DIABETES IN PREGNANCY

by Neil Murphy, MD

SIGNIFICANCE OF DIABETES IN PREGNANCY

Diabetes in pregnancy is associated with morbidity and mortality for both the pregnant patient and her offspring. Management of diabetes in pregnancy offers a unique opportunity to positively impact both patients' lives. The rates of diabetes in pregnancy among American Indians/ Alaska Native (AI/AN) women are higher than the US all races, plus there was an alarming 58% rate of Navajo women who developed diabetes or impaired glucose tolerance in 4 years after pregnancy with gestational diabetes mellitus (GDM). Life table analysis predicted a 70% rate of diabetes by 11 years in that group of women. (Steinhart)

Diabetes in pregnancy is increasing in AI/AN. Rates of diabetes in pregnancy in AI/AN range from 3.5 percent to over 15 percent. A review of PubMed reveals 28 articles on Alaska Coastal Indians (Murphy), Chippewa (Rith-Narjarian), Navajo (Straus, Steinhart, Sugarman), Pima (Pettitt), Tohon O'odham (Livingston), Yu'pik Eskimos (Murphy), and Zuni (Benjamin).

In the general population, approximately 40% of GDM women will go on to develop overt type II diabetes within 15 years of the index pregnancy, but among AI/AN women, over half will develop overt diabetes in as little as 4 to 6 years after the index pregnancy. Cumulative incidence of diabetes was as high as 70% in studies that examined women up to 28 years postpartum. (Kim)

PATHOPHYSIOLOGY

Pregnancy is a diabetogenic state manifested by insulin resistance and hyperinsulinemia. The resistance stems from the placental secretion of diabetogenic hormones including growth hormone, corticotropin-releasing hormone, placental lactogen (human chorionic somatotropin), and progesterone. Appropriate metabolic adaptations occur in normal pregnant women, assuring that the fetus has an ample supply of fuel and nutrients at all times.

Gestational diabetes mellitus occurs when a woman's pancreatic function is not sufficient to overcome the insulin resistance created by the anti-insulin hormones and the increased fuel consumption necessary to provide for the growing mother and fetus. The diagnosis and treatment of gestational diabetes are important because of the association of poor control with increases in the incidence of the following:

- Preeclampsia
- Polyhydramnios
- Fetal macrosomia
- Birth trauma
- Operative delivery
- Neonatal metabolic complications (hypoglycemia, hyperbilirubinemia, hypocalcemia, and erythrema)
- Perinatal mortality
- Development of obesity and diabetes in offspring during childhood.
- Later development of overt diabetes mellitus in the mother.

SCREENING PROCEDURES

Note: AI/AN are AT RISK for gestational diabetes and all pregnant AI/AN women should be universally screened.

- Patients with pre-gestational diabetes do not require gestational diabetes screening. Proceed directly to management plan. Do not perform glucose challenge testing.

If the patient does not tolerate the standard glucose solution, there are several alternative modalities. (Appendix A)

- Initial Screen, Average AI/AN Risk Patients

  All non-diabetic patients should be screened at 24-28 weeks, (or at first visit, if after 28 weeks) as follows:

  1. Give a 50-gram oral glucose load, at any time of day, without regard to time of last food intake.

  2. Draw a venous blood sample one hour later.

  3. A venous serum or plasma glucose level of 140 mg/dL or greater at one hour constitutes a positive screen.

- Initial Screen, High AI/AN Risk Patients

  High-risk patients include those with the following factors:

  - history of infant over 8 lb.14oz. (4000 grams) at birth;
  - family history of diabetes (parents or sibling);
  - initial visit weight > 190 lbs. or body mass index (BMI) $\geq$ 25 BMI = kg/m^2 X 100 (see Appendix C);
  - past history of stillbirth, habitual abortion, or congenital anomaly
  - current pregnancy: unexplained polyhydraminos, persistent glycosuria
  - age > 35 years;
  - prior maternal history of gestational diabetes.
  - AI/AN with a high prevalence of diabetes in pregnancy.

  Screen high-risk patients on the first prenatal visit with either

  - 50 gram oral glucose load screening test, or
  - perform a one-step diagnostic oral glucose tolerance test (OGTT). See method, below.

The one-step approach may be cost-effective in certain AI/AN populations with a high prevalence of diabetes in pregnancy.

