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TABLE OF
CONTENTS

VOLUME 07 ISSUE 11

Thalassemia in Pakistan: Addressing a Genetic Health Crisis

OPEN ACCESS

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ARTICLE INFO

Thalassemia, a genetic disorder usually caused by the defective genes. These genes are responsible for production of hemoglobin, a protein necessary for the transfer of oxygen in body through blood. Prevalence of thalassemia in Pakistan is concerning to a significant level. Global prevalence of this disease has affected millions of people and their lifestyles. Moreover, the disease leads to the burden on the diseased person's family and the medical resources of the country, causing an alarming concern.

The main issue of high prevalence of this disorder in Pakistan is associated with high percentage of cousin marriages. This cultural practice between the close relatives increases the chances of inheriting mutated genes into next generations. Each year more than 5000 children in Pakistan are born with disease. The rate of thalassemia is considerably higher in first cousin marriages (76.7%) than in second cousin marriages (23.3%) [1]. Furthermore, the inadequate spread of awareness among people and the lack of preventative measure by people is contributing to the increase in the number of thalassemia cases

Thalassemic patients do require blood transfusion in an adequate to survive and live a normal life. Moreover, after transfusion they need financially draining therapies like iron chelation that is being required to manage the overload of iron in blood. The limited medical resources and poor infrastructure of hospitals and clinics in the rural areas can lead to the increase of complications then reducing the problems come with this disease. This kind of public healthcare system can affect the diseased individuals to level to develop life threatening problems such as stunted growth, and organ failures etc.

To address this problem, a national program stating that genetic screening before marriage is necessary can lead to the reduction in the rate if this disease. Premarital screening for inherited diseases including Thalassemia is being carried out in middle east for last more than a decade. Some countries like Iran have overcome this problem to a great level by taking these kinds of initiatives, which shows that how important is it to detect the disease occurrence through premarital screening and counseling [2]. There should be campaigns for the public awareness highlighting the importance of genetic screening so that the cause of occurrence of this disorder can be decreased.

Additionally, medical advancements have provided the hope. Despite being costly and scarce, for certain patients with thalassemia, bone marrow transplants (BMT) have proven to be a curative treatment, success rates for those who satisfy the right criteria, such as younger patients with matched related donors, range approximately between 80 and 95% [3]. Future advances in repairing genetic abnormalities at their origins may be possible thanks to emerging gene-editing technologies like CRISPR. To make these remedies available in Pakistan, however, significant funding for medical infrastructure and research is needed.

Despite being avoidable, thalassemia will continue to take lives and put a burden on families and communities unless immediate action is taken. Pakistan can considerably lessen the impact of this genetic health disaster and clear the path for a healthier future by placing a high priority on education, early identification, and cutting-edge treatments.

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Original Article

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Antimicrobial Resistance Pattern of Pseudomonas aeruginosa Isolated from Urine Specimen in Peshawar, Pakistan

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ARTICLE INFO

ABSTRACT

Pseudomonas aeruginosa can cause many nosocomial infections, especially in the urinary tract, particularly in severe burns, bed ulcers, and immune-compromised patients. **Objective:** To determine the antibiotic resistance pattern and prevalence of *Pseudomonas aeruginosa* isolated from urine specimens. **Methods:** This a cross-sectional study. Urine samples were collected from UTI patients and culture on CLED agar and susceptibility was checked with 7 antimicrobial drugs by Disc Diffusion Method. SPSS software version 25.0 was used for data analysis. **Results:** A total of 243 urine samples collected from patients were tested, out of which *Pseudomonas aeruginosa* was isolated from 132 (54.32%) samples. In patients aged less than 8 years it accounted for 14.4 % of the sample, 19.7 % in those aged between 9 and 30 years, 28.8% in patients aged between 31 and 50, and 37.1 % in patients aged between 51 and 70. 7 different antibiotics were tested on *Pseudomonas aeruginosa* isolated from the urine samples. The resistance of *Pseudomonas aeruginosa* to Imipenem, (29.5%), Cefotaxime (90.2%), Cefoperazone (59.1%), Polymyxin-B (3.0%), Colistin, (10.6%), Aztreonam,(26.5%) and Tobramycin (22.0%). There were no significant differences in antibiotic resistance patterns between males and females. **Conclusions:** The results of this study showed that *Pseudomonas aeruginosa* was more common in females than males. Most of the stains were found to be resistant to Cefotaxime and the most sensitive to polymyxin-B. This study also showed a higher resistance percentage in older (51-70 years).

INTRODUCTION

Twenty to forty-nine percent of all hospital-related infections are Urinary Tract Infections (UTIs), with Pseudomonas responsible for seven to ten percent of these cases [1]. *Pseudomonas aeruginosa* particularly causes infection in those patients using catheters, and it is responsible for around 10% of all catheter-associated UTIs and almost 16% of UTIs in Intensive Care Unit cases. It commonly causes infection in those patients with immune-compromised systems, and those with lung diseases like cystic fibrosis [2]. In the United States, about $1.6 billion yearly is wasted while fighting against Urinary Tract Infections (UTIs) [3]. World Health Organization (WHO) declares *Pseudomonas aeruginosa* as a significant antibiotic-resistant bacterium. Although, Escherichia coli is the most common pathogen of UTIs, but *Pseudomonas aeruginosa* often showed higher levels of antibiotic resistance than Escherichia coli [3]. *Pseudomonas aeruginosa* showed resistance to antibiotics through several methods, like efflux pump, enzyme degradation, gene expression, forming a protective biofilm, a mutation in porin protein, and antibiotics target site modification [4, 5]. Several bacterial pathogens, particularly those belonging to the ESKAPE group (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumonia, Acinetobacter baumannii, *Pseudomonas aeruginosa*, and Enterobacter), have been identified as being extremely drug-resistance [6, 7]. *Pseudomonas aeruginosa* is one of the most important pathogens of the ESKAPE group [8, 9].

The rise of antibiotic-resistant bacteria in healthcare is a serious problem. The hospitals, especially the ICU are the primary sources of microbial diversity. A recent study has shown that microbial diversity and drug-resistant microbes mainly populate the ICU [8]. *Pseudomonas aeruginosa* patients have few treatment choices now due to antimicrobial resistance, which has turned into a significant and serious problem that results in 51,000 healthcare infections in the USA annually [9]. As per the World Health Organization (WHO) and the US Centers for Disease Control and Prevention (CDC), the growing antimicrobial resistance is highly alarming and dangerous to human health, and it can potentially return us to time before the arrival of antibiotics [10]. Studies have shown that the sensitivity pattern of bacteria alters with time and varies from place to place [11, 12]. Regular observation and updated antibiotic resistance patterns can guide doctors in selecting the most effective antibiotics for treatment, thereby improving patient satisfaction [13].

METHODS

A descriptive cross-sectional study was employed, using a convenience sampling technique [14]. The sample size for this study was 243. It was calculated by using the frequency of multi-drug resistant *Pseudomonas aeruginosa* as 18.6% prevalence from the previous study [15]. Approval was given by the Institutional Ethics Committee of NCS University System Peshawar on 10 August 2023, NCS/AHS/1302/23. This study was conducted at Hayatabad Medical Complex Hospital and Sina Lab in Peshawar from August 2023 to December 2023. Samples were collected in the Department of Microbiology of HMC. All the male and female patients of any age presented with clinical symptoms associated with urinary tract infection and all the patients willing to participate were included. Patients with asymptomatic urinary tract infections and those who used the antibiotic against the UTIs at least one week before the urine sampling collection were excluded. Consent was obtained from patients before urine samples were collected. The urine samples were collected from patients using normal microbiological procedures. Urine bags for infants and the clean catch method for adults were used for urine collection. To avoid bacterial contamination, women were directed to wash their hands first, and then three disposable wipes were provided to them to clean the area around the urethral opening. The midstream urine was collected in sterile containers. The specimens were transported to the HMC microbiology lab and Sina Lab as soon as possible for tests of resistance and sensitivity to culture. To prevent leukocyte decline, all collected samples were examined rapidly after collection [16]. Isolation and Identification of *Pseudomonas aeruginosa:* The samples were cultured on CLED agar to detect the microorganisms involved. On CLED agar, 0.001 ml of urine specimen was inoculated using a standardized wire loop that was free of

germs. After that, the culture media were incubated for 24 hours at 42 °C. To confirm, the samples that showed no growth after 24 hours of incubation were further incubated for an additional 48 hours. To estimate the load of bacteria per milliliter (ml) of urine specimen, the numbers of solitary colonies of bacteria were counted and multiplied by the dilution factor. Different biochemical tests were used for the identification of *Pseudomonas aeruginosa* like oxidase test, oxidase fermentation test, motility test, and catalase test [17]. The total number of samples was 243, while 132 samples were found positive for *Pseudomonas aeruginosa*. Oxidase test: This test was used to differentiate the Pseudomonas from the Enterobacteriaceae family, and other oxidase-negative bacteria. Reagents: Tetra methyl-p-phenylenediamine dihydrochloride manufacturer = Oxoid, and catalog no=BR0058B. Procedure: The oxidase test followed the manufacturer's guidelines. The test organism was shifted to a filter paper sprayed with the oxidase reagent. A blue-purple color change within 10 seconds was taken as oxidase-positive, while no color change was interpreted as oxidase-negative. The oxidation-fermentation test: This test distinguishes microorganisms that ferment carbohydrates anaerobically, like any member of the Enterobacteriaceae family, and those that oxidize carbohydrates (aerobic utilization), like Pseudomonas aeruginosa. Reagents: N2CI (Manufacturer; Merck, catalog No; 108030):5.0g, Peptone (manufacturer: HiMedia, catalog No: MO28-500G): 2.0g, Di-potassium hydrogen phosphate K2HPO4 (Manufacturer: Merck, catalog No: 105970): 0.3g, Bromothymol Blue (1% aqueous solution) (Manufacturer; Merck, catalog No; 116270): 3.0 ml, Agar (manufacturer: Oxoid, catalog No: LP009B): 3.0g, Water: 1.0Litre. Before autoclaving, the pH was brought to 7.1. Then add the carbohydrate to a final concentration of 1%. After that, the medium was inserted into tubes to a depth of roughly 4 cm. Both tube (sealed and non-sealed) turn into yellow fermentative organisms. Non-sealed tube turns into yellow oxidative organisms, Catalase Test Principle: Some microorganisms contain catalase enzyme, when these microorganisms were added to hydrogen peroxide, they liberate oxygen. A small inoculum of microorganisms of a test was added to a tube or on a slide that has a 3 percent solution of hydrogen peroxide (Manufacturer; HiMedia, catalog No;107089) with a sterile wooden or glass rod. Gas bubble produced Positive (*Pseudomonas aeruginosa*),Gas bubble not produced Negative. Motility Test:There were two approaches to performing the test:The Tube Motility Test and the Wet Mount.Tube Motility Test Reagents: 5 ml of Tube Motility Media per tube was needed for the Tube Motility Test Peptone Water containing 0.2% New Zealand Agar (Manufacturer; HiMedia, catalog No; M170). Sterile, Single-use, Disposable Inoculating Needle (1ul) (Manufacturer; HiMedia, catalog No; LA020). Non-motile organisms, like Acinetobacter species and B. anthraces, will form a single

