



Diagnosis & Management of Gestational Diabetes Mellitus(2021)

by

-Diabetes in Pregnancy study Group India



DIPSI PANEL

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Heart of the Matter –

Care of Women with Gestational Diabetes:

Any diagnostic criteria and procedure should be simple, doable, economical and evidence based. In this aspect diagnosis of Gestational Diabetes Mellitus with a “Single Test Procedure” recommended by “Diabetes in Pregnancy Study Group India (DIPSI)” and endorsed by Ministry of Health Government of India is an affordable test to meet the requirement of all strata of society. This Test Procedure has been approved by World Health Organization (WHO), International Federation of Gynecologists and Obstetricians (FIGO) and International Diabetes Federation (IDF). Taking into consideration of health delivery care facilities that are available throughout the country and limited knowledge of health care givers in non-urban areas, this guideline is a preferable one. May be useful for medical professionals and para-medicals practicing in urban areas also.

- Prof Dr. V. Seshiah

DIPSI

An appraisal on Gestational Diabetes Mellitus by the Diabetes in Pregnancy Study Group India - is based on the National Guidelines by the Ministry of Health & Family Welfare Government of India.

Preamble:

Ministry of Health Government of India mandated screening all pregnant women for Gestational Diabetes Mellitus (GDM) as part of routine antenatal package according to country's 2014 national guidelines¹. But its real operationalization at primary health-care level is still suboptimal². Again, Ministry of Health Government of India came up with National guidelines for diagnosing and management of GDM in February 2018³. Still implementation of diagnostic procedure is unsatisfactory. One of the reasons for this inertia could be due to the incongruent opinion for the diagnosis of GDM among a few Physicians of our country.

There appears to be no single strategy that is universally applicable to striking a reasonable balance in diagnosing GDM. Pragmatic local measures with careful documentation of outcomes offer the best or, perhaps more accurately, “least worst” solution. Fortunately, India has got its own guideline for diagnosing GDM. It is high time that clinicians take into consideration that “Indian Problem needs Indian Solution”.

Epidemiology of GDM and its implications: Diabetes mellitus is a rapidly escalating global public health problem with rising prevalence among all age groups. The International Diabetes Federation (IDF 2019) estimates that diabetes affects about 463 million people globally which is projected to increase to 642 million people by 2040⁴. There is an equally high burden of pre-diabetes - approximately 318 million are estimated to have pre-diabetes which is likely to increase to about 481 million by 2040⁴.

In 2019 the global prevalence of Hyperglycemia in Pregnancy (HIP) in the age group 20-49 years was estimated to be 20.4 million or 15.8% of live births⁴. They had some form of hyperglycemia in pregnancy, of which 83.6% were due to GDM⁴. Hence, all women should be screened for Gestational Diabetes Mellitus, even if they have no symptoms⁵. Gestational Diabetes Mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy. A community-based screening study for GDM in 2009 included 12056 pregnant women in Tamil Nadu funded by World Diabetes Foundation revealed, GDM prevalence at three settings were: 17.8% in urban, 13.8% in semi-urban, and 9.9% in rural areas⁶. Further prevalence study has not been performed in the country.

GDM has emerged as a global public health problem. In India alone, GDM complicates nearly 4 million pregnancies annually, representing large subset of population at high risk for adverse perinatal morbidity and mortality if left inappropriately managed⁷. Beyond perinatal implications, GDM marks beginning of a vicious cycle in which Diabetes begets Diabetes, leaving a legacy for both affected mother and her offspring to face impending long-term consequences like Type 2 DM and other Non-Communicable Diseases (NCD). As substantiated by “fetal origin of adult disease” hypothesis⁸, perpetuation of this ongoing cycle needs check to avoid occurrence of unfavourable consequences in future generations. Considering wide range of GDM prevalence in the country, its early identification assumes national significance.

The incidence of HIP which includes both GDM and pre-diabetic women with pregnancy (Pre-GDM), parallels the prevalence of prediabetes, overweight, obesity and type 2 diabetes in a given

population. Further, the age of onset of Type 2 DM, pre-diabetes, overweight and obesity is declining while the age of child-bearing is increasing thus more women entering pregnancy have risk factors that make them vulnerable to HIP.

The increased prevalence of Diabetes is usually attributed to: a. The aging population structures. b. Urbanization, c. Obesity epidemic and d. Physical Inactivity. While all these factors contribute to the epidemic of diabetes, intra-uterine exposures (gestational programming) are emerging as potential risk factors.

Intrauterine Programming: Gestational programming is a process whereby stimuli (hyperglycemia) or stresses that occur at critical or sensitive periods of fetal development, permanently change structure, physiology, and metabolism, which predispose individuals to disease in adult life. Manifestation of hyperglycemia in pregnancy that is GDM represents detection of chronic β cell dysfunction and is considered to be a stage in the evolution of Type 2 DM. Women with a history of GDM are at increased risk of future diabetes, predominantly type 2 diabetes, as are their children and the following subsequent generations. “Trans generation Transmission Occurs”⁹.

Consequences of GDM: Maternal risks of GDM (Table 1) include polyhydramnios, pre-eclampsia, prolonged labour, obstructed labour, caesarean section, uterine atony, postpartum haemorrhage, infection and progression of retinopathy which are the leading global causes of maternal morbidity and mortality.

Fetal risks (Table 1) include spontaneous abortion, intra-uterine death, stillbirth, congenital malformation, shoulder dystocia, birth injuries, neonatal hypoglycaemia and infant respiratory distress syndrome. Long-term clinical effects of GDM are important

contributors to the burden of non-communicable diseases in many countries.

Table 1:

Maternal Risk	Fetal Risk
<ul style="list-style-type: none"> • Abortion • Polyhydramnios • Pre-eclampsia • Prolonged labour • Obstructed labour • Caesarean section • Uterine atony • Postpartum haemorrhage • Infection 	<ul style="list-style-type: none"> • Spontaneous abortion • Intra-uterine death • Stillbirth • Congenital malformation • Shoulder dystocia • Birth injuries • Neonatal hypoglycaemia • Infant respiratory distress syndrome

National evidence:

Evidences from India show that women in the country are at much higher risk of developing glucose intolerance during pregnancy as compared to white women. In pan India study conducted by Federation of Obstetricians and Gynaecologist Society of India(FOGSI) and Diabetes in Pregnancy Study Group India(DIPSI) shows about one-third of the pregnant women are diagnosed with GDM during the first trimester and over quarter of them have a history of fetal loss in the previous pregnancies¹⁰. Similar findings were also found in GDM demonstration project in Hoshangabad where pregnant women diagnosed for GDM during first, second and third trimester were 33%, 40% and 28% respectively(Personal Communication). Advancing age and BMI were found to be important risk factor for developing GDM, but their positive predictive value differed substantially from rural to urban settings³.

