Pregnancy Outcomes of Overweight and Normal Weight Women in a South African Outpatient Clinic

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INTRODUCTION

According to a national South African study 56.6% of women older than 15y were overweight or obese (BMI >/= 25 kg/m^2) (Puoane et al., 2002). Obesity among women of reproductive age has been related to several gynaecological disorders, including polycystic ovary syndrome, infertility, menstrual disorders and pregnancy hypertension (Lake et al., 1997). Data on pregnancy weight-gain patterns from developing countries are scarce, due to difficulties in collecting data throughout pregnancy (Subcommittee on nutritional status and weight gain during pregnancy, 1990; Winkvist et al., 2002). There is very limited data available about weight gain patterns of pregnant South African women and the effects of pregnancy weight gain on obesity later in life (Vorster et al., 1997; Dannhauser et al., 2000). Eclampsia of pregnancy occurs most commonly among women who are overweight at conception, or those who gain weight excessively during the second and third trimesters of pregnancy (Perlow et al., 1992). Obese women are more likely to deliver infants with macrosomia, or with intrauterine growth restriction, or who require admittance to an intensive care unit than do their normal-weight counterparts (Perlow et al.,1994). Women who are obese during pregnancy have a higher likelihood of caesarean delivery and peri-operative morbidity after caesarean delivery, as well as urinary tract infections than do normal weight women (Perlow et al., 1992; Parker and Abrams, 1993). Stevens-Simon et al. (2002) reported a significant increase from conception in fasting serum insulin and glucose-to-insulin ratio in pregnant women at 30 weeks gestation and that insulin resistance was significantly related to total and subcutaneous adiposity. Obese women are also more likely to suffer from hypertension and/ or diabetes mellitus during pregnancy (Lake et al., 1997; Perlow et al., 1994; Parker and Abrams, 1993). After adjusting for BMI at the age of 7 years and social class at birth, obese women had an odds ratio of 3.02 (95%CI 1.96, 4.63) to be hypertensive (Lake et al., 1997). With increasing rates of obesity worldwide, postpartum weight retention is an important pregnancy outcome. Studies reviewed by the Institute of Medicine (IOM)'s Subcommittee on Nutritional Status during Pregnancy (Subcommittee on nutritional status and weight gain during pregnancy, 1990) suggested an average weight retention of 1kg per birth. Black women showed a greater increase in postpartum weight retention with increasing pregnancy weight gain and were more likely to retain more than 6kg than were white women (Keppel and Taffel, 1993). This difference in weight retention after pregnancy has been mentioned as one of the determinants of a higher prevalence of obesity among black women compared to white women (Kumanyika, 1999; Hilson et al., 1997).

The aim of this study was to monitor pregnancy weight gain and maternal health during pregnancy, and to compare health during pregnancy and pregnancy outcomes of over- weight and normal weight women in a South African outpatient clinic.

METHODOLOGY

Pregnant women visiting a midtown antenatal clinic in Potchefstroom, South Africa were asked to volunteer as participants for the study. The inclusion criteria were that they should be on their first visit to the clinic, still within the first 28 weeks of pregnancy and have a singleton pregnancy. This midtown clinic serves mostly black women. The study was done over a one-year period. All participants (n = 98) signed an informed consent form and the study has been approved by the Ethics Committee of the North-west University. Demographic information (including age, educational status, occupational status, average household income, marital status) of the participants were collected during face-to-face interviews. Trained fieldworkers collected information regarding their dietary intake, using a previously validated food frequency questionnaire (FFQ) and food portion photo book (Venter et al., 2000). A maternal health questionnaire was used to record blood pressure, symphyseal fundal (SF)-measurement, smoking status, allergies, parity and haemoglobin levels. Blood pressure was measured using a sphygmomanometer after a rest period of at least five minutes with the patient sedentary, by experienced registered nurses. The clinic nurses also did blood tests for Human Immu-

nodeficiency Virus (HIV) only for subjects who gave their consent and haemoglobin tests by comparing undiluted blood with pre-calibrated colour standards (Haemoglobinmeter, Medsurge, Johannesburg, South Africa).

