Australian Government
Australian Institute of Health and Welfare

Diabetic ketoacidosis (DKA) among children and young people with type 1 diabetes

Monitoring progress in reducing the impact of diabetes and its complications is relevant to 2 goals of the Australian National Diabetes Strategy 2016–2020 (Health 2016).

This fact sheet provides the most recent available data on hospitalisations for diabetic ketoacidosis (DKA) in Australia, based on data from the National Hospital Morbidity Database (see Box 1: Data sources and classifications).

Although DKA can occur in older people with type 1 diabetes and in those with type 2 diabetes, this fact sheet focuses on children (0–14 years) and young people (15–24 years) with type 1 diabetes.

What is diabetic ketoacidosis?

Diabetic ketoacidosis (DKA) is a complication of diabetes, caused by a lack of insulin. Without enough insulin, the body's cells cannot use glucose for energy and, to compensate, the body burns fat for energy. This leads to the production of high levels of blood acids, known as ketones, which are also present in the urine (Craig et al. 2011).

The symptoms of DKA include dehydration, rapid breathing, vomiting, frequent urination, tiredness, abdominal pain and confusion. In the lead-up to a DKA episode, unexplained weight loss can also be observed. If not treated urgently, DKA can lead to coma, acute kidney failure, cerebral injury, or even death.

Who is at risk of DKA?

Children and young people with diagnosed or undiagnosed type 1 diabetes are at increased risk of DKA, as their body cannot produce insulin (Craig et al. 2011; Usher-Smith et al. 2011). Those diagnosed with type 1 diabetes rely on daily insulin injections for their survival and, if the use of injected insulin is inadequate for the individual's needs at a particular time, DKA may occur.

There are a number of factors which can increase the risk of DKA in people with type 1 diabetes. These include sub-optimal glycaemic control; hormonal changes during the transition to adolescence in females; acute illness or stress; psychological conditions such as eating disorders; low awareness of the signs or symptoms of type 1 diabetes; treatment with certain pharmaceutical drugs; and limited access to specialised diabetes care (Umpierrez 2003; Usher-Smith et al. 2011; Craig et al. 2011).

Fast Facts

DKA hospitalisation rates among children and young people with type 1 diabetes were:

1.4 times as high among females as males

Similar between 2009–10 and 2014–15

1.5 times as high for those living in *Outer regional* and *Remote and very remote* areas as for those living in *Major cities*

2.4 times as high for those in the lowest socioeconomic group as for those in the highest socioeconomic group

DKA that occurs in people with undiagnosed type 1 diabetes could be prevented through the earlier detection of type 1 diabetes at its onset. For those already diagnosed with type 1 diabetes, prevention of DKA can be improved through careful monitoring and effective treatment and management.

DKA hospitalisations

In 2014–15, there were 7,132 hospitalisations with a principal diagnosis of DKA—that is, DKA was considered to be the diagnosis chiefly responsible for occasioning an episode of patient care (hospitalisation).

Most of the hospitalisations (5,996 or 84%) were for people with type 1 diabetes, and of these, half (3,245 or 54%) were for children and young people aged under 25.

Note: The counts presented in this fact sheet are of DKA hospitalisations, and would include multiple hospitalisations experienced by the same individual, if the individual had more than one episode of DKA in the year. The DKA hospitalisation rates presented in the following sections have been calculated based on the population with type 1 diabetes sourced from the National (insulin-treated) Diabetes Register (see Box 1: Data sources and classifications).

Age and sex

In 2014–15, DKA hospitalisation rates were similar between children and young people with type 1 diabetes (around 164–165 per 1,000 population with type 1 diabetes).

Hospitalisation for DKA was more common in females than in males aged under 25 (1,808 compared with 1,437 hospitalisations, respectively). The corresponding rates were 1.4 times as high in females as in males (192 and 138 per 1,000 population with type 1 diabetes, respectively).

The DKA rate among females peaked at age 15–19 (at 247 per 1,000 population with type 1 diabetes) while for males it was highest between birth and 9 years (at 172 per 1,000 population with type 1 diabetes). (Figure 1).

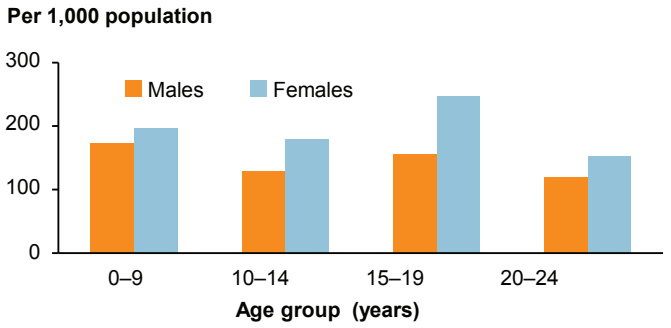

Figure 1: DKA hospitalisation rates for children and young people with type 1 diabetes, 2014–15

Recent trends

The number of hospitalisations for DKA among children and young people increased from 2,841 in 2009–10 to 3,245 in 2014–15, a rise of 14%. However, hospitalisation rates for DKA have remained relatively stable over this period, at around 160 per 1,000 population with type 1 diabetes.

