

Factors associated with diabetes and impaired fasting glucose in individuals with a family history

Christina M. Lefante, MPH¹

L. Joseph Su, PhD, MPH¹, Eric Ravussin, PhD², S. Michal Jazwinski, PhD³, Katie E. Cherry, PhD⁴, David A. Welsh, MD⁵, Jennifer C. Rood, PhD, DABCC, FACB², and Crystal Traylor, WHNP².

¹Department of Epidemiology, School of Public Health, Louisiana State University Health Sciences Center ²Pennington Biomedical Research Center

³Department of Biochemistry & Molecular Biology, Louisiana State University Health Sciences Center ⁴Department of Psychology, Louisiana State

University ⁵Department of Pulmonary & Critical Care Medicine, Louisiana State University Health Sciences Center

Objectives

Louisiana Healthy Aging Study (LHAS)

- Identify an individual's risk profile for impaired fasting glucose and type 2 diabetes by family history status
- Recognize the need for diabetes education and screening within an at risk population

Introduction

- Diabetes is the 6th leading cause of death in the United States
- Louisiana has the highest mortality rate from diabetes in any state
 - 39.9 per 100,000 – Louisiana (2004)
 - 24.9 per 100,000 – United States (2004)
- Estimated **16.7 million** U.S. adults have diabetes
- Estimated **12.3 million** U.S. adults have impaired fasting glucose, a potential indicator of progression to type 2 diabetes

Diabetes Screening

- Focus on high risk populations, in a healthcare setting within the doctor/patient relationship
- American Diabetes Association
 - Screening every 3 years beginning at age 45
 - Emphasis placed on individuals with a BMI >25 kg/m²
 - Screening should be considered at a younger age if the individual is overweight and presents with one or more of the known type 2 diabetes risk factors
- The U.S Preventive Services Task Force
 - screen individuals with elevated blood pressure or cholesterol

Type 2 Diabetes Risk Factors

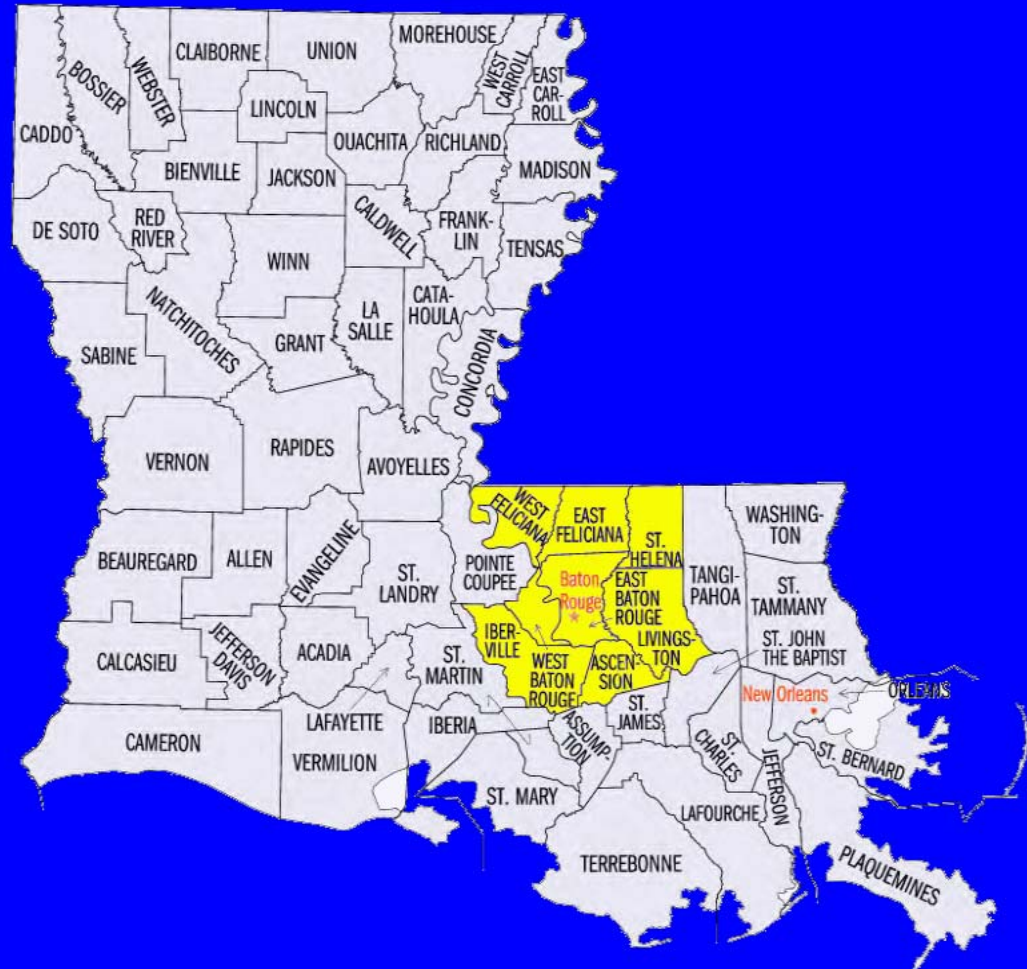
- 45 yrs of age or older
- Overweight; BMI > 25 kg/m²
- Family history of diabetes
- Physical inactivity
- Race/ethnicity
 - African Americans
 - American Indians/Alaska Natives
 - Asian Americans/Pacific Islanders
 - Hispanics and Latinos
- Previously identified Impaired fasting glucose or Impaired glucose tolerance
- History of gestational diabetes
- High blood pressure
- High cholesterol
- Polycystic ovary syndrome
- History of vascular disease

