Type 2 diabetes in young Indigenous Australians in rural and remote areas: diagnosis, screening, management and prevention

The Baker IDI Heart and Diabetes Institute convened a group of key clinicians, policymakers and researchers (including as authors) to consider the actions that need to be taken to address type 2 diabetes mellitus (T2DM) in Australian Indigenous (Aboriginal or Torres Strait Islander) children and adolescents. This article provides a clinically focused summary of the recommendations for diagnosing, screening for, managing and preventing T2DM among Australian Indigenous children and adolescents living in rural and remote settings. This article also highlights the need for coordinated and informed health policy, to address the social determinants of health, and the importance of partnerships between communities and research. The recommendations are supported by evidence graded as follows: high-quality evidence (grade A evidence), intermediate-quality evidence (grade B evidence) or consensus (grade C evidence). The major recommendations are shown in Box 1.

Background

Indigenous Australians experience a disproportionately high rate of T2DM. The most striking features of this epidemic include the excess risk among those living in remote settings and the premature age of onset.1 Despite data being limited, T2DM among Indigenous children and adolescents appears to be increasing in incidence and the burden is much greater than that experienced by non-Indigenous young people.2-4 Indigenous children and adolescents with T2DM typically have a family history of T2DM and are overweight or obese, and may have signs of hyperinsulinism such as acanthosis nigricans.5,6 Onset of T2DM is usually during early adolescence and patients are asymptomatic at diagnosis and typically have a family history of T2DM. T2DM is an epidemic that disproportionately affects Indigenous Australians and is related to excess weight, low levels of physical activity, and a diet containing high levels of fat.7,8 Indigenous Australians experience a high rate of T2DM, particularly those living in rural and remote settings, and the rate is higher than in non-Indigenous young people and appears to be rising, although data on epidemiology and complications are limited. Young Indigenous people living in remote areas appear to be at excess risk of T2DM.

Summary

- The burden of type 2 diabetes mellitus (T2DM) among Indigenous children and adolescents is much greater than in non-Indigenous young people and appears to be rising, although data on epidemiology and complications are limited. Young Indigenous people living in remote areas appear to be at excess risk of T2DM.

- Most young Indigenous people with T2DM are asymptomatic at diagnosis and typically have a family history of T2DM, are overweight or obese and may have signs of hyperinsulinism such as acanthosis nigricans. Onset is usually during early adolescence.

- Barriers to addressing T2DM in young Indigenous people living in rural and remote settings relate to health service access, demographics, socioeconomic factors, cultural factors, and limited resources at individual and health service levels.

- We recommend screening for T2DM for any Aboriginal or Torres Strait Islander person aged > 10 years (or past the onset of puberty) who is overweight or obese, has a positive family history of diabetes, has signs of insulin resistance, has dyslipidaemia, has received psychotropic therapy, or has been exposed to diabetes in utero.

- Individualised management plans should include identification of risk factors, complications, behavioural factors and treatment targets, and should take into account psychosocial factors which may influence health care interaction, treatment success and clinical outcomes.

- Preventive strategies, including lifestyle modification, need to play a dominant role in tackling T2DM in young Indigenous people.

Diagnosis

Criteria for diagnosis in Indigenous children and adolescents are shown in Box 2. While diagnosis of T2DM can be made based on random blood glucose levels (repeated or in combination with symptoms), confirmation of the diagnosis should be made with a fasting venous blood glucose test, in conjunction with other...
Oral glucose tolerance tests (OGTTs) can be impractical in certain circumstances, particularly in rural and remote settings where health resources are limited. An OGTT should not be performed if diabetes can be diagnosed using fasting, random or postprandial criteria as excessive hyperglycaemia can result. OGTTs should not routinely be used to diagnose T2DM in Indigenous children and adolescents in rural and remote settings (grade C evidence). If there is doubt about the diagnosis, referral should be made to a paediatrician or endocrinologist for an OGTT (grade C evidence).

The use of point-of-care glycated haemoglobin (HbA\textsubscript{c1c}) testing to diagnose diabetes in adults is recommended, and is advantageous in remote settings. However, no clear recommendations are yet available for children and adolescents, and recent data has shown HbA\textsubscript{c1c} testing to be a poor screener for dysglycaemia and diabetes in children and adolescents. HbA\textsubscript{c1c} testing should therefore not be used for the diagnosis of T2DM in Indigenous children and adolescents (grade B evidence).

