Relationship between diabetes knowledge, glycaemic control and quality of life: Pilot study

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Article points

1. Knowledge of diabetes by the individual with the condition is important for effective management.
2. In this pilot study, participants' knowledge about type 2 diabetes was limited and varied with the subgroup and mode of treatment.
3. Type 2 diabetes had a negative impact on all domains and glycaemic control was suboptimal.
4. No significant association between type 2 diabetes knowledge, glycaemic control and quality of life could be demonstrated.
5. Overall, the findings suggest that the relationship between participants' knowledge of diabetes and glycaemic control is complex.

Key words

- Diabetes knowledge
- Glycaemic control
- Quality of life
- Type 2 diabetes

Authors' details can be found at the end of the article.

While it is generally assumed that good diabetes knowledge in the individual with the condition leads to better clinical outcomes (including glycaemic control) and diabetes-related quality of life (QoL), studies exploring the relationship between knowledge, glycaemic control and QoL are lacking. This article describes a pilot study conducted to examine this relationship in people with type 2 diabetes managed in primary care. Findings suggest that the relationship between knowledge and diabetes control is complex. The authors conclude that the challenge is to develop educational programmes that enhance knowledge in tandem with other factors reflecting the characteristics and needs of the individual at specific points in their disease experience.

The World Health Organization (2000) has estimated that at least 171 million people worldwide have diabetes, and this number is predicted to double by 2030. Type 2 diabetes accounts for 70–90% of the diabetes population, and diabetes complications impact adversely on both the quantity and quality of life (QoL) and are very costly to manage. There is, however, strong evidence that effective management with tight glycaemic control significantly reduces the onset and progression of complications and mortality (Stratton et al, 2000; Holman et al, 2008a; b).

Central to this management is support for individuals in managing their own care through self-care behaviours relating to diet, exercise, self-monitoring of blood glucose and adherence to medication regimens. The acquisition of diabetes knowledge is regarded as a major component in the development of self-care behaviours. However, many people with diabetes find it difficult to adapt their lifestyle and adhere to therapeutic regimens (Murata et al, 2003; Whittemore et al, 2003), which suggests that the relationship between knowledge and self-care behaviours is complex.

At a more fundamental level, it is not known whether good diabetes knowledge leads to better diabetes outcomes, including glycaemic control, (Duke et al, 2009). Evidence from meta-analyses of educational interventions (Brown, 1990; 1992; Norris et al, 2002; Loveman et al 2003) show that, while education increases knowledge, the effect on glycaemic control is smaller and declines over time (Davies et al, 2008), although regular reinforcement or programmes of longer duration are associated with more enduring outcomes.

While glycaemic control is a central objective in the management of diabetes, QoL is a particularly important consideration. The relationship between QoL and diabetes knowledge is not well researched. Studies of educational interventions suggest that diabetes education (and acquisition of associated knowledge) may promote QoL (Özer et al, 2003; Tankova et al, 2004); however, this effect could be independent of the knowledge gained. It is therefore important to understand more about the effect of knowledge on QoL as well as on glycaemic control.

Aim

This pilot study was conducted to explore the relationship between diabetes knowledge, glycaemic control and diabetes-related QoL in people with type 2 diabetes managed in primary care in the UK.

Method

A cross-sectional survey was conducted in a primary care setting. As a pilot study it also set out to explore the influence of potential confounding factors, including treatment levels (diet only, oral therapy and insulin), and examine the feasibility of the method. Additional data were collected to explore the relationship between diabetes knowledge and diabetes-specific QoL.

The analysis addressed the following questions:

1. Are there any variations in diabetes knowledge by demographic variables?
2. Are there any differences in diabetes knowledge by disease variables?
3. Is there a relationship between diabetes knowledge, glycaemic control and diabetes-specific QoL?

Sample

Participants were recruited from a single general practice in northwest London. The practice had seven doctors and three practice nurses, as well as a GPSI in diabetes. The total number of people on the practice list was approximately 7500. All those with type 2 diabetes known to the practice (i.e. on the practice diabetes register; *n*=182) were invited to participate.

Data collection

Data were collected from participants' electronic medical records and by structured interviews using two standardised instruments for the assessment of diabetes knowledge and QoL, respectively. The clinical records provided some demographic data and a full set of clinical data (current management regimen and glycaemic control).