growth line on the motility-test medium along the original inoculum stab. Around the inoculum stab, motile organisms will create a diffuse growth zone. Incubate the tube aerobically at 35–37°C for 18 to 24 hours. Positive: *Pseudomonas aeruginosa.* Negative: Acinetobacter spp, Determination of Antimicrobial Susceptibility Profile. Antimicrobial susceptibility test was done according to CLSI using the antibiotic discs of (drugs with concentrations given in brackets) Cefoperazone (75ug), Aztreonam (30ug), Imipenem (10ug), Colistin (10ug), Cefotaxime (30ug), Polymyxin–B (25µg), Tobramycin (30µg) from Oxoid Limited Company, United Kingdom on the Muller Hinton agar which were pre- inoculated with each isolate [18, 19]. The study variables comprised both quantitative and qualitative data. Quantitative variables were age and resistance rates. The type of antibiotics tested as well as gender were considered qualitative variables.SPSS software, version 25.0, was used for data analysis, while Microsoft Excel 2010 for data visualization. Frequency and percentage distributions were calculated for both age and gender. Frequency tables and bar charts were used to present the results, including gender-wise and age-wise percentage distributions of *Pseudomonas aeruginosa*. To assess the antibiotic resistance patterns of *Pseudomonas aeruginosa*,cross-tabulations were created to determine the proportion of isolates that were resistant to each antibiotic. The results were presented in tabular format and visually represented through bar charts. The Chi-square test was used to find the relationship between antibiotic resistance patterns and categorical variables like gender and different age groups. A p-value of less than 0.05 was considered statistically meaningful, representing significant associations.

RESULTS

The below table showed the percentage of UTI due to *Pseudomonas aeruginosa* in males and females. The females have higher percentage of *Pseudomonas aeruginosa* than males. The samples which showed growth of *Pseudomonas aeruginosa* were 132 (54.3%) out of 243; 55 (41.7%) were of male and the remaining 77 (58.3%) were of female patients (Table 1).

Table 1: Gender Distribution among *Pseudomonas aeruginosa* Isolates

Gender	N (%)
Male	55 (41.7%)
Female	77 (58.3%)
Total	132 (100%)

Table 2: Age Distribution among *Pseudomonas aeruginosa* Isolates

Age	N (%)
<8 Years	19 (14.4%)
9–30 Years	26 (19.7%)
31-50 Years	38 (28.8%)
51-70 Years	49 (37.1%)
Total	132 (100%)

Antimicrobial resistance pattern of *Pseudomonas aeruginosa*:7 different antibiotics on *Pseudomonas aeruginosa* isolated from the urine sample were tested. Cefotaxime was found to be the most resistant drug, while polymyxin–B was the most sensitive drug to *Pseudomonas aeruginosa*(Table 3).

Table 3: Gender Distribution among Pseudomonas aeruginosa Isolates

Antibiotics	Resistance N (%)
Imipenem	39 (29.5 %)
Cefotaxime	119 (90.2%)
Cefoperazone	78 (59.1%)
Polymyxin-B	4 (3.0 %)
Colistin	14 (10.6 %)
Aztreonam	35 (26.5 %)
Tobramycin	29 (22.0 %)

The total *Pseudomonas aeruginosa isolates* were 132, out of them 77 were females and 55 were males. The table showed the frequency (%) of male and female resistance to each antibiotic. The chi-square test was applied and p values were calculated for each drug, indicating that there was no association between antibiotic resistance patterns of *Pseudomonas aeruginosa* and gender (Table 4).

Table 4: Association of Antimicrobial Resistance Patterns of Pseudomonas aeruginosa by Gender (n=132)

Antibiotics	Male N (%)	Female N (%)	p-value
Imipenem	16 (29.09%)	23 (29.87%)	0.84
Cefotaxime	49 (89.09%)	70 (90.90%)	0.71
Cefoperazone	33 (60.00%)	45 (58.44%)	0.80
Polymyxin-B	2 (3.64%)	2 (2.60%)	0.62
Colistin	6 (10.91%)	8 (10.39%)	0.79
Aztreonam	15 (27.27%)	20 (25.97%)	0.81
Tobramycin	12 (21.82%)	17 (22.08%)	0.86

The following table showed the resistance pattern of Pseudomonas aeruginosa in different age groups. The frequency and percentage of resistance of each antibiotic were mentioned. Overall there was a higher resistance trend to various antibiotics in older ages (51-70 years). The chi-square test was applied, and the p-value was significant (0.04), indicating an association between the resistance pattern of Pseudomonas aeruginosa and age groups (Table 5).

Table 5: Comparison of Antimicrobial Resistance Patterns of *Pseudomonas aeruginosa* by Age Group

Age	IMI N (%)	CEF N (%)	CEFO N (%)	POL N (%)	COL N (%)	AZT N (%)	TOB N (%)
<8 Year	1 (2.5%)	12 (10%)	3 (3.8%)	0 (0.0%)	0 (0.0%)	1 (2.8%)	1 (3.4%)

	IMI	CEF	CEFO	POL	COL	AZT	TOB
9-30 Year	4 (10.2%)	23 (19.3%)	10 (12.8%)	0 (0.0%)	1 (7.1%)	2 (5.7%)	3 (10.3%)
31-50 Year	12 (30.7%)	36 (46.1%)	29 (37.1%)	1 (25%)	3 (21.4%)	7 (20%)	4 (13.7%)
51-70 Year	22 (56.4%)	48 (40.3%)	36 (30.2%)	3 (75%)	10 (71.4%)	25 (71.4%)	21 (72.4%)

IMI=imipenem, CEF= cefotaxime, CEFO= cefoperazone, POL= plymyxin B, COL= colistin, AZT= aztreonam, TOB= tobramycin

DISCUSSION

Pseudomonas aeruginosa was a significant human pathogen responsible for many types of infectious diseases, particularly in individuals with weakened immunity and specifically in patients with burns, wounds, and respiratory and urinary tract infections [9]. This study investigates 132 samples for antibiotic susceptibility patterns of *Pseudomonas aeruginosa* in UTI. The patients aged less than 8 years have 14.4 % of *Pseudomonas aeruginosa* in UTI and the patients aged between 9 to 30 years have 19.7 %.The patients aged between 31 and 50 were 28.8%, and those aged between 51 and 70 were 37.1% of the total sample. The percentage of *Pseudomonas aeruginosa* in this study was found to be female (58.3%) and male (41.7%). The overall prevalence was found to be 54.32%. These results were related to the reports of another study which showed prevalence higher in females (64.71%)than males (35.29%) and the highest incidence was seen in the age of 61 to 80 [13]. A study done in India showed contrasting results, which found the incidence higher in males (55%) than females (45%), the resistant pattern of 7 different antibiotics on *Pseudomonas aeruginosa* isolated from the urine sample was tested [20]. The most sensitive drug was polymyxin-B, while the most resistant drug was found to be Cefotaxime. This study found resistance to Polymyxin-B (3.0%), and cefotaxime (90.1%). The resistance of polymyxin-B was reported (2% and 00.0%) by studies done in Suzhou district, China [21], and Nepal [19] respectively. A contrasting result was reported by a study in Minia, Egypt which showed resistance to polymyxin-b was (49.8%) another study in Khyber Teaching Hospital, Peshawar reported resistance to Cefotaxime (30.5%), while a study in Nepal (56.5%), in another study, the reported resistance was found to Cefotaxime (34.0%) [22, 14, 19, 23]. This study found resistance to Imipenem (29.5%), which was almost similar to another study done in Saudi Arabia, which reported resistance to imipenem (36.7%). Other studies done in Iran and China reported resistance to imipenem (19.2%), and (16.2%) respectively [24-25]. Studies done in Karachi, and at Nishtar Hospital, Multan reported contrasting results showing resistance to Imipenem (80.0%), (10.4%), and (50.0%) respectively [26, 27]. According to this study, resistance to Tobramycin was (22.0%), which was almost the same as the study done in

Nepal (28.2%) and in India (16.2%) [19, 25]. A study done in Karachi, Pakistan found resistance to Tobramycin (58.4%) [15], while another study reported (60.2%), which was a contrast to this study's finding [28]. This study found resistance of Colistin and Aztreonam to *Pseudomonas aeruginosa:* (10.6%) and (26.5%), respectively. Another study in Pakistan reported resistance to Colistin (00.0%) and aztreonam (80.0%, 56.7%, and 13.5%) [29]. Resistance to Cefoperazone was (59.0%), which was almost similar to the previous study which reported (60.1%), this study showed that there was no significant difference in antibiotic resistance patterns between males and females. This was true for another study that reported no difference in gender resistance patterns [28, 30]. This study found overall higher resistance in older ages and these findings were aligning with other study [31].

CONCLUSIONS

The results of this study showed that urinary tract infection due to Pseudomonas aeruginosa was more common in females than males. Pseudomonas aeruginosa showed different percentages of resistance to various drugs used in UTI. Polymyxin-B was found to be the most sensitive drug, while Cefotaxime is found to be the resistant drug. The result showed that there was no significant difference in resistance pattern of Pseudomonas aeruginosa between females and males. This study also showed, the higher resistance percentage in older age group (51-70 year).

