PREGNANCY AND OBESITY
AN ANALYTIC STUDY AND REVIEW OF LITERATURE

by

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Introduction

Obesity as a medical problem has continued to interest the physicians for a long time. Later on, obese individuals came to be regarded as special surgical risks. But it is only recently that obstetricians have been studying the effect of increase of weight in pregnancy, labour and puerperium and vice versa. Works on these lines have appeared in British, American and Australian medical literature, but the study of the obese individual as an obstetric patient is by no means complete.

There are three main reasons for increase of weight in pregnancy, and these are due to the products of conception, increase in blood volume and hypertrophy of breasts and uterus; due to retention of water, and finally due to deposition of adipose tissue. Weight gain due to water retention and that due to fat deposition are two different conditions and it is very difficult to assess the latter in pregnancy. When the pregnancy is over, weight gain due to water retention should be lost fairly rapidly, whereas that due to obesity tends to persist or even to increase.

Pregnancy per se has been shown to be a direct cause of obesity (Sheldon, 1949). Studying the details of 100 primigravidae, Poidevin (1959) found that 70 per cent remained heavier than their prepregnant weight six months after delivery. Excessive adiposity is an important sign in Cushing's syndrome, and pregnancy is regarded by many authors as a 'Physiological Cushing's Syndrome'. Clinical evidence of this fact has been put forward by Browne (1958), and Poidevin (1959 a and b), as well as laboratory evidence by Venning (1946), Gemzell (1953), Robinson et al (1955), Jailer (1956), Gold (1957) and McKay et al (1957).

It must be admitted that there still exists much controversy about the phenomenon of gain of weight in pregnancy, and different obstetric units adopt different attitudes to the problem (Rhodes, 1962). These facts

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prompted us to study and see for ourselves the effect of excessive weight gain in pregnancy due to obesity rather than due to water retention, and the present investigation is the outcome of this curiosity.

Review of Previous Studies

For over 20 years, considerable amount of work has appeared regarding increase of weight in pregnancy and its association with toxaemias of pregnancy. In this connection, works of Siddall and Mack (1938), Cummings (1934), Chesley (1944), Hamlin (1952), Thomson and Billewicz (1957), Poidevin (1960) and Rhodes (1962) are noteworthy. It is only very recently, however, that excessive weight gain due to obesity has been studied, and an attempt has been made here to review in chronological order some of the important works.

Browne (1946), after reviewing a number of works, wrote, "On the whole, therefore, provided too much is not expected from it, a case appears to have been made out for routine weight taking in pregnancy."

Gilbert (1949) reported evidence to show a correlation between progressive maternal obesity, the birth of unusually large babies, high foetal loss rate and ensuing maternal diabetes.

Sheldon (1949) compared 40 women who developed obesity during pregnancy with another 40 women who did not develop this complication and noted an increase in incidence of large, heavy babies, stillbirths and neo-natal death rates in the former group.

Leitner (1955) found obesity to be a predisposing factor for essential hypertension in later life and since the publication of his report the close association between obesity and essential hypertension has been widely accepted.

Petrie (1956) limited his study to a review of obesity and pregnancy and among other things, found that retention of some of the excess weight gained during repeated pregnancies is a major cause of obesity.

Williams (1957) wrote that patients who started their pregnancies with a high initial weight were more likely to develop toxaemia of pregnancy.

Fisher and Fray (1958) published an important paper and concluded that obesity influences both pregnancy and parturition. Anaemia was uncommon, but hypertension and toxaemia were common. Obese patients, in their experience, did not gain as much weight during pregnancy, yet they lost the same amount as the non-obese after the delivery.

Whitton (1958) studied a large series of cases and noted, as others did, an increase in incidence of toxaemia and hypertensive disease. In his experience, caesarean section rate in obese patients was higher than non-obese group, partly due to large weights of the infants. He did not find any significant increase in incidence of diabetes mellitus.

Fish et al (1959) concluded from a study of 1000 women that excessive weight gain and toxaemia should be largely dissociated.

Pomerance, Stone and *King* (1959) pointed out that pre-diabetic state and its pathological counterparts exist years before obvious abnormali-

ties of carbohydrate metabolism appear. Benign glycosuria and obesity, especially when other well-known pre-diagnostic manifestations are present, should be viewed with suspicion, in the pregnant woman. Proper treatment of these conditions will favourably alter the foetal and maternal prognosis in this pre-diabetic state.

