East African Medical Journal Vol. 98 No. 2 February 2021
IS THERE A NEED FOR EXTRA-LENGTH SPINAL NEEDLES FOR OBSTETRIC SPINAL ANAESTHESIA IN OBESE PARTURIENTS? A MULTI-CENTRE STUDY
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ABSTRACT

Background: **Neuraxial blocks are often the preferred anaesthetic techniques in obese mothers for caesarean section because of increased risk of difficult intubation in them. However, these techniques may be challenging possibly because of poor landmark of spinal space and poor selection of spinal needles in them.**

Objective: **To investigate if there is need for extra-length spinal needles in obese parturients during caesarean section.**

Design: **A prospective observational study**

Setting: **Four University Teaching Hospitals in South-Western Nigeria.**

Subjects: **Parturients scheduled for caesarean section under spinal anaesthesia**

Results: **The mean age, weight, body mass index and skin to subarachnoid space depth (SSD) were 31.49 ± 5.12 years, 75.21 ± 14.14 kg, 27.68 ± 5.45 kg/m^2 and 6.08 ± 0.98 cm respectively. Of the 485 parturients, 156 (32.2%) were obese. Majority of the obese patients were greater than 30 years of age when compared with those that were under 30 years and this was statistically significant (p= 0.007). Only one obese**

parturient needed an extra-length spinal needle for skin to sub-arachnoid space depth (SSD) of 10 cm. There was a more positive linear correlation between depth of spinal needle and weight (0.455) than BMI (0.229)

Conclusion: **Although about one-third of parturients in our study were obese, only one required an extra-length spinal needle. Extra-length spinal needle is rarely needed in our population**

INTRODUCTION

There has been an increasing trend in the caesarean section rate in the last two decades, not just in developed countries but also in developing countries (1) including Nigeria. In addition, more caesarean sections are being performed under regional anaesthesia compared to general anaesthesia. The popularity of spinal anaesthesia for caesarean section could be because it is faster, possibly cheaper, technically easier to institute, and involves the use of lesser anaesthetic agents compared to multiple ones used in provision of general anaesthesia. Studies have shown that tendency for caesarean delivery increased as body mass index increased (2, 3). In a study on regional anaesthesia for caesarean section in obese pregnant women by Rodrigues et al (4), it was demonstrated that 91.1% of the obese parturients had caesarean sections out of which majority (62.2%) were done under spinal anaesthesia. Similarly, 65.8% and 67.7% of obese parturients were done under spinal anaesthesia for caesarean section in studies done by Edomwonyi et al (5) and Bamgbade et al (6) respectively.

Spinal anaesthesia is usually established by the anaesthetist via a lumbar puncture. This has traditionally been accomplished using a surface landmark-guided technique in which the approximate location of the neuraxial midline and lumbar interspinous and interlaminar spaces are determined based on palpation of the intercristal line and the tips of the spinous processes. Not surprisingly, the technical difficulty of neuraxial blockade correlates with the quality of palpable surface landmarks. These surface landmarks may be absent, indistinct, or distorted in obese obstetric patients (7). The major challenges in these patients are related to identifying appropriate landmarks, positioning the patient prior to performing the block and using a needle of sufficient length (4, 8).

A conventional spinal needle of 9 cm length may be too long for a lean patient while it may fall short of length in the obese patient resulting in multiple punctures, unsuccessful attempts and increased patient discomfort as reported by Jayaraman et al (8). Spinal anaesthesia for an obese patient with the use of extra-length spinal needle after several attempts of using conventional length spinal needle was eventually successful in that study. With increasing obesity in the parturients and need for spinal anaesthesia for caesarean section, it may be necessary to do an anecdote preparation for the use of extra-length spinal needle.

We therefore performed a prospective multi-centre observational study to assess: the pattern of obesity among caesarean section patients scheduled for spinal anaesthesia; the relationship between Body Mass Index (BMI); skin to subarachnoid space distance and the need for extra-length spinal needles for spinal anaesthesia in the obese patients for caesarean section in our institutions.

