

WEIGHT GAIN DURING PREGNANCY OF URBAN BANTU WOMEN*

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It was concluded from facts elicited during a recent study of the literature¹ that the average weight gain of any representative group of non-toxaemic pregnant women would provide an indication of their level of food consumption. As a part of a nutrition status survey on pregnant Bantu women, the average weight gain was therefore determined of 389 apparently healthy subjects as reflected in the ante- and postnatal records of the Pretoria Municipal Clinic at Atteridgeville, a typical urban Bantu community.

CLINIC PROCEDURE

The clinic is attended by residents of Atteridgeville, an urban Bantu community of more or less indigent inhabitants, whose low protein and vegetable intake is compensated for by an apparently liberal consumption of mealie meal porridge. Antenatal clinics are held once a week and the attendances are large, often exceeding 100 per session. The patients are instructed to attend once every 3 weeks during pregnancy and once every 6 weeks after parturition.

Details of the obstetrical history and current pregnancy, including the date of the last menstrual period, are obtained from each new patient by a trained Bantu midwife and filled in on a card which is used throughout pregnancy and the postnatal period to record weight, blood pressure, urine analysis and doctors' comments and prescriptions. Any available records for previous pregnancies are attached to this card.

The patients are weighed by Bantu midwives on a 'Detecto-Medic' scale, marked in $\frac{1}{4}$ -pounds, and for the purpose of weighing they are dressed in a light gown approximately 8 oz. in weight.

Urine is tested for the presence of albumin by the Bantu midwives on specimens brought by the patients. Blood pressures are taken by experienced European sisters thoroughly trained in the procedure. Diastolic pressure is read at the point of muffling of the sound. These sisters also take a specimen of blood from each new patient for the serological tests for syphilis. Each patient is finally seen by a doctor, whose comments and prescriptions are written down in a space provided for the purpose. All prescriptions are dispensed free of charge at the clinic.

The confinement details, including infant weight, are recorded on a special card by the hospital staff or district midwife and later transferred to the antenatal card.

It may here be remarked that the prescription of dietary supplements in the form of yeast, cod liver oil, crude liver, various vitamin preparations (multivite, B-complex, thiamine, riboflavine, nicotinic acid, vitamins C and E) and an iron-containing tonic is almost universal. Few patients indeed attend the clinic for the duration of a pregnancy without receiving some form of vitamin and/or iron supplementation.

*Read in a shorter form at the 11th Interim Congress of the South African Society of Obstetricians and Gynaecologists, Port Elizabeth, September 1962.

EXTRACTION OF RECORDS

The study was restricted to patients whose first attendance for the pregnancy in question fell within a period of one year, viz. May 1960 — April 1961. A new scale installed at the clinic shortly before the earlier date was used throughout this period. The total number of new patients seen during the period under survey was about 1,000. However, they included several hundred who had ceased to attend after one or two visits, whose date of confinement was not known or was not yet written in, or (in the later part of the period in question) who had not yet been confined; these cases had to be disregarded automatically.

Since the primary object of this study was to enquire into the weight gained by apparently healthy urban Bantu women during the course of a normal pregnancy, cases were excluded which did not satisfy the following criteria: absence of systemic disease, absence of overt toxæmia (hypertension, excessive oedema or albuminuria) and natural delivery of an infant weighing not less than 5½ lb. This weight is generally regarded as representing the threshold of prematurity in European infants. It was not possible to use the date of the last menstrual period as an indication of the length of gestation, since, according to this date as recorded on the cards, one half of all infants born to the women who attend this clinic are premature (the explanation probably being that instead of the date of the last period that of the first missed period is given).

