

Life-cycle approach for prevention of gestational diabetes mellitus

Surabhi Mishra^a, Chythra R. Rao^b, Ajeet Singh Bhadoria^{a,*}, Soumya Mohanty^a, Surekha Kishore^a,
Aparna Sen Chaudhary^b

^a Department of Community and Family Medicine, All India Institute of Medical Sciences (AIIMS), Rishikesh, 249203, Uttarakhand, India

^b Department of Community Medicine, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, 576104, Karnataka, India



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ABSTRACT

Problem considered: Despite enough evidence available supporting temporal relation between gestational diabetes mellitus (GDM) and overt DM, former has earned less attention while managing current diabetes epidemic. This calls for a community-based 'Life-cycle approach' that could employ mutually-linked interventions specific to GDM prevention at various stages of life cycle by utilizing involving already existing Indian health system. **Methods:** Freely accessible, full-text articles published between 1990 and 2018, available in PubMed and Google Scholar in English language, pertaining to GDM risk factors and its preventive strategies were reviewed using combination of medical subject headings (MeSH) and keywords.

Results: GDM prevention begins right from pre-pregnancy phase. Adoption of a healthy lifestyle, mass awareness of risk factors, early identification and prompt referral are key to avert pre-GDM development. During pregnancy, government of India (GoI) mandates universal GDM screening for all Indian pregnant women, avoiding any undiagnosed/untreated GDM woman, thus preventing occurrence of complications including overt DM. Those screened GDM positive are more likely to develop overt DM throughout postpartum. During postpartum, American Diabetes Association (ADA) recommends postpartum diabetes screening for all women with GDM, by employing two h 75 g oral glucose tolerance test (OGTT) and HbA_{1c} prior to and beyond three months postpartum, respectively.

Conclusions: Promotion and practice of life-cycle approach would be key to curb overall diabetes incidence.

1. Introduction

Gestational diabetes mellitus (GDM) has been classically defined as any degree of glucose intolerance first recognized during pregnancy.¹ Many studies have provided indirect evidences supporting temporal relation between GDM and Type II DM.^{2–4} Although researches in past have pointed towards influence of genetics,⁵ environmental, and behavioral changes,⁶ recent attention has been drawn at possible role of hyperglycemia during pregnancies leading to current diabetes epidemic.⁷ A recent meta-analysis has reported seven-fold increase in Type II DM risk among GDM subjects compared to controls.⁸ However, in most countries including India, diabetes is mainly managed by strategies that include mere lifestyle modifications or medical interventions late in life offering little help as they target post-primary prevention.

Thus, to combat current diabetes epidemic, there exists a need of community-based continuum of care approach that could employ mutually-linked GDM specific preventive interventions at various stages of life by involving already existing Indian health system. Reiterating 'Life-

cycle Approach' under Reproductive, Maternal, Newborn, Child, and Adolescent health (RMNCH+A) strategy [Reproductive and Child Health (RCH) programme], continuum of care is a pressing need of the present time.⁹ It has been further emphasized that RMNCH+A are closely linked such that the health of an adolescent girl influences her pregnancy and, in turn, the health of her offspring.⁹ Thus, keeping this in view, the present article outlines the comprehensive 'Life-cycle approach' for GDM prevention specific to Indian population.

1.1. LIFE-CYCLE approach

Life-cycle approach (LCA) deals with two dimensions: (1) Stages of life cycle and (2) levels of health care.⁹ Under RCH programme, this approach was widely accepted considering reproductive, maternal and child health as these cannot be addressed in isolation. Since GDM development is closely linked with different stages of life-cycle, mutually coupled interventions are needed at all health care levels to improve maternal and child health, for preventing GDM development and its

* Corresponding author.

E-mail address: ajeetsinghbhadoria@gmail.com (A.S. Bhadoria).

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long-term consequences including overt DM. Whereas comprehensive primary level health care will keep up early identification of GDM risk factors preventing pre-GDM development, sound referral systems will contribute significantly to early treatment and management of likely complications.

Therefore, specific to GDM prevention, LCA includes all three phases of life cycle: Pre-pregnancy, Pregnancy and Postpartum. The pre-pregnancy phase covers all female children, adolescent girls, and women aged < 30 years. Women aged 30 years and above are dealt separately. This is, in addition, to existing three-tiered health system with community-based programme already in place. LCA provides a strong platform for adequate delivery of health services of superior quality across entire continuum of care, from all three levels of health care utilizing 8.7 lakh ASHA workers. This integrated approach can potentially promote greater efficiencies while reducing duplication of resources and efforts in the on-going programme. By defining integrated packages of services, LCA provides an effective framework for seamless delivery of services at state as well as district levels.⁹

2. Methods

Freely accessible, full-text articles published between 1990 and 2018, available in PubMed and Google Scholar in English language, pertaining to GDM risk factors and preventive strategies to overcome GDM were reviewed using combination of medical subject headings (MeSH) and keywords. Key words were mapped to existing subject headings, which included risk factors, diabetes, gestational, India, prevention, and control.

