MATERNAL BODY MASS INDEX AND HYPOTENSION IN PATIENTS UNDERGOING CAESAREAN SECTION UNDER SPINAL ANAESTHESIA AT KENYATTA NATIONAL HOSPITAL.

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A DISSERTATION TO BE SUBMITTED IN PART FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN ANAESTHESIA OF THE UNIVERSITY OF NAIROBI.

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Course Name: MASTER OF MEDICINE IN ANAESTHESIOLOGY

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ABBREVIATIONS

ASA	-	American Society of Anaesthesiologists
BMI	-	Body Mass Index
CS	-	Caesarean section
ERC	-	Ethics and Research Committee.
G.A	-	General Anaesthesia
IV	-	Intra-venous
KNH	-	Kenyatta National Hospital
L.A	-	Local Anaesthesia
MAC	-	Mid arm circumference
MOH	-	Ministry of Health
R.A	-	Regional Anaesthesia
S.A.B	-	Sub-arachnoid block
UON	-	Univeristy of Nairobi
WHO	-	World Health Organization
>	-	Greater than
<	-	Less than

ABSTRACT

Pregnancy and obesity are both independently associated with increased anaesthetic risks. This study sought to determine the incidence and severity of hypotension in patients with a raised BMI undergoing CS under spinal anesthesia in a tertiary hospital in Kenya.

This study was carried out between the months of January and April 2015 at the Kenyatta National Hospital, Nairobi Kenya. The objective was to determine and compare the frequency and severity of hypotension in parturients with high maternal BMI (> 25) and those with normal BMI (18.5-24.9) during spinal anaesthesia. We designed a comparative cross sectional study. The study population included all women of childbearing age undergoing caesarean section in KNH.

The sample population was divided into two groups. One group was women who were obese BMI > 30 (74 women) and the other group was women with normal BMI i.e. 18.5-24.9. (76 women)

The outcome of interest was the development of hypotension during spinal anaesthesia and its severity and a comparison was made between the two groups.

The incidence of hypotension in the obese group of women was 83.8% as compared to those with normal BMI whose incidence was 69.7%. Obese patients were more likely to have moderate or severe hypotension (27% and 18.9%, respectively) compared to normal weight (11.8% and 5.3%, respectively) patients undergoing caesarean delivery under spinal anaesthesia and on average the blood pressure reduced by 0.6% from the baseline level for each unit increase in BMI.

There was no significant difference in the fluid volumes used intra-op between the two groups and neither did it differ with the severity of hypotension. ($p = 0.513$)

Both groups of patients in our study received boluses of ephedrine when they had hypotension. There was a significant association between ephedrine dosing and correction of hypotension ($p < 0.001$). The obese group had moderate and severe hypotension necessitating higher doses of the vasopressors.

In conclusion the study showed a higher incidence of hypotension in obese parturient women with an average blood pressure reduction of 0.6% from the baseline level for each unit increase in BMI. There was no significant difference in the fluid volumes used intra-op between the two groups. Ephedrine was mainly used to correct hypotension with higher doses required in the obese patients.

1.0 INTRODUCTION

The word obese is derived from the Latin word obesus which meant 'having eaten until fat' [1]. A condition associated with ‘excessive fat’as the layman would call it but which is known to have pathophysiological consequences in every major organ system.[2] Obesity has for a long time been believed to be a problem of developed countries, however, there is an increasing prevalence especially in urban areas of the developing countries. The prevalence rate of obesity in Nairobi rose from 39% in 2003 to 41% in 2009. In females of child bearing age (15-45 years) the prevalence of obesity stands at 23% countrywide.[3]

The WHO defines overweight and obesity as abnormal or excessive fat accumulation that may impair health.[4]

Maternal obesity has been shown to be associated with more co- morbidities, increased caesarean delivery and significant risks for both the mother and child.[5] An obese pregnant woman may present with various risk factors and difficulties that an anaesthetist should anticipate and manage to reduce the associated morbidity and mortality for both mother and child.

Obesity has been reported as a risk factor for hypotension in women undergoing caesarean section under regional anaesthesia.[6]

The physiological changes of pregnancy include an increase in body weight. The increase is due to an increase in blood volume, the weight of the foetus, placenta and amniotic fluid, and increase in body fat stores. Recent advances in Bioelectrical Impedance Analysis (BIA) allow direct measurements of fat and fat distribution to be made during pregnancy. Studies on weight gain in pregnancy have suggested that maternal weight on average increased by 0.5–2.0 kg in the first trimester of pregnancy. Critically the mean maternal weight and thus, mean BMI do not change significantly. There is also no alteration in mean maternal body composition especially in reference to mean body fat measurements. Therefore, accurate measurement of weight or body composition at any time in the first trimester may be used as a baseline for subsequent comparison.[7] It is important to recognize that the weight gain during pregnancy in women with a normal BMI is different from the allowable weight gain in women with an elevated or low BMI.[8]

TABLE 1

PREPREGNANCY BMI	BMI (KG/M²) WHO	TOTAL WEIGHT GAIN (KGS)	RATES OF WEIGHT GAIN 2ND AND 3RD TRIMESTER (MEAN RANGE IN KG/WK)
UNDERWEIGHT	<18.5	13-18	0.5-0.6
NORMAL WEIGHT	18.5-24.9	11-16	0.4-0.5
OVERWEIGHT	25-29.9	7-11	0.2-0.3
OBESE (INCLUDES ALL CLASSES)	>30	5-9	0.18-0.27

Obesity is measured by taking the patient's BMI. The body mass index (BMI), or Quetelet index, is a measure of relative weight based on an individual's mass and height. It was devised around 1832 by the Belgian statistician, Adolphe Quetelet during the course of developing social sciences. It is defined as the individual's body mass divided by the square of their height. The value universally being given in units of kg/m2.[9]

FORMULAE 1:

BMI Weight (kgs) / (Height (m))^2

Weight (lb) / (Height (in))^2 * 703

Body Mass Index (BMI) more than or equal to 25 is classified as overweight, a BMI more than or equal to 30 is classified as obesity, BMI more than or equal to 35 as morbidly obese and BMI more than or equal to 45 as super obese.[4]

BMI is a surrogate anthropometric measure of fatness and is inexpensive and simple to perform. However, there are certain important circumstances where there is a mismatch between the surrogate measures (especially BMI) and true body fatness, which results in the surrogate measures giving misleading information. These include: infancy and childhood; ageing; racial differences; athletes; military and civil forces personnel; weight loss with and without exercise; physical training; and special clinical circumstances.[10]

Hypotension is one of the most common complications of spinal anaesthesia with an incidence of 15% to 33% in the general population. In obstetric patients, hypotension has a higher incidence of 20-100% and may be associated with maternal and foetal complications ranging from an increased incidence of nausea and vomiting to foetal hypoxia due to changes in utero-placental blood flow with consequent foetal acidosis.[11]

Many anaesthesiologists are giving more regional anaesthesics as compared to general anaesthesia for caesarean section unless contra-indicated due to the fewer adverse outcomes noted with the use of regional anaesthesia as compared to general anaesthesia. With the increasing numbers of overweight and obese women many of them are also receiving the regional anaesthesia in the form of spinal, epidural or combined spinal- epidural anaesthesia.[5]

The new guidelines showed above are a reflection of the new knowledge of the importance of the BMI in the pregnancy outcomes for both mother and child. It also acknowledges the change in the health and age of many of the women of child bearing age.[12]

Weight gain higher than that recommended in women who are obese and pregnant is associated with increased adverse outcomes, such as foetal macrosomia and increased incidence of wound infection.[13]Pregnant women with a BMI ≥40 are recommended to have an antenatal consultation with an obstetric anaesthetist, so that potential difficulties with venous access, regional or general anaesthesia can be identified. An anaesthetic management plan for labour and delivery should be discussed and documented in the medical records.[14]

OVERVIEW OF MATERNAL AND OBESITY RELATED PHYSIOLOGICAL CHANGES

Pregnancy and obesity are independently associated with increased anaesthetic risks. Hence when both situations present together, compounded by other medical conditions the risks are increased.[15]

Current evidence suggests that obesity may be a risk factor for maternal death: the Confidential Enquiry into Maternal and Child Health's (CEMACH) report on maternal deaths in the 2003–2005 triennium showed that 28% of mothers who died were obese, whereas the prevalence of obesity in the general maternity population within the same time period was 16-19%.[14]

Airway:

Obese patients have limited mouth opening and neck movements. They also have narrow pharyngeal opening due to excess adipose tissue and higher Mallampati grades on airway assessment. Mucous membranes of pregnant women are more oedematous and therefore more prone to bleeding especially those with pregnancy induced hypertension. Increased breast size also predisposes them to difficult airway with difficulty inserting a laryngoscope.[16]

Due to all these factors, the incidence of failed intubation in obstetric patients is 1:280, compared to the general population where the incidence is 1:2500. Pregnancy and obesity combined, further increases the difficult and failed intubation incidence to 1:3. It is also associated with difficulty in adequate manual mask ventilation and oxygenation. [17]

Respiratory:

In pregnancy, there is stimulation of the respiratory centre in the brainstem by the increased progesterone levels. There is also relaxation of the airway smooth muscle and decrease of airway resistance, which reduces some of the negative effects of obesity on the respiratory system.[18]

The expiratory reserve volume (ERV), residual volume (RV) and functional residual capacity (FRC), progressively decrease during pregnancy due to the enlarging uterus and are about 15-20% less than that of the non-pregnant state.