The question of excessive gain without other signs of toxæmia presented something of a problem, since excessive gain is, in accordance with the usual practice, in itself regarded as a sign of toxæmia at this clinic. Patients are usually instructed to go on a salt-free diet and to restrict fluid intake after a single episode of excessive gain, and ammonium chloride is sometimes prescribed. Some of the patients whose records were studied responded to this treatment by gaining less weight or by losing weight, and might conceivably have been toxæmic. On the other hand, patients who had gained excessively during a single interval and were not placed on salt-free routine rarely continued to gain as rapidly and frequently lost weight during the next 3-week interval. It was finally decided to include all the treated patients for as long as the excessive gain was sustained. Those whose rate of gain fell after treatment were included only up to the day on which treatment was first prescribed. As the rate of gain in a proportion of these cases would probably have fallen in any case, their inclusion up to the point of maximum gain would tend to raise the curve and compensate for the possible masking of further excessive gain in other treated cases.

A total of 389 women met the above criteria and the number of attendances varied from 3 to 12. About two thirds returned from 5 to 10 weeks after delivery for a postnatal examination, but the postnatal weight was not always recorded.

The date of confinement was taken as representing 40

weeks' gestation, and the week of gestation at each antenatal visit was calculated from this date. The weight gain or loss for each successive visit was split up into weekly components and the resulting figures tabulated on forms prepared for the purpose. All weights throughout were expressed in pounds to the second decimal place. Postnatal weight loss was tabulated as a function of the weight at 33 weeks and later corrected for the gain from 33 to 40 weeks. The weight changes in each column were then expressed as an average for the whole group and for various sub-groups which will be specified under *Results*.

The number of women seen during the first 13 weeks of pregnancy was too small to provide reliable averages. Twenty-three had been seen by the 14th week, however, and the number increased progressively to 320 at the 32nd week, then fell again to 101 at the 39th and 25 at the 40th weeks. Postnatal weights were available in 185 cases. The average gains for the earlier weeks of pregnancy, in which the number of cases fell below 30, were discarded for the purpose of the discussion which follows.

RESULTS

As no weight-gain studies have heretofore been carried out in South Africa, the curves for the Bantu women will be presented for purposes of comparison with the following curves selected from published data as covering the entire period of pregnancy and being typical of 3 dietary categories:

1. Stander and Pastore² (New York): average weight gain of approximately 2,500 non-toxaemic pregnant women on an unrestricted diet + 2 pints of milk a day (average pregravid weight 128 lb.). The predelivery weight loss recorded by these authors will be disregarded for the sake of simplification.

2. Thomson and Hytten³ (Aberdeen): average weight gain of healthy primiparas on an unrestricted diet (average pregravid weight 118 lb.).

3. Tompkins and Wiehl⁴ (Philadelphia): average weight gain of a group of 60 women of standard build selected for above-average obstetrical performance, their total weight gain being equivalent to that found with moderate dietary restriction (average pregravid weight not given).

The maximum weight gain recorded for the Bantu women for any 7-day period was 5 lb. and the maximum loss 2 lb. Such extreme weight changes were very rare indeed and gains of 2 lb. or losses of 1½ lb. were seldom exceeded. Roughly one third of all patients lost weight at some stage during pregnancy and about 16% of all weight differences were losses.

The average birth weight of the infants in the entire group (para 0—11) was 7.18 lb. This figure is not a true average for Bantu infants since it excludes all those below 5½ lb. in weight. It corresponds fairly closely with the average weight (6.90 lb.) of the 90 Bantu infants of 5½ lb. and over born at the St. Gerard's Nursing Home, Pretoria, during December 1961.

TABLE I. SECOND AND THIRD TRIMESTER GAIN OF BANTU AND CERTAIN WHITE GROUPS

Locality	Weight gain in pounds			Diet
	2nd trimester	3rd trimester	2nd and 3rd trimesters	
Atteridgeville	9.82	8.25	18.07	Maize staple, low protein
New York ²	14.6	13.4	28.0	Unrestricted + 2 pints milk a day
Washington ¹¹	14.0	10.5	24.5	? Unrestricted
Eugene ¹²	12.4	11.6	24.0	? Unrestricted
Ann Arbor ¹²	13.1	10.5	23.6	Balanced diet advised
Jersey City ¹⁴	8.0	12.0	20.0	Moderate restriction
East Orange ¹⁵	10.0	7.0	17.0	Rigid restriction

