

Psychosocial and Socioeconomic Risk Factors for Premature Death in Young People With Type 1 Diabetes

SUSAN P. LAING, PHD¹
MICHAEL E. JONES, PHD¹
ANTHONY J. SWERDLOW, DSC¹

ANDREW C. BURDEN, MD²
WENDY GATLING, DM³

OBJECTIVE — Mortality from acute diabetes-related events is greatly raised in young adults with type 1 diabetes. Psychosocial and socioeconomic risk factors are examined for deaths from acute events separately from deaths due to other causes.

RESEARCH DESIGN AND METHODS — This study had a nested case-control design. The cases were patients from the Diabetes UK cohort who died before age 40 years. Deaths were categorized as acute events or chronic conditions related to diabetes. Where possible, two matched control subjects were selected for each case. Data relating to psychosocial and socioeconomic factors and variables related to diabetes complications were extracted from the case notes. Risks of death were estimated by calculation of odds ratios (ORs).

RESULTS — Case notes were obtained for 98 case and 137 control subjects. Fifty-one deaths were attributed to acute causes, 34 to chronic conditions related to diabetes, and the remaining 13 were unrelated to diabetes. Living alone (OR 4.4), past drug abuse (5.7), and previous psychiatric referral (4.6) were all significantly associated with death from acute events but not death from chronic conditions. There was no association between deaths from acute events and nephropathy, hypertension, neuropathy, or retinopathy, although all of these were associated with deaths from chronic conditions.

CONCLUSIONS — The results indicate that psychosocial factors are powerful risk factors for mortality from acute events in patients with type 1 diabetes, although not for mortality from chronic conditions. The data enable the identification of a high-risk group suitable for targeting with preventive measures to reduce acute event mortality.

Diabetes Care 28:1618–1623, 2005

Mortality in patients with type 1 diabetes is higher than in the general population at all ages (1). Previous results from the Diabetes UK (formerly British Diabetic Association) cohort study have indicated that at ages <40 years, mortality is increased approximately threefold in men and fivefold in women compared with mortality in the

general population. After age 30, the majority of deaths can be attributed to long-term complications of diabetes, with cardiovascular disease the greatest single cause of death. In patients <30 years of age, mortality is predominantly due to either acute events related to diabetes or due to accidents and violence (2).

If mortality is to be reduced in young

patients with type 1 diabetes, then deaths from acute events need to be specifically addressed. It is likely that risk factors for mortality from acute events might be different from those related to deaths from long-term complications of type 1 diabetes. In particular, it is postulated that some psychosocial and socioeconomic variables might be more closely associated with deaths from acute events than with deaths from long-term complications.

In the past 3 decades, there has been increasing interest in the relation of the psychosocial and socioeconomic status of young adults with diabetes to the management of their condition. It was probably no coincidence that this interest developed at the same time as more stringent glycemetic control was advocated as a means of reducing late complications of diabetes (3), and there is evidence linking various psychosocial and socioeconomic variables to either noncompliance or poor glycemetic control (4,5).

Several studies have looked for associations between psychosocial and socioeconomic variables and all-cause mortality in patients with type 1 diabetes. There have been two case-control studies (6–8), and in both studies, although there was some evidence that socioeconomic factors (for example, the level of education) might play a role, mortality was most strongly associated with diabetes complications. A number of cohort studies have indicated that socioeconomic variables are related to overall mortality (9–11), even after adjusting for the presence of other long-term complications such as renal disease. It is to be expected that deaths from chronic conditions would be associated with long-term complications of diabetes, and none of these studies have subdivided the deaths into those from chronic conditions and those from acute events such as hypoglycemia.

To our knowledge, there have been no published studies analyzing risk of death separately for mortality from acute events in relation to psychosocial and socioeconomic variables. To do this, we

From the ¹Section of Epidemiology, Institute of Cancer Research, Sutton, Surrey, U.K.; the ²University of Leicester, Leicester, U.K.; and ³Poole Hospital NHS Trust, Poole, U.K.

Address correspondence and reprint requests to Dr. Susan Laing, Section of Epidemiology, Brookes Lawley Building, Institute of Cancer Research, Cotswold Road, Sutton, Surrey SM2 5NG, U.K. E-mail: susan.laing@icr.ac.uk

Received for publication 14 October 2004 and accepted in revised form 18 March 2005.

Abbreviations: ACORN, A Classification of Residential Neighborhoods.

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

© 2005 by the American Diabetes Association.

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked "advertisement" in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.

conducted a nested case-control study within the Diabetes UK cohort.

