# Health-related Quality of Life among North Carolina Adults with Diabetes Mellitus

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## Abstract

***Background:*** *Previous research on health-related quality of life among people with diabetes used subgroups of diabetics who were not representative of a larger population and long questionnaires that are not practical for surveillance.*

***Objective:*** *To identify people with diabetes in North Carolina who are at risk for a poor quality of life based on demographic and medical characteristics using surveillance data.*

***Methods:*** *Analysis of Behavior Risk Factor Surveillance System data from North Carolina, years 1998 through 2001, to examine associations between demographic and medical characteristics among people with diabetes and four different health-related quality-of-life outcome indicators, including general health status, physically unhealthy, mentally unhealthy, and functionally limited days. The demographic and medical characteristics studied were age, sex, ethnicity, marital status, education, income, health insurance, obesity, duration of diabetes, and insulin use. These same characteristics were also tested for independent associations with functionally limited days.*

***Results:*** *Ethnicity and gender were not associated with any of the quality-of-life measures among people with diabetes. Those younger than age 65 were more likely to have mentally unhealthy days, but age was not related to the other outcomes. A household income of less than $20,000 was related to poor general health and greater than one week each of physically unhealthy, mentally unhealthy, and functionally limited days. Subjects with a high school education or less, no health insurance, and those not married or cohabiting had at least one poor health-related quality-of-life outcome. Obesity, duration of diabetes of ten or more years, and insulin use were also associated with at least one poor quality-of-life outcome. The only characteristic that was independently related to the number of functionally limited days was income. People with diabetes of working age and with low incomes were more likely to have greater than one week of functionally limited days (aOR = 10.3; 95% CI = 4.9-21.5).*

***Conclusions:*** *Our results suggest an association between poor quality of life and low-socioeconomic status among people with diabetes in North Carolina.*


## Background

This study's objective was to determine if there are demographic and/or medical characteristics that can identify North Carolinians with diabetes who are at risk for a poor health-related quality of life. Using general quality-of-life measures, people with diabetes consistently rate their health status worse than those without diabetes.[1-8] Not only is quality of life an important health outcome as a measure of well-being, but people's subjective perceptions of health are also related to more conventional health outcomes such as mortality and healthcare use.[9-11] As we consider interventions to improve health-related quality of life among people with diabetes, information about which subgroups have a poor quality of life may help us target our resources and interventions more effectively.

Previous research among people with diabetes has helped identify possible demographic and medical characteristics related to physical and mental quality of life. Other investigators have associated age, sex, marital status, education, income, and insurance status with health-related quality of life among people with diabetes.[8,12-19] Many researchers have failed to observe a relation between ethnicity and quality of life among people

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with diabetes.[12,14,17,20,21] However, research using *Healthy Days** surveillance data among a general population sample found that Hispanics and blacks were more likely to have a poor health-related quality of life compared to whites.[1] Other researchers have associated a number of comorbid diseases, such as obesity,[2] cardiovascular disease,[2,16,22] arthritis,[21,22] chronic lung disease,[22] and depression,[20,21,23,24] with poor quality of life among people with diabetes. Diabetes complications, duration of diabetes, and use of insulin are also related to quality of life in most studies.[7,12-17,20,21,25-30]

Nevertheless, prior studies yield conflicting results and may not be generalizable since almost all used clinic-based populations. The only population-based research on quality of life among people with diabetes in the United States was a study by Glasgow et al. using a marketing sample population.[12] Other population-based studies of people with diabetes were done in Europe, where healthcare entitlement is universal and population characteristics differ significantly from the United States.[2-4,7,8,13-15,23] In the clinic-based studies, most researchers used a select group of patients seen at diabetes clinics,[16,17,20-22,24,25,31-33] patients with specific diabetes complications,[26-29] or patients who participated in clinical trials.[30,34,35]

In addition, previous research has used quality-of-life measures that are time and labor intensive and, therefore, not suitable for tracking large population groups. Currently, the Medical Outcomes Study Short-Form General Health Survey is the most widely used generic measure of health-related quality of life in clinical research.[10] This survey consists of physical, social, and role functioning scales as well as measures of mental health, perceptions of overall health, and pain intensity. Although this instrument is extensively used and reliable, it is impractical to use for population surveillance because of its length. In addition, the scales do not provide the kind of concrete measures of health-related quality of life that policy makers need to calculate the associated economic and social costs.

