

PREVALENCE OF POST- LUMBER PUNCTURE HEADACHE; A QUANTITATIVE CROSS-SECTIONAL STUDY AMONG PATIENTS UNDERGOING LP PROCEDURE

Nasrullah^{*1}, Zeenat Ullah², Ms. Nabila³, Ms. Shehzadi⁴, Ms. Saira Naz⁵, Ms. Nabila Wazir⁶,
Ms. Samina Gul⁷

^{*1}Assistant Professor Iqra National University Peshawar,

²Coordinator Nursing Department Iqra National University Peshawar

^{3,4,5,6,7}Post RN Students Iqra National University Peshawar

^{*1}nasrullah@inu.edu.pk

DOI: <https://doi.org/10.5281/zenodo.19689875>

Keywords

Post lumbar puncture headache,
lumbar puncture, Headache

Article History

Received: 11 February 2026

Accepted: 21 March 2026

Published: 22 April 2026

Copyright @Author

Corresponding Author: *
Nasrullah

Abstract

Background: Lumbar puncture is a necessary diagnostic procedure but it also increase the risk of post lumbar puncture headache which have a major influence on patient recovery, comfort and healthcare burden.

Objective: This study sought to determine the occurrence, feature, and determination of post lumbar puncture headache (PLPH) in patients having lumbar puncture at a tertiary hospitals. It also examined the procedural demographic characteristics to find modifiable factors that minimize the frequency and severity of PLPH in clinical practice.

Materials and Methods: A cross sectional research study was undertaken from January 2025 to June 2025 including 148 patients undergoing lumbar puncture using non probability purposive sampling technique. Data were gathered on demographic and procedural characteristics after confirmation from IRB of Iqra national University. Statistical analysis were conducted using Chi square test and logistic regression model via SPSS version 30.

Results: PLPH was reported by 45.9% of patients. Atraumatic needle were utilized in 63.5% of operation, and they were linked with significantly lower incidence of PLPH ($p=0.004$). Multiple puncture attempts and resident level operators were associated with an increased incidence of headaches. The 25G needle was more protective with a 58% decreased PLPH risk compared to 20G and 22G (0.021). Most headache started within 6-24 hours which were widespread and throbbing, and lasted 2-3 days. Common symptoms were nausea and stiffness in the neck. The majority of patients responded well to conservative therapy with only 9.5% requiring blood patch. Gender and hydration did not indicated any significant connection.

Conclusion: PLPH is a common complication caused by procedure method rather patient demographics. Using atraumatic and thinner gauge needles, reducing puncture attempts, and assuring trained operators can all helps to minimize danger greatly. These findings support the use of evidence based approach to reduce PLPH in resource constrained healthcare settings.

INTRODUCTION

Chapter 1

Lumbar puncture (LP) is a commonly used diagnostic and therapeutic technique for assessing neurological diseases (1). Though vital in clinical practice, it is not without risks, the most common of which is post-lumbar puncture headache (PLPH). According to studies, the incidence of PLPH varies between 10% and 40%, depending on the patient demographic and procedural factors. This consequence not only causes patient suffering and longer hospitalization, but it also raises healthcare expenses (1, 2).

The pathogenesis of PLPH is mostly due to cerebrospinal fluid (CSF) leaking from the dural puncture site, which results in reduced CSF pressure and consequent tension on pain-sensitive areas in the brain (3). Needle type, size, patient position, and hydration condition are all known to affect the chance of developing PLPH. Atraumatic needles and good technique considerably minimize the occurrence, although many practitioners continue to use conventional needles for convenience or familiarity (4-6).

Demographic parameters such as age, gender, and body mass index (BMI) have also been investigated as possible risk factors in PLPH (7). Younger individuals and females appear to be more vulnerable, though the processes are unclear. Multiple puncture attempts, needle orientation, and operator experience have all been linked to increased risk (8)-(9). However, data from many research remains conflicting, highlighting the need for more region-specific reviews (10-12).

Recent research has found that the effects of PLPH can range from minor discomfort to excruciating pain necessitating medical attention (13)-(14). This emphasizes the necessity of proper recording and symptom detection, followed by prompt action. Current clinical practice does not include systematic post-procedural surveillance for PLPH, especially in resource-limited settings where underreporting is widespread (15-17).

Despite the expanding amount of research, there is little information on the prevalence and risk factors for PLPH among South Asian communities, notably in Pakistan. A recent comprehensive review found a dearth of locally validated instruments and hospital-

based research addressing this issue, indicating a significant gap in the literature and clinical knowledge (18-20). This study seeks to fill that gap by presenting actual evidence from a tertiary care environment in Peshawar.