The average weight gain for the entire group of Bantu women for the period 14—40 weeks was 17.59 lb. (the nature of the data does not permit the calculation of a standard deviation), as compared with 26.87 lb. for Stander and Pastore's non-toxaemic group (New York), 24.0 lb. for the Aberdeen primiparas and 20.4 lb. for the Philadelphia select group. Plotted graphically at one-week intervals (Fig. 1) the weekly average gains of the Bantu women gave a very regular curve, slightly steeper in the second than in the third trimester, the average weekly gain for the 2 trimesters being respectively 0.74 and 0.62 lb. Thomson and Billewicz⁷ reported that the average weekly gain for normotensive Aberdeen primiparas was 1.03 lb. from 20 to 30 weeks and 0.87 lb. from 30 to 36 weeks. The ratio of second to third trimester gain is thus similar for the Bantu women and the Aberdeen primiparas, and this same ratio (1:0.84) is seen to hold for the Philadelphia select group, where the average weekly gains for the second and third trimesters were respectively 0.85 and 0.72 lb.

In Table I the corrected weight gain of the Bantu women for the second and third trimesters (1 trimester = 13½ weeks) is compared with that of certain other groups as

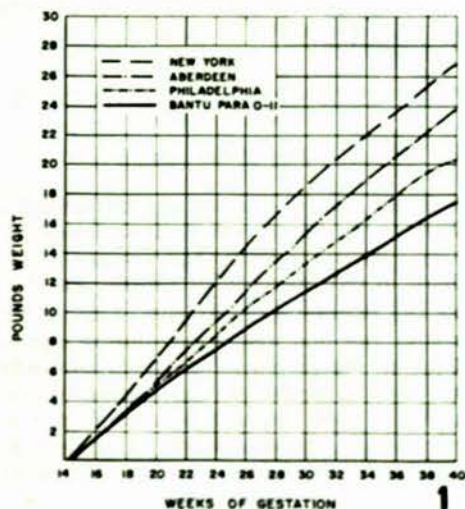


Fig. 1. See text.

calculated by Chesley.⁶ It is evident that the weight gain of the Bantu women of Atteridgeville is substantially lower in the second and third trimesters than that of White women on an unrestricted diet.

Further evidence of the low weight gain of Bantu women is provided by the figure for average weight loss from the 40th week of gestation to the date of the postnatal visit, which usually occurred on the 6th to 8th week after delivery. During this period the Bantu women lost 15.58 lb. as compared with 20.75 lb. for Stander and Pastore's group and 20.5 lb. for a group on a restricted diet investigated by McIlroy and Rodway.⁷ The relative loss of the Bantu women was actually greater than that of the New York group, since the former had regained their weight at 17 weeks' gestation while the latter had regained their weight at 19 weeks. Other figures cited by Chesley⁶ for weight loss during delivery and the puerperium are not comparable since they include only the first 10 days of the puerperium. Even these figures, however, are considerably higher (average 17.9 lb.) than that for the Bantu women.

Division of the whole Bantu group into 2 sub-groups, viz. primiparas (95) and multiparas (294), gave almost coincident curves for the period 19 to 40 weeks. Comparison with the weight-gain curve of the Aberdeen primiparas for this period (Fig. 2) shows a substantially lower gain

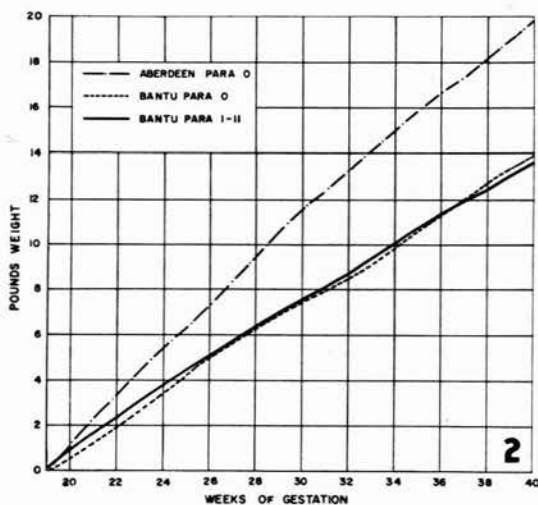


Fig. 2. See text.

