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COLLEGE OF HEALTH SCIENCE SCHOOLE

DEPARTMENT OF ANESTHESA

COMPARISON OF LEVEL OF BLOCK ACHIEVED AFTER SPINAL ANESTHESIA IN OVER WEIGHT AND NON OVER WEIGHT PATIENT UNDERGOING SURGERY BELOW UMBILICUS AT SELECTED PUBLIC HOSPITALS IN ADDIS ABABA BETWEEN JAN 1 TO MARCH 30,2025.MULTI CENTER PROSPECTIVE COHORT STUDY

A THESIS TO BE SUBMITTED TO THE DEPARTMENT OF ANESTHESIA AT ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCES, IN ORDER TO MEET A MASTERS DEGREE REQUIREMENT IN CLINICAL ANAESTHESIA.

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Full title of the research project	Comparison level of block achieved after spinal anesthesia in over weight and non over weight patient surgery blew umbilicus: Multi center prospective observational chort study.
Duration of project	April/2025-june.5/2025 GC
Study Area	Black Lion comprehensive Specialized Hospital, St. Paul's Hospital Millennium Medical College and Zewditu memorial hospital at Addis Ababa, Ethiopia
Total Cost of the project	> 25000ETB
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SUMMARY

Background: Obesity and its influence on Spinal anesthesia is a significant factors for surgeries below an umbilicus associated with effective level of sensory and motor block, As well as it has been a significant effect on the cephalic spread of a spinal block (SB) due to a reduction in cerebrospinal fluid (CSF).

Objective: To compare level of block achieved after spinal anesthesia in over weight and non over weight patients undergoing surgery below umbilicus at selected Public hospitals in western shewa, Oromia, Ethiopia.

Methods: This study divided 140 patients who had surgery below the umbilicus into two groups: 70 patients who were overweight and 70 patients who were not. A level of sensory and motor assessed by A bilateral T12-T4 and bromage scale 0,1,2,3, respectively within induction phase(5minuts),10 minutes and at the end of surgery of the intrathecal medication injection was deemed to indicate an effectiveness level of spinal block for lower umbilicus surgery under spinal anesthesia. Using numerous variables that independently affect the spinal anesthesia outcome, logistic regression was used to assess the parameters that affect the procedure..

Results: On multivariate analysis, overweight's were had higher sensory and complete motor block. AOR:1.95CI(1.5-2.5), $p<0.001$,andAOR:1.5,CI:(1.2-1.87), $p<0.001$ respectively in contrast to their counterparts and dose of bupivacaine also were significantly associated to higher motor and sensory blocks. Additionally, the dose of bupivacaine (AOR:1.56(CI: 1.24-1-2.3), $P:0.028$) were independent predictors of effective anesthesia in the patients where as BMI kg/m² was found to be a predictor of effective level of block under spinal anesthesia by multivariate analysis (odds ratio at 95% CI: 1.25; 1.1-1.4, $p: 0.001$). Moreover, the multivariate analysis's findings also showed that overweight, body mass index (BMI), and level of spinal block were predictors of spinal anesthesia. Additionally, it was discovered that the over weight group experienced bupivacaine-induced sensory and motor blocking level than the non-over weight group.

Conclusion:. These findings imply that overweight people had a high level of sensory and motor block, than non-over weight patients. Additionally, BMI, and bupivacaine dosage are significant predictors of level of spinal block under spinal anesthesia.

Keywords: Spinal anesthesia, Bupivacaine, Obesity, Body mass index, Ethiopia

DECLARATION

I certify that this thesis is entirely original with no presentations at this or any other university, and that all references to the materials used in the proposal have been properly cited.

Name_____ Signature _____Date _____

Adviser (I)

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Adviser (II)

Name_____ Signature _____Date _____

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ACRONYMS/ABBREVIATION

ASA=American Society Association
AC=Abdominal Circumference

BMI=Body Mass Index

CSE =Combined Spinal-Epidural

CSF=Cerebro Spinal Fluid

MBP=Mean Blood Pressure

TASH= Tikur Anbesa Specialized Hospital

ZMH hospital =Zewuditiu Memorial Hospital

SSS=Single-Shot Spinal Anesthesia

TKRA = Total Knee Replacement Arthroplasty.

TURP=Trance Urethral Resection of Prostate

USA=United State of America

WHO= World Health Organization

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Paul's Millennium Medical College, the personnel at Zewditu Memorial Hospital, the Addis Ababa health administration research team, and all participants in the research area.

CHAPTER ONE: INTRODUCTION

1.1. Back ground

Spinal anesthesia, a type of regional block, involves temporarily numbing the sensory, motor, and sympathetic nerves by injecting a local anesthetic and other drugs into the subarachnoid space, which surrounds the spinal cord and has long been seen as a serious issue in people who are overweight or obese as it works by distributing the local anesthetic through the subarachnoid fluid, which surrounds the nerve roots and creates the desired blockage (1–3)..Because of its quick onset, predictability, and dependable blocking, spinal anesthesia is the recommended option for lower abdominal and lower extremity procedures, including orthopedic, urologic, gynecologic, general surgery, and caesarian sections (3). Additionally, it offers superior postoperative pain management without the dangers of general anesthesia, like pulmonary aspiration (4,5). Nonetheless, it has been

found that obesity makes regional anesthesia difficult in locations with obscured anatomic features in conjunction with additional possible reasons could include the relatively small needle, difficulty palpating bony structures, or trouble finding the midline(2).

An additional characteristic of spinal anesthesia in obese patients is a greater propensity for local anesthetic to disseminate cephalically than in non-obese people due to physiological variations in obese people, such as decreased CSF volume, changed medication distribution, and epidural space compression(6). Since obese individuals often have reduced cerebrospinal fluid (CSF) volume due to factors like extradural vein distention and increased epidural fat, this reduction in CSF volume can lead to a higher spread of the anesthetic agent, potentially causing a higher level of sensory and motor block (6). Additionally, tissue blood flow affects the removal of local anesthetics; higher blood flow encourages the removal of local anesthetics, and the anterior part of the spinal cord has significantly higher blood flow, which speeds up the removal of local anesthetics as well as obese people's increased epidural fat can also change the distribution of the anesthetic drug because it may act as a barrier, influencing how the medication spreads throughout the epidural region and potentially causing variations in the degree of sensory and motor block. As a matter of fact, number of factors, including the patient's age, gender, height, weight, site and speed of injection, spinal needle tip orientation, baricity and dose of local anesthetics, intrathecal adjuvant administration, and patient position, baricity of local anesthetic agents, body-mass index (BMI), spinal anatomy, and duration of spinal anesthetic, must be taken into account in addition to physiological variations (4).

Nonetheless, there is still disagreement over how BMI affects spinal anesthesia, with most of the literature reporting contradictory results. For instance, this study has brought attention to the variability in the anesthesia's spread, with some investigations observing variations in the number of spinal segments impacted(7,8).

Research has indicated that there may be considerable variation in the way the anesthetic distributes across the spinal column, which may lead to variations in the number of spinal segments that the anesthetic affects. Given that The amount of anesthetic used, the injection's speed, and the patient's position during and after the procedure are some of the variables that affect this. However, research has indicated that physiological variations among patients can impact the efficacy and dissemination of spinal anesthetic(1,9).

