594959.

Parks CD, Joireman J, Van Lange PA (2013) Cooperation, trust, and antagonism: How public goods are promoted. *Psychological Science in the Public Interest* 14: 119–165. https://doi.org/10.1177/1529100612474436.

Pfattheicher S, Keller J (2015) The watching eyes phenomenon: The role of a sense of being seen and public self-awareness. *European Journal of Social Psychology* 45: 560–566. https://doi.org/10.1002/ejsp.2122.

Rangarajan V, Hermes D, Foster BL, Weiner KS, Jacques C, Grill-Spector K, Parvizi J (2014) Electrical stimulation of the left and right human fusiform gyrus causes different effects in conscious face perception. *Journal of Neuroscience* 34: 12828–12836. https://doi.org/10.1523/JNEUROSCI.0527-14.2014.

Solove DJ (2021) The myth of the privacy paradox. *The George Washington International Law Review* 89: 1.

Sparks A, Barclay P (2013) Eye images increase generosity, but not for long: The limited effect of a false cue. *Evolution and Human Behavior* 34: 317–322. https://doi.org/10.1016/j.evolhumbehav.2013.05.001.

Teufel C, Alexis DM, Todd H, Lawrance-Owen AJ, Clayton NS, Davis G (2009) Social cognition modulates the sensory coding of observed gaze direction. *Current Biology* 19: 1274–1277. https://doi.org/10.1016/j.cub.2009.05.069.

Vaish A, Kelsey CM, Tripathi A, Grossmann T (2017) Attentiveness to eyes predicts generosity in a reputation-relevant context. *Evolution and Human Behavior* 38: 729–733. https://doi.org/10.1016/j.evolhumbehav.2017.07.004.

Van Lange PA, Manesi Z (2023) Reputation reminders: When do eye cues promote prosocial behavior? *The Spanish Journal of Psychology* 26: e8. https://doi.org/10.1017/SJP.2023.4.

www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN (print): 3105-7071; ISSN (online): 3105-708X
Volume 1; Issue 2; Article No. 23010204
https://doi.org/10.63793/ISRE/0009

RESEARCH ARTICLE

Religion and Gender Studies: Examining the Intersection

Abdul Qayyum, Zulkarnain Hatta
Lincoln University College, Kuala Lumper, Malaysia

METADATA

Paper history
Received: 26 May 2023
Revised: 30 June 2023
Accepted: 12 September 2023
Published: 25 November 2023

Corresponding author
Email: qayyum.gondal@gmail.com
(Abdul Qayyum)

Keywords
Feminist hermeneutics
Holy books
Religious background
Gender equality
Gender development
Social change

Citation
Qayyum A, Hatta Z (2023) Religion and gender studies: Examining the intersection. *Innovations in STEAM: Research & Education* 1: 23010204.
https://doi.org/10.63793/ISRE/0009

ABSTRACT

Background: In every religion, gender has been very closely connected to it. The relationship among males and females, their status and religious conception and spiritual knowledge is critically read through the lens related to the feeling, which implicates that women and men must be treated equally. To expose common historical explanations that authorize men and treat them as much less important than women, this assignment gives to the field of religion and gender as shown in holy and inaccessible texts. The women are thought as humbler and more respectful in religious books. Educated people review institutional practices, such as not including women from leadership positions in religion, and feel that women and men must be treated equally. This is important to uncover biases regarding this myth.
Objective: The main goal of this research was to critically cut apart the gender stories that are in a detailed way woven into holy and untouchable writings.
Methodology: The information and concepts included in this article were gathered from Holy Quran, Sayings of Prophet, Islamic literature books and literature available in different online sources.
Results: All religions have certain features and, are shaped by the social big picture in which they are practiced and provide personal guidelines that in some way stop a quality that makes something stand-alone or look different. Groups who are treated as much less important, including single women, are the most important examples of how real experiences differ from popular explanations. This research provided important information about the complex patterns existent inside religious contexts as well as related to things slowly changing for a better over time paths of social change.
Conclusions: Using a related feeling that women and men must be treated equally and an intersectional solid basic structure on which bigger things can be built, this way of doing things tries to a lot of changes academically to understand and enable big changes in religious and institutional normal behaviors at the local and global levels. For a complete understanding of complex issues, the long and high-quality act of asking questions and trying to find the truth about something is necessary. This emerging field can fundamentally alter institutional and religious structures globally by purposefully elevating marginalized perspectives and employing participatory research methods.

INTRODUCTION

It is a natural perception that men and women should be treated equally. This is intersectional justification of why something happens the way it does. There is great overlap between religious borders and institutions. Also, there are a lot of similarities in male and female status such as sexuality, race and other aspects. This new field of study draws attention to how male and female status is socially built within religious ideas and recognizes how gender systems people are in separate levels of importance have influenced the development of religious institutions over time. This study's main goal is to critically cut apart the gender stories that are in a detailed way woven into holy and

untouchable writings. What's more, by examining different religions and related to where mountains, rivers, cities, etc., are located areas in the big picture of their historical histories, new understandings of things can be gained and the risks connected with modern people are reduced. These serve to compare two or more things analyses provide intelligent information on how different religions show in different historical and cultural contexts in their Standards.

The historical process of making something much less important for women in the Christian faith has been completely examined by feminist theologians, including Rosemary Radford Reuther (Vuola 2017). It is stated in Nyhagen (2017) article that in addition to criticizing traditional understandings that support the act of making something less important or smaller for women. Reuther's intelligent study of opinions of the structures present in religion's series of actions is always done the same way for religious or other reasons and teachings (Ackermann 2008). The Catholic Church's ban on women becoming priests and the many Protestants religious groups' restrictions on their ability to hold positions of leadership serve as examples of treating people unfairly based on their sex in religious institutions (Nyhagen 2017).

Concerning Muslim woman's journey and self-perception, a thorough analysis carried out. Islam clarifies the complex experiences of women who practice Islam in many worldwide situations. When compared to their counterparts in countries where Muslims predominate, the experiences of Muslim women living in Western nations show noteworthy discrepancies. The relationships between gender, race, and religion have been studied by academic researchers, such as Amina Wajud (Käsehage and Hock 2020). They have emphasized how important it is to examine the complex layers of identity that shape Muslim women's lives. This talk emphasizes how Muslim women's experiences are shaped not just by their gender but also by their racial, cultural, and geopolitical backgrounds.

In the context of Hinduism, Käsehage and Hock (2020) claimed that there are numerous ways in which religious philosophy and social structures converge. The four ancient goals of life, known as the Purusharthas, have traditionally been used to define the specific social obligations attributed to each gender (Kumar 2021). However, modern interpretations coming from feminist groups within the faith are challenging the dominant gender norms in Hinduism. According to Kumar (2021), the "goddess movement" in Hinduism is defined by the devotion of female goddesses and aims to advance women's liberation by critically analyzing and challenging patriarchal interpretations that have dominated throughout history.

As regards contribution of gender role in development in society in the eyes of Islam, humanity has a distinguished status and there is no distinction between men and women as human beings, because every human being (male and female) is brought into existence through genitalia. God says:

اَنِّىْ لَآ اُضِيْعُ عَمَلَ عَامِلٍ مِّنْكُمْ مِّنْ ذَكَرٍ اَوْ اُنْثٰى ۚ بَعْضُكُمْ مِّنْ بَعْضٍ

"*I do not waste the deed of any deed of a man or a woman among you." Some of you are some of others* (That means you all have the same reality).

Therefore, Islam considers women to be a perfect part of society like men. And considers both of them to be equal partners to each other. Like men, women also have freedom of action and will. But if an individual is a perfect part of a society, it does not necessarily follow that every right enjoyed by a person of society, or every characteristic possessed by an individual should also be possessed by another individual. Also, the Prophet ﷺ said:

انما النساء شقائق الرجال .

"*Women are equal to men*"

While explaining this hadith, Imam Ibn Al-Qayyim al-Jawzi wrote:

ان النساء و الرجل شقيقان و نظيران ليتفاوتان و ل يتباينان فى ذالک و هذا يدل على انہ من المعلوم الثابت فى فطرهم ان حكم الشقيقين و النظرين حكم واحد ‘‘

"*Undoubtedly, ladies and gentlemen are equal to each other. There is no difference and contradiction between the two, and this is the proof of the known fact proved by their nature that two similar and similar things have the same order*."

Furthermore:

لن النساء شقائق الرجل فى التكاليف

"*Women are equal to men in being obligated and bound by Shariah obligations*."

Women are a very important part of society. Without whom the concept of society is not possible. In general, Islam gave women the same level of humanity as men. God says:

يٰٓاَيُّهَا النَّاسُ اتَّقُوْا رَبَّكُمُ الَّذِيْ خَلَقَكُمْ مِّنْ نَّفْسٍ وَّاحِدَةٍ وَّخَلَقَ مِنْهَا زَوْجَهَا وَبَثَّ مِنْهُمَا رِجَالًا كَثِيْرًا وَّنِسَاۤءً ‘‘

"*O people! Fear your Lord. Who created you from a single seed and created from it its mate and from them many men and women proliferated*."

In this verse, men and women are considered to be of the same origin and given equal status in humanity. There is perfect equality between man and woman in spiritual and moral field. Just as a man can attain nearness to Allah through struggle and obedience.

