ADDIS ABABA UNIVERSITY SCHOOL OF MEDICINE

COLLEGE OF HEALTH SCIENCE

DEPARTMENT OF ANESTHESIA

MAGNITUDE AND ASSOCIATED FACTORS OF POST-DURAL PUNCTURE HEADACHE FOLLOWING SPINAL ANESTHESIA AMONG NON-OBSTETRIC PATIENT AT ADDIS ABABA PUBLIC HOSPITAL IN 2022; (A MULTICENTER CROSS-SECTIONAL STUDY)

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DURATION	FROM AUGUST 30, 2022 TO NOVEMBER 30, 2022.
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Certification

The researcher verifies that they examined the magnitude and contributing factors of post-dural puncture headaches after spinal anesthesia in non-obstetric patients at four selected public hospitals in Addis Ababa, Ethiopia. The reference section includes a comprehensive list of articles and books utilized for the discussion and literature review.

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List of Abbreviations and Acronyms:

1. **AAU - Addis Ababa University**
2. **ADP - Accidental Dural Puncture**
3. **AOR - Adjusted Odds Ratio**
4. **BMI - Body Mass Index**
5. **CSF - Cerebrospinal Fluid**
6. **ETI - Endotracheal Intubation**
7. **GA - General Anesthesia**
8. **ICHD - International Classification of Headache Disorders**
9. **LP - Lumbar Puncture**
10. **NA - Neuraxial Anesthesia**
11. **NRS - Numeric Rating Scale Score**
12. **OR - Operating Room**
13. **PDPH - Post-Dural Puncture Headache**
14. **SA - Spinal Anesthesia**
15. **SAB - Subarachnoid Blockade**
16. **SPGB - Sphenopalatine Ganglion Block**

ABSTRACT

Background: Post-dural puncture headache is a common complication of spinal anesthesia, which can occur after an inadvertent dural puncture and have devastating implications for the patient's postoperative condition, affecting patients' quality of life due to risk factors like female gender, needle size, operator experience, and previous PDPH.

Objectives: To assess the magnitude and associated factors of post-dural puncture headache following spinal anesthesia among non-obstetric patients at Addis Ababa Public Hospital, Ethiopia (2022).

Methods: The study was conducted using a multicenter cross-sectional study design with a simple random sampling technique from August 30 to November 30, 2022. Data was collected using a standardized questionnaire and analyzed using SPSS version 26, with findings reported in the form of tables, figures, and frequencies. The study used multiple logistic regression to identify independent variables predicting post-dural puncture headaches and the odds ratio and 95% confidence interval was determined.

Result: 403 participants were recruited, which led to a 100% response rate. The total magnitude of post-dural puncture headache in this study was 28% (95% CI: 23.6-32.4). Female gender AOR = 2.08 (95% CI: 1.17-3.68), history of previous post-dural puncture headache AOR = 3.05 (95% CI; 1.44-6.46), experience of anesthetist AOR = 3.45 (95% CI: 2.005-5.92), large size of spinal needle AOR = 6.79 (95% CI; 2.79-16.53), medium size AOR=3.164(95% CI;1.713-5.845) and multiple attempts AOR = 6.97 (95% CI; (3.63-13.35) were associated factors for the occurrences of post-dural puncture headache in non-obstetric surgery.

Conclusion and recommendation: In this study, the overall magnitude of post-dural puncture headaches in non-obstetric surgery was significant. Female gender, multiple attempts, a large or medium spinal needle size, a history of previous post-dural puncture headaches, and anesthetist expertise were all associated with post-dural puncture headaches. Use fine needles and decrease the number of attempts to avoid post-puncture headaches.

Keywords*: Magnitude, PDPH, Non-obstetric Patients, Spinal Anesthesia,*

CHAPTER ONE: INTRODUCTION

1.1. Background

Spinal anesthesia is a neuraxial anesthesia technique that involves injecting a local anesthetic directly into the intrathecal space (subarachnoid space) and is commonly used for surgical procedures in the lower abdomen and extremities(1,2). However, this approach has its challenges.

August Bier first introduced spinal anesthesia in 1898 using cocaine. On August 24, August Bier's assistant administered spinal anesthesia. During the procedure, a significant amount of cerebrospinal fluid was lost, causing Bier to develop a Post Puncture Headache (PPH). Bier later proposed that the underlying mechanism of post-dural puncture headache involves the leakage of cerebrospinal fluid from the puncture site(4). However, the exact mechanism of the post-dural puncture headache is not clear.

In the last century, the prevalence of PDPH has declined from ~70% to ~1%. However, the recently documented occurrence of post-dural puncture headache remains significantly diverse across clinical contexts and places when different techniques are utilized in patients of any age(5).

Several factors have been identified as increasing the risk of post-dural puncture headache, such as pregnancy, perpendicular bevel orientation, repeated dural punctures, needle gauge, multiple puncture attempts, prior history of headaches, age, and female gender (6–8). This type of headache is primarily attributed to significant cerebrospinal fluid (CSF) leakage (9). Given that post-dural puncture headaches can be life-threatening, prompt diagnosis and treatment are crucial.

While needle diameter is often linked to the incidence of post-dural puncture headache, a study by Dr. V. Srivastava et al. found that in non-obstetric cases, the headache rate was consistent regardless of the needle used. However, in obstetric patients, the incidence was 2% with a 27G Whitacre needle compared to 4% with a Quincke spinal needle(10).

Early research found that the incidence of post-dural puncture headache ranged from 1.5–3.7% with a Quincke (cutting) needle, and could be as high as 10.4% (9). However, subsequent

research has revealed that the incidence with a non-cutting Sprotte needle can reach 8.2%. Larger diameter spinal needles are associated with an increased risk of post-dural puncture headache. To help reduce this complication, smaller diameter spinal needles and pencil-point needles may be used, as they separate dural fibers rather than cutting them during the procedure.

1.2. Statement of the Problem

PDPH is the most common complication of spinal anesthesia, causing significant patient discomfort and disability(7,9) 11). The incidence varies based on patient characteristics, needle type and technique, and follow-up methods(12). It is a major source of morbidity for patients and stress for clinicians.

Literature reports PDPH incidence ranging from 0.3% to 40%, influenced by factors like age, gender, needle size and type, multiple attempts, spinal injection position, and previous PDPH history(7,13,14). While spinal anesthesia is becoming more prevalent worldwide, it carries the risk of adverse effects, including PDPH, which remains a serious concern for both providers and patients. It has a tremendous impact on both the patient's psychological and physical health(4,5,7).

The incidence of PDPH in non-obstetric patients varies significantly, particularly in African countries, where the extent and associated factors are increasing due to limited clinical resources and lack of implementation of preventive measures.

The prevalence of post-dural puncture headache (PDPH) varies significantly across countries, with reported rates ranging from 0.16% in Japan to as high as 33% in Ethiopia. In Iran and India, the incidence is 3.1% and 3.9% respectively. This disorder can have a significant impact on patient quality of life, satisfaction.

PDPH can negatively affect a patient's physical and psychological well-being, including their socioeconomic status, healthcare costs, hospital stay duration, readmission rate and overall quality of life.

The magnitude of the post-dural puncture headache (PDPH) problem is exacerbated by several factors, including insufficient follow-up activities, a lack of national prevention and management guidelines, inattention and mindlessness during procedures, insufficient supporting evidence, and a lack of consensus on a uniform management strategy. Additionally,

PDPH prevalence data is limited for non-obstetric patient populations, as previous research has primarily focused on parturient.

Despite the common presentation of PDPH as a postural headache following a dural puncture, many anesthesia providers continue to use outdated treatments like strict bed rest and aggressive hydration. These ineffective approaches have actually increased the prevalence of PDPH and exacerbated the associated problems. Notably, there remains a lack of consensus on a standardized management approach for this condition(15).