RESEARCH DESIGN AND METHODS

The assembly of the Diabetes UK (formerly British Diabetic Association) cohort of patients with insulin-treated diabetes from diabetes registers compiled throughout the U.K. has been described elsewhere (1). The earliest subjects in the cohort entered follow-up in 1972 and the latest in 1993. In all, the cohort includes >23,000 subjects with insulin-treated diabetes diagnosed under the age of 30 years. Details to identify each patient were sent to the relevant National Health Service Central Registers, and we were subsequently notified by them of all deaths and emigrations in cohort members.

This present study was restricted to southeast England and comprised the registers from Leicester, Poole, and the southeast component of the Diabetes UK register. These registers were chosen for logistical reasons because the research nurses who were to extract the data from hospital case notes were based in London. Where possible, two control subjects per case were selected. These were selected from within the same register as the case, and also matched on sex, date of birth (within 6 months), and date of diagnosis of insulin-treated diabetes (within 1 year). If the cohort contained no matched control subjects within the above criteria, then the date of birth and date of diagnosis criteria were extended by 6 months.

For each case and control subject, we attempted to find the hospital case notes for the study period, and if a subject had moved hospitals during this period, we contacted all of the relevant hospitals. Data were extracted by systematically searching through the case notes for the period from the date of diagnosis up to the date of death for the cases and from the date of diagnosis to the index date (the date of death for the matched case) for the control subjects. There are arguments to be made for using age, duration of diabetes, or date of death when defining the index date, but given the matching system, there is little practical difference. We extracted from the case notes details of the initial illness and diagnosis, clinical details including any complications of diabetes, and past medical history and family history. We also collected data on a number of psychosocial and socioeconomic variables measured at the index date such

as unemployment, marital status, and whether the subject was living alone. In addition, we recorded whether a history of drug or alcohol abuse, smoking, or psychiatric referral had ever been reported. From the postcode at the index date, we obtained the ACORN (A Classification of Residential Neighborhoods) score (12), a measure of social profile that categorizes the subject's underlying lifestyle and demographic characteristics as indicated by their postal address. For those variables that are not routinely recorded in hospital notes and might only be recorded if the variable was positive (e.g., a history of alcohol abuse), we used a category of "no mention" rather than "not known," which we applied if we could find no reference to the variable in the case notes and interpreted this as no history of that particular variable. For those variables, "no mention" was taken as the baseline in the analysis.

The cause of death was taken as the underlying cause of death reported on the death certificate. This had been independently coded according to national criteria and was independent of the data abstraction conducted for the study. Since deaths coded to the underlying cause "diabetes" might reflect a range of different short-term metabolic events or long-term degenerative complications, the full statements relating to the cause of death were examined and all cardiovascular and renal deaths were recoded to the relevant categories. The cases were grouped according to whether the death was considered to be an acute event, a chronic consequence of diabetes, or unrelated to diabetes. The acute death category included sudden episodes of diabetes such as hypoglycemia or coma, as well as deaths from accidents and violence. All deaths from causes related to renal or cardiovascular disease that were plausibly diabetes related were included in the chronic death category.

Risks of death in relation to the study variables were estimated by calculating odds ratios (ORs) and CIs using conditional logistic regression methods for matched case-control studies (13). The difference between the ORs for acute and chronic causes of death were evaluated by fitting a model with an interaction and carrying out a likelihood ratio test. The *P* values cited are two sided.

RESULTS— In total, there were 146 deaths of cohort members from the study registers who met the case criteria, and of these, it was possible to obtain case notes for 98. The majority of the 48 case notes that could not be obtained had been destroyed, either because the hospital had been relocated or because the death had occurred more than 10 years previously. For the rest, every effort was made to retrieve notes from the various hospitals that the subjects had attended. For each case for whom case notes were located, two matched control subjects were sought. For 39 cases, 2 control subjects could be found, but for 59, only 1 control subject was available, either because only one subject on the study file met the matching criteria or the notes for the other potential control subject could not be found. In total, therefore, 139 control subjects were included.

Among the cases there were 51 deaths from acute causes, which included 24 acute complications of diabetes but also deaths from accidents (15 deaths) and suicides or possible suicides (12 deaths). Chronic conditions related to diabetes accounted for 34 of the deaths (22 from cardiovascular disease and 12 from renal disease), and the remaining 13 deaths were not considered to have any association with diabetes and included deaths from cancer, gastric complications, and respiratory diseases. None of the deaths were unexplained (14).