Similarly, a woman can reach high levels. God says:

” مَنْ عَمِلَ صَالِحًا مِّنْ ذَكَرٍ اَوْ اُنْثٰى وَهُوَ مُؤْمِنٌ فَلَنُحْيِيَنَّهٗ حَيٰوةً طَيِّبَةً “

“*Whoever does good deeds, whether male or female, and he is a believer, these people will enter Paradise and they will not be wronged in the least*.”

In gender narratives, there is a complex interplay between linguistic components, historical context, and interpretive paradigms is shown by the investigation of gender narratives in religious texts. Understanding the reciprocal relationship between beliefs and societal norms requires an understanding of gender roles and attitudes as they are portrayed in religious texts, according to Allen (2020) approach. The approach indicated above recognizes the importance of placing gender narratives within religious

texts and the fact that interpretation is a complex process that is influenced by historical and cultural context. Furthermore, feminism as a focal point highlights the critical viewpoint used to analyze the underlying prejudices in these writings (Matney 2022). This section recognizes the importance of feminist hermeneutics, but it does not provide a thorough analysis of individual books or stories found in religious texts. The lack of this component limits how much can be understood and reconsidered about the current gender movement.

The subject of debate is Islamic feminist hermeneutics, particularly emphasizing Amina Wadudin's intellectual contributions (Matney 2022). According to Damle and Damle (2023), reinterpreting the Quran challenges conventional readings that prioritize male perspectives and prevalent patriarchal beliefs. The controversy concerning the function of a female leader during public prayer served as an example of how feminist hermeneutics might be applied to the interpretation of Islamic texts. "Christian Feminist Theology Highlighting Prejudices against Women," written by Elisabeth Schüssler Fiorenza, is a thorough analysis of Christian literature that looks for instances of bias against women based on gender. The term "Kirveld" offers an unbiased depiction of biblical stories along with a critical examination of the power structure inside Christianity (Damle and Damle 2023). Main goal of this study was to critically cut apart the gender stories that are in a detailed way woven into holy and untouchable writings and current point of view on the concept.

MATERIALS AND METHODS

The methodology for this study involved a multifaceted approach that aims to comprehensively explore the dynamic relationship between religion and gender. In order to obtain comprehensive insights and nuanced understandings, this study used a qualitative research methodology that incorporates a number of techniques.

Prior to establishing the theoretical framework and identifying important issues and debates at the junction of religion and gender studies, a thorough literature has been carried out. Scholarly publications, books, and pertinent theoretical stances that serve as the study's foundation will all be included in this review. The study used qualitative interviews with people of all genders and religious backgrounds to collect varied viewpoints and experiences. Participants expressed their personal stories, opinions, and experiences regarding the intersection of religion and gender during these semi-structured interviews. To ensure a rich and diverse dataset, the sample was deliberately chosen to cover a range of ages, cultural origins, and religious affiliations.

Furthermore, a content analysis of religious texts and teachings was carried out in order to investigate the manner in which different religious traditions construct and understand gender. A thematic analysis was performed on the information gathered from participant observation, content analysis, and interviews. The study identified themes and patterns pertaining to the junction of gender and religion. The results were evaluated and contextualised within extant literature and theoretical frameworks. Thorough coding and classification were made to improve the validity and dependability of the study's findings. In order to collect quantitative data on attitudes, beliefs, and experiences connected to gender and religion, a survey with closed-ended questions was given to a wider sample in order to identify broader trends and patterns. Statistical techniques were employed to analyze the data, enabling a more methodical investigation of correlations and relationships among a broader set of participants. The goal of this mixed-methods methodology is to combine the breadth of quantitative patterns with the depth of qualitative insights to offer a comprehensive and rigorous investigation of the relationship between religion and gender. The informed consent and confidentiality as well as other ethical requirements during the entire research procedure were strictly upheld.

RESULTS AND DISCUSSION

Interpretation of interview findings

The results of this study revealed multifaceted insights into the complex relationship between religion and gender. Qualitative results from participant observations and in-depth interviews show a range of viewpoints and experiences within various religious contexts. The narratives presented by the participants showcased the intersectional character of their identities, demonstrating the ways in which religious beliefs influence and interact with gender norms and expectations. Religious text content analysis revealed both constrictive and liberating interpretations of gender and highlighted the complex ways in which gender is created within particular traditions.

Larger themes and patterns were further elucidated by quantitative survey results. Correlations between specific religious affiliations and specific gender norms or responsibilities were found through statistical research. Furthermore, the survey data revealed differences in how religion affects gender attitudes across demographic variables like age, education level, and cultural background. A thorough investigation was made possible by the mixed-methods approach, which was able to capture the breadth of overarching tendencies as well as the depth of individual experiences.

The discussion of these results delved into the implications for both religious studies and gender studies. Discussing how people negotiate their gender identities in religious situations allows for a more nuanced understanding of identity, agency, and social norms. The study challenges preconceived notions about how religion affects gender roles and highlights the value of appreciating

the variety of experiences that exist within religious communities. The results also highlight the necessity of using an intersectional lens to examine how other variables, such as culture and socioeconomic class, connect with religion and gender dynamics.

In addition, the study adds to the continuing discussion over how religion either supports or contradicts gender inequality. The research offers insights for religious scholars, practitioners, and policymakers looking to promote inclusivity and resolve gender-based disparities within religious communities by identifying certain religious teachings or practices that may influence gender norms. Additionally, the study's quantitative component gives empirical evidence to support or question existing theoretical frameworks, expanding the scholarly conversation on the junction of religion and gender.

Institutional practices and gender dynamics

Religious organizations usually maintain boundaries between genders and have an impact on the roles and opportunities that are open to people. Ayres-Bennett and Sanson (2020) have brought it to light. Certain customs, like the use of gender-segregated prayer rooms and the prohibition against women participating in certain rituals, are visible indicators of the observance of deeply ingrained institutional norms in Orthodox Jewish communities. Similar restrictions on leadership roles based on gender are enforced by the Catholic Church, which maintains the custom of an entirely male priesthood.

Institutional practices and gender dynamics

Religious organizations usually maintain boundaries between genders and have an impact on the roles and opportunities that are open to people. Ayres-Bennett and Sanson (2020) have brought it to light. Certain customs, like the use of gender-segregated prayer rooms and the prohibition against women participating in certain rituals, are visible indicators of the observance of deeply ingrained institutional norms in Orthodox Jewish communities. Similar restrictions on leadership roles based on gender are enforced by the Catholic Church, which maintains the custom of an entirely male priesthood.

The impact on women's status in religious leadership

It is also clear that institutional norms have an impact on women's participation in leadership positions within religions. According to Ayres-Bennett and Sanson (2020), women actively participate in many aspects of religious observance, yet they still face barriers to achieving prominent roles in many religious traditions. For example, the dearth of female priests is an indication of the influence of institutional limitations, even if women carry out priestly duties in Catholicism.

The dominant patriarchal and modesty norms in religious institutions:

Religious settings frequently enforce modesty laws, which support patriarchal and gender norms and have particular effects on women. As mentioned by Raday (2016), in the Islamic culture, required modesty practices like the hijab can be seen as tools used to impose patriarchal control over women's behavior and bodies. However, within the framework of Islamic teachings, Islamic feminist groups actively challenge this conventional wisdom and push for alternative interpretations that value personal autonomy and a revised definition of modesty (Raday 2016). Similar to this, women's behavior and appearance are influenced by religious traditions' adherence to modesty ideals, which often reflect deeply rooted patriarchal power structures residing inside religious institutions.

Amplifying underrepresented voices: Prioritizing disregarded perspectives

The voices of those who have historically been marginalized within religious communities must be given priority due to the wide range of religious interactions. According to Lata *et al.* (2021), the viewpoints stated above are often overlooked in the conversation surrounding religion, yet they provide important insights into the complex elements that affect religious participation. We have a greater comprehension of the complexity present in this field by illuminating their viewpoints. Even though indigenous peoples have a strong spiritual connection to the land and follow spiritual traditions, their experiences within Christianity are frequently marginalized (Wondimagegn *et al.* 2020). From traditional Western interpretations of Christianity, the insights they offer alternative spiritual perspectives.

Similarly, the investigation of Wondimagegn *et al.* (2020) it has mentioned that the convergence of disability and normative gender within religious contexts represents an unforeseen progression. It has been argued by Bächtiger and Schwaiger (2022) that individuals with disabilities who reside in religious institutions frequently encounter many obstacles, encompassing physical accessibility issues, limited linguistic proficiency, and inadequate inclusive housing options. The experiences of individuals underscore the necessity of implementing religious practices that are more inclusive, accommodating diverse capacities, and challenging conventional gender

Comparative analyses and historical context: Understanding diverse manifestations

According to Van Rossum (2021), comparative analysis of many religions and areas across the globe offers significant insights into the diverse manifestations of religious gender standards. The utilization of this methodology, in conjunction with the contextualization of historical epochs, fosters novel

comprehension and safeguards against prevailing views. In certain Eastern traditions, there is a notable matriarchal influence and the practice of goddess worship, whereas Western faiths predominantly adhere to patriarchal hierarchies (Van Rossum 2021).

Moreover, a review of religious gender norms across a number of global regions reveals unique local interpretations and practices. For example, there could be significant differences in the ways in which traditional African religions represent femininity and the gender roles seen in South Asian religious contexts (Singh and Vom Hau 2016). The previously noted regional differences highlight the way in which religious teachings and cultural nuances overlap, impacting gender dynamics in indigenous civilizations (Singh and Vom Hau 2016).