Diabetes knowledge was assessed using the Audit of Diabetes Knowledge (ADKnowl) standardised tool (Speight and Bradley, 2001), one of the few diabetes knowledge measures designed for use with people who have type 2 diabetes. It comprises 27 item-sets and the scale scores from 0 to 100, reflecting the percentage of correctly answered items. There are limited data on the reliability and validity of the measure, although the subscales show a high level of internal consistency (α=0.78; Rosal et al, 2005).

QoL was assessed using the ADDQoL (Audit of Diabetes Dependent QoL; Bradley et al, 1999). The ADDQoL comprises two overview items as indicators of QoL and the impact of diabetes on QoL, and a further 18 items regarding the impact of the disease on specific aspects of life, such as working life, family life, physical functioning, finances and freedom to eat (Bradley and Speight, 2002).

The items use a seven-point scale (3 to –3) and ask participants how particular aspects of their life would be if they did not have diabetes (impact); participants then rate the importance of these aspects on a 4-point scale (3 to 0) (importance). Impact ratings are weighted by importance ratings to give a weighted impact score ranging from 9 to –9 and the average of responses to all applicable domains is taken. This gives an average weighted impact (AWI) score indicating overall diabetes-related QoL. AWI ranges from –9 (maximum negative impact of diabetes) to +9 (maximum positive impact of diabetes), with a score of 0 indicating that diabetes has no overall effect on the QoL aspects measured by the scale.

Page points

1. This pilot study was conducted to explore the relationship between diabetes knowledge, glycaemic control and diabetes-related quality of life (QoL) in people with type 2 diabetes managed in primary care in the UK.
2. Participants were recruited from a single general practice in northwest London. The practice had seven doctors and three practice nurses, as well as a GPSI in diabetes.
3. Data were collected from electronic medical records and from structured interviews using two standardised instruments for assessment of diabetes knowledge and QoL, respectively.
4. Diabetes knowledge was assessed using the Audit of Diabetes Knowledge standardised tool.

Page points

1. A pre-pilot study indicated that postal recruitment was unlikely to yield an adequate response rate, so a face-to-face approach in the form of structured interviews was adopted.
2. Participants were also given the option to self-complete the questionnaire if they wished.
3. The aim of the study was to identify any potential relationships between diabetes knowledge, glycaemic control and diabetes-related quality of life.
4. Consideration was also given to any potential confounding factors (demographic and diabetes characteristics) to inform larger-scale modelling.
5. The analysis focused on identifying underlying trends in the data rather than on testing specific effects.

Internal consistency is high (α=0.92; Bradley and Speight, 2002).

A pre-pilot study indicated that postal recruitment was unlikely to yield an adequate response rate, so a face-to-face approach was adopted. Invitation letters with full information about the project were sent to all potential participants. Once written consent was obtained, a structured interview was conducted. The scales were replicated on to large laminated cards so that participants could indicate their response easily. Participants were also given the option to self-complete the questionnaire if they wished. Ethical approval was obtained from a UK health service research ethics committee.

Table 1. Characteristics of participants.

Characteristic	Number of participants (%)
Gender	
Male	23 (56.1)
Female	18 (43.9)
Age (years)	mean 69.3 (SD 9.6)
Marital status	
Single	8 (19.5)
Married	25 (60.9)
Separated	1 (2.4)
Divorced	1 (2.4)
Widowed	6 (14.6)
Employment status	
Employed	10 (24.4)
Unemployed	1 (2.4)
Unable to work due to long-term illness	1 (2.4)
Looking after home/family	1 (2.4)
Retired from paid work	26 (63.4)
Retired for other reasons	2 (4.9)
Ethnicity	
White	27 (65.9)
Black/Caribbean	3 (7.3)
Black/African	1 (2.4)
Indian	2 (4.9)
Pakistani	2 (4.9)
Any other	6 (14.6)
Mean diabetes duration (years)	6.1
Treatment type	
Diet only	10 (23.8)
OADs only	22 (52.4)
Insulin only	3 (7.1)
Insulin and OADs	7 (16.7)
HbA$_{1c}$	mean 7.75% (61.2 mmol/mol) SD 1.9% (21 mmol/mol)

OAD=oral antidiabetes drug;
SD=standard deviation

Data analysis

The aim of the analysis was to identify any potential relationships between knowledge, glycaemic control and QoL, considering any potential confounding factors (demographic and diabetes characteristics) to inform larger scale modelling. The analysis focused on identifying underlying trends rather than on testing specific effects, and was guided by the questions posed earlier.

