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NUTRITION IN PREGNANCY

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THE maternal mortality rate in Canada has been gradually reduced in the last 14 years, from 5.7 per 1,000 live births in 1926, to 4.0 per 1,000 live births in 1940. The preliminary Annual Report, Vital Statistics of Canada, 1940,¹ contains the following facts:

- Total births, 1940: born alive 243,835; stillborn 6,605.
- Maternal deaths, Canada, 1940, 973.
- Maternal mortality rate, 4.0 per 1,000 live births.
- Infant deaths, under 1 year, 13,754 (excluding stillbirths).
- Infant mortality rate, 56 per 1,000 live births.
- Infant deaths, under 1 month, 7,247 (excluding stillbirths).
- Neonatal mortality rate, 30 per 1,000 live births.

The neonatal mortality rate accounts for more than one-half of the infant mortality rate in Canada. Great progress has been made in the reduction of the total infant mortality rate, but only slow progress in the neonatal rate. There is the irreducible fetal and neonatal mortality rate, but the present rate is capable of further improvement. In a recent publication from this clinic² 229 consecutive deaths occurring before or during delivery, or within the first two weeks of life, were analyzed. In this series prematurity accounted for 49 deaths, and it is possible that adequate prenatal care of the mother and postnatal care of the baby might reduce this figure. The second commonest cause of these deaths was fetal deformity, which accounted for 37, and these are obviously beyond control. The accidents of labour and chronic illness of the mother accounted for the remainder, and these

present obstetrical problems which carry with them a considerable irreducible fetal mortality.

The rôle of nutrition in the growth and development of the infant has been recognized for a long time but the relation of adequate diet for the mother during pregnancy to fetal mortality rates has not been recognized. It is our purpose to try to point out the need for careful dietary supervision during pregnancy and to show how this could be carried out. A recent study of the influence of poor, improved, and good prenatal diet on the course of pregnancy is herein presented. The method of study has been reported elsewhere.³

The increased demands upon the maternal organism during pregnancy are well recognized. These demands are over and above normal non-pregnant requirements for good nutritional health. If the mother's diet is only barely adequate for her own needs, the increasing demands of the parasitic fetus will make the diet deficient for the mother. If the diet is already inadequate the deficiencies will become even greater if the needs of the fetus are satisfied.

TABLE I.
DIETARY REQUIREMENTS DURING PREGNANCY

Calories.....	2,400-2,800	Vitamins:
Protein.....	80-100 grams	A —6,000 i.u.
Fat.....	80-100 grams	B ₁ —500-1,000 i.u.
Carbohydrate	350-400 grams	B ₂ —3.0-3.5 mg.
Calcium.....	1.5 grams	C —50-75 mg.
Iron.....	0.020 grams	D —500-1,000 units
Iodine.....	in iodized salt	

We recognize the amounts in Table I as the daily nutritional requirements during the second half of pregnancy. The figures are for normal pregnant women, doing light house-work. Transferred into practical terms this means that the average daily diet should have the following

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essential foods: 40 ounces of milk daily, cheese, 1 oz.; one egg, butter and meat daily; liver once a week; two servings of vegetable besides potato daily; one orange or one-half grapefruit, or 5 ounces of tomato juice; at least one-half of cereals and bread in whole grain form; two teaspoonfuls of cod liver oil or equivalent in concentrate; salt to be iodized, and medicinal iron to be used if indicated.

Under certain abnormal conditions the above foods would have to be modified. In obesity the amount of fat and sugar should be reduced without interfering with the necessary amounts of the essential food factors.

In practice it is found that many women are receiving an inadequate diet. This is more frequent, of course, in the low income class. Lack of knowledge of the proper food to eat, together with long established habits, results in many poor diets. Fads and fancies about food during pregnancy also produce a few of the deficiencies encountered. In the treatment of special obstetrical cases, such as persistent vomiting, the dietary needs are often impossible to maintain. This requires expert management.

Education of the profession and the public in nutrition has become much more extensive in recent years. Unfortunately this does not reach everyone, particularly the poorer people who are perhaps in most need of this knowledge. Those with sufficient income are more likely to obtain the necessary foods for proper health. A more specific program of nutrition education in the schools with special reference to the diet and its importance during pregnancy should be given to all girls from 14 to 18 years of age. It seems to be impossible to reach more than a fraction of the female population with nutritional education after they have left school.