MATERIALS AND METHODS

This cross-sectional analytical study was carried out at the obstetric theatres of four teaching hospitals (two federal, one state and one private) in South West, Nigeria after institutional ethical approvals. The health facilities were Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Osun State; University College Hospital, Ibadan, Oyo State; Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State and Babcock University Teaching Hospital, Ilishan, Ogun State. All patients scheduled for caesarean section and fit for subarachnoid block were recruited from labour wards during the pre-operative reviews for a period of three months using a multistage sampling technique. Exclusion criteria were unbooked patients, patients' refusal, high-risk pregnancies, previous history of allergy to local anaesthetic agents, neurological disorders and any known contraindications to spinal anaesthesia. BMI of each patient was calculated by using weight in kg/height in square meter. This was developed from patient reported height and weight at the last antenatal visit.

Written consent was taken from every patient that fulfilled the inclusion criteria. Patients received intravenous ranitidine 50 mg to prevent gastric acid aspiration and metochlopramide 10 mg as prokinetic agent about 30 minutes before transfer to the operating room. In the theatre, baseline vital signs were obtained and two wide bore intravenous canulae were inserted. Patients were preloaded with a litre of normal saline or lactated Ringers. Each patient was placed in a sitting position on the operating table with stool support for the feet, instructed to flex the back and the iliac crest was identified. After preparing the patient's back with povidone iodine and sterile drape was applied, 1% lignocaine infiltration in the midline at the level of the L3-L4 interspace was done. A 25G spinal needle was inserted in the midline perpendicular to the skin. After successful location of the intrathecal space as evidenced by free-flowing cerebrospinal fluid, 10 mg to 14 mg of 0.5% hyperbaric bupivacaine was administered into the subarachnoid space with or without adjuvants. Following intrathecal injection by the performer, an assistant grasped the spinal needle firmly between the thumb and the index finger abutting the patient's back and removed. A sterile dressing was applied. The depth of insertion was then measured in centimetres using a standard scale and recorded. Patient was then placed in supine position with pillow support for the shoulder and wedge placed under the right buttock. Vital signs were monitored.

Data collection: Biodata, parity, estimated gestational age (EGA), height in metres, body weight in kilogrammes, body mass index of patients and depth of spinal needles were recorded into a proforma. Mosteller formular (9) was used to calculate body surface area BSA (m^2) = ([Height (cm) x Weight (kg)/3600) $^{1/2}$. WHO classification of BMI $kg.m^{-2}$ was used (10). Patients were further categorized into BMI <30 kg/m^2 as non-obese and ≥30 kgm^2 as obese. Skin to subarachnoid space depth (SSD) of up to 9 cm was regarded as conventional length and greater than 9 cm as extra-length.

Data analysis: The data obtained from this study were analysed by Statistical Package for Social Sciences (SPSS) version 23. Numerical variables were expressed as mean and standard deviation values. Categorical variables were presented as numbers and percentages. Differences between obese and non-obese group were assessed by Mann-Whitney U test for continuous data. The associations between the SSD, BMI and weight

were assessed by using Pearson correlation coefficients or Fisher's exact test as appropriate for frequency data. P-value less than 0.05 was considered statistically significant.

RESULTS

During the period of recruitment, 502 parturients fulfilled the inclusion criteria and 17 of them were excluded for incomplete data. In the remaining 485 parturients, 329 were non-obese and 156 were obese. The complete participant flow chart is shown in Figure 1. The mean age, weight, body mass index and skin to subarachnoid space depth (SSD) were 31.49 years, 75.2 kg, 27.68 kg/m^2 and 6.08 cm respectively as shown in Table 1.

Table 1

Patients' characteristics of the overall study population (N=485)

Characteristics	Mean±SD	Range
Age (years)	31.49±5.12	18-54
Weight (kg)	75.21±14.14	38.0-132.0
Height (cm)	16.2±0.07	140-188
BMI	27.68±5.45	17.30-46.67
BSA	1.83±0.19	0.60-2.51
SSD	6.08±0.98	3.80-10.0
Gestational age	38.31±1.91	28-45
Parity	1.26±1.19	0-6.0

SD -Standard deviation; BSA -Body surface area; BMI -Body mass index

The unadjusted mean depth from skin to subarachnoid space increased with BMI (from 5.72±0.98 at BMI <18.5 to 6.96±1.38 for BMI >40) as shown in Table 2.

