Childhood Influences on Diabetes among Older Americans

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INTRODUCTION

Adult-onset, or type 2 diabetes, has reached near epidemic levels globally. In the United States, diabetes is the sixth leading cause of death (Wray et al, 2004), with approximately 1.3 million new cases diagnosed each year (CDC, 2002). Diabetes prevalence rates have increased by approximately 30% since 1980 in the United States. The rate of growth exceeds that for all other major chronic conditions (McKinlay and Marceau , 2000). The consequences of diabetes are far-ranging and impact several biological systems. These include kidney-related conditions such as end-stage renal disease (Harris, 1998), diabetic retinopathy, which is the leading cause of vision problems of American adults aged 20-74 years, and various ailments of the nervous system (NDIC, 2003) which may cause a delay in food digestion or nerve damage in the feet and hands. In the U.S., diabetes is estimated to reduce the average life expectancy by approximately 15 years (McKinlay and Marceau, 2000).

Although symptoms usually manifest in mid- and later life, the physiological onset of diabetes can occur in adolescence and young adulthood. Social mechanisms have been posited to influence susceptibility to diabetes at an earlier period in life. The lack of essential nutrients, unhealthy eating habits, poor family socioeconomic status, and low educational attainment, among others, are all known to have adverse effects on glucose-insulin metabolism. These crucial social factors in early life, in turn, may have negative health consequences in adulthood (e.g. obesity) and influence socioeconomic achievement processes, which may further increase individuals' chances of acquiring diabetes (Lawlor, Ebrahim, and Davey Smith, 2002; McKeigue, 1997). In this sense, the consequences of childhood circumstances are contingent on the pathways and experiences negotiated or constrained in adulthood.

This study builds on prior research in a number of ways. First, we assess whether associations detected in community- or hospital-based samples are evident in a nationally representative (and highly heterogeneous) sample of older Americans 50 years of age and older. Second, we evaluate the influence of a number of theoretically important aspects of childhood (place of birth, SES, significant health problems and education) to identify the major facets of childhood associated with adult diabetes and associated impairments. Third, we investigate the core mediating mechanisms potentially linking childhood conditions with diabetes—adult achievement processes, region of birth, and adult lifestyle factors such as obesity.

THEORETICAL BACKGROUND

The role of early life conditions in influencing the adult diabetes experience is quite complex, as shown by life course epidemiologists (Harris, 1998; Lawlor et al., 2003). Several researchers have previously detailed the impact of how biological and social factors present in childhood have prevailing effects on health circumstances, such as diabetes and cardiovascular disease, in adulthood (Hattersley and Tooke, 1999; Kuh et al., 1997; Lawlor et al., 2002). Biological precursors of diseases can occur as early as *in utero*, as factors such as mother's nutrition play an instrumental role in the genetic structure of an infant's life (Wadsworth, 1997). Nutritional deprivation during infancy and childhood can also be damaging, causing the body to permanently "program" detrimental alterations, such as insulin resistance and other diabetes-related complications (Hales and Barker, 2001; Lawlor et al., 2003).

Unfortunately, research addressing the impact of childhood influences on diabetes in adulthood is sparse. However, several studies on British cohorts have managed to unmask some of the associations of adult-onset diabetes to both biological and social circumstances from infancy to later life (Eriksson et al, 2003; Lawlor et al, 2002; Lithell et al, 1996; McKeigue, 1997). Among this literature, the intrauterine environment is the earliest possible time individuals can become susceptible to harmful and enduring risk factors for diabetes. Aside from the possible role genetics play in the onset of diabetes in later life, nutritional deprivation *in utero* can lead to what is known as the "thrifty phenotype" hypothesis (Allen and Cheer, 1996; McKeigue, 1997), which contends that this undernourishment leads to a "thinness", or low birth weight, and subsequently type 2 diabetes at older ages. This concept has been extended further by Eriksson and colleagues, who found in a Helsinki cohort that the rate of growth in the first three months of life, not the actual birth weight itself, is a better predictor of diabetes in adulthood (2003). In these subjects, slow growth in the earliest stages of infancy is highly related to the onset of diabetes and coronary heart disease.

On the other hand, rapid weight gain in early life proves to be detrimental as well, as body mass can also play an important role as early as infancy. Within the first two years of life, rapid weight gain (measured by BMI) is also a significant indicator of diabetes in adulthood (Eriksson et al, 2003). Poor nutrition *in utero* is not the only nutritional-based risk factor of diabetes in childhood. Regardless of birth weight, children who experience rapid gains in weight are more likely to be the offspring of mothers with higher than average scores on body mass indices (Ericksson et al, 2003). This correlation truly speaks to how risk factors that are often considered to be behavioral or lifestyle-related are directly passed down to children before they even have contact with their environments.

The effects of negative environmental factors on childhood and subsequent adult health are better documented (Blackwell et al, 2001; Elo and Preston, 1992; Hayward and Gorman, 2004; Wadsworth, 1997). Perhaps one of the most salient risk factors is family socioeconomic status. In a study using the British Women's Heart and Health Study, researchers found an independent relationship between women who grew up in a lower (e.g. manual) social class and the presence of insulin resistance and obesity. Upward mobility throughout the life course did not buffer social conditions experienced in childhood, as the significant association between insulin resistance and being from a manual class at childhood persists among those who were able to move out of this social class (Lawlor et al, 2002).