Generally, addressing these gaps through improved protocols, established guidelines, training, and research is crucial to mitigating the significant burden of post-dural puncture headaches on non-obstetric patients.

Therefore, this study aims to assess the magnitude of PDPH and associated factors among non-obstetric patients in Addis Ababa, Ethiopia

1.3. Significance of Study

A potential complication of a lumbar puncture is post-dural puncture headache, with symptoms caused by traction on pain-sensitive structures caused by low cerebrospinal fluid pressure following a lumbar puncture(1). It is a major cause of patient morbidity and physician stress(15).

This study excluded obstetric patients, as pregnant women's unique physiological factors may heighten their sensitivity to post-dural puncture headache (PDPH), despite extensive past reporting on the magnitude and associated factors of PDPH.

The focus on non-obstetric patients is important, as they have unique factors that may influence PDPH, such as the procedure itself, age, gender, and diagnoses so, there is no prior study on this population in the country. The findings will help healthcare providers, governments, and non-governmental organizations (NGOs) improve quality of care and reduce PDPH prevalence through targeted interventions

This comprehensive study enhances quality assurance and patient care by identifying the burden and associated factors of PDPH, creating benchmarks for evidence-based practices, and laying the groundwork for future investigations into relevant subjects.

This study can serve as a baseline for future research and raise awareness among institutions and policymakers about the need for evidence-based guidelines and protocols to manage PDPH. It will address the limitations of previous local studies and provide a well-defined, large-scale assessment of the PDPH situation in the region.

CHAPTER TWO: LITERATURE REVIEW

2.1. Definition and Mechanisms of Post-Dural Puncture Headache

Post-dural puncture headache is defined as any headache that occurs after a lumbar puncture, worsens within 15 minutes of sitting or standing, and is relieved within 15 minutes of the patient lying down. It can happen after spinal anesthesia or, more commonly, during an epidural catheter placement attempt(16)(17)

According to the International Classification of Headache Disorders criteria, a headache begins within 5 days of dural puncture and resolves spontaneously within 1 week or up to 48 hours after an epidural blood patch. The headache may be accompanied by neck stiffness, tinnitus, hypoacusia, photophobia, and nausea. Dull throbbing pain in the frontal-occipital region is caused by PDPH. Sitting or standing usually aggravates the headache while lying down relieves it(4,16).

Clinically, post-dural puncture headache is diagnosed by identifying the typical positional headache within 72 hours of a dural puncture. Approximately 90% of PDPHs occur within 72 hours of a dural puncture, though onset has been reported as late as two weeks. In one study of 133 patients who developed PDPH after diagnostic lumbar puncture (LP), 55.6% for neck stiffness, 46.6% for shoulder stiffness, 33% for nausea and vomiting, 22% for tinnitus, and 23% for photophobia were reported(1).

The exact pathophysiology of headache after lumbar puncture is unknown. However, it is most likely related to the "hole" in the left dura after the needle has been withdrawn, resulting in a persistent leak of CSF from the subarachnoid space. This leakage reduces intracranial CSF volume and pressure. Reduced CSF pressure results in a loss of the cushioning effect normally provided by intracranial fluid. A second possible cause is the distension of the cerebral blood vessels. Vasodilatation of intracranial vessels occurs in response to a sudden drop in CSF pressure, resulting in a pathophysiology similar to that of a vascular headache(4)(10).

2.2. Magnitude of Post-Dural Puncture Headache

The occurrence of post-dural puncture headaches in non-obstetrics patients undergoing SA greatly varies from country to country.

In India (2018), Sumitra G et al. reported that out of 487 patients in the group, the incidence and management of post-dural puncture headache following spinal anesthesia and accidental dural puncture in non-obstetric patients were 3.9% in the SA group and 25% in the ADP group (18). There was a positive correlation between needle size, type, and PDPH, which was more prevalent in the 20–40 age groups.

In a retrospective database study conducted by Makito et al. in Japan, in 2020, the incidence of PDPH after spinal anesthesia, epidural anesthesia, and combined spinal epidural anesthesia in non-obstetric patients was 0.16%, 0.13%, and 0.23%, respectively(19).

In a cross-sectional study conducted in Ethiopia (2016) at the Black Lion specialized referral hospital among 76 patients aged 15 and greater undergoing SA for orthopedic and urologic procedures, the prevalence of PDPH was 33% with the use of a large and traumatic needle (22G Q-needle) and repeated spinal attempts (> 2 attempts)(20).

In a prospective cohort study published by DelPizzo K et al., 300 patients (15-45 years old) who underwent simple knee arthroscopy under spinal anesthesia with a total incidence of post-dural puncture headache from a 27G pencil-point needle in young ambulatory surgery patients was 2.0% (95% CI 0.9-4.4; 6/295). They looked at the incidence of PDPH by age group, gender, and history of headache, they discovered that it was 16.7% (95% CI 4.7–44.8; 2/12) for the 15-19 age group, 2.5% (95% CI 0.5–14.8) for females vs. males, and 15.4% (95% CI 2.8–114.4) for patients with and without a history of headache. This study discovered a low overall incidence of PDPH among patients aged 15–45) (21).

In a 2017 prospective cohort study at Wolayita Sodo University, Weji et al. discovered that 28.7% of 150 pregnant women who gave birth by cesarean section had PDPH. In regards to post-dural puncture headache frequency, they discovered that a small spinal needle performed much better than a large, cutting spinal needle(22).

Faramarz Mosaffa et al. conducted a double-blind randomized controlled trial to evaluate the prevalence of post-dural puncture headaches in patients undergoing orthopedic surgery using either a median or a paramedian approach. The incidence of PDPH was similar in both groups, with seven [9.3%] of patients in the median approach group and eight [10.7%] of patients in

the paramedian approach group experiencing typical post-dural puncture headache (P = 0. 875). However, there was a significant difference in PDPH incidence between males and females (P = 0. 041) (9; 16.7% vs. 6; 6.3%)(23).

In cross-sectional research done by Singh J et al. (2010) in Nepal, the incidence of PDPH among 120 patients undergoing spinal anesthesia at Dhulikhel Hospital was 25%. Furthermore, the incidence of PDPH is 30% in males and 70% in females, which is statistically significant, and it is 2.33 times greater in the age group 18–30 years than in the age group 31–45 years. This study revealed that the incidence of PDPH was higher in females and the age group of 18–30 years(24).

In a prospective randomized study conducted by L. Pirbudak et al. in Turkey, out of 613 patients, those aged 25 to 40 (p 0.001) and C/S patients (p = 0.003) reported more headaches during the postoperative period than older patients and other procedures. The other two important criteria were the physician's experience (p = 0.013) and physical exhaustion on the day of surgery (p = 0.001). They discovered that a physician's expertise and physical condition, TUR or anorectal surgery, a patient over the age of 40, and the use of pencil-point spinal needles during the spinal anesthetic procedure were all associated with a lower incidence of post-dural puncture headache(25).

In a prospective study conducted in Brazil, JA Amorim et al. (2008) discovered that eight (19%) of 42 patients with a previous history of PDPH developed a new PDPH episode, but only 15 (6.9%) of 216 patients without a previous history of PDPH presented with PDPH. Patients who had previously had PDPH were 2.7 times more likely to have a new episode than those who had not. This study found that having a history of PDPH increases the likelihood of having another episode after spinal anesthesia(26).

Dagmar Oberhofer et al. (2013) conducted a prospective observational study in Croatia on the frequency and clinical significance of PDPH in two patient groups: 56 parturient undergoing Caesarean section and 59 orthopedic patients undergoing arthroscopic knee surgery, who were predominantly male (81.4%) and significantly younger than parturient (27.85.5 vs. 33.74.7 years, P0.0001). However, the incidence of PDPH in parturients was 14.3% and 13.6% in orthopedic patients, which was not significantly different. They discovered that the prevalence of PDPH was comparable in young orthopedic patients and parturients (27).

