There are almost 3.5 million people who have been diagnosed with diabetes in the UK.\(^1\) Type 2 diabetes accounts for about 90% of all people with diabetes; it generally appears in people over the age of 40 years.\(^2\) The problem is huge and continues to grow. Diabetes affects many major organs, including heart, blood vessels, nerves, eyes and kidneys.

In the Dutch prospective Doetinchem Cohort Study, at five-year follow-up, the decline in global cognitive function in diabetic patients was 2.6 times greater than that in individuals without diabetes. Elderly patients with diabetes also showed a reduced cognitive flexibility compared with individuals without diabetes.\(^3\)

Arvanitakis \textit{et al.} report that type 2 diabetes is associated with cognitive impairment, especially in semantic memory and perceptual speed in elderly non-demented subjects.\(^4\) Strachan \textit{et al.} conducted a review of published studies in 1997 and found that verbal memory is the most commonly affected cognitive ability.\(^5\) Verbal learning, abstract reasoning and complex psychomotor functioning were more impaired in diabetic than in non-diabetic subjects.\(^6\)

Modest cognitive impairment is already present at the early stage of type 2 diabetes. Immediate memory, learning rate and incidental memory appear to be the most affected in the early stages.\(^7\) Furthermore, glycaemic control appears to play a role in determining the degree of cognitive dysfunction detected in patients with type 2 diabetes.\(^8\) A 1% higher \(\text{HbA}_1\text{C}\) value (\(\geq 7.5\%\)) was associated with a 1.75-point lower Digit Symbol Substitution Test (DSST) score and a 0.20-point lower Mini Mental State Examination (MMSE) score.\(^9\) The DSST is a subtest of the Wechsler Adult Intelligence Scale (3rd edition), which assesses visual motor speed, capacity for learning, sustained attention, and working memory. A similar effect of increased \(\text{HbA}_1\text{C}\) was demonstrated by Ravona-Springer \textit{et al.} with a decrease of 1.37 points in the MMSE per unit increase in \(\text{HbA}_1\text{C}\).\(^10\)

Mortby \textit{et al.} found blood glucose levels, even in the high normal range, were associated with lower grey/white matter regional volumes in the frontal cortices and poorer cognitive performance.\(^11\) They found this association to be specific to men. They argue for a rethink of what could be an optimal level of blood glucose (in their sample the blood glucose level range was between 3.2 and 6.1 mmol/L). Furthermore, duration of the disease seems to be important in diminished motor speed tasks in type 2 diabetes patients.\(^12\) Compared with normoglycaemics, people diagnosed with diabetes 15 or more years earlier had significantly slower processing speed and poorer executive function performance.\(^13\)

The question as to whether diabetes is a risk factor for Alzheimer’s disease has produced conflicting answers. It has long been accepted that type 2 diabetes increases the risk of stroke, and its effect on cognition may be mediated through the factors important in cardiovascular disease. In a five-year longitudinal study, MacKnight \textit{et al.} reported that diabetes mellitus at baseline was associated with incident vascular cognitive impairment; they did not find an association between diabetes and incident Alzheimer’s disease.\(^14\) On the other hand, the Honolulu-Asia Aging Study found diabetes to increase the risk of total dementia by 50% (RR 1.5 \([95\% \text{ CI } 1.01–2.2]\)). Patients with diabetes were at greater risk of developing vascular dementia and the risk of Alzheimer’s disease was increased by 80% (vascular dementia RR 2.3 \([1.1–5.0]\) Alzheimer’s disease RR 1.8 \([1.1–2.9]\)).\(^15\)

Type 2 diabetes is associated with hippocampal and amygdalar atrophy, regardless of vascular pathology linking it to the development of Alzheimer neuropathology.\(^16\)

Improvement in glycaemic control results in moderate improvement in cognition, especially working memory.\(^17\) Verbal learning and memory may improve with improved glycaemic control.\(^18\)

A post-mortem study\(^19\) demonstrated significantly fewer neuritic plaques in the brains of diabetic subjects who received both insulin and oral anti-diabetic medication.

Antidiabetic drugs were effective in alleviating the decline in physical and cognitive functioning among older Mexican Americans with diabetes, especially for those with a longer duration of the disease.\(^20\)

\section*{Conclusion}

The evidence associating diabetes with dementia is increasing; it is becoming clear that both vascular and Alzheimer’s types of dementia can be attributed to...
diabetes. There is also accumulating evidence that achieving normoglycaemia with medications can lead to improvement in cognitive ability.

GPs are uniquely placed to diagnose and treat diabetes. Awareness needs to be raised among GPs about the detrimental effect of untreated diabetes on brain function. Cognitive decline and dementia should be added to the list of complications of diabetes, in addition to cardiovascular disease, kidney disease, blindness and limb amputation.

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References