Positioning of the patient in supine or Trendelenburg position worsens the lung volumes resulting in small airways collapse, ventilation-perfusion mismatch and shunting leading to hypoxia partly explaining the rapid desaturation observed in obese parturients.

Cardiovascular system:

The cardiovascular changes seen during pregnancy are due to increased oxygen demand, blood volume expansion and reduced systemic vascular resistance increasing the cardiac output in the 1st and 2nd trimester. During labor, cardiac output increases further and peaks to about 75% due to the immediate postpartum uterine contraction.[19]

Excess weight as seen in obesity results in a proportional rise of cardiac output. Every 100 g of fat increases cardiac output by 30-50 ml/min. This is in addition to the already increased cardiac output.[20]

Increased cardiac output combined with increased peripheral vascular resistance and greater conduit artery stiffness seen in many obese patients leads to systemic hypertension. However, the extent of cardiovascular pathological changes due to obesity, is dependent on the duration of obesity and its severity.[21]

The aorto-caval compression syndrome is exacerbated in the obese parturient due to the increased intra-abdominal adipose tissue which in addition to the gravid uterus further compromises venous return to the maternal heart and predisposes to uterine arterial hypotension.[22]

Gastrointestinal system:

Obese parturients have five times greater gastric volume than in non-obese women and, therefore, the risk of regurgitation and aspiration is higher. Gastric emptying is also delayed during labour.[22]

2.0 LITERATURE REVIEW

Incidence

There are a few studies in Africa showing the incidence of obesity among parturients undergoing a caesarean section. West African studies have revealed rates of between 50.7 and 54% for obesity with a morbid obesity prevalence of up to 12.4% [25][26]. These respectively compared with values of 34% and 7.2 % in the developed world [27][28].

Studies on maternal obesity and pregnancy outcome have demonstrated an increase in induction of labour and caesarean section deliveries in obese women.[5]

Systematic reviews and meta-analysis on obesity as an independent risk factor for elective and emergency caesarean delivery in nulliparous women also shows that the caesarean delivery risk is increased by 50% in overweight women and more than doubled for obese women compared with women with normal BMI.[28]

Co morbidities

Cohort studies and systemic meta-analytical reviews on effect of higher BMI on pregnancy outcome in KNH and other centers, have demonstrated that increased maternal BMI predisposed women to increased incidence of adverse maternal and neonatal outcomes. A linear relationship has been noted between increasing maternal BMI and risk of developing co-morbidities such as pre-eclampsia, pregnancy induced hypertension and glucose intolerance. Patients with increased BMI also had higher incidence of induction of labour, caesarean delivery, LGA, and still births.[5][26][29][49]

The risk of preeclampsia for example typically doubled with each 5–7 kg/m2 increase in pre-pregnancy BMI.[30]

Intra-operative Anaesthetic Challenges

There are various risks factors associated with obese parturients and these may pose various difficulties for the anaesthesiologist attending the delivery.

Obese patients undergoing caesarean section under general anaesthesia have an increased risk of difficult intubation with the incidence of failed intubation as high as 15.5% in obese patients and 33% in morbidly obese patients as compared to 0.13 to 0.35% patients in the general obstetric population.[31]This emphasizes the need for optimal airway assessment in parturients especially

those obese. It has been shown that weight gain of more than 15kgs in an obese parturient is associated with suboptimal laryngoscopic view.[32]

Regional anaesthesia is increasingly being applied as compared to general anaesthesia in obstetric surgery. There are various challenges faced when administering neuraxial anaesthesia to obese patients. These are related to positioning of the patient correctly, identification of the midline, identification of the epidural space, and dislodgement of epidural catheters.[32]

Jordan et al. noted 74.4% of massively obese parturients needed more than a single attempt with 14% requiring more than three attempts at epidural insertion. When these parturients are placed in the lateral position with knee-chest positioning for epidural placement, there is difficulty in maximal lumbar flexion and also decreased cardiac output.[33]Ultra sound application has been used ease this difficulty[34][35]

Single shot spinal anaesthesia remains the most common type of anaesthesia employed for caesarean section especially due to its rapid onset of action. However there are still challenges which include technical difficulties (similar to those for locating the epidural space), potential for high spinal blockade, profound dense thoracic motor blockade leading to cardiorespiratory compromise and the inability to prolong the blockade.[36]

Other technical difficulties in management of the obese parturient intra operatively include use of an appropriate sized BP cuff for non-invasive blood pressure measurements. Forearm blood pressure measurement may be used if an appropriate-sized blood pressure cuff is not available or if the upper arm cuff slides from its position due to the shape of the obese patient's upper arm. There is a good correlation between upper arm and forearm non-invasive measurements, but forearm pressures exceed upper arm pressures by 10 ±10 mm Hg (mean ±SD). In selected cases, invasive monitoring of blood pressure with an intra-arterial catheter may be desirable.[36] [37]

The incidence of intra-operative challenges has been shown to be more significant in obese parturients. These complications included difficulty in establishing I.V access, difficult tracheal

intubation, respiratory distress, hypotension, and inadequate spinal anaesthesia among others.[26] [27]

Hypotension is a common occurrence in regional anaesthesia application especially in neuraxial blockade. In obstetrics, incidence rates of up to 64% have been observed.[50] Post-regional anaesthesia hypotension is defined as a 10% to 30% fall from baseline levels or fall of systolic blood pressure below 100 mmHg. Hypotension is associated with significant reduction in utero-placental perfusion, foetal acidosis and poor APGAR score. In the mother this may present as nausea and vomiting but in extreme may lead to myocardial ischaemia, dysrrythmias and maternal collapse. Ventilatory impairment may also occur in hypotension due to impaired medullary blood flow and hypoxia of the respiratory centre .[11]

The risk factors for hypotension include preoperative hypertension, older age, type of spinal anaesthesia and higher infant birth weight.[38] In prospective studies of hypotension after spinal anaesthesia for caesarean section incidences of hypotension of up to 65.1% have been reported. Age > 35 years and BMI > 35 were two non-modifiable risk factors that increased the incidence. The level of sensory analgesia ≥T5 was the only modifiable risk factor.[11] [39]

Other studies have shown no co-relation of BMI to spread of sensory blockade. [51] [52]

Various methods have been investigated to prevent hypotension in women undergoing caesarean section. These include application of lateral uterine displacement using a wedge or table tilt, but this does not reliably prevent hypotension as optimal degree of tilt is unknown and is often overestimated.[40]

Other forms of prevention of hypotension include fluid therapy, leg wrapping and intravenous vasopressors.[41] [42] Several previous studies have shown that leg wrapping is moderately effective in preventing hypotension, but this technique does not appear to have found wide acceptance in clinical practice.

Vasopressors have also been used to prevent hypotension in pregnancy and are now the first line in the management of hypotension. In a study comparing use of ephedrine, phenylephrine and a combination of both, it was found that the mean systolic arterial pressure was similar for the three groups. Giving phenylephrine alone by infusion at caesarean delivery was associated with a lower incidence of foetal acidosis and maternal nausea and vomiting than giving ephedrine alone.[43] [44]

The risk of antepartum venous thromboembolism increases with increased maternal weight. The obese pregnant women may warrant prophylactic measures against venous thromboembolism, such as compression stockings or prophylactic low-molecular-weight heparin, especially if exposed to other risk factors (e.g., bed rest after caesarean section). [45]

A large prospective multi-center database was studied by Weiss et al to determine whether obesity is associated with other obstetric complications and caesarean delivery. This confirmed the increased risk of foetal macrosomia and large-for-gestational age neonates among obese patients. With a significantly increased risk for birth weight greater than 4500 g compared with controls. They also found increased caesarean rates among obese patients which had implications for their intraoperative and postoperative outcomes. Operative complications for obese and morbidly obese patients included excessive operative blood loss greater than 1000 mL, an increased operative time, and increased incidence of postoperative wound infection. [46]

The incidence of primary postpartum haemorrhage (PPH) which is defined as blood loss of ≥500ml has been found to be up to 38% for women with a BMI ≥35 which is about four times higher than the rate in the general obstetric population, while the incidence of major PPH (i.e. >1000ml) was 5%. Pre-eclampsia, birth weight >4kg, and caesarean section are all risk factors for PPH but after controlling for these risk factors, it was noted that each BMI unit increment in women with a BMI ≥35 was associated with a 2.6% increase in risk of PPH. [47] Associated surgical complications may compound the increased risk of caesarean delivery on pregnancy outcome in obese patients.[46]

The risk of postoperative complications like hypoxaemia, atelectasis and pneumonia, deep vein thrombosis and pulmonary embolism, pulmonary oedema, postpartum cardiomyopathy, postoperative endometritis and wound complications such as infection and dehiscence is an increased risk in obese parturients. Measure such as early mobilisation, thrombo-prophylaxis, aggressive chest physiotherapy and adequate pain control are essential as part of the postoperative care in such patients. [31] [48]

3.0 STUDY JUSTIFICATION

Obesity is a significant public health concern especially with the increasing prevalence in the population.

Obesity during pregnancy is associated with increased use of health care services. The obese parturient will have longer length of hospital stay than other women with normal BMI. They also have significantly more prenatal foetal tests, obstetrical ultrasounds, outpatient medications dispensed and prenatal visits with physicians.[2324] Anaesthesiologists are now handling more overweight and obese women undergoing caesarean sections and it is important that they are aware of their perioperative challenges.

There is paucity of data comparing complications of spinal anaesthesia in pregnant women with increased weight to those patients with normal BMI for caesarean section in the developing world. This study is therefore important due to the high incidence of obesity in pregnant women, many of whom also undergo spinal anaesthesia for caesarean section in which hypotension is one of the noted complications.[25] As the baseline data available from Africa generally (and even more specifically from East Africa) is little, it will provide important data on the obese parturients having a caesarean section done in a tertiary hospital.