GDM is an important problem at all levels of economic development, but immediate and pragmatic considerations, may limit the resources devoted to this issue in developing countries¹¹.

Universal Screening: In the yester years, most of the attention on gestational diabetes was to recommend diagnostic cut off values related to the future risk of Type 2 DM in the mother with less attention paid to perinatal outcomes particularly among women with 'mild gestational hyperglycaemia'. Studies in the last decade have shown significant association between adverse pregnancy outcomes and levels of maternal glucose considered within the nondiabetic range.

Universal early testing in population with high prevalence of type 2 DM is recommended. Indian women have 11-fold increased risk of developing glucose intolerance during pregnancy compared to Caucasian women¹². Among ethnic groups in South Asian countries, Indian women have the highest frequency of GDM¹³. Hence, the current recommendation is, all pregnant women should be screened for Gestational Diabetes Mellitus, even if they have no symptoms⁵. The present concept is to screen for GDM in the early weeks of pregnancy, if negative to be repeated in the subsequent weeks of pregnancy as GDM manifests in all the trimesters of pregnancy¹³.

Guidelines for Diagnosing GDM:

Diabetes in Pregnancy Study Group India (DIPSI): A Prospective study performed in India, established that GDM can be diagnosed if 2hr PG \geq 140 mg/dl with 75g oral glucose administered to pregnant women in the fasting or non-fasting state, irrespective of the last meal timing¹⁴. Rational for this diagnostic test is, after a meal, a

normal glucose tolerant woman would be able to maintain euglycemia despite glucose challenge due to brisk and adequate insulin response. Whereas, a woman with GDM who has impaired insulin secretion, her glycemic level increases with a meal and with glucose challenge, the glycemic excursion exaggerates further.

It stands to reason that if in the non-pregnant state 2hr PG > 140mg/dl is considered abnormal (Impaired glucose tolerance- IGT) and given attention, then why can't it be considered abnormal during pregnancy? This "Single Test Procedure" has been approved by the Ministry of Health Government of India², WHO¹⁵, IDF¹⁶ and International Federation of Gynecologists & Obstetricians Society¹⁷ (FIGO). National Institute of Clinical Excellence (NICE) guidelines also recommend 2hr PG > 140 mg/dl as diagnostic criteria for GDM based on the study performed in multi ethnic population of UK¹⁸.

Advantages of DIPSI procedure are:

Pregnant woman need not be fasting. Causes least disturbance in a pregnant woman's routine activities. Serves as both screening and diagnostic procedure (Universal testing is possible). Diagnosis of GDM with 2-h PG \geq 140 mg/dl and treatment is worthwhile with a decreased macrosomia rate, fewer emergency cesarean sections, serious perinatal morbidity and may also improve the women's health-related quality life^{19,20,21}.

Methodology: Test for diagnosis:

"A Single Test Procedure" (Recommended by Ministry of Health Government of India)

- 75 gm glucose is to be given orally after dissolving in approximately 300 ml water whether the pregnant woman comes in fasting or non-fasting state, irrespective of the last

mealtiming. The intake of the solution has to be completed within 5-10 minutes.

- A plasma standardized glucometer should be used to evaluate plasma glucose 2 hours after the oral glucose load.
- If vomiting occurs within 30 minutes of oral glucose intake, the test has to be repeated the next day. If vomiting occurs after 30 minutes, the test continues.
- The threshold plasma glucose level of ≥ 140 mg/dL (more than or equal to 140) is taken as cut off for diagnosis of GDM³.

Logistics required for screening:

For plasma glucose testing

- ❖ Glucose pouches 75gms
- ❖ Disposable glasses and stirrers (at facility or Steel Glass by ANM with Spoon)
- ❖ Drinking water 300ml (at the facility available)
- ❖ Glucometer with calibration strips---
- ❖ Sterile lancet (cannot be reused).
- ❖ Cotton spirit swab or alcohol wipes
- ❖ Register to record the results
- ❖ Yellow and black dust bins (at facility)
- ❖ Puncture proof container (at facility)

Previously Glucometer calibration was recommended after 20, using calibration strips, provided with glucometer measurements but recalibration of glucometer not needed even after 500 testing (as per Roche company Statement)

Instrument used for diagnosis (Point of Care):

Laboratory test requires

1. Complex infrastructure
2. Skilled technicians
3. Stable supply of electricity

(>70% of the Indian population lives in rural areas)

Testing time is more in laboratories, which results in number of women leaving community health centers before diagnosis

established. Point of care testing will have a transformative effect on health care. Hence consideration in testing for hyperglycaemia in pregnancy, a portable blood glucose meter is the only option¹⁵.

Plasma calibrated glucometer measures plasma glucose from capillary blood by finger prick. Glucometer can be used for getting the results immediately. Publications in the National and International journals recommend Accu-Chek glucometer Performa/active of Roche²². Accu-chek glucometer is used in Diabetes Prevention Control Project, Uttar Pradesh. Sponsored by National Health Mission with the World Diabetes Foundation, Denmark. Testing facility with a glucometer should be available at all facilities in the Ante Natal Clinic (ANC) itself. This facilitates getting the result immediately so that necessary advice may be given the same day so that pregnant women need not come yet another day. A glucometer should also be available in the labour room for close monitoring of GDM cases during labour. Routine calibration of glucometer is not necessary (Please refer above).

Technical guidelines on testing & management of GDM:

Protocol for investigation:

The first testing should be done during the first trimester as almost one third of GDM positive women are detected during this period²³ or first antenatal contact as early as possible in pregnancy. The chances are, a few of them may have pre-diabetes. The second testing should be done during 24-28 weeks of pregnancy if the first test is negative. It is important to ensure second test as many pregnant women develop glucose intolerance during this period (24-28 weeks). If it could not be done during this time, then it can be done any time after 24 weeks of pregnancy. There should be at least 4 weeks gap between the two tests.

The test is to be conducted for all pregnant women even if they come late in pregnancy for Ante Natal Clinic (ANC) at the time of first

contact. If she presents beyond 28 weeks of pregnancy, only one test is to be done at the first point of contact.