Table 2

WHO Classification (11) of BMI and their depths of spinal needle insertion characteristics

BMI (kg/m2)	Frequency (%)	Depth of spinal needle insertion Mean±SD
<18.5 (underweight)	7 (1.4)	5.72±0.98
18.5-24.9 (normal)	156 (32.2)	5.91±1.03
25.0-29.9 (overweight)	166 (34.2)	6.05±0.91
30-34.9 (obese I)	112 (23.1)	6.12±0.86
35-39.9 (obese II)	32 (6.6)	6.68±0.91
>40 (Obese III)	12 (2.5)	6.96±1.38

SD -Standard deviation; BSA -Body surface area, BMI -Body mass index

Of the 485 parturients, a third (34.2 %) were overweight with obese and normal weight patients shared equal proportion of 32.2% each. Most of the obese patients were above 30 years of age, but has no significant effect on the parity and gestational age of the patients as shown in Table 3.

Table 3

Crosstabulation of patients' characteristics in obese and non-obese parturients

Obstetrics characteristics and length of spinal needle		**Obese (%) n= 155**	**Non-obese (%) n= 330**	**p-value**	**Remarks**
Age (years)	<30	46 (29.7)	135(40.9)	0.017	Significant
	≥30	109 (70.3)	195 (59.1)		
Parity	Nulliparous	45 (29.0)	116 (35.2)	0.69	Not significant
	1	40 (25.8)	101 (30.6)		
	>1	70 (45.2)	113 (34.2)		
Gestational age(weeks)	<37	11 (7.1)	23 (7.0)	0.959	Not significant
	37and above	144 (92.9)	307 (93.0)		
SSD (cm)	Conventional length (9 cm)	154 (99.4)	330 (100.0)	0.144	Not significant
	Extra-length (>9 cm)	1 (0.6)	0 (0.0)		

Only one morbidly obese parturient of age 35 years and BMI 42.8 kg/m^2 needed an extra-length spinal needle for skin to SSD of 10 cm. There was a more positive correlation between depth of spinal needle and weight than BMI. In Figure 2, there is a more positive linear relationship between weight and SSD (r =0.207, p=0.000) when compared with results in Figure 3.

Figure 3 also reveals a positive linear relationship between BMI and SSD (r =0.053, p =0.000 implying that as BMI increases, SSD also increases. Although in few cases, the scatter plots show parturients of lower BMI with unexpected high SSD and patients of high BMI with unexpected low SSD.