Louisiana Healthy Aging Study

A multi-disciplinary, cross-sectional study that examines the determinants of healthy aging through the genetic, metabolic, physical, and cognitive affects of aging

Study Population

- Individuals residing within the eight parishes in the catchments areas of Baton Rouge
 - Ascension
 - Iberville
 - Livingston
 - St. Helena
 - East Baton Rouge
 - West Baton Rouge
 - East Feliciana
 - West Feliciana



Study Population

- Individuals over the age of 20 were randomly sampled
 - Ages 20 – 64 recruited through voter registration files
 - Ages 65 – 90+ recruited through Medicare beneficiary and voter registration files
- Recruitment
 - Introductory mailing with pre-paid postcard
 - Follow-up mailing
 - Phone call

Louisiana Healthy Aging Study

- Participants were administered
 - Pre-visit blood draw
 - Medical history questionnaire
 - Demographic questionnaire
- Cognitive, physical function, and metabolic testing was also administered based on age and study specific qualifications

Methods

- Impaired fasting glucose (IFG) measured from pre-visit blood draw
 - Individuals were classified as normal, pre-diabetic, or diabetic based on American Diabetes Association guidelines
 - ≤ 99 mg/dL = normal
 - $100 \leq 125$ mg/dL = pre-diabetes
 - ≥ 126 mg/dL = diabetes
- Self-reported diabetes recorded as ever having a diagnosis of diabetes

Methods

- Family history of diabetes
 - Self-reported family history of disease was reported on the medical history questionnaire

| | | | | | |
|-----------|---------------------------------|---------------------------------|-----------------------------------|----------------------------------|---------------------------------|
| Diabetes: | <input type="checkbox"/> Father | <input type="checkbox"/> Mother | <input type="checkbox"/> Children | <input type="checkbox"/> Brother | <input type="checkbox"/> Sister |
|-----------|---------------------------------|---------------------------------|-----------------------------------|----------------------------------|---------------------------------|

- Participants positively marking any of the listed relatives, were categorized as having a family history
 - 253 (35%) reporting a family history
 - 469 (65%) not reporting a family history

Table 1a. Characteristics of study participants with and without a Self-Reported Family History of Diabetes

| | | n | Family History of Diabetes | | | | p* |
|------|---------|-----|----------------------------|-----|-----|-----|---------|
| | | | Yes | % | No | % | |
| Sex | Female | 429 | 159 | 63% | 270 | 58% | 0.168 |
| | Male | 293 | 94 | 37% | 199 | 42% | |
| Race | White | 626 | 201 | 79% | 425 | 91% | <0.0001 |
| | Black | 96 | 52 | 21% | 44 | 9% | |
| Age | 20 – 40 | 148 | 41 | 16% | 107 | 23% | 0.045 |
| | 41 – 64 | 217 | 86 | 34% | 131 | 28% | |
| | 65 – 89 | 150 | 60 | 24% | 90 | 19% | |
| | 90 + | 207 | 60 | 26% | 141 | 30% | |