Descriptive characteristics of the study sample are shown in Table 1. The majority of the cases (86.8%) and control subjects (90.5%) diagnosed were under the age of 15, and 87.7% of the deaths occurred between the ages of 20 and 39 years. Although there appears to be a small difference at older ages between the case and control subjects in terms of age at diagnosis, this is because there are more often two rather than one control subject for the cases diagnosed at a younger age; therefore, this does not bias the analysis.

The ORs for mortality from all causes in relation to psychosocial and economic variables are shown in Table 2. Living alone, unemployment, a high ACORN score (indicative of poor social profile) at the index date, and a past history of drug abuse and psychiatric referral were all related to all-cause mortality. There was no relation between a history of either smoking or alcohol abuse and all-cause mortality. The ORs are also shown separately for

Table 1—Descriptive characteristics of the case and control subjects

Characteristic	Cases	Control subjects
<i>n</i>	98	137
Sex		
Male	53 (54.1)	71 (51.8)
Female	45 (45.9)	66 (48.2)
Year of birth		
1940–1949	1 (1.0)	1 (0.7)
1950–1959	11 (11.2)	11 (8.0)
1960–1969	61 (62.2)	91 (66.4)
1970–1977	25 (25.5)	34 (24.8)
Year of diagnosis of diabetes		
1950–1959	1 (1.0)	1 (0.7)
1960–1969	3 (3.1)	2 (1.5)
1970–1979	77 (78.6)	109 (79.6)
1980–1989	16 (16.3)	24 (17.5)
1990–1993	1 (1.0)	1 (0.7)
Age at diagnosis (years)		
Under 5	14 (14.3)	20 (14.6)
5–9	28 (28.6)	46 (33.6)
10–14	43 (43.9)	58 (42.3)
15–19	5 (5.1)	4 (2.9)
20–24	6 (6.1)	7 (5.1)
25–29	2 (2.0)	2 (1.5)
Age at death (years)		
Under 10	0 (0.0)	
10–19	12 (12.2)	
20–29	53 (54.1)	
30–39	33 (33.6)	

Data are *n* (%) unless otherwise specified.

the group dying from acute events and the group dying from chronic conditions. Deaths from acute events, but not from chronic conditions, were significantly associated with living alone, drug abuse, and past psychiatric referral. The OR for acute deaths was significantly higher than that for chronic deaths for psychiatric referral ($P = 0.029$). A high ACORN score and unemployment were significant risk factors for dying from chronic conditions. Although it was not possible, for statistical reasons, to calculate a matched OR for unemployment because the numbers of unemployed control subjects were so small (only 1 of 47 control subjects were unemployed at the index date compared with 12 of the 34 cases), the risk was clearly highly significant and the OR was significantly higher for chronic deaths ($P = 0.002$).

The risk of death in relation to known complications of diabetes before the index date is shown in Table 3. Death from all causes was significantly associated with hypertension, renal disease, and di-

abetic neuropathy, although not significantly associated with retinopathy. However, when the deaths were analyzed by cause, there was no evidence of any association between these complications of diabetes and deaths from acute events, whereas there was an association between renal disease, retinopathy, neuropathy, and hypertension and deaths from chronic conditions. The ORs for chronic deaths were significantly higher than those for acute deaths for hypertension ($P = 0.041$), retinopathy ($P < 0.001$), and renal disease ($P = 0.011$).

CONCLUSIONS— Previous results from the Diabetes UK cohort have shown that from the age of 30 years onwards, cardiovascular disease is the predominant cause of death in patients with type 1 diabetes and that deaths from renal disease are also common in this age-group (2). However, acute diabetes-related events, such as ketoacidosis, were responsible for the greatest number of deaths in early adulthood, closely followed by deaths

from accidents and violence. In both men and women with type 1 diabetes, the mortality rates for death from these causes were much higher than in the general population. Within the Diabetes UK cohort, the young men were more vulnerable than the young women and the rates of death from acute complications of diabetes in men aged 20–39 were twice as high as the rates in women. The rates of death from accidents and violence were almost three times as high.

The present study was conducted to investigate the hypothesis that risk factors for death from acute events in young patients with type 1 diabetes may be different from those associated with death from long-term complications of the condition and that psychosocial and socioeconomic risk factors may be more closely related to death from acute events. Deaths from acute diabetes-related events were grouped together with deaths from accidents and suicides, as these two causes together accounted for all the unexpected deaths in this age-group. It is possible that there is a degree of overlap between these two categories; for example, an accident may have resulted from a hypoglycemic attack and a possible suicide from an inadvertent insulin overdose.