The impact of obesity on spinal anesthesia has been examined in other earlier research, although the findings have been inconsistent (4). Since spreads are impacted by the baricity of the local anesthetics used for spinal anesthesia as well, hyperbaric bupivacaine results in a greater degree of

sensory block than isobaric solutions as it settles more predictably in the desired region due to gravity, leading to a consistent block. And is particularly beneficial for surgeries requiring higher levels of anesthesia, such as lower abdominal procedures(10). However, compared to hyperbaric medications, isobaric bupivacaine has been demonstrated to produce analgesia for a longer period of time, which makes it appropriate for operations like some lower limb and perineal surgeries where a longer-lasting block is beneficial. Additionally, they often have less adverse consequences. For example, they have less toxicity to the central nervous system and less negative inotropic effects, which lessen the force of the heart's contractions. They are therefore a safer choice for those who have underlying neurological or cardiovascular issues (4,5).

While studies on all surgical procedures in Ethiopia are lacking, research on spinal anesthesia outcomes, particularly among overweight and non-overweight patients, is notably absent. Although some studies have focused on obstetric mothers, their findings cannot be generalized to the broader population due to various confounding factors. A significant gap exists in research concerning the effect of BMI on the level of sensory and motor block in Ethiopian patients. Most of the available literature on this topic does not include data from the Ethiopian population. This is a critical oversight, as patient, drugs, and clinical factors can significantly influence how individuals respond to anesthesia, making it essential to conduct localized research to ensure optimal patient care and safety.

The relevance of international research to the Ethiopian population is debatable in a healthcare setting where resource constraints and distinct patient demographics present major obstacles. Inadequate spinal anesthetic in this situation can raise the risk of surgery, cause poor pain management, and increase the likelihood of complications like bradycardia, hypotension, and the need to switch to general anesthesia. Additionally, problems like shivering, nausea, and vomiting

can cause patients to experience severe discomfort, worry, and a longer recovery time. A common consequence after dural puncture is Postural Puncture Headache (PDPH), which increases patient morbidity. This study was created to explicitly address the knowledge gap within the Ethiopian community in light of these important challenges. The aim is to compare the level of sensory and motor block achieved after spinal anesthesia in overweight and non-overweight patients undergoing sub-umbilical surgery. This research, conducted in selected hospitals in Addisababa, Ethiopia, in 2025, seeks to provide crucial, locally-relevant data to improve patient safety and outcomes.

1.2. Statement of the Problem

Globally, being overweight is becoming a bigger public health issue(11). U.S. Centers for Disease Control and Prevention (CDC), shows that a significant majority of the adult population is either overweight or has obesity Specifically, the CDC's National Health and Nutrition Examination Survey (NHANES) data from 2017-2018 reported that 73.6% of adults in the United States were classified as overweight and obesity among adults was 40.3% (12) whereas 87% of women in South Africa, 74.1% in Tanzania, 66.7% in Nigeria, and 57.4% in Uganda were overweight or obese and of reproductive age. Overweight and obesity are the most prevalent risk factors for noncommunicable diseases (NCDs), according a review carried out in Ethiopia (13).Nonetheless, the percentage of Ethiopian reproductive women who are overweight also rose gradually, rising from 6.09% in 2005 to 8.54% in 2011 and 10.16% in 2016(13)]. As a result, increasing adipose tissue among obese obscure anatomical markers, making spinal anesthesia more difficult to effectively administer (14).

A growing body of global evidence suggests that body mass index (BMI) is a crucial factor influencing the efficacy and safety of spinal anesthesia. Overweight and obese patients often present

unique anatomical and physiological challenges that can alter the spread and duration of local anesthetics, potentially leading to suboptimal block levels, increased risk of complications, and the need for conversion to general anesthesia(15).

Despite this recognized association, a significant gap exists in the understanding of how these factors apply to the Ethiopian population. Comprehensive studies encompassing all surgical procedures have not been conducted, and existing research often lacks representation from diverse demographics, including those in the Addisbaba. While some studies have focused on specific groups like obstetric mothers, their findings cannot be broadly generalized due to the distinct physiological factors associated with pregnancy.

This knowledge deficit is particularly problematic in Addisababa where the prevalence of overweight and obesity, especially among urban women, is rising. Studies conducted in selected public hospitals in Addis Ababa indicate that approximately one in five adults is overweight or obese, underscoring the relevance of this issue to local healthcare(13). The unique genetic, environmental, and cultural factors of this population, which can influence anesthetic responses, necessitate localized research to ensure optimal patient care.

Suboptimal spinal anesthesia in a resource-limited setting like Addisababa public hospitals can have serious practical implications. It can lead to increased surgical risks, patient discomfort, and prolonged recovery times, which strain already limited hospital resources. The lack of a clear understanding of how BMI affects spinal anesthesia outcomes leaves clinicians without evidence-based guidelines tailored to their patient population.

Therefore, this study is essential to fill this critical knowledge gap. By comparing the level of spinal anesthesia block in overweight and non-overweight patients, this research will provide the first-of-its-kind evidence from the Addisababa, Ethiopia . The findings will serve as a foundational resource for developing local clinical protocols and training programs, ultimately aiming to improve the safety and effectiveness of spinal anesthesia and enhance patient outcomes in the region.

1.3. Significance of the study

The significance of this study is multi-faceted, addressing a critical knowledge gap and promising to deliver tangible benefits for patient care, clinical practice, and medical education in Ethiopia.

Guiding Evidence-Based Clinical Practice: This research will provide the first-of-its-kind, locally-generated data on how BMI affects spinal anesthesia outcomes in the West Shewa region. The findings will equip anesthesiologists and other healthcare providers with the evidence needed to adapt their techniques, dosage, and patient management strategies, moving from generalized practices to evidence-based care tailored to the unique patient population.

Optimizing Patient Outcomes and Safety: By identifying the specific challenges associated with spinal anesthesia in overweight patients, the study will directly contribute to a reduction in complications such as failed blocks, patient discomfort, and the need for conversion to general anesthesia. This will lead to a safer, more predictable surgical experience and improved patient satisfaction and recovery.

Informing Local and National Health Policy: The data from this multi-center study can serve as a cornerstone for developing official clinical guidelines and protocols for anesthesia administration in Ethiopia. This is crucial for standardizing care across hospitals and ensuring that all patients, regardless of their BMI, receive the most appropriate and effective anesthetic management.

Advancing Medical Knowledge and Education: The study will fill a significant gap in both the local and international anesthesia literature. Its results can be integrated into the curricula of medical and nursing schools, providing a practical, region-specific case study that enhances the training of future healthcare professionals. It will also serve as a foundation for further, more comprehensive research on anesthesia and related health challenges in Ethiopia.

Improving Resource Utilization: By reducing the incidence of failed spinal blocks and complications that require additional resources (e.g., more drugs, equipment for general anesthesia, or extended hospital stays), this study can indirectly contribute to more efficient and cost-effective use of the limited resources available in public hospitals.

