



## 22q11.2 deletion syndrome

22q11.2 deletion syndrome (which is also known by several other names, listed below) is a disorder caused by the deletion of a small piece of chromosome 22. The deletion occurs near the middle of the chromosome at a location designated q11.2.

22q11.2 deletion syndrome has many possible signs and symptoms that can affect almost any part of the body. The features of this syndrome vary widely, even among affected members of the same family. Common signs and symptoms include heart abnormalities that are often present from birth, an opening in the roof of the mouth (a cleft palate), and distinctive facial features. People with 22q11.2 deletion syndrome often experience recurrent infections caused by problems with the immune system, and some develop autoimmune disorders such as rheumatoid arthritis and Graves disease in which the immune system attacks the body's own tissues and organs. Affected individuals may also have breathing problems, kidney abnormalities, low levels of calcium in the blood (which can result in seizures), a decrease in blood platelets (thrombocytopenia), significant feeding difficulties, gastrointestinal problems, and hearing loss. Skeletal differences are possible, including mild short stature and, less frequently, abnormalities of the spinal bones.

Many children with 22q11.2 deletion syndrome have developmental delays, including delayed growth and speech development, and learning disabilities. Later in life, they are at an increased risk of developing mental illnesses such as schizophrenia, depression, anxiety, and bipolar disorder. Additionally, affected children are more likely than children without 22q11.2 deletion syndrome to have attention deficit hyperactivity disorder (ADHD) and developmental conditions such as autism spectrum disorders that affect communication and social interaction.

Because the signs and symptoms of 22q11.2 deletion syndrome are so varied, different groupings of features were once described as separate conditions. Doctors named these conditions DiGeorge syndrome, velocardiofacial syndrome (also called Shprintzen syndrome), and conotruncal anomaly face syndrome. In addition, some children with the 22q11.2 deletion were diagnosed with the autosomal dominant form of Opitz G/BBB syndrome and Cayler cardiofacial syndrome. Once the genetic basis for these disorders was identified, doctors determined that they were all part of a single syndrome with many possible signs and symptoms. To avoid confusion, this condition is usually called 22q11.2 deletion syndrome, a description based on its underlying genetic cause.

### Frequency

22q11.2 deletion syndrome affects an estimated 1 in 4,000 people. However, the condition may actually be more common than this estimate because doctors and

researchers suspect it is underdiagnosed due to its variable features. The condition may not be identified in people with mild signs and symptoms, or it may be mistaken for other disorders with overlapping features.

## **Genetic Changes**

Most people with 22q11.2 deletion syndrome are missing a sequence of about 3 million DNA building blocks (base pairs) on one copy of chromosome 22 in each cell. This region contains 30 to 40 genes, many of which have not been well characterized. A small percentage of affected individuals have shorter deletions in the same region. This condition is described as a contiguous gene deletion syndrome because it results from the loss of many genes that are close together.

Researchers are working to identify all of the genes that contribute to the features of 22q11.2 deletion syndrome. They have determined that the loss of a particular gene on chromosome 22, *TBX1*, is probably responsible for many of the syndrome's characteristic signs (such as heart defects, a cleft palate, distinctive facial features, hearing loss, and low calcium levels). Some studies suggest that a deletion of this gene may contribute to behavioral problems as well. The loss of another gene, *COMT*, in the same region of chromosome 22 may also help explain the increased risk of behavioral problems and mental illness. The loss of additional genes in the deleted region likely contributes to the varied features of 22q11.2 deletion syndrome.

## **Inheritance Pattern**

The inheritance of 22q11.2 deletion syndrome is considered autosomal dominant because a deletion in one copy of chromosome 22 in each cell is sufficient to cause the condition. Most cases of 22q11.2 deletion syndrome are not inherited, however. The deletion occurs most often as a random event during the formation of reproductive cells (eggs or sperm) or in early fetal development. Affected people typically have no history of the disorder in their family, though they can pass the condition to their children. In about 10 percent of cases, a person with this condition inherits the deletion in chromosome 22 from a parent. In inherited cases, other family members may be affected as well.

## **Other Names for This Condition**

- 22q11.2DS
- autosomal dominant Opitz G/BBB syndrome
- CATCH22
- Cayler cardiofacial syndrome
- conotruncal anomaly face syndrome (CTAF)
- deletion 22q11.2 syndrome
- DiGeorge syndrome

- Sedlackova syndrome
- Shprintzen syndrome
- VCFS
- velo-cardio-facial syndrome
- velocardiofacial syndrome

## **Diagnosis & Management**

### Genetic Testing

- Genetic Testing Registry: Asymmetric crying face association  
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0431406/>
- Genetic Testing Registry: DiGeorge sequence  
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0012236/>
- Genetic Testing Registry: Opitz G/BBB syndrome  
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C1801950/>
- Genetic Testing Registry: Shprintzen syndrome  
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C0220704/>

### Other Diagnosis and Management Resources

- GeneReview: 22q11.2 Deletion Syndrome  
<https://www.ncbi.nlm.nih.gov/books/NBK1523>

### General Information from MedlinePlus

- Diagnostic Tests  
<https://medlineplus.gov/diagnostictests.html>
- Drug Therapy  
<https://medlineplus.gov/drugtherapy.html>
- Genetic Counseling  
<https://medlineplus.gov/geneticcounseling.html>
- Palliative Care  
<https://medlineplus.gov/palliativecare.html>
- Surgery and Rehabilitation  
<https://medlineplus.gov/surgeryandrehabilitation.html>