The Screening Timing

Screening	Week of pregnancy
I Screening	Ideally 12 – 16 weeks or at the time of first visit for AN Checkup
II Screening	24 – 28 weeks
III Screening	32 – 34 weeks

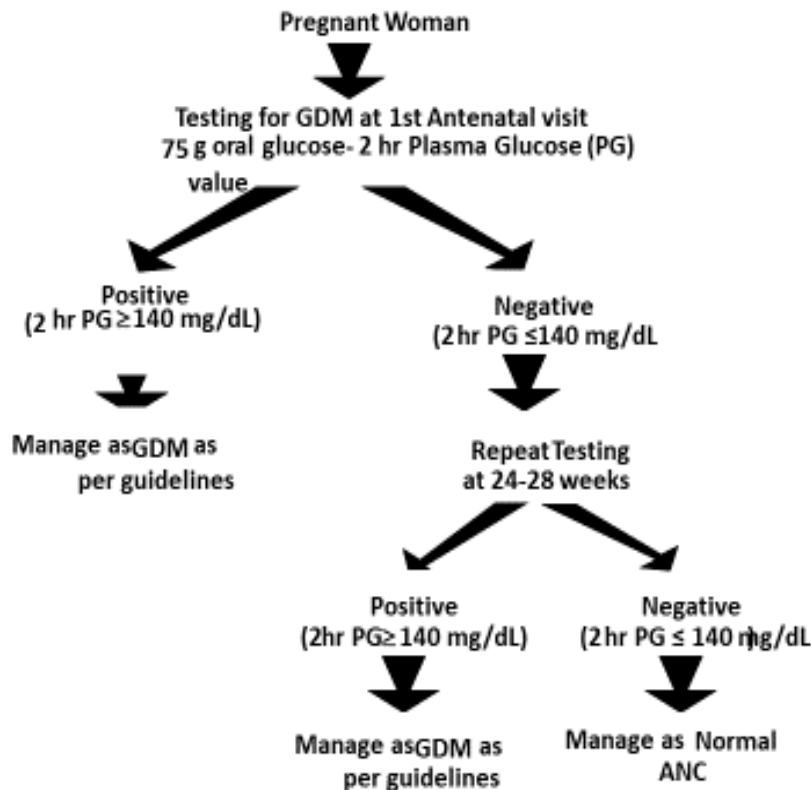
- ❖ Even if they come less than 12 weeks of gestation the test can be done as we can pick up if they have pre-pregnancy diabetes.

OGTT of all pregnant women should be done at Pradhan Mantri Surakshit Matritva Abhiyan (PMSMA) sites as per protocol. If the test is positive at any point, protocol of management should be followed as given in this guideline.

At all other facilities up to PHC level, there should be an in-house arrangement of glucometer and 75gm glucose pouches for conducting the test & giving report immediately so that necessary advice can be given on the same day by the treating doctor.

- ❖ If 75g glucose pouch is not available, 100g glucose pouch can be procured and from that 5-teaspoon full of glucose can be removed and the remaining 75g glucose can be used for the test.

Universal testing for



Glycosylated Haemoglobin (A1c):

There are very little data on the use of A1c to diagnose diabetes in pregnancy. Consequently the 2013 WHO guideline does not include A1c as a means of diagnosing diabetes in a pregnant woman and for monitoring¹⁵. The standardization of A1c is impossible in countries like India where all the laboratories do not possess equipment and standardization is a problem.

Management of GDM:

Guiding Principles

- All Pregnant women who test positive for GDM for the first time should be started on Medical Nutrition Therapy (MNT) and physical exercise for 2 weeks. The woman should walk/exercise (for 30 minutes) or perform household work.

- If 2hr Post Prandial Plasma Glucose (PPPG) remains >120 mg/dl with MNT and lifestyle changes Metformin or Insulin therapy is recommended.

Medical Nutrition Therapy (MNT):

An easy method for the dietary guidelines for Primary health care providers.

Level of Activity	Energy requirement during pregnancy	Total energy requirement (kcal/Day)
Sedentary work	1900+350	2250
Moderate work	2230+350	2580
Heavy work	2850+350	3200

Every Day

- **Carbohydrates**

Breakfast lunch and dinner: 3 servings - each has 45 grams and Two snacks of 30 grams each.

- **Proteins:** 2 to 3 Cups of thick Dhal or whole pulses per day for vegetarians.

For non-vegetarians 2 eggs per day (preferably white only) or cooked chicken or Fish 1 Cup per day served with 1 Cup of dhal.

- **Fats:** Use 20 ml per day of cooking oil which is 4 teaspoons

- **Milk** 500 ml toned milk as milk or curd. After 2nd trimester make it 750 ml per day as milk or Curd.

- ❖ **Meal Plan for a plate of 10 inches radius**



- Half of the plate... cereals or whole grains or millets are preferred.

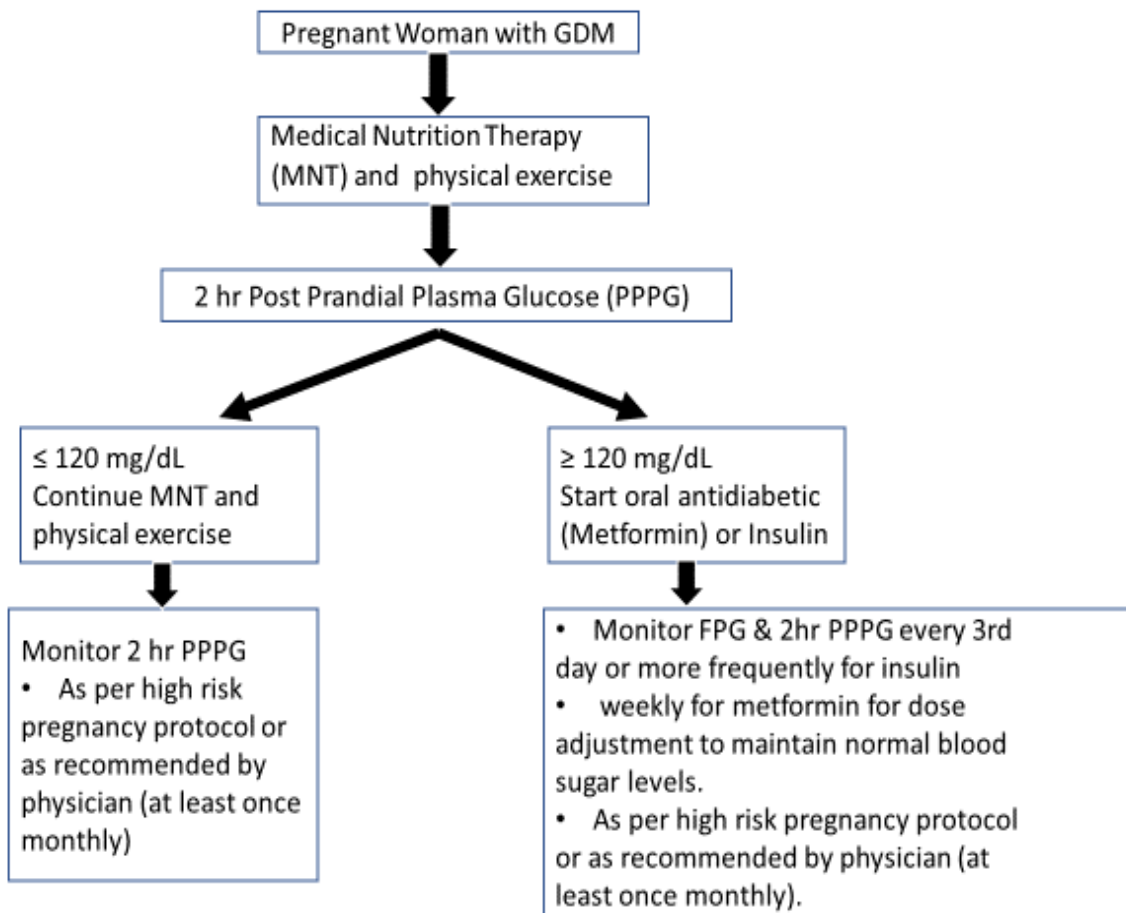
- Quarter of the plate... proteins-dhal and whole pulses for vegetarians.
- Egg or fish or chicken or mutton and dhal for non-vegetarians.
- Quarter of the plate green leafy vegetables, watery vegetables, traditional vegetables and beans variety.
- Curd 200 ml for breakfast, lunch and dinner.
- Snacks preferably Roasted / Boiled Bengal gram and sprouts or salads.