The value of prenatal care by private physicians and prenatal clinics is now recognized and used by a large proportion of the expectant mothers. The use of a part-time dietitian in all prenatal clinics would seem to be of value. She can give short practical instruction to groups of patients about the fundamentals of nutrition, and can co-operate with the physician in arranging the necessary help in planning a suitable diet for special cases.

In order to study the course of pregnancy in women on poor and on good prenatal diets we have studied the diet records and obstetrical course of some 400 women attending the prenatal clinic of the Toronto General Hospital.³ We

have found that the most satisfactory method of determining the individual's diet is to have a record kept of everything consumed for each meal during a period of one week. In the study referred to, such a record was in each case analyzed by the dietitian attached to the clinic. We then placed the patient in one of three groups for observation.

1. In those with a poor diet record and a low income alternate patients were left on their poor diet. There were 120 of these observed as controls.

2. The other patients in this group with a poor diet and a low income were given certain foods which made a fairly good diet: 90 of these were followed and will be referred to as the Supplemented Group.

3. Those found to have sufficient income were given advice if their diet was deficient in any respect. They formed a group of 170 women who were improved by education, and will be called the "Good Diet Group".

Thus we have 120 women left in the Poor Diet Group, 90 women who were on poor diets until the 5th or 6th month of pregnancy and were then given extra food until 6 weeks after delivery, and 170 women with fairly adequate income who were instructed in the proper food to be eaten during pregnancy. The diet records were checked again at a later period.

To the Supplemented Group we had the dairy deliver daily 30 ounces of milk and one egg. The diet was further supplemented by 32 ounces of canned tomatoes, one-half pound of cheese, and 7 oranges per week. At the clinic we distributed viosterol capsules containing 2,000 units of vitamin D,* and embryo, a palatable wheat germ, with instructions to take one viosterol capsule and two tablespoonfuls of wheat germ daily. Instructions were also given for planning the remainder of the diet from the available income. The average cost of the food supplied to each patient was twenty-five dollars.

Table II is an analysis of the diets of the three groups of patients, comparing the first food record made about the sixth month of pregnancy with the second record made during the eighth month. Further details of the dietary findings have been published elsewhere.³

From Table II it will be noted that we have succeeded in improving the diet of the Supplemented Group by sending food to the patient

* Kindly supplied by Mead Johnson & Co.

TABLE II.
DIET ANALYSIS

<i>Average daily calories</i>			
	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
1st record	1,672	1,690	2,206
2nd record	1,837	2,424	2,521
<i>Average daily protein</i>			
	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
1st record	56	56	81
2nd record	62	94	92
<i>Average daily calcium</i>			
	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
1st record	0.537	0.562	0.886
2nd record	0.746	1.61	1.30

and by giving advice, while the Good Diet Group was improved by education alone.

Table III shows that the average total income of the persons not on relief was \$3.34 in the Poor Diet Group, only \$2.64 in the Supplemented Group, and was \$6.02 in the Good Diet Group.

TABLE III.
ANALYSIS OF ECONOMIC STATUS OF PATIENTS STUDIED

	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
Families on Welfare Relief	44	48	3
	per cent	per cent	per cent
Average weekly income families not on relief	\$12.02	\$10.94	\$16.94
Average income per person	3.34	2.64	6.02

From Table IV it will be noted that the average age and duration of observation are comparable in the three diet groups. There were more primiparæ in the Good Diet Group than in the other two groups.

TABLE IV.
PATIENTS IN PRENATAL DIET STUDY

	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
Average age	26 yrs.	27 yrs.	25 yrs.
Average duration of prenatal observation	4.4 mos.	4.7 mos.	4.4 mos.
Primiparæ	31	29	46
	per cent	per cent	per cent

The percentages of complications in previous pregnancies in the three groups are compared in Table V. The number of miscarriages, prematures, and stillbirths was greater in the Supplemented Group. Therefore, one would expect an equal proportion of complications to develop

in the pregnancy being studied. The only conditions which differed in the care and management of these patients was the food supplied to the Supplemented Group and the education given to the Good Group. The obstetrician and nurses in charge of the patients were not aware of the diet group to which the patients belonged. No patient was included in the study if found to have any condition which might complicate the study and all were observed and confined at the Toronto General Hospital. The study began in November, 1938, and was concluded in March, 1941.