*p = p-value for Chi-Square test

Table 1a. Characteristics of study participants with and without a Self-Reported Family History of Diabetes

| | | n | Family History of Diabetes | | | | |
|-------------------------|-------------------------------|------------|----------------------------|------------|------------|------------|---------------|
| | | | Yes | % | No | % | p* |
| BMI | (<18.5) Underweight | 15 | 3 | 1% | 12 | 3% | 0.0002 |
| | (18.5-24.9) Normal | 224 | 63 | 26% | 161 | 36% | |
| | (25.0-29.9) Overweight | 254 | 84 | 34% | 170 | 38% | |
| | (≥30.0) Obese | 202 | 95 | 39% | 107 | 24% | |
| ↑ Cholesterol | Yes | 193 | 72 | 28% | 121 | 26% | 0.503 |
| | No | 523 | 181 | 72% | 342 | 74% | |
| ↑ Blood Pressure | Yes | 290 | 118 | 47% | 172 | 37% | 0.013 |
| | No | 426 | 135 | 53% | 291 | 63% | |

*p = p-value for Chi-Square test

Table 1a. Characteristics of study participants with and without a Self-Reported Family History of Diabetes

| | | n | Family History of Diabetes | | | | |
|-------------------------------|---------------------|------------|----------------------------|------------|------------|------------|--------------|
| | | | Yes | % | No | % | p* |
| Self-Reported Diabetes | Yes | 76 | 40 | 16% | 36 | 8% | 0.001 |
| | No | 643 | 213 | 84% | 430 | 92% | |
| Fasting Blood Glucose | Normal | 394 | 120 | 47% | 274 | 58% | 0.002 |
| | Pre-Diabetes | 263 | 100 | 40% | 163 | 35% | |
| | Diabetes | 64 | 33 | 13% | 31 | 7% | |

*p = p-value for Chi-Square test

Table 2. Among non-diabetics, presence of impaired fasting glucose in individuals with or without a family history of diabetes