Inevitably, a case-control study of this type is dependent on the quality of the case notes, but for a mortality study, these may be the only available source of data. Despite great efforts to gather data as completely as possible, a number of case notes could not be found, in many instances because the notes had already been destroyed. It seems unlikely, however, that this would have resulted in bias because note destruction is related to the general notes policies of hospitals and not the characteristics of specific cases. There was also potential for bias as a result of missing data within the case notes that could be examined. In general, however, the proportion of subjects with such missing data was low enough, in relation to the size of the relative risks found, that bias of this type seems unlikely to explain the results.

To our knowledge, no other studies have examined risks of death subdivided by cause, and there have been few previous case-control studies of factors related to all-cause mortality in young patients with diabetes with which to compare our findings. Results from a case-control study from Pittsburgh in 1985 (6) indicated that the presence of renal complica-

Table 2—Risk of death in relation to psychosocial and socioeconomic factors

Risk factor	All causes of death			Acute deaths			Chronic deaths		
	Cases (n)	Control subjects (n)	OR (95% CI)	Cases (n)	Control subjects (n)	OR (95% CI)	Cases (n)	Control subjects (n)	OR (95% CI)
Living alone									
No	66	108	1.0 (baseline)	33	61	1.0 (baseline)	24	34	1.0 (baseline)
Yes	22	7	4.1 (1.7–9.8)‡	13	4	4.4 (1.4–13.8)*	7	2	4.3 (0.9–21.4)
Not known	10	22	0.7 (0.3–1.5)	5	9	0.9 (0.3–3.0)	3	11	0.3 (0.1–1.4)
Unemployed									
No mention	77	130	1.0 (baseline)	45	68	1.0 (baseline)	22	46	1.0 (baseline)
Yes	21	7	4.5 (1.8–11.2)‡	6	6	1.4 (0.4–4.5)	12	1	—§
ACORN score									
1–20	32	57	1.0 (baseline)	18	28	1.0 (baseline)	10	22	1.0 (baseline)
21–38	39	61	1.1 (0.6–2.1)	21	35	1.0 (0.5–2.3)	11	19	1.2 (0.4–3.5)
39–54	22	17	2.4 (1.1–5.2)*	9	11	1.3 (0.4–3.8)	11	5	5.3 (1.3–22.3)*
Not known	5	2	4.1 (0.7–23.0)	3	0	—	2	1	4.3 (0.3–64.2)
Smoking									
No	41	72	1.0 (baseline)	21	26	1.0 (baseline)	14	13	1.0 (baseline)
Yes	39	46	1.5 (0.8–2.5)	17	36	1.9 (0.8–4.5)	16	28	1.7 (0.7–4.3)
Not known	18	16	2.0 (0.9–4.7)	13	12	3.5 (1.1–11.2)*	4	6	1.3 (0.3–5.4)
Alcohol abuse									
No mention	86	127	1.0 (baseline)	43	69	1.0 (baseline)	31	43	1.0 (baseline)
Yes	12	10	1.5 (0.6–3.5)	8	5	2.1 (0.7–6.6)	3	4	0.9 (0.2–4.1)
Drug abuse									
No mention	89	134	1.0 (baseline)	44	72	1.0 (baseline)	33	46	1.0 (baseline)
Yes	9	3	4.6 (1.2–17.3)*	7	2	5.7 (1.2–27.9)*	1	1	1.4 (0.1–23.6)
Psychiatric referral									
No mention	60	111	1.0 (baseline)	26	61	1.0 (baseline)	25	35	1.0 (baseline)
Yes	38	26	2.7 (1.5–4.9)†	25	13	4.6 (1.8–11.5)†	9	12	1.0 (0.4–2.9)
Total	98	137		51	74		34	47	

* $P < 0.05$, † $P < 0.01$, ‡ $P < 0.001$. §OR cannot be calculated because of the small number of unemployed control subjects. ||ACORN score: scoring is based on post code; a low score indicates high income, home ownership, and low unemployment, whereas a high score indicates low income, council housing, and high unemployment.

tions was most strongly associated with premature mortality together with, in men, early familial mortality, alcohol consumption, and lack of participation in school sports. More recently, in a study

similar to ours, a case-control study of 90 matched pairs was reported from the Japanese arm of the Diabetes Epidemiology Research International cohort (8). Survival, after adjusting for renal disease, was

related to better education and better compliance with the treatment regimen.