CHEPTER TWO: LITERATURE REVIEW

The study of spinal anesthesia has evolved significantly over the years, with initial studies focusing on the basic principles and techniques. As understanding grew, research began to delve into specific factors that influence anesthesia outcomes, including body weight and BMI(18–20).With the discovery of local anesthetics, the first of which was cocaine (the only naturally occurring local anesthetic), regional anesthesia began to take shape. The first spinal anesthesia procedure was carried out in 1898 in Germany by August Bier, and spinal anesthesia was the first regional anesthetic treatment used. The only local anesthetic methods used prior to this were infiltration anesthesia and topical anesthesia of the eye. Effect of body mass index on spinal anesthesia has been recognized as a significant factor in spinal anesthesia adverse outcomes (13,21)

Some of previous Studies demonstrate that overweight and obese patients may experience different anesthesia spread compared to non-overweight patients[4,5,17]. Some key factors is Variability in Anesthesia Spread:found that BMI affects the spread of spinal anesthesia, often leading to

inconsistent block levels, Increased Complications: highlights that higher BMI increases the risk of complications such as hypotension and failed anesthesia, Need for Dosage Adjustments: Studies suggest that adjustments in anesthetic dosage are often necessary for achieving optimal outcomes in obese patients. Mechanisms of BMI Influence on Block Height is Several physiological mechanisms explain how body mass index affects the height and effectiveness of spinal anesthesia blocks (22,23) These mechanisms involve changes in drug distribution and anatomical differences between patients with varying BMI. key factor is reduced CSF Volume; found that obese patients often have a reduced cerebrospinal fluid (CSF) volume, affecting anesthetic distribution, Increased Epidural Fat; reported that excess epidural fat in obese patients can compress the epidural space, influencing anesthetic spread. Altered Pharmacokinetics; highlighted how higher body fat changes drug distribution, impacting the onset and duration of anesthesia.

When 209 patients underwent elective total knee replacement arthroplasty (TKRA) surgery in the Republic of South Korea in 2015, they were divided into two groups: the obese (O) group ($\text{BMI} \geq 30 \text{ kg/m}^2$, $n = 68$) and the non-obese (NO) group ($\text{BMI} < 30 \text{ kg/m}^2$, $n = 141$). Anesthesia was deemed successful if, within 15 minutes of intrathecal drug delivery, a bilateral T12 sensory block formed and the degree of sensory block was higher than T12 at the end of the surgery. To discover which characteristics independently impacted the spinal anesthesia outcome, a logistic regression analysis was conducted using numerous variables known to influence spinal anesthesia. The NO and O groups received bupivacaine at comparable dosages. The O group had a considerably reduced rate of anesthetic failure [$n = 43$ (30.5%) in the NO group compared to $n = 10$ (18.9%) in the O group, $p = 0.014$]. Hyperbaric bupivacaine dosage [odds ratio (OR) 2.12, 95% CI: 1.64–2.73] and obesity status ($\text{BMI} \geq 30 \text{ kg/m}^2$, OR 2.86, 95% CI: 1.25–6.52) were independent predictors of effective anesthesia in all patients. Both the time to first self-void and the time to first report postoperative pain were noticeably longer in the O group. These findings imply that obese patients had a longer duration of block with hyperbaric bupivacaine, and that both obesity and bupivacaine dosage are independently related to spinal anesthetic outcomes. Confirming the impact of obesity on spinal anesthesia will require a follow-up study that includes patients with morbid obesity and uses a fixed dosage of bupivacaine (10,24).

A study conducted in Turkey in 2021 found that because obesity reduces cerebrospinal fluid (CSF), it significantly affects the cephalic spread of a spinal block (SB). In addition to the CSF, tissue blood flow regulates SB. Hemodynamic alterations may result from specific surgical postures and procedures. The impact of potential hemodynamic alterations during lithotomy position (LP) and

transurethral prostate resection (TURP) on the sensory block level in obese versus non-obese individuals were examined. Sixty patients who had received spinal anesthesia for TURP surgery were split into two groups: non-obese (BMI < 25 kg/m², Group N) and obese (BMI ≥ 30 kg/m², Group O). Following the LP, SB assessments were documented. The peak SB level and SB at 6 and 120 minutes were compared between the two groups. Following LP, hemodynamics were monitored. The groups' peak and 6-minute SB levels were comparable, while Group O's 120-minute SB levels were noticeably greater ($P < 0.05$). Following the LP, Group N's blood pressure (BP) was noticeably higher ($P < 0.05$). In contrast to Group O, LP and TUR-P raised Group N's blood pressure. Increased hemodynamics improves spinal cord blood flow and may result in non-obese people having SB levels that are comparable to those of obese patients (6,25).

Obesity may be linked to the spread of spinal anesthesia in female patients, according to a 2017 study conducted in South Korea in female patients, central adiposity is associated with a more widespread spread of spinal anesthesia (8). Another study was conducted by Leiguan in China in 2017. Bupivacaine dosage (odds ratio at 95% CI = 2.08; range: 1.61 - 2.67) and obesity status (odds ratio at 95% CI = 2.83; range: 1.21 - 6.49) were found to be independent predictors of effective anesthesia in the patients. The multivariate analysis's findings also showed that obesity, body mass index (BMI), and bupivacaine dosage were predictors of spinal anesthesia. Additionally, it was discovered that the obese group experienced bupivacaine-induced sensory blocking for a longer duration than the non-obesity group (26).

In a 2019 study conducted in Theran, the two groups' body weight, height, and BMI differed significantly, and the obese patients' duration to achieve sensory block T10 was noticeably shorter. Compared to the non-obese group, the obese group required more time to recover from sensory and motor block. Furthermore, the two groups' blood pressure patterns during surgery differed from one another. The study's findings indicated a relationship between spinal block anesthetic time and BMI. Moreover, patients with a greater BMI may experience a longer duration of analgesia, and the maximum motor and sensory block described in obese patients occurs more quickly (23).

A 2020 study conducted in Egypt found that while there was no significant difference in the mean blood pressure (MBP) between groups A and B, there was a significant difference between group C and the other two groups. While there was no significant difference in the incidence of hypotensive episodes between groups A and B ($P < 0.001$), group C experienced a significantly higher mean number of hypotensive episodes than group A. Compared to groups A and B, group C had a higher total dose of vasopressor and a larger total amount of fluid infused. Five patients (12.5%) in group A

had a maximum block level that extended above T3, with a predominance of T5 (35%); ten patients (25%) in group B had a maximum level that extended above T3, with a predominance of T4 (45%); and twenty-one patients (52.5%) in group C had a maximum block level that extended above T3, with a predominance of T3 (32.5%). Thirty minutes after the subarachnoid injection of bupivacaine, group C's mean peak expiratory flow rate (PEFR) was significantly lower than that of groups A and B (343.75 ± 35.06 vs 335.36 ± 32.96 vs 320.38 ± 24.0 ml; $P = 0.004$). Analgesic supplementation was not necessary in any of the instances (16)

According to study in turkey 2022, We observed no significant demographic differences in age, gender, or ASA risk class between the groups; however, we found a statistically significant difference between the groups' BMIs and waist circumferences (6,11).

Lastly, the 2023 study With a p-value of less than 0.001, the fat group outperformed the non-obesity group in terms of time for ascent of sensory block (T6) as determined by the cold swab test and motor blockade as determined by the Bromage scale. We conclude that after a same dose of spinal anesthetic was given to obese patients, sensory motor block was more severe and had a faster start than in non-obese patients (18).

The lack of studies comparing the degree of block following spinal anesthetic in adult surgery patients who are overweight and those who are not is a gap in the literature.