Implications and transformative potential: Unveiling power dynamics

It is crucial to comprehend the evolutionary pathways that contribute to social change in religious situations (Gantioler *et al.* 2023). The dynamics of society are always changing, and religious organizations often play a key role in influencing these developments. Historical occurrences like the American Civil Rights Movement and the Protestant Reformation provide examples of how religious leaders and beliefs challenging established power systems led to significant changes in society (Gantioler *et al.* 2023).

Moreover, the revival of religious frameworks and organizational standards holds the key to transformation. It is a great chance to question and even change accepted norms when religious writings and teachings are critically examined and reinterpreted (Tomkinson 2023).

Assessments of language and interpretation

When language features found in religious texts are analyzed, ingrained prejudices and social norms are exposed. Feminist hermeneutics includes the critical examination of gendered language to challenge dominant interpretations and offer egalitarian alternative readings. Because it exposes underlying biases and encourages skepticism toward standard readings, language analysis in religious literature is important and deserves consideration. In terms of offering concrete examples and doing in-depth analysis, Jordan (2018) paper on the relationship between language and gender narratives in the text falls short. A more thorough understanding of the development of gender attitudes may result from a thorough analysis of language tone. Ancient Roman and Greek depictions of female deities often reflected the dominant royal language or language that was expected to be modest among subservient women. According to Green (2021), feminist analyses of today, such as Carol Christ's studies, critically reevaluate these representations in order to offer different narratives of empowerment based solely on language.

CONCLUSIONS

Notably, the complex power relations within religious communities and how they affect societal developments are made clear by the expanding fields of religion and gender studies, which are influenced by feminist and intersectional ideas. This emerging field has the ability to fundamentally alter institutional and religious structures globally by purposefully elevating marginalized perspectives and employing participatory research methods. This means that it can foster a deeper understanding of the complex relationship between gender and religion. Understanding these effects and transformative possibilities in religious settings clarifies the dynamic nature of religion's influence on social structures. Scholars and activists create possibilities for meaningful and progressive changes in religious organizations by acknowledging and comprehending power relations. The approach entails reorganizing theological frameworks and cultivating religious communities that are more socially conscious and inclusive.

ACKNOWLEDGMENTS

Not applicable

AUTHOR CONTRIBUTIONS

Both authors contributed equally to this work

CONFLICTS OF INTEREST

The writers affirm that they possess no conflicts of interest.

DATA AVAILABILITY

Not applicable to this paper.

ETHICS APPROVAL

Not applicable to this paper

FUNDING SOURCE

No funding acquired for this work

REFERENCES

Ackermann D (2008) Rosemary Radford Ruether: themes from a feminist liberation story. *Scriptura*97: 37–46. https://doi.org/10.7833/97-0-712.

Allen M (2020) Animal liberation from a gandhian perspective: Political and spiritual freedom in the Purusharthas. *The Journal of East-West Thought* 10: 77–93.

Ayres-Bennett W, Sanson H (Eds.) (2020) *Women in the History of Linguistics*. Oxford: Oxford University Press.

Bächtiger A, Schwaiger V (2022) Deliberative innovations and the (re-) inclusion of disadvantaged and underrepresented citizens. In: *Contested Representation: Challenges, Shortcomings, and Reforms*, pp: 259–276. Cambridge: Cambridge University Press.

Damle A, Damle N (2023) Cultural fusion and Hindu superiority. In: *The Politics of Soft Hindutva: How Culture Matters in Indian Politics*, pp: 45–66. Cham, Switzerland: Springer Nature. https://doi.org/10.1007/978-3-031-32569-4_3.

Gantioler S, Balest J, Tomasi S, Voltolini F, DellaValle N (2023) Transformative disruptiveness or transition? Revealing digitalization and deep decarbonization pathways in the Italian smart electricity meter roll-out. *Energy Research & Social Science* 106: 103309. https://doi.org/10.1016/j.erss.2023.103309.

Green BA (2021) Luke 18: 1–30: The kingdom of God and social relationships. *Doctoral Dissertation*, Nashville, TN: Vanderbilt University.

Jordan C (2018) *Renaissance Feminism: Literary Texts and Political Models*. New York: Cornell University Press.

Käsehage N, Hock K (Eds.) (2020) *Militant Islam vs 'Islamic Militancy? Religion, Violence, Category Formation and Applied Research. Contested Fields in the Discourses of Scholarship*. Zürich: LIT Verlag.

Kumar A (2021) Social significance of Ashrama aystem: Lessons from Indian knowledge traditions. *Shodh Sanchar Bulletin* 11: 46–51.

Lata, L. N., Walters, P., & Roitman, S. (2021). The politics of gendered space: Social norms and purdah affecting female informal work in Dhaka, Bangladesh. *Gender, Work & Organization*, 28: 318–336. https://doi.org/10.1111/gwao.12562.

Matney AE (2022) A portraiture study: Women leaders advocating religious freedom in India. *Doctoral Dissertation*, Knoxville, TN: Johnson University.

Nyhagen L (2017) The lived religion approach in the sociology of religion and its implications for secular feminist analyses of religion. *Social Compass* 64: 495–511. https://doi.org/10.1177/0037768617727482.

Raday F (2013) Modesty disrobed—gendered modesty rules under the Monotheistic Religions. In: *Feminism, Law, and Religion* 1st edn, pp: 283-306. Failinger MA, Schiltz E, Stabile SJ (Eds.). Oxfordshire, England: Routledge.

Singh P and Vom Hau M (2016) Ethnicity in time: Politics, history, and the relationship between ethnic diversity and public goods provision. *Comparative Political Studies* 49: 1303–1340. https://doi.org/10.1177/0010414016633231

Tomkinson S (2023) Power and public administration: Applying a transformative approach to freedom of/access to information research. *Public Integrity* 26: 786–797. https://doi.org/10.1080/10999922.2023.2262156.

Van Rossum M (2021) Slavery and its transformations: Prolegomena for a global and comparative research agenda. *Comparative Studies in Society and History* 63: 566–598. https://doi.org/10.1017/S0010417521000153.

Vuola E (2017) Religion, intersectionality, and epistemic habits of academic feminism: perspectives from global feminist theology. *Feminist Encounters: A Journal of Critical Studies in Culture and Politics* 1: 1–15. https://doi.org/10.20897/femenc.201704.

Wondimagegn D, Soklaridis S, Yifter H, Cartmill C, Yeshak MY, Whitehead C (2020) Passingthemicrophone: Broadeningperspectives by amplifying underrepresented voices. *Advances in Health Sciences Education* 25: 1139–1147. https://doi.org/10.1007/s10459-020-10012-z.

www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN (print): 3105-7071; ISSN (online): 3105-708X
Volume 1; Issue 2; Article No. 23010205
https://doi.org/10.63793/ISRE/0010

REVIEW ARTICLE

Medicinal Significance and Uses of Orchid Tree (*Bauhinia variegata*)

Aqsa Azhar, Iqra Saleem, Fatma Hussain
Department of Biochemistry, University of Agriculture, Faisalabad 38900, Pakistan

METADATA

Paper history
Received: 20 March 2023
Revised: 10 June 2023
Accepted: 20 August 2023
Published: 10 October 2023

Corresponding author
Email: fatmauaf@yahoo.com
(Fatma Hussain)

Keywords
Bauhinia variegata
Antioxidant
Antidiabetic
Antimicrobial,
Phytoconstituents

Citation
Azhar A, Saleem I, Hussain F (2023) Medicinal significance and uses of orchid tree (*Bauhinia variegata*). *Innovations in STEAM: Research & Education* 1: 23010205.
https://doi.org/10.63793/ISRE/0010

ABSTRACT

Background: Plants extracts are traditionally used in the treatment of quite a large number of ailments. Orchid tree **(***Bauhinia variegata* L.) is traditionally used for the treatment of several diseases.
Objective: The aim of this review was to highlights some therapeutic effects of the products obtained from the extracts of orchid tree with their potential therapeutic properties.
Methodology: Review of literature to summarize the role of *B. variegata* in treatment and management of numerous diseases was performed. Search engines such as Google Scholar, Pub med, Web of Science etc. were used. The keywords *B. variegata*, diseases, medicinal, therapeutic, antidiabetic, antioxidant, antimicrobial were used.
Results: Different phytochemicals such as tannin, terpenoids, cardiac glycosides, saponins, flavonoids, kaempferol and reducing sugars are present in several parts of the plant. Quercetin, rutin, apigenin and glucoside are flavonoids that are present in different parts of *B. variegata*. It has immune-modulatory, anti-bacterial, anti-carcinogenic, anti-diabetic, hepatoprotective, anti-inflammatory and antioxidant activities.
Conclusion: Orchid tree (*B. variegata*) is a source of quite a large number of phytochemicals with great therapeutical properties and effects. The root extract has cholesterol and lipoproteins lowering properties. Stem and root extracts are also rich in flavonoids and effective in blocking HMG-CoA. With these properties, the orchid tree is a target plant for future research for exploring a greater number of phytochemicals with their health improving properties and effects.