Asking about quality of life in the Behavioral Risk Factor Surveillance System (BRFSS)[9] allows for the collection of continuous, comparable data on large population groups. Likewise, asking for the number of unhealthy days provides a concrete measure of poor quality of life that can be used to quantify costs, thereby allowing employers, legislators, and health and social welfare agencies to understand better the impact of diabetes mellitus on quality of life.

Researchers have used the *Healthy Days* questions from the BRFSS to compare patients with diabetes mellitus to the general population.[1] However, no study has looked for identifiable subgroups of patients with diabetes who are at risk for poor quality of life as defined by *Healthy Days*. By using a state population-based survey with the *Healthy Days* questions, policy makers can quantify the costs associated with poor health-related quality of life and perform future analyses to track changes.

## Methods

### Design

This cross-sectional study evaluates the associations between multiple demographic and medical characteristics with health-related quality of life among people with diabetes in North Carolina. Our protocol was assessed by the North Carolina Public Health Institutional Review Board and was determined to be exempt from review.

### Sample and Setting

Our sample of people with diabetes in North Carolina was from the BRFSS, a state-based, random-digit-dialed telephone survey of civilian, non-institutionalized adults age 18 and older. Response rates in the North Carolina BRFSS, calculated as the number of completed interviews divided by the number of eligible units, ranged from 56.2% in 2001 to 61.7% in 1998. The final BRFSS data were weighted to adjust for sampling probabilities and non-response rates.[34]

We identified adults with diabetes by "yes" responses to the question, "Have you ever been told by your doctor that you have diabetes?" Females with only a history of gestational diabetes were not included in the analyses. Due to the relatively small number of adults with diabetes per year, we combined data from years 1998-2001 (n = 1,035).

### Measures

Based on our literature review, we included a number of independent variables thought to be related to poor health-related quality of life. The demographic characteristics included age, sex, ethnicity, marital status, education, income, and insurance status. Ethnicity was dichotomized into white and non-Hispanic versus non-white and/or Hispanic (the majority of whom were English-speaking). The medical characteristics included obesity, duration of diabetes, and use of insulin. Due to the survey's limitations, certain medical comorbidities as well as complications of diabetes could not be included in our analyses.

We used *Healthy Days* to measure health-related quality of life. Earlier analyses of the BRFSS core *Healthy Days* questions in representative surveys of adults show these measures to be internally consistent, accurate identifiers of population groups with poor quality of life and concurrently valid when compared with a self-rated health measure for all adults.[9] For example, a Centers for Disease Control and Prevention (CDC) study using national BRFSS data adjusted for age found a "tenfold difference in *unhealthy days* between adults reporting excellent versus poor general health."[9]

Our study examined four separate outcomes: general health rating, physically unhealthy days, mentally unhealthy days, and number of days with functional limitations due to poor physical

* To track health-related quality of life among state populations, the CDC developed a measure called *Healthy Days* for its BRFSS. Using four basic questions, this measure asks about a person's self-rated health and evaluates physical health, mental health, and functional health by assessing the number of unhealthy days in the past month.

**Table 1.**
**Demographic, Social, and Health Characteristics of the Sample of Adults with Diabetes** (Unweighted number: 1,035)

| Characteristic | Unweighted number | Weighted percent |
|---|---|---|
| Sex | | |
| Male | 373 | |
| Female | 662 | 56 |
| Ethnicity | | |
| White, non-Hispanic | 665 | 68 |
| Non-White or Hispanic | 358 | |
| Age | | |
| < 65 | 594 | 60 |
| > 65 | 429 | |
| Marital status | | |
| Married/cohabitating | 470 | 59 |
| Divorced/separated/widowed/single | 561 | |
| Annual income | | |
| < $20,000 | 332 | |
| > $20,000 | 459 | 62 |
| Education | | |
| < high school | 396 | |
| > college | 635 | 61 |
| Health insurance | | |
| Yes | 930 | 89 |
| No | 102 | |
| Obesity | | |
| BMI > 30 kg/m2 | 544 | 56 |
| BMI < 30 kg/m2 | 423 | |
| Duration of Diabetes | | |
| < 10 years | 556 | 61 |
| > 10 years | 359 | |
| Insulin Use | | |
| Yes | 287 | |
| No | 666 | 70 |