for both Bantu groups. The average birth weights of the infants born to the Bantu primiparas and multiparas were respectively 6.96 and 7.25 lb. The average weight of the infants born to the Aberdeen primiparas was 7.26 lb.

Stander and Pastore² claim to have observed throughout their investigations that weight gain during pregnancy was proportional to the pregravid weight of the patient. Unfortunately they do not tender any evidence in support of this statement. Their impression is confirmed by many other investigators, however, and it seems likely that where the opposite was found to obtain, the heavier women had been subjected to dietary control.

In the present study the weight gain of light and heavy

Bantu women was compared by grouping them according to their weight at 33 weeks of gestation, since their pregravid weights were not available. Such a procedure must cause a certain amount of artificial divergence of the curves for the 2 groups, for in the heavy group would be included some light patients who had gained excessively and *vice versa*. Despite this possible forcing, the divergence proved to be small, viz. 1.87 lb. for the period 17 to 40 weeks, the lighter women having gained 14.59 lb. and the heavier women 16.46 lb. This finding suggests that the percentage weight gain of the lighter women was on the average greater than that of the heavier women. Both light and heavy Bantu women gained less during the period cited than Tompkins and Wiehl's select group (18.0 lb.) and less even than Stander and Pastore's computed average

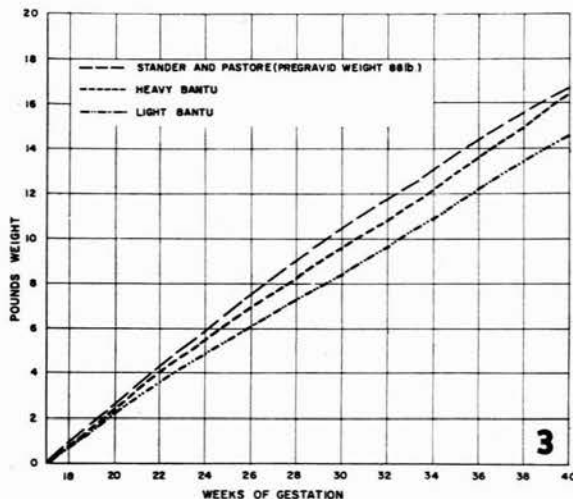


Fig. 3. See text.

(16.68 lb.) for women of pregravid weight 88 lb. (Fig. 3). The average infant weights for the light and heavy Bantu groups were respectively 6.96 and 7.44 lb., i.e. a difference of only 0.48 lb., which indicates that the extra weight gained by the heavy women must for the greater part have accrued in the maternal non-reproductive tissues.

The data were further analysed for evidence of additional weight gain on the part of women who gave birth to heavier infants. The group para 0—11 was divided into 2 according to the birth weight of the infants, the average infant weight being taken as the dividing line. The following results were obtained:

Average infant weight (lb.)	Average gain from 19-40 weeks (lb.)
6.40	13.35
7.96	13.99

The slight difference of 0.64 lb. in maternal weight gain from 19 to 40 weeks despite the considerable difference in infant weight (1.56 lb.) indicates that excessive foetal development occurred in the majority of cases at the expense of the maternal organism, i.e. the increment of weight in the maternal non-reproductive tissues was smaller in the

mothers of heavy infants. These findings and those reported in the foregoing paragraph suggest that rapid maternal weight gain is not a pointer to excessive foetal growth.