Female hospitalisation rates have been consistently higher than male rates over this period, at around 180 compared with 130 per 1,000 males with type 1 diabetes (Figure 2).

The number of hospitalisations for DKA among children remained relatively unchanged, increasing by 5% from 1,040 in 2009–10 to 1,063 in 2014–15. For young people, however, the number of hospitalisations increased by 21%, from 1,801 to 2,182. Hospitalisation rates for children and young people were, however, fairly stable over this period.

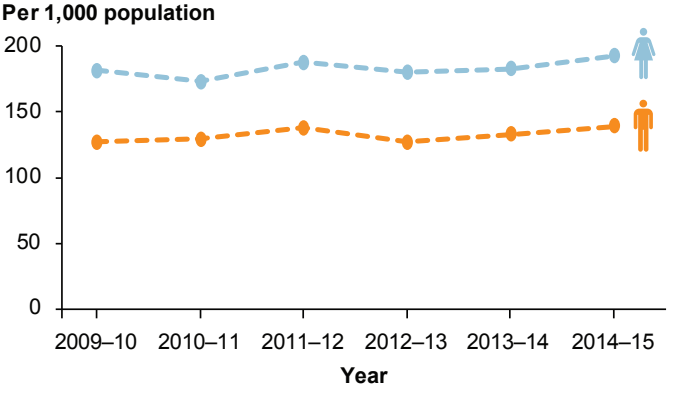

Figure 2: DKA hospitalisation rates for children and young people with type 1 diabetes, 2009–10 to 2014–15

Length of stay

The average length of stay in hospital for DKA among children and young people with type 1 diabetes was 2.9 days, with the length of stay similar for males and females (2.8 and 2.9 days, respectively). The average length of stay for children was longer than for young people (3.5 and 2.6 days, respectively).

Conditions associated with DKA among young people

DKA hospital records for type 1 diabetes list additional diagnoses which impacted on patient management during their hospitalisation.

In 2014–15, these additional diagnoses for young people included:

- psychological or behavioural conditions, including psychoactive substance use or mood or anxiety disorders such as depression (16% of DKA hospitalisations)
- infectious and parasitic diseases (12%)
- genitourinary diseases (11%).

Further, 40% of DKA hospitalisations had 'a history of non-compliance with diabetes treatment regimen' (ICD-10-AM code Z91.1) listed as an additional diagnosis. This indicates that these cases, at least, had previously been diagnosed with diabetes and were receiving treatment for type 1 diabetes.

Population groups

As Figure 3 shows, DKA hospitalisation rates tend to increase both with remoteness and with socioeconomic disadvantage.

DKA hospitalisation rates for children and young people with type 1 diabetes in *Outer regional* and *Remote and very remote* areas were 1.5 times as high as those living in *Major Cities*.

DKA hospitalisation rates for children and young people with type 1 diabetes in the lowest socioeconomic group were 2.4 times as high as those in the highest socioeconomic group.

On average, there were 200 hospitalisations for DKA among Aboriginal and Torres Strait Islander people with type 1 diabetes aged under 25 each year between 2011–12 and 2014–15. Rates could not be calculated reliably and so have not been presented.

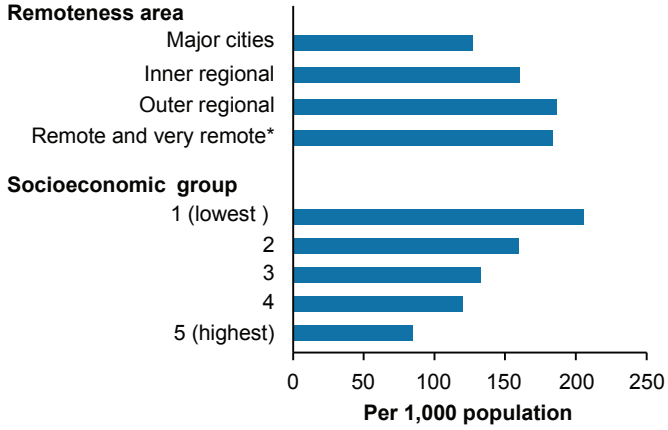

Figure 3: DKA hospitalisation rates for children and young people with type 1 diabetes, by population group, 2009–10 to 2013–14

*See footnote (b) Table 1.

What's missing?