The association between psychosocial factors and all-cause mortality in patients with type 1 diabetes has also previously

Table 3—Risk of mortality in relation to chronic complications of diabetes

Complication	All causes of death			Acute deaths			Chronic deaths		
	Cases (n)	Control subjects (n)	OR (95% CI)	Cases (n)	Control subjects (n)	OR (95% CI)	Cases (n)	Control subjects (n)	OR (95% CI)
Hypertension									
No mention	75	123	1.0 (baseline)	43	65	1.0 (baseline)	21	43	1.0 (baseline)
Yes	23	14	2.6 (1.2–5.50)*	8	9	1.1 (0.3–3.3)	13	4	5.9 (1.7–21.2)†
Retinopathy									
No mention	56	91	1.0 (baseline)	39	50	1.0 (baseline)	9	13	1.0 (baseline)
Yes	42	46	1.4 (0.8–2.4)	12	24	0.5 (0.2–1.2)	25	34	7.5 (2.2–25.6)†
Renal disease									
No mention	71	128	1.0 (baseline)	44	68	1.0 (baseline)	16	46	1.0 (baseline)
Yes	27	9	5.5 (2.3–13.6)‡	7	6	1.6 (0.5–5.9)	18	1	25.4 (3.4–192)†
Neuropathy									
No mention	77	127	1.0 (baseline)	45	69	1.0 (baseline)	21	42	1.0 (baseline)
Yes	21	10	3.4 (1.4–8.2)†	6	5	1.5 (0.4–5.5)	13	5	5.4 (1.5–19.5)*
Total	98	137		51	74		34	47	

* $P < 0.05$, † $P < 0.01$, ‡ $P < 0.001$.

been noticed from a number of cohort studies, although again the analyses have not been grouped according to cause of death. Smoking, low social class, leaving school before 16 years of age, living in a council house, and unemployment have all been shown to be associated with death after adjusting for renal complications (9–11).

In the present study, psychosocial factors were much more closely associated with deaths due to acute events than chronic complications. Living alone, a past history of drug abuse, and previous psychiatric referral were shown to be related to deaths from acute events and have not previously been identified as risk factors for all-cause mortality. The ACORN score, as a marker of socioeconomic status, was significantly related to all-cause death although not significantly related to acute event deaths once deaths were subdivided. Unemployment was also related to all-cause mortality but not associated with acute death, and although it was significantly associated with death from chronic conditions, it seems possible that unemployment was a consequence rather than a precursor of long-term complications of diabetes.

Other studies have shown that social factors are related to diabetic control in young adults (15) and hence give one mechanism by which acute deaths may occur. A supportive family background and better quality of life have each been related to better glycemic control (5,16,17), and a history of psychiatric disorders and not living in a two-parent home were shown to be related to non-compliance with medical treatment (4). However, there is no evidence that young people with diabetes in general have more social problems than those without diabetes (18,19). Instead, it would appear that the combination of diabetes and social problems leads to particular difficulties with compliance and poor control, which in turn might lead to acute death.

In this study, all-cause mortality was shown to be associated with hypertension, neuropathy, and renal disease, but it was interesting to note that none of these were associated with acute causes of death, only as the precursors of premature deaths from cardiovascular and renal disease.

Because the case and control subjects were matched for sex and age in this study, the analysis could not examine these variables as risk factors for mortal-

ity, although we have shown in an earlier report from the Diabetes UK cohort (see above) that young men with type 1 diabetes were particularly at risk of death from both acute complications of diabetes and accidents and violence. The present study adds several further factors with which to identify patients with diabetes at high risk of sudden death, and a combination of these findings and previous reports would suggest that these are as follows: young and of the male sex, a low socioeconomic background, living alone, a history of drug abuse, and past psychiatric problems. These groups are particularly vulnerable and would merit specific research and clinical attention.

Acknowledgments—The study was funded by Diabetes UK.

We thank the many individuals who worked to assemble the registers from which the cohort was identified, listed in Laing et al. (1). We recognize with thanks the roles of Drs. A. Bloom, D.R. Gamble, and T.M. Hayes in compilation of the original British Diabetic Association register and the input of physicians throughout the U.K. who contributed data to that register. We thank Dr. J.L. Botha, who contributed to the assembly of the Leicester

register, and Dr. R.D. Hill, who contributed to the assembly of the register from Poole. We also thank the research nurses Maureen Swanwick and Pip Murnaghan and the computer programmer Zongkai Qiao.