Whereas childhood circumstances influence the onset of diabetes, conditions in adulthood impact the disease process through its ability to temper the potential scarring effects that may have occurred in early life. In general, SES is negatively associated with the presence of diabetes; however, this relationship has undergone a social change. For instance, in earlier populations, individuals with higher educational, financial, and overall social status had higher rates of diabetes prevalence (Rewers and Hamman, 2003). This represents a picture that is quite different from that of today's diabetes sufferers. The advancement of medical care as well as the attainment of better health and dietary knowledge among the upper class may be responsible for this previous pattern of disease prevalence. Now, diabetes patients are disproportionately individuals who have less than a high school diploma and low levels of financial achievement (Rewers and Hamman, 2003).

DATA AND MEASURES

The 1998 wave of the biannual Health and Retirement Study (HRS) is used to model the associations between childhood conditions and adult diabetes. The 1998 wave of the HRS includes persons aged 51 years of age and older (and their spouses) and is nationally representative of the American population for those ages. Most importantly, for this analysis, the

1998 wave of the HRS included a battery of items asking respondents about their socioeconomic conditions and health experiences when they were 16 years of age. To our knowledge, no other nationally representative survey of population health contains such an array of information about childhood conditions. The HRS also collected information about adult socioeconomic achievement processes and health behaviors, which permits the investigation of the ways in which childhood conditions are associated with diabetes in the older population. Our final analysis is based on 17,412 (unweighted) age-eligible, non-Hispanic respondents in 1998 (14,719 whites and 2,693 blacks). Appropriate individual-level sample weights were utilized to re-create representative subgroups of the U.S. population.

Dependent Variables

Our analyses are based on a diabetes severity scale constructed by the authors. Diabetes prevalence is measured in terms of a 3-category severity scale of whether respondents reported no diagnosis of diabetes at the time of interview (based on self-reports), diabetes without any major functional limitations, or diabetes with a major functional limitation. To assess functional limitations, respondents were asked to assess if they had any difficulty engaging in the following activities: bathing, dressing, eating, getting in and out of bed, or walking across a room. In this paper, we do not distinguish between the ADLs and use a conservative method for analyzing impairments, meaning that if a person with diabetes has difficulty with any of the preceding ADLs, then he or she is classified as having a functional limitation. Because the presence of functional limitations among respondents may be unrelated to diabetes, we also created and examined alternative definitions of diabetes severity involving co-morbidity with CVD and diabetes symptoms (e.g. vision problems, swelling of feet). These findings are not discussed in detail in this paper.

Independent Variables

In addition to key demographic variables used in this analysis (e.g. race, age, marital status, and education), other key covariates characterizing both childhood and adult social circumstances are evaluated as well. *Origin of birth* indicates whether a respondent is born in the South. This variable builds upon previous work linking region of birth to health outcomes and subsequent mortality in adulthood (Fang et al, 1996; Kington et al, 1998; Schneider et al, 1997; Vagero, 1997). Past literature has documented poorer health and higher mortality rates among Southern-born blacks (Greenberg and Schneider, 1992; Mancuso and Redmond, 1975; Vagero, 1997), although this association has been shown to decrease if these individuals migrate to other areas (Kington et al, 1998). To assess *childhood health*, respondents were asked to rate their health from birth until age 16, using a five-point scale ranging from poor to excellent.. Financial difficulties during childhood are measured by indicating whether respondents could recall if their families were financially poor (*SES*). We acknowledge that these questions required individuals to recall social circumstances from birth to adolescence (age 16), which could lead to reliability concerns regarding retrospective data. For instance, retrospective responses can also lead to a conservative estimate of childhood SES effects and a subsequent overrepresentation of the most severe cases.

While biological risk factors experienced in childhood tend to dominate the public health-based diabetes literature, lifestyle and behavioral determinants of diabetes, particularly in adulthood, are equally important to our understanding of diabetes from a life course perspective.

Abstinence from alcohol consumption or heavy drinking (Hu et al, 2001; Valmadrid et al, 1999; Wei et al, 2000), for instance, has been shown to increase the risk of diabetes incidence. *Alcohol consumption* is divided into non-drinkers, moderate drinkers, and heavy drinkers. Non-drinkers are those who stated that they do not consume alcohol at anytime. Moderate drinkers consume less than three drinks (on the days they drink), while those who are designated heavy drinkers consume three or more drinks a day.

Smoking, both in the present as well as in the past, has been linked to type 2 diabetes. Several reports contend that smoking has adverse effects on diabetes (Haire-Joshu, 1999; Kawakami et al, 1997), often operating through increased upper body fat distribution (Chan et al, 1994) and other chronic conditions, such as cardiovascular disease (Sowers, 1998; Wei et al, 1996; Yudkin, 1993). However, a few studies have shown that individuals without diabetes are more likely to smoke (Cowie et al, 1993), which is possibly due to cigarette smoke's ability to halt the rise in glycated hemoglobin (Meigs et al, 1996). Our analysis of smoking classifies respondents into those who never smoke, those who were previous smokers but not at the present time, and individuals who are currently smoking.