CHEPTER THREE: OBJECTIVES:

3.1. General objectives:

Comparison of spinal anesthesia block level in overweight and non-overweight patients undergoing surgery below the umbilicus in AddisAbaba public hospitals Ethiopia Jan 1, 2025 to March 30,2025 .

Specific objectives

- Identify the level of sensory block achieved after spinal anesthesia in over weight vs non overweight patient.
- Determine the highest level of motor block achieved after spinal anesthesia in over weight vs non overweight patient.

CHEPTER FOUR: METHODOLOGY

4.1. Study area and period

Zewditu Memorial Hospital in Addis Ababa, Ethiopia; St. Paul's Hospital Millennium Medical College; and Black Lion Comprehensive Specialized Hospital. According to the 2024 population census, Addis Ababa, Ethiopia's capital city, has 5,704,000 residents spread across an estimated 530.14 square kilometers. This is where these three hospitals are located. Ten of the 29 hospitals in the city that have operational operating rooms are Federal Hospitals. People travel to those hospitals from all around Ethiopia in order to receive specialist care. This research will be carried out at a specific hospital in Addis Ababa, Ethiopia. General surgery, pediatric surgery, neurosurgery, urological surgery, ENT surgery, obstetric surgery, orthopedic surgery, and cardiothoracic surgery are the surgical specialties now offered by those chosen facilities. This research will be carried out at a specific hospital in Addis Ababa, Ethiopia from Jan 1, 2025 to March 30,2025 .

4.2. Study design: A multi -center prospective cohort study design conducted from Jan 1, 2025 to March 30,2025 .

4.3. Population

4.3.1. Source population: All adult patient obese and non-obese patients admitted to the selected hospitals to undergo lower umbilicus surgery.

4.3.2. Study population: All Adult surgical patients who underwent lower umbilicus surgery it include: urology surgery, cesarean section, arthroplasty and lower extremty surgery under spinal anesthesia.

4.4. Sample size determination and Sampling technique:

- Mean difference (effect size) you expect = 1 dermatome level
- SD = 2 dermatomes
- $\alpha = 0.05$, power = 80%
- Outcome is approximately normally distributed,
- Using the formula for comparing two means:

- $n=2(Z\alpha/2+Z\beta)^2\cdot\sigma^2 / \Delta^2$,
- Where: $Z\alpha/2=1.96$ (for 95% CI), $Z\beta=0.84$ (for 80% power), $\sigma=2$,
 $\Delta=1, n=122(1.96+0.84)^2\cdot 2^2=12\cdot(2.8)^2\cdot 4=2\cdot 7.84\cdot 4=62.72$
- 70 patients in each group were selected under systematic random sampling method.

4.5. Eligibility criteria

4.5.1. Inclusion: all adult patients who scheduled for elective and emergency surgery below umbilicus: urology surgery, cesarean section, and lower extremity surgery under spinal anesthesia and age, 18-65 .

4.5.2 Exclusion:: Age <18yrs, Patient with severe comorbidities, missed medical records

4.6. Method of Data collection: One hundred forty patients who had surgery below the umbilicus were split into two groups for the study: those who were overweight (BMI ≥ 25 kg/m²) and those who were not (BMI <25 kg/m²). Commence with the preoperative evaluation, which includes the patient's BMI (weight divided by height square), demographics, the duration of the procedure and anesthesia, the degree of sensory and motor block, and any variations in hemodynamics between the two groups. The injection is usually administered at the L3-L4 intervertebral space. Needle Insertion; A spinal needle, typically 23-25 gauge, is used to puncture the dura mater and deliver the anesthetic into the subarachnoid space. Injection Speed of ,the anesthetic solution was injected slowly over 10 seconds to avoid excessive spread and ensure better control of block height. For Observation standard monitoring was applied in order to manage the patient's vital signs and to avoid further complication associated with spinal anesthesia drug off 0.5% heavy and plain bupivacaine. On the other hand, sensory and motor level frequently assessed at induction(5minuts), 10minuts and at the end of surgery to make sure that block's effectiveness and detect any adverse reactions promptly, 15mg-20mg off 0.5% dose of bupivacaine had used with adjuvant fentanyl 25mcg accordingly. Evaluated the sensory block level using a pinprick test or ice to assess the effectiveness of anesthesia. motor block by asking the patient to move their legs or feet. And, Continuously monitor blood pressure, heart rate, and oxygen saturation had managed 2-

5ml/min as needed. Any hemodynamic changes managed by using nor adrenalin and adrenalin 5mcg-10mcg and 10mcg-25mg drug as used respectively

4.7. Variables of study

Dependent Variables: level of sensory and motor block

Independent variables:

- ✚ Patient related factors; age, height, weight, BMI, gender and positioning.
- ✚ Clinical factor: physiological and anatomical difference, pregnancy, duration of surgery and ASA I/ II /III.
- ✚ Medication factors: dose, Bari city.
- ✚ Spinal block technique factors include the anesthetist's technique, intrathecal adjuvant, spinal needle tip, injection site and speed, and more.

4.8. Operational Definitions:

- Spinal anesthesia is a Neuraxial technique in which local anesthetic is placed directly in the intrathecal (subarachnoid space).
- Sensory Block Level: This is typically assessed using a pinprick test or cold sensation test. The level of sensory block is determined by the highest dermatome level at which the patient no longer feels the pinprick or cold sensation[19].
- Motor Block Level: This is often evaluated using the Bromage scale, which measures the degree of motor impairment. The scale ranges from 0 (no block) to 3 (complete block with no movement possible)[19].
- Overweight is a condition of excessive fat deposits with BMI>25-29.9 and[14]
- Non over weight is BMI<25[14].

4.9. Data quality assurance:

By implementing a detailed training program on questionnaire administration, ethical considerations, and standard operating procedures, we can ensure consistency and accuracy in data collection. The Participants were selected based on criteria similar to those of the main study population. The questionnaire were pre tested 5% to identify any ambiguity and unclear questions. By implementing rigorous supervision and monitoring procedures, potential errors in data collection were identified and addressed in real-time.

4.10. Analysis

: By using Excel spread sheet for raw data and analyzed by SPSS version 26 software program. Data had summarized by using descriptive statistics, continuous data was compared using the mann-white-tney U-test, the chi square test used to categorical variable test. Logistic regression model used to measure univariate and multivariate for the prediction of factors affecting the level of sensory and motor block under spinal anesthesia, as well as succussablity and fuilarity associated with BMI and dose of bupivacaine. Univariate logistic regression used to analysis for the purpose of possible predicting factors or criteria to identify the variables that could be feet for multivariate analysis based on(p-value is <0.05) regarding with level spinal block and successful anesthesia induction. The multivariate regression model were summarized only the variable in univariate had included and significance in univariate analysis (p- <0.05). A missing data were handled by using imputation technique or excluding incomplete data if appropriate. Reporting the proportion of missing data and assessing its impact on the result were done

4.11. Ethical consideration:

The Institutional Review Board (IRB) of Addis Ababa University's College of Health Science granted ethical clearance, Upon approval, they provided a letter of support to be distributed to hospitals, as It was inquired. and a formal letter of collaboration was delivered to the hospitals, followed by the case team or relevant departments. As a result, surveys were protected, patient privacy was preserved, and patient identities were not revealed.