INTRODUCTION

All over the world several plants are used to heal a variety of human disorders. *Bauhinia variegata* L., commonly known as Orchid tree or Mountain ebony, is also included among these thousands of medicinal plants. It belongs to the family Fabaceae and is native to Asia. Each part of *B. variegata* has its own set of therapeutic properties. The presence of several vigorous components such as proteins, steroids, tannins, flavonoids, resins, carbohydrates and cardiac glycosides is confirmed with phytochemical screening in *B. variegata* leaves, stem, flower and bark extracts. Pharmacological studies revealed that *B. variegata* has antimicrobial, anticancer, anti-inflammatory, antiulcer and hepatoprotective activities (Tshidino and Montsho 2017; Kumar *et al*. 2019). This review highlights some medicinal properties of *B. variegata.*

ANTIMICROBIAL ACTIVITY

Antimicrobial compounds play critical role in lowering the worldwide problem of infectious disorders. The growth and spread of multidrug resistant strains among some pathogenic bacteria, on the other hand, is rise as a major public health concern. Still, only a few effective antimicrobial compounds are present. In health care services fungal and bacterial infections make up the majority of illnesses. Though, 90% of these diseases are caused only by the bacterial infection.

A large variety of therapeutic plants have been acknowledged as significant suppliers of natural antibacterial substances. Different phytochemicals are produced in the plant's secondary metabolism that makes the plants effective against microbial resistance and diseases. *Salmonella typhi* and *Escherichia coli* are resistant to synthetic antimicrobial agents, however these microbes

are sensitive to extracts of different parts of *B. variegata.* Different phytochemicals extracted with ethanol from the bark of the *B. variegata* was efficient against gram-negative and gram-positive bacteria and also useful against fungus infections (Ahmed *et al.* 2012). *B. variegata* has dynamic antimicrobial activity because of the presence of different subordinate metabolites such as flavonoids, terpenoids, tennis and alkaloids.

Phenolic compounds inhibit the microbial activity through reaction with -SH groups or protein interaction, in this reaction phenolic compounds cause enzyme inhibition by oxidizing compounds (El-Moula *et al*. 2019). In different plant extracts, flavonoids are present which show antimicrobial potential. These plant-derived flavonoids can also be effectively used to fight against human pathogens. Flavonoids are hydroxylated phenolics constituents and are produced by plants in response to bacterial diseases (Mishra *et al.* 2013). Several plants developed flavonoids are very important in the treatment of bacterial diseases because these compounds use different mechanisms for treatment than those of synthetic drugs. Plasma membrane of bacterial cell performs different functions for the maintenance of the cell including lipid biosynthesis, osmoregulation, process of transport and respirations, as well as peptidoglycan synthesis and cross-linking. Plasma membrane integrity plays crucial role in performing all above functions and any interruption in membrane can indirectly or directly leads to dysfunction of metabolism and at the end death of bacterial cell occur. Antimicrobial agents that derived from the plants are the big available source for treatments. Plant-based antimicrobials have a lot of therapeutic capability as they can fix the problem without adverse effects that synthetic antimicrobials have. Today, more research and development of plant-based antimicrobials is required (Gunalan *et al.* 2011).

ANTIDIABETIC ACTIVITY

For the treatment of diabetes mellitus, herbal medications play a crucial role. Medicinal plants have been shown to offer potent anti-diabetic activities with no destructive side effects. These plants are rich source of antidiabetic chemicals which increase pancreatic tissue efficiency by releasing insulin secretion or by inhibiting the absorption of glucose in the intestine. According to the literature there are almost 410 scientifically proved therapeutic plants with antidiabetic activities but only 109 of them have been studied with their complete mechanisms. Carbohydrate metabolism and assimilation, tricarboxylic acid cycle, glycogen synthesis and breakdown, glycolysis, synthesis and release of insulin, gluconeogenesis and cholesterol synthesis have all been found to be modulated by extracts of several therapeutic plants (Jacob and Narendhirakannan 2019). Plants' antihyperglycemic action is mostly related to their capability to reestablish the function pancreatic tissue by inhibiting glucose absorption in the intestine, increasing insulin secretion, or facilitating different metabolites in insulin dependent diabetes mellitus. Different tissues and cells often develop a resistance to the endogenic insulin that's why most diabetic people are suffering from the non-insulin dependent diabetes. By the use of herbal medicinal substances, resistance of the cells can be converted into sensitivity (Choudhury *et al.* 2018).

Recently, it has been revealed that leaves of *B. variegata* contain proteins that have insulin-like properties. This protein is found in chloroplasts of the leaves and has the same amino acid sequence as bovine insulin. When injected into diabetic rats, this protein may be able to control the levels of glucose into the blood. This protein may be responsible for decreased level of blood glucose. The leaves consist of roseoside, a main metabolite which exhibits insulinotropic activities (Shahana and Nikalje 2017).

A study was conducted by Shahana and Nikalje (2017) in which oral administration of hydro-alcoholic, aqueous and ethanolic extracts of *B. variegata* bark and leaves showed considerable antidiabetic activity. After the administration it was seen that extracts of plant improved the glucose metabolism and lowered the high level of glucose in blood at different doses. During *in vitro* research, it was found that an ethanolic extract of *B. variegata* leaves and its primary ingredient roseoside enhanced insulin production in the β-cell line. Bark extracts regenerated the β-cells and normalized the level of blood glucose.

The hypoglycemic effect of plant is due to the presence of flavonoids which is shown the property of insulin production besides having the ability to improve the redevelopment of β-cell and inhibit the enzyme cyclooxygenase. In non-diabetic and diabetic rats, the effects of plant extracts were assessed on serum lipid profile such as low-density lipoproteins (LDL), high-density lipoprotein (HDL), total cholesterol, phospholipids, very low-density lipoprotein (VLDL), very high-density lipoprotein (HLDL), triglycerides and blood glucose level. After this assessment it was seen that there is effective improvement in high-density lipoproteins and significant reduction in low-density lipoproteins and cholesterol. The result of this study proves that the *B. variegata* have an incredible hypoglycaemic effect (Fig. 1).

After treatment with ethanolic leaves extract of *B. variegata,* glucose levels of plasma in both kinds of diabetes were observed to be considerably lower. The antidiabetic activity of ethanolic extract was comparable to that of glipizide medicine. The activity of ethanolic extract in reducing plasma glucose levels was seen without a significant change in plasma insulin level. Ethanolic extracts of *B. variegata* leaves do not have any expressive side effects on liver enzymes like alkaline phosphatase, alanine amino transferase and aspartate amino transferase in both types of diabetes. In diabetic rats, ethanolic extracts of leaves significantly increase the level of albumin and total proteins. These extracts also improve the function of kidney by reducing the levels of blood urea nitrogen (BUN) and creatinine (Gurjar *et al.* 2018).

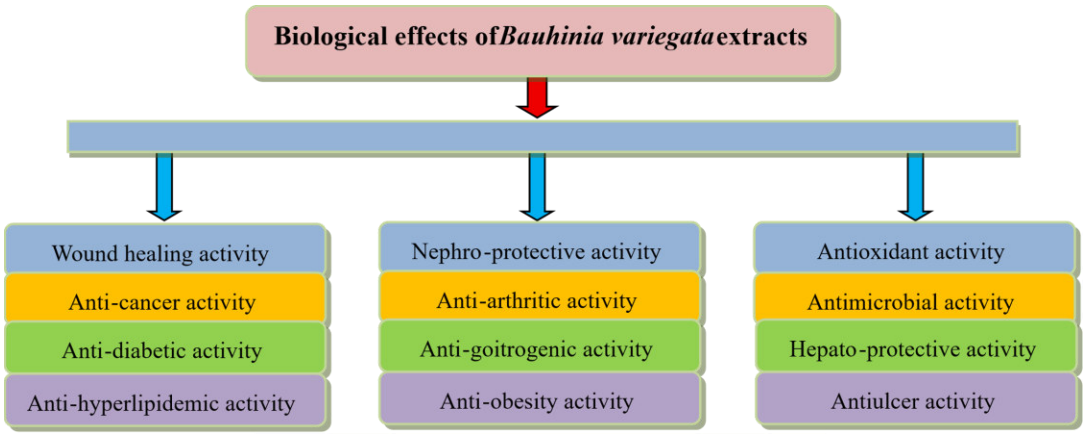


Fig 1: Therapeutic properties and effects of *B. variegata* plant extracts

The antidiabetic effect of *B. variegata* bark extract was as good as the metformin, which lowers both postprandial hyperglycaemia and fasting by the promotion of insulin facilitated exterior glucose utilization and metabolism in adipose tissues. Skeletal muscles provide some endogenic insulin through the upregulation of glucose transporter. However, detailed mechanism of hypoglycaemic activity of *B. variegata* bark extracts is unknown. It is possible that the extract works in the same way that metformin does or enhancing insulin activity at the cellular level. In previous investigations, antidiabetic herbs showed antihyperglycemic activities in diabetic rats by boosting insulin action or glucose homeostasis or promoting glucose metabolism. The antihyperglycemic activity of *B. variegata* bark extract could be explained by a similar mechanism. The occurrence of insulin-like proteins in *B. variegata* leaves extract is the reason of hypoglycemic effects of leaves. The bark extract, on the other hand, had no such hypoglycemic impact. Important antihyperglycemic activities were observed in *B. variegata* bark extracts, which could be due to improved glucose metabolism (Kumar *et al.* 2012).

ANTIOXIDANT ACTIVITY

In recent years, isolated compounds from the plant or the antioxidant potential of herbal plant extracts, has grabbed the people's attention because of the statement that free radical have been linked to a variety of disorders as well as the ageing progression. In many biological routes, free radical reactions particularly with the involvement of oxidative radicals have been shown that giving elevation to a different type of disorders by causing damage to nucleic acid, lipids, membranes and proteins. In the origination and development of several disorders including cardiovascular diseases, inflammatory damage, atherosclerosis and cancer, reactive oxygen species play a significant role. All oxygen-using organisms produce reactive oxygen species due to the regular metabolic activities (Saraswathy *et al.* 2011).