Another important health risk factor is excess weight. For this study, respondents' body mass indices (*BMI*) were calculated from reports of height and body weight. Adopting the BMI standard of the World Health Organization (WHO), I classify a BMI of less than 18.5 as underweight or undernourished. Individuals of normal weight are classified as having a BMI between 18.50 and 24.99. Overweight individuals have BMIs between 25.00 and 29.99. Respondents with a BMI over 30.00 are classified as obese (Himes, 2000; WHO, 2003).

Respondents also provided measures of *exercise and physical activity levels*. Individuals were asked if they had participated in any vigorous physical activity three or more times a week in the past year. In the HRS, physical activity was defined as participating in sporting activities, heavy household chores, or a physically challenging job. Low levels of physical activity are associated with higher insulin levels and type 2 diabetes (Trovati et al, 1984; Rewers and Hamman, 2003).

Medicare coverage is the primary variable used to measure insurance activity. Also, any *additional insurance* is assessed as well, in order to obtain an overall view of respondents' insurance coverage, which may include any employer-provided health insurance. Medicare coverage, by law, supplies people suffering from diabetes with blood glucose monitoring supplies, insulin pumps, and diabetes educational support. However, Medicare does not cover insulin, syringes, and oral medication to many older Americans (ADA, 2003). Therefore, the presence of additional insurance is important for these extra services; older individuals with diabetes have a harder time finding a reasonably priced insurance policy (ADA, 2003).

ANALYSIS

As stated earlier, diabetes prevalence is measured with a 3-category variable that considers functional limitations. For the analyses, the 3-category variable is comprised of no reported diabetes, diabetes without any major functional limitations, and diabetes with functional limitations. While the ADL-diabetes measurement model captures severity at a particular time point, it also serves as an indirect indicator of "age at onset," since diabetics with functional problems are likely to have had the condition longer compared to diabetics with no functional problems, all else being equal. In the context of our statistical models, we thus expect to see a gradient where childhood conditions are most strongly tied to odds of diabetes with functional limitations.

Nested multinomial logistic regression models are estimated, where we begin by assessing the associations between the childhood conditions and the odds of diabetes, controlling for age, race/ethnicity, marital status, and childhood conditions (model 1). We then introduce measures indicating possible mediating pathways. For example, we introduce obesity, smoking, alcohol abuse, and other lifestyle factors into the baseline model and evaluate how the associations between the childhood measures and diabetes are altered across the two models (model 2). This model building exercise is also used to evaluate whether household income and total wealth in adulthood mediate the effects of childhood conditions (model 3). The final model adds insurance coverage to examine its effects on adult diabetes.

RESULTS

Figures 1 and 2 provide a graphical interpretation of the age profiles of diabetes prevalence by sex. The severity of diabetes is heavily placed upon women. Females not only experience a higher prevalence of diabetes at each age group, but the women in our sample also suffer from diabetes with at least one functional limitation at greater proportions than their male counterparts. Starting around age 81, over half of the female diabetic respondents have functional limitations; this number increases at the highest ages. About half of the diabetic men, on the other hand, have functional problems between the ages of 81 to 90. The disparities in diabetes prevalence in terms of functional limitations between males and females concurs with past findings stating that women are more likely to suffer from diabetes (Best, 2004) as well as more likely to experience difficulties in physical functioning at the older ages. These findings are also indicative of more women surviving to the highest ages.

INSERT FIGURES 1 AND 2 ABOUT HERE

A more detailed breakdown of the graphical interpretations of the age by sex profiles can be found in Table 1, which illustrates the means and percentages for the socio-demographic predictors in the analyses. As expected, those who suffer from more severe forms of diabetes, regardless of gender, are older respondents. Southern-born respondents report a higher percentage of having diabetes, particularly with functional limitations. For childhood circumstances, adverse childhood outcomes are slightly more pronounced in women. However, we see a fairly substantial percentage of our sample reporting poor family SES in childhood, regardless of gender.

Perhaps the most interesting findings in Table 1 are the breakdown of percentages regarding BMI. A noticeable percentage of female respondents who have diabetes with an impairment are classified as underweight (11.4%), indicating a possible frailty component spanning the life course of these individuals stricken with diabetes. Past research has suggested that people who were underweight as a child and as a teenager, two crucial points of human development, had a greater risk of developing diabetes in adulthood (Holbrook, Barrett-Connor, and Wingard, 1989). Being underweight as an adult may signal a lifetime of undernourishment as well. In a study of diabetes-related complications, researchers found that both underweight and obese individuals had a greater likelihood of suffering from severe forms of diabetes (Klein, Klein, and Moss, 1997). After controlling for a host of potential risk factors, the authors found that being underweight was significantly related to a higher risk of experiencing diabetic retinopathy, lower-extremity amputations, and premature mortality due to ischemic heart disease—all signals of severe forms of diabetes (1997).