4.12. Dissemination plan

Copies of the final results will be delivered to the hospitals where the study carried out .First and foremost, a concerted attempt will made to publish the study's results in an internationally recognized journal. Lastly, the study's will be presented at the yearly conferences of the Association of Ethiopian Anesthetists and distributed to hospitals which were studied.

CHAPTER FIVE: RESULTS

The prospective study included 170 individuals, 16 of whom were excluded due to various medical conditions, including hypertension, instability of patient, and patient refusal of spinal anesthesia. Analysis covered the remaining and eligible 140 patients who grouped in to over-weight and non-over weight, each entailed 70 patients. Majority of patients were females who covered 59.3%. The median age were 36(28-45).

On multivariate analysis, overweight's were higher sensory and Complete motor block. AOR:1.95CI(1.5-2.5), $p<0.001$, and AOR:1.5, CI:(1.21.87), $p<0.001$ respectively in contrast to their counterparts and dose of bupivacaine also were significantly associated to higher motor and sensory blocks. as well as bupivacaine dosage was one of the independent indicators of the patients' effective anesthesia. AOR:1.56(CI: 1.24-1-2.3), $P;0.028$ and). BMI kg/m² was found to be a predictor of effective level of block under spinal anesthesia by multivariate analysis (odds ratio at 95% CI: 1.25; 1.1-1.4, $p: 0.001$). The multivariate analysis's findings also show that

The relation between body mass index (BMI), and level of spinal block were predictors of spinal anesthesia. Additionally, it was discovered that the over weight group experienced bupivacaine-induced sensory and motor blocking level than the non-over weight group

Regarding the failure of anesthetic induction and the complication associated with spinal anesthesia, there were no discernible difference between the groups with and without over-weight. However, compared to the non-over weight group, the over-weight group experienced a substantially higher level of sensory and motor blocking in the induction of anesthesia. (induction in the NO vs. O group = T10(T10-T11)vs. T7(T6-T8), $p = 0.01$).The incidence of bradycardia, nausea, and tourniquet pain, did not significantly differ between the two groups, and neither group reported experiencing any surgical pain throughout the procedure. Furthermore, the two groups did not differ significantly in how long it took them to experience their initial postoperative discomfort. Only fifty non-over weight patients received a score of three on the Bromage scale, compared to 69 obese patients (level motor block was highly achieved among over-weight patients).(see Table 2)..BMI , weight, and bupivacaine dosage (in milligrams) were found to be significant predictors of successful anesthesia in univariate analysis of predictors of successful anesthesia (Table 3). BMI kg/m² was found to be a predictor of effective anesthesia by multivariate analysis (odds ratio at 95% CI: 1.25; 1.1-1.4, $p: 0.001$).on the other hand BM greater than 25 kg/m² was independently linked to spinal anesthesia success (odds ratio at 95% CI: 3.0; range: 1.05 – 9, $p: 0.001$).

Table 1: patient related factors and their clinical information

Variables	Non-Over weight	Over weight	P value
Age	31(26-45)	36(30-45)	0.404
Height	1.70(1.63-1.70)	1.68(1.60-1.70)	0.179
Weight	65(60-70)	79(75-87.5)	<0.01
BMI	23(22-24.1)	28.3(26.1-31.7)	<0.01
Gender (M/F)	36/35	21/48	<0.01
ASA(I/II/III)	36/33/2	6/61/2	0.015
Bupivacaine Dose	17.5(17.5-20)	17.5(17.5-20)	0.007
Duration of surgery	60(50-120)	60(45-120)	0.473

Comparing the NO and O groups on the features of spinal anesthesia and its perverse occurrences. two groups' demographic and clinical characteristics were associated.(See table 1) Furthermore, the groups did not get the same dosage of bupivacaine. By definition, the Over weight group

experienced a significantly lower rate of anesthetic failure (13 failures, 9.3%) compared to the NO group (20 failure, 14.3%)

Figure 1 : Logistic regression mean line graph association of level of sensory block in a groups..... 20

Parameters	Non-over weight	Over-weight group	P-value
Success of anesthesia vs. failure of induction of anesthesia (n/%)	50/20	57/13	0.044
	35.7/14.3	40.7/9.3	
Sensory blockage peak at 10' after anesthesia induction	T9 (T8-T10)	T7(T6-T8)	<0.01
Sensory nerve blockade level upon completion	T10(T10-T11)	T10(T9-T10)	0.051
Bromage scale at 10'(3/2)	50/20	69/1	<0.01
Tourniquet pain (n, %)	3(2.1)	5(3.6)	0.443
Hypotension (n, %)	15(10.7)	22(15.7)	0.150
Adrenaline and nor-ad apply (n,%)	8(5.7)	9(6.4)	0.749
Mean blood pressure baseline (mmHg)	90(85-100)	90(85-100)	0.835
Lowest mean blood pressure (mmHg)	70(65-75)	70(60-76.5)	0.677
Bradycardia (n, %)	3(2.1)	7(5)	0.175
Vomiting (n, %)	16(11.4)	19(13.6)	0.496
Nausea (n, %)	12(8.6)	18(12.9)	0.187
Shiver (n, %)	35(25)	42(30)	0.170
Duration of injection(sec)	10	10	0.511
Post op pain	120(120-180)	120(60-150)	0.450

Regarding the failure of anesthetic induction and the complication associated with spinal anesthesia, there were no discernible difference between the groups with and without over-weight. However, compared to the non-over weight group, the over-weight group experienced a substantially higher level of sensory and motor blocking in the induction of anesthesia. (induction in the NO vs. O group = T10(T10-T11)vs. T7(T6-T8), $p = 0.01$).The incidence of bradycardia, nausea, and tourniquet pain, did not significantly differ between the two groups, and neither group reported experiencing any

surgical pain throughout the procedure. Furthermore, the two groups did not differ significantly in how long it took them to experience their initial postoperative discomfort. Only fifty non-over weight patients received a score of three on the Bromage scale, compared to 69 obese patients (level motor block was highly achieved among over-weight patients).(see Table 2)..BMI , weight, and bupivacaine dosage (in milligrams) were found to be significant predictors of successful anesthesia in univariate analysis of predictors of successful anesthesia (Table 3). BMI kg/m² was found to be a predictor of effective anesthesia by multivariate analysis (odds ratio at 95% CI: 1.25; 1.1-1.4, p: 0.001).However, BM greater than 25 kg/m² was independently linked to spinal anesthesia success (odds ratio at 95% CI: 3.0; range: 1.05 – 9, p: 0.048).

Table 2: Univariate analysis of over weight and non-overweight groups for predictors of successful anesthesia at the study area during study period.

variables	Success of anesthesia (n = 122)	Failure of anesthesia (n = 18)	Crude odds ratio (95% CI)	P value
Age	36(27.8-45)	36(30-48.5)	2.02(1.97-1.07)	0.045
Height	1.7(1.62-1.7)	1.68(1.6-1.71)	0.17(0-32)	0.20
Weight	70(62.8-76)	81(66.5-88.3)	1.06(1.013-1.20)	0.01
BMI <kg/m ²	31.5(23-33.3)	24.5(23-26.9)	1.3(1.1-1.4)	0.001
BMI> 25kg/m ²	57(40.7)	13(9.3)	3(1-8.8)	0.05
Bupivacaine dose	15(15-17.5)	17.5(17.5-20)	2.3.0(1.8-3.3)	0.001

Univariate analysis on predictors of successful anesthesia showed that height of the patient were not important predictors for successful anesthesia, table 3.

