Diabetologia (1983) 24: 166–171

**Diabetologia**


# Sexual Responsiveness in Diabetic Women

G. Tyrer[1], J. M. Steel[2], D. J. Ewing[3], J. Bancroft[1], P. Warner[1] and B. F. Clarke[2]

[1]The Medical Research Council Reproductive Biology Unit and [2]Diabetic Department and
[3]University Department of Medicine, Royal Infirmary, Edinburgh, Scotland, UK

**Summary.** Sexual responsiveness in 82 Type 1 (insulin-dependent) diabetic women was compared with that of 47 normal control subjects, using an interview method for rating various aspects of sexual response, and attitude questionnaires. The diabetic women were questioned about symptoms of autonomic neuropathy, and cardiovascular autonomic nerve function tests were performed. There were differences between the two groups in the reports of vaginal lubrication, but in most other respects the groups were similar. The diabetic women were not less orgasmic, and reported significantly fewer unpleasant feelings during sexual intercourse. They saw themselves and their husbands as less 'potent' than did the normal subjects. The possible enhancing effect of diabetes on the marriage of some diabetic women possibly counteracted the relatively mild physiological deficits involved. There was very little difference in sexual response between women with and without symptomatic autonomic neuropathy.

**Key words:** Type 1 diabetes, sexual function, women, autonomic neuropathy.

The association between diabetes and impotence in men is now well documented [1]. The reported prevalence varies between 27% and 59%, increases with age and duration of diabetes and is related to the presence of autonomic neuropathy and retinopathy [1, 2]. Many diabetic men have difficulty with erection, but they do not lose the capacity for orgasm and any loss of interest in sex is more likely to be a psychological reaction to their impotence [3].

By contrast, the sexual responses of diabetic women have received scant attention. This may be part of a more general tendency to ignore the sexual implications of physical illness in women [2]. The few studies published of female diabetic sexual response have come to different conclusions; only two involved control groups. Kolodny [4] reported a reduction in orgasm in diabetic women compared with control subjects whereas Jensen [5] found only minor differences. Other evidence from uncontrolled studies has been reported both for [6, 7] and against [8] an increased incidence of sexual problems in diabetic women. Ellenberg [8] found no difference in incidence of sexual problems between women with and without clinical evidence of autonomic neuropathy, but none of these studies has involved formal autonomic nerve function tests.

We report a detailed investigation of sexual and autonomic nerve function in a group of insulin-dependent diabetic women with varying duration of diabetes and a comparison of their sexual function with that of a group of 'normal' control subjects.

## Subjects and Methods

### *Subjects*

One hundred and four Type 1 female diabetic patients (aged 18 to 45 years) who were regular attenders at the Diabetic Department of the Royal Infirmary, Edinburgh, were invited to take part in the study. They were all married or co-habiting for at least 1 year and living with their partners. Initially all patients fulfulling these criteria were considered for the study, but as the interviews were difficult to arrange when patients lived a long way away, the study was limited to those living within a 10-mile radius of Edinburgh. Of the 84 women eligible living within a 10-mile radius, 66 agreed to take part (79% acceptance). Twenty unselected patients from outside this area were also asked before the geographical restrictions were made and 16 agreed (80% acceptance). As these women were very similar to the other group in age, social class, duration of diabetes and incidence of diabetic complications, it was decided to include them making a total of 82 diabetic patients. Their mean duration of diabetes was 13.5 years (range 2–32 years). Thirteen were pregnant at the time of interview, all in the third trimester. A comparison of those who agreed to participate with those who refused found the latter to be somewhat older, though the difference was not significant (mean ± SD: $30.7 \pm 7.9$ years and $34.9 \pm 6.3$ years, respectively).

The control group was 47 healthy women (aged 18 to 45 years), married or co-habiting for at least 1 year, who were attending a family