BMI=Body Mass Index

or mental health. The questions for each of these outcomes were (1) "Would you say that, in general, your health is excellent, very good, good, fair, or poor?" (2) "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?" (3) "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" and (4) "During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?" We then dichotomized the last three of these outcomes based on our examination of the responses, which suggested seven days as an appropriate cutoff. We postulated that one week of unhealthy days would represent a major impact on both the respondent and, for example, the respondent's employer.

## Results

### *Descriptive Data*

Table 1 shows the characteristics of adults with diabetes in North Carolina as determined by the BRFSS samples from 1998-2001. Using the weighted data, the majority of the sample are female, white, younger than 65 years, currently married or living with a partner, have household incomes greater than $20,000 per year, completed more than a high school education, have health insurance, are obese, were diagnosed with diabetes less than ten years ago, and do not use insulin.

Our study analyzed the four different health-related quality-of-life outcomes asked by the BRFSS among adults who reported a diagnosis of diabetes (see Table 2). Overall, an equal proportion of adults in North Carolina with diabetes rated their health as excellent, very good, or good (49%) compared to those who rated their health as fair or poor (51%). The overall mean for physically unhealthy days was 9.3 per month, for mentally unhealthy days 4.5 per month, and for functionally limited days 5.7 per

**Table 2.**
**Average Scores for Healthy Days Outcomes among North Carolina Adults with Diabetes**

| Measure | Percent or Mean number of days | Median number of days | Percent < 7 days |
|---|---|---|---|
| Self-reported health status: | | | |
| fair or poor | 51% | N/A | N/A |
| excellent, very good, or good | 49% | N/A | N/A |
| Number of days during the past 30 days that physical health was not good | 9.3 | 1.0 | 66 |
| Number of days during the past 30 days that mental health was not good | 4.5 | 0 | 84 |
| Number of days during the past 30 days that poor physical or mental health restricted activities | 5.7 | 0 | 77 |

month. However, the unhealthy days outcomes were all greatly skewed, with the median number for each at zero or one day per month. The majority of the sample (range 66-84%) reported seven or fewer unhealthy days for each unhealthy days outcome (physically unhealthy days, mentally unhealthy days, and functionally limited days).

### *Associations between Demographic and Medical Characteristics with* Healthy Days

Table 3 shows the differences in health-related quality of life by the independent variables of sex, ethnicity, age, marital status, income, education, insurance status, obesity, duration of diabetes, and use of insulin. In this table, the subgroups with an asterisk are significantly different (based on Pearson's chi-square at the $p < 0.01$ level). Of the demographic characteristics, socioeconomic variables were associated with the greatest differences in quality of life. Gender and ethnicity were not associated with any of the dichotomized quality-of-life outcomes. Respondents less than age 65 and not currently married or living with a partner were each associated with more than one week of mentally unhealthy days. However, people with diabetes were significantly more likely to have a poor quality of life on all of the outcomes if they had a lower-household income (all p-values < 0.001). The other two socioeconomic characteristics, education and insurance, were also strongly related to a poor quality of life. Those with less education and those with no health insurance were more likely to have a poor quality of life on three of the four outcomes.