Table 3: Multivariate analysis of over-weight and non-over weight groups for predictors of successful anesthesia at the study area during study period.

Sensory level	Low Block (>T6)	High block(=<T6)	Odd ratio	P value
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	Coefficient	Adjusted odds ratio (95% CI)	P value
BMI >kg/m ²	0.22	1.25(1.1-1.4)	0.001
BMI<25kg/m ²	1.1	3(1.05-9.0)	0.048
Bupivacaine dose	0.61	1.56(1.24-1-2.3)	0.028

Age	35(26-45)	36(30-45)	1(1-1.05)	0.379
Height	1.7(1.63-1.7)	1.67(1.6-1.7)	0.058 (0-89)	0.447
Weight	65(60-70)	80(75-89)	1.05(1-1.1)	0.073
BMI> kg/m2	24(22.2-25)	29.7(26.7-33)	1.5(1.14-1.9)	0.002
Bupivacaine dose	15(17.5-20)	15(15-17.5)	11(3-40)	<0.001
Motor	Complete	Incomplete	Odd ratio	P value
Age	36(28-45)	36(27-47.5)	1.0(0.96-1.05)	0.78
Height	1.69(1.62-1.71)	1.7(1.61-1.7)	1.7(0.001-25.9)	0.884
Weight	74(65-80)	65(60-67.5)	1.1(1.03-1.16)	0.001
BMI> kg/m2	25.97(23.66-28.7)	23.43(22-24.15)	1.4(1.13-1.62)	0.01
Bupivacaine dose	15(15-17.5)	17.5(17.5-20)	7.3(1.7-30.4)	0.006

Table 4: Univariate analysis of level of sensory and motor block

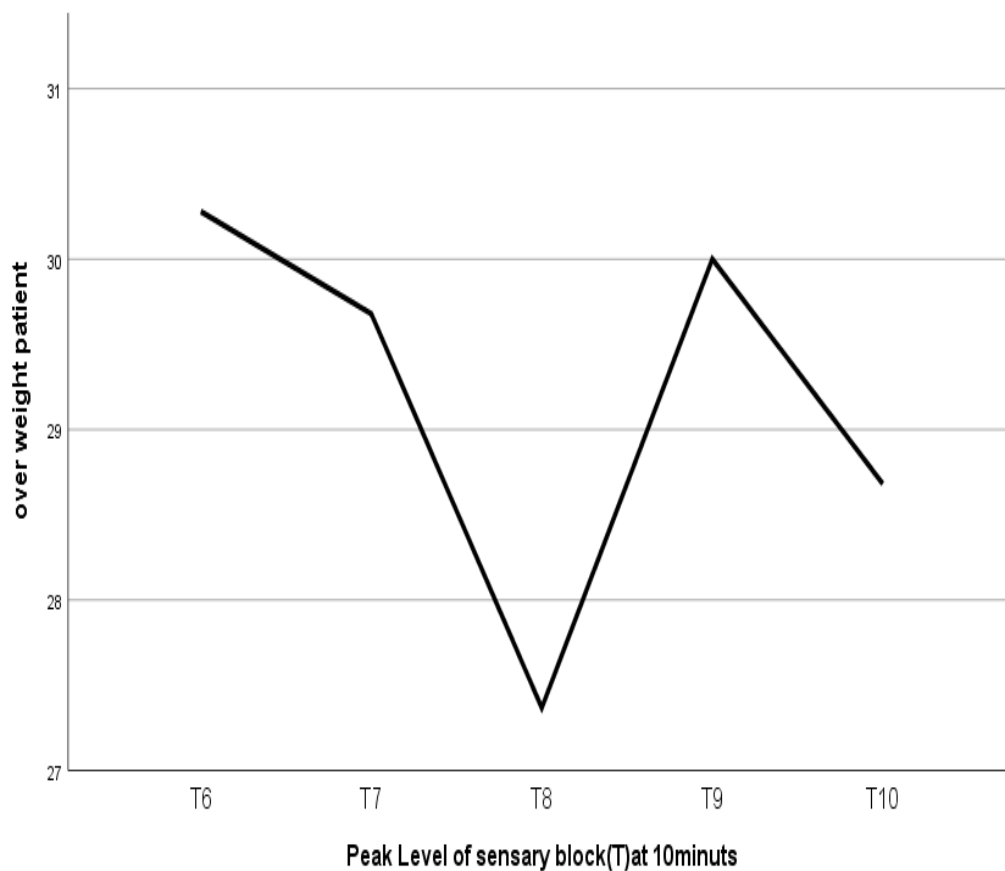
A multi variate analysis of level of sensory block with overweight patients were higher than their counter parts and complete motor blockage (=3) were significantly seen among over-weights AOR:1.95 CI(1.5-2.5), p:<0.001, and AOR:1.5, CI:(1.2-1.87), p:<0.001, respectively. in contrast to their counterparts and dose of bupivacaine were significantly associated to higher motor and sensory blocks.

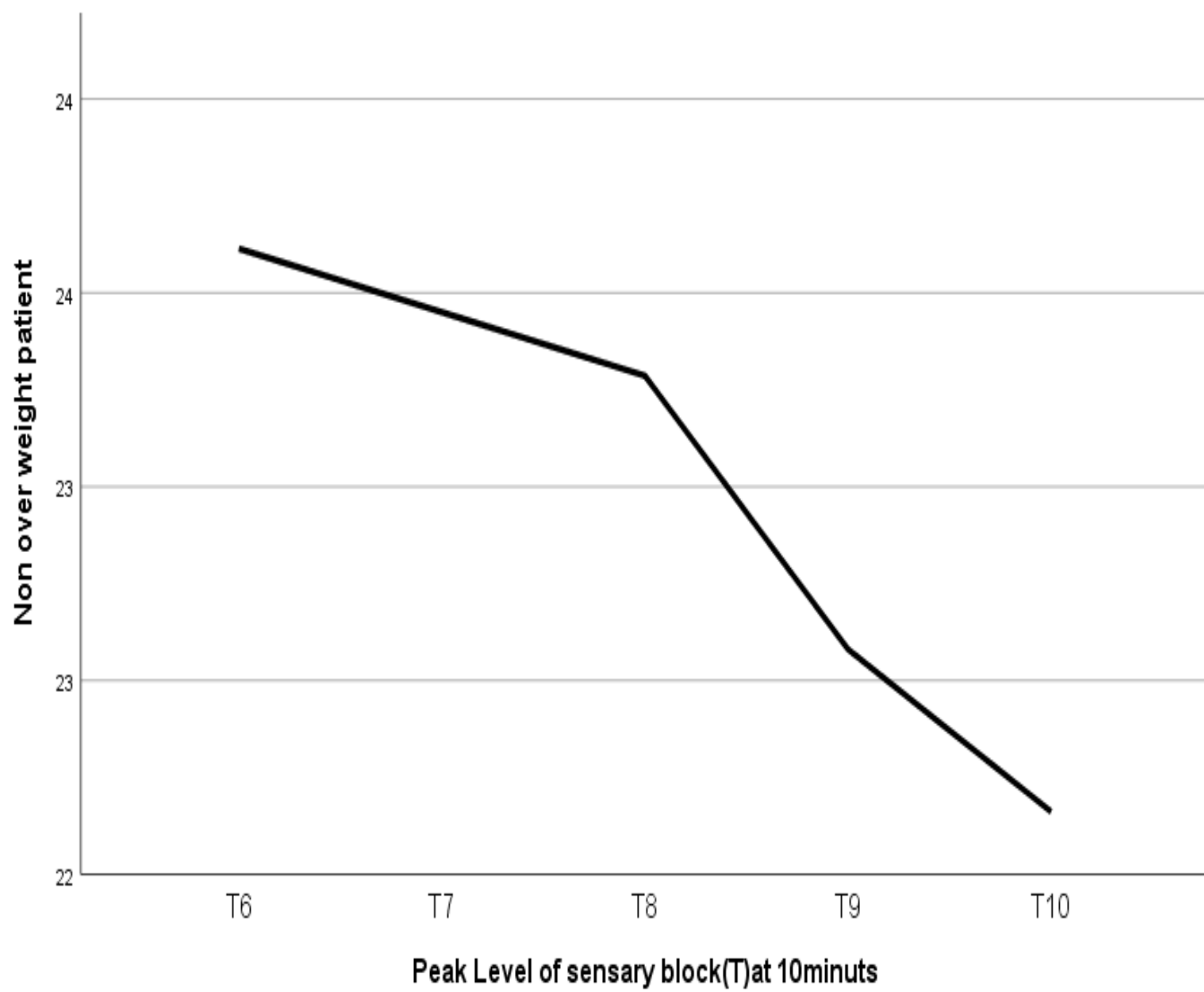
Table 5: Multivariate analysis of level of sensory and motor blocks of predictors of high and complete block at the study area during study period.

