

## **Literature Review on Diabetes, Diabetes Risk Factors, and the National Public Health Initiative on Diabetes and Women**

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### **Diabetes and Pre-Diabetes**

Diabetes is one of the most deadly, disabling, and costly diseases facing the nation at this time and the disease continues to be on the rise at epidemic proportions. Women tend to be hardest hit by diabetes with 9.6 million women having diabetes. This represents 8.8% of the adult population of women 18 years of age and older in 2003 and a two fold increase from 1995 (4.7%). Women of minority racial and ethnic groups have the highest prevalence rates with two to four times the rates of the white population. With the increased growth of minority populations, the number of women in these groups who are diagnosed will increase significantly in the coming years. By 2050, the projected number of all persons with diabetes will have increased from 17 million to 29 million.<sup>1,2</sup>

Diabetes is metabolic disorder where people that have the disease either have a shortage of insulin or have a decreased ability to utilize their insulin. Insulin is a hormone that is produced by the pancreas and allows glucose to be converted to energy at the cell level. Diabetes that is uncontrolled, that is consistently high levels of blood glucose ( $\geq 200\text{mg/dL}$ ) leads to micro and macro vascular disease complications, such as, blindness, lower extremity amputations, end stage renal disease, and coronary heart disease and stroke. Diabetes is found in approximately one in ten individuals, but by the time a person reaches 65 years of age, the increase is one in five.<sup>2</sup>

Pre-diabetes is a condition where blood glucose levels are higher than normal but not high enough to be classified as diabetes. Pre-diabetes raises the risk of developing type 2 diabetes, heart disease, and stroke. People with pre-diabetes have impaired fasting glucose (IFG) or impaired glucose tolerance (IGT). Some people have both IFG and IGT. Impaired fasting glucose (IFG) is a condition in which the fasting blood glucose level is 100 to 125 milligrams per deciliter (mg/dL) after an overnight fast and impaired glucose tolerance (IGT) is the blood glucose level is 140 to 199 mg/dL after a 2-hour oral glucose tolerance test. The population who has “pre-diabetes” is estimated to be 41 million adults 40-74 years of age to have either IGT or IFG or both. Progression to diabetes among those with pre-diabetes is not inevitable. Studies have shown that people with pre-diabetes who lose weight and increase their physical activity can prevent or delay diabetes and even return their blood glucose levels to normal.

Diabetes affects women across the lifespan. The National Agenda for Public Health Action: A National Public Health Initiative on Diabetes and Women's Health addressed diabetes and women across the life stages. ([www.cdc.gov/diabetes/projects/women](http://www.cdc.gov/diabetes/projects/women)) The following paragraphs highlight the affects of diabetes in women in these stages. <sup>1</sup>

#### *Adolescent Years (10-17 Years)*

- About 86,192 females younger than 20 years old have type 1 diabetes; 92% are white, 4% are black, and 4% are Hispanic or Asian American.
- Eating disorders may be higher among young women with type 1 diabetes than among young women in the general population.
- There is an apparent increase in the number of youth of all racial and ethnic groups being diagnosed with type 2 diabetes, and it appears to be more common among girls than boys.
- By age 20 years, 40%-60% of people with type 1 diabetes have evidence of retinopathy, or diabetic eye disease. Untreated retinopathy can lead to blindness. The risk for developing proliferative retinopathy—the most severe form—is higher for girls than for boys (in at least one study).

#### *Reproductive Years (18-44 Years)*

- An estimated 1.3 million women of reproductive age have diabetes; about 500,000 of them do not know they have the disease.
- Type 2 diabetes accounts for most diabetes cases during this life stage. Most women with type 1 diabetes were diagnosed during childhood or adolescence.
- Women of minority racial and ethnic groups are two to four times more likely than non-Hispanic white women to have type 2 diabetes.
- Reproductive-aged women with type 2 diabetes have fewer years of education, have lower income, and are less likely to be employed than women without diabetes.
- Estimates of the overall prevalence of gestational diabetes in the United States range from at least 2.5% to 4% of pregnancies that result in singleton live births, with higher percentages among some ethnic groups and older women. Most gestational diabetes occurs in women with risk factors for type 2 diabetes; they are unable to secrete sufficient insulin to overcome the increased insulin resistance that normally results as pregnancy proceeds.
- Gestational diabetes usually ends after the baby is born, but women with gestational diabetes have a 20%-50% chance of developing type 2 diabetes in the 5-10 years after childbirth.
- Children whose mothers had diabetes during their pregnancies have a greater likelihood of becoming obese during childhood and adolescence and of developing type 2 diabetes later in life.
- New evidence shows that 1 in 3 American babies born in 2000 will develop diabetes sometime during their lifetime.