All of the medical characteristics we included showed an

**Table 3.**
**Relationship between *Healthy Days* Outcomes and Demographic, Social, and Health Characteristics**

| | Fair or poor general health | | | > 7 physically unhealthy days | | |
|---|---|---|---|---|---|---|
| **Characteristic** | **N** | **percent** | **p-value** | **N** | **percent** | **p-value** |
| Sex | | | | | | |
| Male | 177 | 48.1 | | 103 | 29.6 | |
| Female | 363 | 54.1 | 0.14 | 240 | 36.9 | 0.06 |
| Ethnicity | | | | | | |
| White, non-Hispanic | 336 | 49.7 | | 229 | 34.6 | |
| Non-white and/or Hispanic | 197 | 54.9 | 0.21 | 109 | 43.6 | 0.96 |
| Age | | | | | | |
| < 65 | 285 | 47.8 | | 186 | 33.4 | |
| > 65 | 251 | 57.2 | 0.02 | 154 | 34.5 | 0.78 |
| Marital status | | | | | | |
| Married/cohabitating | 225 | 47.4 | | 146 | 32.3 | |
| Not married | 314 | 57.4 | 0.01 | 196 | 35.8 | 0.36 |
| Annual income | | | | | | |
| < $20,000 | 241 | 73.4* | | 162 | 52.8* | |
| > $20,000 | 167 | 36.9 | < 0.000 | 96 | 21.4 | < 0.000 |
| Education | | | | | | |
| < high school | 396 | 61.7* | | 256 | 41.2* | |
| > college | 142 | 35.4 | < 0.000 | 86 | 22.5 | < 0 .000 |
| Health insurance | | | | | | |
| Yes | 474 | 49.9 | | 293 | 31.3 | |
| No | 63 | 63.3 | 0.04 | 49 | 51.2* | 0.002 |
| Obesity | | | | | | |
| Yes | 234 | 55.1 | | 147 | 37.0 | |
| No | 274 | 50.0 | 0.20 | 168 | 31.4 | 0.15 |
| Duration of Diabetes | | | | | | |
| < 10 years | 268 | 47.8 | | 158 | 30.1 | |
| > 10 years | 211 | 58.1 | 0.02 | 146 | 40.2 | 0.01 |
| Insulin Use | | | | | | |
| Yes | 184 | 65.1* | | 130 | 45.8* | |
| No | 312 | 46.1 | < 0.000 | 183 | 28.4 | < 0.000 |

* These subgroups are significantly different (based on Pearson's chi-square at the p < 0.01 level)

association with at least one of the *Healthy Days* outcomes. Obesity was associated with more than one week of functionally limited days. A longer duration of diabetes was associated with more physically limited days. Insulin use was associated with a poor general health rating and greater than one week of physically unhealthy days, in addition to more mentally unhealthy and functionally limited days.

We found no strong independent association between most of the socioeconomic and medical characteristics and functionally limited days. The only characteristic that was independently related to the number of functionally limited days was income. Subjects with an annual household income of less than $20,000 were more likely to have greater than one week of functionally limited days ($p < 0.001$). However, due to an interaction between income and age (p=0.002), an income of less than $20,000 showed a stronger association with more than one week of functionally limited days among persons with diabetes who were younger than 65 (aOR=10.3; 95% CI 4.93-21.5) than among those who were 65 and older (aOR=1.9; 95% CI 0.7-5.1).

## Conclusions

In this study, the majority of adults with diabetes in North Carolina rate their health-related quality of life as good and report less than a week of physically unhealthy, mentally unhealthy, and functionally limited days. However, our study also identified subgroups with poor quality of life, based on only a few demographic and medical characteristics. The greatest differences were between socioeconomic groups—those of lower socioeconomic status reported more mentally, physically, and functionally unhealthy days and had a lower general health rating. We found that, of the demographic and medical characteristics studied, an annual household income of less than $20,000 was the only one associated with poor quality of life on all of the outcome questions. People with less education and no health insurance were also strongly disposed to be physically unhealthy and likely to report more functionally limited days. Less education was related to a poor health rating and no health insurance to mentally unhealthy days, while low income was the only characteristic independently associated with greater than one week of functionally limited days, especially among those of working age (younger than 65 years of age). The finding of a significant loss of functional days among people with diabetes who have low incomes should be of importance to policy makers since this reflects the number of days people say that they are unable to work or do their usual activities. Further investigations could determine if it is the type of work (e.g., physical labor)—or poor access to healthcare that is most closely associated with a loss of functional days among low-income people with diabetes.