Sands (1960) found that the pregnant woman tends to be anxious, tense and agitated, and frequently overeats in response to this emotional state. Administration of barbiturates results in a calmness that helps to control this state, and thus assists in arresting or limiting excessive food intake. He found that mild hypertension in many of these patients responded pari passu to reduction in weight as pregnancy progressed.

Stewart and Hewitt (1960), in addition to showing the preponderance of essential hypertension and toxaemia of pregnancy in obese women, also found that it occurred less often than average in those who were underweight. These findings, were, however, questioned by Lowe (1961) on the ground that the diagnosis of pre-eclamptic toxaemia was based on blood pressure readings only and hence probably included a number of cases of essential hypertension.

Emerson (1962) in an interesting paper concluded that one in five patients attending the ante-natal clinic can be classed as obese; such individuals are more prone to develop pre-eclamptic toxaemia and essential hypertension. Ante- and post-partum haemorrhages are frequent occurrences, as also are breech presentations. Correction by version of such breech babies often fails. Induction of labour, forceps and caesarean section are more often needed. Their babies are larger and foetal loss is higher. Lactation is not satisfactorily established in most cases. He advocates a carbohydrate-free diet to begin with and then after a week or two restricted carbohydrate diet; once toxaemia is suspected in such persons, hospitalization is obligatory.

Material and Method of Study

From a series of 1895 case notes obtained from either the Thanet Hospital obstetric units or Kent and Canterbury Hospital obstetric unit over a period of 33 months extending between the years 1958-1961, it was found that 550 cases were suitable for the present study. The remainder, namely 1345 case notes were rejected, either on account of insufficient detailed data, important for this investigation, or they were found to be medical emergencies or unbooked cases, or because some cases were not under my (J. B. B.) personal supervision. Detailed notes were recorded from each case paper about every obstetric factor and item including the weight of the infant, and these were analysed. A questionnaire was sent out to each of these 550 women and below is a list of the questions asked:

1. Height of patient.
2. Present weight of the patient.
3. Weight of the patient before any pregnancy, or basic weight.
4. Weight of the patient before the last pregnancy.
5. Length of time contraception

was practised or not before starting the first pregnancy.

Cases considered in this study totalled 550; they were divided into two groups, obese and non-obese.

The presumption is made here that a weight in excess of 10 stone 4 pounds in a non-pregnant woman from a group whose average age is 26, as in our series, indicates obesity.

At the thirty-sixth week of pregnancy the foetus, liquor and placenta with changes in the breast, uterus, and general body fluids cause a normal increase of 24 pounds in weight (Browne, 1950), so that at this stage of pregnancy a weight in excess of 12 stone can be properly taken as an indication of obesity. By this classification 148 patients were labelled as obese and 402 as non-obese.

It is appreciated that some patients classed as obese may have been overweight owing to more than average height or age; to check these possibilities, letters were sent to 148 obese patients. Seventy-three replies were received, and of these 95.8% were not of unusual height or age. It is, therefore, reasonable to apply this figure to those who did not reply and it can therefore be assumed that 95.8% of the obese group as a whole were in fact correctly labelled.

Part I

Obstetric Complications

Malpresentations. Little difference was noted in the incidence of malpresentations between the obese and the non-obese groups. The former showed 10 cases (6.6 per cent) and the latter 35 cases (8.5 per cent). This is not surprising, as the causes of malpresentation are not likely to be affected by obesity per se, although the diagnosis of a malpresentation or attempts to convert a breech into a vertex by external version may be difficult. If hydramnios is associated with obesity, it may be virtually impossible to make out foetal presentation or position by palpation. Occasionally however, palpation of the foetus and outlining of the foetal parts can be done with unusual clarity through an obese abdominal wall. This probably depends upon the consistency of the fat.

Twin pregnancy was found in 6 cases (4.05 per cent) in the obese group and in 7 cases (1.7 per cent) in the non-obese group. The reason for this is not clear; it may just be a coincidence.

Premature Labour. This was more frequent in the non-obese cases (75 or 18.6 per cent) than in the obese cases (23 or 15.1 per cent).

Postmaturity. Thirty obese patients (19.8 per cent) and 63 non-obese patients (15.3 per cent) were delayed by two weeks, past the expected date of delivery. The slightly increased incidence in the obese group may be due to minor degrees of menstrual irregularities so often encountered, or some alteration in the labour-initiating centre in the hypothalamus (Table I). Thus the number of labours starting within two weeks of the expected date were almost the same in the two groups, although prematurity was less and postmaturity more common in the obese group; the reverse holds good for the non-obese group.

