INTRODUCTION

Diabetes mellitus is one of the leading causes of morbidity and mortality worldwide. Although women are no more prone to develop diabetes than men, the economic and health burden due to diabetes weighs more heavily on the latter due to biological, socioeconomic, and psychological factors. As the health of a nation depends largely on the health of its mothers, any condition adversely affecting women's health will have far-reaching implications.

It is estimated that diabetes is the ninth leading cause of death among women worldwide. The International Diabetes Federation estimates that there are currently 187 million women with diabetes in the world today, and this number is expected to increase to 288 million by 2030.\(^1\) China and India contribute the lion's share to the burden of diabetes among women. According to the Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) study (which is a national study on diabetes and associated metabolic disorders such as obesity, hypertension, and dyslipidemia in India), 30.3 million women in India have diabetes as of 2011, with a significant proportion developing the disease during the prime of their lives.\(^2\) According to the World Health Organization, 55% of diabetes deaths occur in women.\(^3\)

RISK FACTORS FOR DIABETES IN WOMEN

The majority of women with diabetes have type 2 diabetes mellitus (T2DM). The most important risk factors for T2DM are positive family history, obesity, and sedentary lifestyle. While the first of these cannot be modified, the other two most certainly can, offering scope for prevention of T2DM.

There is currently a pandemic of obesity worldwide, and women are as likely to be obese as men, if not more. The ICMR-INDIAB study showed that 11.2% of women in India were overweight and 24.1% were obese. The prevalence of diabetes was 7.8% among overweight women and 17.3% among obese women compared to 4.2% among those of normal weight.\(^4\) Women tend to gain weight during puberty, pregnancy, lactation, and menopause. The weight gain is often permanent.

Physical activity levels are extremely low in India, particularly among women. Only 40.4% of women in the ICMR-INDIAB study were classified as physically active (compared to 59.7% of men).\(^5\) Women derived most of their physical activity from household chores; recreational physical activity is virtually absent. With increasing urbanization leading to increased availability of calorie-dense foods and household appliances obviating the need for physical labor in the home, physical inactivity levels are set to rise in India, further driving the epidemic of obesity and T2DM.

WOMEN AND DIABETES COMPLICATIONS

Women with diabetes are as prone to the micro- and macrovascular complications of diabetes as men. In fact, owing to poorer glycemic control and poorer follow-up, it is likely that complications may occur more frequently and be more severe in women with diabetes. There is a mistaken conception among many clinicians that women are protected from vascular disease due
to their gender; this is certainly not true in the case of women with diabetes. This is particularly so in the case of cardiovascular disease, where the presentation of disease may be atypical, leading to further delay in diagnosis. Diabetic ketoacidosis is more common among girls with type 1 diabetes than boys.\(^7\)

**DIABETES DURING THE LIFE-COURSE OF A WOMAN**

In contrast to males, the life course of females is marked by several clear-cut milestones, such as puberty, pregnancy, lactation, and menopause, which may be associated with far-reaching changes in the hormonal milieu. In many cases, diabetes control becomes more difficult and deteriorates during these periods in the women’s life, leading to untoward consequences for both the woman as well as her offspring (in the case of diabetes complicating pregnancy and gestational diabetes).

**Girl Child and Adolescent with Diabetes**

Development of diabetes (usually type 1 diabetes) is a devastating event for any child, but more so for the girl child in India, who has to live with not only the disease, but also with the prejudices against female offspring prevalent in many parts of India. This often leads to suboptimal management of diabetes, with devastating consequences for future health.

Adolescence is a time of rapid physical and psychological transition in girls. The hormonal changes inherent in puberty often lead to worsening of insulin resistance and deterioration of glycemic control among a significant proportion of girls.\(^8\) There is often also a sudden decline in recreational physical activity during puberty, as social taboos against women engaging in physically active pursuits start to raise their head. Eating disorders, such as anorexia nervosa and bulimia, brought on in part by a distorted body image perception, can also worsen diabetes control. These conditions are uncommon in India but are probably underreported, as is the issue (common in Western nations) of teenage girls with diabetes deliberately underdosing insulin to limit weight gain.

**Diabetes in Working Women**

Working women have to juggle the roles of homemaker and professional, and self-care often takes a backseat in the process. The development of diabetes adds another complicating factor to this mix. Fortunately, many women with diabetes are able to effectively manage their condition with support from their family, employers, and coworkers. Working women are usually financially independent and benefit from employee health schemes. Affordability of diabetes treatment is, therefore, less of an issue for them.

**Diabetes in Women of Reproductive Age**

Diabetes is not a contraindication to marriage or parenthood. Nonetheless, women with diabetes in India often have difficulty in finding a life partner. In a scenario where most marriages continue to be arranged by parents and family, the expectation is that the bride be “perfect” in every sense (for some reason, this concept is less applicable to the groom!). This has led in many instances, to the bride and her family hiding the diagnosis of diabetes from the prospective husband and in-laws, with the inevitable breakdown of trust once the truth eventually emerges. Fortunately, the stigma associated with diabetes is fast disappearing and most women with diabetes can now expect to find themselves supportive spouses.

Diabetes is perhaps the most common medical condition complicating pregnancy. It is estimated that 16.9% of all pregnancies worldwide were complicated by hyperglycemia, of whom nearly 84% had gestational diabetes mellitus (GDM; see below) and the remainder had diabetes antedating pregnancy.\(^9\) With the pandemic of T2DM spreading to younger age groups, T2DM complicating pregnancy can be expected to increase in the future. In India, more than 25% of pregnancies are complicated by diabetes.\(^10\)

Pregnancy is not contraindicated in women with diabetes, unless advanced complications are present. Women with renal insufficiency, obstructive coronary disease and advanced autonomic neuropathy are usually advised against conceiving. Women with proliferative diabetic retinopathy need to get their lesions photoagulated prior to pregnancy, since retinopathy can worsen in the course of the gestation.