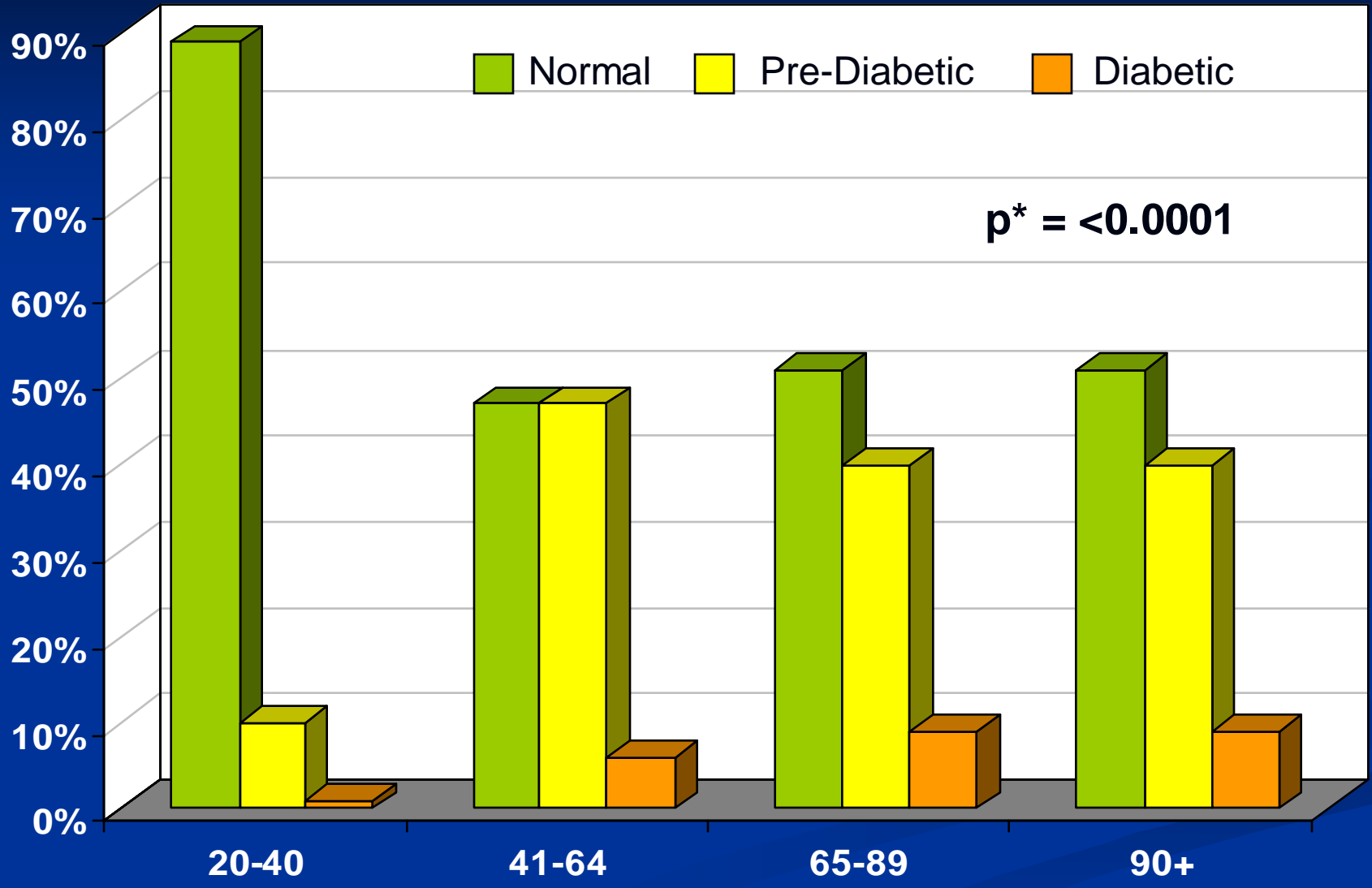
Family History of Diabetes

n = 643

| | Yes | % | No | % | p* |
|------------------------------|------------|------------|------------|------------|--------------|
| Fasting Blood Glucose | | | | | |
| Normal | 112 | 53% | 265 | 62% | |
| Pre-Diabetes | 86 | 40% | 150 | 35% | 0.030 |
| Diabetes | 15 | 7% | 15 | 3% | |

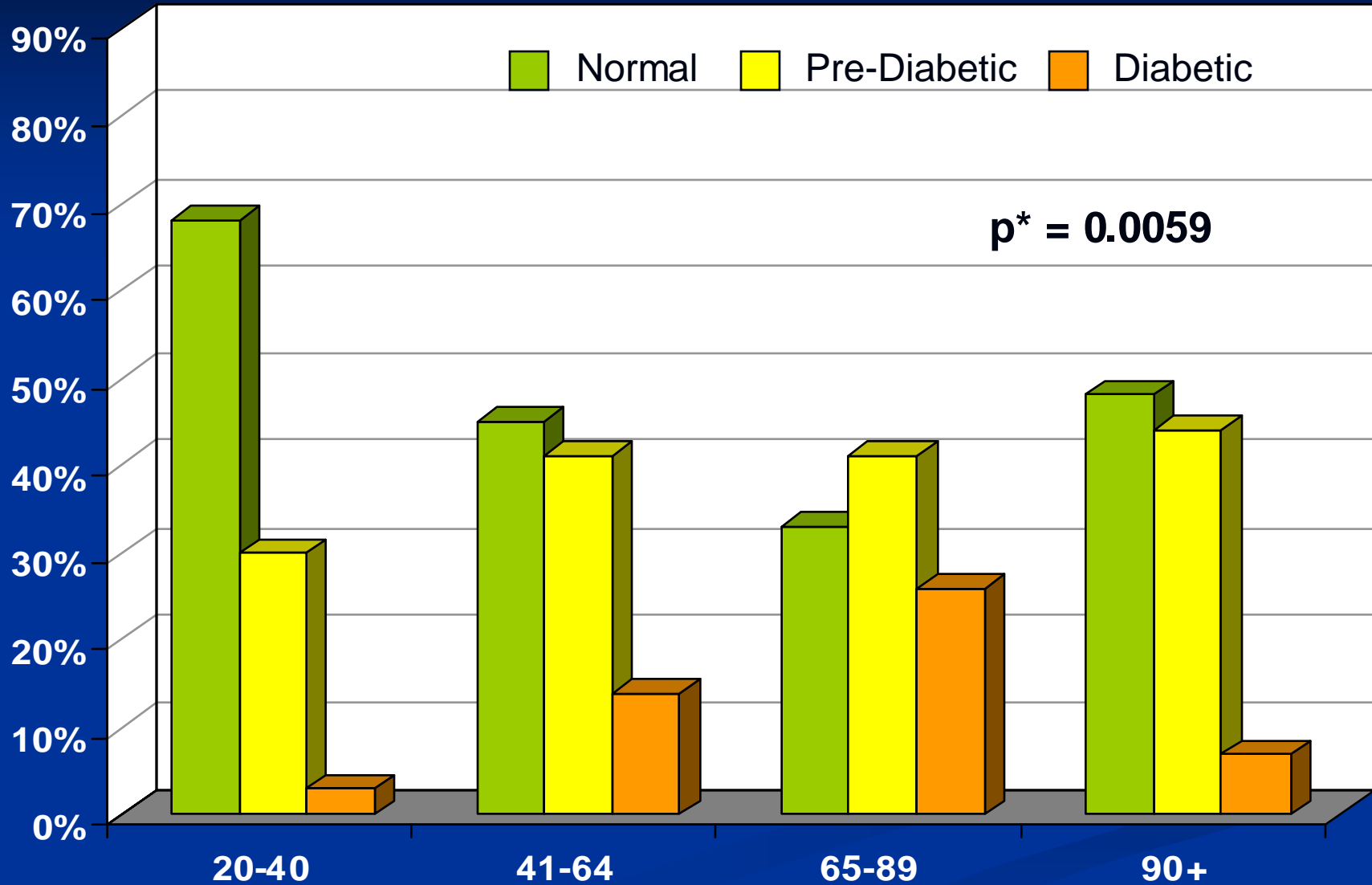
*p = p-value for Chi-Square test, diabetes status by family history status