All children and adolescents with suspected or newly diagnosed diabetes should have blood or urinary ketone levels checked. The presence of ketones requires immediate transfer to hospital and likely management with insulin until the diagnosis is clarified by further testing (grade C evidence).

Screening

Recent international guidelines recommend that screening of asymptomatic young people for T2DM is likely to have a low yield. However, in populations with a high diabetes prevalence, clinicians may favour screening while awaiting more information on effective screening strategies.

At present, the documented burden of T2DM among Indigenous children and adolescents does not justify population screening. In this context, screening should therefore be aimed at enhancing case detection and focused on Indigenous children and adolescents with features suggestive of an elevated risk of T2DM.

We recommend that any Indigenous Australian over the age of 10 years (or past the onset of puberty) who is overweight or obese, has a positive family history of diabetes, has signs of insulin resistance, has dyslipidaemia, has received psychotropic therapy, or has been exposed to baseline investigations (grade C evidence). Thirst is not unusual in hot and dry climates, but the combination of marked polydipsia and polyuria (particularly nocturnal) is suggestive of diabetes and should lead to screening (grade C evidence).

The definitions listed in Box 2 relate to laboratory-measured values. Point-of-care capillary blood glucose levels have been found to be highly concordant with laboratory measured blood glucose levels in remote Australia; a random point-of-care capillary sample with blood glucose level $\geq 12.2$ mmol/L is equivalent to a laboratory-measured venous sample with blood glucose level $\geq 11.1$ mmol/L (grade B evidence).
Clinical focus

3 Barriers to managing type 2 diabetes mellitus in Indigenous children and adolescents living in rural and remote settings

Health seeking (grade B evidence)
- Limited contact with health services, relating to:
  - perceived “health” despite significant morbidity 
  - clinics not being adolescent friendly

Demographic (grade B evidence)
- Remoteness, limited telecommunication facilities, poor school attendance, poor socioeconomic health, no fixed address

Sociocultural (grade C evidence)
- Potential shame of diagnosis
- Acceptance of poor health status (by individuals and the health system)
- Many competing health needs

Physical resources (grade B evidence)
- Limited resources for lifestyle modification
- Food insecurity

Clinic resources — physical (grade C evidence)
- Inaccessibility of essential resources (such as glycated haemoglobin testing) in many remote clinics
- Misplaced or broken blood glucose meters
- Lack of infrastructure to start, maintain or safely store insulin

Clinic resources — staffing (grade C evidence)
- Understaffing and high staff turnover
- Overburdened clinic staff due to acute crisis care
- Limited and poorly coordinated visiting specialist services

Management

Challenges in health care delivery in remote areas: Limited resources at the individual, community and health care levels pose significant challenges to managing T2DM in rural and remote settings (Box 3). Food insecurity and socioeconomic disadvantage can limit opportunities for lifestyle modification. Health systems are often overstretched, responding to high rates of chronic disease in adults; they may be less than adequately staffed and may lack basic resources. The combination of these factors can result in poor and infrequent follow-up for Indigenous young people with T2DM, limited response to persistent hyperglycaemia, reluctance to commence and continue insulin therapy, and limited screening for complications.

Engaging Indigenous young people: Engaging young people with clinical services to screen for, identify and manage T2DM is more likely if the services are accessible, demonstrate equity in service delivery, are acceptable and appropriate for the needs and cultural norms of the community, and are comprehensive and effective. Confidentiality is an essential component of providing health care to young people, particularly in small isolated communities. A young person who does not attend his or her clinic appointment may still care about their newly diagnosed diabetes, and non-attendance should therefore trigger further engagement with all necessary social and family support.

Initial management: Initial management of T2DM is determined by symptoms, severity of hyperglycaemia, and the presence or absence of ketones and ketoacidosis (summarised in Appendix 2; online at mja.com.au). Insulin therapy may be initially required for stabilisation in the setting of significant hyperglycaemia and ketosis, even in the absence of ketoacidosis. Symptomatic patients, particularly those with vomiting and dehydration, should be monitored closely because their condition could deteriorate rapidly.