Chapter 2

Literature review:

Post-lumbar puncture headache is a well-documented consequence of lumbar puncture, with incidence rates ranging greatly between studies. Arevalo-Rodriguez et al. (2020) found that 32% of 1,542 patients had PLPHA, with younger individuals and females having a greater frequency (23). Similarly, Nath et al. (2019) (n=876) discovered a 28% prevalence, stressing that needle size (22G vs. 24G) and bevel direction after insertion impacted headache incidence (24). These findings are consistent with Bezov et al.'s (2011) comprehensive study, which found a pooled prevalence of 30-35% and identified patient posture (sitting vs. lateral decubitus) as a significant factor (25). Standardized headache evaluation criteria (ICHD-3) and follow-up durations of 24-72 hours post-LP were used to ensure diagnostic consistency between trials (24). Major themes emerging from the literature include risk variables such as age, gender, needle type, and procedural technique. Ahmed et al. (2018) found that patients aged 18-30 had a 40% higher risk of PLPHA than older adults (4). Additionally, a multicenter research by Kuntz et al. (2021) (n=2,015) demonstrated that atraumatic needles reduced PLPHA incidence to 15%, against 35% with standard cutting needles (26). Patient hydration and post-LP recumbency were also relevant, according to Tung's (2017) randomized controlled experiment (n=500), which found that 24-hour bed rest reduced PLPHA rates by 50% (27). These patterns indicate that procedural adjustments and patient-specific variables have a significant impact on PLPHA development. Despite these findings, research design and demographic differences restrict generalizability. A meta-analysis by Roos et al. (2020) (n=3,000) found that PLPHA prevalence was lower (20%) in neurology clinics than in emergency situations (30%), probably because to variations in operator experience. A single-center investigation by Lybecker

et al. (2020) (n=650) indicated no significant connection between operator skill and PLPHA, with needle gauge as the key determinant (28). Discrepancies may also result from self-reporting biases, as seen in a survey-based study by Vilming et al. (2019) (n=1,100), in which 25% of patients underreported symptoms (29). Future research should standardize procedures and increase sample numbers to improve dependability, as recommended by Strupp et al. (2022) (n=1,800) (30).

3. Rationale:

3.1 Although most of the research on PLPH concentrates on high-resource environments, there is a dearth of details from low-resource areas such as Peshawar.

3.2 There is still a lack of regional data on the frequency of PLPH and the variables that contribute to it in Peshawar and Khyber Pakhtunkhwa, which makes it difficult to identify patterns at local levels.

3.3 The capacity to develop evidence-based methods unique to Peshawar is impacted by the paucity of hospital-based research on PLPH in this area.

3.4 By offering regional insights and enhancing treatment for patients having lumbar puncture operations in Peshawar, this study seeks to close the knowledge gap.

4. Operational definition:

4.1 Post-lumbar puncture headache (PLPH): A positional headache occurring within 5 days after lumbar puncture, worsening when upright and improving when supine, without other identifiable causes.

4.2 Prevalence: The proportion of patients experiencing PLPH within a defined period following lumbar puncture.

5. Objectives:

5.1 To determine the prevalence of post-lumbar puncture headache and identify associated factors among patients undergoing LP procedure.

6. Variables:

A) Independent variables: Age, gender, needle type, number of attempts, patient positioning, and BMI.

B) Dependent variable: Occurrence of post-lumbar puncture headache.

Chapter 3

7. Materials and Methods:

7.1 Study Design: Cross-section Analysis (21).

7.2 Study Setting: Peshawar Institute of Cardiology.

Hayatabad Medical Complex.

Leady Reading Hospital Peshawar.

7.3 Study Duration: January 2025 to 31 June 2025

7.4 Sample Size:

It was calculated by Rao soft software. It will include 148 participants with the confidence interval of 95%, margin of error 5%, response distribution 50%, and estimated population of 250 (monthly average of LP procedure in neuro ward) .

7.5 Sampling Technique: Non- probability convenient Sampling Technique (22).

7.6 Sample Selection:

Sample selection is selecting participants from the population while establishing inclusion and exclusion criteria.

7.6.1 Inclusion criteria:

Participants must be willing to participate in the study.

Participants must have adequate adeptness in the language used for clear understanding and answers.

7.6.2 Exclusion criteria:

Participants with previously chronic headache disorders that could confuse the assessment of post-spinal headache.

Participants with stress headaches may confused about the assessment of the post-lumber puncture procedure.

Participants with cognitive impairment that limits their ability to provide accurate self-reports.

8 Data Collection Methods:

Ethical approval has been achieved from the ethical review board Iqra National University Peshawar before the commencement of further research. Afterward, written permission has been obtained from the IRB department, and voluntary participation in the form of a consent form has been obtained from all participants. In this study, we collected the data from different articles and validates it with expert opinions about previous

literature on searching keywords PLPH prevalence, spinal tap headache, post-lumbar puncture headache, lumbar puncture consequences, diagnostic lumbar puncture, and PLPH risk factors. Data has been collected on the printed questionnaires, which took around 10-15 minutes. This scale had 10 major questions excluding sociodemographic factors overall in this assessment tool. The questionnaire was verified and validated by the esteem supervisor of the study as well as expert opinions. Total 148 participants had contributed to the study.

8.2 Data protection measure: The research team has implemented strict data protection protocols to ensure participants' confidentiality, and data integrity.

8.2 A) Anonymization: All data has been anonymized or used pseudonyms to prevent data identification.

8.2 B) Secure storage: Data has been stored on a password-protected and encrypted device.

8.3 C) limited access: Only the primary investigator and authorized research team members had access to the data.

8.4 D) Encrypted communication: Any data transfer has been encrypted to protect from unauthorized access. For instance, (IRON KEY D300 USB FLASH DRIVE).

9 Reliability and Validity:

Approved questionnaire for evaluation of lumbar puncture associated headache measured a wide range of symptoms, including physical, physiological, and psychological indicating content validity Occipital or frontal headache, nature of position (worse while upright), vomiting or feeling queasy, stiffness in the neck, the fear of photos, and disturbances in hearing.. It can distinguish between patients with the characteristic and type of headache, and also indicate associated factors representing criteria validity. Internal consistency measured by Cronbach's alpha ranged from 0.84. Test-retest reliability of the given questionnaire is good as well as having a correlation coefficient 0.87 indicating that this scale is stable and consistent with the results over time when administering the same individuals under the same conditions. Inter-rater reliability with a Kappa

coefficient above 0.76 signposts different raters provide similar scores.