2.3. Risk factors of Post-Dural Puncture Headache

There are risk factors that increase the risk of developing a post-dural puncture headache following a dural puncture, either after spinal anesthesia or as a complication during epidural anesthesia. The following factors contribute to the development of headache after lumbar puncture.

According to a prospective randomized double-blinded study conducted by G Lidiya et al. in India (2016), the incidence of post-dural puncture headache between 25G Quincke and 25G Whitacre spinal needles from the age of 18–45 years was 16.5% out of 100 patients. The Quincke group had seven patients get PDPH compared to the Whitacre group, which had just one patient develop PDPH, which was statistically significant. This research found that non-cutting spinal needles, such as Whitacre, have a lower incidence and severity of PDPH than cutting needles, like Quincke(28).

Waise S, et al. (2013) concluded that needle design, gauge, and orientation, as well as stylet reinsertion, are known to affect the incidence of PDPH and that there is no evidence to support the use of hydration. As a result, we advise the reinsertion of the stylus. Although it is commonly acknowledged that utilizing pencil-point needles significantly reduces PDPH rates, using them in clinical settings has been challenging(29).

J. Salzer et al. in Sweden (2019) concluded that the prevention of post-dural puncture headache was assigned to one of three needles in which the smaller bore (25G) atraumatic needle incurred a lower risk of headache compared to the larger bore (22G) atraumatic needle [22.0% (69/314) vs. 30.2% (98/324); OR, 0.65; 95% CI, 0.45-0.93] and compared to the cutting needle 32.8%. This study suggests that using a small atraumatic needle reduces the incidence of PDPH and that stylet reinsertion does not affect PDPH risk(30).

According to Jabbari A et al.'s (2013) cross-sectional descriptive-analytical study in Iran, the incidence of post-dural puncture headache after deliberate dural puncture ranges from 0.1-36%, while it is roughly 3.1% via atraumatic spinal needle. Whitacre 25G(7).

Kassa A et al. (2013) reported a 38.8% incidence of post-dural puncture headache at the University of Gondar Teaching and Referral Hospital in Ethiopia. Multiple attempts [AOR = 0.22; 95% CI: 0.09, 0.54], sex [AOR = 0.2; 95% CI: 0.058, 0.67], and needle diameters [AOR = 5.3; 95% CI: 1.66, 16.93] were all linked to post-dural puncture headache. According to the

findings of this study, we should avoid using large needles and repeat attempts on female patients to reduce the occurrence of post-dural puncture headaches(14).

S. Takmaz et al. conducted a study in Turkey that demonstrated the efficacy and safety of trans-nasal sphenopalatine ganglion block (SPGB) for the treatment of postural puncture headache at 15 minutes post-procedure. At 24 hours post-procedure, more than half of the patients (42.3%) reported no pain, and all patients (100%) reported a VAS score of less than three. According to this study, when conservative symptoms continue, PDPH can be effectively treated with trans-nasal SPGB, which is a non-invasive, safe, and well-tolerated technique with a low complication rate(31).

In China, Chuanjie Wu et al. discovered that the visual analog scale (VAS) score on PDPH was 7.72 ± 1.65 after an intravenous (IV) injection of aminophylline before the initial aminophylline delivery. Overall VAS scores after 30 minutes, one hour, eight hours, one day, and two days were 4.84 ± 2.53, 3.53 ± 2.06, 2.38 ± 1.96, 1.44 ± 1.87, and 0.81 ± 1.79, respectively, and were statistically significant ($P< 0.05$) different from those before treatment. More than half of the patients (17/32) reported being "very much improved" or "much improved" 30 minutes after the initial therapy, rising to 93.8% (30/32) two days later. This research suggests that aminophylline IV injections may be an effective and safe early-stage treatment for PDPH(32).

In meta-analysis research conducted by Xu et al. (2017), using a pencil-point spinal needle resulted in a lower rate of PDPH (RR 2.50; 95% CI [1.96, 3.19]; $P <0.00001$) and severe PDPH (RR 3.27; 95% CI [2.15, 4.96]; $P <0.0001$). They discovered that the pencil-point spinal needle outperformed the cutting spinal needle in terms of PDPH frequency and severity(33).

2.4. Conceptual Framework (10)(19)

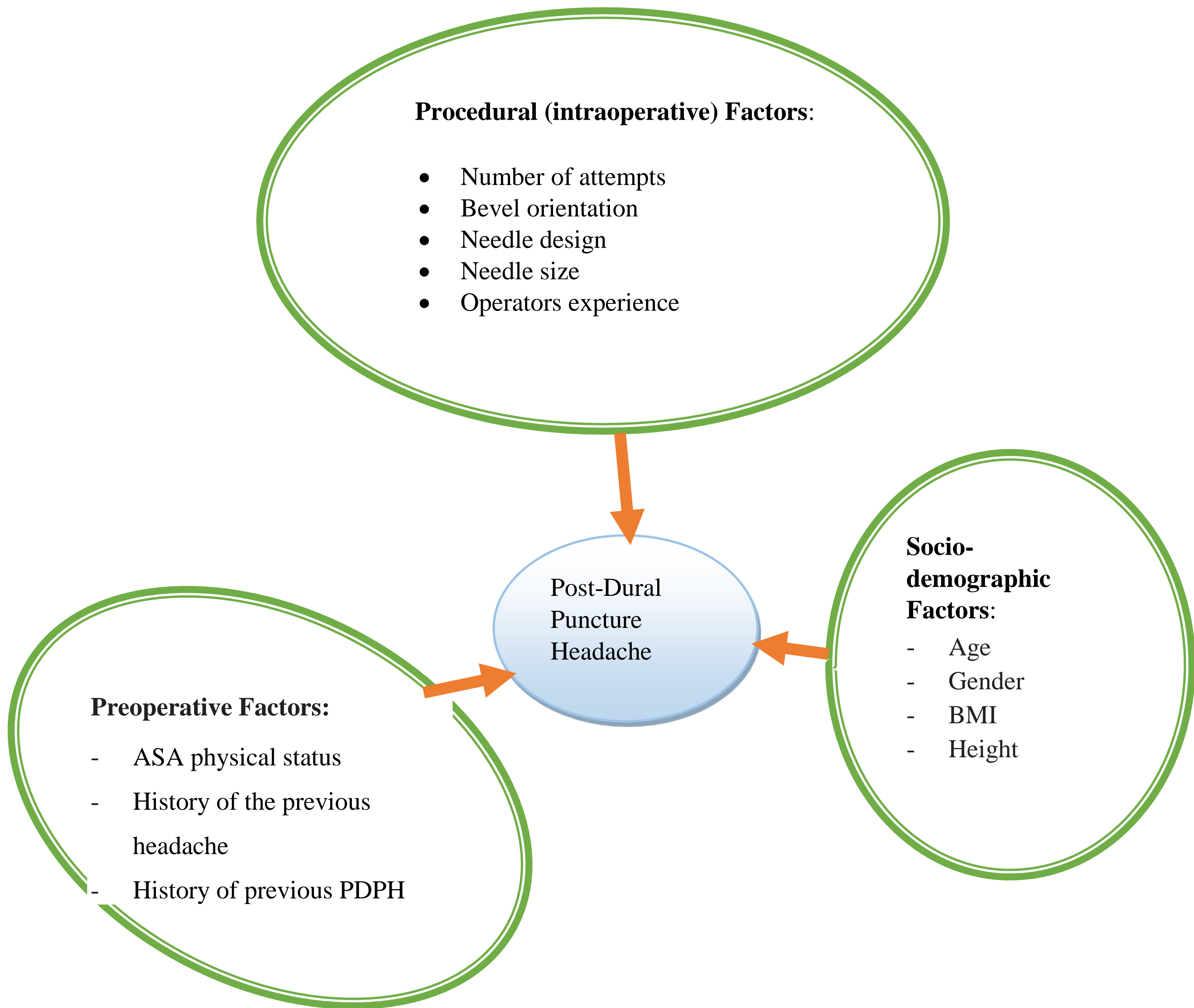


Figure 1-Conceptual framework indicating factors contributing to the development of PDPH among non-obstetric patients following spinal anesthesia at Addis Ababa-selected public hospitals.