Percentages for adult SES measures, for the most part, illustrate that individuals with higher educational and economic attainment tend to not have diabetes. There is over a $25,000 difference in the total household income of those who do not have diabetes and those who have diabetes with a functional limitation among both males and females. This discrepancy could be a result of age differences between the groups, lower socioeconomic attainment among the two diabetic groups, or a loss of earnings due to the inability to engage in everyday activities such as work. Previous data have shown that people diagnosed with diabetes are likely to miss more days from work than those without diabetes (Songer, 2003). Therefore, it is likely that many individuals with diabetes have experienced a significant loss of wages which, assessed over the course of an individual's life, could amount to lower total wealth in later life.

INSERT TABLE 1 ABOUT HERE

Table 2 reports the results of the nested multinomial logistic regression models for males. Among the demographic models, race is an important factor in determining whether or not an individual is diagnosed with diabetes. The full model shows that blacks are approximately 53% more likely to have diabetes than whites. Race/ethnicity has little impact on the odds of having diabetes with functional impairment. The odds of having a severe form of diabetes is significantly higher for blacks in model 1, yet this effect goes away after adult characteristics are considered. Education remains a key predictor of diabetes as well as diabetes severity in men. The effects of high levels of education on the ability to lower individuals' chances of suffering from diabetes remains persistent throughout the models, even after controlling for adult SES achievement processes and lifestyle. Still, obesity, alcohol consumption, and adult achievement processes are important conduits through which education influences the odds of diabetes.

The odds of having diabetes, especially in the severe form, are significantly increased among men who were born in the South. The odds of Southern-born men having diabetes in adulthood is 1.49, meaning that these men are 49% more likely than their Northern counterparts to have diabetes with functional limitations. Although being born in the South has a direct effect on diabetes severity, it appears that Southern birth operates through obesity as well.

The addition of several lifestyle factors to the model provides further insight into the association between childhood and adulthood circumstances and diabetes-related functional limitations. Childhood health problems appear to have an indirect effect on diabetes and possible diabetes-related impairments. Poor health in childhood is significantly related to severe forms of diabetes. In model 1, negative child health increases the odds of having diabetes with ADL impairment (1.54).

Furthermore, we find strong associations between lifestyle factors and diabetes. Respondents who drink, regardless of their consumption level, are less likely to have diabetes or to suffer from diabetes with an ADL impairment. We would like to note that drinking is coded as the number of drinks per day *on the days in which you drink*. Therefore, we may not capture the heterogeneity of drinkers in our population (e.g. those who may report drinking over 3 drinks per day, but do not drink at this level on a regular basis). Not engaging in vigorous exercise activity is consistently a strong predictor of diabetes among our sample of men; as expected, men who are suffering from diabetes with functional limitations are significantly more likely to not participate in vigorous exercise.

The odds of having diabetes, with or without functional limitations, are also linked to adult SES and lifestyle factors. Respondents reporting low household income are more likely to experience diabetes with a functional limitation. Low household wealth is also consistently related to diabetes as well. Insurance coverage proves to be crucial in understanding the effects of childhood experiences on adult diabetes. The odds of experiencing diabetes only (OR=1.38) as well as with impairments (OR=1.39) are elevated for men who are Medicare recipients. However, the presence of additional insurance coverage beyond government assistance significantly affects those who experience severe forms of diabetes. Men who have additional insurance policies are approximately 41% less likely to suffer from diabetes with a functional impairment.

INSERT TABLE 2 ABOUT HERE

Table 3 illustrates the results for females. Similar to men, non-Hispanic black women are more likely to report diabetes, both with and without functional limitations. This association is strong and persistent throughout all models. This result parallels previous findings in the literature regarding women's greater likelihood of suffering from chronic conditions (Link and Phelan, 1995) such as diabetes (Best, 2004) than their male counterparts. Among other demographic covariates, lower levels of education are predictive of adult diabetes for women. This education effect diminishes among the more severe diabetes cases once adult characteristics are added. The odds of diabetes with functional limitations are significantly higher for women who are born in the South. For these Southern-born females, the odds of having diabetes with functional limitations are 1.40 in the full model. This effect remains, even after controlling for all childhood and adult factors.

Negative health problems and poor financial situations in childhood also plague the lives of women in our sample. Poor childhood health has a strong direct effect in the analyses; women reporting ill health during childhood were significantly more likely to have diabetes with at least one functional limitation in adulthood. Interestingly, poor childhood health also decreases the chances of moderate drinking among females. Likewise, poor family SES has a direct, significant effect on the odds of women experiencing diabetes with a functional limitation in later life.

Women's odds of having diabetes are also heightened by experiences in adulthood, such as adult SES and lifestyle/behavioral factors. As expected, body mass plays an important role in the prevalence of diabetes for females. Overweight and obese women are significantly more likely to have diabetes, regardless of its severity, with the odds of having diabetes for obese women being over twice the odds of their normal weight counterparts. As discussed earlier in the literature review, underweight women have a consistently greater likelihood of suffering from severe forms of diabetes (e.g. functional limitations).

Past research indicates the significant correlation between abstaining from alcohol and the presence of a host of chronic conditions (LaCroix et al, 1993; McElduff & Dobson, 1997). In this analysis, the odds of both moderate drinkers (e.g. three drinks or less on the days when alcohol is consumed) *and* heavy drinkers (three or more drinks) for having diabetes is significantly lower than the odds of non-drinkers, thus providing additional evidence for the benefits of moderate drinking on health conditions.