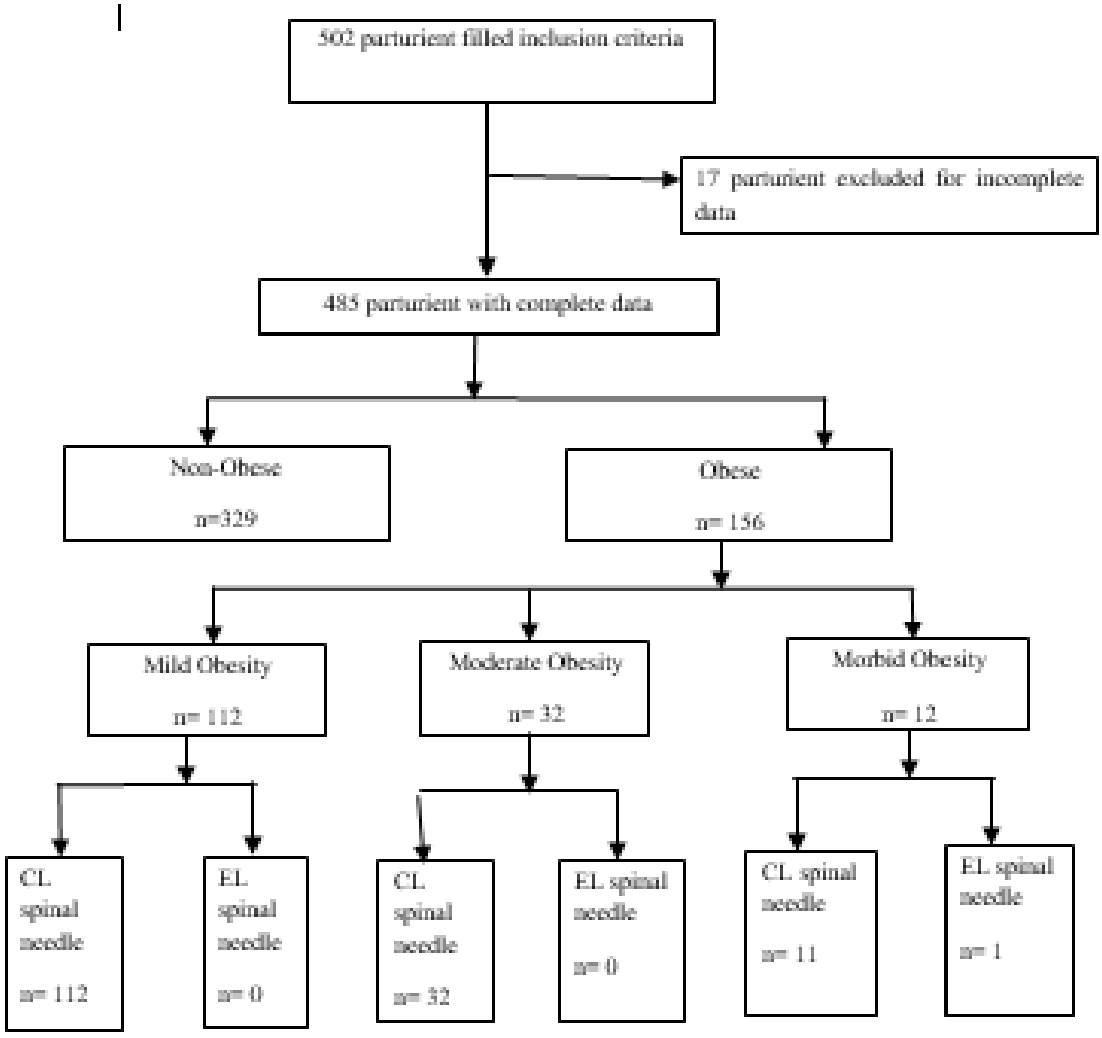

Fig 1: Flow of parturients through the study
CL: Conventional Length; EL Extra length