- If the screen is normal, repeat at 24 weeks.
- Screening may be repeated at 32 weeks, especially if there was one abnormal value on OGTT. (Neiger)

DIAGNOSIS OF GESTATIONAL DIABETES

- All patients with a positive screen (one hour $\geq$ 140 mg/dL) and certain high risk patients should be given a 3 hr GTT after an 8-14 hour fast as follows:

  1. Draw a fasting venous blood sample

  2. Administer a 100-gram oral glucose load in 400 ml fluid.

  3. Draw venous blood samples at one, two, and three hours.

At this time, the most commonly used criteria in the US are the National Diabetes Data Group (NDDG) criteria. Two or more values at or above the following levels establish the diagnosis of gestational diabetes mellitus.

National Diabetes Data Group criteria (NDDG)

time	plasma glucose mg/dL
fasting	≥ 105
one hour	≥ 190
two hours	≥ 165
three hours	≥ 145

- There are some data to suggest that patients with one abnormal value by NDDG criteria have an increased risk of macrosomia. In these patients, Medical Nutrition Therapy (MNT) is suggested.
- Note that glycosylated hemoglobin and finger-stick capillary blood values are not well enough standardized to be used for a definitive diagnosis of gestational diabetes.
- Patients who demonstrate an abnormal OGTT in the first trimester should be considered pre-gestational diabetics, unless other medical circumstances suggest otherwise, e.g., intercurrent illness.

There are little data to support the use of one particular criterion to significantly improve maternal or neonatal outcomes. Other diagnostic criteria, e.g., Carpenter and Coustan and the World Health Organization (WHO), have been suggested by various professional organizations. See **Appendix D.**

The **World Health Organization (WHO) criteria** have the advantage of using the same diagnostic criteria both during pregnancy and outside of pregnancy. In addition, impaired glucose tolerance is treated the same as diabetes, so patients who have a 2-hour glucose ≥ 140 are managed as gestational diabetics. There is also the advantage of not needing an intervening one-hour glucose level, so the WHO system can also be used as a one step definitive test using a 2 hour glucose of ≥140 mg/dL. These criteria utilize a 75 gram oral glucose load.

The **Carpenter and Coustan criteria** can increase the rate of diagnosis by approximately 50%, though no improvements in outcome have been demonstrated. These criteria utilize a 100-gram oral glucose load.

MANAGEMENT OF GESTATIONAL DIABETES

Please note that the next two sections refer to **diabetes initially diagnosed during pregnancy**. Later sections are devoted to women with pre-existing diabetes, Type I DM, and Class B (and above) diabetes in pregnancy.

Gestational Diabetes Classification

Class	Fasting Glucose Level		Post prandial Glucose Level
A-1	< 105 mg/dL	and	< 120 mg/dL
A-2	≥ 105 mg/dL	and/or	≥ 120 mg/dL

Class A-1 patients are those who can achieve glycemic control with diet alone. However, patients in this class may deteriorate to Class A-2. Management should then be changed accordingly.

Class A-2 patients are those who require insulin or hypoglycemic therapy to achieve the above level of control. Prior to initiating insulin or hypoglycemic therapy, the patient should have been treated with at least 2 weeks of Medical Nutrition Therapy (MNT) after consultation with a skilled nutrition counselor.

Management - Class A-1 (diet controlled)

Identifying women with gestational diabetes mellitus is important because appropriate therapy can decrease fetal and maternal morbidity, particularly macrosomia and stillbirth. The general approach to treatment in this disorder is reviewed here.

- **Diet:**

  Please note that these are general recommendations that should be individualized to the reality of each patient's home environment. This following counseling should be reality based and allow enough leeway so that the patient feels she is in control of this process.

  1. Nutrition consult:

     a. initial to include diet recall.
     b. periodic follow-up with nutritionist if possible.

  2. A diet of 30 kcal / kg, or 2,200 calories, is recommended for those patients whose pre-pregnancy weight is < 190 lbs. or BMI is < 30. For BMI see Appendix C

  3. For those patients whose weight > 190 lbs. or have a BMI ≥ 30 on their initial prenatal visit, a diet of 25 kcal / kg pre-pregnancy ideal body weight, can be calculated. In these patients, restrict carbohydrate to 35-40% of the total calories.

  4. In Medical Nutritional Therapy source of calories can be divided as:

     a. 40% carbohydrates, especially complex unrefined carbohydrates
     b. 20% protein
     c. 40 % fat
        -less than 10% saturated fats;
        -up to 10% polyunsaturated fatty acids. The rest of the fats can come from mono-unsaturated sources.