Socioeconomic status measures also provide further insight into the effects of adult characteristics on diabetes and subsequent functional limitations. Unlike their male counterparts, household wealth is not a significant predictor of diabetes. However, household income is negatively related to diabetes throughout all models. Women living in households with larger annual incomes are less likely to have diabetes, with or without ADL limitations. Also, the odds of having diabetes with impairment increased with the usage of Medicare coverage as well as the lack of additional private insurance. Women who are utilizing Medicare are 65% more likely to report diabetes with at least one functional limitation. Yet, for those who have access to additional insurance the odds of having diabetes with functional limitations is 0.66 the odds of those who do not have other methods of coverage.

CONCLUSIONS

This paper illustrates significant effects for our nationally represented population. Diabetes prevalence in today's older population is strongly tied to conditions experienced decades earlier in life. Specifically, we found substantial evidence that adult diabetes is significantly related to early life education, SES, health problems, and Southern birth. For the most part, some evidence that links early life conditions and adult diabetes are biological in nature, meaning that early life circumstances have direct effects on adult outcomes such as diabetes. For example, among men, we found that the odds of having diabetes, especially with limitations, are significantly increased by low education and Southern birth. Poor family SES appears to increase the odds of diabetes once adult lifestyle and SES measures are considered. For women, early life conditions show more prominent direct effects. Among females, the odds of diabetes are significantly higher for persons who have low education, Southern place of birth, negative childhood health problems, and poor family SES in early life.

Also, our analyses display modest evidence suggesting that early life circumstances influence adult diabetes via other causal pathways. The effect of education for both women and men diminishes, albeit slightly, in the presence of higher body mass and alcohol consumption. In sum, adult characteristics, such as the lack of vigorous exercise, obesity, and SES, all influence the odds of diabetes, combining to create an additive influence over the life course. Thus, the odds of having diabetes with or without ADL limitations hinges on social conditions spanning many decades of life—not to any one particular part of the life course.

Even though the HRS offers advantages in examining childhood effects on adult diabetes, we nonetheless are cognizant of methodological pitfalls in our analysis. Childhood information, for example, is necessarily retrospective and thus subject to recall error. Also, we rely on self-reported diabetes responses to measure the outcome of interest. The presence of diabetes is identified based on a respondent's report that a "doctor has ever told them" that they have diabetes or high blood sugar. Underreporting is thus likely and we expect that those persons less likely to visit a doctor will be most likely to under-report. Lastly, because we are analyzing older individuals, selection issues regarding who survives to age eligibility are of concern.

Furthermore, the use of ADLs as a proxy for the level of severity for diabetes in adulthood may also prove to be problematic, for functional limitations assessed through general ADL measures may not be a result, or precursor, of the prevalence or severity of diabetes. To combat this problem, we devised alternative definitions of diabetes severity. One alternative approach was to identify people with diabetes who also have lower extremity and visual limitations. Therefore, instead of defining severity in terms of the presence of ADL limitations, severity was defined based on whether respondents reported, in addition to diabetes, problems with vision, swelling in the feet, kidney problems, or taking oral medication. Another approach, as mentioned earlier, involved defining severity in terms of whether or not respondents also reported cardiovascular disease as well (e.g. stroke or heart attack/disease). In all, childhood effects remained significant throughout the models.

There are several possible methods of defining and evaluating diabetes severity in our models. However, regardless of its definition, measuring diabetes severity must include in-depth analysis of the integration of disease incidence, mortality, and functional problems in order to clearly understand how early life conditions shape healthy life expectancy. Since our data are cross-sectional, we lack the ability to measure disease incidence, which is essential to understanding the timing of disease experiences and mortality selection processes. The integration of these processes may become more defined once we are able to better evaluate significant predictors of diabetes. For instance, in order to fully examine the role of obesity as a conduit for effects of social conditions, we would need more information regarding weight change over the life span. Also, as in most of the scientific literature, no direct observation of the "stress" (e.g. behavioral influences, inflammation and other biological factors) biomedical pathway is achieved with this analysis. As these caveats are adequately addressed, we will have more insight into the numerous causal pathways in which early life conditions affect adult diabetes.