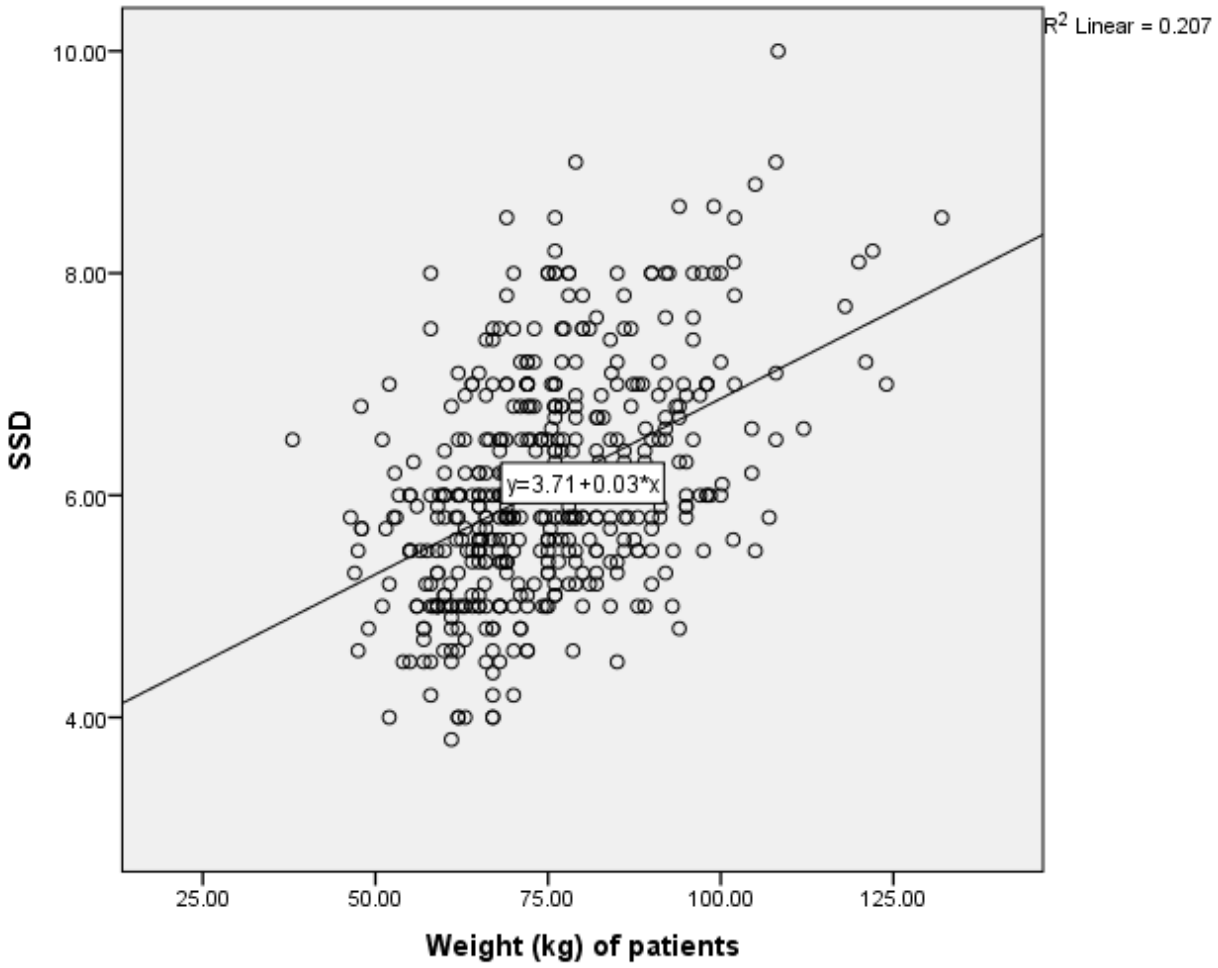

Figure 2: The scatter plot of BMI and SSD. SSD is in cm

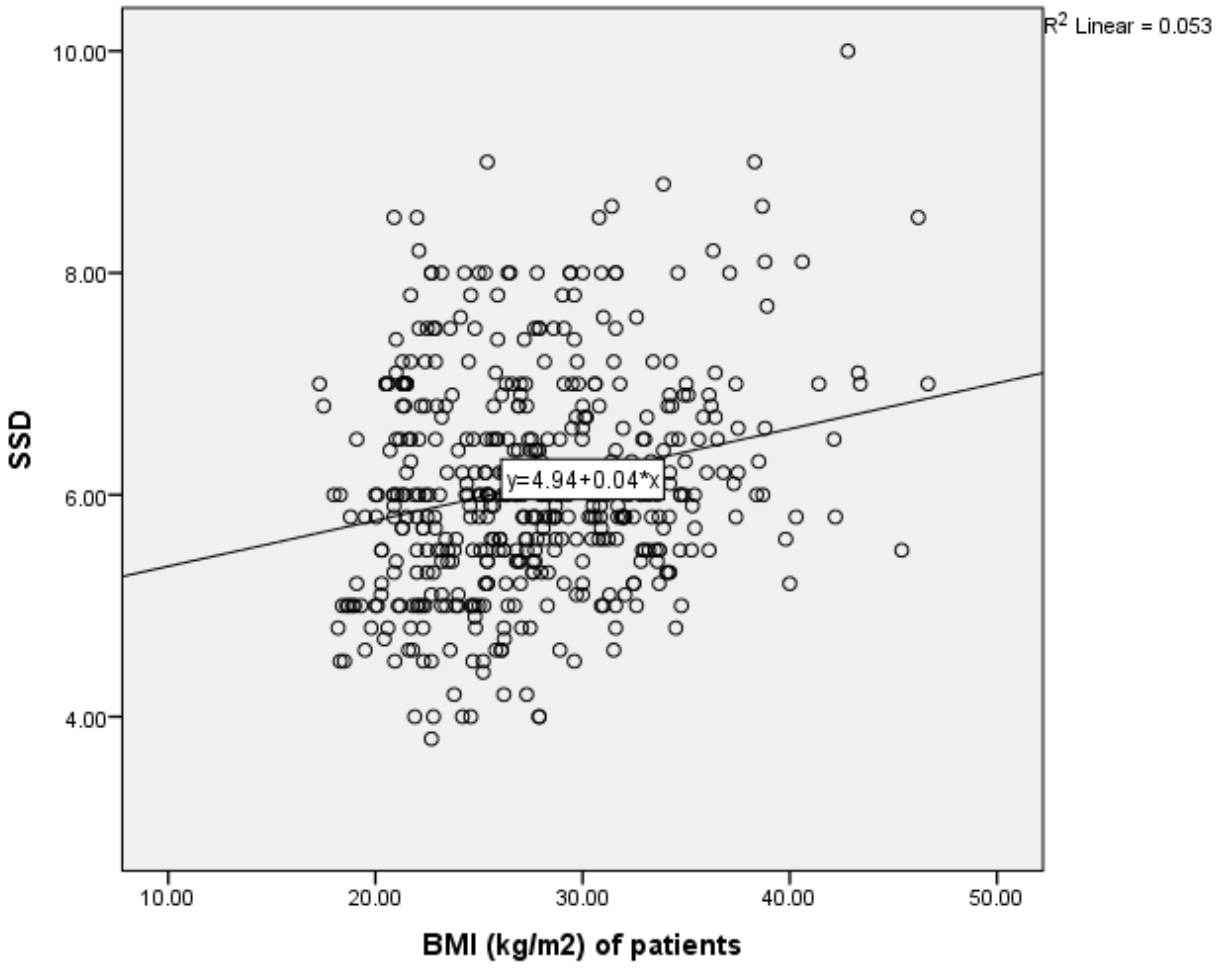

Figure 3: The scatter plot of BMI and SSD in cm

DISCUSSION

Our results demonstrated a rare need for extra-length spinal needle, though about one-third of the study population was obese and 2.5% morbidly obese. The mean BMI was 27.68 kg/m² while the mean skin to subarachnoid space depth was 6.08 cm.

Generally, physiological changes in pregnancy with fat and fluid accumulation secondary to hormonal surge can result in weight gain during this period. Prevalence of obesity in patients for caesarean section in South East Nigeria by Edomwonyi et al (5) was 50.7% which was similar to 54.3% reported in another study in United Kingdom by Bamgbade et al (6). More recently, An et al (11) reported 67.0% in a Chinese obstetric population. The percentage of obese patients in our study was lower (32.2%) when compared with earlier studies. However, about 34.2% were overweight. These results may be pointing to the likelihood of future increase in the prevalence of obesity in parturients presenting for caesarean section in our geopolitical zone of the country in line with the global prediction of rising trend in obese population. The mean BMI of 27.7 kg/m²

in our study was similar to that of Taman et al (12) with 27.91 kg/m^2 in the Egyptian population but reported a higher mean weight of 82.3 kg and lower mean SSD of 4.32 cm when compared with ours. The difference in outcome might be due to the difference in diet and body fat distribution depending on race. We included 485 parturients as against 88 patients included in their study. Other previous studies (13, 14) with lesser obstetric population had corresponding lesser SSD as observed. Our larger sample size may be a better reflection of the true population status. Bassiakou et al (15) study in Greece with larger and purely