It is essential that tight control of diabetes is achieved prior to conception [the glycosylated hemoglobin (HbA1c) should be less than 7%].\(^11\) As the safety of oral antidiabetic agents has not been conclusively proved during lactation, women with T2DM predating pregnancy should be switched to insulin if planning conception, or, failing that, as soon as pregnancy is confirmed.\(^12\) Unfortunately, many women with preexisting diabetes report to the diabetologist with uncontrolled diabetes
after pregnancy is confirmed. All that can be done from that point on is damage limitation, as fetal organogenesis would already have been completed by then. All women with diabetes who are in the reproductive age group should be counseled to report to the diabetologist when conception is planned so as to achieve the best possible control of blood glucose. Till such time as glycemic control is deemed acceptable, the woman (or the partner) should adopt effective contraceptive measures. Barrier methods, low dose oral contraceptives, and intrauterine devices are acceptable alternatives for these couples. It should be appreciated that antidiabetic agents like metformin and thiazolidinediones can stimulate ovulation and may lead to contraceptive failure.

Gestational diabetes mellitus is defined as glucose intolerance of onset or first recognition during pregnancy. It occurs due to the inability of the pregnant woman’s pancreas to cope with the increased insulin demands of mid-to-late pregnancy. Many women with GDM do not need medication and can be managed with diet and exercise alone; the remainder need insulin, usually in small doses.

Maintaining tight control of diabetes during pregnancy is essential for ensuring optimal fetal and maternal outcome. Poorly controlled maternal diabetes is associated with congenital anomalies in the fetus (in the case of preconceptional diabetes). In the case of GDM, where diabetes usually develops during the second trimester, fetal macrosomia is the usual defect observed. This can lead to increased incidence of operative delivery, birth trauma, and neonatal hypoglycemia. A woman with GDM is at high risk of developing T2DM in later life; the child born of a diabetic pregnancy is also at risk of developing obesity and T2DM in later life.13,14 Prompt recognition and management of GDM, therefore, affords the clinician the unique opportunity of preventing T2DM in two generations. Fortunately, women in India usually have the benefit of extensive family support during pregnancy, enabling them to attain and maintain adequately tight glycemic control. In fact, many women with preexisting diabetes present with their lifetime best glycemic control during pregnancy!

However, after delivery, attention shifts to the baby and the mother’s requirements are relegated to second place. Also, advice from well-meaning relatives and friends that the new mother should “eat for two” mean that many women find it difficult to lose the weight gained during pregnancy. Put together, all these factors mean that glycemic control drastically deteriorates during lactation. Fortunately, this has not been shown to adversely affect the baby.

Older Women with Diabetes

Since the prevalence of diabetes increases with age, the majority of women with diabetes seen in the clinic will be in their middle to late years. Women in this age group in India are usually home-makers and dependent on the spouse or children for meeting their medical expenses. Even visits to the doctor will have to await the convenience of the care-givers. If the woman is the only individual in the family with diabetes, preparing diabetes-friendly meals especially for her often presents a challenge. On the plus side, middle-aged women in India can usually count upon support from the immediate and extended family for their healthcare needs, including hospitalizations.

Like puberty, menopause is associated with significant changes in the levels of several hormones, many of which are counterregulatory to insulin and, therefore, diabetogenic. Women also suffer from mood swings and depression during this phase of their life, often worsening the control of diabetes. Physical activity levels often decline precipitously, owing to musculoskeletal problems, such as osteoarthritis and osteoporosis as well as neuropathy. As noted above, women with T2DM lose the relative protection against coronary artery disease (CAD) vis-à-vis men, afforded to their counterparts without diabetes. CAD in women may present with atypical symptoms and the diagnosis may be missed, with devastating consequences.

Diabetes is associated with an increased risk of certain cancers in women. Endometrial carcinoma is the most frequently quoted example.15 The increased risk may be due to shared risk factors like obesity and high socioeconomic status, but a direct potentiating effect of chronic hyperglycemia cannot be ruled out. It is prudent to screen women with diabetes for endometrial and breast carcinoma.

WOMEN AND ANTIDIABETIC MEDICATIONS

Women respond to all classes of antidiabetic medications similarly to men, but there appear to be some differences as regards the side effects. In particular, the use of thiazolidinediones in postmenopausal women has been associated with osteoporosis and bone fractures.16 Given the high prevalence of osteoporosis and osteopenia among Indian females, this drug should probably be avoided in them. Similarly, use of the recently launched sodium glucose cotransporter-2 inhibitors has been associated with an increase in genital infections, particularly in women.17 Notwithstanding the efficacy of antidiabetic medication in women, the INDIAB study showed that
women are more likely to have poor glycemic control (defined as HbA1c >10%) than men."}^{18}

**CONCLUSION**

Diabetes is as common in women as in men, but the former tend to encounter greater difficulties in controlling their blood glucose levels. This is partly due to biological factors (puberty, pregnancy, menopause) and partly sociocultural. Nonetheless, women with diabetes can expect to derive the same benefit from diabetes management as men. In the case of GDM, controlling diabetes has the unique benefit of preventing T2DM in two generations. As the health of the woman is central to the health of the family and therefore the nation, diabetes in women deserves more attention that it currently receives.

**REFERENCES**