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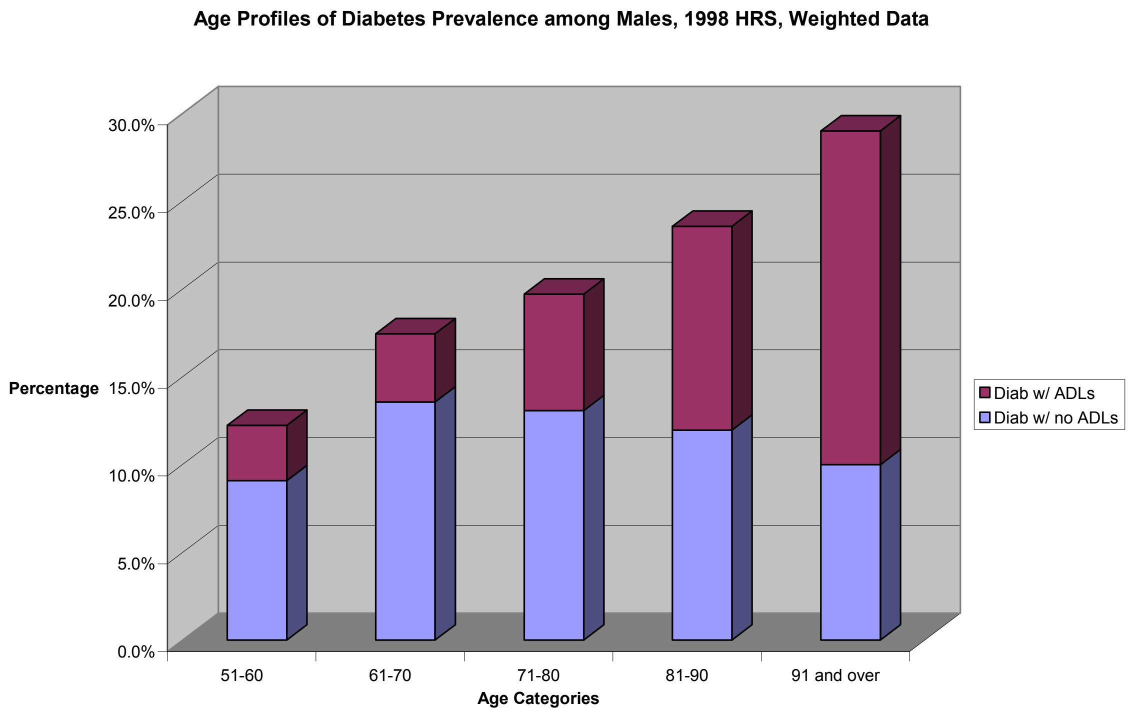
Figure 1



Age Profiles of Diabetes Prevalence among Males, 1998 HRS, Weighted Data
Percentage
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
51-60
61-70
71-80
81-90
91 and over
Age Categories
Diab w/ ADLs
Diab w/ no ADLs

Figure 2

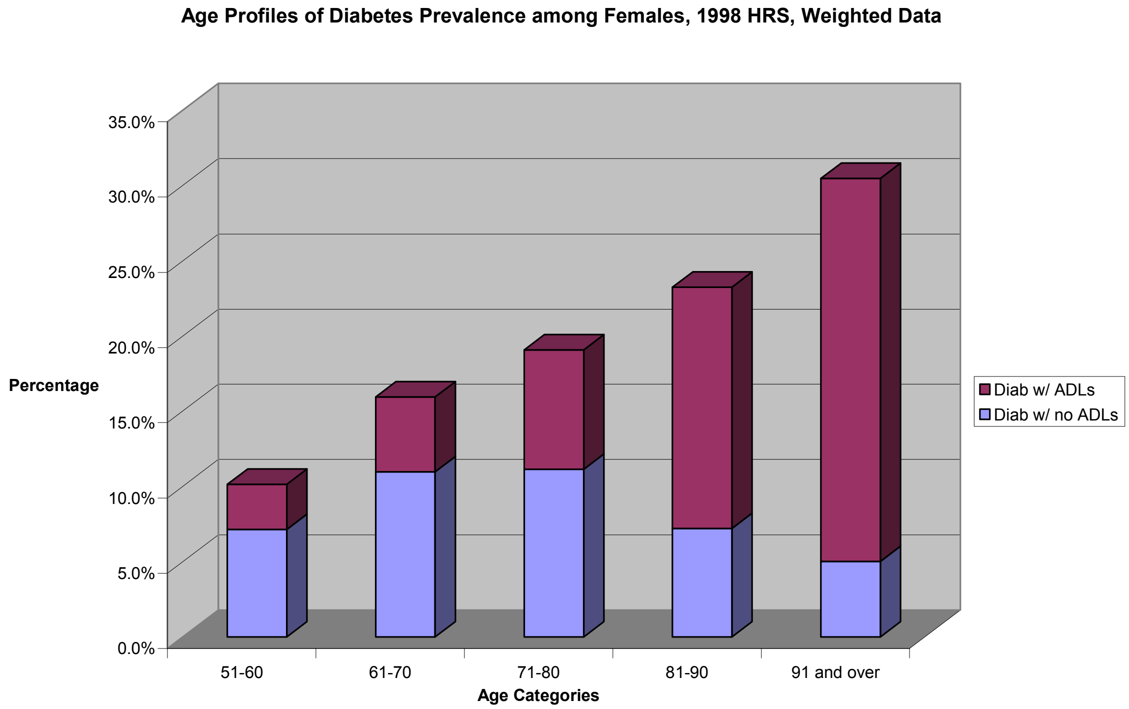

Age Profiles of Diabetes Prevalence among Females, 1998 HRS, Weighted Data
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Percentage
51-60
61-70
71-80
81-90
91 and over
Age Categories
Diab w/ ADLs
Diab w/ no ADLs

Table 1. Means and Percentages for Demographic and Social Variables by Diabetes and Functioning Status, The 1998 Health and Retirement Study, Ages 51 and older, Weighted Data