Psychosocial health: Routine psychosocial assessment promotes recognition of and response to psychosocial comorbidities, and provides appreciation of the context in which lifelong management will need to be established and maintained. Psychosocial health is a critical consideration in establishing a care plan (Box 4). Indigenous health workers play an essential role in the management team, especially in addressing psychosocial health, and should be engaged at all stages of management.

Lifestyle modification: When managing T2DM, the primary emphasis should be on lifestyle modification. It is essential to engage the family in lifestyle modification, respecting the right to confidential health care for older adolescents. Engaging the family increases the likelihood of the young person modifying his or her behaviour, and may also reduce the risk of diabetes and its complications within an at-risk family.

Blood glucose monitoring: The performance and frequency of self-monitoring of blood glucose levels should be individualised, taking into account factors identified during management planning. Once glycaemic control has been achieved, several fasting values per week and daily post-prandial measures (taken after the largest meal) are satisfactory given the values remain in the target range. Young people treated with insulin require more frequent testing to monitor for hypoglycaemia.

HbA1c levels should be tested quarterly (grade C evidence). International guidelines recommend an HbA1c target of < 7.5% for all paediatric age groups and < 7% for adolescents approaching adulthood. The Central Australian Rural Practitioners Association guidelines recommend, for adults, a target of < 7% for T2DM. For simplicity, an HbA1c target of < 7% is recommended for Indigenous children and adolescents with T2DM.

Oral hypoglycaemic agents and insulin: Currently, metformin and insulin are the only hypoglycaemic agents approved for children and adolescents with T2DM; their use is shown in Appendix 2. Dosing of these medications should follow local protocols; for children < 14 years of age, this should be discussed with a paediatrician.
4 Care plan for Indigenous children and adolescents with type 2 diabetes mellitus, adapted from guidelines produced by the International Diabetes Federation, International Society for Pediatric and Adolescent Diabetes and Asian-Pacific Type 2 Diabetes Group15,19,31,32

<table>
<thead>
<tr>
<th>Issue to address</th>
<th>First visit</th>
<th>Quarterly visit</th>
<th>Annual visit</th>
<th>Target</th>
<th>Action if target not met</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifestyle</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Address issues relating to home, education and employment, activities, drugs, depression, sexuality and spirituality*</td>
<td>Engage family, Indigenous health workers, social services and mental health services as required</td>
</tr>
<tr>
<td>Psychosocial health</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Address SNAP: smoking, nutrition, alcohol, physical activity</td>
<td>Engage family, Indigenous health workers, social services and mental health services as required</td>
</tr>
<tr>
<td>Behavioural factors</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Complete baseline investigations: fasting BGL, autoantibodies (GAD, IA2, insulin), C-peptide</td>
<td>Discuss with district medical officer</td>
</tr>
<tr>
<td>Diagnostic tests</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Glycaemic control**

| BGL | ✓ | ✓ | ✓ | Premeal BGL, < 7.2 mmol/L; postmeal BGL, < 10.0 mmol/L | Congratulate on addressing their diabetes; do not blame; consider psychosocial issues; consider compliance and need to escalate treatment; consider specialist advice (Appendix 2) |
| HbA1c | ✓ | ✓ | ✓ | < 7 % (< 53 mmol/mol) | Congratulate on addressing their diabetes; do not blame; consider psychosocial issues; consider compliance and need to escalate treatment; consider specialist advice (Appendix 2) |
| Weight | ✓ | ✓ | ✓ | Reduce body weight | Continue to support healthy diet and exercise, engage family |
| Height, BMI, waist circumference | ✓ | ✓ | ✓ | BMI < 95th centile (non-obese) | Continue to support healthy diet and exercise, engage family |