3. Results and discussion

3.1. GDM risk factors re-addressed

GDM development is the interplay of many factors that determine its likelihood. These include socio-demographic factors, concurrent obstetric and neonatal conditions, marital, menstrual, familial, medical, personal, dietary pattern, and anthropometric factors. In general, these are the same which predict Type II DM occurrence in a non-pregnant adult. These can be non-modifiable and modifiable.

3.1.1. Non-modifiable

Increasing maternal age is a proven risk factor for GDM.^{10–20} However, the exact cut-off at which risk becomes pertinent is still unclear. Many studies identified high GDM risk among subjects aged 30 years and above^{10–17} whereas few studies reported age > 25 years as a significant risk factor for GDM.^{18–20} In addition, many researchers reported high GDM risk among those attaining early menarche.^{21,22} Studies carried out globally also proved positive association between GDM and familial history of DM irrespective of diagnostic methodology employed.^{12,13,17–19} Besides, low education has been identified as a risk factor^[23–25] whereas some studies^{26,27} have found high GDM prevalence among literates. Increased GDM rates have been observed in all settings including high socio-economic status (SES),^{17,26,27} low SES,²⁷ rural,²⁷ and urban.²³

Although all social strata of population are directly or indirectly inflicted with GDM risk, the benefits of early diagnosis and treatment does not need over-emphasis. General awareness regarding important non-modifiable factors requiring extra caution needs to be widely disseminated. Community health workers under RMNCH-A+ may be deployed for identification of high-risk groups for intervention.

3.1.2. Modifiable

High stress level is a proven risk factor for GDM.^{17,28,29} Many studies have supported sedentary lifestyle and decreased physical activity as important determinants of GDM irrespective of the scale used.^{16,17} Subjects with high body mass index (BMI),^{10,13,17,25,27} consuming high

glycemic food^{14,24} largely suffer from high GDM. Though many reported BMI ≥ 25 kg/m² at high risk,^{10,13,17} some studies found BMI cut-off as 30 kg/m² and above significant for GDM.^{25,27}

Studies carried out in different parts of the world have found positive association between GDM and various medical disorders, viz, those suffering/treated for infertility,¹⁵ urinary tract infection (UTI),³⁰ vaginal infections,^{25,30} periodontitis,³¹ irregular menstrual cycles,³² polycystic ovary syndrome (PCOS) and related insulin resistance syndromes.³³

There exists ample evidence in literature identifying multiple obstetric factors as determinants of GDM irrespective of the criteria used. Higher prevalence of such factors among GDM subjects include multigravida, multiparity, past history of obstetric conditions like GDM, pregnancy induced hypertension (PIH), polyhydramnios, abortions, glycosuria, proteinuria, premature rupture of membranes, abruption placentae, abnormal weight gain, induction of labor, pre-term labor, stillbirths, caesarian and assisted delivery, perinatal and neonatal deaths, intrauterine growth retardation (IUGR), intrauterine deaths (IUD), macrosomia, and other neonatal complications like neonatal hypoglycemia, trauma, RDS (respiratory distress syndrome), hyperbilirubinemia, hypoglycaemia, hypoglycaemia, shoulder dystocia, and congenital malformations etc.^{11,12,17,25,27}

To avoid the influence of modifiable factors, their early identification plays an important role, and therefore, the significance of routine antenatal care cannot be over-emphasized. In addition, lifestyle interventions pertaining to diet, physical activity, and stress management is urgently required. Prompt identification of medical disorders and their immediate management should also be mandated. Females on steroids or hormonal methods of birth control must also be periodically reviewed for early detection of diabetes.

3.2. LCA to prevent GDM

For LCA to prevent GDM, a prior knowledge of risk factors is necessary to build a concrete action plan. It forms the basis of strategies needed to prevent/minimize the occurrence/impact of these factors on health of pregnant women so that early development of pre-GDM/GDM can be averted. Although government's initiative to screen all Indian women for GDM has helped in targeting pregnant women of community to prevent GDM-related complications, it has focused on the tip of the iceberg only. Prevention of glucose intolerance requires a rather more comprehensive approach that considers all stages of life cycle. Fig. 1 provides an overview of the probable action plan for GDM specific to Indian population, which not only highlights interventions at multiple stages of life but also embarks relevance of LCA in presently implementing diabetes control programmes and it will help combat the current diabetes epidemic in the country.