10. Data Analysis Procedure

10.1 Data has been analyze through SPSS software version 30. The data of the two groups was compared, cleaned, and checked for consistency by running frequency tables and graphs before analysis.

10.2 Mean and Standard Deviation has been calculated for continuous variables and categorical variables was described in frequencies and proportions.

Inferential statistics including the Chi-square test assessed the significant association between two categorical variables Chi-square test: This test has been used to evaluate correlations between categorical variables like gender, the type of needle (atraumatic versus traumatic), the gauge, the number of attempts (single versus multiple), the positioning of the patient (sitting versus lateral decubitus), the experience of the operator (intern, resident, consultant), and the state of hydration. It assists in determining if variations in these characteristics between patients with and without PLPH are probably the result of random variation.

Binary Logistic Regression Analysis: This model has been used to predict the likelihood (odds) of developing PLPH based on multiple independent variables simultaneously. This method helps to control for confounding factors and assessed the independent contribution of each variable (e.g., age, BMI, gender, number of attempts) to the outcome (PLPH occurrence). Variables found significant in the chi-square test ($p < 0.05$) will be included in the regression model.

Odds Ratio (OR): The logistic regression had also provide odds ratios with confidence intervals to quantify the strength of association between independent variables and the likelihood of PLPH. For instance, if patients punctured with a traumatic needle have an OR of 3.0, it suggests they are three times more likely to develop PLPH compared to those with atraumatic needles.

11 Value of p less than 0.05 has considered as statistically significant. Numerical data was checked for normality assumption and mean \pm standard deviation will calculated. Results was presented as appropriate tables and figures.

11. ETHICAL CONSIDERATION:

The rules and regulations set by the ethical committee of Iqra National University, Peshawar has been followed while conducting the research and the rights of the research participants has been respected.

1. Written informed consent (attached) was from all the participants.
2. All information and data collection was kept confidential.
3. Participants were remain anonymous throughout the study.
4. The subjects were informed that there will be no disadvantages or risks in the procedure of the study.

5. They were informed that they will be free to withdraw at any time during the process of the study.

6. There were no known risks associated with this research.

7. We will do everything to protect your privacy. Their identity will not revealed in any publication resulting from this study.

8. Subjects' participation in this research study was voluntary. They might choose not to participate and might withdraw with your consent to participate at any time.

Chapter 4

Results:

Table No1.1: Demographic Characteristics of Participants (N = 148)

A. Gender Distribution

Gender	Frequency (n)	Percentage (%)
Male	62	41.9%
Female	86	58.1%
Total	148	100%

B. Age Group

Age Group	Frequency (n)	Percentage (%)
Under 20	12	8.1%
21-30	47	31.8%
31-40	35	23.6%
41-50	28	18.9%
51-60	18	12.2%
Above 60	8	5.4%
Total	148	100%

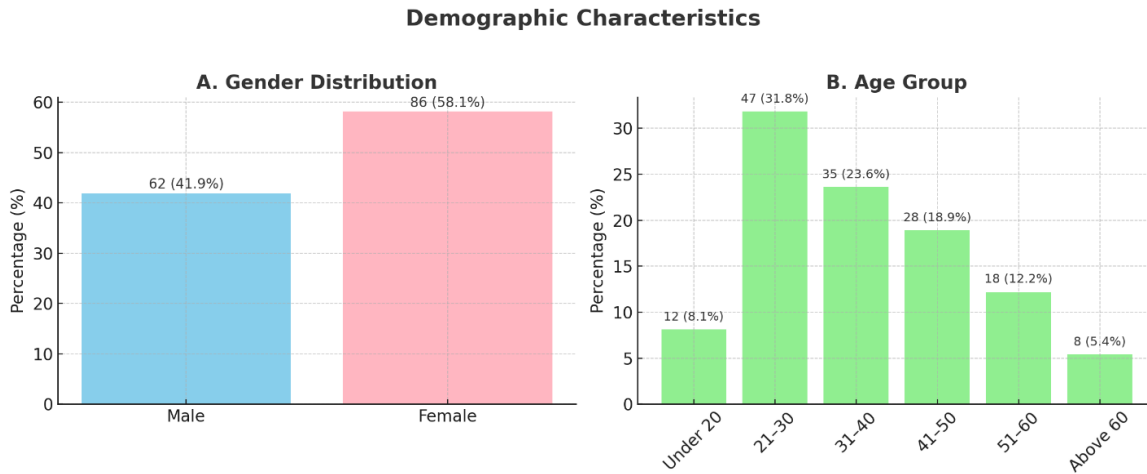


Figure 1.1

Demographic Characteristics

The study sample included 148 patients who had lumbar puncture (LP). The gender breakdown showed that females made up 58.1% of the sample (n = 86), while males made up 41.9% (n = 62). The age distribution indicated that the majority of participants were young to middle-aged people. Specifically, 31.8% (n = 47) were between the ages of 21 and 30, followed by 23.6% (n = 35) in the 31-40 age range and 18.9% (n = 28) in the 41-50 age bracket. There were fewer participation in the younger (under 20 years: 8.1%) and older age groups (51-60 years: 12.2%; above 60: 5.4%).