References

1. Laing SP, Swerdlow AJ, Slater SD, Botha JL, Burden AC, Waugh NR, Smith AWM, Hill RD, Bingley PJ, Patterson CC, Qiao Z, Keen H: The British Diabetic Association Cohort Study. I. All-cause mortality in patients with insulin-treated diabetes mellitus. *Diabet Med* 16:459–465, 1999
2. Laing SP, Swerdlow AJ, Slater SD, Botha JL, Burden AC, Waugh NR, Smith AWM, Hill RD, Bingley PJ, Patterson CC, Qiao Z, Keen H: The British Diabetic Association Cohort Study. II. Cause-specific mortality in patients with insulin-treated diabetes mellitus. *Diabet Med* 16:466–471, 1999
3. Diabetes Control and Complications Trial Research Group: The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 329:977–986, 1993
4. Goldston DB, Kelley AE, Reboussin DM, Daniel SS, Smith JA, Schwartz RP, Lorentz W, Hill C: Suicidal ideation and behaviour and non-compliance with the medical regimen among diabetic adolescents. *J Am Acad Child Adolesc Psychiatry* 36:1528–1536, 1997
5. Bryden KS, Peveler RC, Stein A, Neil A, Mayou RA, Dunger DB: Clinical and psychological course of diabetes from adolescence to young adulthood. *Diabetes Care* 24:1536–1540, 2001
6. Dorman JS, Tajima N, LaPorte RE, Becker DJ, Cruikshanks KJ, Wagener DK, Orchard TJ, Drash AL: The Pittsburgh insulin-dependent diabetes mellitus (IDDM) morbidity and mortality study: case-control analyses of risk factors for mortality. *Diabetes Care* 8 (Suppl. 1):53–60, 1985
7. Dorman JS, LaPorte RE, Tajima N, Orchard TJ, Becker DJ, Drash AL: Differential risk factors for death in insulin-dependent diabetic patients by duration of disease. *Pediatr Adolesc Endocr* 15:289–299, 1986
8. Matsushima M, Shimuzu K, Maruyama M, Nishimura R, LaPorte RE, Tajima N, the Diabetes Epidemiology Research International (DERI) US-Japan Mortality Study Group: Socioeconomic and behavioural risk factors for mortality of individuals with IDDM in Japan: population-based case-control study. *Diabetologia* 39:710–716, 1996
9. Moy CS, LaPorte RE, Dorman JS, Songer TJ, Orchard TJ, Kuller LH, Becker DJ, Drash AL: Insulin-dependent diabetes mellitus mortality: the risk of cigarette smoking. *Circulation* 82:37–43, 1990
10. Rossing P, Hougaard P, Borch-Johnsen K, Parving HH: Predictors of mortality in insulin-dependent diabetes: 10 year observational follow up study. *BMJ* 313:779–784, 1996
11. Robinson N, Lloyd CE, Stevens LK: Social deprivation and mortality in patients with diabetes mellitus. *Diabet Med* 15:205–212, 1998
12. ACORN, the complete consumer classification [article online]. Available from www.caci.co.uk
13. Breslow NE, Day NE: *Statistical Methods in Cancer Research: The Analysis of Case-Control Studies*. Vol. 1. Lyon, France, International Agency for Research on Cancer, 1980 (IARC scientific publ. no. 32)
14. Tattersall RB, Gill GV: Unexplained deaths of type I diabetic patients. *Diabet Med* 8:49–58, 1990
15. Grey M, Boland E, Yu C, Sullivan-Bolyai S, Tamborlane WV: Personal and family factors associated with quality of life in adolescents with diabetes. *Diabetes Care* 21:909–913, 1998
16. Guttman-Bauman I, Flaherty BP, Strugger M, McEvoy RC: Metabolic control and quality-of-life self-assessment in adolescents with IDDM. *Diabetes Care* 21:915–918, 1998
17. Forsander GA, Sundelin J, Persson B: Influence of the initial management regimen and family social situation on glycemic control and medical care in children with type I diabetes mellitus. *Acta Paediatr* 89:1462–1468, 2000
18. Jacobson AM, Hauser ST, Willett JB, Wolfsdorf JI, Dvorak R, Herman L, de Groot M: Psychological adjustment to IDDM: 10 year follow-up of an onset cohort of child and adolescent patients. *Diabetes Care* 20:811–818, 1997
19. Gafvels C, Lithner F: Lifestyle as regards physical exercise, smoking and drinking, of adult insulin-treated diabetic people compared with non-diabetic controls. *Scand J Soc Med* 25:168–175, 1997