Authors Contribution

Conceptualization: AU
Methodology: AJ[2], FM, SU, MK, UUR
Formal analysis: AU, AJ[2], FM, SU
Writing, review and editing: AJ[1], AU, TJ, MK, UUR, AA, AB

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

OPEN ACCESS

Prevalence of Pronation Distortion Syndrome and Anterior Pelvic Tilt in Relation to Body Stability among Amateur Athletes

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A R T I C L E   I N F O

A B S T R A C T

Background: Pronation was defined as simultaneous calcaneal eversion, foot abduction, and dorsiflexion. Pronation was necessary for stability when walking and standing; however, having too much ROM for this action might contribute to overpronation. Good postural balance was required to improve voluntary movement control in sports. **Objective:** To determine the prevalence of pronation distortion syndrome and anterior pelvic tilt among amateur athletes and to observe the correlation between pronation distortion syndrome and body stability in this population. **Methods:** In this cross-sectional study convenience sampling was used. The sample size of this study was 117 amateur athletes. Data were collected from Aleem Dar Cricket Academy, Green Cricket Academy, and Ideal Cricket Club. The tools used to conduct the study were a navicular drop test, handheld inclinometer, and Functional Movement Screening (FMS) Questionnaire. **Results:** The findings of this study demonstrated a 35.9% prevalence of pronation distortion syndrome and a 16.2% prevalence of anterior pelvic tilt. Additionally, this study found a positive association between PDS and FMS (p-value = 0.004), as well as between feet type and tilt (p-value = 0.007). However, a negative association was observed between anterior pelvic tilt and FMS (p-value = 0.184), and between anterior pelvic tilt and PDS (p-value = 0.141). **Conclusions:** This study concluded that amateur athletes exhibited a notable prevalence of pronation distortion syndrome and sixteen percent of amateur athletes were suffering from anterior pelvic tilt presenting poor body stability. Significant association was observed between body stability and both pronation distortion syndrome and anterior pelvic tilt.

INTRODUCTION

Lower body pronation distortion syndrome is one of the common abnormalities that may cause pain in feet and may result in deterioration of the anatomical structure of the talus as well as distal and proximal parts of the foot. Individuals with this syndrome have an internal rotation of the hip, a flat feet deformity, and knee valgus as a result of excessive foot pronation, and worsening lumbar lordosis [1]. The anterior portion of the leg is affected by the postural distortion of the lower extremity mainly referred to as Pronation Distortion Syndrome (PDS). Flat feet are caused by the rotation of the navicular bone and head of the talus downward and inward which causes this abnormality. Moreover, pressure is elevated on the medial aspect of the first and second MTP joints, and a bunion is associated with it [2]. Individuals who have flexible flat feet are more susceptible to suffering pronation distortion syndrome. In pronation distortion syndrome, the victim's longitudinal arch collapses in the center of the foot, increasing the inclination to supinate and pronate [3]. Pronated feet disrupt kinematic coupling owing to unacceptable walk pace technicalities, resulting in inconsistent coordination and a deviation from typical joint angles. This eventually disrupts joint synchronization, which typically specifies mobility. As a result, the glutes are under-activated due to tight hip and ankle muscles[4]. In addition to the gastrocnemius, the iliotibial band provides tension that

influences knee stability, while the hamstrings and vastus medialis are crucial for maintaining proper alignment and patellar tracking. Pronation distortion syndrome could create tension in the iliotibial band and cause lateral pull to the patella resulting in genu valgus [5].Foot overpronation can cause compensations throughout the kinetic chain. Foot overpronation causes the client's hips to adduct and internally rotate, resulting in an excessive inward angle of the femur and an excessive anterior pelvic tilt [6]. An excessive anterior pelvic tilt occurs when the pelvis tilts more than what is deemed normal when the person is standing. The tilt often occurs from tight hip flexors and lumbar spine hyperlordosis. The excessive tilt is also associated with LBP and knee discomfort leading to compensatory movement patterns [7]. Measurements of pelvic tilt derived from radiographic images are applied in research evaluations and surgical planning. The anterior pelvic tilt reference value in the normal healthy population is approximately 8 degrees. In the clinical setups, pelvic tilt is evaluated using an inclinometer, which is the angle between a line connecting the anterior and posterior superior iliac spine (ASIS and PSIS). Static deviations like pronated foot can trigger harmful postural imbalances throughout the kinetic chain affecting knees, tilting hips and upper spine as well if not treated [8]. However, as the literature does not define excessive anterior pelvic tilting with a set cutoff point, the current study defined excessive anterior pelvic tilt as an anterior angle higher than 8 degrees [9]. Successful athletic performance necessitates an exceptional capacity to maintain bodily equilibrium over an extended period. Different sorts of sports, to differing degrees, help trainees acquire the ability to maintain bodily equilibrium [10]. Using this approach to compare hallux valgus with controls, they discovered a significant prevalence of hyperpronation (87.3%) in the HV group. This study had significant implications for the ankle and foot community [11]. Screening of foot posture in amateur athletes is especially important as it substantially impacts biomechanics and general performance. Any deviation from the normal arch structure of the foot may change the kinematics of gait, and force distribution, and increase the likelihood of injuries like plantar fasciitis, and patellofemoral pain syndrome. Knowledge of foot position reveals specific abnormalities that requires therapeutic procedures like orthotics and exercises to improve biomechanics. This is through screening to address these issues that would otherwise lead to injuries or hinder the force transmission through the lower extremities for maximum athletic performance. Excessive pronation can cause higher soft tissue tension and alterations in total lower limb posture, putting the individual at risk for lower extremity injury. Excessive rear foot pronation may result in unusual tibia internal rotation, which may cause increased stress on the

knee structure and disrupt patella tracking [12]. A common chronic illness "Pes Planus" affects 2 to 23 percent of the adult population and is distinguished by calcaneal eversion and lower medial longitudinal arch. The most prevalent issue is overpronation during weight-bearing exercises with pes planus [13] The incidence of retroversion of acetabular is understudied and it may be related to an increase in "anterior pelvic tilt". The frequency of unilateral or bilateral acetabular retroversion in the general population was 24%, with 18% for all hips [14]. In amateur athletes, non-contact injuries are often linked to overuse, where tissues weakens from repetitive stress without adequate recovery time. Similarly PDS can misalign the hip leading to general hip pathologies [15].

The current study aimed at establishing the extent to which amateur athletes are affected by pronation distortion syndrome with an emphasis on lower extremity distortions, muscle imbalance and anterior pelvic tilt as athletes require proper body mechanics and kinetic chain to maintain their body stability during sudden accelerated motions and reflexes. Amateur athletes are often neglected in screening process that's why the study specifically targets them. These studies sought to enhance screening, training, and rehab in relation to foot biomechanical and body stability characteristics so as to enhance athletes' performance and minimize injuries among both amateur and elite athletes.

METHODS

A cross-sectional study design was used to explore pronation distortion syndrome and anterior pelvic tilt about body stability among amateur athletes. The study was approved by the ethical committee board of the University of Management and Technology, Lahore (RE-083-2024). A sample size of 117 was selected by the WHO calculator with a confidence interval of 95%, a true proportion of 0.917, and a margin of error of 0.05 [16]. The participants were selected through the convenience sampling method due to their practicality and ease of access to a specific group of amateur athletes for this study. Written consent was taken from participants before data collection. The time frame to complete this study was 3 months. Inclusion criteria consisted of amateur athletes with the age group of 18-35 years, both male and female gender were included [17]. Participants were regular tournament-playing athletes, participating in at least one tournament per month [18]. Individuals who used particular footwear, previously diagnosed foot abnormalities like clubfoot, and claw foot, and athletes who had a history of using performance-enhancing drugs were excluded from the study. A navicular drop test was used to assess pronation distortion syndrome. For checking body stability, functional movement screening was used. Anterior pelvic tilt was checked by using an inclinometer. Data collection tools used was a navicular drop test to evaluate participants'

Minhas HS *et al.*,

hyperpronation, which was still the most popular and simple exam. This test value reflected the height disparities between the navicular tuberosity in the sitting position and the upright posture. Values greater or equal to 10mm were considered positive tests. The sensitivity and specificity of the navicular drop test were 86% and 75%, respectively[19]. It was performed by measuring the height difference of the navicular bone from a fixed reference point (anatomical landmark) in both a neutral position and after the participant performed a weight bearing. The height difference was measured by a ruler, with a threshold of 10mm established based on previous research indicating that this value correlates with functional issues related to foot biomechanics [20]. An inclinometer was one of the tools that were developed to assess pelvic tilting. The instrument displayed the angle between the horizontal or vertical and the line connecting the two arms of the inclinometer. The physician palpates both the anterior as well as posterior superior iliac spine, then sets the device on them and gets a measurement. Pelvic tilt was evaluated using an inclinometer with test-retest reliability that was equal to between (0.88-0.95) [21]. The functional movement screening was an assessment instrument that was used to assess seven key patterns of movement in people who do not have a current history of ache problems or injuries to the MSK system to assess their body stability. Seven movement patterns are; deep squat, in-line lunge, hurdle step, trunk push-up, shoulder mobility, rotatory stability, and active straight leg raise [22]. Data analysis was conducted using Statistical Product for Social Sciences (SPSS) version 25.0 by applying the chi-square test to show the relationship between variables.

R E S U L T S

The table 1 displays the demographic profile of each variable, including gender, feet type, and BMI, in terms of frequency and percentage of the sample population in research study. The total percentage in each category was 100% showing the total number of participants who were 117. Out of 117 amateur athletes 68 athletes were with normal feet, 7 with flat feet and 42 with flexible flat feet.

Table 1: Demographics of Amateur Athletes

Variables	Frequency (%)
Gender	
Male	73 (62.4%)
Female	44 (37.6%)
Feet Type	
Normal Feet	68 (58.1%)
Flat Feet	7 (6.0%)
Flexible Flat feet	42 (35.9%)
BMI	
0-18.4 (Underweight)	23 (19.7%)
18.5-24.9 (Normal)	77 (65.8%)
25-29.9 (Overweight)	12 (10.3%)

30 above (Obese)	5 (4.3%)
Total	117 (100%)
Age	
Minimum	18
Maximum	35

The figure illustrates that among participants with a positive navicular drop test (>10 mm), 15 (12.82%) exhibited a positive FMS, indicating impaired body stability, while 27 (23.08%) had a negative FMS, suggesting normal body stability. In contrast, among participants with a negative navicular drop, 14 (11.97%) had a positive FMS, while 61 (52.14%) had a negative FMS score (Figure 1).
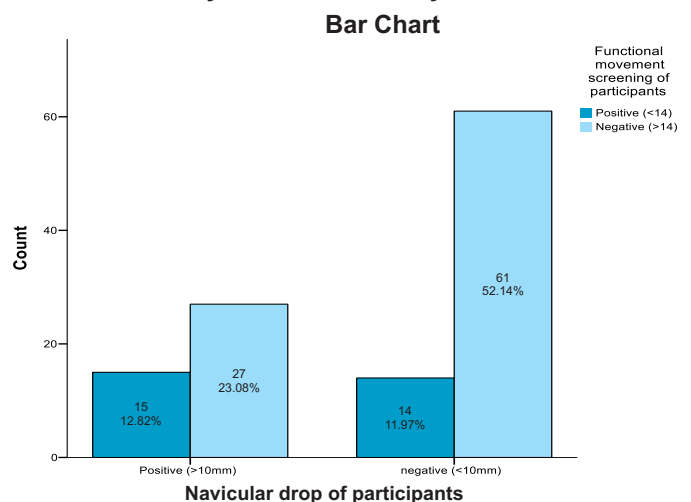
Figure 1: Association between Navicular Drop and FMS

From the table 2, data shows 42 athletes among 117 participants have a navicular drop measurement more than 10 mm thus exhibiting 35.9% prevalence of pronation distortion syndrome. On the other hand, 75 participants (64.1%) have measurement below 10 mm defined that they exhibit better mechanics of their feet.