CHAPTER THREE: OBJECTIVE

3.1. General objective

- To assess the magnitude and associated factors of post-dural puncture headache following spinal anesthesia among non-obstetric patients at Addis Ababa Public Hospital in 2022.

3.2. Specific objective

- To determine the magnitude of post-dural puncture headache among non-obstetric patients after spinal anesthesia.
- To identify risk factors for post-dural puncture headache among non-obstetric patients after spinal anesthesia.

CHAPTER FOUR: METHOD AND MATERIALS

4.1. Study Area and Period

This research was conducted at four public hospitals in Addis Ababa purposively selected from August 30 to November 30, 2022. Addis Ababa is the capital city of Ethiopia and has 13 hospitals and 98 health centers, according to the Ministry of Health's 2012 Ethiopian fiscal year. There has been no credible, complete statistical data to illustrate population trends in Addis Ababa since the city's founding. Addis Ababa's population is increasing at a rate of 3.8 percent per year and is predicted to reach 4.7 million residents by 2030(34).

The study took place at Tikur-Anbessa Specialized Hospital, Saint Peter's Specialized Hospital, Alert Specialized Hospital, and Tirunesh-Beijing General Hospital. The hospitals not only provide health care to Addis Ababa people but also function as nationwide referral centers.

Tikur-Anbessa Specialized Hospital is one of Ethiopia's largest referral hospitals. With over 700 beds, it serves as a teaching facility for undergraduate and postgraduate medical students, and others who deal with the health concerns of the community and country. The hospital includes 12 elective operating rooms and 4 emergency operating rooms.

St. Peter's TB specialty hospital was a government hospital managed by the Federal Democratic Republic of Ethiopia's Ministry of Health (FMOH). It has 400 beds and 4 operating rooms, and it provides a variety of acute care services.

The Addis Ababa City Administration Health Bureau administered the Tirunesh Beijing Hospital. The hospital has contained 100 bedrooms and 5 operating rooms. It provides clinical services for in-patients, outpatients, and emergencies.

Members of the Ministry of Health, Addis Ababa University, and the International Society founded ALERT on December 11, 1965, for the Rehabilitation of the Disabled. There is currently a 240-bed teaching hospital with departments of dermatology, ophthalmology, and surgery, in addition to an orthopedic workshop and a rehabilitation program.

4.2. Study Design

A multicenter cross-sectional study was conducted.

4.3. Source population

The source populations were all surgical patients admitted to surgery who underwent spinal anesthesia in four selected hospitals from August 30-November 30, 2022.

4.4. Study population

The study populations were surgical patients who admitted for non-obstetric surgery undergo spinal anesthesia in four selected hospitals

4.5. Eligibility criteria

4.5.1. Inclusion criteria

Non-obstetric patients under the age of ≥15 underwent spinal anesthesia at selected Addis Ababa public hospitals.

4.5.2. Exclusion criteria

- ✓ Known psychiatric patient
- ✓ Patient taking general anesthesia in addition to SA
- ✓ ASA Class ≥III
- ✓ Obstetrics patient
- ✓ Patients may refuse informed consent
- ✓ Patients may have contraindications for spinal anesthesia

4.6. Sample size determination and sampling techniques

The study on post-dural puncture headache in non-obstetric patients will determine sample size using the single population proportion technique due to unidentified population variability. For patient selection, a simple random sampling technique was used by lottery method, and study settings were selected purposively for four Addis Ababa public hospitals.

Then, P=0.5 was used for the calculation to get the maximum sample size, 95% level of significance, 5% margin of error, and 5% for incomplete or contingency data were used as parameters.

Sample size (n) $= \dfrac{(Z\,\alpha/2)^2\,(pxq)}{d^2}$

$p = 0.5$

$q = 1 - p = 1 - 0.5 = 0.5$

d = Margin error (5%)

$n = (Z\,a/2)^2 \times p \times q / d^2 = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2 = 384$

By Adding 5% contingency for non-response rate (i.e.384+19.2≈ 403). As a result, the total sample size was 403 non-obstetric patients in operation who were undergoing spinal anesthesia were included.

Nf= Final sample size

n= sample size

Z $\alpha/2$= desired 95% confidence interval, **Z**$\alpha/2$=1.96

The sample size was allocated proportionally to four hospitals using the following formula from 800 patients under spinal anesthesia for three months.

Out of 800 surgical patients; TASH=300 cases, St. Peters Specialized hospital =160 cases, Tirunesh-Beijing general hospital=110 cases, and Alert specialized hospitals=230 cases Per three months was performed.

$$n\,j = \frac{n}{N} \quad N\,j$$

.

N (TASH) = n/**N*NJ =403*300/800 =151**

n(St.PETER H)= n/**N*NJ=403*160/800=81**

n(TBGH)= n/**N*NJ=403*110/800=55**

n(Alert.SH)= n/**N*NJ=403*230/800=116**

; where j=1, 2, 3…

N is the total number of allocations in four hospitals,

n -total sample size for the four hospitals

n j=is the sample size of each hospital

Nj=is the source population size of each hospital.