❖ FACILITIES

In places where nutritionists are not available for diet counselling, a ready-made list of diet sheet containing the food items which can be taken in plenty and which should be avoided is made available.

(More detail information on MNT is available in the APPENDIX at the end.)

Management of Pregnant women with GDM



Medical Management (Oral Antidiabetic Drug-Metformin; and Insulin Therapy)

- Metformin or Insulin therapy is the accepted medical management of pregnant women with GDM not controlled on MNT. Insulin is the first drug of choice
- Insulin can be started any time during pregnancy for GDM if Medical Nutrition Therapy (MNT) fails.
- If pregnant women is not willing for insulin, metformin can be recommended provided gestational week is more than 12 weeks²⁴. The starting dose of metformin is 500 mg twice daily orally up to a maximum of 2 gm/day. If the woman's blood sugar is not controlled with the maximum dose of metformin (2 gm/ day) and MNT, there is no other option but to advise Insulin.

- Hypoglycaemia and weight gain with metformin are less in comparison to Insulin.
- If Insulin is required in high doses, metformin may be added to the treatment.

Recent Understanding on the Usage of Metformin in GDM:

Metformin was associated with a lower risk of neonatal hypoglycaemia and less maternal weight gain than insulin. However, in 2015 systematic reviews metformin was found to have a slightly increase in the risk of prematurity. Furthermore, nearly half of patients with GDM who were initially treated with metformin in a randomized trial needed insulin in order to achieve acceptable glucose control. Umbilical cord blood levels of metformin are higher than simultaneous maternal levels because metformin crosses the placenta.

Metformin or insulin for GDM was associated with similar offspring total and abdominal body fat percent and metabolic measures at 7–9 years. Metformin-exposed children were larger at 9 years.

Metformin may interact with fetal environmental factors to influence offspring outcomes²⁵.

With the global increase in the diabetes among reproductive age women, it is anticipated that the use of metformin will likely to increase. As metformin reduces insulin resistance and has the potential to lower the risk of ensuing GDM in PCOS mothers, its role appears truly encouraging. According to ADA, when used to treat polycystic ovary syndrome and induce ovulation, metformin need not be continued once pregnancy has been confirmed but Indian perspective is in contrast. Most of the Obstetricians in India prefer to continue metformin even after the woman conceives based on their experience.

Metformin may be used as a safe and effective oral hypoglycaemic agent in GDM, especially in low-resource settings where cost, storage and compliance are logistic issues²⁴. Metformin therapy was not associated with increased adverse pregnancy outcomes in women with type 2 diabetes as compared with standard insulin

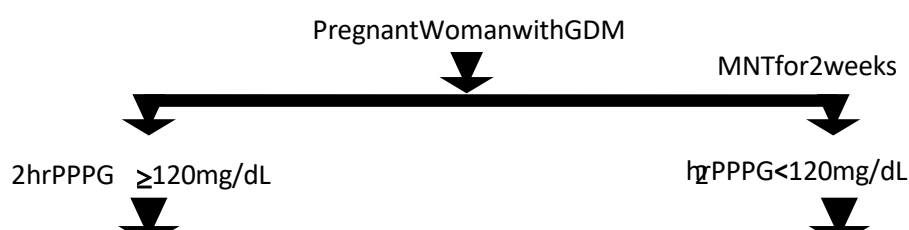
therapy²⁶. Metformin is recommended by the National Guidelines in the Diagnosis and the Management of GDM (Ministry of Health Government of India)⁶.

Monitoring Glycemic Control when on MNT or Metformin:

- After satisfactory glycemic control is achieved, monitoring at least once a month may be performed (places with limited resources).
- Ideal will be monitoring every 2 weeks between 24th to 28th week of gestation.
- After 28th week every week till delivery.