Table 2: Navicular Drop of Amateur Athletes

ND	Frequency (%)
Positive (>10mm)	42 (35.9%)
Negative (<10mm)	75 (64.1%)
Total	117 (100%)

Table 3 shows the anterior pelvic tilt of amateur athletes which was measured by inclinometer. Out of 117, 19 participants (16.2%) have pelvic angle greater than normal which indicated that they have anterior pelvic tilt and 98 participants (83.8%) showed that they have normal pelvic tilt.

Table 3: Anterior Pelvic Tilt of Amateur Athletes

Tilt	Frequency (%)
Positive	19 (16.2%)
Negative	98 (83.8%)
Total	117 (100%)

Table 4 describes the FMS score of athletes. Participants having FMS score less than 14 out of 21 have affected body stability which were 29(24.8%) while 88 participants having FMS score more than 14 have normal body stability. Table 5 showed cross tabulation of feet type of participants and anterior pelvic tilt that illustrated significant association as p < 0.05.

Table 4: Functional Movement Screening of Participants

FMS Score	Frequency (%)
Positive (<14)	29 (24.9%)
Negative (>14)	88 (75.2%)
Total	117 (100%)

Table 5 shows the association between feet type, anterior pelvic tilt of participants, among 68 participants with normal feet 11 participants had positive anterior pelvic tilt, 7 participants with flat feet out of which 4 had positive anterior pelvic tilt as well as out of 42 participants with flexible flat feet 4 had positive anterior pelvic tilt.

Table 5: Cross Tabulation of Feet type of Participants and Anterior Pelvic Tilt Measurement by Inclinometer

Statistical Tests	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.003[a]	2	0.007
Likelihood Ratio	7.637	2	0.022
Linear-by-Linear Association	0.540	1	0.463
Number of Valid Cases	117		

Table 6 shows that there was a relationship (p < 0.05) between Functional Movement Screen (FMS) scores and the navicular drop among 117 participants signifying strong association between pronation distortion syndrome and FMS.

Table 6: Cross Tabulation for Navicular Drop of Athletes and Functional Movement Screening

Statistical Tests	Value	df	Asymptotic Significance (2-sided)	Exact Significance (2-Sided)	Exact Significance (1-Sided)
Pearson Chi-Square	4.197[a]	1	0.040		
Continuity Correction	3.332	1	0.068		
Likelihood Ratio Fisher's Exact Test	4.084	1	0.043	0.047	0.035
Linear-by-Linear Association	4.161	1	0.041		
Number of Valid Cases	117				

In table 7 the results of the chi-square test, which relate the navicular drop and the BMI among 117 respondents, had a p-value of 0.067 and the likelihood ratio test gave greater significance with a p-value of 0.044. Overall, it seems BMI could affect navicular drop with the presence of a linear regression at a statistical level of 95% (p = 0.016).

Table 7: Chi-Square Test Navicular Drop of Participants and BMI of Participants

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.167[a]	3	0.067
Likelihood Ratio	8.088	3	0.044
Linear-by-Linear Association	5.850	1	0.016
Number of Valid Cases	117		

DISCUSSION

This was a cross-sectional study to explore the prevalence of Pronation distortion syndrome and anterior pelvic tilt about body stability among amateur athletes. The data collection tools that were used in this study include Navicular Drop, Inclinometer, and Functional Movement Screening. Ikuta Y et al., in 2022 conducted a study that concluded that excessive rear foot valgus and navicular drop of > 10 mm significantly impact postural stability in adolescent athletes. Compromised postural stability was observed via single-leg standing. In this study, FMS was used for investigation of body stability and there was a significant association present between navicular drop and body stability. Thus, the results of this study are aligned with previous studies [23]. Handheld Inclinometer was used for the measurement of pelvic angle. We placed an inclinometer on the participant's ASIS prominence in the sagittal plane while the participant was in a standing position. The center of the displaced colored fluid was taken from caliber as the reading of pelvic angle tilting. Brekke AF et al., in 2022 measured anterior Pelvic Tilt with acetabular retroversion. The general population was taken as a participant. The study found out 24% prevalence of anterior pelvic tilt with acetabular retroversion. This study supported this study as the prevalence of Anterior pelvic tilt found by this study was 16.2% while this study was taken among amateur athletes [14]. Functional Movement screening test was the key tool for the measurement of body stability which has a cut of value 14. The body stability was linked with our body kinematics and symmetry of pelvic angle. In this study, Functional Movement Screening (FMS) was used for the body stability in Amateur athletes. From seven movements 4 of the movements (Inline Lunge, Hurdle Step, Rotatory Stability, and Shoulder Mobility) were majorly affected in the regular amateur athletes. Meanwhile, Boratino AV in 2022 in a study also used the Functional Movement Screening (FMS) test as a screening indicator or tool of body kinematics and stability in a sports setting. The results indicated four affected movements: single leg squat, inline lunge, deep squat, and hurdle step. Overall, body kinetics was the key factor in total body stability [24]. Body stability in this study was measured with the Functional Movement Screening (FMS). In this Screening test 7 functional movements were performed by the participants with just a single repetition and a score was given according to their body movement and compensations with it. The main purpose of this study was

to find out the association between pronation distortion syndrome and anterior pelvic tilt with dynamic body balance. In this study navicular drop test was used for pronation distortion syndrome and the Functional Movement Screening Test was used to find out the body stability. Results showed a Positive association between navicular drop and body balance. In contrast to this study a study conducted on Foot posture, body balance, and Pelvic tilt by Pradhan D et al., in 2021. In which they conduct a study on healthy recreational runners. They used the foot posture index and Star Excursion balance test as tools. They found a poor correlation between body stability and foot posture (r=0.23) [25]. Normal pelvic symmetry was important for the athletes to prevent injuries. For this, a study was conducted on pelvic symmetry and the range of pelvic movement by Nowak B et al., in 2020. In that study Pelvic symmetry was assessed among young football players and non-playing peers. Results concluded that there was no difference in the value of pelvic symmetry among the two groups and a greater range of pelvic rotation was found. Moreover, they found significant posterior pelvic tilting in young football players. In contrast to that study, this study focused on drawing the results of anterior pelvic tilt among amateur Athletes. A negative association was found between anterior pelvic tilt and navicular drop [26].

CONCLUSIONS

This study concludes there was a notable prevalence of Pronation distortion syndrome and anterior pelvic tilt in amateur athletes. The study further showed a positive relationship between pronation distortion syndrome, functional movement screening and foot type. A significant relation was observed between anterior pelvic tilt and body stability. These findings underscore the impact of Pronation distortion syndrome and anterior pelvic tilt on body stability highlighting the need for proper interventions and enhancement in biomechanical properties of amateur athletes.

Authors Contribution

Conceptualization: HSM, GH
Methodology: AUHC, MAS, AM
Formal analysis: HSM
Writing, review and editing: AH, GH, MAS, AM, MS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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Original Article

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Effect of Prone Positioning and Alternate Nostril Breathing Technique on Oxygen Saturation and Psychological Status in Patients with COVID-19

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ARTICLE INFO

ABSTRACT

Prone positioning has certain benefits in improving respiratory parameters. **Objectives:** To study the effects of prone lying position and alternate nostril breathing in patients diagnosed with COVID-19. **Methods:** This quasi-experimental study was conducted at District Headquarters Hospital Faisalabad, Pakistan. After ethical approval, patients between the ages of 40-80 were recruited with a diagnosis of COVID-19 and received supplemental oxygen. Thirty patients with COVID-19 were divided into two groups, group A opted prone lying alone and group B performed prone lying with alternate nostril breathing. Study outcomes were fractional oxygen concentration in inspired air (FiO2), partial pressure of oxygen (PaO2), and general psychological status recorded at baseline and after one hour of re-supination. A paired sample t-test and ANOVA were applied to find between-group and within-group differences (p≤0.05). **Results:** Out of 30 patients, 16 (53.3) were male and 14 (46.7%) were female. The mean age ± standard deviation of the participants in group A was 57.58±10.4 and in group B was 59.21±9.589. There was a significant inter-group difference in mean scores for General Anxiety Disorder-7, 9.290±2.355 before and 4.677±2.224 after the treatment. The pretreatment mean value of FiO2 was 1.68±0.475; after treatment, the value was 3.45±2.119. A p-value≤0.05 was found statistically significant for all outcome variables improving respiratory parameters and reducing anxiety. **Conclusions:** It was concluded that prone positioning with alternate nostril breathing effectively improves (PaO2), (FiO2) and general psychological state in COVID-19 patients.