  5. Calories can be distributed as:

     a. 0-15% breakfast
     b. 5-10 % snack
     c. 20-30 % lunch
     d. 5-10% snack
     e. 30-40% dinner
     f. 5-10 % bedtime snack.

  6. The objectives for weight gain are:

     a. initial weight < 190 lbs. or BMI < 25, recommend a total gain of 22-28 lbs;
     b. initial weight ≥ 190 lbs. or BMI ≥ 25, recommend gain of not more than 22 lbs;
     c. these goals should be maintained without ketosis, if ketones are noted, have patient check urine QID x1-2 days and report results;
     d. pregnancy is not the time for weight loss.

- **Exercise**
  Exercise has randomized data to support its benefit in control of fasting and postprandial glucose. (Bung et al, Jovanovic-Peterson et al) Dyck et al describe a successful exercise program in Aboriginal women in Saskatoon, Saskatchewan.

An “exercise prescription” is something from which women with GDM should benefit. Something as simple as walking at a comfortable pace for 20-30 minutes after meals will usually favorably impact post-prandial glucose values and result in lower birth weight if done as part of a regular regimen.

A high-fiber diet has also been proposed as helpful for glycemic control because of its effect on intestinal transit time and decreased nutrient absorption, but this has not been able to be confirmed in the trials.

McFarland et al reported that women with GDM should be prescribed diet therapy alone for two weeks before they are prescribed insulin. In those with fasting glucose above 95 mg/dL insulin may be prescribed after 1 week of therapy or at diagnosis.

- **Clinic Management**

There are good data to support the following recommended use of ultrasound, exercise, and levels of blood glucose. There are not good data to support a particular number of prenatal visits, though the following management recommendations have been used successfully in a number of AI/AN settings.

1. Frequency of visits

   a. at least weekly until glucose control is well established,
   b. every four weeks until 36 weeks gestation,
   c. weekly after 36 weeks gestation.

2. Initial nutrition consult, then repeat prior to addition of insulin or hypoglycemic.

3. Exercise therapy, including moderate exercise of 60-150 minutes per week divided 3x/wk improves glucose control.

4. Home glucose monitoring should be taught to all women with GDM, and equipment (machine and strips) should be supplied. The frequency of monitoring should be QID (fasting, and either 1 hrs. or 2 hrs. after meals) initially. Individualize the schedule based on initial few days’ results.

5. Glucose goals: The major goals of management should be maintenance of glucose at

   a. fasting whole blood $\leq$ 95 mg/dL,
   or
   b. 1 hour postprandial whole blood $\leq$ 130-140 mg/dL,
   or
   c. 2 hour postprandial whole blood $\leq$ 120 mg/dL.

6. Periodic lab work

   a. urine dipstick for protein after 36 weeks,
   b. ketone measurement may be helpful in women with initial weight > 190 lbs. or BMI > 30 who are treated with diet restriction.

7. Ultrasound for precise dating prior to 18-24 weeks. Careful clinical dating is important as well.

8. Repeat ultrasound at 29-33 weeks to include abdominal circumference. If abdominal circumference > 70 percentile, then consider insulin therapy.

9. Daily fetal movement count - begin at 32 weeks.

10. Consult an OB-GYN if any of these factors are noted: *

    a. increased blood pressure
    b. prior stillbirth
    c. marked decrease in fetal movement

11. When glucose control is good and no other complications supervene, there is no good evidence to support routine delivery before 40 weeks.

- **Intrapartum Management:**

  Any pregnant woman at 37 weeks not controlled within the above parameters should be transferred to a center with the appropriate level of care. In situations where exceptions are made, specific consultation with an OB/GYN on labor management is advised and documented.

Management - Class A-2, pre-gestational, Class B and above

The goals are to decrease fetal and maternal morbidity, particularly fetal macrosomia and stillbirth. As above, there are good data to support the following recommended use of ultrasound, exercise, and monitoring levels of blood glucose. There are not good data to support a particular number of prenatal visits, although the following management recommendations have been used successfully in a number of AI/AN settings.

The management of pre-gestational diabetics and those GDM patients who require insulin therapy will be presented together.