To determine the weight gain during pregnancy each participant's weight, height, subscapular and triceps skinfold thickness and their mid-upperarm circumference (MUAC) were measured and recorded using standard methods (ISAK, 2003). The weight was measured using a Precision electronic scale (A and D Company, Tokyo, Japan), the height using a wall-mounted stadiometer and mid-upper arm circumference (MUAC) was measured using a Lufkin steel tape (Cooper Tools, Apex, NC). Subscapular and triceps skinfolds were measured using a John Bull skinfold caliper (British Indicators, London, UK). Measurements were done in triplicate and the mean value was recorded. The anthropometry measurements were done by dieticians or trained final year Dietetics students. Pregnancy weight gain was categorized as optimal weight gain, insufficient weight gain and excessive weight gain according to the IOM guidelines. For statistical analysis a regression analysis was used to estimate the mother's pre-pregnancy weight in order to calculate the pre-pregnancy weight and BMI, as described by Olson and Strawderman (2003). The regression was done back to week 14 (gestational age), because weight gain is linear during the second and third trimesters.

Each participant was followed-up for a minimum of three visits. Where possible, the first visit was done within 10 to 28 weeks of gestation, the second at 30 to 32 weeks and the third at 36 to 38 weeks. Most participants were followed up for more than three visits, with a mean total of 3.6 visits per subject. Taxi fees were reimbursed at each visit (SAR10/visit).

At birth, a hospital visit was done to record the infant's birth weight, which was measured by the hospital with a spring scale (Salter model 40A, Tokyo, Japan); length and head circumference measured with an unstretchable tape (Butterfly, China), gestational age and apgar score were recorded. The gestational age of the baby was determined according to ultrasonography. Underweight, HIV positive women and those not gaining enough weight during pregnancy received specialised care, such as advice from the dieticians, medical care and standard clinic nutritional supplements (folic acid, iron and vitamin C tablets).

Statistical Analysis: Subjects were classified according to second and third trimester weight gain, as well as total weight gain (within or outside the IOM guidelines). The maternal health indicators during pregnancy and delivery (blood pressure, caesarean delivery and macrosomia, defined as a birth-weight greater than 4kg) of women overweight at 14 weeks gestation (BMI>26kg/m^2) was compared to those of mothers of normal weight (BMI 19.8-26kg/m^2), using the Mann-Whitney U-test. The three groups of women, with weight gains below, within and above the IOM guidelines were also compared with regard to BMI at 14 weeks gestation, infant birth weight, blood pressure and number of caesarean deliveries, using the Kruskall-Wallis test for non-parametric data, since the group with weight gain below the IOM guidelines consisted of only eight subjects and the data were not normally distributed. Partial correlation coefficients (Spearman's correlation) were calculated for the association between pre-pregnancy BMI, as well as weekly weight gain and birth weight, length and head circumference of the infant, with adjustment for smoking and HIV status. The statistical packages SAS® and Statistica® were used for statistical analyses.

RESULTS

Of the 98 women included in the study, data of 91 women could be analysed. Two pregnancies ended in miscarriage and five women were lost to follow-up. This group of volunteers were a subsample of the total number of 478 pregnant women who attended this clinic over a period of one year. Comparison of age, parity, blood pressure and haemoglobin values between the total group and the subsample showed that this subsample was similar to the total group, with the only difference that the subsample attended the clinic from an earlier stage of pregnancy (22 weeks compared with 28 weeks gestation). Only 32 women consented to an HIV-test, of which eleven were HIV positive and 21 tested negative. None of the women were symptomatic at the time of the study, or received antiretroviral medication. All women in this study subsample had singleton pregnancies.