INTRODUCTION

COVID-19 has emerged as a disastrous threat to the respiratory system leading to a massive number of patients with respiratory failure and an increased number of hospital admissions. Since the outbreak of this disease, many studies have been published to explore various aspects of this acute respiratory condition [1]. World Health Organization has declared this condition as an ongoing pandemic because different variants are being reported in various parts of the world [2]. Clinically the presentation of Coronavirus varies as mild, moderate, and severe symptoms leading to hospitalization. In most severe cases noninvasive and invasive ventilation becomes unavoidable [3]. The common clinical symptoms of this disease are fever, cough, dyspnea, and chest congestion. Depending on the severity of symptoms some patients may progress to acute respiratory distress syndrome within a week or so [4]. The most disabling condition among hospitalized individuals is reduced oxygen saturation in the blood (<93%) or some may present as stable ones without prominent distress with oxygen saturation between 50-60% [5]. Patients are often treated with medication, steroids, supplemental oxygen, and high flow continuous

positive airway pressure and prone positioning [6]. In the supine lying position the weight of the viscera and diaphragm's shape hinder breathing and it becomes worse in chest infection. By changing the position to prone lying the ventilation capacity, efficiency of respiration, and gaseous exchange increase [7]. A Study was conducted on the non-intubated subjects with Coronavirus-19 (COVID-19) who were admitted. This study showed that prone positioning is highly beneficial for patients suffering from COVID-19 and it reduces their chances of intubation [8]. In alternate nostril breathing (ANB) technique, breathing is carried out with one nostril at a time and closing the other nostril manually. Plenty of evidence advocates the significant effects of ANB on the autonomic and cardiorespiratory system [9]. According to a review by Vitacca et al., nasal breathing improved ventilator efficiency and lowered the physiological economy for a given work. Respiratory rehabilitation played a great role in the management of COVID-19 patients from favourable breathing to providing strengthening and training to the muscles of respiration [10]. According to a systematic review, respiratory rehabilitation is one of the most important aspects of the COVID-19 treatment regimens [10]. A randomized controlled trial concluded that breathing practices have a positive impact on mental health in hospitalized patients of COVID-19. The improvement of these respiratory parameters calls for more clinical trials to better understand the phenomenon. There have been several studies conducted to investigate the effects of prone position on PaO2, respiratory rate, and other physiological parameters. The addition of alternate nostril breathing with a prone position and assessment of anxiety score along with respiratory parameters is a novel approach in this population.

This study aims to find the effects of prone positioning and alternate nostril breathing in non-intubated patients suffering from COVID-19. The combined approach of COVID-19 patient positioning and ANB helps in improving ventilation and oxygen saturation in the blood.

METHODS

In this quasi-experimental study, patients diagnosed with COVID-19, receiving supplemental oxygen at District Headquarters Hospital, Faisalabad, Pakistan were recruited. The study was conducted from November 2020 to March 2021 after ethical approval from Sialkot College of Physical Therapy (IRB-SCPT-DPT-138-2020). A sample of 30 patients was estimated using the EPI tool, with a 95% confidence interval and a 5% margin of error. Patients of either gender, diagnosed with COVID-19, between age 40-80, oxygen saturation not less than 70, and with a Glasgow Coma Scale (GCS) score of 15 were included. In contrast, patients with a history of acute respiratory distress syndrome (ARDS) chronic smokers, chronic obstructive pulmonary disease (COPD), intubated patients, and

patients with neurological disorders were excluded from the study. Written informed consent was obtained from the patients. After initial screening for the inclusion criteria, thirty patients were divided into two groups A and B. The data were collected at baseline, and patients were instructed to lie in the prone position, for three hours for group A. In group B, the patients maintained a prone lying position for three hours and after returning to the supine position, performed supervised alternate nostril breathing. In this method patient was instructed to close one nostril with the help of the index finger inhale deeply from the other nostril for three seconds and exhale through the mouth. After that perform the same maneuver with other nostrils and continue doing so for 10 minutes with a rest of 30 seconds after every three minutes. Generalized anxiety was apparent in most of the patients suffering from COVID, so this subjective measure was included along with the facilities available at the COVID ward, the outcome measures were the General psychological state measured through GAD-7 [11], the partial pressure of oxygen (PaO2) measured through a pulse oximeter [12], and the inspired air oxygen fractional concentration (FiO2) measured through a FiO2 monitoring device [13]. The outcome measures were assessed before prone positioning and returning to the supine position after an hour in both groups. Data were analyzed using SPSS version 23.0. The data were found normally distributed (Shapiro Wilk's test) so parametric tests were used. The paired sample t-test was applied to find the within-group difference before and after the intervention and one-way ANOVA was applied to find the difference between the groups. p-value<0.05 was considered statistically significant with a 95% confidence interval.

RESULTS

After screening 30 patients participated in the study. Out of 30 patients, 17 (54.8%) were men and 14 (45.2%) were women. The mean age of the participants in Group A was 57.58 ± 10.41 and in Group B was 59.21 ± 9.58. The mean value of the pulse was 89.03 ± 12.85 (beats/minute) and the mean temperature was 98.45 ± 0.925 Fahrenheit (Table 1).

Table 1: Demographic and Baseline Characteristics of the study participants

Variables	Group-A n=14	Group-B n=16	Total n=30
Mean ± SD			
Age (Years)	59.21 ± 9.58	57.58 ± 10.40	58.39 ± 9.99
Height (cm)	164.21 ± 7.42	163.16 ± 5.62	163.43 ± 6.52
Weight (kg)	67.79 ± 9.25	63.92 ± 7.60	65.855 ± 8.42
BMI (kg/m^2)	25.1 ± 0.852	23.8 ± 0.937	24.7 ± 9.58
Pulse (Beats/minute) 77-134	89.86 ± 14.673	87.50 ± 11.165	88.60 ± 12.848
Temp (F) 98-102	98.57 ± 0.852	98.38 ± 1.025	98.47 ± 0.937
GAD Score 0-16	10.00 ± 2.353	8.63 ± 2.306	9.27 ± 2.392

Gender			
Male	7	9	16 (53.3%)
Female	7	7	14 (46.7%)

A paired sample t-test was applied to find the difference before and after the intervention within the groups. In Group A, the mean of the GAD-7 score was 10.00 ± 2.35 before treatment and after the treatment, its value was 5.50 ± 2.029. Whereas the pretreatment means value O2 saturation and FiO2 were 85.43 ± 5.36 and 0.36 ± 2.470 respectively whereas after-treatment values were 87.71.57 ± 7.89 and 0.28 ± 1.18 respectively. For Group B the mean of the GAD-7 score was 8.63 ±2.30 before treatment and after the treatment, its value was 4.25 ± 1.770 reflecting a reduced generalized anxiety in both the groups. Whereas the pretreatment means value O2 saturation and FiO2 were 89.88 ± 3.13 and 0.36 ± 2.470 respectively whereas after-treatment values were 94.94 ± 2.99 and 0.20 ± 1.14 respectively. The Independent t-test was applied to find the difference between the groups. p-value≤0.05 was considered statistically significant. The Fractional Concentration of Oxygen in inspired air and Partial Pressure of Oxygen improved in both groups. (Table 2).

Table 2: Intergroup and Intragroup Comparison of PaO2, FiO2 and GAD-7 Scores

Variables	Group-A n=14	Group-B n=16	Mean Difference	p-value
P_aO_2 Saturation				
Pre Values	85.43 ± 5.360	89.88 ± 3.138	4.43	0.009
Post Values	87.71 ± 7.898	94.94 ± 2.999	7.23	0.002
Mean Difference	2.28	5.06	–	–
p-value	0.000*	0.000*	–	–
FiO_2				
Pre Values	0.36 ± 2.470	0.34 ± 2.119	0.02	0.008
Post Values	0.28 ± 1.18	0.20 ± 1.14	0.08	0.003
Mean Difference	0.08	0.14	–	–
p-value	0.000*	0.000*	–	–
GAD-7 Scores				
Pre Values	10.00 ± 2.353	8.63 ± 2.306	1.37	0.118
Post Values	5.50 ± 2.029	4.25 ± 1.770	1.25	0.082
Mean Difference	4.50	3.38	–	–
p-value	0.000*	0.000*	–	–

GAD-7: Generalized Anxiety Disorder Questionnaire. FiO2: Fractional Concentration of Oxygen in Inspired Air. PaO2: Partial Pressure of Oxygen.

DISCUSSION

This quasi-experimental study assessed the effects of prone positioning with alternate nostril breathing in patients with COVID-19. The results revealed that patients with prone positioning and alternate nostril breathing showed significant improvement in PaO2, FiO2, and GAD-7 scores. There was a significant between-group difference in mean scores for the GAD-7 score of 9.290 ± 2.355 before

treatment and 4.677 ± 2.224 after the treatment. The effects of prone positioning in patients with COVID-19 have been reported numerous times. A study by Nay et.al 2023 to see the impact of prone positioning versus usual care in intensive care units in COVID-19 awake patients concluded that there was a significant improvement in the prone positioning group and the likelihood of these patients for the intubation was less [14]. The findings of the current study where within-group comparison revealed that prone position significantly improved PaO2, FIO2, and GAD-7 in hospitalized patients, are supported by literature as well. Shelhamer et al., conducted a study to observe the effects of prone positioning in COVID-19 patients with moderate to severe ARDS and concluded that prone position is beneficial in improving physiological parameters and decreasing the mortality rate [15]. In the current study parameters like oxygen saturation were significantly improved in the prone positioning group with pursed lip breathing. In a randomized clinical trial to see the effects of diaphragmatic breathing and pursed lip breathing exercises (PLB), it was concluded that the rate of perceived exertion was significantly reduced [16]. It was an instruction-based program and the way patients performed it was not recorded. Contrary to this intervention, we improvised a supervised clinical intervention and it was observed that physiological parameters and overall psychological state were improved. In most of the studies, the pulmonary parameters of COVID-affected patients have been observed whereas in the current study, the psychological impact caused by both physiological and psychological factors has been addressed by using GAD-7. In a study by G Schifino et al., it was found that a prone lying position in awake non-intubated patients of COVID-19 had a strong association with improved oxygenation. The increased V/Q ratio to the dependent areas of the lungs was evident in all patients. These findings provide a unique rationale in contrast to our study where an increase in PaO2 was observed in the group that remained in the prone position for the specified time [17]. In another review to analyse the outcomes associated with awake prone positioning, it was concluded that it reduced the need for intubation in patients with acute respiratory failure associated with COVID-19. The results of this study provide a strong basis to incorporate this intervention in the treatment of non-intubated patients with COVID-19 [18]. In a randomized clinical trial by Siregar et al., to see the effects of orthopneic positioning and PLB in patients of COPD the respiratory frequency and oxygen saturation were significantly improved in the treatment group [19]. These results advocate for the findings of our study where prone positioning followed by pursed lip

breathing exercises improved oxygen saturation and the fraction of inspired oxygen. In another study by Kader et al., 2022, it was concluded that even a short span of respiratory exercises improves specific respiratory parameters[20]. Prone position and pursed limb breathing is a simple non-invasive and economical technique and may be used to improve respiratory parameters and decrease the anxiety of COVID-19 patients[21]. The current study showed that the prone positioning with alternate nostril breathing is effective in COVID-19 patients in improving ventilation, increasing their partial pressure of oxygen, and reducing their chances of ventilator dependence. Incorporation of this simple yet effective regime can contribute to reducing their hospital stay and improving their anxiety status. A small sample was a major limitation and some other outcomes could add strength to the study. More studies with randomization and sufficient follow-up are suggested to further validate the findings of current studies.