3.2.1. PRE-PREGNANCY phase

Pre-pregnancy is the most appropriate time that provides an opportunity for optimizing and maintaining pre-pregnancy weight. Adoption of healthy lifestyle can be well controlled during this phase. Irrespective of previous health status, all Indian females must be provided with comprehensive health package at following levels of health care during their adolescent phase.

All Female children/Adolescent girls/Unmarried Women aged < 30 years

I. At Primary level

A. The existing community health workers under RMNCH-A+ can be best utilized for spreading general awareness about the following modifiable risk factors:

a. **Nutrition:** According to National Institute of Nutrition (NIN) guidelines,³⁴ Indian females are always advised to consume nutritionally adequate diet from variety of foods in amount appropriate to age, physiological status and physical activity

'Life-cycle Approach' for Prevention of GDM

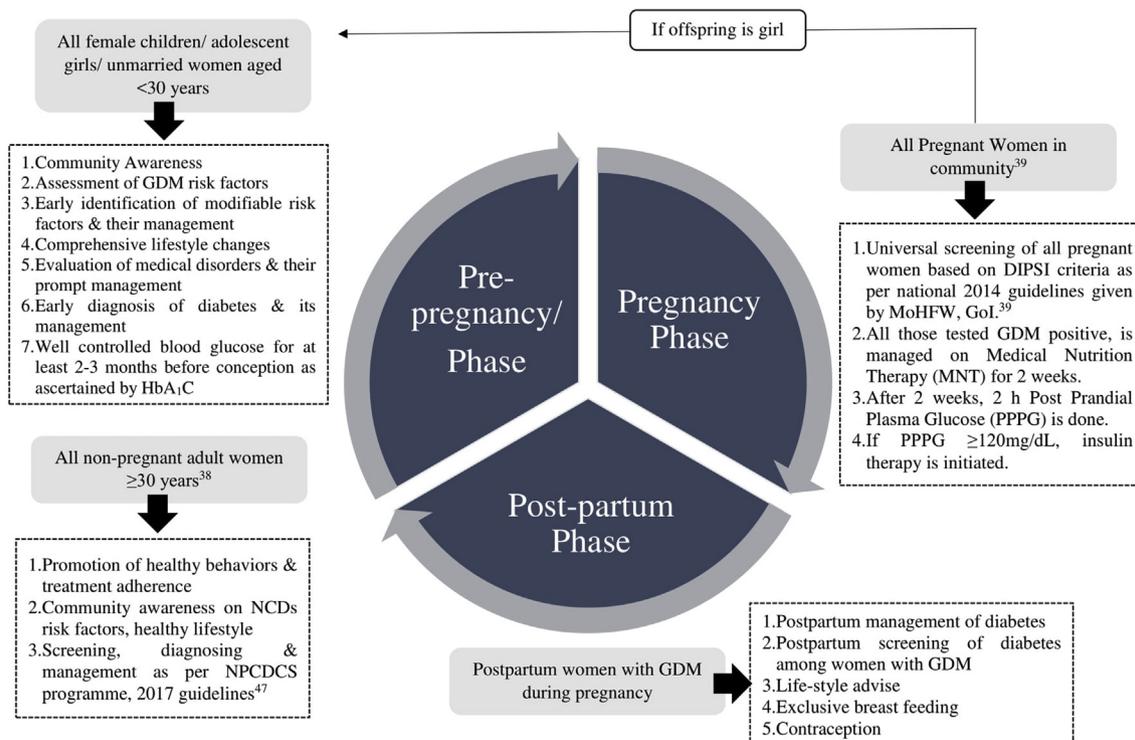


Fig. 1. 'Life-cycle Approach' for prevention of GDM.

as below:

- i. **For healthy infants and those belonging to < 5 years of age,** exclusive breast feeding for a minimum of six months, followed by continued breast-feeding till the attainment of 2 years. Beyond six months of age, in addition to breast milk, other energy-rich foods should also be given in adequate quantity for at least 4–5 times a day. (Table 1).
- ii. **For those 5–10 years old,** wide variety of food including adult family diet must be given in adequate amounts around 5 times a day. The diet should include a healthy combination of energy-rich, body-building and protective foods. (Table 1).
- iii. **Healthy adolescent females (10–19 years)** should be encouraged to consume diet rich in body-building and protective foods which will help in maintenance of adequate growth, maturation and bone development. (Table 1).
- iv. **For being physically active and healthy,** intake of

nutrient-dense low fat foods (skimmed/toned milk instead of whole milk) is recommended.

