Diabetes, Depression, and Quality of Life

A population study

ROBERT D. GOLDNEY, MD
PAT J. PHILLIPS, MA
LAURA J. FISHER, BA HONS
DAVID H. WILSON, PHD

OBJECTIVE — The aim of the study was to assess the prevalence of diabetes and depression and their associations with quality of life using a representative population sample.

RESEARCH DESIGN AND METHODS — The study consisted of a representative population sample of individuals aged ≥15 years living in South Australia comprising 3,010 personal interviews conducted by trained health interviewers. The prevalence of depression in those suffering doctor-diagnosed diabetes and comparative effects of diabetic status and depression on quality-of-life dimensions were measured.

RESULTS — The prevalence of depression in the diabetic population was 24% compared with 17% in the nondiabetic population. Those with diabetes and depression experienced an impact with a large effect size on every dimension of the Short Form Health-Related Quality-of-Life Questionnaire (SF-36) as compared with those who suffered diabetes and who were not depressed. A supplementary analysis comparing both depressed diabetic and depressed nondiabetic groups showed there were statistically significant differences in the quality-of-life effects between the two depressed populations in the physical and mental component summaries of the SF-36.

CONCLUSIONS — Depression for those with diabetes is an important comorbidity that requires careful management because of its severe impact on quality of life.

Diabetes Care 27:1066–1070, 2004

A number of studies, including meta-analyses, have shown the association between diabetes and depression (1–10). This is an important public health issue because depressive disorders generally have been associated with the outcomes of chronic diseases like diabetes (8) and have contributed to the high economic burden of health care costs. Many of the studies have relied on clinical or other convenience samples in describing depression and diabetes as comorbid conditions or in exploring the association of depression with clinical markers such as glycemic control (1,11), blood pressure, cholesterol, and triglyceride levels (11). Indeed, Anderson et al. (2), in a meta-analysis, reported that depression was more prevalent in clinical samples than in the community. However, there have been recent large population-based studies that have confirmed this association (6–9), and Eaton (12) concluded that the effects of depression in diabetes were not trivial.

Several studies have assessed the impact of depression in diabetes in terms of the individual's functional ability or quality of life (3,4,13). Brown et al. (13) examined preference-based time tradeoff utility values associated with diabetes and showed that those with diabetes were willing to trade a significant proportion of their remaining life in return for a diabetes-free health state. One of the factors affecting quality of life in the diabetic group included depression. Understanding which dimensions of quality of life are associated with the comorbidities of depression and diabetes is important for day-to-day clinical management and also for public health policy initiatives aimed at improved health outcomes for the diabetic population. This is even more important given that diabetes is increasing in Australia and in many other industrialized countries (14). In this study of an Australian representative population sample, we investigated the relationship between depression and diabetes and their impact on quality of life.

RESEARCH DESIGN AND METHODS

— The data used in this study were obtained from the year 1998 South Australian Health Omnibus Survey (SAHOS). This is an annual population household interview survey of the South Australian population that has operated each year at the same time since 1990 with consistent survey methodology (15). This involves a multistage clustered area sample of South Australian urban and rural households with one person selected at random in each household according to next birthday with no replacement for nonrespondents. Motels, hotels, hospitals, nursing homes, jails, and other institutions were excluded from the sample as were country towns with a population of <1,000 people. Trained health interviewers interviewed respondents in each household. The sample was drawn from Australian Bureau of Statistics collectors' districts. In the metropolitan area, 10

From the Department of Psychiatry, University of Adelaide, The Adelaide Clinic, Park Terrace, Gilberton, South Australia.

Address correspondence and reprint requests to Professor Robert Goldney, Department of Psychiatry, University of Adelaide, The Adelaide Clinic, Park Terrace, Gilberton, South Australia 5081. E-mail: robert.goldney@adelaide.edu.au.

Received for publication 14 July 2003 and accepted in revised form 22 January 2004.