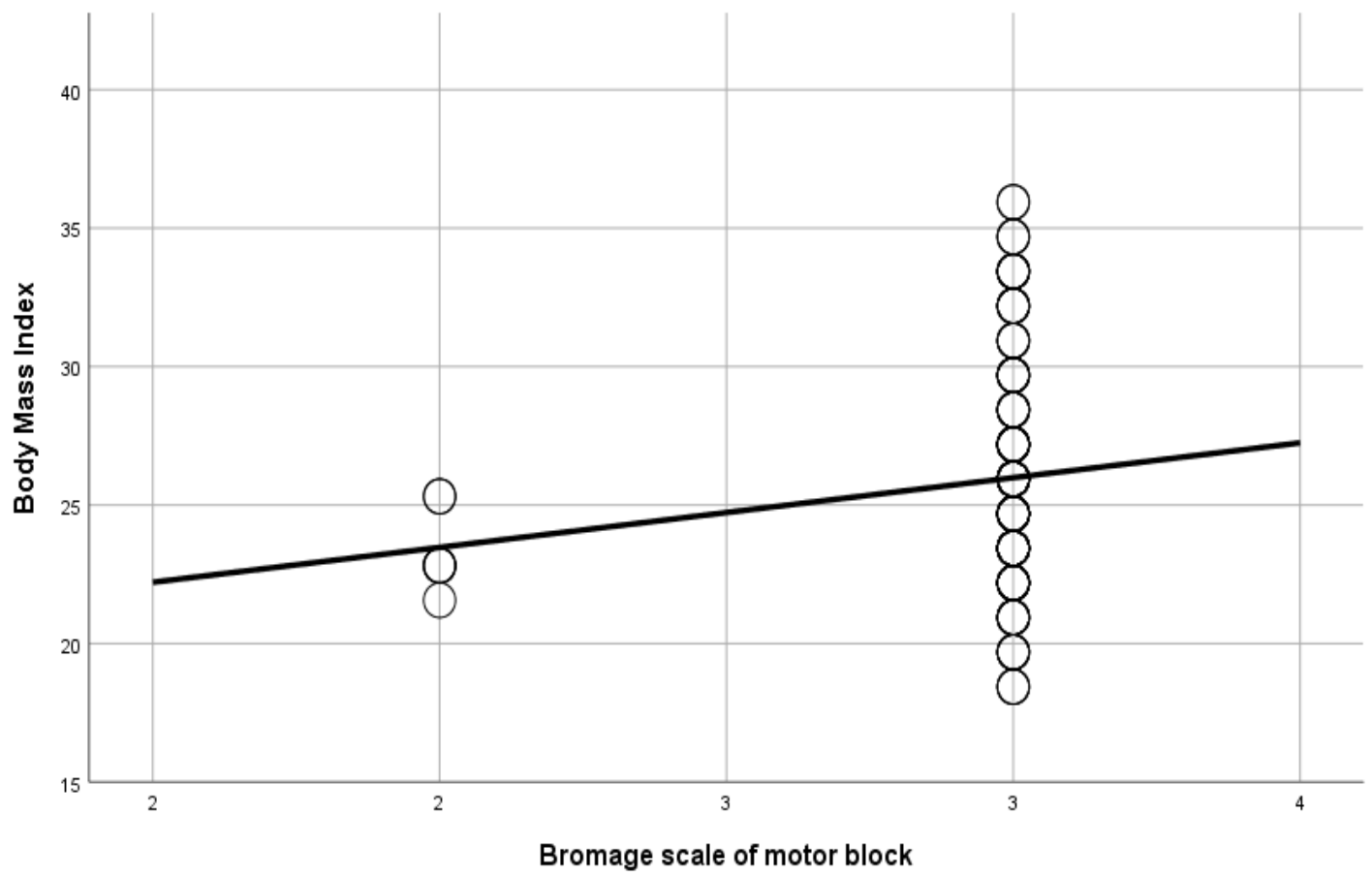
Sensory Level	Coefficient	Adjusted odds ratio (95% CI)	P value
BMI> kg/m2	0.67	1.95(1.5-2.5)	<0.001

Bupivacaine dose	0.50	6.4(1.06-39.2)	0.043
Motor level	Coefficient	Adjusted odds ratio (95% CI)	P value
BMI> kg/m2	0.4	1.5(1.2-1.87)	<0.001
Bupivacaine dose	0.61	1.56(1.24-1-2.3)	0.028

Figure 1 : Logistic regression mean line graph association of level of sensory block in a groups







CHAPTER SIX: DISCUSSION

This prospective study compares the level of sensory and motor block of spinal anesthesia-related indicators between groups that are overweight and non-overweight patient's. Based on BMI, these parameters help determine how the spinal anesthetic drug will go and spread through spinal canal and consequences the spinal anesthesia effect. Actually, the study was only based on BMI charts that were used to divide the patients who had surgeries into two groups. That means, 140 patients divided in to two groups 70 each, over weight and non over weight patient .The anesthetic and surgical characteristics of the patients in the two groups did not significantly differ in this investigation. However, from the group the level of sensory and motor block of the over weight patient had significantly higher than non over weight. On the other hand, the success of anesthesia related with this group also higher than other. In pervious studies, the duration of the initial self-void and the post-surgery pain report were longer in obese patients(18,21,23,27).However, according to this study no significant deference between overweight patient and non-overweight. The literature has a number of contradictory data regarding the direct link between obesity and spinal anesthetics (13,17,18,21).As a result, the exact mechanism behind spinal obstruction remains unclear. Nonetheless, it has been noted that the amount of CSF significantly influences the length and severity of spinal obstruction (27)According to another study, there is a correlation between the peak degree of sensory obstruction and the volume of CSF (8,28).Patient characteristics such age, height, weight, and BMI were considered to be powerful determinants of inter-individual differences in the current prospective investigation. According to a study, the distribution of sensory obstruction and obesity are directly related (21).MRI scans have shown that obese patients have significantly lower CSF volumes (24)Unfortunately, nothing is known about the process underlying obese patients' decreased CSF volume. Increased blood flow through the lumbar vertebral plexus was also noted (19)This is because obese patients have higher abdominal pressure, which obstructs the inferior vena cava. The weight of the stomach contents and extradural vein edema could be the cause of this. Additionally, in obese people, the cerebrospinal fluid area is compressed by the extradural vein, which lowers its volume (29).This could be the reason why anesthetic works better for obese persons.