	FEMALES			MALES		
	No Diabetes (N=8271)	Diabetes No ADL (N=982)	Diabetes w/ ADL (N=719)	No Diabetes (N=6096)	Diabetes No ADL (N=940)	Diabetes w/ ADL (N=404)
Demographic						
Age, (avg, in years)	66	67.5	73.9	64.6	66.6	70.0
Education (avg, in years)	11.0	10.4	10.3	11.9	11.3	10.3
Nonhispanic Black	9.0	19.5	20.5	8.2	12.8	16
Married	55.6	47.5	35.8	76.7	75.3	70.1
Birth Origin						
Born in the South	31.8	39.5	47.3	30.6	33.2	45.8
Childhood Factors						
Negative child health	6.0	7.6	10.4	5.0	5.7	8.8
Poor family SES	27.4	32.8	43.0	32.0	31.8	40.2
Lifestyle						
Non-drinker	72.6	90.0	93.5	55.2	72.9	79.1
Less than 3 drinks	24.1	8.2	5.6	31.3	18.6	13.9
More than 3 drinks	3.1	1.4	0.8	13.1	8.3	6.9
Never Smoke	55.3	59.4	68.8	47.3	55.8	53.8
Ever smoke, but not now	12.5	15.3	10.6	22.2	21.9	17.9
Current Smoker	16.4	13.9	10.8	18.8	11.6	20.2

(continued)

(Table 1, continued)

	FEMALES			MALES		
	No Diabetes (N=8253)	Diabetes No ADL (N=979)	Diabetes w/ ADL (N=843)	No Diabetes (N=6142)	Diabetes No ADL (N=935)	Diabetes w/ ADL (N=457)
Lifestyle, *cont'd*						
Underweight (BMI<18.5)	5.0	2.9	11.4	0.8	0.5	3.2

Normal weight (BMI 18.6-24.9)	43.4	24.0	28.0	30.9	20.8	30.6
Overweight (BMI 25.0-29.9)	32.2	32.4	25.8	47.8	44.7	36.8
Obese (BMI>29.9)	19.4	40.7	34.8	20.5	34.1	29.4
Vigorous Exercise	43.2	33.6	8.8	52.4	42.2	11.4
Economic						
Total Income (in $1,000s)	$49,380	$31,273	$22,058	$60,170	$51,226	$33,785
Total Household Wealth ($1,000s)						
Negative (<0)	2.1	3.9	6.1	2.1	2.7	6.3
Low (0 to 30.2)	16.8	27.9	35.3	12.8	16.3	28.2
Medium Low (30.3 to 96.5)	20.3	25.6	26.5	19.4	24.0	22.8
Medium High (96.6 to 230)	25.5	23.0	17.2	26.1	25.7	22.7
High (> 230)	35.4	19.6	15.0	39.6	31.3	20.0
Insurance						
Medicare Coverage	50.0	61.0	79.6	46.5	59.1	70.8
Additional Insurance	53.9	43.4	25.9	61.1	56.0	34.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 1. KEY FACTORS ASSOCIATED WITH DIABETES BURDEN AMONG MALES, HEALTH AND RETIREMENT STUDY, 1998, Weighted Data*

	MODEL 1		MODEL 2		MODEL 3		MODEL 4	
	Diabetes w/ No ADLs	Diabetes w/ ADLs	Diabetes w/ No ADLs	Diabetes w/ ADLs	Diabetes w/ No ADLs	Diabetes w/ ADLs	Diabetes w/ No ADLs	Diabetes w/ ADLs
Intercept	**-11.441** ***	0.432	**-11.497** ***	-0.066	**-11.672** ***	1.303	**-9.787** ***	**4.306** †
Demographic & Childhood Characteristics								
NH Black	**0.492** ***	**0.381** *	**0.451** ***	0.208	**0.424** ***	0.159	**0.428** ***	0.137
Age	**0.275** ***	**-0.112** †	**0.275** ***	-0.080	**0.285** ***	**-0.114** †	**0.234** ***	**-0.190** *
Age Squared	**-0.002** ***	**0.001** **	**-0.002** ***	**0.001** *	**-0.002** ***	**0.001** *	**-0.002** ***	**0.001** **
Married	-0.060	-0.145	-0.103	-0.109	-0.088	-0.030	-0.088	-0.007
Education	**-0.021** *	**-0.097** ***	-0.013	**-0.079** ***	-0.010	**-0.067** ***	-0.010	**-0.061** ***
Born in the South	0.037	**0.523** ***	-0.008	**0.436** ***	-0.017	**0.418** ***	-0.018	**0.402** **
Negative Child Health	0.086	**0.432** *	0.029	0.318	0.015	0.271	0.016	0.249
Poor family SES	-0.130	0.108	**-0.190** *	0.074	**-0.197** *	0.050	**-0.203** *	0.034
Lifestyle Factors								
non drinker (reference)								
Three drinks or less			**-0.699** ***	**-0.830** ***	**-0.673** ***	**-0.757** ***	**-0.669** ***	**-0.738** ***
Three or more drinks			**-0.573** ***	**-0.727** ***	**-0.562** ***	**-0.695** ***	**-0.558** ***	**-0.680** **
Non smoker (reference)								
Ever smoke, but not now			-0.021	-0.008	-0.029	-0.031	-0.066	-0.083
Current Smoker			**-0.410** ***	0.246	**-0.429** ***	0.183	**-0.441** ***	0.145
Normal Weight (reference)								
Underweight			-0.333	**0.598** †	-0.352	0.558	-0.342	0.546
Overweight			**0.368** ***	-0.002	**0.367** ***	0.011	**0.367** ***	0.019
Obese			**0.925** ***	**0.607** ***	**0.921** ***	**0.633** ***	**0.923** ***	**0.642** ***
Exercise activity			**-0.305** ***	**-1.895** ***	**-0.291** ***	**-1.875** ***	**-0.284** ***	**-1.841** ***