R.D.G. has been on an advisory panel for Sanofi Synthelabo; has received honoraria from Sanofi Synthelabo, Pfizer Australia, and Organon; and has received grant support from Wyeth Australia and Pfizer Australia. P.J.P. has been on advisory panels for AstraZeneca, Aventis, GlaxoSmithKline, and Parke Davis; has received honoraria from Abbott, Eli Lilly, Novartis, and Roche; and has received grant support from Bristol Meyer Squibb, Merck Sharp & Dohme, Novo Nordisk, Pfizer, Sanofi-Synthelabo, and Takeda. D.H.W. has received honoraria from Wyeth Australia and Pfizer Australia for the analysis of the data in this study.

Abbreviations: MCS, Mental Components Summary; PCS, Physical Components Summary; SAHOS, South Australian Health Omnibus Survey; SF-36, Short Form Health-Related Quality-of-Life Questionnaire.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

households were selected in each district, and one person was interviewed in each household according to next birthday. A small variation was made to the sampling methodology in country regions where towns of ≥1,000 were selected before the selection of collectors' districts. This decision was made because the bulk of the South Australian country population live in country towns with >1,000 people, and inclusion of the smaller towns would have increased survey costs considerably. A total sample of 3,010 people was interviewed, providing a nonreplacement response rate of 70.2%. For reliability purposes, 5% of each interviewer's work was selected for reinterview on selected questions. Data obtained were weighted to the 1996 census data by age, sex, region, and probability of selection in the household to provide estimates that were representative of the South Australian population. The 1996 census was most proximate to the SAHOS survey. Age comparisons in the analysis were made between >50 and <50 years of age because a decade of SAHOS has shown that the prevalence of diabetes increases significantly in the 45- to 50-year age-group. Therefore, the end of this period was selected as the cutoff for analysis.

A series of questions were asked about diabetes. To determine doctor-diagnosed diabetes, participants were asked whether a doctor had ever told them that they had diabetes. Demographic information was also obtained on age, sex, employment status, marital status, body mass index, income, and country of birth. Specific racial background data were not collected but can be inferred from country of birth. Depression was assessed using the mood module of the Primary Care Evaluation of Mental Disorders questionnaire. This has been validated to provide estimates of mental disorder comparable with those found using structured and longer diagnostic interview schedules (16). The mental disorders examined in the questionnaire included major depressive disorder, dysthymia, minor depressive disorder, and bipolar disorder. In the analyses of this study because of the limited cell sizes of the individual depression syndromes, these categories were collapsed to provide estimates of depression overall. No double counting of depression syndromes was involved.

The Short Form Health-Related Quality-of-Life Questionnaire (SF-36) was also included to assess the quality of life of the different population groups with and without diabetes. The SF-36 comprises 36 questions that measure eight dimensions of health: physical functioning, role limitations due to physical health, bodily pain, general health, vitality, social functioning, role limitations due to emotional health, and mental health. In addition to dimension scores, two summary scales (the Physical Components Summary [PCS] and the Mental Components Summary [MCS]) can be derived from the scales, and the summary quality-of-life dimensions are also used in this study. The SF-36 has been validated for use in Australia (17). Five groups were examined: the overall population without diabetes and without depression; the overall diabetic population; the depression-only population; the diabetic population without depression; and the diabetic population with depression.

Data were analyzed using the Statistical Package for the Social Sciences version 10 (18) and Epiinfo version 6 (19). Univariate analyses were conducted on the data to explore associations between depression and diabetic status and the demographic variables. Odds ratios were produced, and the χ^2 test was used to determine statistical comparability. A series of MANOVA analyses, controlling for age and sex, were conducted to examine the relationship between diabetic status and each quality-of-life dimension. The MUPLUS procedure was used to produce weighted means for each quality-of-life variable, controlling for age and sex (20). Mean quality-of-life scores were compared using *t* tests. Standard scores were graphed for the summary health PCS and the MCS dimensions. Standard scores were calculated for each dimension by dividing the difference between the quality-of-life scores for those experiencing each symptom severity variable and the dimension norm of the South Australian population by the standard deviation of the South Australian population dimension score (21). A two-factor ANOVA, which included an interaction term between diabetes and depression, was conducted to assess whether the combined effect of diabetes and depression on quality of life was additive or more than additive. In Fig. 1, the mean of the South Australian population is set at zero for each quality-of-life dimension, allowing comparisons to be made with the diabetic groups. Kazis et al. (22) discusses the use of effect sizes for interpreting the differences between groups in standard scores. An effect size of 0.2 or one-fifth of a standard deviation is small or mild; an effect size of 0.5 is moderate; and effect sizes of ≥0.8 are large.