The data obtained will provide a basis for planning anaesthesia in obese parturient and the importance of continued implementation of routine BMI measurements in the ANC clinic and pre-operatively as part of the patients assessment.

The study will also help improve the planning and management of overweight and obese women peri-operatively.

3.1 Research question

What is the relationship between maternal BMI and the incidence and severity of hypotension in parturients undergoing caesarean section under spinal anaesthesia?

3.2 General objective

To determine and compare the incidence and severity of hypotension in parturients with maternal obesity BMI i.e. > 30 and those with normal BMI (18.5-24.9) during caesarean section under spinal anaesthesia.

3.3 Specific objectives

1. To determine the incidence of hypotension in the parturients within the two groups.
2. To compare the types and volumes of intravenous fluids used in both groups of parturients.
3. To determine and compare the type and amount of vasopressors in both groups of parturients.

4.0 RESEARCH METHODOLOGY

4.1 Study Area

This study was conducted in the Maternity theatres of Kenyatta National Hospital (KNH). There are two maternity theatres adjacent to the labor ward, with one theatre running 24 hours daily. An average of 15 Caesarian sections are carried out daily in the 2 theatres.

KNH is the largest teaching and referral hospital in East and Central Africa with a bed capacity of 1,800 and over 6,000 staff. KNH was established in 1901and is centrally located in the Nairobi County, Kenya. The study area was selected since it incorporates a large parturient base and is well equipped with both staff and medical infrastructure required by the study population.

4.2 Study population

The study population was all women of childbearing age undergoing caesarean section in KNH during the study period.

4.3 Study Design

This was a comparative cross sectional study.

4.4 Sampling and Sample size determination

4.4.1 Sampling

This study utilized the purposive sampling of parturients scheduled for spinal anaesthesia in the maternity theatres at KNH.

Parturients were recruited to participate in the study upon enrolment for spinal anaesthesia. The expected sample size was based on the prevalence of hypotension among obese and non- obese parturients. This is determined by a study by Fernando Souza and Marcelo Luis in 2011 in a study where correlation between the Body Mass Index (BMI) of pregnant women and the development of hypotension after spinal anaesthesia for caesarean section was determined. The

incidence of hypotension independently of the number of episodes or their severity was 95.92% in the Eutrophia group and 94% in the Overweight group.

4.4.2 Sample size determination

The sample size was determined by the Cochran (1963:75) formula to yield a representative sample for proportions considering the assumptions mentioned above

$$n_o = \frac{Z^2 pq}{e^2}$$

Where;

n_oIs the sample size

Z^2=is the abscissa of the normal curve that cuts off area desired at 95% Confidence Level

p=estimated proportion of population with desired characteristic (COM)

q = is 1-p

e^2= is the desired level of precision

Required sample
None obese group = 70

$$n_0 = \frac{1.96^2 * 0.9592 * 0.0408}{0.05^2}$$

Obese group = 74

$$n_0 = \frac{1.96^2 * 0.94 * 0.06}{0.05^2}$$

4.4.3 Inclusion criteria

- This study included only parturients scheduled for spinal anaesthesia who consented to participate.
- All ASA I or II women with term singleton pregnancies.

4.4.4 Exclusion criteria

- Standard contra- indications for spinal anaesthesia (e.g. local infection, coagulopathies, severe cardiac disease such as fixed output cardiac disease etc.)
- Patients noted to have hypotension prior to the R.A administration, or with Ante-partum haemorrhage or sepsis.
- Patients with Pregnancy associated hypertension
- Patients given prophylactic vasopressors before administration of spinal anaesthesia.
- Patients given sedation during the caesarean section.

4.5 Case Definition

Normal BMI group was the patients with BMI of 18-24.9 while the obese group was those whose BMI was above 30.

Hypotension was defined as systolic blood pressure of < 100mmHg or a drop in baseline blood pressure of >10%.

Mild hypotension was a drop in baseline blood pressure of up to 10%, moderate hypotension a drop in baseline blood pressure of 20-30% and severe hypotension a drop in baseline blood pressure of > 30%.

4.6 Study Variables

The outcome variable was the frequency and severity of hypotension among parturients after undergoing spinal anaesthesia. Hypotension was defined as a 10-30% fall from baseline levels or fall of systolic blood pressure below 100%

Predictor variable included the age, weight, height, mid-upper arm circumference, indications for caesarean section, volumes of crystalloids and colloids used, amount of vasopressor used, total operation time and total blood loss.

4.7 Materials and Methods

4.7.1 Data collection instruments

Data was collected using structured questionnaire.

4.8 Data Collection Procedure

The parturients were systematically identified and enrolled into the study. They were allowed time to read and understand the consent form and seek clarification over the study then give consent to participate. The structured questionnaire was completed by the principal investigator or research assistant upon examination of pre-operative, intra operative and post-operative procedures.

The women meeting the inclusion criteria were recruited into the study after the caesarean section was prescribed and informed consent was obtained.

The patient's initials were recorded and a serial number noted on the form. BMI was taken at term[25] [26] using the formula

BMI= weight in kilograms ÷height in meters^2.

All the women had their height and weight measured with their shoes off standing erect using a wall-mounted meter-stick (to the nearest 0.1 cm). Their weight was measured using a bathroom weighing scale, wearing light clothing (to the nearest 0.1 kg), and the BMI calculated. Both the meter-stick and weighing scale were provided by the principal investigator.

The BMI obtained was classified into normal, overweight or obese. The mid upper arm circumference was taken and a large cuff is was used for the patients with a MAC > 33 cm. [47]

The SAB was administered as per the KNH protocol. (See appendix 3)

The blood pressure was measured and documented before and immediately after the SAB was administered. Subsequent blood pressures was measured at intervals of three minutes. Hypotension (defined as a 10-30% fall from baseline levels or fall of systolic blood pressure below 100%) was recorded and the time of occurrence and was promptly managed.

The amount of fluids used (both crystalloids and colloids) was documented in both groups. The amount and type of vasopressors given was also recorded. The amount of blood lost during the operation in milliliters was estimated and recorded.

The weight of the baby was also recorded in the data collection form for analysis.

4.9 Quality Control

Quality control was a continuous process throughout the study and prevalence of exposure and outcome assessed at the same point in time to maximize internal and external validity and reliability of the findings of the study.

Pre-test of study instruments was carried out to structure and modify grammar and language used in the research instruments so as to avoid bias, misinterpretations, ambiguity and improve content validity.

The data collection instrument was also be piloted for consistency, timing, accuracy and reliability. Cronbach's alpha coefficient was used to test reliability where an alpha (α) score of 0.70 or higher was considered satisfactory and ascertains reliability.

The questions used in the questionnaire were selected from existing tools that had been used for similar studies.

The research assistant was trained on the study methodology and use of the tools prior to their application.

4.10 Data management and analysis

Data was collected using a structured questionnaire. Data was collected by the principal investigator assisted by a research assistant. Dully filled questionnaires were checked for

completeness and corrections made before examining another patient. Data was entered in a software and processed. The quantitative data collected was processed and assessed for inconsistencies and outliers. Frequencies were also run to check for missing values and figures.

Data was analyzed using SPSS (Statistical Package Service Solutions) version 21. The first level of analysis was to run simple frequencies to determine simple proportions e.g. the ages of the study participants, the proportion of study participants who are overweight, obese, normal weight. Simple computations was done to determine the BMI of the study participants. Vital signs like BP was also be determined.

Relationships between variables was established using chi-square tests of association. For example; the dose of drugs administered to the study participants was determined, NIBP, HR and SpO_2 and checked against time in relation to the BMI of the study participants to establish the relationship between increased BMI and blood pressure.

A multiple regression model was run to establish how different factors contribute to development of low blood pressure. Data has been reported and presented in tables, charts and graphs.

4.11 Ethical considerations

1. Approval to conduct the study was sought from the Kenyatta National Hospital/ University of Nairobi –Ethics and Research and Standards committee prior to commencement of the study, and approval given.
2. Confidentiality was maintained at all stages of the study.
3. Study participants could decline inclusion and/or leave the study at any point without victimization or compromise to their management.
4. The study had no additional harmful effects on the study participants.
5. Any complications observed in any patients during the study were promptly and appropriately managed.
6. No extra costs was incurred by the study participants.

7. Study findings have be availed to the University of Nairobi, Kenyatta National Hospital and the Kenya Society of Anaesthesiologists to facilitate appropriate policy formulation aimed at improving patient care.

5. RESULTS

A total of 150 mothers undergoing caesarean section conducted under spinal anaesthesia at KNH were recruited during the study.

The average age of the patients was 28.2 years (SD 5.95) with a range between 16 and 47 years. The modal age group was between 25 and 29 years containing 54 (36%) of the patients (Figure 1). There were 40 (26.7%) patients in the second most frequent age group of patients aged less than 25 years.

