

Diabetes and vaccines

What is diabetes?

Diabetes is a disorder of the pancreas, the gland which produces insulin. Diabetes occurs when levels of insulin in the bloodstream are too low or absent. Insulin is required to absorb sugar from the blood into the body's cells – without it, sugar levels in the blood become very high and cause serious health problems.

There are two types of diabetes:

1. Type 1 diabetes (insulin-dependent diabetes, IDDM or juvenile onset diabetes), which occurs when the pancreas stops producing sufficient insulin
2. Type 2 diabetes (non-insulin-dependent diabetes, NIDDM), which occurs when the body becomes less sensitive to the effects of insulin

In this fact sheet, diabetes refers to Type 1 diabetes. This is thought to be an autoimmune disease, where the immune system malfunctions to cause destruction of the insulin-producing cells in the pancreas. This is the usual type of diabetes in children, and requires treatment with insulin injections. Without insulin, people with Type 1 diabetes will die. Diabetes is thought to be due to an interaction between inherited and environmental factors, not all of which have been identified.

Is the incidence of diabetes increasing?

There appears to be an unexplained trend towards increasing rates of diabetes in many countries, including Australia. Some countries, however, have shown no rise.

Do genetic or environmental factors (such as infections or medication) cause diabetes?

There is a marked variation in the rates of diabetes in different countries, with higher rates in people of northern European descent. Rates are much lower in Asian and African people. This is thought to be due to genetic factors.

Various environmental factors, including breast feeding, infections, immunisation, nitrates and vitamin D have been studied. Breast feeding is shown to protect children against developing diabetes, while cow's milk feeding may increase the risk. High levels of nitrates in drinking water have also been shown to increase the risk of

diabetes. There are few infectious diseases which have been directly proven to cause diabetes (e.g. mumps), although indirect evidence suggests infections may have a role in causing diabetes. There is a seasonal variation in the incidence of diabetes, with an increase in late autumn and early winter. This suggests that viral infections may play a part in triggering the onset of diabetes in genetically susceptible people. Some medications, such as certain drugs used for the treatment of people with cancer, may also cause or hasten the onset of diabetes.

Do vaccines cause diabetes?

No, there is no evidence that vaccines cause diabetes. There have been a number of studies which have searched for links between diabetes and immunisations. The only studies suggesting a possible increase in risk have come from Dr John B Classen. He found that if the first vaccination in children is performed after 2 months of age, there is an increased risk of diabetes. His laboratory study in animals also found that certain vaccines, if given at birth, actually decrease the risk of diabetes. This study was based on experiments using anthrax vaccine, which is very rarely used in children or adults. Dr Classen also compared diabetes rates with vaccination schedules in different countries, and interpreted his results as meaning that vaccination causes an increased risk of diabetes. This has been criticised because the comparison between countries included vaccines which are no longer used or used rarely, such as smallpox and the tuberculosis vaccine (BCG).

The study also failed to consider many reasons other than vaccination which could influence rates of diabetes in different countries. Later, in 2002, Dr Classen suggested that vaccination of Finnish children with Hib vaccine caused clusters of diabetes 3 years later, and that his experiments in mice confirmed this association.

Other researchers who have studied the issue have not verified Dr Classen's findings. Two large population-based American studies failed to support an association between any of the childhood vaccines and an increased risk of diabetes in the 10 years after vaccination. The highly respected international Cochrane Collaboration reviewed all the available studies and did not find an increased risk of diabetes associated with vaccination.

Expert groups such as the National Institutes of Health in the USA have met and reviewed the evidence and

conclude that there is no link between vaccines and diabetes.

Which vaccines?

The debate about the relationship between vaccines and diabetes has centred mainly on *Haemophilus influenzae* type b (Hib) vaccine, BCG (the TB vaccine) and hepatitis B vaccine.

Do vaccines protect against diabetes?