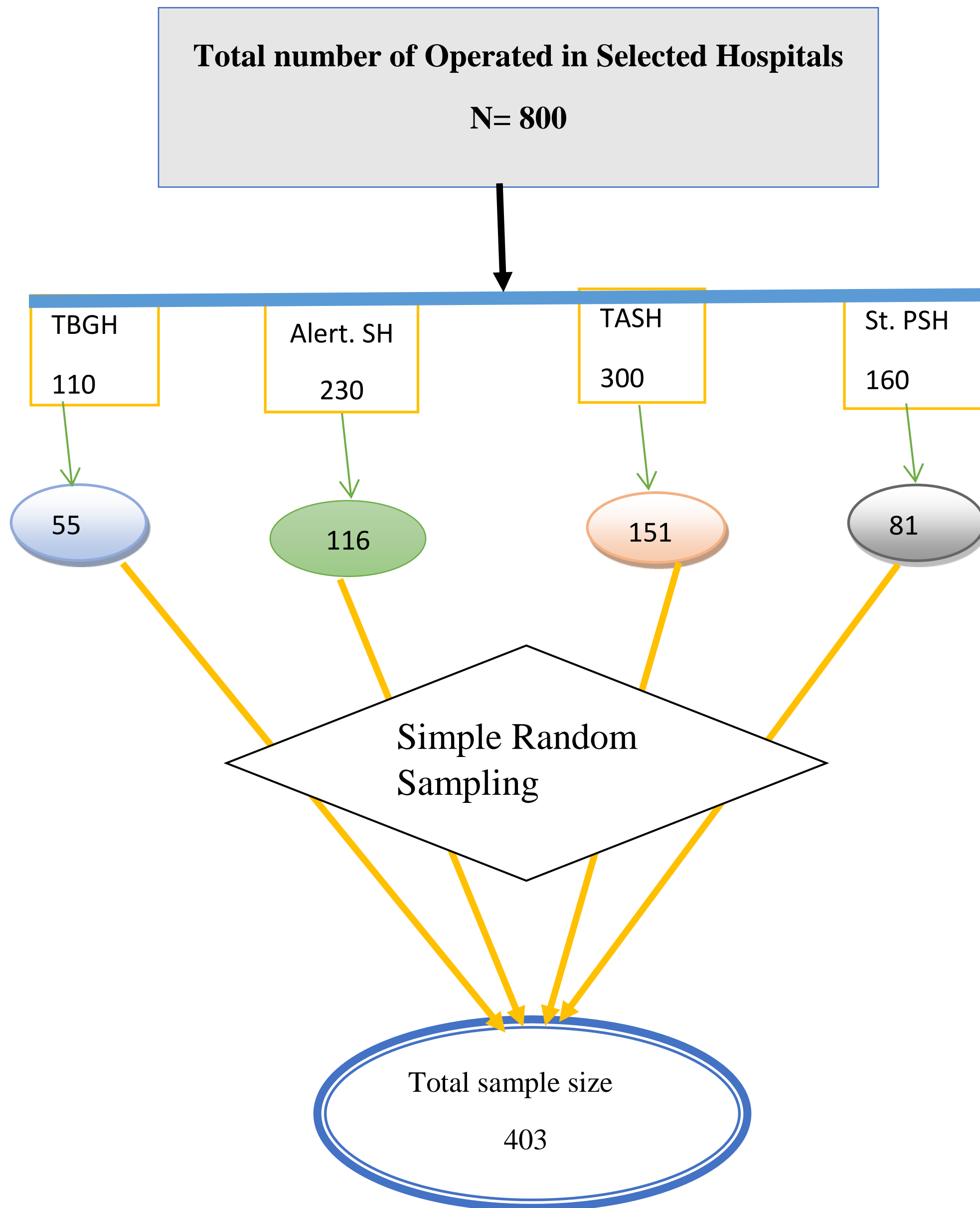


Figure 1-Schematic diagram of a total sample size of population distribution for Non-Obstetric Patients under SA at Selected Addis Ababa Public Hospitals

4.7. Study variable

4.7.1. Dependent variables

- ✓ Post-dural puncture headache (Yes/No)

4.7.2. Independent variables

Socio-Demographic Factors:

- ✓ Age
- ✓ Gender
- ✓ BMI
- ✓ Height

Preoperative Factors:

- ✓ ASA physical status
- ✓ History of headache
- ✓ Previous history of spinal headache

Procedural (Intraoperative) Factors:

- ✓ Needle size
- ✓ Bevel orientation
- ✓ Needle design
- ✓ Number of attempts
- ✓ Operators' experience

4.8. Data collection procedure and tool

Two anesthetists were assigned to each hospital to collect data through observation, chart review, and patient interviews using pre-prepared questionnaires. All patients were monitored for two days after surgery. The initial observation occurred during spinal anesthesia administration to evaluate procedural factors, and post-dural puncture headache (PDPH) was examined every 12 hours after the procedure. Finally, the severity of PDPH was assessed using the Numerical Rating Scale (NRS, 0-10).

4.9. Data Quality Assurance

The data collectors were briefed on the overall relevance and objectives of the study. The research tool, a questionnaire, was prepared in English and pretested on 5% of the study population at the Tirunesh Beijing General Hospital. During the procedure, the data collectors carefully observed and documented key details on the questionnaire, including the number of spinal attempts, the gauge of the spinal needle, the patient's position, the operator's experience, and the types of procedures performed.

Before analysis, the data collectors described the study's goals, risks, benefits, and confidentiality to eligible patients, who provided informed consent. The supervisor and investigator assessed the completeness, clarity, and accuracy of the collected data on a daily basis. Data cleansing and cross-checking were also performed to ensure data quality prior to analysis.

4.10. Data Analysis Procedures

After the data collection in four hospitals, the questionnaires underwent manual review for completeness before being coded and exported to SPSS version 26 for analysis. Descriptive statistics summarized the socio-demographic characteristics and the extent of PDPH, with the results presented in tables, graphs, and text.

The Hosmer and Lemeshow goodness of fit test assessed the logistic regression model's fitness. Binary logistic regression then examined the relationship between each independent variable and the dependent variable. Variables with a p-value less than 0.25 in the bivariable analysis were included in the multivariable logistic regression. Odds ratios, 95% confidence intervals, and p-values < 0.05 determined the strength and statistical significance of the relationships between dependent and independent variables.

4.11. Operational Definitions

The **International Headache Society (IHS**) defines (**post-dural puncture headache**) PDPH as a headache occurring within 5 days of a lumbar puncture caused by cerebrospinal fluid (CSF) leakage through the dural puncture. It usually comes accompanied by one or more of the following indicators: neck stiffness and/or tinnitus, hyperacusia, photophobia, nausea or vomiting (16)(17).

Non-obstetric surgery is defined as a surgical intervention that does not require pregnant patients to undergo a caesarean section or fetal surgery.

Numerical Rating Scale (NRS): requires the patient to rate their pain intensity on a defined scale; i.e. 0–10 where zero is no pain and 10 is the worst pain imaginable. Values 1-3 were considered mild headache, 4-7 moderate headaches, and > 7 was considered severe headache.

Photophobia is the sensation of pain in the eye caused by exposure to bright light.

Spinal anesthesia is a neuraxial anesthesia technique in which local anesthetic is placed directly in the intrathecal space (subarachnoid space) (1,2)

Tinnitus: A ringing, buzzing, hissing, whistling, or booming feeling in one or both ears.

Spinal needle designs are often different in their tip geometry, yet they share fundamental similarities. These needles typically include a stylet and an introducer needle, though larger spinal needles may not require an introducer.

4.12. Ethical considerations

Before beginning data collection, the researchers obtained ethical clearance from the AAU Department of Ethical Clearance, the Addis Ababa Bureau of Public Health Research, and the Emergency Management Directorate. They then wrote an official support letter to the hospital administration to request permission for data gathering. After providing participants with full information about the study's purpose and relevance, each volunteer was asked to provide written informed consent. To maintain confidentiality, the researchers omitted personal identification and used codes to identify patients throughout the study.

4.13. Dissemination plan

The study's findings will be submitted to AAU, the College of Health Sciences, and the anesthesia department. As a result, copies of the report will be disseminated to the appropriate departments and stakeholders. The findings will be presented at scientific conferences, as well

as at the Ethiopian Anesthetists Association's annual meeting, and will be submitted for publication in recognized journals.

CHAPTER FIVE: RESULT

5.1. Socio-demographic and preoperative factors

The study included 403 patients who underwent spinal anesthesia for elective non-obstetric surgeries at four public hospitals from August 30 to November 30, 2022. The response rate was 100%. Of the 403 respondents, 293 (72.7%) were male and 110 (27.3%) were female. The majority of patients, 355 (88.1%), had a normal body mass index. The most common surgical procedure was orthopedics, accounting for 235 (58.3%) of the cases. Most patients were between the ages of 15 and 40 years old.

Table 1: Socio-demographic and preoperative factors of patients who underwent elective non-obstetrics surgery at selected Addis Ababa public hospitals, Addis Ababa, Ethiopia from August 30 to November 30, 2022. (n=403).

Variables	Category	Frequency	Percentage (%)
Age in year	15-40	258	64%
	41-60	91	22.6%
	above 60	54	13.4%
Gender	Male	293	72.7%
	Female	110	27.3%
BMI(kg/m2)	less than 18.5	44	10.9%
	18.5-24.5	355	88.1%
	greater than 24.5	4	1.0%
ASA Status	ASA I	297	73.7%
	ASA II	106	26.3%
Previous history of headache	YES	93	23.1%
	NO	310	76.9%
	YES	53	13.2%

History of spinal headache	NO	350	86.8%
Types of surgery proposed	Plastic surgery	7	1.7%
	Orthopedic surgery	235	58.3%
	Vascular surgery	14	3.5%
	Urologic surgery	114	28.3%
	Anorectal surgery	16	4.0%
	Hernia repair	9	2.2%
	Specific gyne procedure	8	2.0%

5.2. Anesthesia providers' characteristics and intraoperative factors

Operators with bachelor's degrees (i.e., staff) provided spinal anesthesia in 116 patients (28.8%). Anesthetists with ≤ 3 years of experience administered spinal anesthesia in 206 patients (51.1%). A 22G spinal needle was used in 216 patients (53.6%). The most common spinal needle type was Quincke, used in 343 patients (85.1%), and the most common local anesthetic was 0.5% heavy bupivacaine, used in 223 patients (55.3%).