The above discussion has been confined to weight gain during the second and third trimesters of pregnancy. It has been stated in a previous publication¹ that weight gain during the first trimester varies according to different investigators from 0 to 3.5 lb. On this basis the total weight gain of the Bantu women might be anything from 18.07 to 21.57 lb. There seems every reason to suspect, however, that the figures of 1 lb. or less reported by certain authors do not reflect the true measured weight gain during the first trimester, since there is a gap between these low values and the higher values of 2.7—3.5 lb. reported by other workers. The first trimester gains for the New York, Aberdeen and Philadelphia groups selected for comparison all fall within the higher range, and in Fig. 4 the curves for

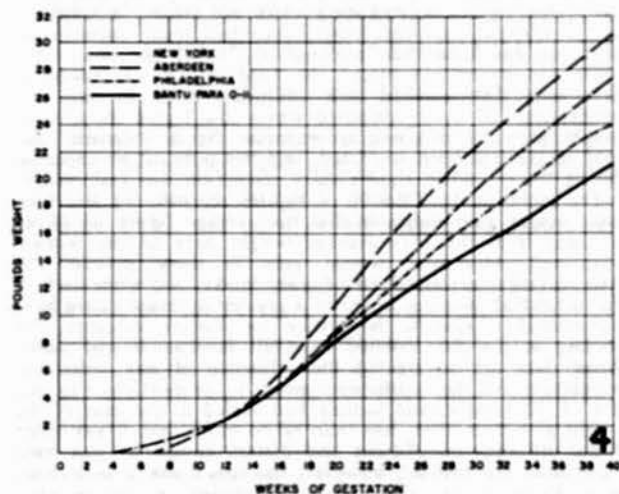


Fig. 4. See text.

these groups are compared with that for the Bantu women when the first trimester gain of the latter is arbitrarily fixed at approximately 3 lb. It can be seen that the resulting curve for the Atteridgeville women falls into reasonable alignment with the other 3, the total gain of the Bantu women on this basis being 21 lb.

The smoothness of the curves, all of which were plotted at 1-week intervals, possibly owes something to the method, which would tend to mask sudden excess gains or losses by spreading them over 2 or more weeks. The overall gain would not, however, be affected except in the case of pre-delivery losses, which might cause a slight flattening of the terminal portion of the curve. I feel justified, therefore, in putting forward the figure of 21 lb. as a reasonable, if not somewhat high, estimate of the average total weight gain of non-toxaemic pregnant Bantu women under their present socio-economic conditions.

DISCUSSION

It is clear from comparison with the findings of other investigators that the weight gain of the Bantu women,

notwithstanding their liberal maize consumption, runs parallel with that of White women on a drastically restricted food intake. The exact cause of the Bantu women's low weight increment is open to conjecture. When a cereal staple is the principle source of calories, the bulk of food required to furnish an adequate calorie intake is considerable (it would take roughly 4½ lb. of stiff mealie meal porridge to provide 2,000 C). The total caloric intake of the Bantu women might therefore have been inadequate in spite of a liberal consumption of maize, and such an inadequacy would presumably limit weight gain during pregnancy. However, there is also evidence^{2,3} that the pregnant woman has a capacity for protein assimilation far beyond that which can occur on the low protein intakes characteristic of the Atteridgeville women. Their low weight increment might therefore have been due specifically to a deficiency of good quality protein.

The main object of the rigid dietary restriction formerly imposed on pregnant women was to reduce the incidence of pre-eclampsia, and it is interesting that the incidence of pre-eclampsia appears to be much lower in Bantu than in White women. Recent figures for the incidence among booked cases at the Bridgman Memorial Hospital (Bantu) and Queen Victoria Hospital (White), Johannesburg, are respectively about 5 and 10%. It would, however, be premature to assume that the lower incidence of pre-eclampsia in the Bantu bears any direct relation to their smaller weight gain.