A. Classification

Non pre-existing diabetes: Patients with an abnormal OGTT should receive a 2-week trial of medical nutrition therapy (MNT). If after 2 weeks of MNT the FBS $\geq$ 105 mg/dL or 2 hour PPBS $\geq$ 120 mg/dL, then they are considered Class A-2 and their care should be discussed with an OB/GYN about possible insulin or hypoglycemic therapy.

Patients with pre-existing diabetes should be classified by Type I or Type II. This can be supplemented with the White Classification. See **Appendix B**

B. **Consult with an OB/GYN prior to initiating insulin therapy**. The following are the objectives to be met at the time of starting insulin. *

- Education on the need for good control;
- Diet education, see previous discussion of Medical Nutrition Therapy (MNT);
- Learning to administer insulin and recognize signs and symptoms of hypoglycemia;
- Reviewing home glucose monitoring by finger-stick;
- Baseline physical assessment relating to diabetes in pre-gestational and above, especially:

  a. creatinine clearance and 24 hour urine protein
  b. ophthalmologic exam
- If not yet done, ultrasound assessment of dates, fetal anatomy, and possible polyhydraminos.

C. **Insulin Therapy**

- The goal is euglycemia. Intensive therapy has been associated with fewer primary cesarean deliveries, and fewer macrosomic neonates, plus their infants are less likely to experience shoulder dystocia and neonatal hypoglycemia. See previous glucose goals.

- Human and DNA Recombinant Origin Insulin should be used.

- Split doses of short and intermediate acting insulin should be given twice daily; two-thirds of the day's insulin is given before breakfast and one-third prior to supper. Each dose can be divided two-thirds intermediate and one-third short acting insulin.

  Insulin lispro is a short acting analogue similar to regular insulin, except that it has a more rapid onset. The patient's food should be on her table before she injects her insulin lispro. Insulin lispro peaks at 30-90 minutes.

- One common formula for initiating therapy is:

  - 20u NPH and 10u Regular insulin before breakfast, or insulin lispro at breakfast,
  - 5-10u Regular before, or insulin lispro at meals,
  - 7u NPH at supper
  - Another helpful approach is to administer the NPH insulin at 9-10 pm to decrease fasting glucose

- The patient should monitor her own blood glucose with chemstrips with a portable glucometer. See glucose goals above. This regimen may be liberalized if stable as an outpatient. The patient should maintain a flow sheet.

- While tight control is the objective, hypoglycemia is a significant risk. If the patient has been admitted to initiate insulin, many feel it is best to discharge the patient when her control approaches but falls short of ideal. Fine-tuning is then done on an outpatient basis under conditions of diet and exercise that are more normal for the patient.

- Diet composition is the same as for Class A-1 but calories need to be spread among three meals and three or four snacks.

- Glyburide has been used successfully as an oral hypoglycemic in the 2^{nd} and 3^{rd} trimesters of pregnancy in one randomized controlled trial at the time of this writing. (Langer). ACOG states that further study is recommended before use of the newer oral hypoglycemic agent can be supported in pregnancy.

D. **Indications for admission:** The patient should be admitted for evaluation and control if any of the following conditions are noted:

- poor adherence or persistent hyperglycemia
- pyelonephritis or severe infection
- ketoacidosis
- hypertension or pre-eclampsia

E. **Clinical Management**

The insulin treated patient should be followed according to these guidelines:

- Frequency of visits

  a. as often as daily until glycemic control as outpatient established;
  b. at least every two weeks until 36 weeks unless glucose control is poor, then q wk;
  c. weekly after 36 weeks.
  d. These visit intervals can be lengthened with good phone follow-up.

- Labs each visit

  a. The home flow sheet should be reviewed and a lab-performed glucose obtained to verify control. This may be liberalized if home/village conditions warrant.
  b. Urine for ketones, glucose, and protein. Note all three results in chart each visit.

- Periodic laboratory studies

  a. For women with diabetes predating pregnancy (Type I or Type II), a glycosylated hemoglobin should be obtained on the first visit. Counseling regarding risk of congenital anomalies should be provided based on result.
  b. Multiple marker maternal serum screening, a.k.a. 'triple test' should be offered at 15-20 weeks.
  c. Fetal echocardiogram at 18-22 weeks.

- Ultrasound exam to be repeated q 4-6 weeks to monitor fetal growth, e.g., AC > 70th percentile. Buchanan suggests insulin therapy for AC > 70^{th} percentile (Buchanan).

- Fetal well-being assessment

  a. daily fetal movement count starting at 28 weeks;
  b. non-stress testing (NST) twice weekly starting at 32 weeks should be considered, although little data supports its benefit. Others have added a weekly AFI.