**Complications screening**

| Blood pressure | ✓ | ✓ | ✓ | Blood pressure, < 95th centile by age, sex and height | Consider ACEI |
| Fasting lipids (total cholesterol, HDL, LDL, triglycerides) | ✓ | ? | ✓ | LDL, < 2.6 mmol/L; triglycerides, < 1.7 mmol/L | Diet, lifestyle, consider statins |
| Urea, creatinine, electrolytes, ACR, microalbuminuria if possible | ✓ | ? | ✓ | Refer to local laboratory reference intervals | Discuss with specialist; treat hypertension and albuminuria with ACEI |
| Eyes: visual acuity, dilated fundoscopy | ✓ | ✓ | ✓ | Monitor and treat retinopathy | Refer to ophthalmologist |
| Feet: pulses and neuropathy | ✓ | ✓ | ✓ | Monitor and treat neuropathy and macrovascular complications | Refer to specialist and podiatrist |
| Liver function | ✓ | ? | ✓ | Refer to local laboratory reference intervals | Maximise glycaemic control and weight loss for NAFLD; refer to specialist |
| Obstructive sleep apnoea | ✓ | ? | ✓ | No obstructive symptoms | Refer for sleep study if obstructive sleep apnoea suspected |

**Opportunistic health screening**

| ✓ | ✓ | ✓ | Consider sexual health (sexually transmitted infections, contraception, and PCOS screening in patients with oligomenorrhoea, acne or hirsutism), immunisation, mental health, nutrition (anaemia), and other health needs |

* = perform test. ? = only perform if test result is abnormal on first visit. ACEI = angiotensin-converting enzyme inhibitor. ACR = albumin–creatinine ratio. BGL = blood glucose level. BMI = body mass index. GAD = glutamic acid decarboxylase. HbA1c = glycated haemoglobin. HDL = high-density lipoprotein. IA2 = insulinoma antigen 2. LDL = low-density lipoprotein. NAFLD = non-alcoholic fatty liver disease. PCOS = polycystic ovary syndrome.

* A psychosocial assessment should cover: home — who the young person lives with, home environment, family supports for diabetes management and behavioural modification, resources available (refrigeration, telephone, distance to the nearest clinic, availability of emergency care); education and employment — education, educational performance, literacy, future needs, employment, finances; activities — exercise and patterns of physical activity, eating practices and determinants of these, activities and interests, peer support; drugs — substance use by peers, family and the young person; depression — depressive symptoms, self-harm, suicidal ideation; sexuality — sexual health review (if appropriate); spirituality — culture and spirituality.

Evidence). Barriers to self-management should be addressed at each visit.

In commencing insulin therapy, close follow-up is required to titrate the dose; this may be over the telephone or in person. All children and adolescents starting on insulin therapy should have access to emergency care and, in particular, should be educated about the symptoms, signs and management of hypoglycaemia (grade C evidence). As diet is often erratic and access to emergency care for hypoglycaemia may be limited, long-acting basal insulin may be the best initial choice (grade C evidence). As a result, screening for complications should be undertaken at diagnosis and annually thereafter (Box 4). Screening for complications such as renal disease, hypertension and retinopathy are of utmost importance in this high-risk group (grade C evidence).

**Specialist referral**: Referral to an endocrinologist (or physician with experience in managing diabetes) and diabetes educator is recommended at diagnosis and again if glycaemic control remains suboptimal despite lifestyle changes and metformin and insulin therapy (grade C evidence).

**Treatment targets**: Achieving the goals of treatment (Box 4) can be a daunting task, and may take some time to achieve. Any small improvement towards these targets should be encouraged.
Prevention

Given the relatively poor prognosis for many young people once a diagnosis of T2DM is made and the continuing increase in prevalence of T2DM, effective prevention needs to play a dominant role in tackling this key health problem. Planned interventions need to be practical and undertaken with due attention to the demographic, social and cultural needs of the Indigenous community. They should involve:

- consultation and engagement of communities and those “at the front line”
- investment in programs that address social determinants of health
- measurement of the problem and evaluation of action
- appropriate funding and resources.

The immediate benefits of investing in lifestyle modification for individuals at risk of T2DM should not be overlooked. While some clinicians may elect to treat adolescents with obesity and metabolic syndrome (particularly those with abnormal glucose tolerance) with metformin, there needs to be an improved evidence base, and outcome data, before this can be recommended as a strategy.23,24

In adults, metformin therapy decreases progression of impaired glucose tolerance to T2DM, but lifestyle modification and a small amount of weight loss (average of 5.6 kg) is a more effective intervention.25 Engaging communities and working with Indigenous health workers is vital for preventing T2DM, not only to better identify those at risk but also to ensure that prevention efforts are appropriate.

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