Many investigators have remarked that heavier women gain more weight than lighter women. It is possible that this difference may be more truly related to stature and bone structure than to weight, a tall woman with a large frame obviously being capable of a greater accumulation of maternal stores than a smaller woman. The Bantu women are small-boned and short of stature, though usually by no means under-nourished in appearance. Their average (= median) height, calculated from 60 consecutive cases measured by me, is only 5 ft. 1½ inches, and their average pregravid weight, calculated from average post-natal weight (total gain — loss during delivery and puerperium) approximately 122 lb. Apart from the dietary aspect, therefore, the absolute weight gain of Bantu women might for somatometric reasons be expected to be slightly lower than that of White women. These somatometric considerations do not apply, however, to *percentage* weight gain (i.e. total gain expressed as a percentage of pregravid weight), which works out at only 17% for the Bantu women as compared with 23% for the Aberdeen primiparas and 24% for the New York group. In chronically under-nourished Indian women the figure may be as low as 14%.²⁰

As the infants born to the Bantu women were very little smaller than those born for instance to the Aberdeen primiparas, the lower weight gain of the Bantu women must have been due to a smaller increment of weight in the maternal non-reproductive tissues. This point is well illustrated when average infant weight is expressed as a percentage of average maternal weight gain. In the case of the Aberdeen primiparas the resulting figure is about 26%, while for the Bantu women it is 34%. In chronically under-

nourished Indian women the figure may be as high as 45%.¹⁰

Although in general not under-nourished in appearance, the women who attend the Atteridgeville Clinic exhibit many of the classical stigmata of malnutrition, such as conjunctival thickening, gingivitis, papillary hypertrophy of the tongue and various skin lesions. It should moreover not be forgotten that their short stature is probably in itself of nutritional origin. Their low weight gain is therefore only one feature of a general picture suggestive of nutritional inadequacy.

SUMMARY

An investigation into the average weight gain during pregnancy of 389 apparently healthy urban Bantu women, as reflected in the records of a municipal antenatal clinic, is described in detail.

The main findings reported are the following: the average weight gain of the Bantu women during the second and third trimesters of pregnancy approximated to that reported in the literature for White women on a rigidly restricted diet; there was very little difference in weight gain during the second and third trimesters between primiparas, multiparas, women delivered of light infants and those delivered of heavy infants; heavy women gained nearly 2 lb. more than light women during the second and third trimesters, but the difference in infant weight was less than $\frac{1}{2}$ lb.

The average total weight gain of the Bantu women is estimated to have been approximately 21 lb.

I am indebted to Dr. Harry Nelson, M.O.H. of Pretoria, for permission to use the Atteridgeville Clinic's records, and to Mr. H. J. Meyer for assistance with the calculations.

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ADDENDUM

Numerous studies have been published on the subject of weight gain during pregnancy, most of them in the USA. In 1944 the available material was reviewed by Chesley,¹ who prepared a list of the findings of various investigators in which the average figures for total weight gain reported by the different authors varied from 13.3 to 37.4 lb.

Although aware that the food intake of the various groups had differed greatly, in some cases even being rigidly curtailed, Chesley did not attempt to relate differences in weight gain to differences in diet. He proceeded instead to pool all the data and calculate a 'grand average' for total weight gain during normal pregnancy. The resulting figure (24.0 lb., S.D. ± 10.8 lb.) has since been widely quoted in the literature, has found its way into obstetrical textbooks and is even accepted as a norm in clinical practice.

Chesley's manner of handling the data seemed open to strong criticism. Very little meaning can be attached to an arithmetic mean if the data from which it is calculated are not comparable and the population represented cannot be defined. It was clear from the stated variation in the dietary conditions of the different groups treated by Chesley as a

single population that they could not have been comparable in respect of this important factor. Moreover, the population represented by the pooled data appeared to lack even anthropological definition and stretched over 2 or 3 generations of changing fashions in the management of pregnancy. An attempt seemed necessary, therefore, to discover whether Chesley's collective treatment of the data had not masked features deserving special consideration.