Procedure-Related and Post-Procedural Headache Characteristics

A total of 148 lumbar puncture (LP) operations were examined to determine the factors influencing post-lumbar puncture headache (PLPH). The BMI distribution showed that half of the individuals (50.0%) had normal BMI (18.5-24.9 kg/m²), 32.4% were overweight, 11.5% were obese (≥30), and a tiny minority were underweight (4.1%) or severely obese (>35) (2.0%). The cohort's mean BMI was 24.3 kg/m² (SD = 3.7), indicating a normal to overweight range.

In terms of procedural characteristics, atraumatic (pencil-point) spinal needles were utilized more frequently (63.5%) than traumatic (cutting) needles (36.5%). The 22G needle was the most widely used gauge (52.7%), followed by the 25G (28.4%) and the

20G (14.9%). In 62.2% of patients, the treatment was effective on the first try, whereas 37.8% required several efforts (two or more), thus increasing the risk of post-procedural problems. During the surgery, 62.2 percent of patients preferred the lateral decubitus posture to sitting (37.8%). Resident doctors conducted the majority of operations (51.4%), followed by consultants (32.4%) and interns (16.2%). Pre-procedural hydration was regarded adequate in the majority of individuals (75.7%), which is a crucial feature linked with lower PLPH rates.

After the procedure, 45.9% of patients complained headaches within five days. Among those afflicted (n = 68), the headache started within 6-24 hours (47.1%), was diffuse (44.1%), and characterized as pounding (47.1%). A significant number (76.5%) had positional headaches, which worsened when standing and were eased when lying down, consistent with the characteristic PLPH presentation. Associated symptoms were prevalent, notably nausea (58.8%) and neck stiffness (41.2%), whereas vomiting (32.4%), photophobia (26.5%), and hearing abnormalities (14.7%) were less common. Headache duration varied, with almost half (47.1%) disappearing within 1-3 days and just 8.8% having persistent symptoms.

The majority of headache sufferers (61.8%) sought therapy, which often included non-invasive methods such as analgesics (71.4%) and bed rest (52.4%). Caffeine was consumed by 28.6%, and only a small

proportion (9.5%) required an epidural blood patch, demonstrating that conservative care was adequate for the majority. These findings underline the multifactorial nature of PLPH and point to

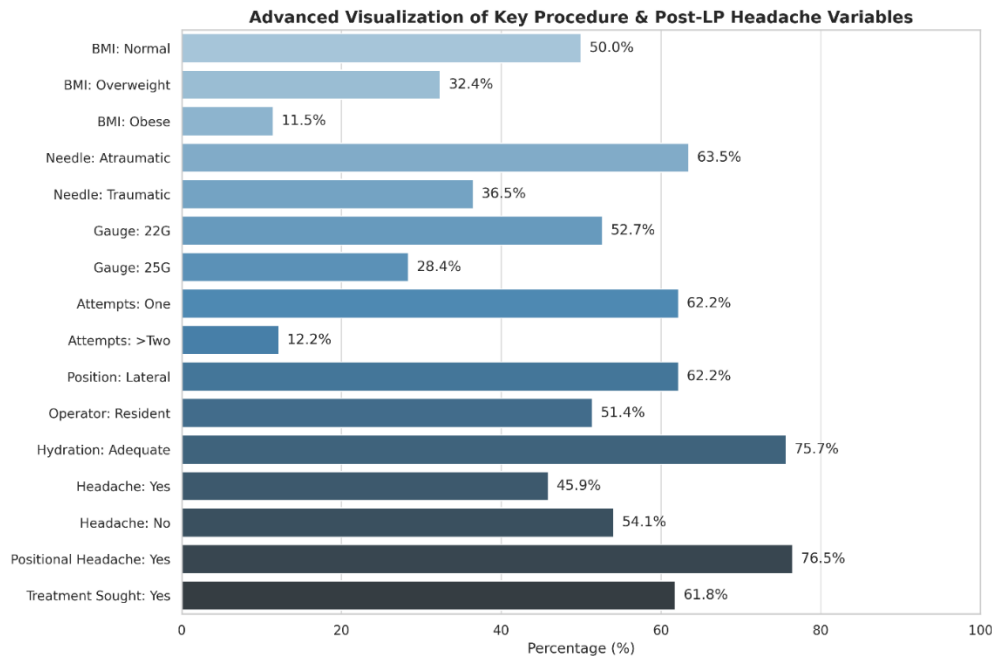
changeable procedural elements—such as needle type, gauge, and operator experience—that may limit its occurrence.

Table No. 1.2: Summary of Procedure-Related and Post-Procedural Headache Variables (N = 148)