- Delivery recommendations need to be tailored to diabetic class on a case by case basis

  a. deliver in the 38th week, if good early dating;
  b. amniocentesis not necessary, if good glucose control and good dating;
  c. cesarean delivery not indicated for EFW < 4,500 g;
  d. an estimated fetal weight greater than 4,500 g, prolonged second stage of labor or arrest of descent in the second stage are indications for cesarean delivery.

- Intrapartum Insulin

- The goal of intrapartum insulin therapy is maternal and fetal euglycemia, with a maternal glucose less than 90 mg/dL.

  If patient is in active labor, then a mainline of IV of D5LR @ 125 cc/hr should be maintained. On the morning of induction patient should arrive NPO, having <u>not</u> taken her usual a.m. insulin dose. Obtain blood glucose q 1 hour in labor. The goal is to maintain glucose between 60–90 mg/dL to decrease the risk for neonatal hypoglycemia.

Mix 125 units regular insulin in 250cc normal saline. (1u/2cc)

Blood glucose	Bolus	Insulin Drip
< 65 mg/dL	-----	0.5 unit insulin/hr
65-99 mg/dL	-----	1 unit insulin/hr
100-125 mg/dL	2 units	1 unit insulin/hr
126-150 mg/dL	3 units	1 unit insulin/hr
> 150 mg/dL	4 units	2 units insulin/hr

Adjust drip to keep glucose between 60 – 90 mg/dL (Curet, Andersen)

POSTPARTUM MANAGEMENT

In the general population, approximately 40% of GDM women will go on to develop overt type II diabetes within 15 years of the index pregnancy, but among AI/AN women, over half will develop overt diabetes in as little as 4 to 6 years after the index pregnancy. Cumulative incidence of diabetes was as high as 70% in studies that examined women up to 28 years postpartum. (Kim)

- The pre-gestational DM patient may undergo a transient "honeymoon period" with euglycemia soon after delivery. The patient should be monitored closely prior to discharge and at home, however, for impending hyperglycemia. The patient needs to be thoroughly evaluated for her insulin requirements at her 6-week postpartum check up.

- Nutrition consult.

- The patient should be encouraged to maintain the exercise or dietary habits learned during pregnancy. The long-term goal should be to maintain her ideal body weight. A significant percentage of these patients will become overtly diabetic within 15 years, especially if BMI >27.

- Glucose tolerance should be re-evaluated at the six-week postpartum check-up and at a minimum of every 3 years thereafter.

- Patients who have either Impaired Fasting Glucose (IFG) or Impaired Glucose Tolerance (IGT) should be re-tested yearly and treated with MNT and exercise because of their high risk of developing diabetes.

- The more sensitive test is a 75 gm 2 hour OGTT, but a fasting glucose can be diagnostic and may be logistically easier. This test requires the use of a glucose load containing the equivalent of 75 gm anhydrous glucose dissolved in water.

- A diagnosis can also be made if the patient has classic symptoms of DM and a casual glucose $\geq$ 200 mg/dL.

- Outside of pregnancy the laboratory criteria for diabetes mellitus are:

Normoglycemia	**Impaired Fasting glucose (IFG)**	**Impaired Glucose tolerance (IGT)**	**Diabetes mellitus**
FPG < 110 mg/dL	FPG 110 -125mg/dL		FPG $\geq$ 126 mg/ dL
2-h PG < 140 mg/dL		2-h PG 140-199 mg/dL	2-h PG $\geq$ 200 mg/dL

A diagnosis of diabetes must be confirmed on a subsequent day by any of the methods.

In 2002 the Diabetes Prevention Program (DPP) reported a study that randomized IGT patients to lifestyle interventions that included diet and moderate exercise a week or metformin. The DPP found that lifestyle changes and treatment with metformin both reduced the incidence of diabetes in persons at high risk. The lifestyle intervention was more effective than metformin.

Please note these lifestyle changes were very attainable and this study included AI/AN subjects. The mean weight loss goal was only 7 percent in 2.8 years and 150 minutes of moderate exercise per week. The DPP outlined their 8 main steps for lifestyle intervention. See the DPP Description of lifestyle intervention for details.