- b. **Physical Activity:** It is always recommended to perform moderate-intensity physical activity lasting for a minimum period of 45 min for at least 5 days in a week to reduce the risk of chronic diseases.³⁴ However, those suffering from known medical disorders should consult a physician before taking up exercise program. In addition, those on low calorie diets for body weight reduction should perform moderate-to-vigorous intensity physical activities for at least 60–90 min daily. Though exercise is essential for successful long-term weight management, its execution needs to be customized based on individual's current BMI and health condition.³⁴
- c. **Stress management techniques:** These techniques are advisable for all individuals on a daily basis. These include progressive muscle relaxation (PMR), autogenic training, relaxation response, bio-feedback, emotional freedom, guided imagery, diaphragmatic breathing, transcendental meditation, cognitive behavioral therapy, and mindfulness-based stress reduction. Individual or a combination of these techniques serves as an effective tool for promoting mental health by reducing or preventing distress.³⁵

Table 1
Classification of Foods based on Function³⁴.

S. No.	Type of Food	Rich in	Examples of Food
1	Energy-rich foods	Carbohydrates and fats	Whole grain cereals and Millets Vegetable oils, ghee, butter Nuts and Oilseeds Sugars
2	Body building foods	Proteins	Pulses, nuts and oilseed Milk and Milk products Meat, fish, poultry
3	Protective foods	Vitamins and Minerals	Green leafy vegetables Other vegetables and fruit Egg, Milk and Milk products, and flesh foods

- B. In addition to mass awareness, they may also be involved in identifying and managing women at-risk for GDM so that necessary interventions can be initiated at its earliest.
 - C. For urgent specialty treatments at higher centres, the health workers can be utilized as a channel for referral. It may however necessitate strengthening of the existing referral system adequately for better management of medical conditions.
- II. At Secondary and Tertiary Levels:
- a. Evaluate for selected medical disorders positively associated with GDM development as discussed above.
 - b. Measure blood pressure and evaluate for dyslipidemia, vitamin D levels, fasting C-peptide concentrations for early identification of

insulin resistance and accordingly manage with diet, exercise, and statins etc. prior to conception of pregnancy.³⁶

- c. Evaluate HbA_{1c} levels prior to pregnancy to rule out pre-GDM. If diabetic, then ensure appropriate management. It is in order to ensure well controlled blood glucose levels at least three months prior to conception of pregnancy as ascertained by HbA_{1c}. (Fig. 1).
- d. Use of extra folic acid up to 1 mg daily is recommended in obese patients to avoid neural tube defects (NTDs).³⁷
- e. Lastly, evaluate for anorexia nervosa and bulimia commonly seen in Type I DM.³⁶

3.2.1.1. All Women aged 30 Years and above. As per National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular diseases and Stroke (NPCDCS) 2017 guidelines, instituting universal population-based screening of NCDs/risk factors including diabetes is mandatory.³⁸ The programme has included all adult men and non-pregnant women aged 30 years and above to be screened for diabetes by auxiliary nurse midwives (ANMs) on a yearly basis. An ANM will be assisted by accredited social health activist (ASHA) and other members of the Village Health Sanitation and Nutrition Committee (VHSNC). Screening will be first carried out on a community-based assessment checklist (CBAC) followed by random capillary blood sugar (RCBS) levels assessment using glucometer at village/sub-center level. Those screened positive will be then referred to a nearest Primary Health Centre (PHC) where the medical officer will diagnose diabetes by performing fasting and post-prandial glucose level measurements on venous blood samples. Following diagnosis, cardiovascular risk assessment will be carried out in addition to treatment and management of diabetes. In case of complications, the programme also ensures referral to the nearest Community Health Centre (CHC)/District Hospital (DH) for further follow-up and support. The programme has also included increasing general awareness in the community regarding risk factors of NCDs, healthy lifestyles, support network systems, and individual and family counselling for those who have been initiated on treatment for compliance.³⁸ (Fig. 1).