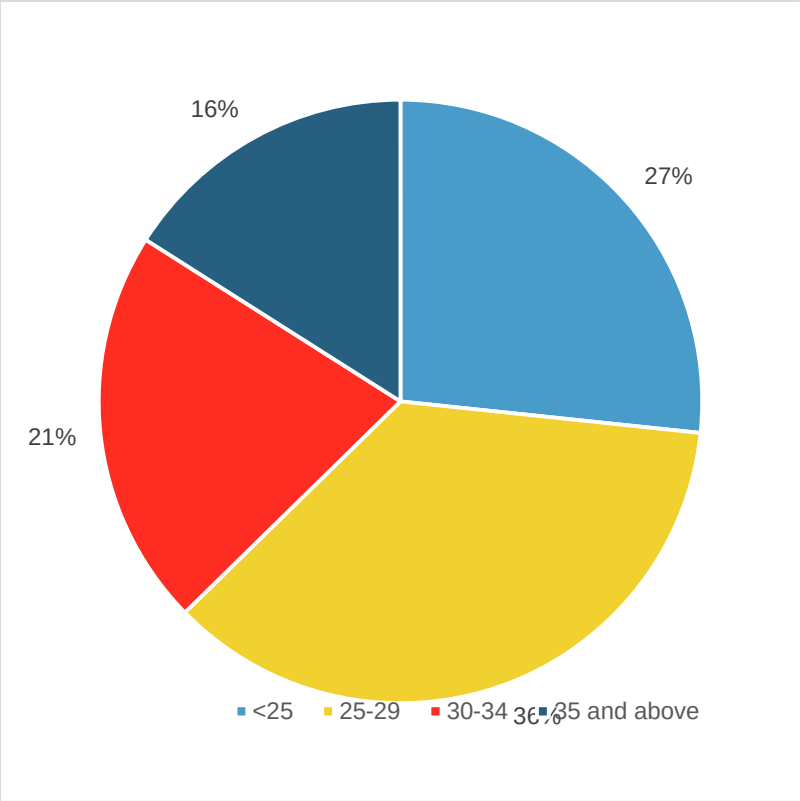

Figure 1: **Age distribution of mothers undergoing caesarean section under spinal anaesthesia at KNH**

The average height of the patients undergoing CS was 158.7cm (SD 8.3); range (140 to 200), and the average weight was 76.6 kgs (SD 13.9); range (47.5 to 124). The average BMI was 30.7 (SD 6.3) with a range from 18.5 to 43.7.

Figure 2 representing the BMI distribution shows that 74 (49.3%) of the study participants were obese (BMI > 30).

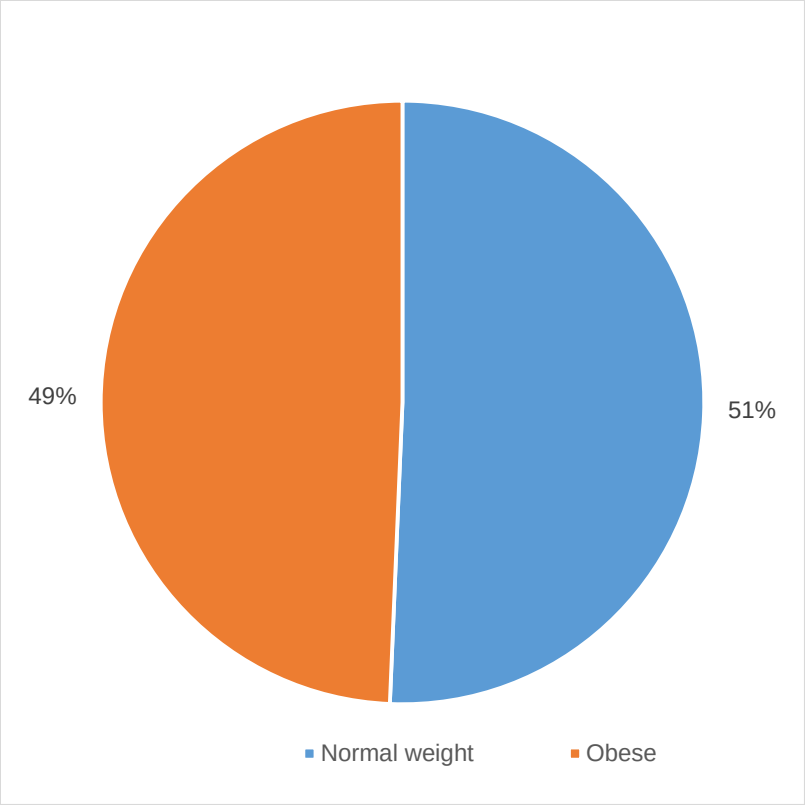

Figure 2: **BMI of mothers undergoing caesarean section under spinal anesthesia at KNH**

The baseline vital signs for patients taken in the pre-operative phase are presented in Table 2. The average systolic blood pressure was 124.3 (±13.8) mmHg, and the diastolic blood pressure was 71.3 (±10.1) mmHg. The average heart rate was 87.2 (±12.4) beats per minute. The median oxygen saturation was 100% with range from 96-100%. There were no significant differences in baseline vital signs between the normal weight and obese patients (Table 2).

Table 1: **Baseline vital signs of mothers undergoing caesarean section under spinal anaesthesia in KNH**

	Obese	**Normal weight**	**P value**	**All patients**	
	Mean ±SD	**Mean ±SD**		**Mean ±SD**	**Range**
Systolic blood pressure (mmHg)	126.4 ±14.2	122.2 ±13.2	0.064	124.3 ±13.8	92 - 166
Diastolic blood pressure (mmHg)	71.8 ±8.3	70.8 ±11.6	0.549	71.3 ±10.1	41 - 100
Heart rate (beats per minute)	87.8 ±12.2	86.7 ±12.6	0.548	87.2 ±12.4	57 - 120
SPO_2	99.9 ±0.1	99.9 ±0.5	0.149	99.9 ±0.4	96 - 100
Median SPO_2	100 (100-100)*	100 (100-100)*	0.178	100 (99-100)*	96 - 100

*values refer to median (IQR)

Sensory block level of spinal anaesthesia

The majority 123 (82.6%) of spinal blocks were at the T8 level, followed by T7 and T6 with 16 (10.7%) and 10 (6.7%) patients having sensory blocks done at these levels respectively (Figure 3).

There were no significant differences in the level of spinal block according to BMI. In both obese and normal weight patients T6 was the most commonly attained level of sensory block.

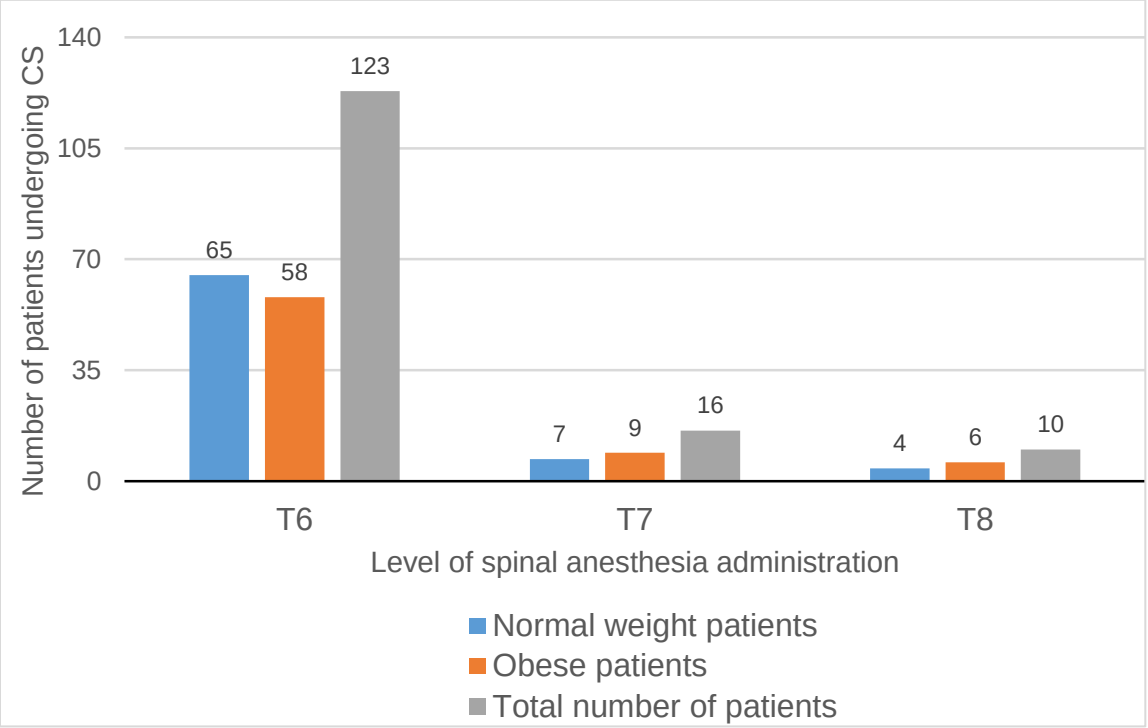

Figure 3: **Level of spinal block in patients undergoing caesarean section under spinal anaesthesia in KNH**

Hypotension

There was a significant association between maternal BMI and the occurrence of two signs namely nausea ($p<0.001$) and vomiting ($p = 0.002$) during cesarean section. Both signs occurred more commonly among obese patients compared to non-obese patients. Dizziness was not associated with maternal BMI ($p = 0.684$).

Table 2: **Presence of signs and symptoms among obese and normal weight mothers during cesarean section**

		BMI			
Sign	**Present**	**Obese**	**Normal weight**	**Chi square**	**P value**
Dizziness	Yes	25(52.1)	23(47.9)	0.2	0.684
	No	49(48.5)	52(51.5)		
Nausea	Yes	46(71.9)	18(28.1)	22.7	<0.001
	No	28(32.6)	58(67.4)		
Vomit	Yes	39(65.0)	21(35.0)	9.4	0.002
	No	35(39.3)	54(60.7)		

Percent reduction in BP

Figure 4 shows that blood pressure reduction was positively correlated withmaternal BMI with a correlation coefficient (*r*)of 0.32 (p = 0.0001).