Insulin Therapy

18



FPG <90 mg/dL
2hr PPPG <120

Continue same
dose of insulin +
MNT and physical
exercise



FPG <90 mg/dL
2hr PPPG ≥120 mg/dL

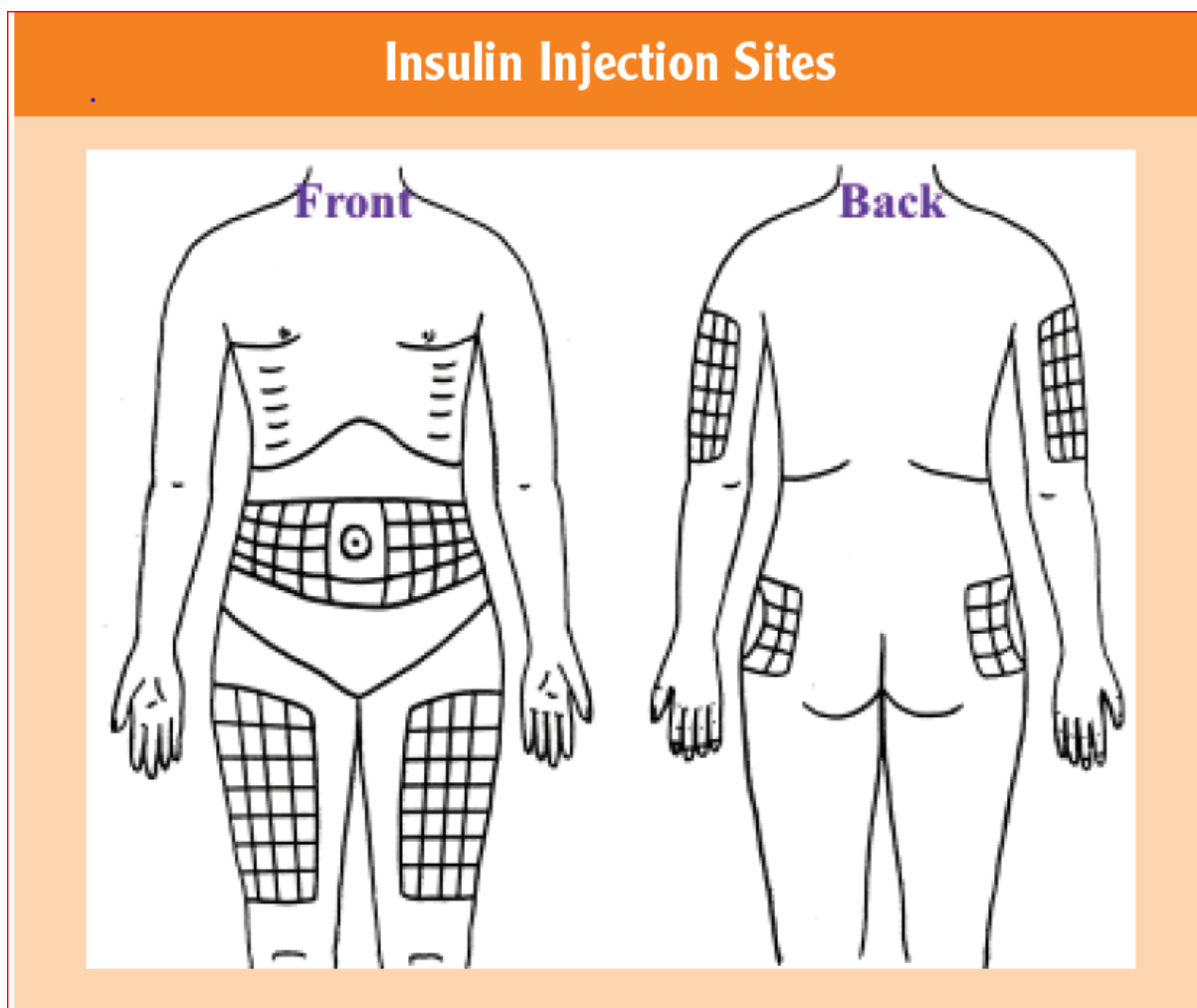
- Repeat FPG & 2 hr PPPG every 3rd day
- Add 2 U pre-breakfast if PPPG is raised
- Add 2 U pre-dinner if FPG is raised
- Continue till desired levels of 90 mg/dL and 120 mg/dL are achieved for FPG and PPPG respectively



FPG ≥90 mg/dL
2hr PPPG ≥120 mg/dL

- Continue same dose of insulin + MNT and physical exercise in all cases.

- The recommended starting dose of insulin in GDM is 0.1 unit/kg of body weight per day. Dose can be increased on follow up till 2hr PG is around 120 mg/dl.
- Rarely a GDM woman may require more than 20 units of insulin per day. If she requires multiple doses of insulin, she may be referred to a higher center where physician is available.
- Pre GDM (Type 1 & Type 2 Dm) may require pre meal regular insulin and bed time basal insulin or premixed insulin twice a day is an option. But PHC is not expected to manage pre GDM unless physician is available.
- Insulin analogs are safer during pregnancy.



Target Glycemic Control:

Historically, the treatment goal in pregnancies complicated by diabetes has been to mimic pattern of glycaemia in normal pregnancy.

Fig-1 The success of prevention of type 2 DM entirely depends on aiming for target glycemic level, that is, maternal glucose should be maintained similar to non-diabetic pregnant women Fig-2. It has been documented that occurrence of macrosomia has a continuous relationship to the 2hr plasma glucose above 120 mg/dl (adjusted odds ratio 3.02 [95% CI 1.30 – 7.00], $P < 0.05$)^{27,28}; and to fasting plasma glucose which becomes significant above 90 mg/dl (adjusted odds ratio 2.08 [95% CI 1.24 – 3.48], $P = 0.005$)^{29,30}. FBG < 90 mg/dl prevents macrosomia as well as other adverse outcomes, such as preeclampsia and contrary to belief, neonatal hypoglycaemia doesn't occur in women with GDM³¹. Pregnant women experience less hypoglycaemia in response to exogenous insulin in comparison to non-pregnant subjects³². Hence, any recommendation (ADA) to maintain FPG at ≤ 95 mg/dl is not acceptable. American College of Obstetrics & Gynaecology (ACOG) recommends Fasting ≤ 90 mg/dl and 2hr Postprandial ≤ 120 mg/dl³³ similar to DIPSI Target.