Descriptive and bivariate analyses were conducted using the statistical package SPSS, (version 13.0). Statistical significance was set at $\alpha \leq 0.05$ and all inferential tests were two-tailed, as the direction of the effect was not hypothesised. A comparison of participant and non-participant characteristics was undertaken using chi-squared tests for categorical and t-test for continuous variables. Between-group comparisons were undertaken using one-way analysis of variance (ANOVA), the Mann-Whitney U test and the Kruskal–Wallis test. The relationship between diabetes knowledge, glycaemic control and diabetes QoL was explored using Pearson's correlations.

Results

Characteristics of participants

Forty-two of the 182 invited patients participated, giving a response rate of 23% (*Figure 1*). Participants' characteristics are detailed in *Table 1.* There are missing data for two participants: one did not fill out the demographic part of the questionnaire and one did not fill out the ADKnowl questionnaire. Where both variables are considered (in *Tables 2* and *3*) there are data for 40 participants. The only statistically significant difference between participants (n=42) and non-participants (n=133) was age, with participants being older (P<0.001).

Diabetes knowledge (ADKnowl)

The mean overall knowledge score was 55.5 (standard deviation [SD] 21.6). The complications subscale had the highest mean knowledge score (78.3; SD 21.6), followed by the effects of physical exercise (51.3; SD 35.3), diet and food (49.5; SD 20.0) and treatment (47.1; SD 22.3) subscales.

Glycaemic control (HbA$_{1c}$)

HbA$_{1c}$ levels ranged from 5.7% (39 mmol/mol) to 12.1% (109 mmol/mol) (mean 7.75% [61.2 mmol/mol]; SD 1.9% [21 mmol/mol]; *Table 1*). As expected, glycaemic control varied with mode of treatment, with better HbA$_{1c}$ levels in the diet-only group (mean 6.3% [45 mmol/mol]; 95% confidence interval [CI] 5.1–7.4% [32–57 mmol/mol]) compared with the medication group (mean 7.9% [63 mmol/mol]; 95% CI 7.2–8.7 [55–72 mmol/mol]) and insulin group (mean 8.0% [64 mmol/mol], 95% CI 6.7–9.2% [50–77 mmol/mol]) (P=0.048).

There were no significant differences in HbA$_{1c}$ level between men and women. HbA$_{1c}$ level was not significantly correlated with either age or diabetes duration, although there was a slight trend towards an inverse relationship between HbA$_{1c}$ level and age (r=–0.3; P=0.06).

Diabetes-related QoL (ADDQol)

Diabetes had a negative impact on participants' QoL. The mean AWI was –2.2 (SD 2.0). The five domains where diabetes had the greatest negative impact were enjoyment of food (mean –4.2; SD 3.3), freedom to eat (mean –3.8; SD 3.7), family life (mean –3.3; SD 3.3), social life (mean –2.8; SD 3.4) and worries about the future (mean –2.7; SD 3.2).

Participants on insulin therapy and oral medication had significantly lower QoL (P=0.04) than those on diet only. There were no significant differences in QoL related to gender, and no significant correlation between age and QoL (r=–0.05). There was a weak association between QoL and disease duration (r=–0.23).

Question 1. Are there any variations in diabetes knowledge by demographic variables?

There was no statistically significant difference in the overall knowledge scores of men and women, but men showed a trend towards a higher mean knowledge (*Table 2*). This trend was consistent across the knowledge subscales, except for the food subscale where women scored higher. This difference was strongest in the treatment subscale, reaching statistical significance (P=0.01).

Age was negatively correlated with diabetes knowledge (older people were less knowledgeable), but the correlation was not statistically significant (r=–0.3; P=0.06). Weak and non-significant correlations between age and knowledge subscales were also seen: physical exercise (r=–0.29), complications (r=–0.23), treatment (r=–0.16) and food (r= –0.12).

Question 2. Are there any differences in diabetes knowledge by disease variables?

Overall diabetes knowledge (ADKnowl total score) varied significantly with mode of treatment (diet only, oral medication only and on insulin). The medicated groups (oral and insulin) showed significantly higher levels of knowledge (*Table 2*) although most of the difference was contributed by the treatment subscale. When this subscale was used as a covariate, the difference between the treatment groups' total ADKnowl scores were no longer significant. No significant correlations were found between disease duration and overall diabetes knowledge (ADKnowl total score) or any ADKnowl subscales.