On average blood pressure reduced by 0.6% from the baseline level for each unit increase in BMI.

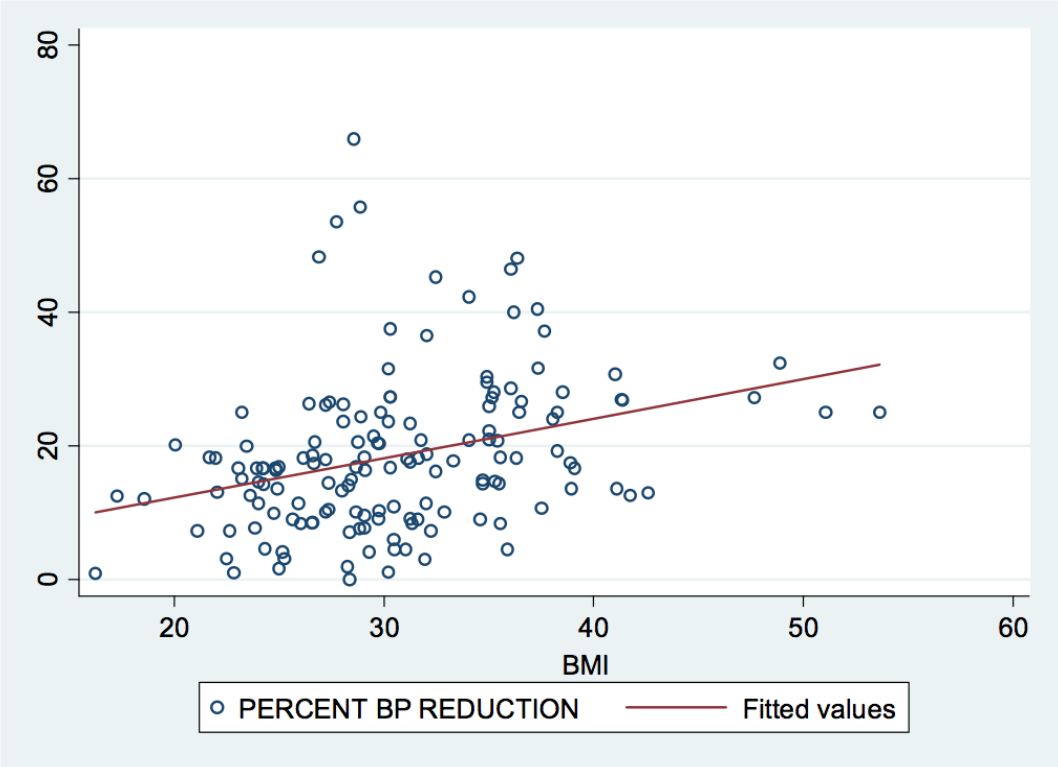

Figure 4: **Correlation between MAP reduction and BMI in patients undergoing caesarean section under spinal anaesthesia**

Most patients 115 (76.7%) developed hypotension after administration of spinal anaesthesia (MAP drop of more than 10%). 68 (45.3%) developed mild hypotension, 29 (19.3%) patients had moderate hypotension and 18 (12%) had severe hypotension. (Table 3)

Table 3: **Intraoperative hypotension during caesarean section conducted under spinal anaesthesia in KNH**

	Hypotension			
	Yes	**No**	**Chi square**	**P value**
BMI				
Normal weight	53(69.7%)	23(30.3%)	4.1	0.042
Obese	62(83.8%)	12(16.2%)		

The association between hypotension and BMI was also evident when a comparison of BMI and hypotension severity was conducted ($p = 0.002$).

Figure 5 shows that obese patients were more likely to have moderate or severe hypotension (27% and 18.9%, respectively) compared to normal weight (11.8% and 5.3%, respectively) patients undergoing caesarean delivery under spinal anaesthesia.

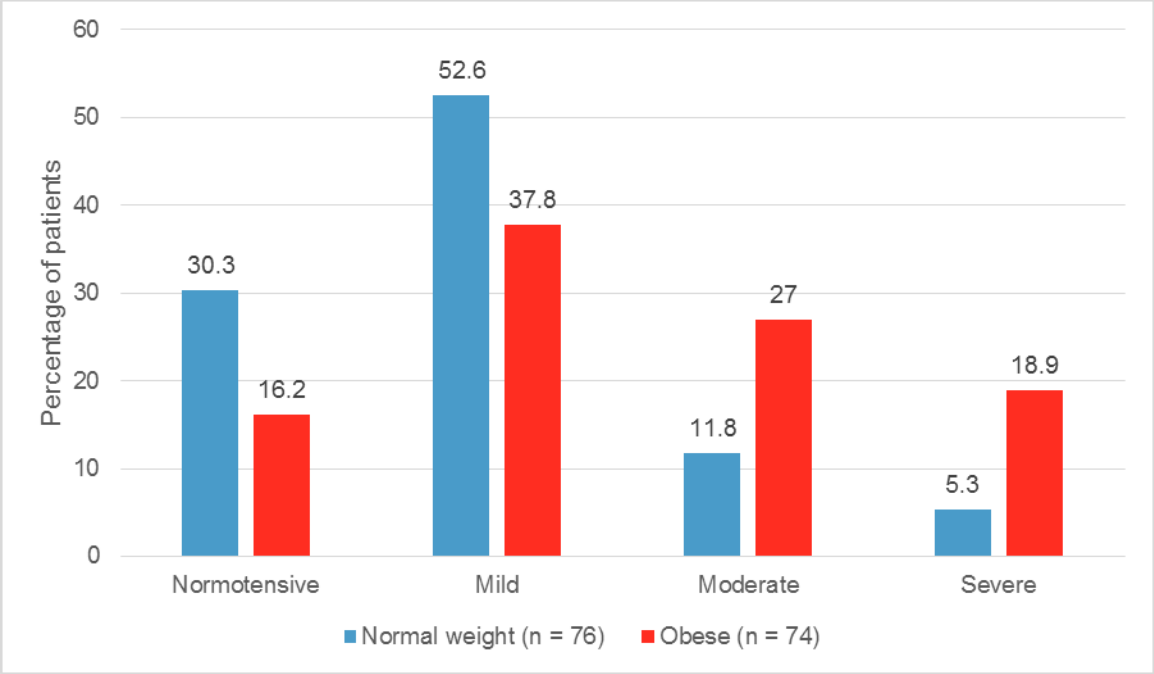

Figure 5: Hypotension severity and its association with BMI in mothers delivering through caesarean conducted under spinal anaesthesia in KNH

Total fluid volume

Crystalloids

All mothers (n = 150) had a crystalloid administered during surgery and the median volume was not associated with severity of hypotension that developed (p = 0.513). The median volume of crystalloid administered in patients with no hypotension or mild hypotension was 1500 mls (IQR 1500-2000), Figure 6.

For moderate hypotension the median volume was 20000 mls (IQR 1500-2000) similar to median of 2000 mls (1500-2500) in severe hypotension.

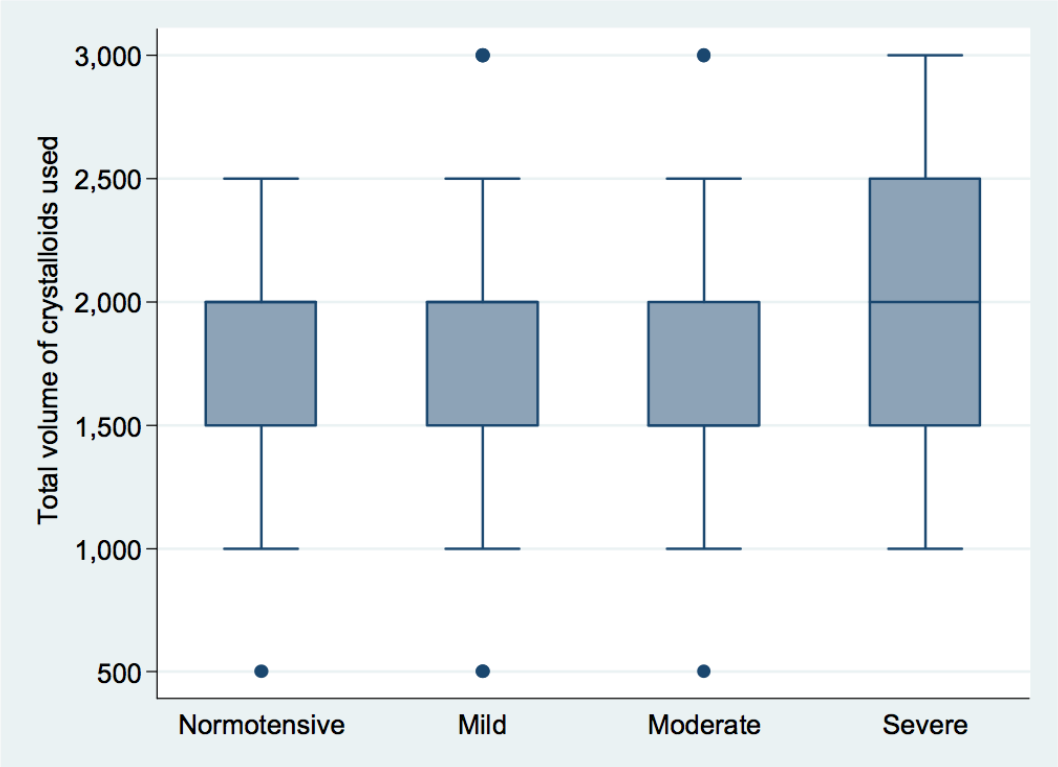

Figure 6: **Crystalloid administration in mothers undergoing caesarean section under spinal anaesthesia in KNH**

Colloids

Out of the 150 patient, 11 received colloids including blood products. The median volume of colloids administered to these patients was 500 ml, (IQR 500 to 2000).