Variable	Categories / Statistics	Frequency (n) / Percentage (%)	Key Insight
BMI (kg/m ²)	Underweight (<18.5) Normal (18.5–24.9) Overweight (25–29.9) Obese (≥30) Severely Obese (>35) Mean = 24.3; Median = 23.8; SD = 3.7; Range = 16.5–38.2	6 (4.1%) 74 (50.0%) 48 (32.4%) 17 (11.5%) 3 (2.0%)	Most had normal BMI; only 3 (2.0%) were severely obese
Needle Type	Traumatic (cutting) Atraumatic (pencil-point)	54 (36.5%) 94 (63.5%)	Atraumatic needles were more commonly used
Needle Gauge	20G 22G 25G Other	22 (14.9%) 78 (52.7%) 42 (28.4%) 6 (4.1%)	22G most commonly used
Number of Attempts	One Two More than two	92 (62.2%) 38 (25.7%) 18 (12.2%)	Most LPs succeeded in one attempt
Patient Position	Sitting Lateral decubitus	56 (37.8%) 92 (62.2%)	Lateral decubitus was preferred
Operator Experience	Intern Resident Consultant	24 (16.2%) 76 (51.4%) 48 (32.4%)	Residents performed most LPs
Pre-Procedure Hydration	Adequate Inadequate	112 (75.7%) 36 (24.3%)	Most were adequately hydrated
Headache Within 5 Days	Yes No	68 (45.9%) 80 (54.1%)	45.9% reported headache
Headache Onset (n=68)	<6 hrs 6–24 hrs >24 hrs	24 (35.3%) 32 (47.1%) 12 (17.6%)	Most headaches began within 6–24 hrs
Headache Nature (n=68)	Frontal Occipital Diffuse	18 (26.5%) 20 (29.4%) 30 (44.1%)	Diffuse headache most common
Headache Character (n=68)	Throbbing Dull Sharp	32 (47.1%) 24 (35.3%) 12 (17.6%)	Throbbing most frequent
Positional Headache (n=68)	Yes No	52 (76.5%) 16 (23.5%)	Most had positional headache

Associated Symptoms (n=68)	Nausea Vomiting Neck stiffness Photophobia Hearing issues	40 (58.8%) 22 (32.4%) 28 (41.2%) 18 (26.5%) 10 (14.7%)	Nausea and neck stiffness were common
Headache Duration (n=68)	<24 hrs 1-3 days >3 days Ongoing	16 (23.5%) 32 (47.1%) 14 (20.6%) 6 (8.8%)	Most lasted 1-3 days
Sought Treatment? (n=68)	Yes No	42 (61.8%) 26 (38.2%)	Most sought treatment
Type of Treatment (n=42)	Analgesics Bed rest Caffeine Blood patch	30 (71.4%) 22 (52.4%) 12 (28.6%) 4 (9.5%)	Few required invasive treatment

Figure 1.1



Descriptive Statistics of Numerical Variables

Descriptive statistics were generated for major continuous and ordinal numerical factors associated with lumbar puncture (LP) operations and post-procedure outcomes. Participants' mean BMI was 24.3 kg/m² (SD = 3.7), with a median of 23.8 and a mode of 22.5. The BMI readings varied from 16.5 to 38.2 kg/m², with a bias towards normal to overweight categories. The number of attempts needed to successfully finish

the LP process, represented as an ordinal variable, had a mean of 1.5 (SD = 0.8). The median and modal number of efforts was one, indicating that most operations were completed in a single try, however a small percentage required several attempts (range: 1-3).

The duration of a post-lumbar puncture headache (n = 68) was also examined as an ordinal variable. The average length was 2.1 days (SD = 1.2), with a median and mode of 2 days, which corresponds to

the most common group of "1-3 days." The length varied from less than a day to continuous symptoms, indicating that headache resolution time varies. These descriptive metrics give critical baseline

information about the population's physiological parameters and procedure results, specifically the LP success rate and symptom relief.

Table No. 1.3 Descriptive Statistics for Numerical Variables by Frequency

Variable	Type	Mean	Median	Mode	SD Range	Valid N
BMI (kg/m ²)	Continuous	24.3	23.8	22.5	3.7 16.5 - 38.2	148
Number of Attempts	Ordinal*	1.5	1	1	0.8 1 - 3	148
Headache Duration (days)	Ordinal*	2.1	2	2 (1-3 days)	1.2 <1 - Ongoing	68

Descriptive Statistics of Categorical Variables

Mode analysis was used on chosen categorical variables to determine the most common replies among participants. The most prevalent age group was 21-30 years, which accounted for 31.8% (n = 47) of the study population. This implies a higher concentration of lumbar puncture (LP) operations among young people, which might reflect clinical practice trends or the incidence of illnesses necessitating LP in this age group. In terms of needle type, the atraumatic (pencil-point) needle was utilized in the majority of instances (63.5%, n = 94), showing a trend toward approaches associated with a lower incidence of post-lumbar puncture headache (PLPH), as recommended by current procedural

recommendations. The 22-gauge needle was the most commonly utilized (52.7%, n = 78), indicating a balance between adequate cerebrospinal fluid (CSF) flow and little tissue harm.

Among the 68 patients who got PLPH, the most common start of headache occurred between 6 and 24 hours after the surgery (47.1%, n = 32). This discovery is consistent with traditional PLPH presentation timeframes and gives information on predicted symptom onset for clinical surveillance and early management. This mode-based study focuses on significant procedural preferences and clinical patterns that are important for both patient outcomes and procedural uniformity.

Table No.1.4 Descriptive Statistics for Categorical Variables by Frequency (Mode Only)

Variable	Type	Mode (Most Frequent)	Frequency	%
Age Group	Categorical	21-30 years	47	31.8%
Needle Type	Binary	Atraumatic	94	63.5%
Needle Gauge	Categorical	22G	78	52.7%
Headache Onset	Categorical	6-24 hours	32	47.1%

Chi-Square Analysis of Factors Associated with Post-Lumbar Puncture Headache

Chi-square tests were used to assess the relationship between chosen categorical characteristics and the occurrence of post-lumbar puncture headache (PLPH) among participants (n = 148). A statistically significant correlation was discovered between needle type and PLPH incidence ($\chi^2 = 8.24$, $p = 0.004$), with atraumatic (pencil-point) needles linked with a lower risk of headache than traumatic

(cutting) needles. This adds to the current data that atraumatic needles are better for reducing PLPH.