FAMILY PLANNING AND FUTURE PREGNANCY CONSIDERATIONS

- All contraceptive modalities are appropriate for the gestationally diabetic woman. Caveats in her long-term care include the risk of weight gain with injectable medroxyprogesterone acetate (Espey) and the occasional possibility of increased insulin requirements with the use of combination oral contraceptives by diabetic women.

- Estrogen progestin combinations are contraindicated in patients with vascular disease, including cardiovascular, cerebrovascular disease, because of the risk of thromboembolic or thrombotic complications. These patients can utilize progestin-only methods, however.

- Family planning and six-week postpartum weight control, exercise, and diet considerations are the same as for Class A-1 and pre-gestational DM patients.

PRECONCEPTION COUNSELING

- Weight loss and tight glycemic control should be effected before conception of the next pregnancy. The teratrogenic effects of diabetes usually occur before the pregnancy is diagnosed. Euglycemia can dramatically reduce the risk for these effects.

- Pre-existing diabetic preconception goals

  Before meals (capillary blood glucose), 70 - 100 mg/dL
  2 hours after meals (capillary blood glucose), < 140 mg/dL
  Hgb A1C within lab normal range

- The gestationally diabetic patient may prevent overt diabetes with her next pregnancy by achieving her ideal body weight prior to conception.

- Folic acid supplementation is particularly important for diabetic women who already are at increased risk of malformations. Patients with no previous offspring with neural tube defects should take 0.4 mg/day and those with a previous infant with neural tube defects should take 4 mg/day.

SUMMARY OF RECOMMENDATIONS

- **Blood glucose monitoring recommendations**

Fasting glucose levels	less than 95 mg/dL
1 hour postprandial levels	less than 130-140 mg/dL
2 hour postprandial levels	less than 120 mg/dL

- When medical nutritional therapy has not resulted in the above glucose levels, then insulin Or hypoglycemic therapy should be considered.

- AI/AN women are at high risk for developing diabetes in pregnancy. This disorder can be effectively diagnosed and treated with the guidelines presented. Gestational diabetes, as a harbinger of future glucose intolerance for the patient and her offspring, is a serious public health concern.

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Diabetes in Pregnancy: Part 1 Screening and Diagnosis
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Diabetes in Pregnancy: Part 2 Management and Postpartum
http://www.ihs.gov/MedicalPrograms/MCH/M/DP21.asp#top

National Guidelines Clearinghouse

Many practice guidelines compiled by the Agency for Healthcare Research and Quality (Level III)
http://www.guideline.gov/

PubMed

Use Search for: gestational diabetes and American Indians
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APPENDIX A

Alternative Options for Screening

Give 50 g of Polycose solution. Polycose is the best tolerated, e.g., no nausea, bloating, or lightheadedness and most reproducible. The Polycose can be prepared ahead of time in the Pharmacy by mixing 50 g of Polycose*, 50 mL of unsweetened club soda, and 1.5 gm of unsweetened lemon-lime Kool-Aid mix. Use the standard blood glucose screening criteria. Note that this can be easily prepared in the Pharmacy: Polycose 50 g = 100 mL of 43% polymer solution (2 cal/mL).

Alternatively, for patients who cannot tolerate the oral glucose or polycose challenges, give either 28 each Brach No. 110 or 18 each of the Brach 150 jellybeans per pound. Use the standard blood glucose screening criteria, but be aware that this regimen has poorer sensitivity compared to Polycose.