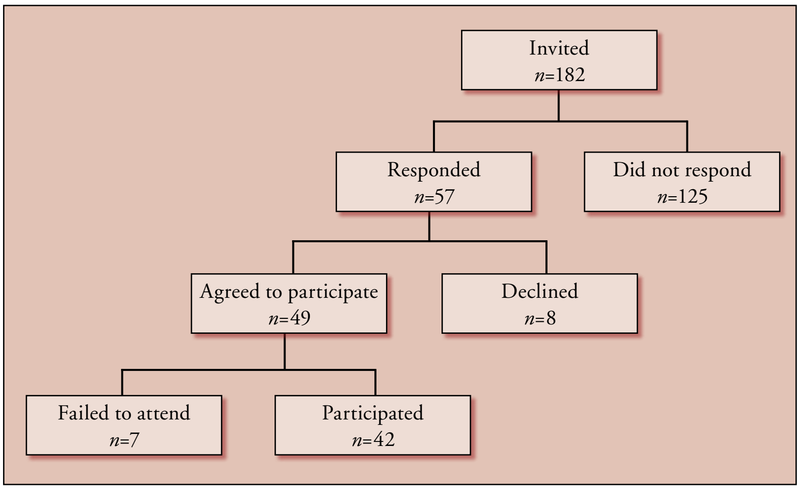


Figure 1. Flowchart of sample participation.

Page points

1. There were no significant differences in HbA$_{1c}$ level between men and women. HbA$_{1c}$ level was not significantly correlated with either age or diabetes duration, although there was a slight trend towards an inverse relationship between HbA$_{1c}$ level and age.
2. There was no statistically significant difference in the overall knowledge scores of men and women, but men showed a trend towards a higher mean knowledge.
3. Age was negatively correlated with diabetes knowledge (older patients were less knowledgeable), although this correlation was not statistically significant.
4. Overall diabetes knowledge varied significantly, depending on treatment (diet only, oral medication only, and on insulin).

Table 2. Knowledge scores by gender and mode of treatment.

	Gender			Mode of treatment			
ADKnowl scales	Male (*n*=22) Mean (95% CI)	Female (*n*=18) Mean (95% CI)	*P*-value	Diet only (*n*=9) Mean (95% CI)	OADs only (*n*=22) Mean (95% CI)	Insulin (*n*=10) Mean (95% CI)	*P*-value
Total score	60.7 (52.0–69.5)	50.5 (40.5–60.4)	*P*=0.07	41.8 (27.7–55.8)	60.4 (51.9–68.8)	60.3 (47.7–72.9)	*P*=0.02*
Subscales							
Food	48.4 (39.6–57.2)	50.9 (40.8-60.9)	*P*=0.81	41.9 (27.4–56.4)	51.1 (42.3–59.8)	53.5 (40.6–66.5)	*P*=0.4
Treatment	54.5 (45.4–63.7)	37.4 (27.0-47.8)	*P*=0.01**	26.8 (12.5–41.1)	54.9 (46.2–63.5)	46.4 (33.6–59.2)	*P*=0.006**
Physical exercise	56.8 (41.6–72.1)	42.6 (25.3-60.0)	*P*=0.22	34.4 (9.5–59.2)	51.1 (36.2–66.1)	65.0 (42.8–87.2)	*P*=0.2
Complication risk	83.2 (74.1–92.4)	71.0 (60.6-81.3)	*P*=0.08)	64.1 (49.3–78.8)	84.4 (75.5–93.3)	76.3 (63.0–89.5)	*P*=0.06

*$P \leq 0.05$; **$P \leq 0.01$; ADKnowl=Audit of Diabetes knowledge; CI=confidence interval; OAD=oral antidiabetes drug

Table 3. Knowledge scores overall and by gender and mode of treatment: Pearson's correlation (*P*-value).