Table 1 shows the demographic data of the group (n = 91) collected through a demographic questionnaire on the first visit to the clinic. Figure 1 shows the women who gained adequate, inadequate and excessive weight according to the IOM's recommendation (Sub-committee on nutritional status and weight gain during pregnancy, 1990). Of those women with a pre-preg-nancy BMI <19.8, classified as underweight (n = 15), 14

Table 1 : Demographic data of the participants (n=91,numbers may vary due to incomplete data)*

Demographic data	*N*	*(%)*
First Language:		
African language (Xhosa/Zulu/ Tswana/Sotho)	90	(98.9%)
English/Afrikaans	1	(1.1%)
Marital Status:		
Married, live with baby's father	16	(17.6%)
Live with partner, baby's father (not married)	29	(31.9%)
Live with partner, not baby's father (not married)	2	(2.2%)
Widow, live alone with other relatives	1	(1.1%)
Never married, live alone	1	(1.1%)
Never married, live with relatives/ friends	41	(45.0%)
Highest Qualification:		
None	7	(7.7%)
< Grade 8	17	(18.7%)
Grade 8 – 10	9	(9.9%)
Grade 8 – 10 + trade	4	(4.4%)
Grade 11 – 12	36	(39.6%)
Grade 11 – 12 + trade	10	(11%)
Grade 12 + tertiary education	8	(8.8%)
Employment:		
Employed	44	(48.4%)
Unemployed	47	(51.6%)
Occupation:		
Professional (teacher/nurse/other with tertiary education)	4	(9%)
Self-employed, formal	3	(6.8%)
Office work/ sales assistant	13	(29.5%)
Domestic service/ cleaner	22	(50%)
Informal sector (hawker)	2	(4.5%)
Main Source of Income:		
Own salary/wage	37	(40.6%)
Parents/ Grandparents	29	(31.9%)
Relative's pension	2	(2.2%)
Husband/ Partner	19	(20.9%)
Other: brother or sister	4	(4.4%)
Total Household Income per Month:		
<R500 per month (±72USD)	26	(28.6%)
R500 – R1 000 per month	36	(39.6%)
R1 000 – R2 000 per month	21	(23.1%)
R2 001 – R5 000 per month	8	(8.8%)
Type of Housing and Services:		
Brick house	67	(73.6%)
Zinc informal house	21	(23.1%)
Other: prefabricated/wood	3	(3.3%)
Access to Electricity	84	(92.3%)
Water: Tap inside house	32	(35.2%)
Tap outside in own yard	50	(54.9%)
Communal tap within 200m from house	9	(9.9%)

gained weight according to the IOM recommendations, and only one above the recommendations. Of those with a normal prepregnancy BMI (19.8 – 26) (n = 46), 17.4% (n = 8) had a weight gain below, 54% (n = 25) gained weight within and 28.3% (n = 13) had a weight gain above the IOM recommendations. Of the mothers classified as overweight (n = 12) based on a pre-pregnancy BMI (>26-29kg/m^2) most gained weight above the recommended ranges (58.3%, n = 7), whereas eight of the 18 obese women also gained excessive weight (Sub- committee on nutritional status and weight gain during pregnancy, 1990).

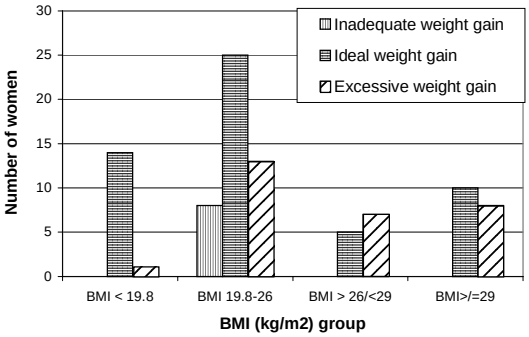

Fig. 1. Weight gain of pregnant women per BMI group according to IOM recommendations

Table 2 shows the data for age, weekly weight gain, dietary intake, and birth data for women according to their pre-pregnancy BMI categories. No significant differences between the variables of the different groups were found, except for age, the obese women being older than the normal weight and underweight women. For further analyses the data of underweight and normal weight women were combined, as well as the data for overweight and obese women. The birth data of the boys and girls in this group are shown in Table 3. No significant differences between the birth weight, length and head circumference of female and male infants could be found. For further analyses the data of boys and girls were combined.