RESULTS — Of the 3,010 respondents, 2,266 (75.2%) were born in Australia; 381 (12.7%) were born in either the U.K. or Ireland, and 363 (12.1%) were born in other countries including Asia. Of the population sample, 205 (6.8%) were classified as having major depression, 130 (4.3%) had minor depression, 105 (3.5%) had partial remission of major depression, 79 (2.6%) had dysthymia, and 5 (0.2%) had bipolar disorder (depressed phase). No depressive syndrome was detected in 2,486 (82.6%) respondents. The population point prevalence of doctor-diagnosed diabetes in this survey was 5.2% (95% CI 4.6–6.0). The prevalence of depression in the diabetic population was 23.6% (22.1–25.1) compared with 17.1% (15.8–18.4) in the nondiabetic population. This difference approached statistical significance ($P = 0.06$).

Table 1 shows the variables associated with depression in a univariate analysis of the data for the total population sample in which the diabetic individuals are compared with those without diabetes. Female sex, household income <A$20,000 per year, not currently in a relationship, smoking status, and not in the workforce were all significantly associated with depression. Diabetes status approached statistical significance ($P = 0.06$). The significant univariate variables together with diabetes were entered into a logistic regression analysis (23) with depression as the dependent variable. Depression was most strongly associated with not currently being in a relationship (odds ratio [OR] 1.40; 95% CI 1.15–1.69; $P = 0.001$), earning <A$20,000 (0.57; 0.48–0.71; $P = 0.001$), female sex (1.23; 1.01–1.49; $P = 0.04$), smoking (1.95; 1.60–2.39; $P < 0.001$), and diabetes (1.49; 1.03–2.17; $P = 0.04$).

A second univariate analysis of the diabetic group, comparing those suffering diabetes who were depressed with those suffering diabetes who were not depressed, was a post hoc analysis and showed that the only variable that approached a statistically significant differ-

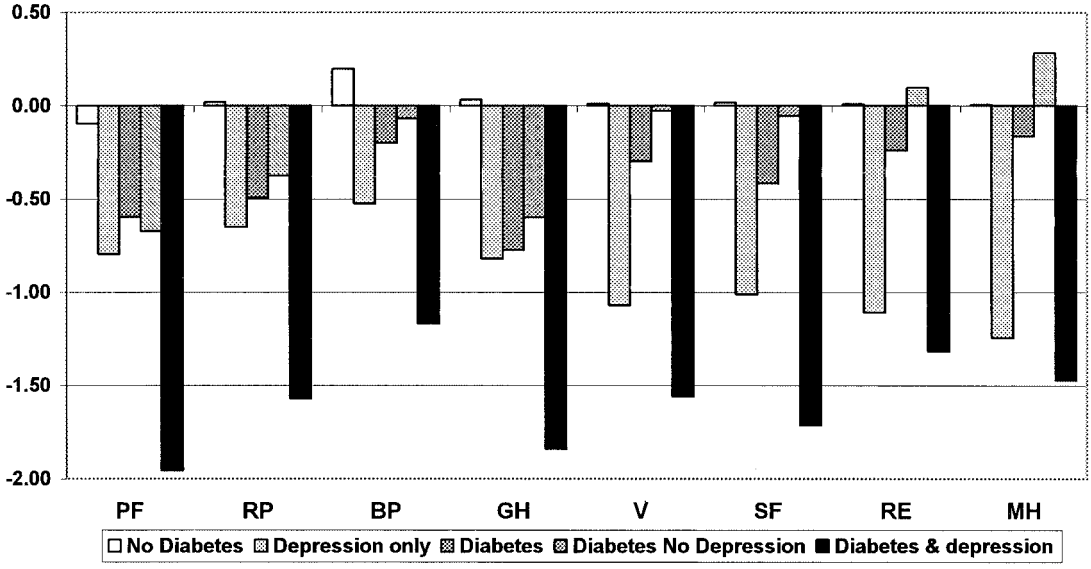

Figure 1—*SF-36 health-related quality-of-life scores according to diabetes and depression status.*

ence was age >50 years (OR 2.0; 95% CI 0.78–5.24; $P = 0.1$).