Antepartum and Postpartum hae-

TABLE I
Labour in Relation to Maturity

Type of labour	Obese group	Non-obese group
Premature	23 (15.1 per cent)	75 (18.6 per cent)
Labour within two weeks of the expected date	95 (65.1 per cent)	264 (66.1 per cent)
Post-mature	30 (19.8 per cent)	63 (15.3 per cent)

morrhage. This is shown in Table II. It will be noted that haemorrhages in pregnancy are not affected by obesity.

Manual Removal of Placenta. This however, showed some significant change. Seven cases (1.7 per cent) of the normal group and 5 patients (3.3 per cent) among the obese group required manual removal of the placenta, or roughly twice often in the latter group. This is mainly due to the fact that in excessively obese abdomen, it is difficult to express the placenta by fundal pressure (the method commonly employed in our units) because a good grip is not obtained. Sometimes, a flabby uterus may be lost within the abdomen and it may be difficult to rub up a contraction. Hence it is recommended that ergometrine with anterior shoulder should be given routinely to such patients, and Brandt-Andrews method of delivery of the placenta be the method of choice.

Maternal and Foetal Distress. An analysis is made in Table III. Remarkably, maternal distress was found to be extremely uncommon in the obese patients, a condition usually to be expected considering the physical build of such individuals. Little difference however, was found regarding foetal distress in the two groups under consideration.

Caesarean Section. Only 1 patient (0.6 per cent) among the obese group required a caesarean section, compared to 18 patients (4.2 per cent) in the other group. This suggests that labour usually proceeds and ends more smoothly in obese individuals than in their non-obese sisters.

TABLE II
Ante- and Post-partum Haemorrhages

Type of haemorrhage	Obese group	Non-obese group
Ante-partum	4 (2.7 per cent)	11 (2.7 per cent)
Post-partum	12 (8.1 per cent)	33 (8.2 per cent)

Toxaemias of Pregnancy. Almost all authorities agree that the incidence of toxaemias of pregnancy is greatly increased in obese individuals. Our findings also corroborate the same view (Table IV). Thus, it is imperative that obese patients in

TABLE III
Maternal and Foetal Distress

	Obese group	Non-obese group
Maternal distress	1 (0.6 per cent)	14 (3.4 per cent)
Foetal distress	15 (9.9 per cent)	33 (8.2 per cent)

TABLE IV
Incidence of Pregnancy Toxaemias

Feature of toxaemia	Obese group	Non-obese group
Hypertension (blood pressure 140/90 or over)	57 (38.5 per cent)	61 (15.2 per cent)
Oedema	56 (37.8 per cent)	72 (17.9 per cent)
Albuminuria	14 (9.45 per cent)	19 (4.7 per cent)

pregnancy should be dieted from an early stage, and a careful watch is necessary to detect evidences of toxaemia at the earliest opportunity; and if found the patients should be admitted to hospital. Later on, further details have been given regarding weight gain in obese patients.

Baby. The size of the infant was found to bear a direct relation to the maternal weight. Thus it was found that in the obese group 59 babies, or 39.0 per cent of all babies, weighed more than 8 lb., whereas only 113 or 28.1 per cent in the non-obese group weighed as much. This finding has been confirmed by Petrie (1956), Whitton (1958), Pomerance (1959), Emerson (1962) and others.

The foetal loss was 3 or 1.9 per cent in the obese group and 7 or 1.7 per cent in the non-obese group. Thus there was no significant difference in the foetal wastage rate in the two groups, although in the experience of Emerson (1962), the foetal mortality rate in the obese group was four times higher than in the non-obese group.

Lactation. Contrary to the findings of other workers, it has been our experience that breast feeding was satisfactorily established in 71.7 per cent of the obese mothers compared to 54.9 per cent in their slender counterparts. Table V demonstrates the details of method of feeding.

Thus it appears that obese patients are more successful in breast feeding the babies, and it seems to be due to sheer zeal and perseverance on their part. Non-obese patients are more inclined to bottlefeed their babies. Sheldon (1949) observed that lactation was normal in most obese women but some had galactorrhoea.