In general, These findings imply that overweight people had a high level of sensory and motor block, than non-over weight patients. Additionally, multivariate analysis reveals that over weight, BMI, and bupivacaine dosage are significant predictors of level of spinal block under spinal anesthesia.

Regarding the failure of anesthetic induction and the complication associated with spinal anesthesia, there were no discernible difference between the groups with and without over-weight. However, compared to the non-over weight group, the over-weight group experienced a substantially higher level of sensory and motor blocking in the induction of anesthesia Future research to confirm the impact of over-weight on spinal anesthesia should include a fixed dose of bupivacaine.

CHAPTER SEVEN: CONCLUSION

These findings imply that overweight people had a high level of sensory and motor block, than non-over weight patients. Additionally, multivariate analysis reveals that over weight, BMI, and bupivacaine dosage are significant predictors of level of spinal block under spinal anesthesia. Future research to confirm the impact of over-weight on spinal anesthesia should include a fixed dose of bupivacaine.

STUDY LIMITATIONS

This study is subject to certain constraints. First of all, there was no set dosage of bupivacaine given to either group. Second, the study was purely prospective and observational. Third, speed of injection also may not exact. Therefore, it is advised that in level of spinal block studies, a single, predetermined dose with types of bupivacaine and be employed. Fourthly, those with overweight should have had a larger injection level.

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CHAPTER NINE: ANNEXES /APPENDIX

9.1. Informed consent and Questionnaire

Data gathering instruments for the department of anesthesia at Addis Ababa University's College of Health Sciences

Between March 1 and August 30, 2025, a comparison of the amount of block attained following spinal anesthetic in overweight and non-overweight patients undergoing surgery below the umbilicus at a few public hospitals in Addis Ababa. I am _____ I work in the anesthesia department at Addis Ababa University as a member of the data collection team. This questionnaire's objective is to collect data on the degree of block attained following spinal anesthetic in patients who are overweight or not who are having surgery below the umbilicus. All information gathered will be kept confidential, including the patient's name and exact address. As long as patients are not interested, they may drop at any time. The study's findings will be useful in identifying risk factors for perioperative respiratory complications in pediatric surgery patients who have recently had an upper respiratory tract infection at Addis Ababa Public Hospitals.

Part One: Patient related factors

- a) Age _____ Gender: _____
- b) Male _____ Female _____
- c) Weight _____
- d) Height _____
- e) Body mass Index _____
- f) over weight (BMI >25kg/m²) Yes _____ No _____
- g) Non over weight (BMI<25kg/m²) Yes _____ No _____
- h) Positioning _____
- i) Duration of injection _____
- j) Spinal needle size _____

Part two : Clinical parameters:

- a) Injection site L3 and L4 _____ L4 and L5 _____
- b) ASA _____

- c) Bupivacaine 0.5%:Hyperbaric _____ Plain bupivacaine _____ Hypobaric _____
- d) Dosage _____
- e) Adjuvant drug used _____
- f) Duration of surgery _____
- g) Tourniquet apply : Yes _____ No _____

Part three: Characteristics of spinal anesthesia

- a) Induction of spinal anesthesia
- I. Successful _____
- II. Failed _____
- b) Peak level of sensory block at anesthesia induction(5min): _____
- c) Peak level of motor block(Bromage Scale) at anesthesia induction(5min). _____
- d) Time to peak sensory block (10min): _____
- e) Maximum Motor blockage (Bromage Scale): _____
- f) Level of sensory block at the end of surgery _____
- g) level of motor block(Bromage Scale)at the end of surgery _____
- h) Incidence of tourniquet pain: Yes _____ No _____

Part four: Incidence or complication of adverse events

- a) Hypotension Yes _____ No _____
- b) Use of Vasopressor Yes _____ No _____
- c) Baseline MBP (mmhg) _____
- d) Lowest MBP (mmhg) _____
- e) Decrease in MBP (mmhg): _____
- f) Bradycardia: Yes _____ No _____
- g) Nausea/Vomiting Yes _____ No _____
- h) Shivering: Yes _____ No _____
- i) Time to first report of postoperative pain (min) _____
- j) Surgery: CS _____ Urology _____ Obstetrics _____ Orthopedic _____

9.2. Information sheet

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

Title: Comparison level of block achieved after spinal anesthesia in over weight and non over weight patient undergoing surgery below umbilicus at selected public hospitals in Addis Ababa from Jan1 to march 30,2025 (Prospective cohort)

Name of principal Investigator: **Kedir Abafira** , Email: , Kediryasin14@gmail.com
[Tel:+251910015797](tel:+251910015797)

Advisors 1. Mr.Wesenyeleh(MSc,Assit prof.)

2 .Ms. Selamawit (BSC ,MSC)

3.corenel Mebratu(MPH), Name of sponsor: Addis Ababa University ,

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 compare level of block achieved after spinal anesthesia in over weight and non over weight patient undergoing surgery below umbilicus at selected public hospitals in Addis Ababa from Jan1 to march 30,2025 in Tikur Anbesa Specialized Hospital,Paulos Hospital And Zewuditu Memorial Hospital.

Incentive : there is no incentive or payment to be gained by taking part in this project. The information collected from this research project will be kept confidential and only accessed the researcher and research assistant only. This research project will be reviewed and approved by ethical committee of Addis Ababa University College of Health science.

Confidentiality : Except the principal investigator, no one will have access to the collected data, name or anything taken from your chart. The data will be kept coded and locked with no labeling specifying anyone participating in the research.

Whom to contact : this research project was received and approved by Ethical Committee of Addis Ababa university, Department of Anesthesia.

If any question, contact any of the following individuals and may ask at any time wanted:

9.3 .Data safety assuring sheet

s.no	Tools were examined.	Yes	No	Data entry
1.	Are the criteria for inclusion and exclusion properly completed?	yes		

Data Accuracy check sheet

s.no	Tools	Yes	No
	Have you filled out all the sociodemographic data questions correctly?	yes	
	Is all the information on the preoperative evaluation filled out correctly?	yes	
	Are all perioperative data filled out correctly?	yes	

9.4. Principal investigator assurance

The undersigned pledges to take accountability for the technical, scientific, and ethical conduct of the study and to provide the necessary progress updates as this application is sent in accordance with the Research Publications Office's terms and conditions that were in force at the time of the grant.

Name of the student: _____

Date. _____ Signature _____

Approval of the primary Advisor

Name of the primary advisor: _____

Date. _____ Signature _____