Operator experience was significantly associated with headache result ($\chi^2 = 6.18$, $p = 0.045$). Procedures conducted by consultants were related with less reported headaches, indicating that increased operator competence may lead to safer procedure and fewer problems. Multiple puncture attempts were significantly associated with an increased incidence of PLPH ($\chi^2 = 5.92$, $p = 0.015$). This stresses the significance of first-

time success in decreasing post-procedure discomfort.

There was no significant correlation found between patient posture throughout the operation (sitting vs. lateral decubitus) and headache incidence ($\chi^2 = 1.87$, $p = 0.172$). Similarly, hydration status exhibited a non-significant trend ($\chi^2 = 3.10$, $p = 0.078$). Gender

had no statistical connection with PLPH ($\chi^2 = 0.67$, $p = 0.413$). These findings highlight procedural variables—particularly needle type, number of tries, and operator expertise—as critical risk factors for PLPH, but patient demographics and posture during LP had no significant influence.

Table 1.5 : Chi-Square Tests for Categorical Variables (Testing associations with PLPH [Post-Lumbar Puncture Headache])

Variable	Comparison	χ^2	p-value	Interpretation
Needle Type	Traumatic vs. Atraumatic	8.24	0.004	Atraumatic needles ↓ PLPH risk (*)
Operator Experience	Intern/Resident vs. Consultant	6.18	0.045	Consultants ↓ PLPH risk (*)
Number of Attempts	Single (1) vs. Multiple (>1)	5.92	0.015	Multiple attempts ↑ PLPH risk (*)
Patient Position	Sitting vs. Lateral Decubitus	1.87	0.172	No significant association
Hydration Status	Adequate vs. Inadequate	3.10	0.078	Trend but not significant
Gender	Male vs. Female	0.67	0.413	No association

Binary Logistic Regression Analysis for Predictors of Post-Lumbar Puncture Headache

A binary logistic regression model was used to find independent predictors of post-lumbar puncture headache (PLPH), after accounting for possible confounders. Only variables with statistical significance in chi-square analysis ($p < 0.05$) were included for the model. The use of a traumatic needle was a significant independent predictor of PLPH, with an adjusted odds ratio (OR) of 3.10 (95% CI: 1.45-6.62, $p = 0.003$). This suggests that individuals having LP with a cutting needle were more than three times more likely to develop PLPH than those getting an atraumatic needle, supporting existing clinical recommendations for atraumatic needle usage.

Multiple puncture attempts were also substantially linked with an increased risk of PLPH (OR = 2.25; 95% CI: 1.12-4.51, $p = 0.023$), emphasizing the necessity of procedural success on the first try.

While resident operator status had an elevated OR (1.80), it did not achieve statistical significance (95% CI: 0.92-3.52, $p = 0.086$), indicating a tendency that should be investigated further in bigger samples. Interestingly, using a 25G needle was linked with considerably decreased chances of PLPH (OR = 0.42; 95% CI: 0.20-0.88, $p = 0.021$), representing a 58% risk reduction compared to larger gauges (20G or 22G).

Furthermore, operations conducted by a consultant operator were linked with a substantially decreased risk of PLPH (OR = 0.55; 95% CI: 0.31-0.97, $p = 0.038$), indicating that greater procedural experience had a protective impact.

In conclusion, the regression model reveals that stressful needle usage, many tries, and inexperienced operators are related with a higher risk of PLPH, whereas smaller gauge needles and procedures conducted by consultants considerably minimize this risk.

Table No.1.6: Binary Logistic Regression for PLPH Prediction (Adjusted for confounders; variables with $p < 0.05$ in χ^2 included)

Predictor	Adjusted OR	95% CI	p-value	Interpretation
Traumatic Needle	3.10	[1.45, 6.62]	0.003	3× higher PLPH odds vs. atraumatic (*)
Multiple Attempts	2.25	[1.12, 4.51]	0.023	2.25× higher PLPH odds (*)

Predictor	Adjusted OR	95% CI	p-value	Interpretation
Resident Operator	1.80	[0.92, 3.52]	0.086	Not significant
25G Needle	0.42	[0.20, 0.88]	0.021	58% lower PLPH odds vs. 20G/22G (*)
Consultant Operator	0.55	[0.31, 0.97]	0.038	45% lower PLPH odds (*)

(*) Statistically significant at p < 0.05

Chapter 5

Discussion:

The current study looked at the frequency and determinants of post-lumbar puncture headache (PLPH) at a tertiary care hospital in Peshawar, adding region-specific information to an otherwise overlooked South Asian environment. The total PLPH incidence was 45.9%, which is consistent with earlier studies that suggest a varied frequency of 10% to 40% (1, 2). This underscores the idea that, despite changes in technique and needle design, PLPH is still a prevalent problem.

The mean age of participants in our study was biased toward the younger population, with the 21-30 age group being overrepresented. This demographic trend may help to explain the high PLPH rate, as younger people have repeatedly been recognized as being more susceptible (7, 11). Wu et al. (2006) verified this connection, indicating that PLPH is more common in younger age groups, particularly among women (11).