Vasopressors

Vasopressors were administered during caesarean section when patients had hypotension: ephedrine was used in 149 patients (99.3%). The mean reduction in blood pressure among the 149 patients receiving ephedrine was 18.5% (range 0 to 66%).

Figure 6 shows that there was a significant association between ephedrine dosing and correction of hypotension ($p < 0.001$). The median drug volume administered increase from 6 mg in

normotensive patients and patients with mild hypotension to 12mg in moderate hypotension and 27 mg in severe hypotension.

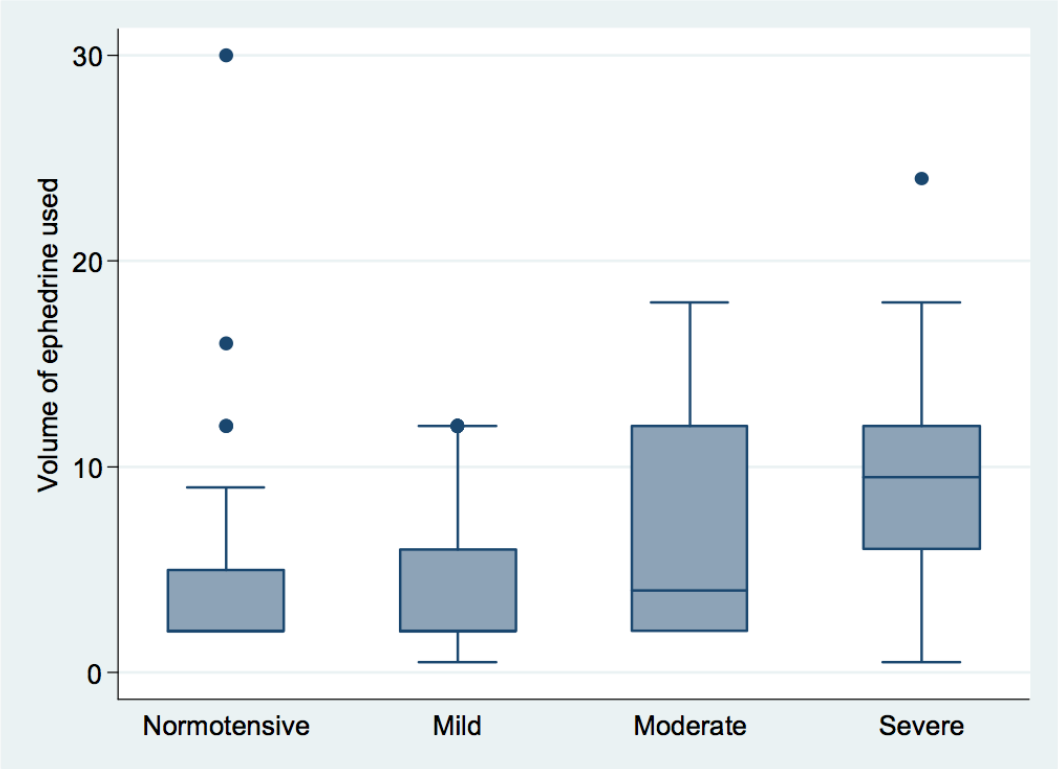

Figure 7: **Ephedrine administration in mothers undergoing caesarean section under spinal anaesthesia in KNH**

There was a significant association between the dose of vasopressor administered and BMI ($p = 0.01$).

As shown in figure 8, the median dose in normal weight mothers 6mg (IQR 6mg-18mg) was significantly lower than the median dose administered in obese mothers 18mg (IQR 6mg-36mg).

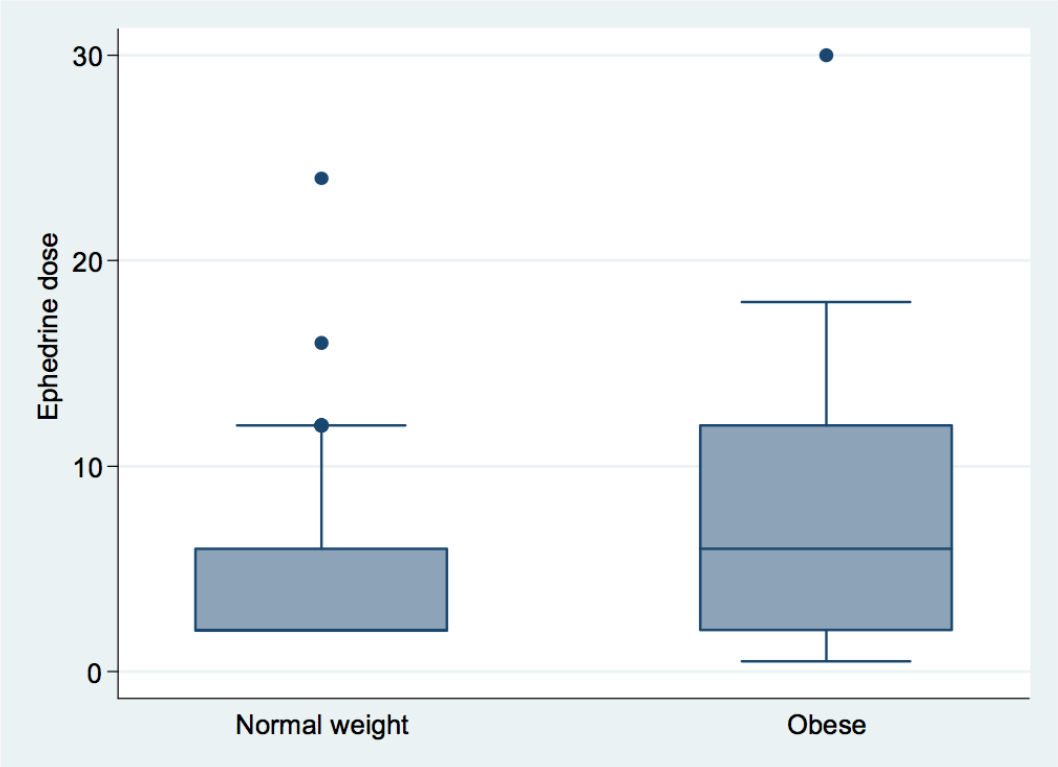

Figure 8: **Maternal BMI and median vasopressin dose administered during Cesarean section**

Caesarean section outcomes

The average birth weight of the babies delivered through caesarean was 3287 gm (SD ±612).

Figure 9 shows that newborn birth weight was significantly associated with maternal BMI ($p = 0.005$).

The average birth weight of babies born to normal weight mothers was 3149.5 gms (SD = 628) compared to an average birth weight of 3430.3 gms (SD 564.2) among babies of obese mothers.

Figure 9: **Maternal BMI and newborn birth weight**

Two outcomes of caesarean section among women operated under spinal anaesthesia were examined: total operation time and blood loss. There was no significant difference in the operation time for patients with hypotension (median = 45 minutes, IQR 45-45) compared to no hypotension (median = 45 minutes, IQR 45-60), p = 0.122.

Hypotension was associated with the volume of blood loss during surgery. The median blood loss increased with increasing severity of hypotension from 500 (450-550) and 500 (450-600) in patients with mild and moderate hypotension to 525 (500-600) in patients with severe hypotension, p = 0.002 (Table 7).

Blood loss was not significantly associated with BMI as shown in Table 4 (p = 0.02). The median blood loss among normal weight mothers was 500 mls (400-500) similar to a median loss of 500 mls (450-600) in obese women.

Table 4: **Blood loss according hypotension and BMI status in mothers undergoing caesarean delivery under spinal anaesthesia in KNH**

	Median	Lower IQR	Upper IQR	P value
Hypotension				
Normotensive	450	400	500	0.002
Mild	500	450	550	
Moderate	500	450	600	
Severe	525	500	600	
BMI level				
Normal weight	500	400	500	0.02
Obese	500	450	600	

6. DISCUSSION

The prevalence of obesity in Nairobi has been on the rise from 39% in 2003 to 41% in 2009. In females of child bearing age (15-45 years) the prevalence of obesity stands at 23% countrywide.[3]

Maternal obesity has been shown to be associated with more co- morbidities, increased caesarean delivery and significant risks for both the mother and child.[5]
Obesity has been reported as a risk factor for hypotension in women undergoing caesarean section under regional anaesthesia.[6]

Hypotension is one of the most common complications of spinal anaesthesia with an incidence of 15% to 33% in the general population. In obstetric patients, hypotension has a higher incidence of 20-100% and may be associated with maternal and foetal complications ranging from an increased incidence of nausea and vomiting to foetal hypoxia due to changes in utero-placental blood flow with consequent foetal acidosis.[11]

Our study sought to determine and compare the prevalence and severity of hypotension in parturients with high maternal BMI i.e. > 30 and those with normal BMI (18.5-24.9) during caesarean section under spinal anaesthesia.
Our study captured women within the childbearing age group with a range between 16-47 years with a majority falling between 25-29 years. The group with normal BMI had an average age of 26 while those who were in the obese group had an average age of 30. These results show patients were slightly younger than those found by Edomwonyi et al whose obese group had an average age of 32 while none obese group was 29.