### *Middle Years (45-64 Years)*

- Approximately 3.8 million women aged 45-64 years have diabetes.
- Diabetes is a leading cause of death among middle-aged American women.
- Coronary heart disease is an important cause of illness among middle-aged women with diabetes; rates are three to seven times higher among women 45-64 years old with diabetes than among those without diabetes.
- In 2000, at least one in four women aged 45-64 years with diabetes had a low level of formal education, and one in three lived in a low-income household. Women with diabetes were more likely than women without diabetes to have a low socioeconomic status regardless of race, ethnicity, or living arrangements (marital status, size of household)

### *Older Years (65 Years and Older)*

- About 4.0 million women aged 65 years and older have diabetes; one-quarter of them do not know they have the disease. Most elderly women with diabetes have type 2 diabetes.
- Because women make up a greater proportion of the elderly population and women with diabetes live longer than their male counterparts, elderly women with diabetes outnumber elderly men with diabetes. Diabetes is one of the leading underlying causes of death among women aged 65 years and older.
- Being older and having diabetes accelerate the development of diabetic complications such as heart disease, stroke, kidney disease, and blindness. Elderly women with diabetes are at particularly high risk for coronary heart disease, visual problems, hyperglycemia or hypoglycemia, and depression.

### *Factors That Place Women at Risk for Diabetes and Its Complications*

Women face increasing risk of diabetes and its complications because of certain social, cultural, and economic trends. National surveys have indicated that since the 1970s there are increasing trends in the numbers of women who are at risk, such as:

- live in poverty (by age 65, women are twice as likely as men to be poor);
- work in small companies that provide fewer benefits and lower pay than larger companies, and face significant challenges to balance job and family responsibilities;
- are uninsured and/or lack access to health care (approximately one in seven women lack health insurance);
- are having a difficult process with finding the balance between the self-management demands of diabetes and their preferred lifestyle...increased stress and depression;<sup>3</sup>
- are overweight and do not exercise regularly (about one-half of women aged 20 years or older are overweight, and more than one-quarter do not engage in regular physical activity).

## **Diabetes, Women and Risk Factors**

Diabetes risk includes age, heredity, obesity, high blood pressure, high blood cholesterol, and ethnicity/race. The link between diabetes and obesity is striking; nearly 47% of all women with diabetes have a body mass index (BMI) greater than 30 compared to 25% of all women.<sup>3, 4,5,6,7,8,9,10</sup>

Body Mass Index (BMI) is a practical measurement which measures overweight and obesity by calculating weight in relation to height. There is an interaction between genetic predisposition, behavioral and environmental risk factors resulting in type 2 diabetes. There is strong evidence that the modifiable risk factors of obesity and sedentary lifestyle are causal. Impaired glucose tolerance associated with obesity is an intermediate stage between normal glucose and overt diabetes and this stage is currently being called “Pre-diabetes.”

Much emphasis in the past has been placed on increasing physical activity to reduce the consequences of diagnosed type 2 diabetes and improve glycemic control, but little on the prevention effects of physical activity on “pre-diabetes” or the metabolic syndrome. The metabolic syndrome is a group of conditions including high blood pressure, high lipids, insulin resistance and obesity that precede the development of overt diabetes and/or cardiovascular disease. A recent JAMA article contained a meta-analysis of 235 citations related to physical activity, type 2 diabetes, obesity, and cardiovascular health. This analysis reflected that physical activity improves cardiac function, reduces blood pressure, creates insulin sensitivity, and reduces total fat and abdominal fat, thus addressing the metabolic syndrome including “pre-diabetes and pre-hypertension.”<sup>7</sup> The Finnish Diabetes Prevention Study and the Diabetes Prevention Program both found that increased leisure time physical activity reduces the risk of type 2 diabetes with impaired glucose tolerance.

Recent studies have been conducted to determine the feasibility and benefit of various interventions to prevent or delay the onset of type 2 diabetes. Well-designed randomized controlled trials report that individuals at high risk for diabetes can be identified and that lifestyle interventions can reduce the progression of diabetes. The Diabetes Prevention Program, the DaQing, and the Finnish study are comparable in their study hypothesis and study subjects. Subjects were middle aged, obese adults with impaired glucose tolerance who with a lifestyle intervention reduced the progression of diabetes.

Focus on physical activity and diet can decrease diabetes by 32-58%. The lifestyle interventions included:

- losing 7% of body weight,
- reducing fat intake to 30% of total calories,
- increasing fiber with the consumption of 3-5 fruits and vegetables daily, and
- exercising 150 minutes per week.

The results of these trials are striking and tell health care professionals and the public that diet, exercise, and changing behaviors can reduce the risk.<sup>3,4,5,6,7,8,9,10</sup>

The following tables provide information on diabetes and its risk factors of overweight, obesity, and sedentary lifestyles across the lifespan. These tables are reflective of the previous discussion.