The antioxidant property of *B. variegata* ethanol root extracts was achieved by free radical scavenging *in vitro* using the chemicals super oxide, (DPPH) 1,2-diphenyal-1,2 picrylhydrazyl and nitric oxide (Rajani and Ashok 2009). When compared with other extracts, the ethanolic extracts had much higher antioxidant activity. Antioxidant property of any herbal plant is dependent upon the occurrence of whole phenolics molecules. The antioxidant property of plant extracts is proportional to the quantity of total phenolic content present. Both the ethanolic and aqueous extracts of roots had significant antioxidant property by scavenging a range of free radicals such as nitric oxide (NO), 1,2-di phenyl 1,2-picrylhydrazyl (DPPH) and superoxide (SO) (Kumar *et al*. 2020).

Pandey and Agarwal (2009) found the antioxidant property in the *B. variegata* methanolic extract by suppressing the production of thiobarbituric acid reactive substances (TBARS) *in vitro*. They discovered flavonoids, tannin, and other phenolic compounds in plant extracts. Fractions and crude extracts of *B. variegata* were also used to test the antioxidant activity of plant. According to the study, in comparison to traditional quercetin, the elements of ethyl acetate, n-hexane and methanol show different scavenging efficacy.

In another study, the antioxidant and DNA-protective properties of a methanol extract from tree bark were evaluated. The findings revealed that methanolic extract has significant antioxidant activity and may protect pBR322 DNA from oxidative impairment. In the bark of B. variegata different compounds like flavonoids and phenols are present that play significant role in antioxidant activity DNA protection. The separation of bioactive phytoconstituents such as lupeol, sitosterol, quercetin, and kaempferol was achieved through chemical analysis of a methanolic extract from the stem of *B. variegata*. These phytochemicals extracted from plants have been thoroughly investigated and are known to exhibit significant biological activity (Kumar *et al.* 2020). Because of its reducing capacity, radical

neutralization and strong binding leaf extracts *B. variegata* could counteract oxidative impairment (Mishra *et al*. 2013). As compared to stem bark and leaf extracts of plant, extracts from floral buds show most powerful antioxidant property (Pandey 2017; Shahana and Nikalje 2017).

ANTICANCER ACTIVITY

Cancer is a term used to describe a group of disorders in which aberrant cells divide uncontrollably and can infect neighbouring tissues. Cancer is the biggest reason of mortality in all over the world, and it has a significant social impact. It is a significant impediment to extending life hope in the twenty-first century. The World Health Organization (WHO) claims that, cancer claimed the lives of 9.6 million people last year. Cancer is the most serious medical problem confronting our world today. It is becoming more common over the world, and the mortality toll continues to rise. It has become so common that we will almost certainly all be affected by it at some point in our lives, whether we get cancer to ourselves or know someone who suffer from cancer. The nature and phase of cancer determine the treatment options. The majority of patients receive a mix of therapies, such as radiation therapy and chemotherapy along with surgery (Yun *et al*. 2021).

Therapeutic plants and traditional drugs are inexpensive, effortlessly accessible and sometimes free of cost. Ethnopharmacological studies on therapeutic plants, which have historically been used to cure cancer, were lately examined using scientific databases. However, in rural regions, the finding of unfamiliar shrubberies that may be used for the treatment of cancer is still a hot subject (Agyare *et al*. 2018).

Ethanolic extracts of plants had a substantial role in cytotoxic and anticancer activities, as well as being useful in the reduction of liver cancer and human cancer lines (Naeem and Ugar 2019). Extracts of different parts of Kachnar have the ability to reverse tumor induced alterations in the proteins and different haematological parameters. Similarly, they discovered that giving extract of Kachnar to people orally reduced the growth of solid tumours (Lim 2014).

Different compounds extracted from plants stimulate cell death and cell cycle arrest in many tumor cells and show anticancer activities. Cancer can be treated more effectively by the combining of *B. variegata* extracts and chemotherapy as compared to only plant extract. These extracts from plants decrease the volume of cancer cells and increase the survival time of organisms, also reduce the cancer doubling time. In the assembly of different cellular developments such as proliferation, cell differentiation and apoptosis, glutathione play a significant role in cancer inhibition. Any instabilities in the level of glutathione lead to the development of many human sicknesses as well as cancer. Reduced levels of glutathione cause cancer because susceptibility to oxidative stress is raised. Treatment of cancer with *B. variegata* extracts raised the level of glutathione and restored the antioxidant contents in the body. Anticancer activity of *B. variegata* may be because of the free radicals and antioxidant scavenging ability (Pandey 2017).

An *in vitro* study discovered that extracts of *B. variegata* inhibited the growth of several cell lines, indicating that it was anti-tumor. In another study it was stated that methanol extracts of plant leaves at different doses of 300, 600 and 900 mg/kg showed anticancer activity by maintaining the composition of chromosomal abnormalities and micro molecules in cyclophosphamide induced cancer in cells of bone marrow in experimental rats (Singh *et al*. 2019).

There are several reports present, revealed that different phytochemical compounds such as phenols, polyphenols and flavonoids aids as a growth inhibitor or toxic to the cancerous cells because of their biological connections with the further biological developments, different enzymes and proteins. Furthermore, flavonoids have the impressions on signal transduction in angiogenesis and cell proliferation that's why also show the anticancer activities. The stem flavonoids of *B. variegata* found to exhibit cytotoxic effect against lymphoma, leukaemia, Dalton's ascetic and a variety of other cancer cell lines. It has been stated that against the ovarian cancer cell lines flavonoids in *B. variegata* have been found to be extra selective. In the future, further extensive study on the separation and categorization of exact chemical medieties from the leaf extract of *B. variegata* as well as biological tests, could lead to the development of a harmless anticancer drug (Mishra *et al*. 2013).

HEPATOPROTECTIVE ACTIVITY

Liver serves as significant organ for the detoxification of different cellular waste materials. Thus, liver dysfunction (hepatopathy) can progress to multi-organ stoppage and, ultimately, death of organisms occurs (Pani *et al.* 2011a, b). Hepatoprotective substances can be found in large quantities in herbal medicines. In the treatment of numerous liver ailments, mono- and polyherbal formulations have been employed. In experimental rat, ethanolic extract of *B. variegata* stem showed the hepatoprotective activities against the liver tumor that was induced by N-nitrosodiethylamine. N-nitrosodiethylamine-induced liver tumors were suppressed by ethanolic extract of plant stem, as evidenced by a reduction in N-nitrosodiethylamine-induced raised levels of lipid peroxidase, total bilirubin, oxaloacetate transaminase, serum glutamate, glutathione peroxidase, gamma glutamate trans peptides, pyruvate transaminase and alkaline phosphatase (Al-Snafi *et al.* 2019).

Hepatotoxins raise total lipid levels in the liver. In carbon tetrachloride (CCl_4) intoxicated rats, alcoholic extract of *B. variegata* bark showed great hepatoprotective

activity. In these rats, whole lipid content in liver and blood increased significantly but after the treatment with stem bark extract of plant their concentrations returned to normal level. This is a strong sign that the liver cells' functional integrity was improved. The liver's ability to produce albumin is harmed by CCl_4. As a result, the protein level of serum drops in such situations. The hepatoprotective activity of *B. variegata* bark extract and its usage as a liver tonic was further confirmed by the restoration of protein concentration to normalcy (Negi *et al.* 2012).

Gul *et al.* (2021) administered methanolic flower extract of *B. variegata* to CCl4 intoxicated rats, which showed considerable hepatoprotective movement. Concentrations of several enzymes and bilirubin increased after administration of CCl_4. However, after ingesting methanol flower extracts bilirubin and levels of different enzymes decreased. Reportedly, the function of cells is improved by flavonoids present in *B. variegata* and can block hepatocytes cellular leakage caused by CCl_4. Correspondingly, with bilirubin, the ranges of AST, ALP, ALT and GGT were effectively controlled with numerous dosages of flower extracts. Flower extracts of *B. variegata* were also useful in the treatment of hepatocyte pycnosis, inflammation and breakdown of liver cells, which are caused by CCl_4. Histological studies revealed that *B. variegata* has the potential for the medication of liver cell damage because of the presence of flavonoids.

NEPHROPROTECTIVE ACTIVITY

In vivo study of *B. variegata* demonstrated that ethanolic extracts of plants are related with nephroprotective activities. In a study in rats, in which nephropathy was artificially induced by the use of cisplatin, it was reported that giving the ethanol extract of *B. variegata* at different doses of 400 and 200 mg/kg for 14 days extensively reversed the impacts of cisplatin. The plant extract raised the output of urine volume, body weight and also lowered the blood concentration of the urea and creatinine at the dosage of 400mg/kg. Histological destructions were lower in rats treated with the extracts of *B. variegata* as compared to intoxicated rats. Statistical significance of nephroprotective activity of BV-treated group and the polyherbal drug cystone (standard group)-treated group (both the groups were compared against toxic control) were found almost equal as both groups gained same level of significance (P<0.001) against the toxic group in most of the parameters including serum urea and creatinine (Kumari *et al*. 2021).