SES Measures								
Household Income					0.000	**0.0 (neg)** ***	0.000	**0.0(neg)** **
Household Wealth					**0.0 (neg)** *	**0.000 †**	**0.0(neg)** *	0.000
Insurance Measures								
Medicare Coverage							**0.325** **	**0.332 †**
Additional Insurance							0.036	**-0.528** ***
Likelihood Ratio	2602.93		6244.2		7401.98		7371.62	

*Note: † p<.10; * p<.05; **p<.01; ***p<.001 (two-tailed tests)
Model specification: Model 1 includes race, age, education, and childhood characteristics; Model 2 adds lifestyle factors; Model 3 adds SES measures; Model 4 adds insurance coverage

*Reference Category is individuals without diabetes

TABLE 2. KEY FACTORS ASSOCIATED WITH DIABETES SEVERITY AMONG FEMALES, HEALTH AND RETIREMENT STUDY, 1998, Weighted Data*

	MODEL 1		MODEL 2		MODEL 3		MODEL 4	
	Diabetes w/ No ADLs	Diabetes w/ ADLs	Diabetes w/ No ADLs	Diabetes w/ ADLs	Diabetes w/ No ADLs	Diabetes w/ ADLs	Diabetes w/ No ADLs	Diabetes w/ ADLs
Intercept	**-12.095** ***	**-3.665** *	**-12.459** ***	**-4.978** **	**-11.523** ***	**-3.412** *	**-10.695** ***	0.656
Demographic & Childhood Characteristics								
NH Black	**0.920** ***	**0.716** ***	**0.657** ***	**0.441** ***	**0.594** ***	**0.324** **	**0.587** ***	**0.311** *
Age	**0.287** ***	-0.034	**0.280** ***	0.003	**0.264** ***	-0.022	**0.245** ***	**-0.127** *
Age Squared	**-0.002** ***	**0.001** *	**-0.002** ***	0.000	**-0.002** ***	**0.001** †	**-0.002** ***	**0.001** ***
Married	**-0.134** *	-0.090	-0.077	-0.041	-0.010	0.069	-0.007	0.061
Education	**-0.031** **	**-0.031** *	**-0.024** *	-0.015	**-0.021** *	-0.009	**-0.021** *	-0.007
Born in the South	0.06	**0.452** ***	-0.014	**0.390** ***	-0.028	**0.366** ***	-0.034	**0.337** ***
Negative Child Health	0.165	**0.460** **	0.176	**0.395** **	0.139	**0.328** *	0.131	**0.309** *
Poor family SES	0.117	**0.538** ***	0.042	**0.479** ***	0.018	**0.439** ***	0.016	**0.439** ***
Lifestyle Factors								
non drinker (reference)								
Three drinks or less			**-1.060** ***	**-1.177** ***	**-0.992** ***	**-1.060** ***	**-0.989** ***	**-1.061** ***
Three or more drinks			**-0.763** **	**-0.822** †	**-0.723** *	**-0.744** †	**-0.722** *	**-0.741** †
Non smoker (reference)								
Ever smoke, but not now			**0.333** **	**0.257** †	**0.330** **	**0.243** †	**0.320** **	0.197
Current Smoker			0.100	0.014	0.046	-0.083	0.036	-0.114
Normal Weight (reference)								
Underweight			-0.067	**0.913** ***	-0.077	**0.901** ***	-0.079	**0.890** ***
Overweight			**0.506** ***	**0.261** *	**0.480** ***	**0.234** *	**0.481** ***	**0.233** *
Obese			**1.198** ***	**1.140** ***	**1.155** ***	**1.081** ***	**1.154** ***	**1.074** ***
Exercise activity			**-0.215** **	**-1.667** ***	**-0.200** **	**-1.633** ***	**-0.196** *	**-1.614** ***
SES Measures								
Household Income					**0.0(neg.)** ***	**0.0(neg.)** ***	**0.0(neg.)** **	**0.0(neg.)** ***

Household Wealth					0.0(neg.)	0.0(neg.)	0.0(neg.)	0.0(neg.)
Insurance Measures								
Medicare Coverage							0.085	**0.502** **
Additional Insurance							-0.124	**-0.422** ***
Likelihood Ratio	3253.54		7296.03		9328.36		9296.87	

*Note: † p<.10; * p<.05; **p<.01; ***p<.001 (two-tailed tests)
Model specification: Model 1 includes race, age, education, and childhood characteristics; Model 2 adds lifestyle factors; Model 3 adds SES measures; Model 4 adds insurance coverage

*Reference Category is individuals without diabetes