Because diabetes is caused by abnormal immune mechanisms, and vaccines act by creating immunity to various diseases, some vaccines (particularly BCG) have been studied to see if they offer protection against diabetes. In animal experiments, BCG does seem to be protective against diabetes, but researchers have not been able to translate this benefit to humans. This research is still ongoing. An initiative of the Australian Government Department of Health & Ageing and the International Juvenile Diabetes Foundation will see the establishment of a centre in Australia to develop a vaccine to prevent diabetes.

Should there be any changes to the vaccine schedule?

Expert bodies have addressed this question around the world, and concluded that there is no evidence to support any changes in the vaccination schedule. This will be kept under continued review with large registers of people with diabetes around the world, including Australia.

Further reading

1. Blom L, Nystrom L, Dahlquist G. The Swedish childhood diabetes study. Vaccinations and infections as risk determinants for diabetes in childhood. *Diabetologia* 1991;34:176-181.
2. Classen JB. The timing of immunization affects the development of diabetes in rodents. *Autoimmunity* 1996;24:137-145.
3. Classen DC, Classen JB. The timing of pediatric immunization and the risk of insulin dependent diabetes mellitus. *Infectious Diseases in Clinical Practice* 1997;6:449-454.
4. Classen JB, Classen DC. Clustering of cases of insulin dependent diabetes (IDDM) occurring three years after *Haemophilus influenzae* (Hib) immunization support causal relationship between immunization and IDDM. *Autoimmunity* 2002;35:247-253.
5. Dahlquist G, Gothefors L. The cumulative incidence of childhood diabetes mellitus in Sweden unaffected by BCG-vaccination. *Diabetologia* 1995;38:873-874.
6. Heijbel H, Chen RT, Dahlquist G. Cumulative incidence of childhood-onset IDDM is unaffected by pertussis immunization. *Diabetes Care* 1997;20:173-175.
7. Hyoty H, Hiltunen M, Reunanen A, et al. Decline of mumps antibodies in type 1 (insulin-dependent) diabetic children and a plateau in the rising incidence of type 1 diabetes after introduction of the mumps-measles-rubella vaccine in Finland. *Diabetologia* 1993;36:1303-1308.
8. Parent ME, Siemiatycki J, Menzies R, et al. Bacille Calmette-Guerin vaccination and incidence of IDDM in Montreal, Canada. *Diabetes Care* 1997;20:767-772.
9. Graves PM, Barriga KJ, Norris JM, et al. Lack of association between early childhood immunizations and beta-cell autoimmunity. *Diabetes Care* 1999;22:1694-1697.
10. Allen HF, Klingensmith GJ, Jensen P, et al. Effect of Bacillus Calmette-Guerin vaccination on new onset type 1 diabetes. A randomized clinical study. *Diabetes Care* 1999;22:1703-1707.
11. Jefferson T, Demicheli V. No evidence that vaccines cause insulin dependent diabetes mellitus. *Journal of Epidemiology & Community Health* 1998;52:674-675.
12. Qin HY, Singh B. BCG vaccination prevents insulin-dependent diabetes mellitus (IDDM) in NOD mice after disease acceleration with cyclophosphamide. *Journal of Autoimmunity* 1997;10:271-278.
13. Verge CF, Howard NJ, Irwig L, et al. Environmental factors in childhood IDDM. A population-based, case-control study. *Diabetes Care* 1994; 17:1381-1389.
14. DeStefano F, Mullooly JP, Okoro CA, et al. Childhood vaccinations, vaccination timing, and risk of type 1 diabetes. *Pediatrics* 2001;108:E112.
15. Black SB, Lewis E, Shinefield HR, et al. Lack of association between receipt of conjugate *Haemophilus influenzae* type B vaccine (HbOC) in infancy and risk of type 1 (juvenile onset) diabetes: long term follow-up of the HbOC efficacy trial cohort. *Pediatric Infectious Disease Journal* 2002;21:568-569.