**Table 1: Diabetes, inadequate physical activity, overweight, and obesity among US women (BRFSS 2003)**

	Diabetes <sup>a</sup>	No Physical Activity in Past Month	Insufficient Physical Activity <sup>b</sup>	Overweight (BMI=25-29.99)	Obese (BMI >=30)
<b>Race</b>					
White	6.5	23.3	37.4	26.8	18.8
Black	12.0	34.9	37.9	28.7	35.0
Asian	5.8	27.0	43.8	22.4	3.9
American Indian	13.0	28.0	29.1	30.0	27.9
Multiracial	9.2	27.5	36.7	25.4	24.9
Hispanic	8.2	39.0	34.7	28.1	22.8
<b>Education</b>					
Less than HS	13.7	47.8	29.3	27.4	27.6
HS grad	8.7	33.5	37.6	28.8	24.0
Some college/tech.	6.7	22.5	39.0	27.0	21.2
4 or more years college	4.1	14.9	38.0	25.1	14.2
<b>Income</b>					
<\$15,000	14.5	42.9	33.3	26.4	29.0
\$15-24,999	9.4	35.6	37.4	28.8	26.8
\$25-34,999	7.5	27.7	39.8	28.7	23.4
\$35-49,999	6.2	22.1	40.7	27.6	21.5
\$50,000+	3.4	14.9	38.5	26.9	15.8

<sup>a</sup> Not including gestational diabetes only

<sup>b</sup> Moderate physical activity for 30 minutes or more per day for five or more days per week or vigorous physical activity for 20 minutes or more per day for three or more days per week

**Table 2: Diabetes, inadequate physical activity, overweight, and obesity among US women aged 18-44 (BRFSS 2003)**

	Diabetes <sup>a</sup>	No Physical Activity in Past Month	Insufficient Physical Activity <sup>b</sup>	Overweight (BMI=25-29.99)	Obese (BMI >=30)
<b>Race</b>					
White	2.1	17.5	37.8	23.0	15.9
Black	4.8	31.3	39.3	28.8	31.2
Asian	3.6	26.3	44.2	19.5	3.4
American Indian	5.6	20.3	30.4	29.6	23.4
Multiracial	2.5	23.0	36.3	23.3	21.2
Hispanic	3.6	37.6	34.4	25.3	20.2
<b>Education</b>					
Less than HS	4.3	42.7	28.4	22.2	24.5
HS grad	3.3	30.2	37.9	26.2	21.8
Some college/tech.	2.7	19.8	38.9	24.5	19.2
4 or more years college	1.8	13.3	39.0	22.2	12.0
<b>Income</b>					
<\$15,000	5.5	37.6	35.0	22.6	25.7
\$15-24,999	3.6	31.0	37.2	26.0	25.1
\$25-34,999	2.7	24.2	38.8	26.4	20.8
\$35-49,999	2.4	19.6	40.4	25.1	18.8
\$50,000+	1.6	13.3	38.3	23.9	13.3

<sup>a</sup> Not including gestational diabetes only

<sup>b</sup> Moderate physical activity for 30 minutes or more per day for five or more days per week or vigorous physical activity for 20 minutes or more per day for three or more days per week

**Table 3: Diabetes, inadequate physical activity, overweight, and obesity among US women aged 45-64 (BRFSS 2003)**

	Diabetes <sup>a</sup>	No Physical Activity in Past Month	Insufficient Physical Activity <sup>b</sup>	Overweight (BMI=25-29.99)	Obese (BMI >=30)
<b>Race</b>					
White	8.1	23.0	39.8	28.5	23.6
Black	19.5	37.1	39.5	29.2	42.7
Asian	7.6	26.7	43.2	29.2	4.0
American Indian	15.7	37.0	30.6	30.7	33.0
Multiracial	15.3	31.9	39.3	28.2	30.6
Hispanic	13.8	42.3	37.2	34.9	29.3
<b>Education</b>					
Less than HS	20.2	53.1	33.8	31.3	35.3
HS grad	11.5	33.9	40.4	30.0	29.5
Some college/tech.	9.6	22.8	41.5	29.4	26.5
4 or more years college	5.7	14.6	38.4	28.0	18.3
<b>Income</b>					
<\$15,000	22.1	48.3	33.5	27.4	39.0
\$15-24,999	14.3	39.5	40.9	30.3	33.7
\$25-34,999	11.7	32.0	43.2	30.4	30.5
\$35-49,999	10.1	23.8	43.2	29.2	27.5
\$50,000+	5.1	16.2	39.4	30.4	19.7