Health information, which includes the participants' blood pressure, urine test results and anthro-pometric measurements (mean triceps skinfold, mean subscapular skinfold and mid-upper arm circumference) are shown in Table 4. The mean systolic and diastolic blood pressure of the overweight and obese women were significantly higher at the first and second visits than those of normal and underweight women. Women with BMI>26kg/m^2 tended to have higher blood pressure at the third visit, more positive urine tests for leucocytes and heavier babies, with similar head circumference than women with BMI=/<26kg/m^2. The overweight and obese

Table 2: Data regarding age, weight gain, dietary intake and birth data for mothers with regard to their pre pregnancy BMI, (n=91)

	Women with a pre-pregnancy BMI < 19.8 (n=16)			
	Mean[1]	*Min*[2]	*Max*[3]	*SD*[4]
Age (years)	24.69	18.00	40.00	5.88
Weekly weight gain (kg)	0.63	0.44	0.87	0.12
Energy intake (kJ)	12497.8	6467.0	17988.0	3568.0
Protein intake (g)	92.89	35.30	183.10	38.70
Iron intake (mg)	11.61	4.30	15.50	3.72
Calcium intake (mg)	756.29	337.00	1219.00	274.08
Birth weight (kg)	3.08	2.40	3.70	0.38
Birth length (cm)	49.75	46.00	57.00	3.10
Head circumference (cm)	34.25	31.00	38.00	1.65
	Women with a pre-pregnancy BMI 19.8 – 26 (n=45)			
Age (years)	26.38	14.00	37.00	5.69
Weekly weight gain (kg)	0.49	0.12	1.08	0.24
Energy intake (kJ)	11678.1	5014.0	20149.0	3809.0
Protein intake (g)	79.56	23.80	178.70	29.08
Iron intake (mg)	10.98	4.90	19.60	3.83
Calcium intake (mg)	802.93	177.00	2182.00	406.51
Birth weight (kg)	3.05	1.90	4.12	0.47
Birth length (cm)	49.43	43.00	57.00	2.94
Head circumference (cm)	34.70	31.00	40.00	1.89
	Women with a pre-pregnancy BMI > 26 and =/<29 (n=12)			
Age (years)	26.42	19.00	38.00	5.63
Weekly weight gain (kg)	0.48	0.15	0.93	0.24
Energy intake (kJ)	12248.3	4069.0	21799.0	4085.7
Protein intake (g)	86.22	22.60	175.60	29.99
Iron intake (mg)	13.32	3.70	30.00	5.48
Calcium intake(mg)	838.31	240.00	2088.00	429.09
Birth weight (kg)	3.18	2.5	4.02	0.47
Birth length (cm)	50.72	46.00	58.00	3.31
Head circumference (cm)	34.72	32.00	37.00	1.55
	Women with a pre-pregnancy BMI > 29 (n=18)			
Age (years)	31.52	19	47	7.34
Weekly weight gain (kg)	0.40	0.13	1.13	0.26
Energy intake (kJ)	12654.710	251.5	21799.0	4832.7
Protein intake (g)	91.25	42.5	157.4	24.6
Iron intake (mg)	14.52	3.700	30.00	6.239
Calcium intake (mg)	968.89	286.00	2088.00	56.250
Birth weight (kg)	3.29	2.49	4.2	0.52
Birth length (cm)	50.53	45	56	2.88
Head circumference (cm)	34.4	32	37	1.55

[1]Mean, [2]Min: minimum, [3]Max: maximum, [4]SD standard deviation

Table 3: Birth data of boys and girls

	Boys (n = 44)			
	Mean[1]	*Min*[2]	*Max*[3]	*SD*[4]
Birth weight (kg)	3.14	2.5	4.0	0.46
Birth length (cm)	49.85	43.0	58.0	2.93
Head circumference (cm)	34.98	32.0	40.0	1.78
	Girls (n = 47)			
	Mean[1]	*Min*[2]	*Max*[3]	*SD*[4]
Birth weight (kg)	3.10	1.9	4.2	0.48
Birth length (cm)	49.87	44.0	57.0	3.06
Head circumference (cm)	34.21	31.0	37.0	1.61