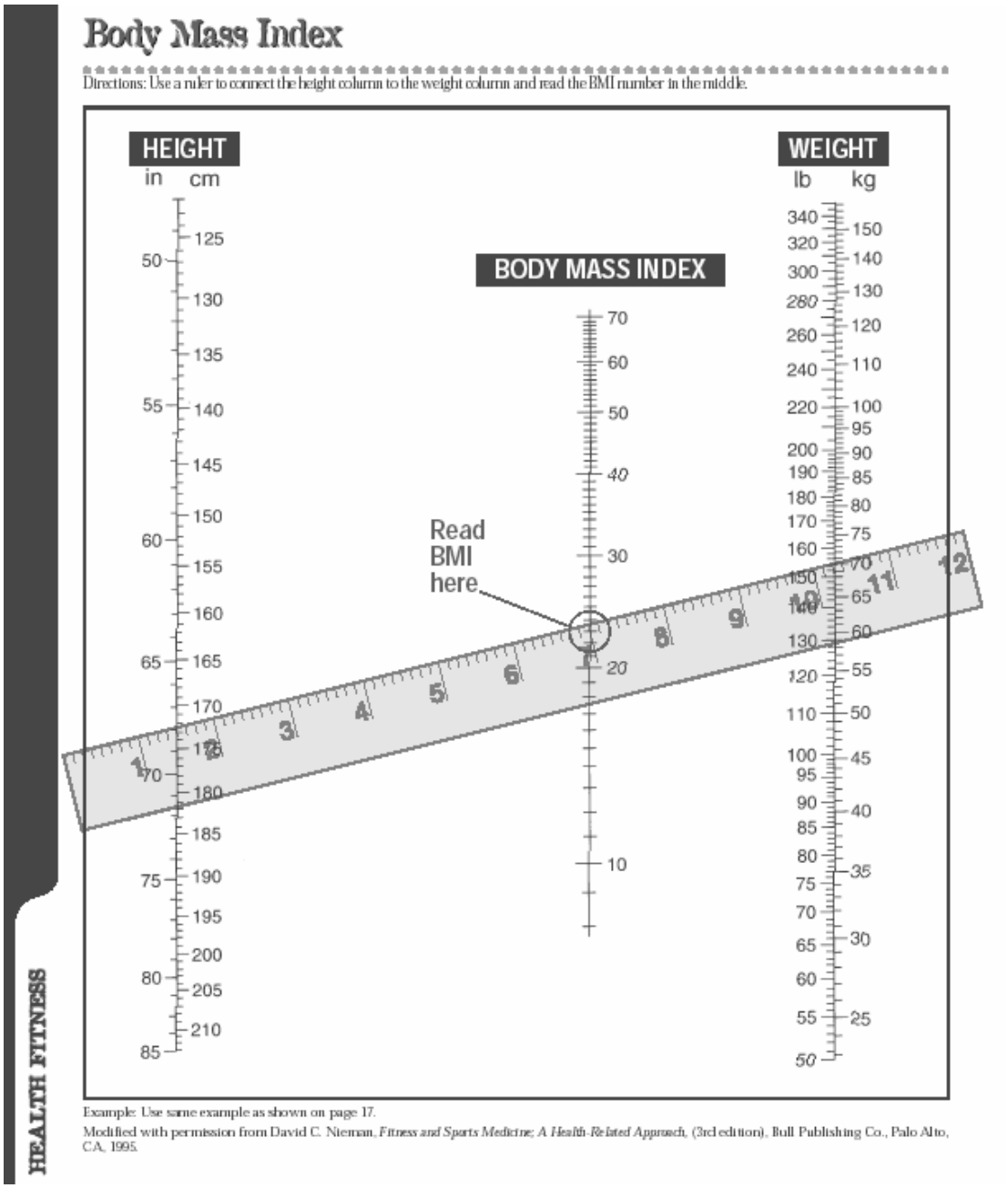
APPENDIX B

Diabetes Predating Pregnancy: The White Classification

Class	Age of Onset (year)		Duration (year)	Vascular Disease		Therapy
A	Any		Any	0	A-1, A-2,	Diet only Insulin
B	> 20		< 10	0		Insulin
C	10-19	or	10-19	0		Insulin
D	10	or	20	Benign retinopathy		Insulin
F	Any		Any	Nephropathy		Insulin
R	Any		Any	Proliferative retinopathy		Insulin
H	Any		Any	Heart Disease		Insulin

APPENDIX C

Body Mass Index Nomogram



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Appendix D

Other diagnostic criteria

The **World Health Organization (WHO) criteria** have the advantage of using the same diagnostic criteria both during pregnancy and outside of pregnancy. In addition, impaired glucose tolerance is treated the same as diabetes, so patients who have a 2 hour glucose ≥ 140 are managed as gestational diabetics. There is also the advantage of not needing an intervening one hour glucose level, so the WHO system can also be used as a one step definitive test using a 2 hour glucose of ≥140 mg/dL. These criteria utilize a 75 gram oral glucose load.

World Health Organization Criteria

time	plasma glucose mg/dL
fasting	≥ 140
two hours	≥ 200 for DM
two hours	≥ 140 for IGT

The **Carpenter and Coustan criteria** can increase the rate of diagnosis by approximately 50%, though no improvements in outcome have been demonstrated. These criteria utilize a 100 gram oral glucose load.

Carpenter and Coustan Criteria

time	plasma glucose mg/dL
fasting	≥ 95
one hour	≥ 180
two hours	≥ 155
three hours	≥ 140