**Table 1.** Characteristics of diabetic women and control subjects

| | Diabetic patients ($n=82$) | Control subjects ($n=47$) | Comparison |
|---|---|---|---|
| Age (years) (mean ± SD) | 31 ± 8 | 32 ± 6 | $t$ = 1.19 127 d.f. NS |
| Duration of current sexual relationship (%) | | | |
| 0– 2 years | 18 | 4 | $\chi^2$ = 11.97 3 d.f., |
| 3– 6 years | 33 | 17 | $p$ = < 0.01 |
| 7–10 years | 15 | 28 | |
| > 11 years | 34 | 51 | |
| Social class (%) | | | |
| I | 9 | 5 | $\chi^2$ = 4.17 4 d.f., |
| II | 20 | 11 | |
| III | 52 | 70 | NS |
| IV | 16 | 11 | |
| V | 4 | 2 | |
| Contraception (%) | | | |
| Oral | 21 | 62 | $\chi^2$ = 37.1 4 d.f. |
| I.U.D. | 4 | 13 | |
| Barrier | 12 | 15 | $p$ = < 0.001 |
| Sterilisation | 32 | 9 | |
| None | 32 | 2 | |
| Ever pregnant (%) | 84 | 77 | $\chi^2$ = 0.68 NS |

planning clinic and had never requested help for a sexual problem. They had been asked to participate as 'controls' by the clinic doctors, who on the basis of their clinic attendances, believed them to be free from obvious sexual problems, though they had not been systematically screened for 'normality'.

The characteristics of the two groups of women are shown in Table 1. They were similar in social class. The diabetic women were younger but this difference was not significant. More important was the tendency for the diabetic women to have had current sexual relationships of shorter duration. Examination of the control group showed that a number of the variables used in this study were associated with both age and duration of relationship. It was therefore considered unacceptable to make a direct comparison of these two groups without allowing for the biasing effects of age and duration of relationship. The subjects in the control groups were therefore 'weighted' so that the control group mimicked the diabetic in the distribution of these two variables. To achieve this, each group was first cross-tabulated according to these two variables. For each cell a weighting factor (W) was calculated using the following formula W: $\frac{Di}{82} \times \frac{47}{Ci}$ for cell i, when Di = number of diabetics and Ci = number of controls in cell i. This weighting factor was then applied to all control subjects in that cell, ensuring that the new 'weighted' number of subjects in that cell formed the same proportion of the total control group ($n$ = 47) as the proportion of diabetic patients in that cell. The weights once calculated were applied in all statistical calculations. This is an accepted method for dealing with samples where some substrata have been over or under sampled [9]. Standard statistical methods: $\chi^2$ and Student's t-test were then applied.

## Methods of Assessment

### *The Interview*

Each subject was interviewed by a female psychologist (GT). The interview lasted 30–45 min and consisted of two parts: (a) direct questioning about sexual function in the past 3 months leading to a number of interview ratings. (In the case of the pregnant women, the 3 month period before pregnancy was assessed). (b) a semantic differential measurement of attitudes about 'self' and 'partner'.

*Interview ratings:* This method of assessment is being developed to quantify various aspects of sexual function in men and women [10]. The interviewer in this study has been trained in the use of these rating scales to the point where high agreement with the trainer (JB) was achieved. Each of the following aspects were rated on a 4 to 6 point scale – spontaneous sexual interest; positive (pleasant) feelings during sexual intercourse; negative (unpleasant) feelings during sexual intercourse; frequency and speed of vaginal lubrication; non-genital arousal; orgasm; vaginismus; dyspareunia, partner's erection, non-genital arousal and speed of ejaculation. Some definitions of scale points are provided in the tables of the results. In most instances, categories have been combined because of small numbers. (Details of the rating scales and methods of use are available on request (JB).

The diabetic women were also asked whether they believed they had a sexual problem and if so whether they would like help, and whether they felt that being diabetic had any effect on their marital relationship.

*Semantic differential:* The version of this attitude measure reported by Whitehead and Mathews [11] was used. Each woman was asked to rate the concepts 'myself' and 'my partner' on a series of seven point scales. These were combined to provide ratings of sexual attractiveness, sexual arousability, lovingness, calmness, potency and a general evaluation. For example, 'potency' is derived from three scales: 'strong-weak', 'active-passive' and 'fast-slow'. A proportion of women were also given the sexual experience scale [12] and this is reported elsewhere [13].

### *Autonomic Nerve Function*

Patients were asked about four symptoms of autonomic neuropathy: sweating abnormalities, nocturnal diarrhoea, postural hypotension and hypoglycaemic unawareness. Cardiovascular autonomic nerve function tests were performed in 80 of the 82 diabetic women. These consisted of the heart rate responses to the Valsalva manoeuvre, deep breathing and standing up, and the blood pressure response to sustained handgrip and posture [14–16]. The patients were classified as normal ($n$ = 50) if they had no symptoms and normal tests, borderline ($n$ = 16) if they had no symptoms but one or more abnormal tests, and symptomatic ($n$ = 14) when they had two or more symptoms attributable to autonomic neuropathy and two or more abnormal tests. No patients fell into the possible intermediate groups.