1 No significant differences between the means for boys and girls, 2 Minimum, 3 Maximum, 4 Standard deviation

Table 4: Health information of the underweight and normal weight women (mean±SD*), compared with overweight and obese women(BMI>26kgm^2)

Variable	*Women with BMI</=26kg /m^2 n=61*	*Women with BMI>26kg /m^2 n=30*	*Two-sided P value*
Systolic blood pressure at first visit (mm Hg)	111.0±11.9	116.5±13.6	0.017
Diastolic blood pressure at first visit (mm Hg)	68.2±8.5	72.6±10.4	0.032
Systolic blood pressure at second visit (mm Hg)	109.90±13.2	117.7±11.1	0.004
Diastolic blood pressure at second visit (mm Hg)	66.1±8.2	72.3±7.7	0.002
Systolic blood pressure at third visit (mm Hg)	0.3081		
Diastolic blood pressure at third visit (mm Hg)	111.5±14.1	113.9±10.6	NS
Urine test at first visit	68.0±8.7	70.6±8.7	0.189 NS
Urine test at second visit	0.52#	0.77#	0.24,NS
Urine test at third visit	0.54#	0.63#	0.64,NS
Triceps skinfold (mm)	0.51#	0.59#	0.78,NS
Subscapular skinfold (mm)	17.3±6.6	28.8±9.8	P<0.0001
Infant birth weight (kg)	15.7±6.9	30.6±11.8	P<0.0001
Infant birth length (cm)	3.06±0.4	3.24±0.5	0.132,NS
Infant head circumference (mm)	49.5±1.8	50.6±1.5	0.078,NS
Infants with macrosomia	34.6±1.8	34.5±1.5	NS
Caesarean delivery (n, %)	(n, %)1	(1.6%)	3(10%)
Gestational age at birth (weeks)	7 (11.1%)4	(13.3%)	
	39.03±1.64	39.19±1.36	NS

*SD:standard deviation
#0/1, 0 indicates absence of leucocytes in urine, 1 indicates presence of leucocytes

women had a total of three babies (9.7%) with macrosomia, compared with only one baby (1.6%) of a normal weight woman (Table 4). Four overweight/obese women (13.3%) and seven (11.1%) normal/underweight women had caesarean deliveries. Women with a BMI >26 had more children on average (mean = 1.56, SD 1.26) than those with a BMI <26 (mean = 0.78, SD 0.97). There were no significant differences in the gestational ages of the two groups of women (39.03±1.64 versus 39.19±1.36 weeks, Table 4). There were no significant correlations between prepregnancy BMI or weekly weight gain of the mothers and birth weight, length or head circumference, respectively of the infants.

When the women who gained weight during pregnancy within the IOM guidelines were compared with those who gained insufficient or excessive weight, it was found that there was a significant difference between the pre-pregnancy BMI of the three groups (Kruskall-Wallis H = 7.19, P = 0.03). Women who gained excessive weight had a significantly higher pre-pregnancy BMI than women in the other two groups. Systolic blood pressure at the third visit (Kruskall-Wallis H = 6.48, P = 0.04) was also significantly higher in women who gained excessive weight than in their counterparts who gained according to the recommendations or less.

DISCUSSION

The results in Table 1 show that less than one-fifth of the participants were married and less than half of them lived with the babies' father. Most of the women lived with relatives. About one quarter of the women had no school education or only primary school education. More than half of the women were unemployed, with most of those employed being domestic workers (50%) and being responsible for their own income (40.6%). Only one out of every five women were financially supported by the baby's father. All women were from the low-income group with a household income of less than R5 000 per month. One-quarter of them reported living in informal housing and only one-third had access to piped water from an inside tap. Most of them had electricity in their homes. These living conditions are typical of low-income families in South Africa (Vorster et al., 1997).

