Control of type 1 diabetes mellitus and shift work

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Background
People with type 1 diabetes may find diabetic control more difficult when working shifts.

Aims
To investigate the proportion of people with type 1 diabetes in employment undertaking shift work and diabetic control as assessed by glycosylated haemoglobin (HbA1c) among individuals undertaking shift work compared to those not doing so.

Methods
A postal questionnaire sent to all those aged 16–65 attending two city hospitals for type 1 diabetes care. HbA1c results were used to assess diabetic control.

Results
Twenty-two per cent (296 of 1370 eligible patients) responded. Sixty-seven (23%) respondents were involved in shift work. Shift workers had higher mean HbA1c values than non-shift workers (9.02 versus 8.35; \(P < 0.01\)).

Conclusions
Poorer control of diabetes was associated with working shifts in this study. Occupational health practitioners should be aware of this association and be able to advise on management strategies to improve diabetic control while working shifts.

Key words
Diabetes; employment; HbA1c; shift work.

Introduction
Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycaemia due to insulin deficiency or resistance or both. It leads to both microvascular and macrovascular complications [1]. HbA1c is a fraction of glycosylated haemoglobin (normal value <7%), and its measurement provides an accurate estimate of mean glucose levels over the preceding 6 weeks, which correlates with the risk of microvascular complications [1].

Previous research suggested twice the number of people with type 1 diabetes who do shift work experience problems with their jobs compared to controls [2]. In addition, a higher rate of sickness absence has been shown to be associated with manual work activity in those with diabetes [3]. Recent research continues to show that sickness absence is higher in people with diabetes (types 1 and 2) [4,5]. A previous study of 32 workers with diabetes did not show an effect of shift work on the control of diabetes [6]. However, since these earlier studies evidence has emerged of the benefit of ‘tight’ control to reduce the rate of microvascular complications [7].

This study set out to assess the proportion of employed people with type 1 diabetes working shifts, and diabetic control in shift workers compared to those not involved in shift work.

Methods
All patients with type 1 diabetes who attended two city hospitals annually, who were at least a year post-diagnosis and aged between 16 and 65 were identified from the SCI-DC (Scottish Care Information Diabetes Collaboration) database, a reliable source of clinical information updated regularly by community and hospital staff in Scotland. Ethical approval was granted by the Glasgow Royal Infirmary Research and Ethics Committee.

Over a 3-month period, they were sent a questionnaire, information sheet and consent form. Questions covered demographics, length of time with diabetes, employment status and type (using a modified standard occupational classification) and whether their work involved shift or night work. Shift work was defined as work scheduled outside standard daytime hours and night work as 3 h work between 11 p.m. and 6 a.m. After 4 weeks, non-responders were sent repeat paperwork.

The HbA1c result was retrieved electronically.

The results were analysed using the SPSS software package (SPSS Inc., Chicago, IL) using both descriptive (t-test, chi-squared test) linear and logistic regression analysis.
Results

A total of 296 of 1370 eligible patients (22%) responded. A single patient with type 2 diabetes was identified and excluded from the analysis; 149 (50%) were male, 231 (78%) were in employment of whom 79 (33%) undertook manual work and 152 other types of work (including professional (45; 15%), office workers (39; 13%) and nursing (22; 7%)). Overall shift work was performed by 67 (23%) with 47 (70%) involved in night working. Shift work was more common in manual workers (42%; 33/79) compared with non-manual workers (21%; 32/152; \( P < 0.01 \)). The majority (61%) of participants had been diagnosed with type 1 diabetes for more than 15 years.

The mean HbA1c overall was 8.6% (range 5.3–12.3%). Both advancing age and increased duration of type 1 diabetes were associated with higher HbA1c values. Shift work was significantly associated with higher HbA1c in shift workers (9.0% versus 8.35% in non-shift workers) (Figure 1). Multivariate regression modelling, performed on the employed participants, suggested that shift work may itself have a significant effect on control of diabetes (\( P < 0.01 \)) whereas age, duration of diabetes and type of employment had no significant effect.

Discussion

The principal finding was that shift work was associated with poorer diabetic control in workers with type 1 diabetes. Other variables had no effect in multiple logistic regressions.

Shift and night work lead to differing activity levels and changes to meal times and may involve snacking on high fat foods as these may be all that is available outside normal working hours. Changes in the circadian rhythms of counter-regulatory hormones may also impact on the ability to control blood glucose, an example being the ‘dawn phenomenon’ where blood sugar elevation occurs in the morning as a result of changes in counter-regulatory hormones [8,9]. Changes to wake/sleep patterns caused by shift work impact on circadian rhythms which may not adapt to a night work schedule in non-diabetic workers [10]. Intolerance of shift working due to failure to align the circadian rhythms to a new working time pattern is more likely in rapidly rotating shifts. For those with diabetes, such a work pattern requires changes to meal times and the timing of insulin doses need to be adjusted without inducing hypoglycaemic episodes. This may account for their poorer glycaemic control.

Twenty-three per cent of subjects undertook shift work, a figure higher than the UK average at the time of the study (18.4%). Both groups had poor glycaemic control but this was significantly poorer in shift workers.

The main limitation of this study is the low response rate, which may have introduced a bias in our results. We found more shift workers in our study population than expected, suggesting a selection bias. Higher participation may have been achieved by face-to-face interviews. Despite reassurances of confidentiality reasons for the low response may include sensitivity regarding employment status, reluctance to disclose private health details and concerns that participation may affect benefit payments. However, the numbers studied who were in employment (shift workers and non-shift workers) were sufficient to be able to compare diabetic control between these groups. A study of this kind cannot confirm a causal association between shift work and poorer diabetic control and further studies are required to investigate this association more fully. Other studies have demonstrated that this is detrimental to short-term sickness absence [3] and long-term health [7]. This study did not enquire about the varying working hours and patterns of shift working, which is a topic requiring further investigation.

![Figure 1](image_url). HbA1c of non-shift (n = 164) and shift workers (n = 67) showing that shift workers have a higher HbA1c result (\( P < 0.05 \), t-test).
Our findings suggest shift work may adversely affect diabetic control and occupational health practitioners should therefore be aware of the available methods of treatment for type 1 diabetes and be able to counsel workers on how best to manage diabetes during shift working and during changing shift patterns.

**Key points**
- The current global trend towards round the clock working may result in more people with type 1 diabetes working shifts and at night.
- Control of blood sugars with rotating shift patterns, varied eating habits and times, alterations in physical activity and fluctuations in natural hormone levels represents a challenge to optimum insulin dosing in diabetic workers working shifts and at night.
- Study subjects with type 1 diabetes who worked shifts were more likely to have a higher HbA1c, increasing their risk of microvascular complications in the long term.

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**Conflicts of interest**
None declared.

**References**