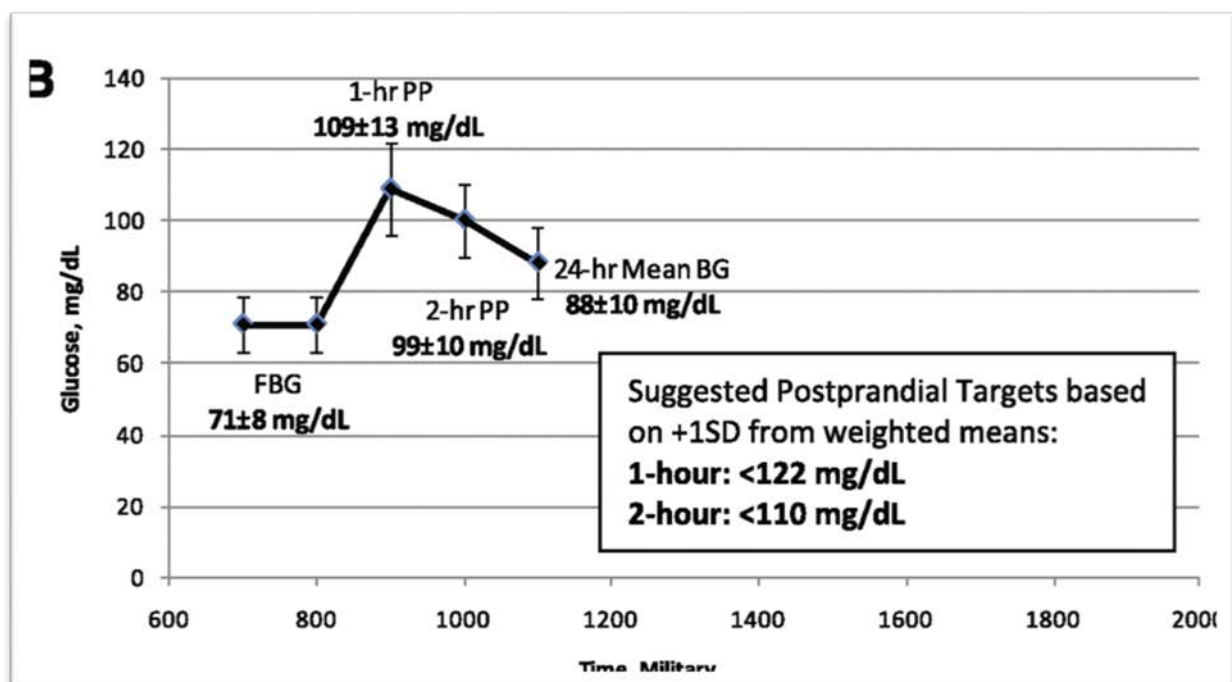


Fig. 1: Pattern of glycaemia in normal pregnancy (adopted from Hernandez)³⁴

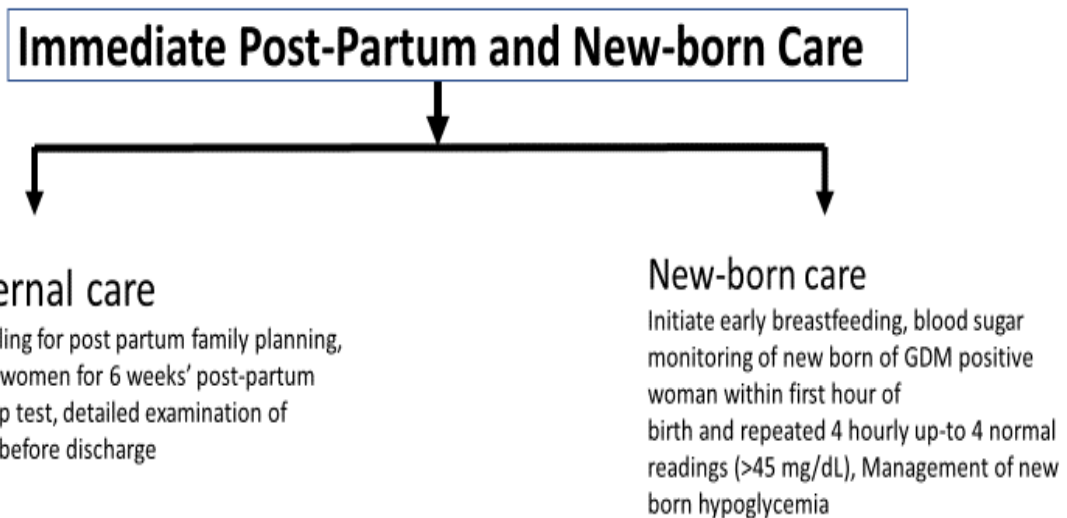
TARGET BLOOD GLUCOSE LEVELS SHOULD BE THAT OF NORMAL PREGNANCY

<i>Fasting PG</i>	<i>PPG</i>	<i>Mean PG level</i>
80 mg %	110 mg %	95 mg %
↕	↕	↕
90 mg %	120 mg %	105 mg %

The goal is to obtain newborn babies Birth weight appropriate for gestational age between 2.5 and 3.5 Kg

(A step to prevent offspring developing Diabetes in future)

Fig. 2: Target blood glucose level and birth weight



Post-partum care:

All GDM positive women should be tested for glucose intolerance, 6 weeks after delivery. In the post-partum period, the “single test procedure” which was followed in the ante-partum period can be followed. This test which was good in the ante-partum period should also be good for the post-partum period. Further the health care workers are all familiar with the single test procedure of DIPSI. If facility to perform 75g OGTT is available, she should be diagnosed to have Impaired Fasting Glucose (IFG) if FPG > 100 mg/dl and 2hr post

glucose >140 mg/dl is diagnosed to have Impaired Glucose Tolerance (IGT).

If GDM woman is on insulin she may not require insulin immediately after the delivery and in the post-partum period. GDM woman who was on metformin may be advised to continue if her post-partum blood glucose is high (≥ 140 mg/dl). Metformin can be continued during breastfeeding. It is well documented that woman with GDM have a very high risk of developing type 2 diabetes and cardiovascular disease postpartum. This risk can be reduced by promoting weight loss and through breastfeeding. Women with diabetes have delayed milk production and lower rates of breast feeding, therefore lactation support should be offered to these patients

Key points

- Universal testing of all pregnant women for GDM
- Testing recommended twice in pregnancy; at 1st antenatal visit and then at 24-28 weeks of gestation.
- Single Test Procedure with 75 gm OGTT to be performed.
- Pregnant women testing positive (2 hr OGTT ≥ 140 mg/dL) should be started on MNT for 2 weeks.
- If 2 hr PPPG ≥ 120 mg/dL after MNT and physical exercise, medical management (metformin or insulin therapy) of pregnant women to be started as per guidelines.
- Pregnant women to be monitored by 2 hr PPPG throughout pregnancy as per high-risk pregnancy protocol. Recommended 8 antenatal visits (4 additional visits) to be conducted during pregnancy period (at least a monthly visit to be ensured).
- Pregnant women with GDM on Insulin therapy with uncontrolled blood sugar levels (2 hr PPPG ≥ 120 mg/dL) or insulin requirement >20 IU/day should be referred for delivery to the centre which has an obstetrician.

- GDM pregnancies are associated with delay in lung maturity of the fetus; so routine delivery prior to 39 weeks is not recommended.
- Early delivery with administration of prophylactic corticosteroid therapy for fetal lung maturity to be planned only if obstetrician and physician services are available.
- Vaginal delivery preferred, LSCS for only obstetric indications or fetal macrosomia- In centre where Obstetrician is available.
- Neonatal monitoring for hypoglycaemia and other complications.
- Postpartum evaluation of glycemic status by a 75 g OGTT at 6 weeks after delivery.

Guidelines envisages provision of plasma calibrated glucometer with strips, 40 IU insulin syringe/insulin pen, calibrated fluids, lancets, cotton swabs, disposable 300 ml glasses, spoons, 500ml beakers with marking, and drugs like metformin, insulin at all antenatal clinics and labor rooms located at medical college, district hospitals, and other CEMOC centers with facility for sample collection and results interpretation. At remaining health-care facilities up to PHC level, an in-house arrangement of glucometer and 75 g glucose pouches are mandated for conducting test and providing report immediately. This is done so that necessary advice can be given on the same day of testing.

Conclusion:

Preventive measures against Type 2 DM should ideally start even before conception (being conceived by healthy parents is the best gift a child can receive) but certainly during intra-uterine period and continue throughout life from early childhood. It is necessary to optimize metabolic control early in pregnancy. This will necessitate pre pregnancy planning for women with pre-existing diabetes, as well as for those at increased risk of GDM, and better means to normalize glycemia. It also requires that all women are tested early and appropriately using a single test procedure and receive good

care to ensure optimal glucose control is achieved early in pregnancy and is maintained throughout pregnancy.