Only a partial picture of the burden of DKA in children and young people has been presented, as data are not currently available to assess whether the DKA hospitalisations presented in this fact sheet were for initial or recurrent DKA events, or whether these events occurred in those with a pre-existing diagnosis of type 1 diabetes. Additionally, DKA events that occurred, and/or were managed, in an emergency department or outside the hospital are not included. The availability of nationally linked hospitalisation data would assist in filling some of these information gaps, as the longitudinal nature of this data set would allow identification of those events that were initial rather than recurrent events, especially among children and young people.

Statistical table

Table 1: Hospitalisations for DKA as a principal diagnosis among children and young people with type 1 diabetes, by selected characteristics

	0–14	15–24	0–24	0–14	15–24	0–24
	Number of hospitalisations			*Rate per 1,000 population with type 1 diabetes*		
Sex (2014–15)						
Males	474	963	1,437	145	136	138
Females	589	1,219	1,808	185	196	192
Persons	1,063	2,182	3,245	165	164	164
Average length of stay (days)[(a)] (2014–15)	3.5	2.6	2.9	—	—	—
Remoteness (2009–10 to 2013–14)						
Major cities	2,662	5,634	8,296	125	128	127
Inner regional	1,127	2,076	3,203	155	163	160
Outer regional	573	984	1,557	196	181	186
Remote and Very remote[(b)]	85	219	304	162	193	183
Socioeconomic group (2009–10 to 2013–14)						
Group 1 (lowest)	1,291	2,491	3,782	203	206	205
Group 2	1,001	2,127	3,128	148	166	160
Group 3	843	1,721	2,564	134	132	133
Group 4	784	1,534	2,318	124	118	120
Group 5 (highest)	526	1,037	1,563	85	84	85

(a) Excludes same day separation from the calculation of average length of stay.

(b) Rates should be interpreted with caution. Coverage of the National Diabetes Scheme Services (NDSS) may be lower in *Remote* and *very remote* areas, potentially underestimating the number of people with type 1 diabetes and consequently inflating rates in these areas.

Sources: AIHW National Hospital Morbidity Database (NHMD) and AIHW National (insulin-treated) Diabetes Register.

Box 1: Data sources and classifications

Diabetic ketoacidosis (DKA)

The data source for children and young people with DKA is the **National Hospital Morbidity Database (NHMD)** compiled and held by the AIHW. The NHMD is a compilation of episode-level records from admitted patient morbidity data collection systems in Australian hospitals. 'Hospitalisation' refers to an admitted patient episode of care or separation from hospital after the episode.

Note: Hospitalisation counts are counts of admitted patient episodes of care not individual patients, and would include multiple hospitalisations experienced by the same individual if the individual had more than one episode of DKA in the year. These may include DKA events among individuals with diabetes that was undiagnosed prior to hospitalisation and events for people with previously diagnosed type 1 diabetes. Only hospitalisations with DKA as a principal diagnosis were included in this analysis. This does not include hospitalisations for which DKA may have been present with another complication of diabetes that was regarded as the principal diagnosis. It would also not include cases where DKA had its onset during the hospitalisation. An unknown number would have been hospitalisations of people with no previous diagnosis of diabetes.

Type 1 diabetes mellitus with ketoacidosis is defined according to the International Classification of Diseases 10th Revision (ICD-10-AM) codes as E10.11 without coma, E10.12 with coma, E10.15 with lactic acidosis without coma, E10.16 with lactic acidosis with coma.

For more information see <http://www.aihw.gov.au/publication-detail/?id=60129554702> and the NHMD Data Quality Statement (DQS) at <http://meteor.aihw.gov.au/content/index.phtml/itemId/638202>.

continued

Box 1 (continued): Data sources and classifications

Children and young people with type 1 diabetes

The data source for the population count of children and young people with type 1 diabetes is the **National (insulin-treated) Diabetes Register (NDR)**. The AIHW maintains the NDR and it is derived from 2 primary data sources: the National Diabetes Services Scheme (NDSS) and the Australasian Paediatric Endocrine Group (APEG). The NDSS is an initiative of the Australian Government to subsidise the supply of diabetes-related products to people diagnosed with diabetes who are registered with the scheme. A diagnosis of diabetes substantiated by a health professional is required in order to register with, and purchase products through, the NDSS. APEG, which represents health professionals involved in the management and research of disorders of the endocrine system, maintains clinic-based state and territory diabetes registers. The NDSS, combined with APEG data and linked to the National Death Index (NDI), was used to derive the prevalent population with type 1 diabetes, and used as the denominator in the calculation of rates. The type of diabetes was derived from age at diagnosis and insulin-use criteria.

For more information, see <http://meteor.aihw.gov.au/content/index.phtml/itemId/632137>.

Remoteness

Classification of areas is based on the Australian Statistical Geography Standard 2011 Remoteness Structure of usual residence.

Socioeconomic groups

Socioeconomic groups are classified using the Index of Relative Socio-Economic Disadvantage, which is based on 2011 Census Statistical Area Level 2 (SA2) of usual residence.

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