TABLE V.
PAST OBSTETRICAL HISTORY OF PATIENTS STUDIED

	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>
Miscarriages	38.1	39.0	24.4
Prematures	10.7	20.3	13.3
Stillbirths	9.5	4.7	2.2

The senior resident obstetrician in charge of the patients in the Prenatal Clinic and in the hospital has given his rating of the condition and progress of the patient in each period of pregnancy. He was unaware of the diet group to which each patient belonged. A "good" rating indicated that the patient had progressed satisfactorily. "Fair" rating indicated that minor complications had developed at some stage of the period of observation. "Poor" meant that many or major complications had developed, while "bad" was reserved for serious complications endangering the life of the mother or resulting in the death of the baby.

TABLE VI.
PRENATAL RATING BY OBSTETRICIAN

	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Bad</i>
	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>
Poor Diet	30.2	33.6	32.8	3.4
Supplemented	49.4	41.4	9.2	0
Good Diet	52.2	35.5	11.9	0.3

Thirty-six per cent of those in the Poor Diet Group were given a poor or bad rating, as compared with only 9 per cent in the Supplemented Group (Table VI). The complications which affected the obstetrician's rating are shown in the next table (Table VII). It will be noted that there were more cases of anæmia, eclampsia, and threatened miscarriage in the Poor Diet Group, while the total number of complications in this group was almost double that in the Supplemented Group.

TABLE VII.
COMPLICATIONS DURING PRENATAL PERIOD

	Poor diet	Supple- mented	Good diet
	percentage	percentage	percentage
Numerous minor com- plaints.....	33.6	20.7	19.7
Anæmia (below 65 per cent Hgb.).....	28.6	16.1	21.6
Pre-eclampsia and eclampsia.....	12.6	9.1	7.8
Threatened miscarriage (any prenatal vaginal bleeding).....	11.2	8.3	4.7
Accidental hæmorrhage.	3.2	4.7	0
Placenta prævia.....	0.8	0	1.1
Severe vomiting.....	3.4	1.1	1.2
Pyelitis.....	5.0	3.4	4.2
Streptococcal vaginitis.	1.7	0	0
No complications recorded.....	30.3	45.9	48.5

In a similar manner the obstetrician also gave a rating during labour (Table VIII). A "poor" or "bad" rating was given to 24 per cent of those in the Poor Diet Group during the actual labour period, as compared with only 3 per cent of those in the Supplemented Group.

TABLE VIII.
RATING BY OBSTETRICIAN OF
CONDITION DURING LABOUR

	Good	Fair	Poor	Bad
	percentage	percentage	percentage	percentage
Poor Diet..	58.6	17.2	14.7	9.5
Supple- mented..	85.1	12.6	2.3	0
Good Diet..	69.8	24.3	4.0	1.9

Variation in the incidence of miscarriages, premature births, and stillbirths is strikingly shown in Table IX. The other complications, while not as striking, are nevertheless significant, being more frequent in the Poor Diet Group.

TABLE IX.
MAJOR COMPLICATIONS DURING LABOUR

	Poor diet	Supplemented	Good diet
	percentage	percentage	percentage
Miscarriages.....	6.0	0	1.2
Premature births...	8.0	2.2	3.0
Stillbirths.....	3.4	0	0.6
Hæmorrhage-post- partum.....	6.5	5.9	5.8
Long labour.....	7.0	3.4	9.0
Primary uterine in- ertia.....	6.0	0	3.5
Secondary uterine inertia.....	3.5	1.1	4.2
Required blood transfusion or in- travenous.....	2.6	0	0.6
No complications recorded.....	58.6	84.0	68.0

The average duration of labour was found to be greater in the Poor Diet Group, both in primiparous and multiparous patients (Table X).

TABLE X.
AVERAGE DURATION OF LABOUR

	Poor diet	Supplemented	Good diet
	Hours	Hours	Hours
Primipara.....	21.7	16.6	20.2
Multipara.....	11.9	10.2	10.8

A rating of postpartum convalescence was also made by the resident obstetrician. Table XI gives these findings.

TABLE XI.
CONDITION OF MOTHER DURING CONVALESCENCE IN
HOSPITAL

	Good	Fair	Poor	Bad
	percentage	percentage	percentage	percentage
Poor Diet..	59.9	28.6	9.8	1.7
Supple- mented..	79.5	17.0	2.3	1.2
Good Diet..	70.2	20.8	9.05	0

The number of complications, particularly anæmia, uterine and breast inflammation, was greater in the Poor Diet Group (Table XII).