ADKnowl scales	Overall (*n*=40)		Gender: Male (*n*=22)		Gender: Female (*n*=18)		Mode of treatment: Diet only (*n*=9)		Mode of treatment: OADs only (*n*=22)		Mode of treatment: Insulin (*n*=10)	
	HbA_{1c}	ADDQoL	HbA_{1c}	ADDQoL	HbA_{1c}	ADDQoL	HbA_{1c}	ADDQoL	HbA_{1c}	ADDQoL	HbA_{1c}	ADDQoL
Total score	0.20 (*P*=0.3)	0.09 (*P*=0.5)	0.08 (*P*=0.7)	0.16 (*P*=0.5)	0.22 (*P*=0.4)	0.13 (*P*=0.6)	–0.33 (*P*=0.4)	0.36 (*P*=0.4)	0.14 (*P*=0.5)	0.11 (*P*=0.7)	–0.37 (*P*=0.4)	–0.51 (*P*=0.1)
Subscales												
Food	0.17 (*P*=0.3)	0.20 (*P*=0.2)	0.23 (*P*=0.3)	0.22 (*P*=0.3)	0.08 (*P*=0.8)	0.22 (*P*=0.4)	–0.10 (*P*=0.8)	–0.06 (*P*=0.9)	0.13 (*P*=0.6)	-0.01 (*P*=0.9)	0.13 (*P*=0.8)	–0.24 (*P*=0.5)
Treatment	0.19 (*P*=0.3)	0.04 (*P*=0.8)	0.16 (*P*= 0.5)	0.24 (*P*=0.3)	0.08 (*P*=0.8)	-0.33 (*P*=0.9)	–0.33 (*P*=0.8)	0.25 (*P*=0.7)	0.14 (*P*=0.5)	0.12 (*P*=0.6)	–0.46 (*P*=0.3)	–0.42 (*P*=0.2)
Physical exercise	0.16 (*P*=0.4)	–0.10 (*P*=0.5)	–0.02 (*P*=0.9)	–0.03 (*P*=0.9)	0.38 (*P*=0.2)	–0.10 (*P*=0.7)	–0.08 (*P*=0.9)	0.44 (*P*=0.4)	0.14 (*P*=0.5)	0.11 (*P*=0.6)	–0.25 (*P*=0.6)	–0.43 (*P*=0.2)
Complication risk	0.06 (*P*=0.8)	0.09 (*P*=0.6)	–0.05 (*P*=0.8)	0.33 (*P*=0.1)	0.02 (*P*=0.9)	0.08 (*P*=0.8)	0.02 (*P*=0.9)	–0.06 (*P*=0.9)	0.00 (*P*=0.9)	0.13 (*P*=0.7)	–0.45 (*P*=0.3)	–0.29 (*P*=0.4)

ADDQoL=Audit of Diabetes Dependent Quality of Life; ADKnowl = Audit of Diabetes knowledge; OAD=oral antidiabetes drug

Question 3. Is there a relationship between diabetes knowledge, glycaemic control and QoL?
There were no significant correlations between either HbA_{1c} or ADDQoL and total and subscale ADKnowl scores (*Table 3*). The same variables showed no significant correlations by gender, although there were some variations between genders in the direction of the correlations. While positive for both genders, total knowledge seemed to be more strongly associated with HbA_{1c} in females, suggesting that the potential association between being knowledgeable and poorer glycaemic control was stronger in women. Food and treatment subscales were positively related to HbA_{1c} (more knowledge on these subscales was associated with higher HbA_{1c}) whereas physical exercise and complication risk subscales were inversely associated with HbA_{1c} (more knowledge on these subscales associated with lower HbA_{1c}).

In terms of ADDQoL, the strength of the association between total knowledge score and QoL was comparable in both genders. However, women's QoL was more likely to be negatively impacted by greater knowledge, especially in the treatment and physical exercise subscales. No significant correlations with mode of treatment were found, although there were differences in the underlying direction of the relationships between the groups. In the diet and insulin groups, greater knowledge was associated with better glycaemic control, whereas in the OAD only group greater knowledge was weakly associated with poorer control (*Table 3*). Among those on insulin therapy, greater knowledge was consistently more strongly associated with poorer QoL compared with those on diet only or on OADs.

Discussion

The overall level of knowledge, as measured by the ADKnowl, suggested that participants had a basic knowledge of their condition. However, there were some important limitations to their knowledge, particularly in relation to treatment and diet. As in previous studies, an inverse association was identified between age and knowledge, and between duration of diabetes and knowledge (Brown, 1990; Speight and Bradley, 2001; Murata et al, 2003), and insulin-treated people were more knowledgeable than non-insulin treated people.