CONCLUSIONS

It was concluded that in inspired air oxygen fractional concentration (FiO2) was increased and anxiety disorder was decreased in both groups. However, the partial pressure of oxygen was improved in group B only.

Authors Contribution

Conceptualization: SA, WP, MC
Methodology: SA, MC, SKR
Formal analysis: AH, SKR
Writing review and editing: WP

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

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Effects of Hyperglycemia on Outcomes of Traumatic Brain Injury among Patients Admitted in Tertiary Level Hospital

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ABSTRACT

Various factors contribute to unfavorable outcomes of Traumatic Brain Injuries (TBI) and hyperglycemia is one of them. It occurs frequently at an early stage after having traumatic brain injuries and previous studies have identified that hyperglycemic patients encounter worse outcomes in terms of disability and death. **Objectives:** To determine the association of hyperglycemia to prognosis of traumatic brain injury patients with distinct blood glucose levels and co-morbidities. **Methods:** A cross-sectional study was conducted from June 2022 to October 2022 at Liaquat University Hospital, Hyderabad on 171 young to middle aged participants, admitted patients of TBI with GCS scores 3-13 selected through purposive sampling technique. Data were collected on a multi-sectioned questionnaire and analyzed by SPSS version 26.0. The results were analyzed by applying chi-square test at $p=\leq 0.05$ as the cut-off level of significance. **Results:** 44.4% of participants were hyperglycemic. Four times greater mortality rate was recorded in hyperglycemic patients as compared to normoglycemic patients. No patient could survive who had hyperglycemia at 72 hours of injury. Hyperglycemia at 24 hours as well as at 72 hours of TBI was significantly associated to poor prognosis ($p<0.01$). **Conclusions:** Hyperglycemia at 24 hours of injury resulted in four times greater mortality as compared to normoglycemic TBI victims, therefore blood glucose level should be maintained between 70-180 mg/dl for a favorable outcome of TBI. Moreover, patients with persistent hyperglycemia and comorbidities of hypertension, diabetes mellitus, and ischemic heart disease have shown more tragic outcomes of TBI so it should be investigated on a large scale sample size in different populations.

INTRODUCTION

Traumatic brain injuries (TBIs) are frequent cause of morbidity and mortality worldwide and a significant part of these injuries occur due to road traffic accidents [1]. TBIs are the major cause of mortality in general and particularly among young adults. In the United States of America over 64 thousand lives are lost every year because of TBIs [2, 3]. The situation is declining health status worldwide, specifically in low and middle-income countries (LMICs). Retrospective content analyses in Jakarta Indonesia reported 30.8% deaths among victims of road traffic accidents due to TBI [4, 5]. Like other LMICs, Pakistan is also suffering due to increasing burden of TBI. A tertiary care level hospital in Peshawar recorded an average of 13 hospitalizations per day due to TBIs. Another study by Uzair

Yaqoob et al described that approximately 56 patients per day visit emergency department of Jinnah Postgraduate Medical Center Karachi owing to TBIs and almost 10% of these patients need hospitalization [6, 7]. There are various factors that contribute to unfavorable outcomes of TBI, and hyperglycemia is one of them. It is associated with poor prognosis of TBI and occurs frequently at early stage after having TBI [8]. A cross-sectional study at National Center of Neurological Sciences Sudan reported 66.6% deaths in traumatic brain injury patients presented with hyperglycemia [9]. Another retrospective study at a regional trauma center in Southern Taiwan recorded significantly high mortality ratio among hyperglycemic TBI patients as compared to patients with normal blood sugar

levels [10]. In the same way Tseng et al., identified that hyperglycemic traumatic brain injury patients encounter worse outcomes in terms of excessive hospital admissions, increased length of hospital stay, higher infection rates and deaths [11]. Previous studies have established hazardous role of hyperglycemia in worse clinical outcomes of TBI, hence some investigators controlled confounding factor of diabetes mellitus, while other factors contributing to poor prognosis due to hyperglycemia are not addressed [10]. No research data are available in Pakistan regarding association of hyperglycemia and its impact on outcome of TBI.

This study aims to determine association of hyperglycemia with the prognosis of traumatic brain injury and outcome among patients with distinct blood glucose levels and comorbidities. The main objective is to bridge the gap of epidemiological data concerning TBI in developing regions of the world which will ultimately help avert morbidity and mortality incurred due to hyperglycemia in TBI patients.

METHODS

A cross-sectional study was conducted during June 2022 to October 2022 at Liaquat University Hospital, Hyderabad. Research Ethics Committee and Advanced Studies and Research Board of Liaquat University of Medical and Health Sciences Jamshoro approved this study(Ref no: LUHMS/REC/-25). Informed consent was provided by patients' family members in the local language, with assurances that the study would not affect participants. Confidentiality was maintained, and all data were securely stored. The study followed standard research protocols set by the REC at LUMHS. The sample size was estimated 171 by using Raosoft calculator, based on a prevalence of poor prognosis of hyperglycemic traumatic brain injury patients (66.6%) [9], margin of error was taken as 5% and level of confidence 95%. An additional 10% was added to account for potential loss of follow-up cases. All admitted TBI patients with 3-13 GCS score in young and middle age group (15-50 years) whose family member gave permission were made part of the study. A non-probability consecutive sampling method was used to recruit participants. These individuals came from Hyderabad and nearby areas and exhibited a range of socio-demographic and clinical characteristics, including comorbidities such as type-II diabetes mellitus, cancer, liver disease, hypertension, kidney disease, and ischemic heart disease. Patients with poly trauma, associated spinal injuries, history of type-I diabetes mellitus, cerebrovascular accidents or who required cortisone or hyperglycemic medicine were excluded. A total of 171 patients of TBI were selected through purposive sampling technique. A self-developed questionnaire with information regarding socio-demographic status, physical examination findings laboratory results and outcome was administered. Blood sugar level was recorded after 24 and 72 hours of injury at

minimum six to eight hours of fasting. Patients were followed till six weeks of admission or end outcome in hospital. Upon enrolment, the first two sections of the questionnaire (sections A and B) were completed by reviewing medical records and conducting interviews with the patient's family to collect socio-demographic information and the history of comorbidities. Physical examination findings were noted, including the patient's diagnosis and Glasgow Coma Scale (GCS) score which is widely regarded as a reliable and effective tool for assessing the severity of traumatic brain injuries and predicting patient outcomes. Data were recorded from the patient's file and were noted in section C of the questionnaire. The GCS score was assessed at admission and discharge by a neurosurgeon. Blood sugar levels were measured at two time points: first, after 24 hours of injury following a fasting period of 6-8 hours and then again after 72 hours. For section D of the questionnaire, patient outcomes were followed up to either discharge or death during hospitalization, or for up to six weeks after admission. The final outcome was recorded as declared by treating neurosurgeon. After data collection, all questionnaires were carefully reviewed to ensure completeness. The data were then entered into SPSS version 26.0. Descriptive statistics, including the mean and standard deviation for continuous variables such as blood glucose levels and age, were computed. For inferential analysis, chi-square tests and cross-tabulations were applied to sections B, C, and D of the questionnaire to compare the prognosis of traumatic brain injury (TBI) across different glycemic cut-offs and to identify associations. A p-value of ≤0.05 was considered statistically significant, ensuring robust analysis and valid conclusions drawn from the sample to infer findings for the population.

RESULTS

Mean age of the patients was 31.61 ± 9.40 SD. Young and middle-aged male encountered traumatic brain injury more frequently than female and teenagers. Peoples with good education and financial status experienced TBI regularly as compared to low income and poor literacy profile peoples as presented in table 1.

Table 1: Socio-Demographic Profile of Study Subjects

Gender Distribution	Frequency (%)
Male	138 (80.7)
Female	33 (19.3)
Other	-
Total	171 (100.0)
Age Distribution	
15-20 Years	31 (18.1)
21-35 Years	95 (55.6)
36-50 Years	45 (26.3)
Total	171 (100.0)

Literacy Status	
Illiterate	55 (32.2)
Literate	86 (50.3)
Graduate and Above	30 (17.5)
Total	171 (100.0)
Monthly Income	
15000-25000	56 (32.7)
26000-40000	82 (48.0)
40000 and Above	33 (19.3)
Total	171 (100.0)

In general road traffic accidents at national highway and link roads caused TBIs but victims of assault and fall also got head injured as shown in figure 1.
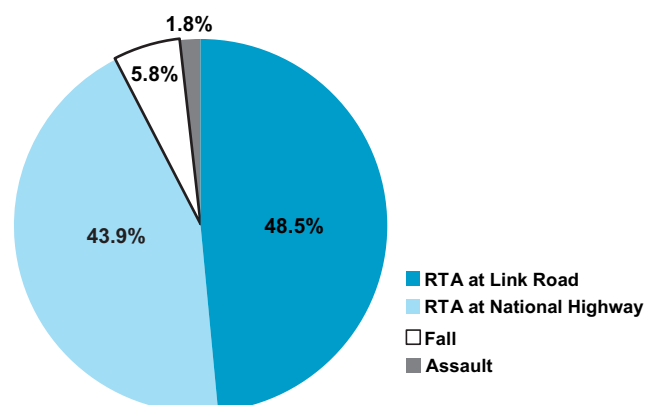
Figure 1: Mode of the Injury reported among the participants

Glycaemic status at 24 hours of injury and outcome of TBI had statistically significant association (p=0.001). Among 171 patients, hypoglycaemia detected only in 4(2.3%) patients, whereas 91(53.2%) were normoglycemic and 76(44.4%) had hyperglycaemia. Discharge from the hospital was the outcome of all hypoglycaemic patients and death occurred in 14.2% normoglycemic patients. While almost four times greater mortality rate (61%) was recorded in hyperglycaemic patients as compared to normoglycemic patients as shown in Table 2.