Venous Complications. As was expected, varicose veins and venous thrombosis in the puerperium were much more common in the overweight group. This is shown in Table VI. Proper care of the varicose veins in pregnancy in obese patients is very important to forestall venous thrombosis and other serious complications in the puerperium or postoperatively. Early treatment with

TABLE V
Breast and Bottle Feeding

	Obese group		Non-obese group	
	Breast	Bottle	Breast	Bottle
Primipara	50	30	134	102
Multipara	54	11	83	76
Total	104 (71.7%)	41 (28.3%)	217 (54.9%)	178 (45.1%)

TABLE VI
Incidence of Venous Complications

	Obese group	Non-obese group
Varicose veins	25 (16.5 per cent)	38 (9.4 per cent)
Venous thrombosis	6 (4.05 per cent)	6 (1.4 per cent)

anti-coagulants offers the best hope of cure in these groups of patients.

Chest Complications. The incidence of this was 5 or 3.3 per cent in the obese group and 21 or 5.2 per cent in the non-obese patients. This is difficult to explain, as one would expect more such complications in the obese group in view of the increased incidence of venous complications.

Change of Weight Associated with Pregnancy

For the purpose of these investigations, the necessary information was recorded from 242 answers to the questionnaire (Table VII).

With the exception of the women of 31-45 years with four or more children there is a consistently higher percentage of women of all age groups and stages of parity who maintain their gain in weight over those who lost weight. It is particularly noticeable that in all groups without exception more gained *excessive* weight after one or more pregnancies. The discrepancy is not so significant however if one compares the number who gained weight with the total number of those who lost weight and those whose weight was unchanged.

In considering this increase of weight following successive pregnancies an analysis was made of those

TABLE VII
Change of Weight from before the 1st to within 3 years of the Last Pregnancy

Age	Parity	Gain 0-14 lb.	Gain 15-66 lb.	Loss 0-14 lb.	Loss 15-22 lb.	No change 5 lb.±	Total
16-30	0	43% 23 + 46%	29	32% 16 + 47%	23	30 25%	121
31-45	0	3 + 49%	7	4 + 22%	2	6 27%	22
16-30	1-3	7 + 47%	22	7 + 30%	6	17 29%	59
31-45	1-3	5 —	9	4 —	5	7 23%	30
16-30	4+	—	—	—	—	— —	—
31-45	4+	50% 2 +	3	50% 3 +	2	— —	10
							242

primiparous patients who were overweight, underweight or of average weight according to their age and height before pregnancy (Table VIII).

TABLE VIII

Age	Parity	Over basic weight		Normal		Under basic weight		
		No.	%	No.	%	No.	%	Total
16-30	0	26	21.5	32	26.5	63	52	121
31-45	0	5	23	6	27	11	50	22

It was apparent that taking the two age groups together only 22.25% were overweight, 26.75% of normal weight and 51% underweight, before their first pregnancy.

These findings emphasize that although more women maintain their gain of weight after pregnancies, more are of average or underweight before their first pregnancy.

Weight Gain during Pregnancy Associated with Certain Complications in Pregnancy or Labour

We wished to ascertain whether gain in weight per se during pregnancy as opposed to obesity itself could have any association with conditions such as pre-eclamptic toxaemia; hypertension or oedema separately, or with the incidence of forceps deliveries or foetal death (Table IX).

In the 16-30 age group, excessive gain of weight occurred in 53% and average gain of weight in 47%. In the 31-45 age group the reverse holds, excessive gain of weight was present in 42% and average gain in 58%. Taking all groups together excessive gain was 47.5% and average gain of weight during pregnancy occurred in 52.5%.

This estimation for the excessive weight gain is a conservative one because all women were treated when over-weight. A diet of low carbohydrate, reduced fat and high protein was advised and certain cases required hospital admission and were given diets of low caloric value. In 242 cases diet was given to 77; of these 15 showed no response but 62 did lose weight or weight remained stationary over a period of several weeks. One woman was 1 lb. lighter than her initial weight, at the end of pregnancy.

It seems that 52.5% or just over

TABLE IX

Age	Parity	Gain 1 to 24 lbs.		Gain 25-49 lbs.		Total No.
		No.	%	No.	%	No.
16-30	0	55	47	66	53	121
16-30	1-3	29		30		59
16-30	4+	—	52.5	—	47.5	—
31-45	0	13		9		22
31-45	1-3	13	58	17	42	30
31-45	4+	4		6		10
		114		128		242

half the patients gained up to the accepted weight of 24 lbs.