There are two possible explanations for this difference: first, those with type 2 diabetes on insulin tend to have had diabetes for longer and, through time, acquire more knowledge; second, the complex nature of the self-care associated with insulin therapy demands a greater knowledge level. However, the insulin-treated group also had poorer glycaemic control, which may have prompted healthcare professionals to increase their exposure to educational messages, thereby increasing their knowledge.

The data suggest that participants with the weakest knowledge were those in the early stages of the disease. This indicates a failure to provide effective initial patient education or inadequate reinforcement of messages regarding lifestyle and self-care behaviour.

In recognition of this potential care deficit, a programme of structured education based in primary care, DESMOND (Diabetes Education Self-Management On-going and Newly Diagnosed) was introduced into the UK. A multicentre randomised controlled trial by Davies et al (2008) found improvements in weight loss and smoking cessation as well as positive improvements in beliefs about illness, but no differences in HbA_{1c} levels up to 12 months after diagnosis. Davies et al (2008) reinforced previous reports (Zabaleta and Forbes, 2007) of a lack of significant effect of group-based education programmes on glycaemic control in primary care, although its impact on longer-term glycaemic control has not yet been studied. The message here may be that in addition to education (even education following an empowerment model), people with diabetes need further support to translate their educational experiences into enduring positive coping skills and self-care behaviours.

In terms of QoL, the data were consistent with other studies showing a negative effect of diabetes on QoL (Bradley and Speight, 2002; DAFNE [Dose Adjustment for Normal Eating] Study Group, 2002). The findings also suggest that QoL differed significantly among the treatment groups, with those on insulin having significantly poorer QoL, confirming Bradley et al's (1999) observation

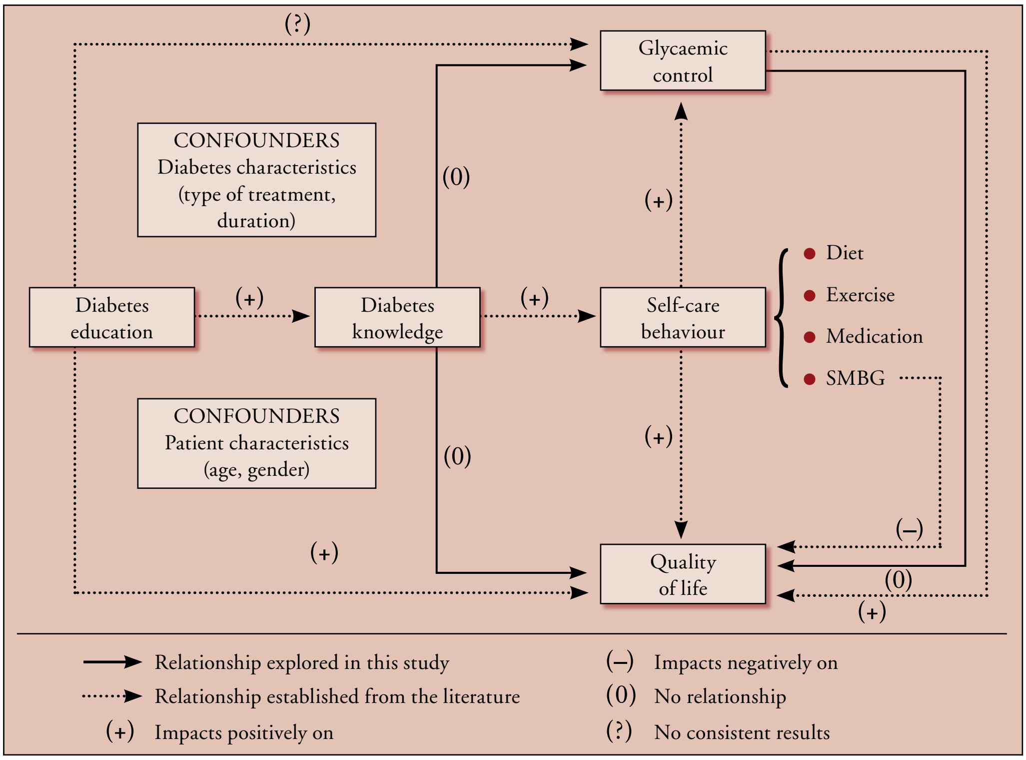
Page points

1. While positive for both genders, total knowledge seemed to be more strongly associated with HbA_{1c} in females, suggesting that the potential association between being knowledgeable and poorer glycaemic control was stronger in women.
2. Food and treatment subscales were positively related to HbA_{1c} (more knowledge on these subscales was associated with higher HbA_{1c}) whereas physical exercise and complication risk subscales were inversely associated with HbA_{1c} (more knowledge on these subscales associated with lower HbA_{1c}).
3. The data suggest that participants had a basic knowledge of their disease, but with some important limitations, particularly in relation to treatment and diet.