Chart 1. Diabetes Status in Individuals without a Family History by Age Group



*p-value for Chi-Square test, diabetes status by age-group

Chart 2. Diabetes Status in Individuals with a Family History by Age Group



*p-value for Chi-Square test, diabetes status by age-group

Table 4. Odds ratios of having elevated fasting blood glucose for individuals without a family history of diabetes

| | | n = 469 | Elevated Fasting Blood Glucose | | | |
|------------------|------------|---------|--------------------------------|------------------|-------------|-------------------|
| | | | Crude OR | 95% CI | Adjusted OR | 95% CI |
| Sex | Male | 199 | 2.4 | 1.6 - 3.6 | 2.3 | 1.5 - 3.6 |
| Race | Black | 44 | 1.0 | 0.5 - 2.0 | 1.0 | 0.5 - 2.3 |
| Age | 20-40 | 107 | 1.0 | ----- | 1.0 | ----- |
| | 41-64 | 131 | 2.0 | 1.3 - 3.0 | 8.1 | 3.8 - 17.5 |
| | 65-89 | 90 | 1.5 | 0.9 - 2.5 | 5.7 | 2.4 - 13.3 |
| | 90+ | 141 | 1.6 | 1.0 - 2.4 | 7.1 | 3.0 - 16.5 |
| BMI | Normal | 161 | 1.0 | ----- | 1.0 | ----- |
| | Overweight | 170 | 1.2 | 1.7 - 3.9 | 1.5 | 0.9 - 2.6 |
| | Obese | 107 | 2.2 | 1.4 - 3.5 | 3.4 | 1.8 - 6.4 |
| ↑ Blood Pressure | | 172 | 2.6 | 1.7 - 3.9 | 1.7 | 1.0 - 2.6 |
| ↑ Cholesterol | | 121 | 2.2 | 1.4 - 3.5 | 1.3 | 0.8 - 2.1 |

¹OR = Odds Ratio; ²CI = Confidence Interval; ³OR = Model adjusted for sex, race, age, BMI, self-reported high blood pressure and cholesterol