**Table 2.** Frequency of sexual intercourse in previous 3 months

| | < 1/month | < 1/week | 1 or 2/week | 3 or 4/week | > 4/week | Comparison |
|---|---|---|---|---|---|---|
| Diabetic patients (%) ($n$ = 82) | 5 | 21 | 22 | 41 | 11 | $\chi^2$ = 4.61 4 d.f. NS |
| Control subjects ('weighted') (%) ($n$ = 47) | 4 | 9 | 28 | 40 | 19 | |

**Table 3.** Positive and negative feelings during sexual intercourse

| Positive feelings | Always pleasurable (4)[a] (as % of total) | > 50% pleasurable (3) (as % of total) | < 50% pleasurable (0–2) (as % of total) | Comparison |
|---|---|---|---|---|
| Diabetic patients ($n$ = 82) | 83 | 6 | 11 | |
| Control subjects ('weighted') ($n$ = 47) | 72 | 15 | 13 | $\chi^2$ = 2.99 2 d.f. NS |
| **Negative feelings** | **No negative feelings (0) (as % of total)** | **< 50% negative feelings (1) (as % of total)** | **Negative feelings on > 50% occasions (2–5) (as % of total)** | |
| Diabetic patients ($n$ = 82) | 73 | 9 | 18 | |
| Control subjects ('weighted') ($n$ = 47) | 52 | 34 | 14 | $\chi^2$ = 12.49 2 d.f. $p$ = 0.005 |

[a] Scale 0–4)

**Table 4.** Vaginal lubrication and non-genital arousal during sexual intercourse

| Vaginal lubrication | Usually inadequate or requiring prolonged stimulation (0–2)[a] (as % of total) | Adequate on majority of occasions but sometimes delayed (3–4) (as % of total) | No problem (5) (as % of total) | Comparison |
|---|---|---|---|---|
| Diabetic patients (n = 82) | 10 | 24 | 66 | |
| Control subjects ('weighted') (n = 47) | 2 | 41 | 57 | $\chi^2$ = 7.8 2 d.f. $p$ = < 0.02 |
| **Arousal** | **None or slight only (0–2)[b] (as % of total)** | **Moderate on majority of occasions (3) (as % of total)** | **Strong on majority of occasions (4) (as % of total)** | |
| Diabetic patients ($n$ = 82) | 15 | 46 | 39 | |
| Control subjects ('weighted') ($n$ = 47) | 23 | 51 | 26 | $\chi^2$= 3.0 2 d.f. NS |

[a] Scale 0–5; [b] scale 0–4

**Table 5.** Frequency of orgasm during sexual activity

| | Never (%) | 25% of occasions (%) | 50% of occasions (%) | 75% of occasions (%) | Always (%) | Comparison |
|---|---|---|---|---|---|---|
| Diabetic patients ($n$ = 82) | 17 | 6 | 16 | 23 | 38 | |
| Control subjects ('weighted') ($n$ = 47) | 12 | 9 | 24 | 10 | 46 | $\chi^2$ = 5.11 4 d.f. NS |

### *Retinopathy*

All patients had their fundi examined. They were classified as having no retinopathy ($n$ = 55), background retinopathy ($n$ = 24) or proliferative retinopathy ($n$ = 3).

## Results

### *Interview Ratings*

There were no significant differences in the frequency of sexual intercourse in the preceding 3 months between the two groups (Table 2).

The proportion of occasions when intercourse was a predominantly pleasurable experience (positive feelings) and when negative (unpleasant) feelings were experienced at some stage is shown in Table 3. The diabetic women were significantly less likely to report negative feelings. The distributions of ratings of vaginal lubrication and non-genital arousal (i.e. sexual excitement) are shown in Table 4. The diabetic women showed a significantly different distribution for vaginal lubrication with more in the worst and the best categories and fewer in the middle.

There was no significant difference in frequency of orgasm during sexual activity (Table 5). Twelve percent of diabetic women reported some pain and discomfort during intercourse on 25% or more of occasions compared with 4% of the control subjects, but this difference just failed to reach significance ($X^2$ = 3.65, 1 d.f., $p$ = < 0.1). No woman in either group suffered from vaginismus.