Table 2 and Figure 1 show the women divided into categories of pre-pregnancy BMI's and their weight gain during pregnancy. Figure 1 clearly demonstrates the tendency to gain weight above the recommen-dation for all women, not only those who are over-weight during the early phase of pregnancy. This finding is in line with the findings of Carmichael et al. (1997), Caulfield et al. (1996), and Keppel and Taffel (1993). Published studies showed that only 30-40% of women in the USA actually have weight gains within the IOM recommended ranges (Caulfield et al., 1997; Hickey et al., 1995), compared with 59.4% in this study.

Data regarding age, weight gain, dietary intake and birth data for mothers with regard to their pre-pregnancy BMI shown in Table 2 show no significant differences between dietary intakes and pregnancy outcomes of the four groups of women. There were also no correlations between dietary energy or protein intakes and mothers' weekly weight gain. The lack of correlation between dietary intakes and weight gain may be due to under- or over-reporting of dietary intake. Most women had adequate energy and protein intakes in reference to the recommended allowances (WHO, 1985). According to the Klesges et al. (1995) it is now widely recognised that reported energy intakes in dietary surveys underestimate usual energy intake.Under-reporting is worse among women than in men, and is more pronounced among overweight and obese than among lean individuals. Low socio-economic status, characterised by low income, low educational attainment, and low literacy levels increase the tendency to underreport to a greater degree than those who experience frequent hunger. As these women were from a low socio-economic status, especially overweight women may have underreported their intakes.

The average birth weight, length and head circumference of the infants of the four groups of mothers (Table 2) did not differ significantly. Edwards et al. (1996) stated that women with a BMI >29.0 should gain at least 7.0kg during pregnancy, because those who lose weight or gain less than 6kg are more likely to deliver an infant that is small for gestational age. Excessive weight gain in women with a BMI >26 places the child at risk of being large for gestational age and increases the risk of birth injury (Cogswell et al., 1995; Gaultier-Dereure et al., 2000). The incidence of high birth weight did not, however, increase dramatically until pregnancy weight gain exceeded 16kg, the upper limit of the IOM recommended range (Feig and Naylor, 1998). Abrams and Selvin (1995) have described positive relations between second trimester or third trimester weight gains and birth-weight. Increased rates of gain were associated with larger foetal size, and lower rates of gain with smaller size. In this study no

significant correlation between rate of weight gain and birth-weight were found, probably because none of the women were both underweight during the early stages of pregnancy and gained insufficient weight (Fig. 1). The number of women who gained insufficient weight was probably not big enough to show such a relationship. Over-weight and obese women tended, however, to have heavier babies than normal weight and underweight women, whereas the two groups of infants' mean head circumference were similar (Table 4). A higher percentage of overweight and obese women also had babies with a birth-weight above 4kg. Two well-controlled studies showed that the risk of caesarean delivery, as well as perioperative morbidity after caesarean delivery increased with both pre-pregnancy weight and increasing weight gain of the mother (Lawrence et al., 1991; Witter et al., 1995). The relationship between maternal weight gain and caesarean delivery was continuous and the authors could not identify a threshold above which the risk of caesarean delivery increased more rapidly. In the present study there was a higher percentage of caesarean deliveries among women with a pre-pregnancy BMI higher than 26 kg/m^2 than among normal weight and underweight women (Table 4).