The repressive impact of *B. variegata* leaves on lipase and amylase enzymes was investigated during the research that is directed by Patil *et al*. (2017). Salivary gland and pancreas release the α-amylase which is participating in carbohydrates breakdown. In herbal medicines obtained from medicinal plants inhibitors of α-amylase is present which is found to be very advantageous in lowering the hyperglycaemia of post prandial. Alpha amylase inhibitors improve hyperglycaemia by reducing carbohydrate ingestion and glucose absorption, which reduces the uptake of glucose into adipose tissues and decreases triacylglycerol production and storage. Pancreatic lipase hydrolyzed the dietetic lipids into 2-monoacyalglycerol and fatty acids for their intestinal absorptions. Therefore, diet induced obesity can be significantly treated by inhibiting the activities of pancreatic lipase and α-amylase which are digestive enzymes. By using varied doses of extracts, the inhibitory effect of *B. variegata* leaves extract against pancreas and lipase enzyme was determined. On pancreatic lipase and α-amylase, numerous solvent extracts of plant revealed a dose dependent inhibitory action. Highest α-amylase repressing activity represented by the methanolic extracts of *B. variegata* as compared to acetone extract. Similarly, methanol extracts inhibited lipase activity the most, while acetone extract inhibited it the least (Patil *et al*. 2017).

WOUND HEALING ACTIVITY

Any damage or break to the anatomical, functional or cellular stability of the living cells is defined as the wound. The process which involves the repairing of soft tissues such as the skin after wound is known as wound healing process. An inflammatory reaction starts after an injury, and group of cells beneath the skin are activated to produce more collagen protein. After the production of collagen epithelial tissue is regenerated at the site of injury (Rajput and Gohil 2020). *B. variegata* plays a vital role in wound healing that has been used for many years as a healing agent (Naeem and Ugar 2019). Tannins and flavonoids are present in *B. variegata* extract which stimulate the wound curative activity by their antioxidant potential and antimicrobial properties. Triterpenoids can also boost collagen production, which aids in wound healing (Rajput and Gohil 2020).

For the stimulation of the wound healing process lectins act on immune system cells, angiogenesis pro-inflammatory response and collagen synthesis by moderating the release of growth factor and inflammatory cytokines (Cagliari *et al.* 2018). From *Bauhinia* species, just a single lectin protein has been confirmed for the wound healing activity (Cagliari *et al*. 2018). Recently, a recombinant isoform of *B. variegata* lectin (rBVL-1) became available through cloning in *Escherichia coli*. This isoform has similar amino acid and DNA sequence to other familiar Caesalpinoideae lectins. Healing possibilities of *B. variegata* lectins (nBVL) and recombinant lectins (rBVL-1) can be investigated on skin wounds that are artificially induced (Negi *et al*. 2012).

Pro-healing activities are also present in the recombinant isoform of the lectins. Subsequent phenotypic change of fibroblast into myofibroblasts and discharge of different growth factors could explain the experimental speed of wound healing. Even in inflammatory phase fibroblast produce large amount of collagen at injury site and carry out quicker wound shrinkage (Negi *et al*. 2012).

ANTI-HYPERLIPIDEMIC ACTIVITY

Dyslipidemia is characterized by irregular levels of lipoprotein and lipid in the blood. Dyslipidemia is frequently caused by accumulation of high amounts of lipids in the different tissues and blood, an illness known as hyperlipidemia, which is a primary basis of cardiovascular and insulin resistance disease. The appearance of a pro-inflammatory response and hyperlipidemia in the body are due to the increased ingestion of n-6 fatty acids and saturated fats in the diet (Bettadahalli *et al*. 2020).

For the development of heart and circulatory problems hyperlipidemia is a most common risk factor (Kumar *et al*. 2011). Disorders of plasma lipoproteins and instabilities to lipid metabolism are closely linked to the congestive heart failure and atherosclerosis (Rajani and Ashok 2009). Hyperlipidaemia can be treated with a variety of synthetic medicines. Plants' antihyperlipidemic action is significant in lowering the risk of cardiovascular disease. Plant extracts or phytochemical components are sometimes more effective than established hypolipidemic drugs (Asija *et al*. 2016). *B. variegata* stem and root extracts showed an important lowering effect in low-density lipoproteins and cholesterol. This proves that *B. variegata* not only decreases the production rate but may also decrease the absorption of body cholesterol.

Flavonoids are rich components of root and stem extracts that block the activity of HMG-CoA. *B. variegata* ethanolic and aqueous extracts of stem and root decrease the levels of triglyceride by triggering the lipoprotein lipase (LPL). Lipoprotein is a leading enzyme associated with the metabolism of triglyceride. Additionally, very low-density lipoprotein concentrations were also reduced *by B. variegata* extracts. Extracts of *B. variegata* increased the level of high-density lipoprotein and showed defensive action. Increased high-density lipoprotein causes the breakdown of cholesterol and triglyceride in the liver (Rajani and Ashok 2009).

CONCLUSION

The information gathered from various sources has revealed that *B. variegata* is a source of quite a few phytochemicals with great therapeutical effects such as regulating the blood, glucose, lipids and lipoprotein levels. Different parts of plant leaf, root, stem, stem bark, floral parts show therapeutic effects and control different ailments. For instance, stem and root extracts are rich in flavonoids and effective in blocking HMG-CoA. Root extract has cholesterol and lipoproteins lowering properties. With the abovementioned effects, *B. variegata* is a target plant for exploring more phytochemicals with their health improving properties and effects.

AUTHOR CONTRIBUTIONS

AA completed the literature search; IS assisted in write-up, rephrasing and final draft preparation; FH designed and supervised the work and finalized draft of manuscript.

CONFLICTS OF INTEREST

We, the authors have “no conflict of interest”

DATA AVAILABILITY

The data will be made available on a fair request to the corresponding author

ETHICS APPROVAL

Not applicable

FUNDING SOURCE

This research received no grant from any funding agency

REFERENCES

Agyare C, Spiegler V, Asase A, Scholz M, Hempel G, Hensel A (2018) An ethnopharmacological survey of medicinal plants traditionally used for cancer treatment in the Ashanti region, Ghana. *Journal of Ethnopharmacology* 212: 137–152. https://doi.org/10.1016/j.jep.2017.10.019.

Ahmed SJ, Faraj RA, Azawi R, Al-Kareem MMA (2012) Study of comparison of antimicrobial potencies of *Bauhinia variegata* leave extracts with antibiotics against selected bacteria. *IOSR Journal of Pharmacy and Biological Sciences* 4: 44–46.

Al-Snafi AE, Mousa HM, Majid WJ (2019) Medicinal plants possessed hepatoprotective activity. *IOSR Journal of Pharmacy* 9: 26–56.

Asija R, Charanjeet SH (2016) A comprehensive review on antihyperlipidemic activity of various medicinal plants. *International Journal of Current Pharmaceutical Review and Research* 7: 407–415.

Bettadahalli S, Acharya P, Ramaiyan B, Talahalli RR (2020) Evidence on oleic acid and EPA+ DHA role in retinal antioxidant defense, leukocyte adhesion, and vascular permeability: Insight from hyperlipidemic rat model. *Journal of Functional Foods* 67: 103864. https://doi.org/10.1016/j.jff.2020.103864.

Cagliari R, Kremer FS, Pinto L da S (2018) *Bauhinia* lectins: Biochemical properties and biotechnological applications. *International Journal of Biological Macromolecules* 119: 811–820. https://doi.org/10.1016/j.ijbiomac.2018.07.156.

Choudhury H, Pandey M, Hua CK, Mun CS, Jing JK, Kong L, Ern LY, Ashraf NA, Kit SW, Yee TS, Pichika MR (2018) An update on natural compounds in the remedy of diabetes mellitus: A systematic review. *Journal of Traditional and Complementary Medicine* 8: 361–376. https://doi.org/10.1016/j.jtcme.2017.08.012.

El-Moula A, Awad A, El-Sayed A, El-Saadany S (2019) Antibacterial Activity of water and ethanolic extracts of *Bauhinia variegata* leaves. *Zagazig Journal of Agricultural Research* 46: 1141–1148. https://doi.org/10.21608/zjar.2019.47096.

Gul H, Awais M, Saddick S, Ahmed Y, Khan FS, Ahmed E, Afzal U, Naqvi SMZA, Khan MA, Gulfraz M, Raja GK (2021) Quantification of biochemical compounds in *Bauhinia variegata* Linn flower extract and its hepatoprotective effect. *audi Journal of Biological Sciences* 28: 247–254. https://doi.org/10.1016/j.sjbs.2020.09.056.

Gunalan G, Saraswathy A, Krishnamurthy V (2011) Antimicrobial activity of medicinal plant *Bauhinia variegata* Linn. *International Journal of Pharmacy and Biological Sciences* 1: 400–408.

Gurjar HPS (2018) Assessment of antidiabetic potential of leaf extract of *Bauhinia variegata* Linn. in type-I and type-II diabetes. *International Journal of Green Pharmacy* 12: S401–S409. https://doi.org/10.22377/ijgp.v12i02.1793.

Jacob B, Narendhirakannan RT (2019) Role of medicinal plants in the management of diabetes mellitus: A review. *3Biotech* 9: 4. https://doi.org/10.1007/s13205-018-1528-0.

Kumar A, Anand V, Dubey RC, Goel KK (2019) Evaluation of antioxidant potential of alcoholic stem bark extracts of *Bauhinia variegata* Linn. *Journal of Applied and Natural Science* 11: 235–239. https://doi.org/10.31018/jans.v11i1.2015.