Table 2 shows the quality-of-life scores according to diabetes and depression status. There is a clear difference in the quality-of-life scores for the diabetic and depression group when compared with the diabetic group without depression, which should be the most important comparison. Overall, the highest quality-of-life scores are experienced by those without diabetes and depression and the lowest by those with diabetes and depression. In terms of the PCS and MCS of the SF-36, Table 2 shows that the same relative impact applies as for the dimension scores.

Figure 1 shows that the standard scores of those with no diabetes have quality-of-life status comparable with the population mean or slightly better. At the other extreme those with diabetes and depression experience the most severe comparative impact on quality-of-life for every dimension. Between these two extremes, diabetes overall and the diabetes without depression groups have a moderate-to-severe impact on the physical functioning, role limitations (physical), and general health scales (Fig. 1). The results of the two-factor ANOVA showed that the interaction term was significant only for the PCS scale, indicating a greater than additive effect of diabetes and depression on the physical health dimension.

A supplementary analysis comparing both depressed diabetic and depressed nondiabetic groups showed there were statistically significant differences in the quality-of-life effects between the two depressed populations on the PCS and MCS scales. On the PCS scale, the diabetic population recorded a statistically significantly increased effect in the large category ($t = 1005.3$; degrees of freedom [df] =

Table 1—*OR and statistical significance of variables associated with depression*

Variable (*n*/*N*)	OR (95% CI)	*P*
Diabetes		
No diabetes (494/2,389)	1.0	
Diabetes diagnosed (30/97)	1.50 (0.96–2.32)	0.06
Sex		
Male (226/1,239)	1.0	
Female (298/1,247)	1.31 (1.00–1.59)	0.005
Age (years)		
≤50 (357/1,634)	1.0	
>50 (167/852)	0.90 (0.73–1.10)	<0.29
Income		
≥A$20,001 (333/1,917)	1.0	
<A$20,000 (191/570)	0.52 (0.42–0.64)	<0.0001
Relationship status		
In relationship (276/1,575)	1.0	
Not in relationship (248/911)	1.55 (1.28–1.89)	<0.0001
BMI		
Normal weight (243/1,177)	1.0	
Overweight (230/1,086)	1.03 (0.80–1.19)	0.80
Migrant status		
Australia born (392/1,873)	1.0	
Overseas born (132/613)	1.03 (0.82–1.29)	0.79
Smoking		
Nonsmoker (342/1,935)	1.0	
Smoker (182/551)	1.87 (1.52–2.30)	<0.0001
Work status		
Employed (268/1,610)	1.0	
Not in workforce (256/876)	1.76 (1.45–2.13)	<0.0001

Table 2—*Comparison of SF-36 quality-of-life dimension and summary component scores for those with or without diabetes and with or without depression in diabetes*

	No diabetes/ no depression	Depression only	Diabetes overall	Diabetes only	Diabetes and depression
Physical functioning	83.4	69.1*	73.2*	71.6	45.4†
Role limitations (physical)	80.6	56.7*	62.4*	66.5	24.1†
Bodily pain	76.9	61.1*	68.2*	71.1	47.2†
General health	74.6	56.6*	57.6*	61.3	35.0†
Vitality	64.6	42.4*	58.3*	63.8	32.4†
Social functioning	88.3	66.1*	79.0*	86.8	51.0†
Role limitations (emotional)	88.1	55.4*	80.9*	90.6	49.2†
Mental health	80.1	58.8*	77.2*	84.8	55.0†
PCS	49.4	44.9*	43.7*	43.0	34.0†
MCS	50.8	37.9*	48.6*	53.4	36.1†

*Statistically significant lower than those without diabetes or depression at $P \leq 0.05$; †statistically significant lower than those with diabetes and no depression at $P = 0.05$.

154; $P < 0.0001$). For the MCS scale, both of the nondiabetic depressed and the diabetic depressed populations recorded effect sizes in the large category, although the effect for the diabetic population was statistically significantly increased ($t = 91.26$; df = 154; $P < 0.0001$).