Carry Home Message:

- 1. Women should check their blood sugar before planning marriage.**
- 2. Before conception.**
- 3. Check blood sugar before 12th week of pregnancy.**
 - 12th – 16th weeks of pregnancy**
 - 24th – 28th week**
 - 32nd week**

- 1. One test with 75gm oral glucose in the fasting or non-fasting state.**
- 2. One value to diagnose GDM. 2hr PG \geq 140mg/dl.**
- 3. One target for monitoring Mean Plasma Glucose 105 mg/dl (FPG 80-90 mg/dl, 2hr PPG 110-120 mg/dl).**

Prevention of Diabetes Starts before Birth

Table 1¹:

Table 1: Role of health personnel involved at different levels of health facility		
Level of health facility	Health personnel involved	Responsibilities
Village	ASHA	GDM awareness generation, line listing of all pregnant women, and mobilization of antenatal clients on VHND/ANC OPD day for timely testing and follow up
VHND	ANM	Performs OGTT testing and records results in MCP card and ANC register Identify GDM positive women and record in follow-up register for management Counsel for MNT, physical activity and follow-up schedule on same day of diagnosis Refer those needing medical management therapy Prioritize home visits for left out pregnant women for OGTT testing On negative test, counsel about second test
Level I: Subcentre	ANM	All jobs as defined under VHND. In addition, maintains records, monitors, and follow up
Level II: PHC/urban-PHC	MO/SN/ANM/lab technician	Undertake activities as per their defined job profile and training Counsel and performs OGTT testing Counsel for MNT, physical activity and follow-up schedule on the same day of diagnosis, those controlled on MNT are delivered by ANM/SN Initiate medical therapy after assessing MNT compliance, those controlled on medical therapy are delivered by MOs Counsel for postpartum family planning, 6 weeks' postpartum follow up for OGTT, encourage early breastfeeding and assess the condition of mother before discharge. Monitor blood sugars of newborn to identify hypoglycemia, and manage appropriately Refer those uncontrolled on medical therapy/with complications to higher centre for specialist care Maintains records, monitors, and follow up
Level III: District Hospitals and CEmOC centres	Specialist/gynecologist/MO	All jobs as defined under level II In addition, management of all types of GDM cases
NCD clinic	NCD staff	Educate client, screening, diagnosis and treatment of DM Refer difficult or complicated cases to district hospitals

GDM: Gestational diabetes mellitus; MO: Medical officers; DM: Diabetes mellitus; NCD: Noncommunicable diseases; CEmOC: Comprehensive emergency obstetric care services; OGTT: Oral glucose tolerance test; MNT: Medical nutrition therapy; ANM: Auxiliary Nurse Midwife; SN: Staff Nurse; MCP: Mother child protection; ASHA: Accredited Social Health Activist; OPD: Outpatient department; PHC: Primary health care; VHND: Village health and nutrition day; ANC: Antenatal care

We havenot included discussion on International Association of Diabetes in Pregnancy Study Group (IADPSG) guidelines for the following reason:

IADPSG Guideline was based on Hyperglycemia and Adverse Pregnancy Outcome study (HAPO) which included only caucasian population and thus not suitable for non-caucasian population like Indians.

International Association of Diabetes & Pregnancy Study Groups (IADPSG) Recommendations on the diagnosis and classification of hyperglycemia in pregnancy. IADPSG Consensus panel, Diabetes Care 33 (3), 2010.

Instructions for Screening and Recording:

1. To note down the basic information's of the pregnant woman.
 - a. Name Address
 - b. Age Occupation
 - c. Husbands Name
 - d. Date of Last Menstruation
 - e. Gestational Weeks
2. She has to be given 75 gm glucose orally irrespective of whether she is in the fasting or non-fasting state.
3. Around 2 hours after oral glucose finger tip to be wiped with sterile cotton.
4. To be pricked with a sterile needle (not to use again)
5. The drop of blood applied on the glucometer strip.
6. Strip has to be inserted into the glucometer and the reading displayed has to be noted.
7. If <140 mg/dl the test has to repeated in the next trimester.
8. If >140 mg/dl refer to medical officer.
9. Meal plan for two weeks.
10. If 2 hours postprandial glucose remains >120 mg/dl, medical officer should consider using insulin. If she doesn't accept

insulin, she may be advised Metformin 250 mg twice a day and dose to be adjusted till 2hr Postprandial glucose is between 110 & 120.

11. a. Normal Delivery b. Caesarean.

12. New Born Birth Weight.

APPENDIX:

Medical Nutrition Therapy (MNT)

Principles of MNT

Healthy eating during pregnancy

All pregnant women with GDM should get Medical Nutrition Therapy (MNT) as soon as diagnosis is made. MNT for GDM primarily involves a carbohydrate controlled balanced meal plan which promotes

- Optimal nutrition for maternal and fetal health
- Adequate energy for appropriate gestational weight gain
- Achievement and maintenance of normoglycemia.

The importance of the individualised nutrition assessment in GDM

Nutrition assessment in GDM should be individualised to allow an accurate appraisal of the woman's nutritional status. This assessment includes defining her Body Mass Index (BMI) or percentage of desirable pre-pregnancy body weight and optimal pattern of weight gain during pregnancy.

Calories and GDM

- Individualisation is important when determining energy requirement, and adjustments should be made based on weight change patterns.
- Energy requirement during pregnancy includes the normal requirement of adult and an additional requirement for fetal

growth plus the increase in the body weight of pregnant woman.

- Energy requirement does not increase in the first trimester unless a woman is underweight.
- Energy requirement increases during second and third trimester.
- Energy intake should be adequate enough to provide appropriate weight gain during pregnancy.
- As per Indian ICMR guidelines, for an average weight gain of 10-12 Kg, an addition of 350 kcal/ day above the adult requirement is recommended during second and third trimester.
- Severe caloric restriction is not recommended as it may result in ketonemia and ketonuria and impair physical and mental development in offspring.
- Equations proposed by ICMR expert group can be used to calculate adult energy requirement

which are as follows:

- Energy requirement (kcal/d)= BMR ×PAL
- *BMR= Basal metabolic rate and *PAL= Physical activity level
- IBMR (kcal/d) for adult females (18-30 yrs)= $14 \times B.W \text{ (Kg)} + 471$
- BMR (kcal/d) for adult females (30-60 yrs)= $8.3 \times B.W \text{ (Kg)} + 788$
- *B.W= body weight
- Pre-pregnancy body weight to be taken into consideration when calculating the requirement.

Example:

How to determine calorie requirement of a 28 years of age sedentary active pregnant woman in second trimester with height=153 cm, current weight=60 kg, and pre-pregnancy weight=54 kg.