Abrams et al. (2000) found that the best birth weight outcomes were found in women whose weight gains were within the IOM's ranges. In their report, the Subcommittee on nutritional status and weight gain of the IOM (1990) also stated that foetal growth might be influenced more by specific maternal tissue changes, for example, by accretion of lean tissue, fat, or body water, than by gestational weight gain. Campbell-Brown and McFadyen (1985) also found more of a variation in birth weight explained by fat-free mass than by height and weight together. According to them, it seems to be an unknown factor associated with maternal lean body mass and not maternal energy reserves, which regulate infant birth weight. In this study it was not possible to measure maternal lean body mass separately, but the mid-upperarm circumference (MUAC) was measured as an indication of lean body mass. There was a tendency of an association between MUAC of the mother and birth weight of the baby ($r = 0.206$, $P = 0.083$). Fat reserves of the mother do not seem to protect the infant against low birth weight. In this study infants with birth-weights as low as 2.49 and 2.5kg were born to mothers in the overweight and obese categories, while the lowest birth-weight recorded for an underweight mother was similar (2.40kg) (Table 2). Briend (1985) suggested that a direct limitation of foetal growth by maternal energy reserves seem unlikely. He argued that foetal growth may be adapted to produce a baby with a size compatible with the energy reserves of the mother for lactation. It would be advantageous that a malnourished mother gives birth to a small baby with small energy needs. The author also suggested that obese women often give birth to small babies, because they may be prone to cardiovascular problems resulting in poor foetal growth. Campbell-Brown and McFadyen (1985) also found that women with a higher BMI at 20 weeks had smaller babies. In their study infant birth weight correlated significantly with the fat-free mass of the mother ($r = 0.44$) and showed weaker correlations with the weight of the mother ($r=0.22$) and triceps skinfold ($r=0.07$). There is no evidence that maternal fat stores benefit foetal growth among normal weight women (Widga and Lewis, 1999). These results support the hypo-thesis that infant birth weight is not associated with maternal energy reserves, but rather with maternal lean body mass.

Women with a BMI >26 had more children on average (mean = 1.56, SD 1.26) than those with a BMI <26 (mean = 0.78, SD 0.97). Brown et al. (1992) found a direct association between parity and body weight. This finding may indicate that the women tended to retain excessive weight after each pregnancy.There were no significant differences in the gestational ages of the two groups of women. Kramer (1993) also found inconsistent data regarding the effect of maternal weight gain on gestational duration. If maternal weight gain did affect gestational duration, the effect was small. The mean triceps skinfold for women with a pre-pregnancy BMI <26 lies between the 25th and 50th percentile, while those with a pre-pregnancy BMI >26 has a mean measurement between the 50th and 75th percentile (ADA, 1996), which confirms significantly greater subcutaneous fat mass in the women with higher body mass index at the beginning of pregnancy. The significantly higher mean blood pressure measurements in the overweight/obese group confirm the results of Lake et al. (1997), who showed an increase in the risk for hypertension during pregnancy in obese women. Women who gained excessive weight according to the IOM recommendations in this study also had significantly higher systolic blood pressure than women who gained within the recommendations or less, irrespective of their pre-pregnancy BMI. Higher blood pressure during pregnancy has been associated with pregnancy complications, such as pre-eclampsia and preterm birth (Lake et al.,

1997; Subcommittee on nutritional status and weight gain, 1990). Obese women are more likely than normal weight women to suffer from hypertension and/ or diabetes mellitus during pregnancy (Parker and Abrams, 1993; Lake et al., 1997). Stevens-Simon et al. (2002) reported a significant increase from conception in fasting serum insulin and glucose-to-insulin ratio in pregnant women at 30 weeks gestation and that insulin resistance was significantly related to total and subcutaneous adiposity. Subscapular skinfold thickness and ultraso-nically measured subcutaneous fat at the costal site were the best predictors of insulin resistance. Although insulin resistance was not measured in the present study, the significantly greater mean subsca-pular skinfold thickness of the overweight and obese women in this study (Table 4) places them at risk of insulin resistance and gestational diabetes. Women who are obese during pregnancy also have a higher likelihood of urinary tract infections than do normal weight women (Perlow et al., 1994). Women with a pre-pregnancy BMI>26kg/m^2 in this study had positive urine tests for leucocytes more often, although not significantly so, than women of normal weight (Table 4).