3.2.2. PREGNANCY PHASE: all pregnant women in community

As discussed above, recent national guidelines for diagnosis and management of GDM in India (2014) mandated universal testing for GDM among all Indian pregnant women. It recommends employing a one-step procedure using 2 h 75g OGTT twice during the entire antenatal period irrespective of last meal timings.³⁹ The purpose of implementing universal screening in a country like India is to primarily rule out the possibility of pregnant women suffering from undiagnosed pre-GDM especially when they walk into an antenatal clinic for the first time unaware of their pre-pregnancy glycemic levels.³⁹ This situation practically holds true in a country like India where awareness regarding GDM among rural Indian women is suboptimal.⁴⁰

3.2.3. POST-PARTUM PHASE: all postpartum women with GDM during pregnancy

GDM women are more likely to develop Type II diabetes in post-natal period than those normoglycemics, and therefore, the advice of healthy lifestyle becomes important. As per American Diabetes Association (ADA) 2014 guidelines, a GDM woman must be screened for diabetes post-delivery by 2 h 75g OGTT recommended at 6th – 12th week (before three months) of postpartum period.⁴¹ Beyond three months, HbA_{1c} should be carried out as described below in section 5.3.2.. In addition, regular physical activity, healthy eating, weight control, and proper contraceptive choices following pregnancy are important preventive measures. Fig. 1 summarizes postpartum recommendations for women with GDM as proposed by ADA 2014 guidelines.⁴¹

- a. **Postnatal Management of Diabetes:** Though insulin requirements

fall dramatically postpartum, blood glucose levels need to be monitored on the day of discharge and managed accordingly to avoid prolonged hypoglycemia.

- b. **Post-partum Diabetes Screening:** As per ADA 2014⁴¹ recommendations,
 - a) Two hours 75 g OGTT is recommended at 6–12 weeks (before three months) postpartum, and
 - b) HbA_{1c} should be checked after three months postpartum for follow up action as below:
 1. If screened normal, repeat test after one year of delivery, and then every three years thereafter as long as values remain within normal limits
 2. If screened as prediabetes, diagnose as impaired fasting glucose (IFG)/impaired glucose tolerant (IGT). Refer for aggressive lifestyle change. This includes visiting a dietician for medical nutrition therapy (MNT), receiving instruction regarding physical activity, and/or evaluate for the need of insulin sensitizer medication, such as metformin.
 3. If screened as overt diabetes, refer to a specialist.

Other metabolic risk factors including blood pressure, weight, BMI, waist-hip ratio, lipid profile etc. need to be evaluated every one year after delivery. Encourage women to obtain a glucose screen before conceiving again.

- c. **Life-style Advice:** The need for maintaining BMI < 25 kg/m² can hardly be over-emphasized. Strategies may be same as those discussed in section 5.1.1.. However, for those already overweight, there is no single regimen for weight reduction. It needs to be customized. Weight reduction needs to be gradual: reduction of 500 g body weight/week is considered safe. However, extreme approaches should be avoided and use of drugs may be dangerous. Modifications in dietary habits must be incorporated into one's lifestyle along with adequate exercise to keep body weight within normal limits. All weight reduction regimens need to be monitored by a doctor and a dietitian.³⁴

Weight reduction diets should not be less than 1000 Kcal/day providing all nutrients. As fat contains > twice calories (9 Kcal)/g compared to protein (4 Kcal) and carbohydrate (4 Kcal), weight reducing diets should limit fat and carbohydrates intake. However, it should be rich in proteins. Refined sugars (4 Kcal) and alcohol (7 Kcal) providing empty calories should be avoided. Refined carbohydrates that promote fast absorption of glucose (Glycemic carbohydrates) also need to be restricted. Plant foods that provide complex carbohydrates and fiber must be preferred as they reduce blood glucose, cholesterol and triglycerides. Consumption of fruits and vegetables not only result in satiety but also help maintain adequate micronutrient intake. Frequent fasting/semi-fasting (cyclic weight reduction) followed by binge eating should always be avoided.³⁴

- d. **Exclusive Breast-feeding:** It is recommended for a minimum period of first six months. Close monitoring of infants for signs of hypoglycemia is also advised.
- e. **Contraception:** A minimum gap of two years is advisable before a woman plans for her next pregnancy. If a lady with GDM wants to delay her subsequent pregnancy, IUCDs (CuT 380 A & levonorgestrel-releasing IUCDs) and sub-dermal implants would be first-line recommendations. Those who have completed child-bearing and do not desire pregnancy, surgical sterilization would be preferred.^{42–44}

The above timeline ensures that Indian women will be evaluated at least a couple of times at various life stages, for early identification and management of diabetes.

4. Conclusions

Prevention of hyperglycemia requires comprehensive approach that must consider all stages of life cycle. The above discussed action plan, highlights the relevance of RMNCH+A strategy in controlling the current diabetes epidemic, specifically for Indian population and addresses its pressing need of the time. If executed successfully, the plan can help curb the diabetes incidence in future.

Conflict of interest

None to declare.

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Disclaimer

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No.

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Appendix A. Supplementary data

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