Table 2: Association of Distinct Blood Glucose Levels to Prognosis of Traumatic Brain Injury at 24 and 72 Hours of Injury

Category of Blood glucose level	Discharge Frequency (%)	Disability Frequency (%)	Vegetative Status Frequency (%)	Death Frequency (%)	Total Frequency (%)	p-Value
Blood Glucose Level at 24 Hours of Injury and Prognosis						
<70	4 (2.3)	0 (0)	0 (0)	0 (0)	4 (2.3)	
70-180	73 (80.2)	5 (5.4)	0 (0)	13 (14.2)	91 (53.2)	
>180	23 (30.2)	5 (6.5)	1 (1.3)	47 (61.8)	76 (44.4)	0.001*
Total	100 (58.4)	10 (5.8)	1 (0.58)	60 (35)	171 (100)	
*Significant Association df= 6 X2 value=48.5						
Blood Glucose Level at 72 Hours of Injury and Prognosis						
<70	4 (2.3)	0 (0)	0 (0)	0 (0)	4 (2.3)	
70-180	96 (67.6)	10 (7)	1 (0.7)	35 (24.6)	142 (83)	
>180	0 (0)	0 (0)	0 (0)	25 (100)	25 (14.6)	0.00*
Total	100 (58.4)	10 (5.8)	1 (0.58)	60 (35)	171 (100)	
*Significant Association df= 6 X2 value=55.9						

df=Degrees of Freedom; X2 =Chi-Square Value

Most of the patients (71.9%) had no comorbidity and experienced 31.7% death rate. Insignificant association of comorbidities to prognosis of traumatic brain injury (p=0.26) was observed. However high mortality rate was seen among patients who had hypertension (54.6%) and diabetic mellitus along with liver disease (66.6%). Most importantly, patients with diabetes mellitus and hypertension at the same time and patients with ischemic heart disease could not survive as presented in table 3.

Table 3: Association of Comorbidities to Prognosis of Traumatic Brain Injury

Comorbidity	Prognosis					p-Value
	Discharge Frequency (%)	Disability Frequency (%)	Vegetative Status Frequency (%)	DeathFrequency (%)	Total Frequency (%)	
None	73 (30)	10 (8.1)	1 (0.8)	39 (31.7)	123 (71.9)	
Diabetes Mellitus	11 (68.7)	0 (0)	0 (0)	5 (31.3)	16 (9.3)	
Hypertension	5 (45.4)	0 (0)	0 (0)	6 (54.6)	11 (6.4)	
Ischemic Heart Disease	0 (0)	0 (0)	0 (0)	2 (100)	2 (1.1)	
Kidney Disease	3 (100)	0 (0)	0 (0)	0 (0)	3 (1.7)	0.26
Liver Disease	7 (87.5)	0 (0)	0 (0)	1 (12.5)	8 (4.6)	
Cancer	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
DM+HTN	0 (0)	0 (0)	0 (0)	5 (100)	5 (2.9)	
DM+LD	1 (33.3)	0 (0)	0 (0)	2 (66.6)	3 (1.7)	
Total	100	10 (5.8)	1 (0.58)	60 (35)	(171) 100	
df=26 X^2 value=24.5						

DISCUSSION

The results enhanced the evidential base of hyperglycaemia as an unfavourable factor that suppresses the TBI outcomes. In more detail, the identification of hyperglycaemia at 24 hours after the injury has proven that patients with blood glucose levels above 200 g/mL have four times higher mortality compared to patients with normoglycemia, which proves the significance of early glycaemic management. Moreover, sustained hyperglycaemia at 72 hours was found to predict poorer survival and no patient with hyperglycaemia was alive more than this duration. Like the results of this study Khan AA et al., and Ali K et al., pointed out high incidence rate of TBI among young and middle-aged male patients [12, 13]. Road traffic accidents at link roads and national highway were frequent mode of TBI but fall and assault also caused TBI in small number of patients. In the same way different studies in Kingdom of Saudi Arabia, China and Punjab were also reported road traffic incidents, falls and assault as principal reasons of TBI [13-15]. Statistically significant association (p=0.001) was witnessed between glycemic status at 24 hours of injury and outcome of the TBI. Hyperglycemic patients experienced four times greater mortality rate (61%) as compared to normoglycemic patients (14.2%). Similarly with a little difference a retrospective study in Taiwan reported six times high mortality ratio among TBI patients with raised blood sugar level [10]. Another study at National Centre of Neurological Sciences Sudan demonstrated 66.6% increase in death rate due to hyperglycemia in TBI [9]. Furthermore, 53% of the hyperglycaemic patients showed sever TBI as compared to those having normal blood glucose level [16]. Additionally significant association (p=0.00) between glycemic status at 72 hours of injury and outcome of TBI was noticed. Patients with hypertension and diabetes mellitus at the same time and patients with ischemic heart disease could not survive as shown in table 3. Similarly, Ahmadi N et al concluded greater mortality risk due to cardiovascular problems in patients with mild traumatic brain injury [17]. In addition, Shibahashi K et al., described an upsurge in mortality graph among admitted congestive heart failure patients [18]. On the other hand, majority of the studies examining hypertension did not established significant association to mortality, even one study recorded a decrease in short-term mortality among hypertensive older adults with TBI, due to consumption of beta-blockers which is a commonly recommended antihypertensive medicine [18-19]. Concerning outcome of diabetic patients after having TBI this study found lower mortality rate. In contrast to our study findings, Tsai YU et al., described statistically significant higher adverse outcomes in terms of mortality among TBI patients with diabetic hyperglycemia [20]. Nevertheless, the present study has limitations that should be considered even though it has supplied promising data for the link between hyperglycaemia and TBI outcomes. First, the study was a hospital-based study with few participants. Therefore, the study's findings cannot be generalized to other healthcare settings or populations. Moreover, the effects of other co-variables like pre-hospital care, treatment modalities, and the patient's nutritional status have not been otherwise controlled.

CONCLUSIONS

Generally young and middle-aged people get traumatic brain injury and experience adverse outcomes. Road traffic accidents at link roads and national highway predominantly remained principal reasons to TBIs and deaths. Hyperglycemia at 24 hours of injury resulted in four times greater mortality as compared to normoglycemia among TBI victims, therefore blood glucose level should be maintained between 70-180 mg/dl for favorable outcome. Following TBI, high mortality rate was seen in patients who had diabetes mellitus, hypertension and ischemic heart disease, hence TBI patients with comorbidities of hypertension, ischemic heart disease and diabetes mellitus should be investigated further. Furthermore, integrated management protocols should support the early identification of hyperglycemic patients with TBI in emergency and intensive care units.

Authors Contribution

Conceptualization: RA
Methodology: RA, IAS
Formal analysis: KNM
Writing, review and editing: FS, IAS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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Original Article

OPEN ACCESS

The Role of Chest X-Ray in the Radiological Assessment of Pediatric Pneumonia in a Tertiary Care Setting

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ARTICLE INFO

ABSTRACT

Pneumonia is an infection of the lungs that is marked by a fever, respiratory symptoms, and changes seen on imaging. It is important to diagnose and evaluate the seriousness of an allergic disease in children as soon as possible for proper treatment. **Objective:** To analyze whether severe acute pneumonia in children can be predicted using chest X-rays. Patients with severe acute pneumonia had symptoms including difficulty in breathing, low oxygen levels, and findings on X-ray, such as lobar consolidation and interstitial involvement. **Methods:** A retrospective cross-sectional study was conducted in the Department of Radiology, Gujranwala, Pakistan, from December 2022 to March 2023. The study included 60 pediatric patients diagnosed with pneumonia. Patients with pneumothorax were excluded from the study. The study determined the sample size based on previous similar research. SPSS-22 was used for statistical analysis. **Results:** Most children in the research were less than 3 years old. The majority were boys, 41 (68.3%), while girls accounted for 19 (31.7%). The symptom that patients most usually reported was difficulty breathing, 25 (41.7%). The majority of the cases showed consolidation of a lobe, 25 (41.7%), followed by interstitial abnormalities, 14 (23.3%). **Conclusions:** It was concluded that lobar consolidation was the most common radiological finding in children with severe acute pneumonia, particularly in boys under the age of three. Chest X-rays played a crucial role in diagnosing and evaluating the severity of the disease. Regular training for radiologists and clinicians on pediatric pneumonia patterns can further improve diagnostic accuracy.

INTRODUCTION

The term "pneumonia" refers to a lower respiratory tract infection that frequently comes with a fever, respiratory symptoms, and visible parenchymal involvement on physical examination or radiography. Pneumonia remains a leading cause of morbidity and mortality among children, particularly in low- and middle-income countries. Pathologically, it represents an inflammatory disorder that affects the connective tissue, visceral pleura, airways, and alveoli of the lung. Radiology defines pneumonia as an infiltration on a child's chest radiograph who exhibits symptoms of an acute respiratory illness. Clinicians who work in primary care and emergency rooms commonly deal with pneumonia [1]. The leading cause of illness and mortality in developing countries is still pediatric pneumonia. There have been several forms of pneumonia identified, the first of which is walking pneumonia, which is frequently used to describe school-aged children and young people who show radiographic and clinical signs of pneumonia but have mild respiratory symptoms that do not interfere with everyday activities. Mycoplasma pneumoniae has typically been identified as the bacterium thought to be responsible for walking pneumonia [2]. Community-acquired pneumonia is a term used to describe an acute lung infection in a previously healthy person that is obtained in the community as opposed to hospital- or nosocomial-acquired pneumonia [3]. If a child had pneumonia within two days of entering the hospital, it is called hospital-associated pneumonia [4]. It covers individuals who have pneumonia while living in long-term care, as well as people who have just had surgery [5]. The