With increasing rates of obesity world-wide, postpartum weight retention is an important pregnancy outcome. Studies reviewed by the IOM's Sub-committee on Nutritional Status during Pregnancy (1990) suggested an average weight retention of 1kg per birth. A study of postpartum weight retention showed that black women showed a greater increase in postpartum weight retention with increasing pregnancy weight gain and were more likely to retain more than 6kg than were white women (Keppel and Taffel, 1993). This difference in weight retention after pregnancy has been mentioned as one of the determinants of a higher prevalence of obesity among black women compared to white women (Kumanyika, 1999). Obesity among black women is a public health problem in South Africa (Puoane et al., 2002). It is thus important to monitor weight gain among black pregnant women in South Africa and to use the opportunity during antenatal care to educate women about nutrition and weight management.

This study had a number of limitations. As pre-pregnancy weight was unknown, and some women had their first visit in their second trimester, pre-pregnancy weight (to determine pre-pregnancy BMI) had to be calculated with a regression analysis, which could not be done if less than three weights were available. Pre-pregnancy weight and BMI used in this study were in most cases calculated from a regression equation and not the actual measured weight and BMI. Very few of the subjects gave their consent for HIV/AIDS testing. It is thus unknown to what extent HIV status of the women could have an effect on the results. The HIV status of those tested and smoking were, however, considered when the partial corre-lations were calculated, because these factors may confound the association between the variables studied. Although women received nutritional counselling during clinic visits, excessive weight gain could not be prevented in an important proportion of the subjects.

CONCLUSION AND RECOMMENDATIONS

The results found in this study, emphasizes the importance of good, timely care of pregnant women, whether they are underweight, normal weight or over-weight. All the women in this study visited the clinic on a regular basis. The chances of both underweight and overweight pregnant women to have a positive pregnancy outcome through good, timely care is also confirmed, as described previously by Hickey et al. (2000). A study done with participants who do not visit clinics regularly might produce different results, but such a study is almost impossible, since subjects would be very difficult to trace. The tendency of women to gain weight above the IOM's recommended guidelines is important and should not be ignored. Excessive prenatal weight gain in overweight and obese women increases the risk of maternal hypertension, postpartum weight retention and macrosomia in the infant and may necessitate caesarean delivery and perinatal complications (Lake et al., 1997;Gaultier-Dereure et al., 2000). It is still recommended to promote weight gain within the IOM recommendations, for the rate of weight gain as well as for total weight gain. These recommendations are specific for the women's BMI category. Pregnancy provides a window of opportunity to educate women about the benefits of a good diet and a healthy lifestyle. Nutrition education during pregnancy should include advice on total energy intake and weight gain, in order to prevent excessive weight gain, which could contribute to obesity and non-communicable diseases later in life.

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KEYWORDS Obesity. Pregnancy. South African Women. Blood Pressure. Pregnancy Outcomes

ABSTRACT According to a national South African study 56.6% of women were overweight or obese. The aim of this study was to monitor pregnancy weight gain and maternal health during pregnancy, and to compare pregnancy outcomes of overweight and normal weight women in a South African antenatal clinic. Pregnant women on their first visit to the clinic, still within the first 28 weeks of pregnancy and with a singleton pregnancy were recruited for the study over a one-year period. Demographic information, dietary intakes, blood pressure, HIV-tests and haemoglobin levels of the participants were recorded. Each participant's weight, height, subscapular and triceps skinfold thickness and mid-upper arm circumference were measured by dieticians at each clinic visit. Pregnancy weight gain was categorized as optimal, insufficient or excessive weight gain according to the IOM guidelines. A regression analysis was used to estimate the mother's pre-pregnancy weight. At birth the infant's birth weight, length and head circumference were measured. Women tended to gain excessive weight, with only 17% of normal weight women gaining insufficient weight. No significant differences between dietary intakes and birth data for women according to their pre-pregnancy BMI categories were found. The mean systolic and diastolic blood pressure of the overweight/obese women were significantly higher at the first and second visits than those of normal and underweight women. Women who gained excessive weight had a significantly higher pre-pregnancy BMI than women in the other two groups. Systolic blood pressure at the third visit was significantly higher in women who gained excessive weight.

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