**Table 6.** Spontaneous sexual interest

| | (0–1)[a] Never or < once a month (%) | (2–3) < once a week (%) | (4–5) Once or more/week (%) | (6) Daily (%) | Comparison |
|---|---|---|---|---|---|
| Diabetic patients ($n$ = 82) | 45 | 12 | 34 | 9 | $\chi^2$ = 10.94 5 d.f. $p$ = <0.10 |
| Control subjects ('weighted') ($n$ = 47) | 31 | 23 | 41 | 5 | |

[a] Scale 0–6

**Table 7.** Semantic differential scores

| Scale (range) | Self | | | | | | Partner |
|---|---|---|---|---|---|---|---|
| | Sexual attractiveness (2–14) | Easy to arouse sexually (2–14) | Lovingness (3–21) | Calmness (2–14) | Potency (3–21) | General evaluation (2–14) | Potency (3–21) |
| Diabetic patients ($n$ = 77) | 9.6 ± 2.2 | 8.8 ± 2.9 | 18.0 ± 2.5 | 8.0 ± 3.1 | 14.8 ± 3.5 | 10.6 ± 1.8 | 16.5 ± 3.1 |
| Control subjects ('weighted') ($n$ = 43) | 9.7 ± 2.2 | 9.3 ± 1.8 | 17.6 ± 2.6 | 7.7 ± 2.7 | 16.4 ± 3.0 | 10.4 ± 2.0 | 17.8 ± 2.5 |
| Student's t-test | NS | NS | NS | NS | t = 2.52 p = <0.01 | NS | t = 2.27 p = <0.025 |

Results expressed as mean ± SD

**Table 8.** Comparison of women with and without symptomatic autonomic neuropathy for ratings of sexual arousal

| Arousal | None or slight only (0–2) (%) | Moderate on majority of occasions (3) (%) | Strong on majority of occasions (%) | |
|---|---|---|---|---|
| Diabetic patients *without* symptomatic autonomic neuropathy ($n$ = 50) | 12 | 38 | 50 | |
| Diabetic patients with 'borderline' autonomic neuropathy ($n$ = 16) | 13 | 56 | 31 | $\chi^2$ = 6.66 4 d.f. NS |
| Diabetic patients *with* symptomatic autonomic neuropathy ($n$ = 14) | 21 | 64 | 14 | |

Ratings of spontaneous sexual interest (i.e. not in response to partner's approach) are shown in Table 6. Diabetic women were more likely to report infrequent sexual interest, a difference which just missed the 5% level of significance. There were no differences between the groups in the ratings of partner's response.

### *Sexual Experience Scale*

On direct questioning, 70% of the patients believed that diabetes had no effect on their marital relationship, 9% felt that it had a detrimental and 21%, a beneficial effect, mainly because their husbands were more concerned about them.

Eighty-two percent of the diabetic women were satisfied with their sexual relationships, 8.5% were not satisfied but did not want help and the remaining 9.5% wanted to know how to obtain sexual counselling.

### *Semantic Differential*

The mean scores and standard deviations for each of the 'self' scales and the 'potency of partner' are shown in Table 7. None of the other 'partner' scales shows any difference between the two groups. The diabetic women rated themselves and their partners significantly less 'potent' than did the control women.

### *Diabetic Complications*

The 14 women with symptomatic autonomic neuropathy were compared with the 50 diabetic women with normal autonomic function. There were no significant differences in the frequency of sexual intercourse, spontaneous sexual interest, positive feelings, negative feelings, vaginal lubrication, orgasm, frequency or dyspareunia. They did, however, report slightly less sexual

arousal during sexual activity (Table 8), though this just failed to reach statistical significance.

In view of the small numbers, the 24 patients with background retinopathy were combined with three women with proliferative retinopathy. This combined group did not differ from the remainder on any of the measures of sexual function.

## Discussion

Some modest differences in sexual function have been found between our diabetic and control women. The diabetic subjects were different in the way they reported vaginal lubrication, being more likely to show both good and bad rather than intermediate ratings. They were slightly more likely to report dyspareunia and low spontaneous sexual interest. They were not different in orgasmic response and they reported less negative feelings during sexual intercourse.