obstetric population like ours had a slightly higher mean weight of 80.5 kg, BMI of 29.8 kg/m^2 and SSD of 6.5 cm when compared with 75.2 kg, 27.7 kg/m^2 and 6.08 cm respectively in our study. This is however different from the Egyptian and Asian population studies where males and non-pregnant patients were included in their study.

Two Indian studies (13, 14) had SSD of 4.43 cm and 4.73 cm respectively which were slightly higher than the result of Taman's study in Egyptian population. The similarity between their results could have been due to the effect of race and ethnicity on anthropometric measurement of patients. The study by D'Alonzo et al (16) on ethnicity and the distance of skin to epidural space in parturients, it was reported that BMI had a significant influence on skin to lumbar epidural space depth (STLESD). In their study, it was demonstrated that the African American parturients had the highest mean weight of 91.0 kg, BMI (33.7 kg/m^2) and STLESD (6.3 cm) while the Asian patients had the lowest weight (67.8 kg), BMI (26.4 kg/m^2) and STLESD (4.8 cm) respectively. Although their study was on epidural anaesthesia, the values in the Asian population were not too different from SSD in spinal anaesthesia in the two previous Asian studies of Prakash et al (13) and Hazarika et al (14) respectively whose citizens are short stature. Anatomically, epidural space is separated from subarachnoid space by the dura. In a previous study (15), epidural to spinal distance (ESD) of mean/SD value 0.9 ± 0.5 cm and range 0.2-1.5 cm can be used to estimate SSD. With this comparison after the calculation, it is therefore imperative to take ethnicity into consideration when planning for the choice of spinal needle length. This implies that parturients in Nigeria have more tendency towards trunkal obesity with longer SSD like in the western world than the Asian population but not necessarily extralength spinal needle.