1. First calculate the BMI

$BMI \text{ (kg/m}^2\text{)} = \text{weight in kg/height in meter square}$

$$= 54/1.543*1.53$$

$$= 23.06 \text{ kg/m}^2$$

BMI is in normal range

2. Calculate BMR $\text{BMR} = 14 \times \text{B.W(kg)} + 471$

$$\text{BMR (kcal/d) for adult females (18-30yrs)} = 14 \times \text{B.W(kg)} + 471$$

$$= 14 \times 54 + 471$$

$$= 1227 \text{ kcal}$$

3. Identify Physical activity level

Physical activity level of sedentary activity is 1.53

4. Total energy requirement of adult = BMR \times Physical activity level

$$= 1227 \times 1.53$$

$$= 1877.31 = 1877 \text{ kcal}$$

5. Total energy requirement in pregnancy = Total energy

$$\text{requirement of adult} + 350 \text{ kcal/d} = 1877 + 350 =$$

$$2227 \text{ kcal per day}$$

al energy requirement

However, for the ease at field level, expert recommend following calculation

Level of Activity	Energy requirement during pregnancy	Total energy requirement (kcal/Day)
Sedentary work	1900+350	2250
Moderate work	2230+350	2580
Heavy work	2850+350	3200

(kcal/Day)

An addition of 350 kcal can be made for pregnant women after calculating the energy requirement for adults as stated in above table.

Further, addition or deduction of 500 calories per day is recommended as per following table:

Weight Category	BMI(kg/m ²)	Energy requirement (kcal/Day)
Underweight	<18.5	Energy requirement as per level of activity + 500 kcal/day
Normal weight	18.5-22.9	Energy requirement as per level of activity
Overweight	23-24.9	Energy requirement as per level of activity
Obese	>25	Energy requirement as per level of activity - 500 kcal/day

*Desirable weight calculated from the Ideal height/weight chart (Annexure 1)

- Hypocaloric diets in obese women with GDM can adversely impair fetal growth besides ketonemia and ketonuria. However, moderate caloric restriction (reduction by 30% of estimated energy needs) in obese women with GDM may improve glycemic control without ketonemia and reduce maternal weight gain.

Select Carbohydrates Carefully

Carbohydrate foods and daily intakes

- Carbohydrate foods are essential for a healthy diet of mother and baby. Once digested, carbohydrate foods are broken down to glucose which goes into blood stream. The type, amount and frequency of carbohydrate intake has a major influence on blood sugar readings.
- Foods sources of carbohydrate include cereals (wheat, bajra, ragi, corn rice etc.) and its products(suji, refined flour, breads, pasta, noodles etc), pulses (green gram, Bengal gram, black gram etc.), starchy vegetables (potato, sweet potato, corn tapioca etc), fruits, sweets, juices etc.
- Large amounts of carbohydrate foods eaten at one time will lead to high blood sugar level and should be avoided.

- Spreading carbohydrate foods over the day will help to prevent this. It is better to spread carbohydrate foods over 3 small meals and 2–3 snacks each day than taking 3 large meals.
- Complex carbohydrates (like whole-grain cereals like oats, bajra, jowar, ragi, whole pulses, vegetables and fruits with skins) should be preferred over simple carbohydrates like food with lots of added sugar or honey, or foods that are made from refined white flour. Some examples of simple carbohydrates include sweets, cakes, puddings, sweet biscuits, pastry, juice, soft drinks, chips, white bread, naan, pizza etc.
- Counting the number of carbohydrate serves that a mother eats during the day will help her to eat the right amount of carbohydrate. As a guide, aim should be for 2–3 carbohydrate serves at each major meal and 1–2 carbohydrate serves at each snack.
- One serve = approximately 15 grams of carbohydrate. Exchange list for carbohydrate is given in annexure 3.

Understanding Fat Intake during Pregnancy

Saturated fat intake (sources - ghee, butter, coconut oil, palm oil, red meat, organ meat, full cream milk etc) should be less than 10 % of total calories and dietary cholesterol should be less than 300 mg/dL. In obese and overweight patients, a lower-fat diet overall can help slow the rate of weight gain.

Ways to trim the fat from your diet

- Use less fat in cooking and avoid frying of foods.
- Using low-fat dairy products in place of whole milk or full cream products.
- Choosing low fat snacks like substituting fresh fruit, salads, baked and steamed food items for high-fat snacks such as cakes, biscuits, chocolates, pastries, samosas and pakoras etc.
- Using lean meat in place of red meat.

Protein: Protein requirement in pregnancy is increased (additional 23 g/day) to allow for fetal growth. At least 3 serving of protein foods are required every day to meet the increased demand. Sources of protein are milk and milk products, egg, fish, chicken, pulses (dal), nuts etc Fiber: High fiber foods especially soluble fibre may help control blood sugar by delaying gastric emptying, retarding the entry of glucose into the blood stream and lessening the postprandial rise in blood sugar. Soluble fiber in flax seed, psyllium husk, oat bran, legumes (dried beans of all kinds, peas and lentils), and pectin (from fruit, such as apples) and forms in root vegetables (such as carrots) are helpful.

ADDENDUM:

The International Association of Diabetes in Pregnancy Study Group (IADPSG) suggested criteria for diagnosis of GDM based on the Hyperglycaemia and Adverse Pregnancy Outcome (HAPO) study^A. When any one value of Venous plasma glucose ≥ 5.1 mmol/L (92 mg/dL) in the fasting or ≥ 10.0 mmol/L (180 mg/dL) in 1-hour or ≥ 8.5 mmol/L (153 mg/dL) in 2-hour with 75 g OGTT, then the pregnant woman is diagnosed to have GDM. In the HAPO study, population from India, China, South Asian countries (except city of Bangkok and Hong Kong), Middle East and Sub Saharan countries were not included. Thus, essentially HAPO study was performed in Caucasian population^A. The diagnosis of GDM with FPG > 92 mg/dl is preferred by IADPSG. Whereas, in relation to FPG, there is a considerable variability between countries noted in the HAPO study with FPG diagnosing only 22% of GDM in women in Bangkok and Hong Kong compared with up to 71% in some US center. A low diagnostic rate of FPG has also been reported in Asian Indians with a fasting plasma glucose 5.1 mmol/l (92 mg/dl) diagnosing only 24% of GDM^B.

WHO in a lukewarm endorsement of the IADPSG criteria described the quality of evidence for its recommendation as “very low” and the strength of its recommendation as “weak”^C. Further, a recent

publication commented that even at centers, that accepted IADPSG recommendation, the approach varies and needs revision for standardization of the strategy for diagnosing GDM^D. Hence IADPSG guidelines is not favored by DIPSI and Ministry of Health Government of India.

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