Reference to such of the original publications as were available in South Africa revealed that Chesley had included in his list of 22 averages for total weight gain at least four²⁻⁵ which were stated by the authors to cover only 6 (or in one case 6-7) months of pregnancy. A further four⁶⁻⁹ could be suspected of representing less than total weight gain because the figures for first trimester gain were excessively low (0-1 lb.) when compared with those of 2.7-3.5 lb. reported by the other authors¹⁰⁻¹² who gave separate values for this period. In addition, all the figures below 20 lb.^{2,11,14} pertained to groups of women stated to have been subjected to rigid dietary restriction in order to reduce the incidence of toxæmia, while moderate dietary control was stated to have been imposed on at least one¹³ of the groups who gained between 22 and 24 lb. The dietary context associated with the higher figures was in some cases not stated; in others it was mentioned that the food intake had been unrestricted, while in one case¹² (an average of 31 lb. for more than 2,000 non-toxaemic subjects) the food intake was stated to have been supplemented with additional milk. In only one publication¹⁰ of those consulted was a low figure for average weight gain (21 lb.) not accompanied by a statement that food intake had been restricted, and this publication appeared during the era when rigid dietary restriction was fashionable.

The inclusion by Chesley of figures representing less than total weight gain indicates that his average figure of 24 lb. is lower than the true average weight gain of the women concerned. Moreover, weight gain in these women was demonstrably correlated with dietary intake, and while each of the individual averages might to a greater or lesser extent have represented a specific population or dietary category, the pooling of the data robbed it of all representational value. When data are so treated the influence of any individual population on the arithmetic mean is proportional to the size of the sample, and sample size varied in the case of the weight gain data from less than 60 to more than 2,000. Even if the different populations and dietary categories had been statistically represented, however, the result would have been of academic rather than practical interest, as for instance would be figures representing the average nutrient intake of the entire world population.

If weight gain during pregnancy is to be of assistance in the evaluation of nutritional status, its significance will have to be assessed in relation to known averages graded according to the dietary intake of the groups concerned. For this purpose it would probably be more practical to ignore first trimester gain, since figures for this period are always difficult to obtain and appear to be unreliable in the published data available, where differences are far more striking if only second and third trimester gains are compared. However, in view of the emphasis laid on total weight gain since the publication of Chesley's review, the provisional grading given below is based on estimates of total weight gain.

Unfortunately, not all of the original publications cited by Chesley were available to me. From those consulted, however, and from others^{15,16} which have appeared since Chesley's review, the following general picture emerges (and is substantiated when adjustments are made, where indicated, for excessively low first-trimester gains): on an unrestricted diet plus additional milk (2 pints a day) the average total weight gain of pregnant women (presumably White) is approximately 31 lb. (average of more than 2,000 cases); on an unrestricted, unsupplemented diet, it is 26-27 lb.; with moderate restriction it falls to 23 or 24 lb., while with drastic restriction, with or without enforced exercise, it can be arbitrarily limited to levels as low as 21 lb. or less.

In conclusion it should perhaps be pointed out that

'weight-consciousness' is now so general a characteristic of the more sophisticated sections of the population that self-imposed dietary restriction has become habitual to a large number of women whose food intake would be considerably greater if they allowed themselves to eat to appetite. Present-day figures for the weight gain of Western women can therefore be expected to be lower than those of, say, 20 years ago, even when dietary restriction during pregnancy is not specifically advised. The higher values characteristic of unrestrained eaters nevertheless more truly represent the natural weight gain of well-fed women.

SUMMARY

The literature on weight gain during pregnancy available in South Africa was reviewed with the object of establishing whether differences in the average weight gain of groups of pregnant women could be correlated with differences in dietary intake. It was found that average weight gains varying from 31 lb. to less than 20 lb. could be graded according to whether food intake was liberal and supplemented, unrestricted, moderately restricted, or severely restricted.

The figure of 24 lb. put forward by Chesley as the average total weight gain of healthy pregnant women was found to be incorrect and statistically inadmissible.

It is suggested that a comparison of the average weight gains of different populations might serve as a useful pointer to differences in nutritional status.

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