There were no significant differences in baseline vital signs between the normal weight and obese patients in our study.
The prevalence of hypotension in the obese group of women was 83.8% as compared to those with normal BMI whose prevalence was 69.7%. Another important observation made was that the obese patients were more likely to have moderate or severe hypotension (27% and 18.9%,

respectively) compared to the non obese (11.8% and 5.3%, respectively) patients undergoing caesarean delivery under spinal anaesthesia. On average blood pressure reduced by 0.6% from the baseline level for each unit increase in BMI.

These findings are higher than those found by Fernando Souza Nani et al whose similar study done in Brazil showed episodes of hypotension were fewer in the eutrophia group 11% as compared to 15% in the obese group. [11]. Edomwonyi et al also showed a lower prevalence of hypotension in their study in Nigeria with 14% of obese patients and 8% of normal BMI developing hypotension.[53]

Unfortunately the BMI used in our study was calculated at term unlike in Nani et al where they used pre gestational which is the ideal.[11] Edomwonyi et al study was in both general and regional anaesthesia patients making the comparison difficult.

Despite those limitations, the findings of this study signify the importance in the development of hypotension in patients with raised BMI and the need for prevention and early management of the hypotension. Obese patients were also noted to have a larger drop in blood pressure (moderate to severe hypotension) hence may require more aggressive management.
Our secondary objectives included assessing the volumes of fluid used intra-op in both groups of patients.

There was no significant difference in the volumes used intra-op between the two groups and neither did it differ with the severity of hypotension. This is unlike in the study by Nani et al where the volume of crystalloids used in the eutrophia group was smaller (1,299 ± 414 mL vs. 1,549 ± 454 mL; $p = 0.005$) and significant in their study.

Both groups of patients in our study received boluses of ephedrine when they had hypotension. There was a significant association between the ephedrine doses for used to correct hypotension and BMI ($p = 0.01$). There was also a significant association between correction of hypotension

by use of ephedrine and severity of hypotension ($p < 0.001$) As had been mentioned earlier the obese group had moderate and severe hypotension necessitating higher doses of the vasopressors. This is similar to the study by Nani et al where the use of vasopressors was smaller in the Eutrophia group (5.88 ± 3.46 bolus vs. 7.90 ± 4.78; $p = 0.017$).

Our study also looked at the outcomes between the normal BMI and obese groups. It was noted that the average birth weight of the babies delivered through caesarean was 3287 gm (SD ± 612). Obesity in pregnant women is associated with increase in the baby's birth weight with obese mothers having babies with an average weight of 3430gms when compared to those with normal BMI whose average birth weight was 3149gms. This is similar to a study in Canada by Heather E. Robinson et al where the birth weight in moderately and severely obese was higher than that in non-obese patients $p < 0.001$[3854]

The total operation time was also compared between the two groups. In our study no difference in operation time was noted between the two groups. Studies by Weiss JL, et al revealed increased operative blood loss and an increased operative time[46]

6.1 Conclusion

- The study showed a higher prevalence of hypotension in obese parturient women with an average blood pressure reduction by 0.6% from the baseline level for each unit increase in BMI.
- There was no significant difference in the volumes used intra-op between the two groups.
- Ephedrine was mainly used to correct hypotension with higher doses required in obese patients due to the higher severity of hypotension in the group.

6.2 Recommendations

1. All pregnant women should have their pre-pregnancy or first trimester weight recorded and BMI calculated.

2. Special consideration should be made in this group (obese paturients) of patients in the KNH spinal anaesthesia protocol currently in use.

6.3 Study Limitations

- Lack of proper documentation of pre gestational or first trimester weight or BMI. This was overcome by using weight at term for all patients to calculate their BMI at term.

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APPENDIX I: CONSENT EXPLANATION

My name is Dr. Joan Wanyama. I am a postgraduate student specializing in the field of Anaesthesia. I am conducting a study to understand how BMI affects the drop of blood pressure during caesarean section done under spinal anaesthesia.

Upon enrolment to this study, your weight and height will be measured and recorded. Spinal anaesthesia will be administered and standard monitoring will be carried out as per the KNH protocol.

The study is purely observational, non-invasive and will not attract any additional cost to your treatment. Your participation in this research is entirely voluntary. If you choose not to participate in this research project you will not be victimized. You are free to withdraw from this study at any point without victimization. Your participation will not interfere with the regular management of your condition before, during or after surgery. There will be no monetary benefit to you for participating in the study.

You will be informed about your BMI and its effect on your health. In addition; you will be referred appropriately if any complications or health issues are detected. Your participation will be very helpful in improving the way we manage pregnant women during spinal anaesthesia.

Your identity will kept confidential and the information collected will be used for research purposes only.

This study is being conducted with the approval of The Kenyatta National Hospital/ University of Nairobi's Ethical and Research Committee.

For any clarifications or queries kindly contact:
Dr. Joan Wanyama – 0721530744

You may also reach one of my supervisors as follows:

Dr. Julius Muriithi - 0722850375

Dr. Antony Gatheru – 0721 832 774

In addition, for any queries on ethical issues, contact:

Prof. Chindia, Secretary KNH/UON Nairobi Ethical and Research Committee – 020726300-9

If you agree to participate in this study please sign the consent form provided.

CONSENT FORM

I,..... after being fully explained to by Dr. Joan Wanyama and/or the research team the purpose, technique, advantages, possible complications and guarantees of confidentiality, do voluntarily agree to participate in this study. I have also been told that declining to participate in, or withdrawing from the study will not in any way compromise the care I receive.

Signature (Participant) ..... Date.....

Name and Signature (Investigator) .....
Designation..... Date.....

UFAFANUZI WA MAKUBALIANO

Jina langu ni Daktari Joan Wanyama, mwanafunzi katika kitivo cha utabibu katika chuo kikuu cha Nairobi na ninafanya utafiti kujaribu kuelewa athari za uzito wa mama waja wazito kwenye shinikizo la damu wakati wanapojifungua kupitia njia ya opareshenі madaktari wakiwapa dawa ya ganzi.

Ukikubali kushiriki kwenye utafiti huu, kimo na uzito wako utapimwa na kunakiliwa kisha utapewa dawa ya ganzi kabla ya opareshenі ya kujifungua mtoto. Opareshenі na vipimo vya shinikizo la damu vitafanywa kulingana na maadili ya hospitali kuu ya Kenyatta.

Utafiti huu hauna madhara ya ziada kwako wala hakuna malipo ya kushiriki. Madhara yoyote ambayo yatatokea wakati wa opareshenі yatatatuliwa mara moja.

Kushiriki kwenye utafiti huu ni kwa hiari yako na una uhuru wa kujiondoa wakati wowote bila hofu ya kudhulumiwa.

Majina ya kona habari zozote utakazozitoa kwetu zitawekwa kuwa siri zitatumika tu kwasababu za utafiti ilikuimarisha matibabu siku za usoni. Haki zako zitadumishwa wakati wote wa utafitihuu.

Ikiwa utakubali kushiriki, tafadhali tia sahihi au kidole gumba kwenye fomu ya makubaliano ya kushiriki ambayo utapewa hivi punde.

Utafiti huu umeidhinishwa na Kenyatta National Hospital/ University of Nairobi Ethics and Research Committee.

Nambariyanguyasimuni:

Dr. Joan Wanyama

0721530744

FOMU YA IDHINI YA KUSHIRIKI

Mimi....., baada ya kuelezewa kwa kina sababu, manufaa, madhara na kupewa hakikisho ya kuweka siri jina langu, nakubali kwa hiari kushiriki katika utafiti huu. Sitalipishwa chochote kwa kushiriki katika utafiti huu, na sita lipwa kwa njia yoyote. Nimehakikishiwa kwamba, nikikataa kushiriki katika utafiti huu, sita dhulumiwa kwa njia yoyote ile.

Sahihi (mshiriki)..... Tarehe.....

Jina na sahihi (Daktari)..... Tarehe.....

Kwa maelezo zaidi na ufafanuzi, waweza kuwasiliana na

Dkt. Joan Wanyama – 0721530744

APPENDIX 2: MATERNAL BMI STUDY DATA FORM

Serial No:

1. BIODATA

- Initials……

- Age ……years

- Height ……Weight ……. BMI…….

- Mid upper arm circumference …….

2. Baseline vital signs: BP……. MAP…….. HR……. SPO_2……

Dose of Bupivacaine used (plain) …….

Time (mins)	NIBP(MAP)	HR	SPO_2
1 after spinal anaesthesia			
2			
5			
10			
15			
20			

30			
40			
50			
60 (there after every 10min)			

% reduction in BP (baseline systolic –min systolic/ baseline systolic BP) ……

1. Signs and symptoms of severe hypotension (indicate time after administration of spinal anaesthesia it occurred)
   - Nausea ☐
   - Vomiting ☐
   - Dizziness ☐
   - Others ……..

2. Sensory block level of Spinal Anaesthesia (see appendix 4) …….

3. Preloading done
   - Yes ☐
   - No ☐
   - Total Volume used ……. mls

4. Crystalloids used

- Total volume of crystalloids used……mls

5. Total volume of colloids (including blood products) used…….mls

6. Vasopressors used (total in mg)
   - Epinephrine…….
   - Ephedrine……..
   - Phenylephrine…….

7. Total operation time ……min…….

8. Estimated Blood Loss ……mls…..

9. Birth weight…….(grammes)

APPENDIX 3: SPINAL ANAESTHESIA PROTOCOL KENYATTA NATIONAL HOSPITAL MATERNITY THEATRE

PROTOCOL FOR SPINAL ANESTHESIA AT THE KENYATTA NATIONAL HOSPITAL

1. Know the indications & contra-indications
2. Inform the patient what you wish to do and have their cooperation
3. Inform the rest of the team in theatre so you can be assisted appropriately
4. Insert a good gauge I/V cannulae(20 or larger)
5. Pre-load with ½-1L N/saline / Hartmans over 30- 60mins
6. Install your monitors (pulse, respiration, SPO2, BP, ECG) and take baseline readings
7. Position the patient either sitting or lateral knee-chest. Make the patient comfortable
8. Open your Spinal Tray & clean the site & drape.