CONCLUSIONS — Before commenting on these findings, it is pertinent to reflect on potential shortcomings. The present study may be limited by the self-report nature of doctor-diagnosed diabetes, as there could be misclassification of diabetes because of differential health care utilization rates. For example, women of childbearing age are more likely to attend a health care clinic and be diagnosed with gestational diabetes, which they recall in a later survey, although a substantial number of these will progress to substantive diabetes. It is also possible that those with diabetes may not be told they have it or forget or deny it. On the positive side, the study does provide a random and representative population sample. Furthermore, it extends previous studies by using a reliable and valid health-related quality-of-life instrument, the SF-36.

The present study demonstrated that 23.6% of those with diabetes had a depressive syndrome compared with 17.1% of the nondiabetic population, an increase which approached statistical significance. These results are in the range of 8.5–27.3% provided by Gavard et al. (3) in a systematic review of depression in diabetes.

Whereas the increase in depression is important in its own right, perhaps of even greater clinical and societal importance is the fact that depression was associated with a highly significant impact on quality of life, as measured by the large effect size from standardized scores across all SF-36 dimensions for the diabetes with depression group (22). Furthermore, there was a significant interaction between diabetes and depression on the PCS but not on the MCS. One explanation for this finding might be that depression can influence physical outcomes, such as recovery from myocardial infarction, survival with malignancy, and propensity to infection. Various mechanisms have been proposed for this, including changes to the immune system (24). Other possibilities are that depression in diabetes may affect the capacity to maintain medication vigilance, maintain a good diet, and maintain other lifestyle factors, such as smoking and exercise, all of which are likely possible pathways for a greater than additive effect. Whatever the mechanism involved, these data indicate that the addition of depression to diabetes has a severe impact on quality of life, and this needs to be managed in clinical practice.

The effect of depression on quality of life is greater than the effect of diabetes on quality of life. When depression is added to this chronic disease state, the effect, as noted above, is more than additive for the PCS scale. It is at least additive for the MCS scale, and it may simply be sample size that has not allowed us to observe a greater than additive effect in the MCS scale. Although there was no significant interaction between diabetes and depression and the MCS scale, we did observe increases on the effect size for the mental health dimensions and in particular 50% or more on the vitality and social functioning scales. There may be a relationship between vitality and social functioning, and the explanations provided above for the effects on the physical health dimensions may also apply to vitality and social functioning. The smaller effect differences observed on the role emotional and mental health dimensions are also due to the addition of diabetes to depression when compared with the depression-only group. The mechanism for this requires further investigation.

It has been pointed out that depression in diabetes results in a high economic burden to society in terms of both direct and indirect costs (6,8,25). Although antidepressants have demonstrated efficacy in treating depression with comorbid conditions (26), there have been reports of adverse effects on glycemic control with nortriptyline (26), and Lustman and Clouse (27) concluded that optimal therapies are still not available. Nevertheless, despite the imperfections of available treatments for depression, the magnitude of the impact of depression and diabetes on a range of quality-of-life dimensions indicates that attention to the optimum management of depression in the primary care setting would result in appreciable alleviation of suffering in those with diabetes and depression. More so, failure to manage depression may compromise the management of diabetes itself.

References

1. Lustman PJ, Anderson RJ, Freedland KE, deGroot M, Carney RM, Clouse RE: Depression and poor glycaemic control: a meta-analytic review of the literature. *Diabetes Care* 23:934–942, 2000
2. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ: The prevalence of comorbid conditions in adults with diabetes: a meta-analysis. *Diabetes Care* 24:1069–1078, 2001
3. Gavard JA, Lustman PJ, Clouse RE: Prevalence of depression in adults with diabetes: an epidemiological evaluation. *Diabetes Care* 16:1167–1178, 1993
4. Ciechanowski PS, Katon WJ, Russo JE: Depression and diabetes: impact of depressive symptoms on adherence, function and costs. *Arch Intern Med* 160: 3278–3285, 2000
5. de Groot M, Anderson R, Freedland KE,