TABLE XII.
COMPLICATIONS IN MOTHER DURING HOSPITAL
CONVALESCENCE

	Poor diet	Supple- mented	Good diet
	percentage	percentage	percentage
Anæmia (below 65 per cent Hgb.).....	24.1	12.5	19.2
Pelvic inflammation...	9.0	3.4	6.1
Breast inflammation...	4.5	2.3	4.8
Cystitis or pyelitis....	0.9	1.1	3.0
Phlebitis.....	1.8	0	0.6
Impetigo.....	0.9	0	0
Embolism or thrombosis	0	1.1	0.6
Intestinal obstruction..	0	0	0.6
Streptococcal vaginitis.	0.9	0	0
No complications recorded.....	52.6	70.4	59.0

The marked increase of food, and particularly calories, did not apparently have any influence upon the size of the infant at birth. The average birth weight in the poorly fed mothers was slightly greater than in the two better fed groups (Table XIII).

TABLE XIII.
AVERAGE BIRTH-WEIGHT OF BABIES

Poor Diet.....	7 lb. 10 oz.
Supplemented.....	7 lb. 7 oz.
Good Diet.....	7 lb. 6½ oz.

At the follow-up visit, six weeks after the birth of the baby, the obstetrician rated 11 per cent of those in the Poor Diet Group as in poor or bad condition, and only 3 per cent of those in the Supplemented Group (Table XIV). The complications six weeks after delivery were chiefly anæmia, vaginal discharge, cervicitis, and breast inflammation. The total number of complications was four times as great in the Poor Diet Group as in the Supplemented Group (Table XV).

TABLE XIV.
OBSTETRICIAN'S RATING OF THE MOTHER
SIX WEEKS POST PARTUM

	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>Bad</i>
	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>
Poor Diet..	55.7	33.0	11.3	0
Supple- mented...	87.0	10.6	1.2	1.2
Good Diet..	84.8	12.4	2.1	0.7

TABLE XV.
COMPLICATIONS IN MOTHERS
SIX WEEKS AFTER DELIVERY

	<i>Poor diet</i>	<i>Supplemented</i>	<i>Good diet</i>
	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>
Anæmia.....	9.0	0	1.4
Minor complaints..	21.0	7.0	4.2
Cystitis or pyelitis..	2.0	0	0
Vaginal discharge and cervicitis...	8.0	1.1	0.7
Breast abscess....	3.0	1.1	2.0
No complications recorded.....	50.0	88.0	84.0

The record of successful breast feeding was very much better in those mothers who were receiving a good diet, particularly the Supplemented Group (Table XVI).

TABLE XVI.
INCIDENCE OF BREAST FEEDING 6 WEEKS POST PARTUM

	<i>Nursing</i>	<i>Artificially fed</i>
	<i>percentage</i>	<i>percentage</i>
Poor Diet.....	59	41
Supplemented.....	86	14
Good Diet.....	71	29

The condition of the mother's teeth was rated as "Good", "fair" or "poor" by a clinical examination of the mouth six months after the birth of the baby (Table XVII). Complete dental examinations and x-rays were made by Dr. C. B. Shillington during the prenatal period, but the records have not been completed.

The obstetrician also made a rating of the whole course of pregnancy from the time that the mother first came under observation in the

TABLE XVII.
CONDITION OF MOTHER'S TEETH—
6 MONTHS POST PARTUM

	<i>Good</i>	<i>Fair</i>	<i>Poor</i>	<i>False</i>
	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>
Poor Diet..	27	19	48	6
Supple- mented...	44	20	24	12
Good Diet..	60	19	15	6

prenatal clinic until her follow-up visit six weeks after the birth of her baby. Thirty-four per cent of the pregnancies in the Poor Diet Group were considered poor or bad, as compared with only 6 per cent in the Supplemented Diet Group (Table XVIII). In other words, the mothers

TABLE XVIII.
FINAL OBSTETRICAL RATING

	<i>Excellent</i>	<i>Good-Fair</i>	<i>Poor</i>	<i>Bad</i>
	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>	<i>percentage</i>
Poor Diet..	13.1	52.9	22.6	11.3
Supple- mented...	34.5	59.6	5.9	0
Good Diet..	30.6	54.1	14.2	1.1

in the Supplemented Group were considered far better obstetrical risks throughout the whole course of pregnancy. The obstetrician's rating and the lists of complications do not indicate the frequency with which we noted improvement in the general mental attitude of the patients in the Supplemented Diet Group, nor does it indicate the number who lost their minor aches and pains and numerous complaints. These were factors which could not be accurately measured.