Table 2: Anesthesia providers' characteristics and intraoperative factors of patients who underwent elective non-obstetrics surgery at selected Addis Ababa public hospitals, Addis Ababa, Ethiopia from August 30 to November 30, 2022. (n=403).

Variables	Category	Frequency	Percentage (%)
Level of educational status	BSc student	68	16.9%
	BSc staff	116	28.8%
	MSc staff/student	105	26.1%
	Residence	105	26.1%
	Anesthesiologist	9	2.2%
Operators Experiences	≤3yrs	206	51.1%
	≥4yrs	197	48.9%

Local anesthetics used	0.5% bupivacaine with plain,		178	44.2%
	5% lidocaine heavy,		2	0.5%
	0.5% bupivacaine heavy		223	55.3%
Bevel orientation	Parallel		216	53.6%
	Perpendicular		187	46.4%
Spinal needles gauge	21	Large needles	23	5.7%
	22		216	53.6%
	23	Medium needles	65	16.1%
	24		44	10.9%
	25	Small needles	55	13.6%
Spinal needle type	Quincke		343	85.1%
	Whitacre		60	14.9%
Number of attempts	Once		140	34.8%
	Twice		150	37.2%
	Thrice		100	24.8%
	more than three		13	3.2%
Associated symptoms	Neck stiffness Dizziness		49	12.2%
	Nausea, vomiting,		78	19.4%
	Photophobia, Tinnitus		24	6.0%
	None of the above symptoms		252	62.5%

Table 3: Clinical features of headache after spinal anesthesia

Variables	**Category**	**Headache after SA**		**Total**
		YES	**NO**	
Associated Symptoms	Neck stiffness Dizziness	34	15	49
	Nausea, vomiting,	63	15	78
	Photophobia, Tinnitus	16	8	24
	None of the above symptoms	28	224	252
Headache Onset	0-12hrs	66	105	171
	13-24hrs	63	119	182
	25-48hrs	12	38	50

5.3. Magnitude and Severity of Post dural puncture headache

This study examined the magnitude and severity of post-dural puncture headaches (PDPH) in 113 non-obstetric surgical patients who received spinal anesthesia. While 28 patients (7%) reported headaches, they did not meet the criteria for a PDPH diagnosis. Among the 113 PDPH patients, over half (52.21%) experienced mild pain, 44.25% had moderate pain, and 3.54% suffered from severe PDPH.

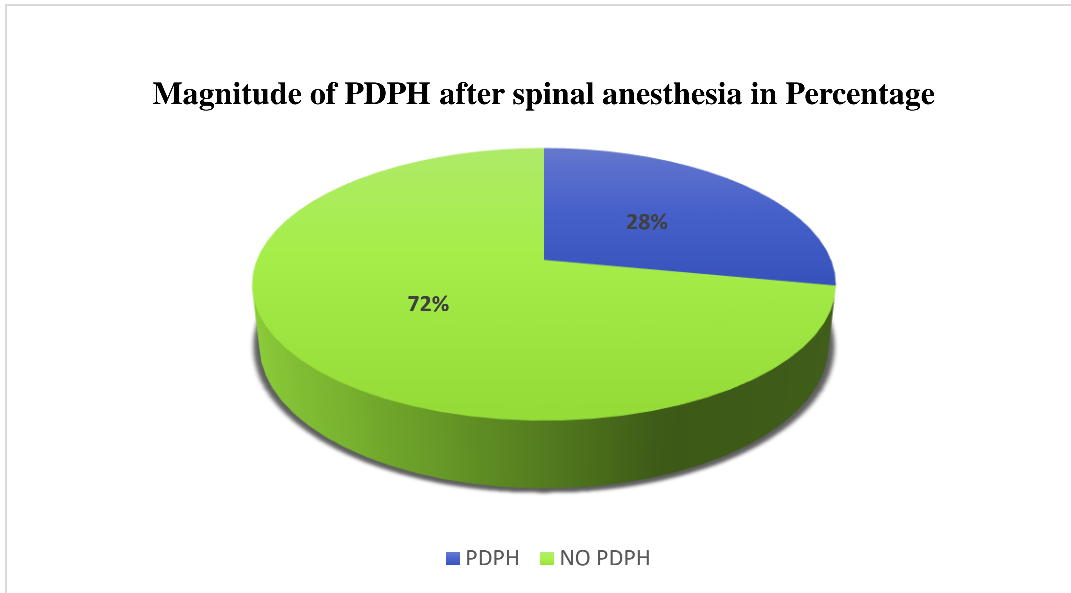


Figure 2: Magnitude of post-dural puncture headache (PDPH) among patients who have had spinal anesthesia in the Addis Ababa selected public hospitals, Addis Ababa Ethiopia, November 30, 2022 (n=403).

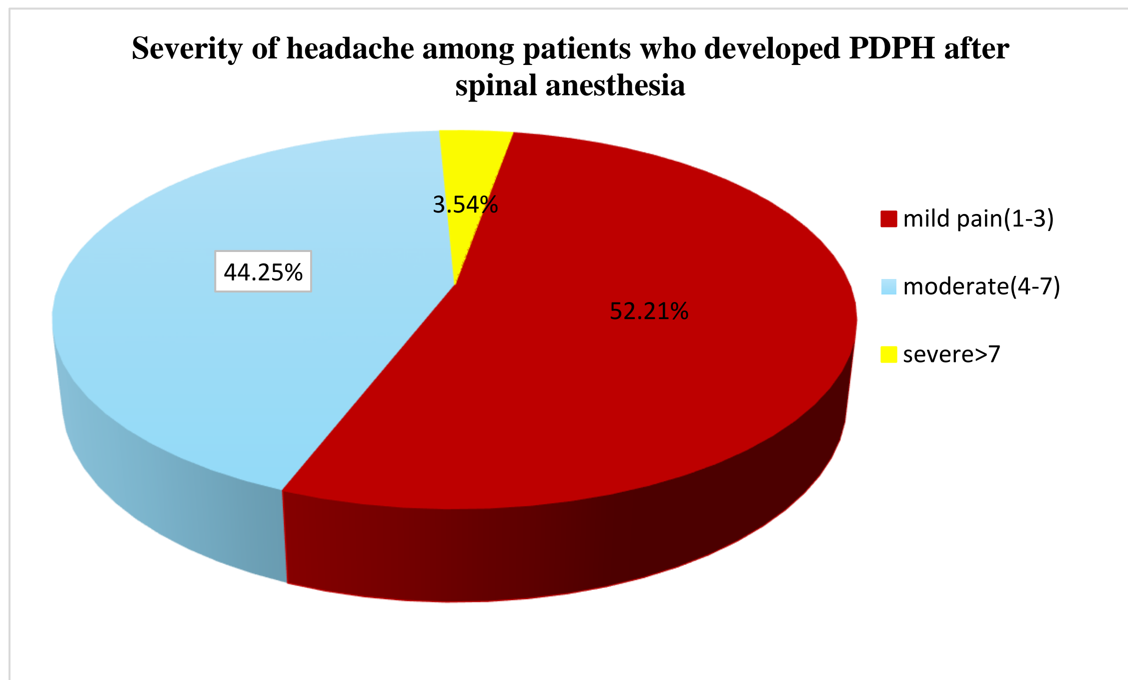
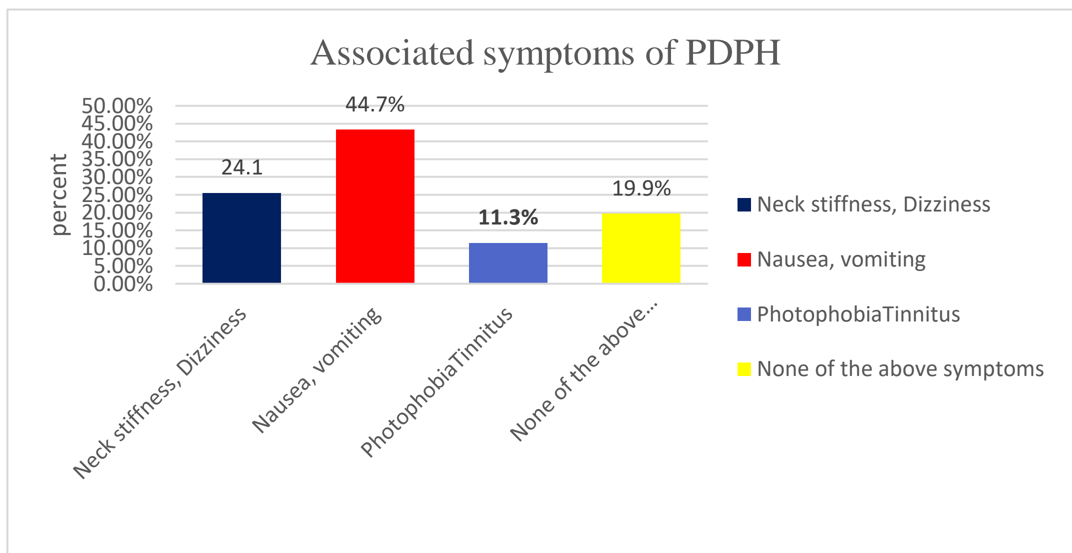