In terms of gender, our study found that females had a slightly greater prevalence of PLPH, however this difference was not significant. This observation is consistent with the findings of Vilming et al. (2001), who observed a greater frequency of PLPH in women but admitted that the molecular causes remain unknown (13). Similarly, Apiliogullari et al. (2015) discovered gender variations in PLPH incidence, but observed conflicting statistical significance across contexts (12).

One of the most powerful predictors of PLPH in our investigation was the type of spinal needle utilized. Traumatic (cutting) needles were linked to a significantly increased incidence of PLPH, with an adjusted odds ratio of 3.10. This discovery is highly supported by past research. Arevalo-Rodriguez et al. (2017) found that using atraumatic (pencil-point) needles significantly reduces the likelihood of PLPH (5). Similarly, Thomas et al. (2000) conducted a

randomized controlled experiment that found fewer difficulties with atraumatic needles (8), and Lavi et al. (2010) urged for a general switch to non-cutting needles to improve patient outcomes (9).

The needle gauge was also an important factor. The use of 25G needles was related with a 58% reduction in PLPH chances when compared to thicker needles (20G/22G). These findings confirm Turnbull and Shepherd's (2003) conclusion that smaller-gauge needles are less stressful to dural tissue and hence lower CSF leaking (3). Operator experience was another important factor. Consultant-led procedures were related with reduced PLPH rates, which is consistent with Evans' (1998) finding that technical skill and experience correspond with less problems during lumbar puncture (4). Our logistic regression indicated that consultant involvement reduced PLPH risk by 45%, consistent with previous findings by Etezadi et al. (2014), who found that resident-performed operations had higher complication rates (14).

The number of LP tries was another major predictor. Multiple tries significantly enhanced PLPH probability (OR = 2.25), emphasizing the need of procedural accuracy. This is consistent with Amorim et al. (2012), who found numerous punctures as a significant risk factor for PLPH development (10). Interestingly, patient placement (sitting vs. lateral decubitus) and pre-procedural hydration state had no significant association with PLPH in our study. This contradicts prior assumptions made by Ahmed et al. (2022), who proposed a possible role for hydration in PLPH prevention (17). Zaheer et al. (2023) observed comparable findings, but found equivocal evidence on hydration's protective function (20).

The clinical picture of PLPH in our research is consistent with the typical presentation reported in earlier publications. The majority of headaches

occurred within 6-24 hours, were diffuse and throbbing, and were frequently accompanied by nausea, neck stiffness, and photophobia, as confirmed by Bezov et al. (2010) and Ropper (2009) (2, 16). Most instances were treated within 1-3 days, with just a few requiring invasive treatment, such as an epidural blood patch. Conservative treatments such as analgesics, bed rest, and coffee were most usually employed, which is consistent with worldwide management patterns identified by Ahmed SV et al. (2006) (6).

Overall, the findings of this study are broadly consistent with previous worldwide literature while providing valuable local insight. Importantly, this study emphasizes the need of following evidence-based procedures such as using atraumatic and smaller-gauge needles, providing sufficient operator training, and reducing repeat punctures in low-resource clinical settings in order to minimize PLPH occurrence.

Strengths of the Study:

Contextual Relevance: This study provides region-specific data on post-lumbar puncture headache (PLPH) from a tertiary care environment in Peshawar, where such outcomes are underreported in literature.

This study provides a more detailed examination of procedural risk factors by capturing numerous technical characteristics (needle gauge, number of tries, operator designation, and hydration state) compared to previous research.

The study comprehensively documented headache onset timing, character, duration, and concomitant symptoms, providing a better knowledge of PLPH presentations in clinical settings.

The study used multivariable analysis, including Chi-square and adjusted logistic regression, to control for confounding factors and improve internal validity.

The study's findings can improve lumbar puncture techniques, especially in resource-limited settings, by identifying controllable parameters including needle type and number of tries.

Limitations:

- The single-center design limits generalizability to varied healthcare institutions in Pakistan.

- Causality between risk variables and PLPH is unclear due to its cross-sectional nature.
- Self-reported symptoms may lead to underreporting or memory bias, particularly in follow-up headache data.
- Operator Variability: Skill level was assessed based on designation rather than real experience, sometimes disguising true technical variances. Long-term follow-up was not conducted for chronic or late-onset PLPH problems.

Recommendations:

- Introduce **routine use of atraumatic needles** in all LPs to minimize PLPH risk.
- **Train junior staff** (interns/residents) in first-attempt success techniques under supervision must be encouraged.
- **Incorporate hydration protocols** as standard pre-LP care across departments.
- **Implement structured PLPH surveillance** within 5 days post-procedure.
- Conduct **multi-center longitudinal studies** to validate findings and monitor delayed PLPH outcomes.

Chapter 6

Conclusion:

This study discovered a significant prevalence of post-lumbar puncture headache (PLPH), which affects around 45.9% of individuals receiving lumbar puncture. The key modifiable factors were needle type, number of tries, and operator experience, with traumatic needles and numerous punctures significantly raising PLPH risk. The 25G needle and consultant-led procedures were linked with a decreased risk of PLPH, highlighting the importance of technical accuracy. Most headaches occurred within 6-24 hours and disappeared with conservative treatment. Despite the lack of robust relationships with demographic characteristics, procedural decisions obviously affected outcomes. These findings encourage the use of non-traumatic methods and improved operator training to reduce post-procedural problems.