Table 4. Odds ratios of having elevated fasting blood glucose for individuals with a family history of diabetes

| | | n = 253 | Elevated Fasting Blood Glucose | | | |
|------------------|------------|---------|--------------------------------|---------------------|--------------------------|------------------|
| | | | Crude OR ¹ | 95% CI ² | Adjusted OR ³ | 95% CI |
| Sex | Male | 94 | 2.6 | 1.5 - 4.5 | 2.5 | 1.4 - 4.6 |
| Race | Black | 52 | 1.0 | 0.5 - 2.0 | 1.1 | 0.5 - 2.4 |
| Age | 20-40 | 41 | 1.0 | ----- | 1.0 | ----- |
| | 41-64 | 86 | 1.1 | 0.7 - 1.9 | 1.7 | 0.7 - 4.1 |
| | 65-89 | 60 | 2.0 | 1.1 - 3.9 | 2.1 | 0.8 - 6.0 |
| | 90+ | 66 | 0.9 | 0.5 - 1.7 | 1.7 | 0.6 - 4.6 |
| BMI | Normal | 63 | 1.0 | ----- | 1.0 | ----- |
| | Overweight | 84 | 1.3 | 0.8 - 2.3 | 1.9 | 0.9 - 4.2 |
| | Obese | 95 | 1.9 | 1.1 - 3.3 | 2.8 | 1.3 - 6.0 |
| ↑ Blood Pressure | | 118 | 2.1 | 1.3 - 3.6 | 1.9 | 1.0 - 3.7 |
| ↑ Cholesterol | | 72 | 1.9 | 1.0 - 3.3 | 1.2 | 0.6 - 2.5 |

¹OR = Odds Ratio; ²CI = Confidence Interval; ³OR = Model adjusted for sex, race, age, BMI, self-reported high blood pressure and cholesterol

Summary of Findings

- We found that **47%** of Individuals reporting a family history of diabetes presented with undiagnosed pre-diabetes or diabetes compared to **38%** without a family history.
- Strong predictors of having undiagnosed diabetes or impaired fasting glucose
 - Without a family history
 - **Male gender** (OR:2.3 CI:1.5-3.6)
 - **Obesity** (OR:3.4 CI:1.8-6.4)
 - **>40yrs** 40-64 - (OR:8.1 CI:3.8-17.5)
65-89 - (OR:5.7 CI:2.4-13.3)
90+ - (OR:7.1 CI:3.0-16.5)
 - With a family history
 - **Male gender** (OR:2.5 CI:1.4-4.6)
 - **Obesity** (OR:2.8 CI:1.3-6.0)
 - Age was not a significant predictor in individuals with a family history

Limitations

- Somewhat limited by the characteristics of the study population
 - Predominantly healthy
 - Educated
 - Close to 90% maintained some form of health insurance
- Low turn out amongst African-Americans sampled

Conclusion

- An individual's diabetes risk profile is altered based on the presence or absence of a family history of disease
- Findings suggest that screening and prevention guidelines should be altered to address the separate needs of the at risk community with and without a family history of disease

Acknowledgments

This research was supported by the Louisiana Board of Regents Millennium Trust Health Excellence Fund [HEF(2001-06)-02] and National Institute on Aging [P01AG022064]

- L. Joseph Su, PhD
- S. Michal Jazwinski, PhD
- Eric Ravussin, PhD
- Katie E. Cherry, PhD
- David A. Welsh, MD
- John Mountz, MD
- Don Scott, PhD
- Michael A. Welsch, PhD
- Crystal Traylor, WHNP
- Jennifer C. Rood, PhD, DABCC, FACB
- Christina K. Rowley, MS
- Hua Cheng

- Centers for Disease Control and Prevention (CDC). National Diabetes Fact Sheet. <http://www.cdc.gov/diabetes/pubs/general.htm> Sept 24, 2007
- Centers for Disease Control and Prevention. CDC Wonder. <http://wonder.cdc.gov/>. October 2007.
- American Diabetes Association: Screening for Type 2 Diabetes (Position Statement). *Diabetes Care* 27:S11-S14, 2004
- Centers for Disease Control and Prevention (CDC). Prevalence of diabetes and impaired fasting glucose in adults—United States, 1999–2000. *MMWR Morb Mortal Wkly Rep* 2003;52:833–837.
- Benjamin SM, Valdez R, Geiss LS, et al. Estimated number of adults with prediabetes in the US in 2000: opportunities for prevention. *Diabetes Care*. 2003;26(3):645-9.
- U.S. Preventative Services Task Force: Screening Adults for Type 2 Diabetes Mellitus: Recommendations from the U.S. Preventive Services Task Force (Summaries for Patients). *Annals of Internal Medicine* 138:212-214and215-229,2003