Spinal Tray should contain:-

a) Sterile towels for draping the patient
b) 2 gulley pots for holding cleaning solutions
c) Appropriate spinal needle (with introducer where required)
d) 2 syringes & Needles

i. 5ml syringe for infiltration of L.A to the site
ii. 2ml syringe for administering the spinal medication
iii. Sterile gauze pads for cleaning & dressing

9. Reconfirm the position of the patient (knee chest)
10. Identify the site: mid-line L3-4/ 4-5 & administer 3ml of 1% lignocaine using a gauze 21 needle to maximum depth. Withdraw the needle as you continue to administer L.A and raise a skin wheal.
11. Give 1-2 minutes for the L.A to take effect as you re-assure & position patient (if administered well, this usually covers one vertebra above & below, should you need to alter position of lumbar puncture)
12. While waiting for L.A to take effect, prepare your appropriate drug. You must have decided whether using plain or heavy L.A

a) Remember Heavy L.A is position dependent. The patient must be appropriately positioned after injection to allow desired distribution.

b) Bupivacaine is usually 0.5% concentration. The highest volume in tall patients will be 4 ml (20mg). Most patients will require between 7.5mg (1.5mls) to 15 mg (3ml).

c) Obstetric patients are more sensitive and will require between 10mg (2ml) to 12.5mg (2.5ml). Aim for a block up to T6. Test and record level of block.

d) Additive: 25mg Fentanyl (0.5ml) is a useful additive to prevent the discomfort of gut handling during CS etc. This must still make up the total volume of 2-2.5 ml of drug injected into the spinal canal. Other drugs have been used as additives but its best to avoid them unless you have been trained to use them. The haphazard use of additives into the CSF may have disastrous results.

e) Remember for CS the volume & position is critical to achieve a good or disastrous spinal block. Aim for a block up to T6.

13. Confirm the L.A has taken effect and note level/site for the block.

Insert the spinal needle. Usually there is a sudden give when the needle goes through the dura. Withdraw the stylet and check for CSF flow. Do not allow unnecessary drainage of CSF. Use the stylet to stop the flow temporarily, if you cannot administer the spinal drug immediately.

14. Administer the drug, dress the puncture site and position the patient appropriately to allow planned distribution of drugs. Rapid positioning after administration is critical if the drug used is hyperbaric (heavy).

15. Start your post-spinal monitoring & make adjustments accordingly. It is recommended to repeat BP readings at 1 minute intervals. You will need to respond rapidly to the initial changes in pulse & BP. Ask the patient to inform you immediately if nausea occurs. Nausea in spinal anaesthesia is most likely due to hypotension. It is an early warning sign that you must not ignore.

16. Test the level of the block. The tilt of the bed may have to be adjusted if using hyperbaric Local Anaesthetic to change drug distribution. This manipulation may only work within the first 10-20 minutes after administration of the L.A into the CSF.

17. Post-operative pain management - I/M Pethidine 1mg/kg 4-6 hourly for 24 hours

- Diclofenac suppository (or equivalent) stat & 12 hourly for 48 hours then orals.
- Follow up visit, within 24 hours.

18. Critical observation

a) Pulse –symptomatic bradycardia –Atropine 0.1 -0.6mg

b) SPO2 saturation ≤90% - Increase the O2 flow.

c) BP –symptomatic Hypotension

- -Ephedrine -5mg-10mg PRN (you may occasionally need an infusion)
- Phenylephrine
- Adrenaline

d) Respiration –falling respiratory rate (usually temporary)

-Give oxygen

-Assist with respiration briefly if required

-Reassure

e) Total Spinal Anaesthesia

i. Convulsions /loss of consciousness

ii. Respiratory failure
iii. Cardiovascular collapse

Intubate, ventilate, cardiac massage, vasopressors, anticonvulsants till vital signs stabilize.

f) Post spinal headaches

May occur post operatively.Are worse on standing & relieved by lying down.

Management

i. Bed rest
ii. Plenty of fluids
iii. Non-Steroidal Anti-inflammatory Drugs (NSAIDS)
iv. Epidural blood patch as a last resort

19. Post-Operatively –monitor BP ¼hourly for 2hrs.

Positioning –make patient comfortable with pillow under the head.

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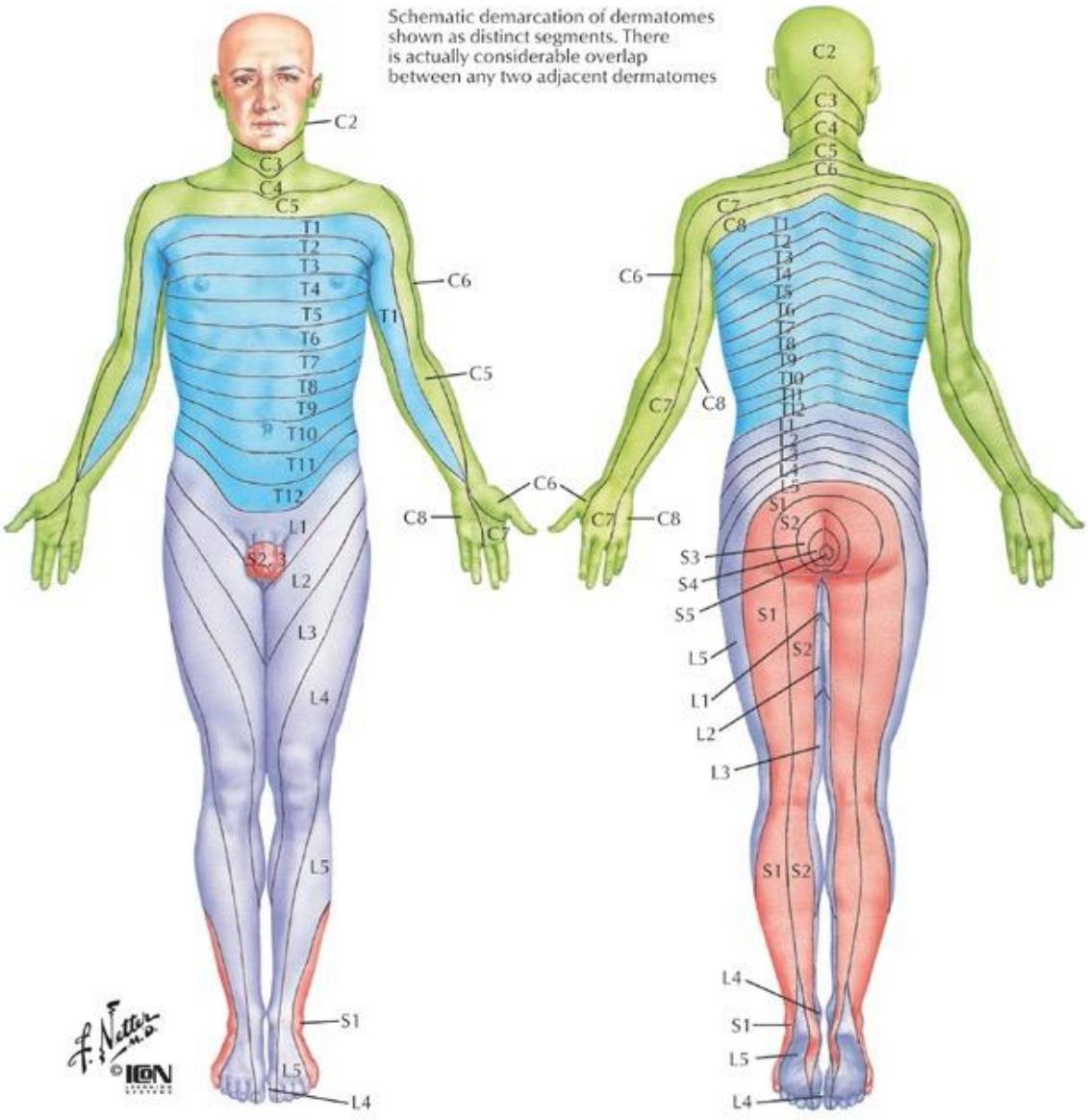
January, 1999.

APPENDIX 4: DERMATOME LEVELS



Levels of principal dermatomes

C5	Clavicles
C5, 6, 7	Lateral parts of upper limbs
C8, T1	Medial sides of upper limbs
C6	Thumb
C6, 7, 8	Hand
C8	Ring and little fingers
T4	Level of nipples
T10	Level of umbilicus
T12	Inguinal or groin regions
L1, 2, 3, 4	Anterior and inner surfaces of lower limbs
L4, 5, S1	Foot
L4	Medial side of great toe
S1, 2, L5	Posterior and outer surfaces of lower limbs
S1	Lateral margin of foot and little toe
S2, 3, 4	Perineum

APPENDIX 5: BUDGET

ITEM	**UNIT COST**
INTERNET	5000
STATIONERY	6000
BINDING	4000
RESEARCH ASSISTANT	15000
STATISTICIAN	20000
ETHICS AND RESEARCH COMMITTEE	2000
WEIGHING SCALE	2000
BP MACHINE	5000
HEIGHT SCALE	2000
TOTAL	**59,000**