In their attitudes, the diabetic women rated themselves and their partners as less 'potent'. (The individual concepts that make up the 'potency' scale are 'strong-weak', 'active-passive' and 'fast-slow').

Bias in selection of the patients and control subjects must be considered. More obvious sexual problems were probably screened out and hence the incidence of sexual difficulties is likely to be lower in our control subjects than in a random sample of the non-diabetic population. The effect of such bias, however, would be to accentuate differences between the groups. The relative lack of differences between them is therefore all the more striking. The differences in contraceptive usage is of uncertain relevance but is to be expected in view of the particular problems of contraception for diabetic women [17].

The assessment of autonomic neuropathy has been based on cardiovascular reflexes, and we have previously shown that these tests correlate with symptoms suggestive of autonomic neuropathy, with prognosis, that they reflect autonomic abnormalities in other systems and provide an objective measure of autonomic nerve damage [14–16, 18].

Borderline autonomic neuropathy did not appear to be associated with sexual impairment, but symptomatic autonomic neuropathy was in one respect. Women in this group were slightly less likely to experience strong sexual arousal or excitement (i.e. non-genital) during sexual intercourse. This modest difference deserves further consideration as it may reflect impairment of cardiovascular responses which is known to occur with autonomic neuropathy.

These various disadvantages that we identified are mild in comparison to those of diabetic men. Not only is the incidence of erectile dysfunction generally high amongst diabetic men, but those with severe autonomic neuropathy are invariably impotent [18]. Sudden unexplained deaths occur in severe symptomatic autonomic neuropathy. Of the 14 women with autonomic neuropathy in this study, two died suddenly a few months after being interviewed. One was troubled by diarrhoea during sexual activity but was still able to lubricate normally and experience orgasm, as was the other patient who died. The continuation of sexual response in the presence of severe autonomic neuropathy was also reported by Ellenberg [8]. Our findings are also similar to those of Jensen [5] who compared 80 diabetic women with 40 'normal' controls. Of his diabetic women, 27.5% reported sexual dysfunction, compared with 25% of the control subjects. The assessment of sexual response in these two studies was considerably less detailed than in our study. The commonest symptom in both Jensen's groups was reduced libido. We also cannot explain the difference between these two very similar studies and that of Kolodny [4] who reported a reduction in orgasmic capacity. In Kolodny's study, 35% of diabetic women had experienced no orgasm during the preceding year. This contrasts with 17% of our diabetic women and 12% of our control subjects, who had experienced no orgasm during the previous 3 months. In Jensen's study [5] the figures were 11% and 7.5% respectively, though the definition was not quite the same and the time interval was not stated. It may be that as hospitalised diabetic patients were used in Kolodny's study, more general debility or poorer diabetic control was present, producing a non-specific effect.

In interpreting these observations, it is appropriate to consider what sexual effects might be expected in diabetic men and women, given the current understanding of both the physiological and psychological factors involved.

Erection in the male is a vascular response under control of the autonomic nervous system [2]. Diabetic men may therefore be affected by either vascular disease, autonomic neuropathy or both. The effect will be an impairment of erection. Interference with autonomic control is probably also responsible for alteration in the emission process, though, typically, orgasm is not affected.

In woman, the genital response to sexual stimulation also relies on vascular mechanisms, the main consequences of which are the production of a vaginal transudate and some tumescence of the vaginal introitus, which facilitates penile entry. Erection of the clitoris does occur but its functional significance is uncertain. It is thought that similar specialised vascular mechanisms are involved in the female as in the male, but because of the anatomical differences, the consequences are different. Erection in the male is, in one important respect, an 'all or nothing' phenomenon. If the erection is not stiff enough, vaginal entry is difficult or impossible. Any impairment may thus generate considerable anxiety which can further inhibit the erectile mechanism. In contrast, the vaso-congestive responses of women are much less crucial to sexual performance. Inadequate vaginal lubrication can be easily corrected by

other means, and it is in any case not an 'all or nothing' phenomenon. There is no physiological reason to expect orgasm to be affected any more in diabetic women than in diabetic men.

The difference in male and female reactions to sexual difficulties are striking in non-diabetics. More than 75% of men attending sexual problem clinics complain of problems with genital or ejaculatory response; they seldom complain of inadequate enjoyment or interest. In women, the converse applies; more than 75% complain of inadequate enjoyment or interest, relatively few complain of orgasmic difficulties, and with the exception of post-menopausal women, few complain of inadequate lubrication [2]. Men typically focus on physiological function whilst women focus on the subjective quality of their sexual relationship.