Clouse RE, Lustman PJ: Association of depression and diabetes complications: a meta-analysis. *Psychosom Med* 63:619–630, 2001
6. Egede LE, Zheng D, Simpson K: Co-morbid depression is associated with increased health care use and expenditures in individuals with diabetes. *Diabetes Care* 25:464–470, 2002
7. Egede LE, Zheng D: Independent factors associated with major depressive disorder in a national sample of individuals with diabetes. *Diabetes Care* 26:104–111, 2003
8. Finkelstein EA, Bray JW, Chen H, Larson MJ, Miller K, Tompkins C, Keme A, Mandersheid R: Prevalence and costs of major depression among elderly claimants with diabetes. *Diabetes Care* 26:415–420, 2003
9. Nichols GA, Brown JB: Unadjusted and adjusted prevalence of diagnosed depression in type 2 diabetes. *Diabetes Care* 26: 744–749, 2003
10. Cassano P, Fava M: Depression and public health: an overview. *J Psychosom Res* 53:849–857, 2002
11. Gary TL, Crum RM, Cooper-Patrick L, Ford D, Brancati FL: Depressive symptoms and metabolic control in African Americans with type 2 diabetes. *Diabetes Care* 23:23–29, 2000
12. Eaton W: Epidemiologic evidence on the comorbidity of depression and diabetes. *J Psychosom Res* 53:903–906, 2002
13. Brown GC, Brown MM, Sharma S, Brown H, Gosum M, Denton P: Quality of life associated with diabetes mellitus in an adult population. *J Diabetes Complications* 14:18–24, 2000
14. Dunstan DW, Zimmet PZ, Welborn TA, De Courten MP, Cameron AJ, Sicree RA, Dwyer T, Colagiuri S, Jolley D, Knuiman M, Atkins R, Shaw JE: The rising prevalence of diabetes and impaired glucose tolerance: the Australian diabetes, obesity, and lifestyle study. *Diabetes Care* 25: 829–834, 2002
15. Wilson DH, Wakefield M, Taylor AW: The South Australian Health Omnibus Survey. *Health Promot J Aust* 2:47–49, 1992
16. Spitzer RL, Williams JB, Kroenke K, Linzer M, deGruy FV 3rd, Hahn SR, Brody D, Johnson JG: Utility of a new procedure for diagnosing mental disorders in primary care: the PRIME-MD study. *JAMA* 272: 1749–1756, 1994
17. McCallum J: The SF-36 in an Australian sample: validating a new generic health status measure. *Aust N Z J Public Health* 19:160–166, 1995
18. SPSS: *SPSS Advanced Statistics 10.0*. Chicago, SPSS, 1999
19. Dean AG, Dean JA, Coulombier D, Brendel KA, Smith DC, Burton AH, Dicker RC, Sullivan K, Fagan RF, Arner TG: *Epi Info Version 6: A Word Processing, Database, and Statistics Program for Epidemiology on Microcomputers*. Atlanta, GA, Centers for Disease Control and Prevention, 1996
20. Norusis MS: *SPSS for Windows. Advance Statistics*. Release 6.0. Chicago, SPSS, 1993
21. Garrat AM, Ruta DA, Abdalla MI, Buckingham JK, Russell IT: The SF-36 health survey questionnaire: an outcome measure suitable for routine use within the NHS. *BMJ* 306:1440–1444, 1993
22. Kazis LE, Anderson JJ, Mennan RF: Effect sizes for interpreting changes in health status. *Med Care* 27:S178–S189, 1989
23. Hosmer DW, Lemeshow S: *Applied Logistic Regression*. New York, John Wiley & Sons, 1989
24. Kiecolt-Glaser J, Glaser R: Depression and immune function: central pathways to morbidity and mortality. *J Psychosom Res* 53:873–876, 2002
25. Peyrot M, Rubin RR: Persistence of depressive symptoms in diabetic adults. *Diabetes Care* 22:448–452, 1999
26. Goodnick PJ, Hernandez M: Treatment of depression in co-morbid medical illness. *Expert Opin Pharmacother* 1:1367–1384, 2000
27. Lustman P, Clouse R: Treatment of depression in diabetes: impact on mood and medical outcome. *J Psychosom Res* 53: 917–924, 2002