A strong association between low income and poor health-related quality of life is also consistent with the results of other research. Using the Healthy Days measures, a study among the general population found that people with household incomes below the federal poverty guidelines had the lowest quality of life on all outcomes measures, including being more likely to report fair or poor health, having more physically and mentally unhealthy days, and having more functionally limited days.[1] A comprehensive and representative study by Glasgow et al. of health-related quality of life among people with diabetes in the United States, showed a similar association between lower incomes and worse quality of life for each scale of physical, social, and mental health in the Medical Outcomes Study quality-of-life measure.[12] This study of a national sample of diabetic adults was similar to our North Carolina sample, in terms of age range, gender distribution, and health insurance status. However, in the Glasgow et al. sample only 47% of the subjects had more than a high school education, compared to 61% in our North Carolina sample; and the majority of the Glasgow et al. sample had higher incomes than those in our sample of North Carolinians. Nevertheless, both studies found the same associations between less education and low income with a poor health-related quality of life. In addition to these associations, Glasgow et al. found strong, independent associations between more medical comorbidities and more diabetes complications with poor physical and mental quality of life[12]—associations that our study could not assess because of survey limitations. Future surveillance using the BRFSS should include important predictor variables, such as questions regarding chronic disease diagnoses and diabetes complications, on an annual basis.

Our study is not designed to prove that any of the demographic and medical characteristics are a cause of poor health-related quality of life. Nevertheless, important associations can help identify groups based on these demographic and medical characteristics that are likely to be experiencing a poor quality of life and that need to be targeted for interventions. Some of the variation in quality of life by different demographic groups may reflect differences in interpretation of questions. Furthermore, since the BRFSS excludes households without telephones and the institutionalized, it may possibly exclude a portion of the population with a low-socioeconomic status and under-represent severely impaired adults.

Similar to other research on quality of life among people with diabetes, this study includes only those who have been diagnosed and is not designed to include the estimated 30% of people who have diabetes but are unaware of it.[38] The data collected through the BRFSS also relies on self-report, but researchers have found a high agreement between the self-report and medical report of common medical conditions, including diabetes, both in the elderly and other population groups.[39,40] In addition, the overall response rate for the BRFSS in North Carolina was only 56-60%, which could therefore introduce sampling bias; however, the sample is weighted to adjust for different response rates between demographic groups. Among this sample of people with diabetes, less than 5% refused to answer each question relating to the independent variables and outcomes studied, except for household income, which almost 25% did not report. Although those older than 65 were more likely to refuse to report their income level, the proportion of each *Healthy Days* outcome was not statistically significantly different between those who answered their income-level question

and those who did not. Therefore, we can say that there was no difference in quality of life between responders and non-responders.

The North Carolina Division of Public Health is interested in quality-of-life surveillance for people with diabetes in order to track health disparities and target its resources. Prior research on health-related quality of life among people with diabetes identified likely associated demographic and medical characteristics. However, these studies, done mostly among clinic populations, yielded conflicting results, and many of them used long, detailed, research tools that are not feasible for surveillance research.

The results of our study are strengthened by the use of a random, population-based, annual state survey and the reliability and validity of the quality-of-life outcome measures. Compared to the research measures used in previous studies, *Healthy Days* is a short, policy-relevant quality-of-life measure. By using surveillance data with easy-to-administer questions regarding quality of life, public health professionals can track how well we are meeting the *Healthy People 2010* goals of increasing the quality and years of life.[41] Since the *Healthy Days* outcomes are included in each state's annual Behavior Risk Factor Surveillance System,[9] studies can also be done of subpopulations with other chronic diseases, such as asthma or arthritis, as well as studies that compare quality of life between people with different diseases and in different states. By measuring the number of days where quality of life is limited due to poor health, *Healthy Days* allows policy makers to calculate the associated economic and social cost of poor quality of life. The results of our study provide information that public health practitioners can use to target resources and interventions to those people with diabetes in North Carolina who are most at risk for a poor quality of life. **NCMedJ**

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