SUMMARY

1. The needs of the expectant mother with respect to her diet are recorded.
2. A study of the diets of 400 expectant women is reported.
3. Milk, eggs, tomatoes, oranges and cheese were supplied to 90 of the women in the study, from the 4th or 5th month of pregnancy until four weeks after discharge from the hospital.
4. There was a much higher incidence of miscarriage, stillbirths, premature births and minor complications in those women found to have Poor Diets throughout pregnancy.
5. The whole course of pregnancy appeared to be influenced by supplying simple foods to those on deficient diets, and by giving advice to those who could afford a proper diet.

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RÉSUMÉ

Le taux de la mortalité maternelle est passé de 5.7 pour 1,000 qu'il était en 1926 à 4.0 pour 1,000 en 1940. On peut faire davantage si l'alimentation de la mère est mieux surveillée. On commence déjà à y parvenir en appliquant aux femmes enceintes les principes de l'hygiène alimentaire traditionnelle et en ajoutant au régime des mères nécessiteuses les éléments nutritifs ou vitaminiques déficitaires. Le public et la profession médi-

cale ont été mieux avertis du problème alimentaire des mères, notamment des mères nécessiteuses. Cette propagande doit continuer dans les écoles et dans les cliniques prénatales. Nous avons classé nos malades selon leurs revenus et nous avons augmenté la ration alimentaire des pauvres; nous avons corrigé les régimes des malades plus aisées. Le groupe des pauvres reçut tous les jours 30 onces de lait, un œuf, des tomates en boîte, du fromage, une orange et du viostérol. Le nombre des fausses couches, des prématurés et des mort-nés fut plus élevé dans le groupe des mères "supplémentées"; celles-ci furent aussi plus fréquemment atteintes d'anémie et la durée de leur travail fut plus longue. Les mêmes remarques sont applicables aux complications du post-partum et à l'état des dents. En somme, tous les besoins alimentaires de la mère sont notés avec les ennuis que produit l'écart de la règle. JEAN SAUCIER

THE INFLUENCE OF IMPROVED PRENATAL NUTRITION UPON THE INFANT

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THE annual statement of the Medical Officer of Health for the City of Toronto for 1939¹ has the following to say about infant mortality. "A reduction of almost 40 per cent has taken place since 1929 . . . Neonatal causes continue to be our main problem in that the average rate for the past five years for deaths occurring under one month of age shows an improvement of only 7 per cent, as against a drop of 37 per cent in mortality among infants from a month to one year of age." The same is true in the statistics for Canada as shown in the preceding paper. Canada's infant mortality ranked 16th in a list of 40 countries in 1937.²

While there are many probable factors responsible for the persistently higher rate in the neonatal period, we are attempting to show how one factor, namely, the mother's prenatal diet, can play an important part in improving the successful outcome of pregnancy.

In a previous publication³ the method of study and nutritional observations have been recorded. In the first section of this paper, the obstetrical results have been summarized.⁴ Three groups of patients attending the prenatal clinic before the sixth month of pregnancy were observed. (a) A group of 120 women on poor diets and low incomes, referred to as the Poor Diet group. Their diet was not altered by the clinic. (b)

A second group of 90 women on diets as poor as those of the first group was sent supplemental foods; this formed the Supplemented Diet group. (c) In a third group of 170 women it was found that the diets were moderately good and the income was sufficient to furnish a good diet. In this group the women were given advice only and are referred to as the Good Diet group.

To the Supplemented group, we were able to send, through a special fund administered through the Visiting Homemakers' Association, the following foods: 30 ounces of milk, one egg and one orange daily; weekly we sent the daily equivalent of 3½ oz. of canned tomatoes and one ounce of cheese. At the clinic we distributed viosterol capsules containing 2,000 units of vitamin D,* and embryo, a palatable wheat germ, with instructions to take one viosterol capsule and two tablespoonfuls of wheat germ daily. Thus we formed three groups: one left on poor diet to serve as controls; another on poor diets but given extra food for 4 or 5 months of the prenatal period and for 4 weeks after leaving the hospital; and a third who were given advice only.

Observations of each patient were made by the obstetrician and each patient was given a rating based upon general condition, progress, complications and final outcome of pregnancy. These ratings are summarized in Table I.

Thirty-four per cent of the women in the Poor Diet group were rated as poor or bad,

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