Kumar D, Parcha V, Maithani A, Dhulia I (2011) Effect and evaluation of antihyperlipidemic activity of fractions of total methanol extract of *Bauhinia variegata* (Linn.) leaves on triton WR-1339 (tyloxapol) induced hyperlipidemic rats. *International Journal of Research in Pharmaceutical Sciences* 2: 493–497.

Kumar P, Baraiya S, Gaidhani SN, Gupta MD, Wanjari MM (2012) Antidiabetic activity of stem bark of *Bauhinia variegata* in alloxan-induced hyperglycemic rats. *International Journal of Research in Pharmaceutical Sciences* 3: 64–66.

Kumar S, Baniwal P, Kaur J, Kumar H (2020) Kachnar (*Bauhinia variegata*). In: *Antioxidants in Fruits: Properties and Health Benefits*, pp: 365–377. Nayik GA, Gull A (Eds.). Singapore: Springer Nature, Pte Ltd. https://doi.org/10.1007/978-981-15-7285-2.

Kumari I, Kaurav H, Choudhary G (2021*) Bauhinia variegata* (Kanchnara), an ornamental plant with significant value in ayurvedic and folk medicinal system. *Himalayan Journal of Health Sciences* 6: 1–16. https://doi.org/10.22270/hjhs.v6i2.94.

Lim TK (2014) *Bauhinia variegata*. In: *Edible Medicinal and Non-medicinal Plants, Vol. 1 Fruits*, pp:754–765. Lim (Ed.). Dordrecht: Springer. https://doi.org/10.1007/978-90-481-8661-7.

Mishra A, Sharma AK, Kumar S, Saxena AK, Pandey AK (2013) *Bauhinia variegata* leaf extracts exhibit considerable antibacterial, antioxidant, and anticancer activities. *Biomed Research International* 2013: 1–10. https://doi.org/10.1155/2013/915436.

Naeem MY, Ugur S (2019) Nutritional and health consequences of *Bauhinia variegata*. *Turkish Journal of Agriculture – Food Science and Technology* 7: 27–30. https://doi.org/10.24925/turjaf.v7isp3.27-30.3144.

Negi A, Sharma N, Singh M (2012) Spectrum of pharmacological activities from *Bauhinia variegata*: A review. *Journal of Pharmacy Research* 5: 792–797.

Pandey S (2017) *In vivo* antitumor potential of extracts from different parts of *Bauhinia variegata linn.* against B16f10 melanoma tumour model in C57bl/6 mice. *Applied Cancer Research* 37: 33. https://doi.org/10.1186/s41241-017-0039-3.

Pandey S, Agrawal RC (2009) Effect of *Bauhinia variegate* bark extract on DMBA-induced mouse skin carcinogenesis: A preliminary study. *Global Journal of Pharmacology* 3: 158–162.

Pani SR, Mishra S, Sahoo S, Panda PK (2011a) Nephroprotective effect of *Bauhinia variegata* (Linn.) whole stem extract against cisplatin-induced nephropathy in rats. *Indian Journal of Pharmacology* 43: 200–202. https://doi.org/10.4103/0253-7613.77370.

Pani SR, Sahoo S, Panda PK, Mishra S (2011b) Hepatoprotective effect of *Bauhinia variegata* (Linn.) whole stem against carbon tetrachloride-induced hepatopathy in rats. *Medicinal and Aromatic Plant Science Biotechnology* 5: 62–65.

Patil MM, Anand T, Ilaiyaraja N, Khanum F (2017) *In-vitro* antioxidant and anti-obesity properties of *Bauhinia variegata. Defence Life Science Journal* 2:128–132. https://doi.org/10.14429/dlsj.2.11355.

Rajani G, Ashok P (2009) *In vitro* antioxidant and antihyperlipidemic activities of *Bauhinia variegata* Linn. *Indian Journal of Pharmacology* 41: 227–232. https://doi.org/10.4103/0253-7613.58513.

Rajput RT, Gohil KJ (2020) Development and evaluation of herbomineral ointment from *Bauhinia variegata* L. for wound healing effects. *Indian Journal of Natural Products and Resources* 11: 96–100.

Saraswathy A, Gunalan G, Krishnamurthy V (2011) *In vitro* antioxidant activity of *Bauhinia variegata* Linn. leaves. *Journal of Pharmacy Research* 4: 3364–3367.

Shahana S, Nikalje APG (2017) A brief review on *Bauhinia variegata*: Phytochemistry, antidiabetic and antioxidant potential. *American Journal of PharmTech Research* 7: 186–197.

Singh A, Singh N, Pabla D (2019) A review on medicinal uses of *Bauhinia variegata* Linn. *PharmaTutor* 7: 12–17. http://dx.doi.org/10.29161/PT.v7.i6.2019.12.

Tshidino SC, Montsho N (2017) Antioxidant and hepatoprotective potentials of *Bauhinia variegata* seeds against ferric chloride-induced lipid peroxidation in chicken liver homogenate. *African Journal of Traditional, Complementary and Alternative Medicines* 14: 219–230. http://dx.doi.org/10.21010/ajtcam.v14i5.25.

Yun D, Yoon SY, Park SJ, Park YJ (2021) The anticancer effect of natural plant alkaloid isoquinolines. *International Journal of Molecular Sciences* 22:16–53. https://doi.org/10.3390/ijms22041653.

Guide to Authors for Manuscript Preparation

FORMAT

Except in the case of reviews, contributions should be no longer than the equivalent of 10 printed journal pages (6000 to 8000 words) inclusive of tables, illustrations and references. Short communications should follow the requirements for original research papers but the text must not exceed 2000 to 3000 words. A typical page of text in the journal contains ~520 words. Manuscripts should be typed on one side of A4 paper, double spaced, with 3 cm margin on each side, text line numbered and paginated. All contributions are subject to editorial revision. To strictly follow the style, authors should download sample paper and organize their papers strictly in line with it. A full-length paper must be organized as:

- **Manuscript type:** Full Length Article/Review Article/Short Communication
- **Title:** Complete title of your manuscript (species names without authority's name)
- **Running Title:** Should not be more than 50 characters (with spaces)
- **Authors:** Full names of the contributors along with their affiliation (please do not use abbreviations)
- **For correspondence:** the e-mail address of the corresponding authors MUST be given. No more than one email address is required (ORCID of the corresponding author, if available be given next to email address). The corresponding author's name and email has to be indicated by asterisk (*)
- **Author contributions:** If first, second or third authors have contributed equally, it should be mentioned by putting dagger (†) mark on all such author names followed by a statement: †Contributed equally to this work and are co-first authors
- **Novelty statement (4-5 bullets):** highlighting scientific merit of the work reported in the manuscript
- **Abstract:** Be no more than 250 words emphasizing objectives, methods, important results, conclusions and practical implications
- **Keywords:** four to six
- **Introduction:** Must highlight the background of the problem in the light of recent literature, hypothesis to be tested and specific objectives.
- **Materials and Methods:** Should be to the point and explicit and also citing references to methods adopted for recording data
- **Results:** Should include statistical significance of treatment effect etc.
- **Discussion:** Should be logical and reflect the originality of the contribution and findings discussed in the light of up-to-date literature
- **Conclusion:** Should be brief and reflect the essence of the work along with practical implications and future directions (if any)
- **Acknowledgement:** Should be as brief as possible
- **Author Contributions:** Clearly state the contribution of each author to the article before submission
- **Conflict of Interest:** Any potential conflict of interest among the authors for any reason be disclosed
- **Data Availability:** A statement that data will be available on a fair request to the correspondence author
- **Ethics Approval:** It has two facets, as mentioned below
    - **Publication ethics**: The following publication ethics are observed and authors beware that:
        - The authors transfer copyrights to the Journal under the following terms and conditions:
        - The paper presents original work not previously published in similar form and not currently under consideration by another journal
        - Each author has seen and approved the content of the submitted manuscript
        - Exclusive permission has been obtained from the author(s)/publisher(s) of the material/ information/data contained/used in any other form that is the intellectual property right of any person(s) other than the Author(s). The copyright material has clearly identified and acknowledged/referenced in the text of the paper. The author(s) are responsible for any violation/breech of the Copyright Law

- There is no conflict of interest among the authors for the publication of paper, and that all the authors have significantly contributed to the paper
- The paper once published will not be withdrawn or retracted unless very serious question(s) arise(s) on the data or originality of the text, and that will be done in concurrence with The University of Faisalabad stated policy
- Once the copyrights are transferred, the published matter will be the sole property of The University of Faisalabad, and exclusive permission will be explicitly sought for partial or full reproduction of the text/graphics/numeric data. However, the author(s) will retain the intellectual property rights of their papers.
- The complaints of plagiarism of papers (if any) are strictly dealt under Plagiarism Policy of Higher Education Commission of Pakistan (HEC ANTI-PLAGIARISM POLICY). Authors are required to explicitly disclose the use of AI tools. Any misuse are strictly dealt under the Generative AI-Policy of Higher Education Commission of Pakistan (HEC Generative-AI POLICY).