Page points

1. A number of confounding factors that may influence the relationship between knowledge and glycaemic control were identified, in particular diabetes duration and higher levels of therapeutic input (oral medication and insulin).
2. A fairer assessment of the relationship between knowledge and glycaemic control might be obtained by considering cohorts of people at similar points in the disease trajectory and those on similar therapeutic regimens.
3. A hypothetical model was developed to help conceptualise the relationship, based on the trends observed and findings of previous studies.
4. The model identifies some of the variables that may be relevant in future modelling of the relationship.

Figure 2. Model of relationships in diabetes management (SMBG=self-monitoring of blood glucose).



during the validation work for the ADDQoL. However, this may have been due to participants on insulin having had diabetes for longer.

While no statistically significant relationships between diabetes knowledge, glycaemic control and QoL were found in this pilot study, some trends and variations in the data are worthy of exploration in a larger study. Indeed, some of these trends were moderately strong (r>0.2), giving a useful indicator for calculating the sample size required for a larger study of sufficient power to test these associations.

This study also highlights a number of confounding factors that may influence the relationship between knowledge and glycaemic control, in particular diabetes duration and higher levels of therapeutic input (oral medication and insulin). These may explain why higher knowledge is associated with poorer glycaemic control. Perhaps a fairer assessment of the relationship between knowledge and glycaemic control would be obtained by considering cohorts of people at similar points in the disease trajectory and those on similar therapeutic regimens.

Overall, the data suggest that the relationship between knowledge and diabetes control is complex. A hypothetical model was developed to help conceptualise this relationship, based on the trends observed in these data and the findings of previous studies (Brown, 1990; Loveman et al, 2003; Persell et al, 2004) (*Figure 2*).

The model identifies some of the variables that may be relevant in future modelling of the relationship between knowledge and glycaemic control or in experiments seeking to manipulate knowledge to establish a glycaemic effect. The model highlights the two main areas relating to the direct association between diabetes knowledge and glycaemic control and QoL, in which the pathway connecting the study variables and potential confounders remains unclear and requires further exploration.

Finally, given the heterogeneous nature of the relationship between different types of knowledge and diabetes control, it may be worthwhile exploring the meaning of diabetes knowledge from the perspective of the person with diabetes in more depth. A clearer understanding of the perceptions of those with the condition would be useful in establishing different patterns of understanding and planning educational input within care pathways.

Study limitations

This study must be considered in the context of the following limitations.

The sample size was small and there is evidence of sample bias, with younger people underrepresented. The fact that participants were older is noteworthy, as older people are often underrepresented in studies, owing to difficulties in recruiting them (Forbes et al, 2002). A possible explanation for this bias is that interviews took place during the daytime, excluding those who were working.

The study was conducted in an ethnically diverse setting, but participants were mainly white Europeans. Recruiting people from minority groups is notoriously problematic. The external validity of the study is therefore limited. However, identifying these biases will be useful in helping to inform a larger study.

Finally, an inherent weakness of cross-sectional studies is that they only describe relationships between variables at one moment in time, limiting the potential to explore any underlying effects or directions in the relationships observed.

Conclusion

The study findings challenge the assumption that improved knowledge of type 2 diabetes leads to better clinical outcomes, and suggest that the relationship between knowledge and clinical outcomes is not straightforward. There may be important variations in the relationship between glycaemic control and knowledge, depending on the individual's level of treatment and diabetes experience, in addition to other underlying factors such as gender and age.

Such variations should caution any view of diabetes knowledge as a stable construct that can be manipulated to achieve better diabetes outcomes. The challenge is to develop educational interventions and programmes that manipulate knowledge in tandem with other factors reflecting the characteristics and needs of the individual at specific points in their diabetes experience. ■

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"The challenge is to develop educational interventions and programmes that manipulate knowledge in tandem with other factors reflecting the characteristics and needs of the individual at specific points in their diabetes experience."

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