Figure 3: Severity of headache among patients who developed PDPH in selected Addis Ababa public hospitals, Addis Ababa Ethiopia from August 30-November 30, 2022.

Among 113 patients who developed PDPH after spinal anesthesia, 80.1% met the following criteria: neck stiffness, nausea, diplopia, vomiting, dizziness, photophobia, and tinnitus.

Figure 4: Associated symptoms complained by patients who had PDPH after spinal anesthesia in the Addis Ababa public hospitals Addis Ababa, Ethiopia, November 30, 2022.



5.4. Factors associated with post-dural puncture headache

A binary logistic regression analysis was conducted to investigate the association between various factors and post-dural puncture headache. In the initial bivariable analysis, several variables were identified as potentially associated with post-dural puncture headache at a p-value less than 0.25, including age, gender, history of previous headache, history of previous PDPH, needle size, number of attempts, bevel orientation, type of spinal needle, and operator experience. These factors were then entered into a multivariable logistic regression model to assess the strength of their association, using the Hosmer-Lemeshow test.

The study found that gender was strongly associated with the outcome variable and post-dural puncture headache (PDPH) in non-obstetric patients. Specifically, female patients were 2.082 times more likely than male patients to develop PDPH [AOR] = 2.082, 95%CI]: 1.176-3.686, p=0.012). Additionally, a history of previous spinal headache was significantly associated with PDPH (AOR = 3.047, 95% CI: 1.437-6.462, p=0.004). Furthermore, the number of spinal anesthesia (SA) attempts was also significantly linked to PDPH. Patients who underwent multiple repeated SA attempts (≥2 attempts) were nearly 7 times more likely to experience PDPH (AOR = 6.967, 95% CI: 3.63-13.35, p<0.001).

Table 4: Bi-variant and Multivariate logistic regression analysis showed that factors associated with PDPH under spinal anesthesia at selected public hospitals in Addis Ababa, Ethiopia, 2022 (n=403)

Variables	Categories	Post-dural Puncture headache		COR,95%CI	AOR,95%CI	P-value
		Yes	No			
Age in year	15-40	97(24.08%)	161(39.94%)	1	1	
	41-60	32(7.94%)	59(14.64%)	0.474(0.238-0.945)	0.488(0.209-1.137)	0.096
	>60	12(2.98%)	42(10.42%)	0.527(0.243-1.141)	0.744(0.289-1.918)	0.541
Sex	Male	85(21.1%)	208(51.6%)	1	1	
	Female	56(13.9%)	54(13.4%)	2.538(1.616-3.984)	**2.082(1.176-3.686)****	**0.012**

History of previous Headache	Yes	39(9.68%)	54(13.4%)	1.473(0.916-2.369)	1.489(0.808-2.743)	0.202
	No	102(25.32%)	208(51.6%)	1	1	
History of Previous Spinal Headache	Yes	32(7.94%)	21(5.21%)	3.369(1.858-6.109)	**3.047(1.437-6.462)****	**0.004**
	No	109(27.06%)	241(59.79%)	1	1	
Operators Experience	≤3yrs,	100(24.82%)	106(26.3%)	3.590(2.313-5.569)	**3.446(2.005-5.922)****	**0.001**
	≥4yrs	41(10.18%)	156(38.7%)	1	1	
Bevel Orientation	Parallel	61(15.142%)	155(38.45%)	0.526(0.348-0.797)	0.877(0.509-1.512)	0.637
	Perpendicular	80(19.858%)	107(26.55%)	1	1	
Needle Size	Large	110(27.30%)	129(32.00%)	5.010(2.270-11.056)	**6.792(2.792-16.525)**	**0.001**
	Medium	23(5.71%)	86(21.34%)	3.188(1.885-5.394)	**3.164(1.713-5.845)**	**0.001**
	Small	8(1.99%)	47(11.66%)	1	1	
Number of Attempts	Single	16(3.97%)	124(30.76%)	1	1	
	Multiple repeated attempts	125(31.03%)	138(34.24%)	7.020(3.954-12.465)	**6.967(3.636-13.351)****	**0.001**
Spinal Needle	Quincke	126(31.28%)	217(53.84%)	1	1	
	Whitacre	15(3.72%)	45(11.16%)	1.742(0.933-3.252)	2.194(0.849-3.416)	0.35

Crude odds ratio- COR P value<0.05 Adjusted odd ratio-AOR

Ref category-1 CI- Confidence interval

CHAPTER SIX: DISCUSSION

Post-dural puncture headache (PDPH) is a complication of dural puncture that occurs intentionally in spinal anesthesia or unintentionally as a complication of epidural anesthesia(32). In this study, the total magnitude of post-dural puncture headache was 28% (95% CI: 23.6-32.4). This finding is comparable to research done by Weji BG et al. in Ethiopia (incidence of PDPH 28.7%) (22), and Hashel A in Kuwait (prevalence of PDPH 29.5%) (35). However, the prevalence of PDPH was lower in studies by Meshram S et al. (1.2%) and in Pakistan (18.9%) (36).

The inconsistency between this study's results and the lower prevalence found in other research may be due to differences in clinical practices, such as a higher number of needle insertion attempts and use of larger needle sizes in this study (37).

This study found that the patient's gender was an associated factor for PDPH, with females having a significantly higher incidence of PDPH after spinal anesthesia (p=0.012). This finding aligns with several previous cross-sectional studies (Kassa et al. 2015, Al-Hashel et al. 2022, Makito et al. 2020) (14,19,35,38). The higher PDPH risk in females may be attributed to hormonal factors, such as elevated estrogen levels (19), as well as anatomical differences, including increased dural fiber elasticity that could maintain a patent dural defect more effectively(40). Additionally, research suggests that gender-based variations in nociceptive information processing, sensitization, and prefrontal cortex activation, along with psychological factors, may contribute to the observed disparity (35).