As already stated pre-eclamptic toxaemia was diagnosed when the blood pressure was above 140/90 and oedema or albuminuria or both were also present. Hypertension was recorded when the blood pressure was over 140/90 on successive occasions. In many normal cases a reading of 140/90 was recorded at the initial visit to the antenatal clinic. Comparing the two groups: pre-eclamptic toxaemia was over three times as common in the excessive gain of weight group and in these patients the highest gains of weight were noted. Hypertension on the other hand was just under twice as much in the patients with average gain of weight. There was a slight increase in forceps deliveries in those with excessive gain of weight, and oedema, as one might expect, was about $1\frac{1}{2}$ times more frequent in this group, and was more generalised in distribution (Table X).

Infertility in Relation to Weight

From 242 answers, 237 women said they had practised contraceptives or not for a period of up to 2 years or longer, the remaining 15 were not included because they were unmarried (Table XI).

In this table only those who had not practised contraceptives for 2 years or longer before conception were included.

In both age groups of those who conceived after 2 to 18 years of marriage, only just under one half were overweight.

In the same age groups of those who conceived within 2 years of marriage, just over one half were overweight.

These observations suggest that obesity alone has no bearing on infertility.

TABLE X

Comparison of the Incidence of Complication in Average and Excessive Weight Gains

	Average gain of weight		Excessive gain of weight	
Pre-eclampsia	3	(2.6%)	11	(8.5%)
Hypertension	9	(8%)	6	(4.7%)
Oedema	8	(7%)	14	(11%)
Forceps delivery	7	(6%)	9	(7%)
Hydramnios	—		2	(1.5%)
Foetal death	—		2	(1.5%)

TABLE XI

Age	Parity	No contraceptives		Over basic weight		Average or under basic weight	
		0-2 years	Over 2 years	No.	%	No.	%
16-30	0		23	8	35	15	65
31-45	0		4	0	—	4	100
16-30	0	61		16	26	45	74
31-45	0	7		3	43	4	57

Comment

Before undertaking this survey we were under the impression that obesity was heir to all ills; however after reviewing certain aspects of the matter we find that our opinion must be more selective.

There is no doubt that an obese woman carries an overall disability in life and of this fact insurance companies are well aware, but when obesity is associated with pregnancy and labour the matter is by no means so apparent.

In pregnancy it appears that an obese woman is prone to be affected by certain complications.

Malpresentations are not more common, but difficulty in diagnosis prevents their correction. The presence of hydramnios can complicate the issue further; therefore radiological examination is invaluable. Incidence of toxaemia is definitely higher as has been shown by other authors and also in this series. Prematurity is comparatively uncommon and postmaturity is proportionately more common in fat women than in their thin counterparts. Labour itself shows no significant change in its course; curiously enough maternal distress was extremely uncommon and there was no increase in foetal distress in the obese women. Among operative procedures the incidence of manual removal is increased, because of technical difficulty in expressing the placenta. This can be obviated in many instances by employing the Brandt-Andrews method of delivery of the placenta following intramuscular or intravenous ergometrine.

Forceps rate is not increased and caesarean section rate is low.

The proportion of babies weighing over 8 lbs. at birth was higher in the obese group; this has previously been observed by other authors.

In the puerperium, lactation is fully established 1½ times more often in the obese group. As to be expected varicose veins and venous thrombosis are more common in the obese pregnant women but chest complications are remarkably uncommon.

In the following analysis involving 242 patients it is clear that nearly twice as many women who have had up to 3 pregnancies maintain their increase of weight from 16-45, i.e. during the child-bearing years, than those who lose weight.

This obesity in the child-bearing period may subject women to the effects of excessive stimulation of oestrogen, since according to Twombly (1962) the excessive adipose tissue in such obese women is unable to excrete the hormone as readily as in thin women.

This increase of weight associated with pregnancy is all the more significant because only 22.25% of women were overweight before their first successful pregnancy.

Contrary to the belief that infertility may be associated with obesity, our observations suggest that this is not so.

Summary

In this small series a study is made of 550 women in pregnancy. Of these 148 are regarded as obese according to our specified standard. The obese are compared with the non-

obese group with regard to pregnancy, labour and puerperium. In a smaller detailed series of 242, the effects of pregnancy on weight change and the effect of obesity on fertility are observed.

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