Our finding shows that SSD correlates with BMI and body weight. This is similar to the outcome of two other studies (14, 15). However, the positive correlation between SSD and weight was stronger than with BMI in our study. This may explain the reason why some of our patients with high BMI still had SSD that are comparable with normal weight and overweight parturients. BMI was observed to be the commonest correlated factor with SSD when compared with weight, BSA and height in other studies (9, 13, 14, 15). This could be because BMI is a mathematical derivative of body weight and height. In a non-obstetric study by Razavizadeh et al (17) on surgery on the lower abdomen and extremities under spinal anaesthesia, a strong correlation was found between depth of spinal needle insertion and BMI but conversely has no significant correlation with weight of the patient. This variation in their study when compared with ours may be related to gender differences as 77% of patients in their study were males although the correlation between needle depth, BMI and weight between sexes is not significant.

In a study by Riley et al (18) more than a decade ago in United States of America, failure to obtain CSF occurred six times when 120-mm-long spinal needle was used for Combined Spinal Epidural (CSE) compared to 127-mm-long spinal needle for parturients. Although data on BMI was not reported in the study, obesity is a common health challenge in the United States.

The use of extra-length spinal needles featured in two non-obstetric case reports. The first was as reported by Jayaraman et al (8) in a 40-year-old man, BMI of 55.4 kg/m^2 with perianal abscess who refused general anaesthesia for fear of perioperative complications but opted for spinal anaesthesia. This technique was eventually successful after several attempts with the use of size 22 G, 17.5 cm long length spinal needle. The second one by Eidelman et al (19) was a 43-year-old woman, BMI 54 with subchondral cyst of the left femur. The procedure was effectively done with the use of a long Quincke spinal needle size 17.7 cm under fluoroscopic guidance. In our obstetric study, the mean age was 31.5 years and those that were above 30 years of age were more on the obese group than the younger ones. The only parturient that required extra-length spinal needle was aged 35 years, body weight of 108.3 kg, BMI of 42.8 kg/m^2 and SSD of 10 cm. Soens et al (20) in their reviews of various anaesthetic techniques for caesarean sections in obese parturients were also of the opinion that conventional spinal needle length could be used in them. However, they submitted that CSE might be needed in some patients because of the advantages of ability to introduce smaller spinal needle through Tuohy needle and facility for top up analgesia because of anticipated long duration of surgery. This suggestion was supported by Lamon and Habib (21) in a more recent discussion on the anaesthetic management for caesarean section on obese patients. It had been reported that obesity has a tendency to increase with age (22). However, the need for long length spinal needle may be less frequently used in the obese obstetric population as it was in our study with only one obese parturient and age greater than 30 years that needed extra-length spinal needle. This assertion is corroborated by a case series report of three obese parturients whose two of the BMIs were 73.0 kgm^2 and 79.4 kg/m^2 respectively and still had a successful spinal anaesthesia catheter with conventional spinal needle (23). It was only one parturient with BMI of 95.3 kg/m^2 that had lumbar intrathecal catheter at a depth of 10 cm.

We were unable to find original articles that evaluated the use of extra-length spinal needles for obese parturients other than case reports or series. Further multicenter studies are needed in our region to evaluate our assertion of rare need of the use long spinal needle for spinal anaesthesia in obese mothers. Our study should have included a large cohort of morbidly obese patients, in which case it is probably that many more long needles would have been required, particularly if the distribution of the adipose tissue is largely centripetal. Another limitation of our study is not adjusting for the years of experience or cadre of anaesthetists as the operator experience could be linked to ease and appropriateness of spinal needle angulation at insertion.

CONCLUSION

It was very uncommon to require a spinal needle longer than 9cm for spinal anaesthesia for caesarean section in women who are not morbidly obese, in the particular units studied in Nigeria, where morbid obesity mothers appear to be relatively uncommon. However,

we recommend that a few longer needles should be made available in the labour ward theatre because there may be a rare need for it and taken into consideration an increase prevalence of obesity worldwide as predicted.

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