This research found that the use of large and medium-sized spinal needles was significantly associated with postural puncture headache (p=0.001). This aligns with previous studies by Weji et al. 2020), and Zorrilla-vaca 2018) (22,25,41,42), which linked the use of larger spinal needles to an increased risk of high cerebrospinal fluid leaks, a major factor contributing to post-dural puncture headache (42).

Multiple attempts during spinal anesthesia administration were a significant factor for the occurrence of post-dural puncture headache, consistent with previous research (14,43). This is likely due to technical difficulties experienced by less experienced providers, such as anesthesia students and recent graduates, who may fail to recognize slow flow through a small needle, leading to repeated dural punctures attempts (21,41). The use of very thin spinal needles can further contribute to these technical challenges, resulting in a higher incidence of post-dural puncture headache.

The study found that a history of previous post-dural puncture headaches was a significant risk factor for the occurrence of post-dural puncture headaches, aligning with previous research by Hashel A. (35). This suggests that people with a history of chronic headaches, such as migraines or tension headaches, may be more susceptible to multiple episodes of post-spinal puncture headaches due to their unique physiological and neurochemical characteristics that predispose them to chronic headache conditions (44).

A single-armed cohort study conducted by Girma T in 2022 (41), found that experienced anesthetists with ≤ 3 years of experience had a significantly higher risk of post-dural puncture headache (AOR 3.446, 95% CI: 2.005-5.922, p=0.001). This contrasts with other studies that showed no association between anesthetist experience and PDPH incidence. This difference may be explained by the fact that in the study setting, graduate and master's students primarily performed spinal anesthesia procedures, whereas other studies involved certified anesthesia professionals conducting the procedures.

6.1. Strength and Limitation of Study

This multicenter study used probability sampling to select patients who underwent a range of different operations performed under spinal anesthesia. As a result, the findings can be generalized to the broader population.

However, the cross-sectional study design was limited in its ability to demonstrate any temporary or causal associations, unlike a longitudinal cohort study. Additionally, the short timeframe for assessing the onset of headaches was a limitation.

Furthermore, the study did not consider several potential risk factors, including the level of spinal puncture, blood glucose levels, hospital type, and patient positioning.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATION

7.1. Conclusion

This study found that post-dural puncture headaches were common and significantly associated with several factors, including a history of previous post-dural puncture headaches, multiple needle insertion attempts, larger spinal needle size, less experienced anesthetists, and female gender.

7.2. Recommendation

For Clinicians:-To prevent post-dural puncture headaches, anesthesia providers should:

- Use fine-gauge needles and avoid repeat puncture attempts
- Implement targeted interventions to mitigate PDPH
- Establish a standardized guideline protocol for PDPH management.

For Researchers:

- Conduct further research that accounts for all relevant confounding factors
- Design cohort studies with long-term follow-up to identify causal relationships
- Incorporate this new study data into meta-analyses and systematic reviews

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Annexes:

Annex I: Title and Informed Consent

Data collection tools to assess the magnitude and associated factors of post-dural puncture headache following spinal anesthesia among non-obstetric patients at Tikur Anbessa Specialized Hospital, St. Peter Specialized Hospital, Alert Specialized Hospital, and Tirunesh Beijing General Hospital in Addis Ababa, Ethiopia, from August 30 to November 30, 2022, (Multi-center cross-sectional study).

My name is------------------------------... I am one of the research team members at Addis Ababa University Department of Anesthesia. This questionnaire aims to gather information on factors associated with post-dural puncture headaches following spinal anesthesia among non-obstetric patients. All information obtained will be kept confidential, and we will not include a patient's name or exact address. However, by using a code number and only the researcher to assess the coded data, a critical role in the study will be successful.

Based on the above information, are you voluntarily participating in this research?

A. Yes B. No

If you have any questions, you can contact me at - hbayisahrsa4510@gmail.com

Name of data collector-----------------------Signature----------------------

Date of data collection ________________

Phone no. +251-922-411-351 or, 0938008194

Annex II: Questionnaire Data:

For each questionnaire, please circle the number of alternatives (s) that fit the response and fill in the black space provided or choice from the given alternatives

Data code _______________

Part One: Socio-Demographic and Preoperative Characteristics' of the Non-Obstetric Patient			
Code No:	**Question**	**Response**	**Remark**
101	Age (years)	A. 15-40yrs B. 41-60yrs C. Above 60yrs	
102	Sex	A. Male B. Female	
103	Weight (in Kg)	___________Kg	
104	Height (in meter)	___________M	
105	BMI (kg/m2)	___________kg/m2	
106	ASA physical status	A. ASA I B. ASAII	
107	Is there a previous history of headaches?	A. Yes B. No	
108	Is there a history of spinal headaches?	A. Yes B. No	
109	Types of surgery proposed under spinal anesthesia	A. Plastic surgery B. Orthopedic surgery C. Vascular surgery D. Urologic surgery E. Anorectal surgery F. Hernia repair	

		G. specific gyne procedure	
Part Two: Anesthetists and Intra-operative Characteristics of the Non-Obstetric Patients during Spinal Anesthesia in the Operating Theatre			
201	Level of educational status	A. BSc student B. BSc staff C. MSc staff, or student D. Residence E. Anesthesiologist	
202	Experiences of anesthesiology (in a year)	A. 3rd or 4th yrs. BSC degree student B. 0-3 yrs. C. 4-7yrs. D. Above 8yrs	
203	Type of local anesthetic used	A. 0.5% bupivacaine with plain, B. 5% lidocaine heavy, C. 0.5% bupivacaine heavy	
204	How will the bevel orientation be applied?	A. Longitudinal/parallel B. Perpendicular	
205	The gauge of the spinal needle	21G, /22G, 23G, /24G, /25G	
206	Types of the Spinal Needle	A. Quincke B. Whitacre	
207	Have any attempts been made at the patient's dural puncture site?	A. Yes B. No	
208	How many attempts do you make?	A. Once B. Twice C. Thrice D. More than three attempts.	

Part Three: Associated Symptoms of Non-Obstetric Patients After Spinal Anesthesia			
301	Have you ever had a headache after SA?	A. YES B. NO	
302	How long have you had headache onset?	A. 0-12hours B. 13-24hours C. 25-48hours	
303	What are the associated symptoms did have after taking spinal anesthesia?	A. Neck stiffness, Dizziness B. Nausea, vomiting, C. Tinnitus, photophobia D. None the above	
304	Was treatment given for your headache? If you are taken, What kind of treatment?	I. Yes; Conservative, or Invasive II. No	
305	The severity of PDPH effects	I. Mild pain (1-3), II. Moderate pain (4-7), III. Severe pain >7	

Annex III: Information sheet

This information sheet is prepared with the aim of explaining the research project.

Title: Magnitude and Associated Factors of post-dural puncture headache following spinal anesthesia among Non-obstetric Surgery, at Addis Ababa Public Hospitals (multi-centered cross-sectional Study)

Name of Principal Investigator: Bayisa Horsa (BSC in Anesthesia)

Name of advisors: Selamawit Shiferaw (BSC, MSC in Anesthesia)

Name of the Organization: Addis Ababa University, College of Medicine and Health Sciences, Department of Anesthesia

Name of the Sponsor: Addis Ababa University

Purpose of the Research Project

To assess the magnitude and associated factors of post-dural puncture headache following spinal anesthesia among non-obstetric patients at Tikur Anbessa Specialized Hospital, St. Peter Specialized Hospital, Alert Specialized Hospital, and Tirunesh Beijing General Hospital in Addis Ababa, Ethiopia.

Incentive

There is no reward or payment for participating in this project. This study project's data was kept private, and only the researcher and research assistant would have access to it. This research project was reviewed and approved by the ethical committee of Addis Ababa University College of Health Science.