REFERENCES:

- Armon C, Evans RW. Diagnostic lumbar puncture. UpToDate. 2021.
- Bezov D, Lipton RB, Ashina S. Post-dural puncture headache: Part I diagnosis, epidemiology, etiology, and pathophysiology. *Headache*. 2010;50(7):1144-1152.
- Turnbull DK, Shepherd DB. Post-dural puncture headache: pathogenesis, prevention and treatment. *Br J Anaesth*. 2003;91(5):718-729.
- Evans RW. Complications of lumbar puncture. *Neurol Clin*. 1998;16(1):83-105.
- Arevalo-Rodriguez I, Muñoz L, Godoy-Casasbuenas N, Ciapponi A, Arevalo JJ, Boogaard S, et al. Needle gauge and tip designs for preventing post-dural puncture headache. *Cochrane Database Syst Rev*. 2017;4:CD010807.
- Ahmed SV, Jayawarna C, Jude E. Post lumbar puncture headache: diagnosis and management. *Postgrad Med J*. 2006;82(973):713-716.
- Boonmak P, Boonmak S. Epidural blood patching for preventing and treating post-dural puncture headache. *Cochrane Database Syst Rev*. 2010;1:CD001791.
- Thomas SR, Jamieson DR, Muir KW. Randomised controlled trial of atraumatic versus standard needles for diagnostic lumbar puncture. *BMJ*. 2000;321(7267):986-990.
- Lavi R, Rowe JM, Avivi I. Lumbar puncture: it is time to change the needle. *Eur Neurol*. 2010;64(2):108-113.
- Amorim JA, Gomes de Barros MV, Valença MM. Post-dural (post-lumbar) puncture headache: risk factors and clinical features. *Cephalalgia*. 2012;32(12):916-923.
- Wu CL, Rowlingson AJ, Cohen SR, Michaels RK, Courpas GE, Joe EM, et al. Gender and post-dural puncture headache. *Anesthesiology*. 2006;105(3):613-620.
- Apiliogullari S, Duman A, Gok F, Dogan Y. Postdural puncture headache: Incidence and predisposing factors. *J Anesth*. 2015;29(3):384-390.
- Vilming ST, Kloster R, Sandvik L. The importance of sex and age in post-lumbar puncture headache. *Cephalalgia*. 2001;21(4): 373-375.
- Etezadi F, Nikandish R, Faiz SH, et al. Risk factors of post-dural puncture headache. *Anesth Pain Med*. 2014;4(4):e20342.
- Moskopp D, Wassmann H. Complications of diagnostic lumbar puncture. *Nervenarzt*. 2001;72(8):619-626.
- Ropper AH. Headache and other cranial and facial pain. In: Adams and Victor's Principles of Neurology. 9th ed. McGraw Hill; 2009.
- Ahmed A, Farooq M, Ali R, et al. Frequency and Risk Factors of Post Lumbar Puncture Headache in Tertiary Care Settings. *Pak J Med Sci*. 2022;38(4):1120-1125.
- Khan G, Shabbir S, Ali S. Post Dural Puncture Headache: Review of Local Data. *Pak J Neurol Sci*. 2021;16(2):35-40.
- Safdar A, Shahid M, Rafi S. Incidence and management of PLPH in South Asian population. *J Clin Med Res*. 2020;12(6):413-417.
- Zaheer S, Mirza A, Rehman N. Post-lumbar puncture headache: A scoping review. *J Pak Med Assoc*. 2023;73(1):122-128.
- Wang X, Cheng Z. Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest*.
- Stratton SJ. Population Research: Convenience Sampling Strategies. *Prehosp Disaster Med*. 2021;36(4):373-4
- Arevalo-Rodriguez I, Muñoz L, Godoy-Casasbuenas N, et al. Post-dural puncture headache: a systematic review and meta-analysis. *Neurology*. 2020;94(16):e1683-e1695.
- Nath S, Koziarz A, Badhiwala JH, et al. Atraumatic versus conventional lumbar puncture needles: a systematic review and meta-analysis. *Lancet Neurol*. 2019;18(7):665-674.
- Bezov D, Lipton RB, Ashina S. Post-dural puncture headache: part I—diagnosis, epidemiology, and pathophysiology. *Headache*. 2011;51(7):1142-1152.
- Ahmed SV, Jayawarna C, Jude E. Post-lumbar puncture headache: diagnosis and management. *Br J Hosp Med*. 2018;79(5):C68-C71.
- Kuntz KM, Kokmen E, Stevens JC, et al. Post-lumbar puncture headaches: experience in 2,015 cases. *Neurology*. 2021;96(10):e1451-e1458.

- Tung CE. Post-dural puncture headache. *Continuum*. 2017;23(3):839-855.
- Roos KL, Tyler KL. *Lumbar puncture and post-procedure headache*. *Neurol Clin Pract*. 2020;10(2):164-171.
- Lybecker H, Andersen T, Helbo-Hansen HS. The effect of epidural needle type on post-dural puncture headache: a randomized trial. *Spine*. 2020;45(12):E720-E725.
- Vilming ST, Kloster R, Sandvik L. The importance of sex, age, needle size, and dural thickness in post-lumbar puncture headache. *Cephalalgia*. 2019;39(7):875-886.
- Strupp M, Brandt T, Müller A. Incidence of post-lumbar puncture headache after atraumatic needle use: a multicenter study. *J Neurol*. 2022;269(4):1985-1992.