- **Ethical Guidelines for Use in Research on Animals**: For research on animals, ISRE observes Policy ARRIVE Guidelines available at PLoS Biol 8(6), e1000412, 2010 when documenting and conducting live animal studies. Authors, reviewers and editors are urged to adhere to these guidelines. It is also emphasized that in research involving animals, any potentially derived benefits must be significant in relation to harm suffered by participating animals. Furthermore, the research conducted using live animals must comply with commonly accepted '3Rs':
  - Replacement of animals by alternatives wherever possible;
  - Reduction in number of animals used;
  - Refinement of experimental conditions and procedures to minimize the harm to animals.
- Submissions made to ISRE with data in which the animals are investigated are required to be approved by an ethical review committee constituted by the institution of the corresponding author and relevant information provided in the Materials and Methods section or alternatively given separately just before the References section. The submissions are not processed further until a certificate is provided by the corresponding author in this regard.

- **Funding Source:** Mention funding source even if no funding is acquired for this work
- **References:** Style for text quotation is: a) with date in parentheses, e.g. as demonstrated by Chirnside (2022); or (b) with names and dates in parentheses, e.g. according to recent findings (Kirsten 2019); (c) Basra and lqbal (2019); (d) as described previously (Basra and lqbal 2019); (e) Rikihisa *et al*. (2024) or (f) as described previously (Hassan *et al*. 2023). If more than two authors, the first author should be given followed by et al., where lists of references are cited. In the text two or more references should be placed in chronological order, e.g., (Jones 2023; Chirnside 2024). If more than one reference by the same author(s) published in the same year are cited, they should be distinguished from each other by placing a, b, etc. after the year. References at the end of the paper should be alphabetically arranged. Names of all authors should be included. References should be set as follows:
  - **Journal reference:** Rahma H, Trizelia M, Liswarni Y, Rusli R, Rozen N, Armelia L, Putri A, Qalbina F (2024) Characterization of plant growth promoting bacteria (PGPB) as biocontrol agents against plant pathogenic fungi *in vitro*. *International Journal of Agriculture and Biology* 32(2): 101–108. https://doi.org/10.17957/IJAB/15.2182.
  - **Article in a journal published ahead of print**: Bakker AB, Emmerik HV, Riet PV (2008) How job demands, resources and burnout predict objective performance. *Anxiety, Stress and Coping* 00: 1–10 [accessed 6 January 2010].
  - **Book reference:** Taiz L, Zeiger E (2015) *Plant Physiology*, 6th edn. Sunderland, Massachusetts: Sinauer Associates.
  - Crouch C, Le Gales P, Trigilia C (2001) *Local Production Systems in Europe: Rise or Demise?* Oxford: Oxford University Press.
  - **Multiauthored edited book reference:** Bintoro MH, Nurulhaq MI, Pratama AJ, Ahmad F, Ayulia L (2018) Growing area of sago palm and its environment. In: Ehara H, Toyoda Y and Johnson DV (eds) *Sago Palm: Multiple Contributions to Food Security and Sustainable Livelihoods*. Singapore. Springer Nature.
  - **Webpage:** Tester J. (2014). *EZproxy*. [online] Eds.a.ebscohost.com.ezproxy.liv.ac.uk. Available at: http://eds.a.ebscohost.com.ezproxy.liv.ac.uk/eds/detail?sid=fa9392f5-3794-4dd7-a8bc-

0f2d5915a373%40sessionmgr4005&vid=4&hid=4110&bdata=JnNpdGU9ZWRzLWxpdmUmc2NvcGU9c2l0ZQ%3d%3d#db=bth&AN=67324416 [Accessed 21 Jun. 2014].

- **Dissertation:** Allen SJ (2009) The social and moral fibre of Celtic Tiger Ireland. *PhD Thesis*. University College Dublin.

PEER REVIEW PROCESS

Immediately after receipt, the manuscripts are promptly handled for initial scrutiny for format by the Editorial Office. If found suitable for further processing, the manuscript is assigned to one of the editors within the area of his/her expertise for handling. The handling editor assigns the paper to three anonymous reviewers. Single blind model is followed for the review of papers. On receipt of reviewer's comments, the handling editor makes a decision to accept or decline the manuscript based on the majority opinion. If the handling editor decides to process the manuscript further, its is sent to corresponding author for a revision within one month (additional time allowed as per request of author). On receipt of satisfactory revision, the manuscript is finally accepted and sent for production for galley proof and final publishing.

POLICIES

Open Access Policy

All articles published in Innovations in ISRE are made immediately available worldwide under an open access license. This means:

- Everyone has free and unlimited access to the full text of all articles published in ISRE.
- Everyone is free to re-use the published material, for non-commercial use, if proper accreditation/citation of the original publication in ISRE is given.

Copyright Policy

For all articles published in ISRE, the authors retain the copyright. However, the exclusive commercial rights belong to The University of Faisalabad.

License and Permissions Policy

All articles are published in ISRE under a Creative Commons License for Non-Commercial Attribution and will be directed to the Creative Commons Attribution Non-Commercial (CC BY NC). The CC BY NC permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

Copyright of any article published by the journal under the CC BY NC license is retained by the author(s). Authors grant The University of Faisalabad (TUF) a license to publish the article and identify itself as the original publisher. Authors also grant any third party the right to use the article freely as long as it is not used for commercial purposes and its original authors, citation details and publisher are identified.

Use by non-commercial users

For non-commercial and non-promotional purposes individual users may access, download, copy, display and redistribute the articles to colleagues, as well as adapt, translate, text- and data-mine the content subject to the following conditions:

- The authors' moral rights are not compromised. These rights include the right of "paternity" (also known as "attribution" - the right for the author to be identified as such) and "integrity" (the right for the author not to have the work altered in such a way that the author's reputation, or integrity may be impugned).
- Where content in the article is identified as belonging to a third party, it is the obligation of the user to ensure that any reuse complies with the copyright policies of the owner of that content.
- If article content is copied, downloaded, or otherwise reused for non-commercial research and

education purposes, a link to the appropriate bibliographic citation (authors, journal, article title, volume, issue, page numbers, DOI and the link to the definitive published version on TUF website) should be maintained.

- Copyright notices and disclaimers must not be deleted.
- Any translations, for which a prior translation agreement with TUF has not been agreed, must prominently display the statement: "This is an unofficial translation of an article that appeared in a TUF publication. The publisher has not endorsed this translation."

Use by commercial "for-profit" organizations

Use of TUF Open Access articles for commercial, promotional, or marketing purposes requires further explicit permission from TUF (info@tuf.edu.pk) and will be subject to a fee.

Commercial purposes include:

Copying or downloading of articles, or linking to such articles for further redistribution, sale or licensing; Copying, downloading or posting by a site or service that incorporates advertising with such content; The inclusion, or incorporation of article content in other works, or services (other than normal quotations with an appropriate citation) that is then available for sale or licensing, for a fee (for example, a compilation produced for marketing purposes, inclusion in a sales pack); Use of article content (other than normal quotations with appropriate citation) by for-profit organizations for promotional purposes; Linking to article content in e-mails redistributed for promotional, marketing or educational purposes; Use for the purposes of monetary reward by means of sale, resale, license, loan, transfer or other form of commercial exploitation such as marketing products; Print reprints of articles can be purchased from info@tuf.edu.pk.

Permissions

- No special permission is required to reuse all, or part of article published by ISRE, including figures and tables for non-commercial purposes.
- Any part of the article may be reused for non-commercial purposes, without permission provided that the original article is clearly cited.
- Reuse of an article does not imply endorsement by the authors, or ISRE.

CONTENT DISCLAIMER

The opinions expressed in any of the published articles in Innovations in STEAM: Research and Education (ISRE) are not the opinions of the journal or The University of Faisalabad (TUF). The Content is not guaranteed to be complete, correct, timely, current or up to date. Like any printed or electronic materials, the content may become out-of-date. TUF undertakes no obligation to update any Content on the Website. Authors of a particular article are responsible for their own content, where applicable, and may update their content at any time without notice and at their sole discretion. TUF reserves the right to make alterations or deletions to the content at any time without notice. TUF does not represent or otherwise warrant that the information available on or through our website will be correct, accurate, timely or otherwise reliable. The ISRE may make changes to the features, functionality or content of our website or services at any time. Any research content provided by the author(s) is of their own opinion, and is not intended to malign any religion, ethic group, club, organization, company, individual, anyone or anything. The TUF reserves the right in its sole discretion to edit or remove any documents, information or other content appearing on TUF website or Services. Any errors discovered are the fault of the authors. In no event shall the TUF be responsible or liable, directly or indirectly, for any damage or loss caused or alleged to be caused by or in connection with the use of or reliance on any such content, goods, or services available on or through any such site or resource.

PUBLISHING MODEL

Open Access

ARTICLE PROCESSING CHARGE (APC)

No APC is levied to the articles published in ISRE

http://www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN Print: xxxx–xxxx; ISSN Online: xxxx–xxxx
https://doi.org/10.63793/ISRE
EO/2023/1–2

Author Index Vol. 1, 2023

http://www.tufsteam.com
Innovations in STEAM: Research & Education
ISSN Print: xxxx–xxxx; ISSN Online: xxxx–xxxx
https://doi.org/10.63793/ISRE
EO/2023/1–2

Subject Index Vol. 1, 2023

The University of Faisalabad

Innovations in STEAM: Research & Education
Published at:
The University of Faisalabad
4 km, Sargodha Road, Faisalabad, Pakistan
Website: https://tuf.edu.pk/
Contacts: +92-41-111-111-883
+92-41-8750971-5
+92-41-8868326-30
info@tuf.edu.pk