What are the implications of diabetes for the quality of a relationship? If there is a tendency for the marriages of diabetic women to be more caring, or for the women to feel less resentment towards their spouses, then the positive consequences on the sexual relationship could counteract any modest physiological deficit. We have some evidence to support this view in that 17 of our patients felt that diabetes made their husbands more concerned about them. Also the diabetic women described less negative feelings during intercourse. They saw their partners and themselves as less 'potent' (i.e., in non-sexual terms), possibly because they saw them as more caring or more gentle. A more detailed analysis of the quality of diabetic marriages will be necessary before this issue can be resolved, but these relationship issues may play a different role in diabetic women than in diabetic men, and account for at least part of the observed differences.

The relative immunity of vaginal response to the effects of autonomic neuropathy is surprising. There may be sex differences as yet not understood in the way the autonomic nervous system controls these genital responses.

In future studies of the sexuality of diabetics, more attention should be paid to the quality of the sexual relationship, in particular the comparison of the marriages of male diabetics with those of females.

*Acknowledgments.* This study was supported by a grant from the British Diabetic Association. Dr. D.J. Ewing holds a Wellcome Trust Senior Lecturership.

## References

1. McCulloch DK, Campbell IW, Wu FC, Prescott RJ, Clarke BF (1980) The prevalence of diabetic impotence. Diabetologia 18: 279–283
2. Bancroft J (1983) Human sexuality and its problems. Churchill Livingston, Edinburgh (in press)
3. Fairburn CG, Wu FC, McCulloch DK, Borsey DQ, Ewing DJ, Clarke BF, Bancroft J (1982) The clinical features of diabetic impotence: a preliminary study. Br J Psychiat 140: 447–452
4. Kolodny RC (1971) Sexual dysfunction in diabetic females. Diabetes 20: 557–559
5. Jensen SB (1981) Diabetic sexual dysfunction: a comparative study of 160 insulin treated diabetic men and women and an age-matched control group. Arch Sex Behav 10: 493–504
6. Zrustová M, Rostlapil J, Kabrhelová A (1978) Sexualníporuchy u žen s úplavici cukrovou Cs Gynekologie 43: 277–280
7. Montenero P, Donatone E, Magi D (1973) Diabète et activité sexualle chez la femme. Annelles Diabetologie de L'Hotel-Dieu. 11–13: 91–103
8. Ellenberg M (1977) Sexual aspects of the female diabetic. Mt Sinai J Med 44: 495–500
9. Nie NH, Hull CH, Jenkins JG, Steinbrenner K, Bent DH (1975) Statistical package for the social sciences, 2nd edn. McGraw-Hill, New York
10. Bancroft J, Tyrer G, Warner P (1982) The assessment of sexual problems in women. Br J Sexual Med 9: 30–37
11. Whitehead A, Mathews A (1976) Attitude change during behavioural treatment of sexual inadequacy. Br J Soc Clin Psychol 16: 275–281
12. Frenken J (1976) Afkeer van seksualiteit. Van Loghum, Slaterus-Deventer. (English summary, pp 219–225)
13. Bancroft J (1982) Sexuality of diabetic women. In: Bancroft J (ed) Diseases of sex and sexuality. Clinics in Endocrinology and Metabolism, 11. Saunders, London, pp 785–789
14. Ewing DH (1978) Cardiovascular reflexes and autonomic neuropathy. Clin Sci Mol Med 55: 321–327
15. Ewing DH, Campbell IW, Clarke BF (1980) Assessment of cardiovascular effects in diabetic autonomic neuropathy and prognostic implications. Ann Intern Med 92: 308–311
16. Clarke BF, Ewing DJ, Campbell IW (1979) Diabetic autonomic neuropathy. Diabetologia 17: 195–212
17. Steel JM, Duncan LJP (1980) Contraception for the insulin dependent diabetic. Diabetes Care 3: 557–560
18. Ewing DJ, Campbell IW, Clarke BF (1980) The natural history of diabetic autonomic neuropathy. Q J Med 49: 95–108

Received: 4 June 1982
and in revised form: 10 November 1982

Dr. J.M. Steel
Diabetic Department
Royal Infirmary
Edinburgh EH3 9YW
Scotland, UK