25

WHO states that about 151 million cases of pediatric pneumonia and 7% of all global deaths happen in developing countries every year. Even though HCV causes many health complications, it is still difficult to make an early and accurate diagnosis and assess the severity in places where resources are short [6, 7]. Pneumonia is 0.28% more common in people with a fever but no cough or tachypnea. Upper lobe pneumonia may exhibit a meningitis-like clinical picture due to radiating neck discomfort. Unspecific abdominal pain that resembles appendicitis is one sign of lower lobe pneumonia. Newborns may develop pneumonia at an early or late stage. In the first three days of life, early-onset pneumonia typically manifests [8, 9]. Additional symptoms include temperature instability, metabolic acidosis, and abdominal distension. The initial steps in treating a child who has suspected pneumonia include a comprehensive history and physical examination. Fever, any associated cough, and tachypnea are more likely to have been present in the past [10]. A thorough physical examination requires the doctor to focus on the patient's appearance as a whole and look for hypoxia and cyanosis. Infants who are still growing may show signs of lethargy, inadequate nutrition, or irritability [11]. When a child with fever and respiratory distress shows infiltrates on a chest radiograph, pneumonia is diagnosed; however, if there is a strong clinical suspicion, the absence of chest X-ray evidence does not rule out pneumonia [12, 13]. Chest X-rays (CXRs) are widely used in clinical practice to support the diagnosis of pneumonia in children presenting with acute respiratory symptoms. Radiographic findings such as lobar consolidation, interstitial infiltrates, or pleural effusions are considered valuable in confirming clinical suspicion and guiding treatment decisions. However, the diagnostic utility of CXR, especially in predicting the severity of pneumonia, remains a subject of debate. Several international studies have explored radiological patterns in pediatric pneumonia, yet limited data exist from Pakistan that contextualize radiologic severity indicators within local healthcare environments. In Pakistan, where pediatric respiratory illnesses are common, the role of imaging particularly CXRs, in assessing pneumonia severity is not clearly defined or standardized. Furthermore, variations in radiological interpretation protocols, lack of consensus on severity grading, and resource constraints may hinder timely and accurate diagnosis. There is a pressing need to understand how chest radiographs contribute to the early identification of severe pneumonia in this setting, especially in children under the age of five who are at highest risk. When there is a serious illness, hypoxemia, or considerable respiratory distress that necessitates hospitalization, a chest radiograph may be advised as a first step [14]. Follow-up chest radiographs are rarely advised in children who have recovered after receiving the right therapy. Follow-up radiographs are advised in patients with complicated pneumonia who are clinically unstable, in those who have received adequate antibiotic coverage for 48 to 72 hours with poor clinical improvement or worsening, and in patients who have pneumonia that recurs in the same lobe to rule out a suspected anomaly, chest mass, or foreign body [15, 16]. When necessary, chest radiographs of individuals older than 4 years old should be obtained in the supine anteroposterior position, whereas those younger than that should be taken in the postero-anterior upright position [17]. When a pleural effusion is suspected, a lateral view is advised, and the affected side should be down for the acquisition of the lateral decubitus view [18]. The current investigation focuses on pediatric pneumonia, including the etiology across age groups, clinical signs, and radiographic findings. To evaluate the role of chest X-rays in predicting severe acute pneumonia in children presenting to a radiology department in Gujranwala, Pakistan. We address the gap in local literature by analyzing radiologic patterns associated with clinical severity and by providing insights into the diagnostic value of CXRs in routine pediatric care. Radiological severity in this study was defined by findings such as lobar consolidation, extensive interstitial involvement, and the presence of pleural effusion. Ethical approval was obtained from the relevant institutional review board, and chest radiographs were interpreted independently by two qualified radiologists, blinded to clinical data, to ensure consistency. Pneumonia remains a leading cause of hospitalization and death among children under five, especially in low-resource settings like Pakistan. While chest X-rays (CXRs) are frequently used to support clinical diagnosis, their role in predicting the severity of pediatric pneumonia is not well defined in the local context. There is limited regional data on how specific radiographic findings correlate with clinical severity in children.

This study aims to evaluate the diagnostic value of chest radiographs in identifying severe pneumonia in pediatric patients. By analyzing radiological patterns and their association with clinical indicators of severity, the study seeks to support more accurate, timely diagnoses and better-informed treatment decisions in resource-constrained healthcare settings.

METHODS

A retrospective cross-sectional study was conducted in the Department of Radiology, Gujranwala, Pakistan, from December 1, 2022, to March 31, 2023. We included 60 pediatric patients under the age of 15 who were diagnosed with pneumonia. The study obtained informed consent from the guardians of all patients. The study determined the sample size based on previously published studies. The study excluded patients with pneumothorax, individuals aged 15 years or older, and those with incomplete radiological records. The study diagnosed pneumonia

based on clinical symptoms (fever, cough, difficulty in breathing, and tachypnea) along with radiological evidence such as lobar consolidation, interstitial infiltrates, or pleural effusion. The study defined severe pneumonia according to WHO guidelines, which include signs of hypoxemia, severe respiratory distress, or chest radiographic findings like dense lobar consolidation or extensive bilateral infiltrates. Two experienced radiologists independently evaluated all chest X-rays while remaining blinded to the clinical history. They interpreted the radiographs using standard pediatric radiology criteria [19, 20], and they resolved any discrepancies by consensus. The study entered, computed, and analyzed the data using SPSS version 22. The study used descriptive statistics to summarize demographic details, clinical symptoms, and radiographic findings.

RESULTS

The study shows the age of the patients. Only children are included in the study. The age of the patients is further categorized into different groups. All participants were under the age of 15. Age was categorized into four groups for descriptive analysis: less than 3 years (46.7%), 4–6 years (26.7%), 7–9 years (16.7%), and 10–12 years (10.0%). The majority of patients 28 (46.7%) were under 3 years of age, indicating higher vulnerability in early childhood (Table 1).

Table 1: Age Distribution of Pediatric Pneumonia Patients

Variables	Frequency (%)	Valid Percent	Cumulative Percent
Less than 3 Years	28 (46.7%)	46.7	46.7
4 to 6 Years	16 (26.7%)	26.7	73.3
7 to 9 Years	10 (46.7%)	16.7	90.0
10 to 12 Years	6 (16.7%)	10.0	100.0
Total	60 (100%)	100.0	

This study also shows the gender of the patients. The study population consisted of 41 boys (68.3%) and 19 girls (31.7%), reflecting a male predominance in pneumonia presentation during the study period (Table 2).

Table 2: Gender Distribution

Variables	Frequency (%)	Valid Percent	Cumulative Percent
Boy	41 (68.3%)	68.3	68.3
Girl	19 (31.7%)	31.7	100.0
Total	60 (100%)	100.0	

Results show the symptoms of the patients. The most frequently reported clinical symptom was difficulty in breathing (41.7%), followed by fever (35.0%) and cough (23.3%). These findings aligned with typical respiratory distress presentations in pediatric pneumonia cases. Chest X-rays were evaluated independently by two qualified radiologists who were blinded to the patients' clinical details. A standardized reporting protocol was followed, and inter-observer agreement was assessed using Cohen's kappa coefficient, which indicated substantial agreement (κ=0.76) (Table 3).

Table 3: Clinical Symptoms in Pediatric Patients

Variables	Frequency (%)	Valid Percent	Cumulative Percent
Cough	14 (23.3%)	23.3	23.3
Fever	21 (35.0%)	35.0	58.3
Difficulty in Breathing	25 (41.7%)	41.7	100.0
Total	60 (100%)	100.0	

Findings shows the X-ray findings in children with pneumonia. Radiographic analysis revealed lobar consolidation as the most common finding (41.7%), suggesting more severe localized infection. Other radiological patterns included interstitial abnormalities (23.3%), pleural effusion (8.3%), bilateral consolidation (8.3%), lymphadenopathy (6.7%), hyperinflation (6.7%), and a small proportion of normal radiographs (5.0%). Severe pneumonia was classified based on WHO criteria, which consider signs such as hypoxemia, chest in-drawing, and significant radiologic involvement (Table 4).

Table 4: Chest X-ray Findings in Pediatric Pneumonia Patients

Variables	Frequency (%)	Valid Percent	Cumulative Percent
Normal	3 (5.0%)	5.0	5.0
Lobar Consolidation	25 (41.7%)	41.7	46.7
Lymphadenopathy	4 (6.7%)	6.7	53.3
Interstitial Abnormality	14 (23.3%)	23.3	76.7
Pleural Effusion	5 (8.3%)	8.3	85.0
Hyperinflation	4 (6.7%)	6.7	91.7
Bilateral Consolidation	5 (8.3%)	8.3	100.0
Total	60 (100%)	100.0	

DISCUSSION

Pneumonia is an infection of the lungs that is marked by a fever, respiratory symptoms, and changes seen on imaging. Ibrahim et al., show that in children, chest X-rays are necessary for pneumonia diagnosis since they help spot radiological signs such as lobar consolidation. This result is similar to those found in the past, as no major variations in radiological findings were found to be related to improvement in fever or tachypnea in children. Lobar consolidation was the frequent reason for diagnosis in children, although the study did not evaluate the results for patients who had it on a scan. At Himachal Pradesh's Civil Hospital, the study was carried out with 83 children who all had severe pneumonia. The most commonly observed finding was lobar consolidation, present in 14 kids, and 26 had abnormalities seen in the lungs' spaces. The findings indicate that radiological information is not very good at predicting how a hospitalized child with severe pneumonia will respond to treatment [1]. The study by Magree et al., indicated that out of 174 children tested with CXR, chest radiography only identified pneumonia in 59 of them. Therefore, CXR helps doctors confirm when a young patient has a chest problem. Still, the differences in chest radiography's usefulness point out that it may not always be accurate, as to how accurate it is, depending on the disease

stage and the technique that is used. The new study confirms their view, in particular in very young children, where diagnosis can be hard just by looking at the physical signs. Researchers also indicated that CXR can assist in the diagnosis of pneumonia in children. In comparison to the earlier study, it was found in the current study that CXR helps diagnose pneumonia in children under five years old [19]. The study in carried out by Gupta evaluated 950 children with possible pneumonia and compared chest CT, lung ultrasound, and chest radiograph. The analysis revealed that CT found lung opacity and sub-pleural consolidation, but ultrasound did a better job at spotting pleural effusion and perilesional edema. This research points out that there are limitations to CXR and that further testing may be required for some cases. Other observations were the changes between organs and the accumulation of medications in the spaces around them, both of which have to be understood closely. With the use of chest radiograph and lung ultrasonography, convex lung opacity, lung consolidation near the diaphragm, fluid around the pleura, and swelling close to the lung could all be detected. It also indicates that CXR reveals lung opacity and consolidation as useful signs for the diagnosis of pneumonia in children[20].

CONCLUSIONS

In conclusion, lobar consolidation was the most frequently observed chest X-ray abnormality in pediatric pneumonia cases, particularly among male patients under the age of three. While chest radiographs were effective in detecting pneumonia-related changes, they had limited value in assessing disease severity. We recommend utilizing chest X-rays as a primary diagnostic tool in resource-limited settings to support the early detection of pediatric pneumonia. Future studies should include larger and more diverse populations, apply standardized severity criteria, and incorporate clinical correlations to enhance the diagnostic and prognostic utility of chest imaging in pediatric respiratory infections.

Authors Contribution

Conceptualization: NT
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Formal analysis: NT
Writing review and editing: NT, AA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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