<sup>a</sup> Not including gestational diabetes only, <sup>b</sup> Moderate physical activity for 30 minutes or more per day for five or more days per week or vigorous physical activity for 20 minutes or more per day for three or more days per week

**Table 4: Diabetes, inadequate physical activity, overweight, and obesity among US women aged 65 and older (BRFSS 2003)**

	Diabetes <sup>a</sup>	No Physical Activity in Past Month	Insufficient Physical Activity <sup>b</sup>	Overweight (BMI=25-29.99)	Obese (BMI >=30)
<b>Race</b>					
White	13.0	35.4	33.2	32.3	18.0
Black	24.8	45.8	29.4	28.4	35.1
Asian	21.1	37.1	43.4	25.3	9.5
American Indian	32.7	37.6	22.0	31.2	33.4
Multiracial	21.0	35.0	32.0	26.0	26.8
Hispanic	23.7	40.4	30.8	28.6	23.8
<b>Education</b>					
Less than HS	21.4	50.3	26.8	31.5	25.4
HS grad	15.1	39.4	33.6	32.1	21.3
Some college/tech.	13.9	30.5	34.9	30.9	17.7
4 or more years college	9.7	23.7	33.5	31.0	13.5
<b>Income</b>					
<\$15,000	22.4	46.9	30.4	32.0	25.5
\$15-24,999	15.2	40.2	34.5	32.7	23.7
\$25-34,999	13.7	30.6	37.7	32.2	20.3
\$35-49,999	11.9	28.3	35.8	34.2	17.6
\$50,000+	8.6	20.8	35.0	32.5	14.0

<sup>a</sup> Not including gestational diabetes only

<sup>b</sup> Moderate physical activity for 30 minutes or more per day for five or more days per week or vigorous physical activity for 20 minutes or more per day for three or more days per week

**The National Agenda for Public Health Action: A National Public Health Initiative on Diabetes and Women’s Health** established ten priorities with recommendations to improve quality of life and extend years for women with or at risk of diabetes. The following are the ten priorities and more information on the Agenda is at ([www.cdc.gov/diabetes/projects/women](http://www.cdc.gov/diabetes/projects/women))

1. **Strengthen advocacy** on behalf of women with or at risk for diabetes.
2. **Expand community-based health promotion education, activities, and incentives for all ages in a wide variety of settings**—schools, workplaces, senior centers, churches, civic organizations, and other locations where women live, learn, work, and play.
3. **Encourage and support diabetes prevention and control programs** in state health departments to develop prevention programs for all women and establish efficient links for women at risk for type 2 diabetes.
4. **Fortify community programs for women** with sufficient funding, training, tools, and materials.
5. **Expand population-based surveillance** to monitor and understand.
6. **Educate community leaders** about diabetes and its management and about the value of healthy environments.

7. **Encourage health care providers** to promote risk assessment, quality care, and self-management for diabetes and its complications in their practice settings.

8. **Ensure access to trained health care providers** who offer quality services consistent with established health care guidelines.

9. **Encourage health care coverage and incentives** for recommended diabetes prevention and management practices by

10. **Conduct public health research** on the following questions to further our knowledge about the epidemiological, socio-environmental, behavioral, translational, and biomedical factors that influence diabetes and women's health.

The above information sets the stage for public health professionals to examine the potential for community or population based interventions that mirror the Diabetes Prevention Study (DPP). For public health professionals to invest their energies in designing community or population based intervention programs, five conditions must be met. Diabetes meets the criteria:

- The disease is prevalent with almost 10% the adult of the population or an estimated 17 million adults with the disease and some 40% or 41 million having met the criteria for pre-diabetes.
- Diabetes has a natural history related to a long duration of hyperglycemia and this combined with the risk factors of age, family history of diabetes, obesity defined by waist-to-hip ratio and BMI, abnormal blood pressure and lipids, becomes predictive of diabetes.
- Two tests meet the detection criterion. Fasting Plasma Glucose and Oral Glucose Tolerance Test are widely available and accepted by the diabetes community as the diagnostic tests of choice.
- The DPP clearly defines that diabetes can be prevented or delayed.
- The DPP also clearly defined the prevention interventions.<sup>3, 4,5,6,7,8,9,10</sup>

Conclusions and recommendations include the following to prevent or delay diabetes:

- **Individuals of high risk for developing diabetes need to become aware of the benefits of modest weight loss and to participate in moderate physical activity.**
- **Individuals of high risk for developing diabetes should be screened for diabetes and for impaired fasting glucose or glucose tolerance particularly if age is  $\geq 45$  year of**

**age, and BMI is  $\geq 25\text{kg/m}^2$ . Screening should be done in younger adults who have the above criteria plus other risk factors.**

Individuals of high risk for developing diabetes should be given a prescription for the recommended lifestyle changes and referred to appropriate team members for counseling on behavior changes.