## **Additional Information & Resources**

### MedlinePlus

- Health Topic: Cleft Lip and Palate  
<https://medlineplus.gov/cleftlipandpalate.html>
- Health Topic: Congenital Heart Defects  
<https://medlineplus.gov/congenitalheartdefects.html>
- Health Topic: Immune System and Disorders  
<https://medlineplus.gov/immunesystemanddisorders.html>

### Genetic and Rare Diseases Information Center

- 22q11.2 deletion syndrome  
<https://rarediseases.info.nih.gov/diseases/10299/22q112-deletion-syndrome>

### Educational Resources

- American Heart Association  
[http://www.heart.org/HEARTORG/Conditions/CongenitalHeartDefects/DiGeorge-Syndrome\\_UCM\\_309017\\_Article.jsp](http://www.heart.org/HEARTORG/Conditions/CongenitalHeartDefects/DiGeorge-Syndrome_UCM_309017_Article.jsp)
- Children's Hospital and Regional Medical Center, Seattle, Washington  
<http://www.seattlechildrens.org/medical-conditions/chromosomal-genetic-conditions/22q112-related-disorders/>
- Children's Hospital of Philadelphia  
<http://www.chop.edu/conditions-diseases/chromosome-22q112-deletion?id=74634>
- Cincinnati Children's Hospital Medical Center  
<https://www.cincinnatichildrens.org/health/v/vcfs>
- Disease InfoSearch: 22q11.2 Deletion Syndrome  
<http://www.diseaseinfosearch.org/22q11.2+Deletion+Syndrome/20>
- Emory University School of Medicine  
[http://genetics.emory.edu/documents/resources/Emory\\_Human\\_Genetics\\_Congenital\\_Heart\\_Defects\\_22q.PDF](http://genetics.emory.edu/documents/resources/Emory_Human_Genetics_Congenital_Heart_Defects_22q.PDF)
- Genetics Education Materials for School Success (GEMSS)  
<https://www.gemssforschools.org/conditions/22q/default>
- MalaCards: chromosome 22q11.2 deletion syndrome, distal  
[http://www.malacards.org/card/chromosome\\_22q112\\_deletion\\_syndrome\\_distal](http://www.malacards.org/card/chromosome_22q112_deletion_syndrome_distal)
- My46 Trait Profile  
<https://www.my46.org/trait-document?trait=22q11.2%20deletion%20syndrome&type=profile>
- Orphanet: 22q11.2 deletion syndrome  
[http://www.orpha.net/consor/cgi-bin/OC\\_Exp.php?Lng=EN&Expert=567](http://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=567)

- Swedish Information Center for Rare Diseases  
<http://www.socialstyrelsen.se/rarediseases/22q11deletionsyndrome>
- UC Davis Children's Hospital  
[https://www.ucdmc.ucdavis.edu/children/clinical\\_services/cleft\\_craniofacial/anomalies/velocardiofacial.html](https://www.ucdmc.ucdavis.edu/children/clinical_services/cleft_craniofacial/anomalies/velocardiofacial.html)
- UC Davis MIND Institute: Chromosome 22q11.2 DS Educational Videos  
[https://www.ucdmc.ucdavis.edu/mindinstitute/videos/video\\_22q.html](https://www.ucdmc.ucdavis.edu/mindinstitute/videos/video_22q.html)

#### Patient Support and Advocacy Resources

- Chromosome Disorder Outreach  
<https://chromodisorder.org/>
- National Organization for Rare Disorders (NORD)  
<https://rarediseases.org/rare-diseases/chromosome-22q11-2-deletion-syndrome/>
- Resource list from the University of Kansas Medical Center  
<http://www.kumc.edu/gec/support/velo.html>

#### GeneReviews

- 22q11.2 Deletion Syndrome  
<https://www.ncbi.nlm.nih.gov/books/NBK1523>

#### ClinicalTrials.gov

- ClinicalTrials.gov  
<https://clinicaltrials.gov/ct2/results?cond=%2222q11.2+deletion+syndrome%22>

#### Scientific Articles on PubMed

- PubMed  
<https://www.ncbi.nlm.nih.gov/pubmed?term=%2822q11.2+deletion+syndrome%5BMAJR%5D%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+720+days%22%5Bdp%5D>

#### OMIM

- DIGEORGE SYNDROME  
<http://omim.org/entry/188400>
- OPITZ GBBB SYNDROME, TYPE II  
<http://omim.org/entry/145410>
- VELOCARDIOFACIAL SYNDROME  
<http://omim.org/entry/192430>

## Sources for This Summary

- Antshel KM, Kates WR, Roizen N, Fremont W, Shprintzen RJ. 22q11.2 deletion syndrome: genetics, neuroanatomy and cognitive/behavioral features keywords. *Child Neuropsychol.* 2005 Feb;11(1):5-19. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/15823980>
- Bassett AS, McDonald-McGinn DM, Devriendt K, Digilio MC, Goldenberg P, Habel A, Marino B, Oskarsdottir S, Philip N, Sullivan K, Swillen A, Vorstman J; International 22q11.2 Deletion Syndrome Consortium. Practical guidelines for managing patients with 22q11.2 deletion syndrome. *J Pediatr.* 2011 Aug;159(2):332-9.e1. doi: 10.1016/j.jpeds.2011.02.039. Epub 2011 May 12.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/21570089>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3197829/>
- Fine SE, Weissman A, Gerdes M, Pinto-Martin J, Zackai EH, McDonald-McGinn DM, Emanuel BS. Autism spectrum disorders and symptoms in children with molecularly confirmed 22q11.2 deletion syndrome. *J Autism Dev Disord.* 2005 Aug;35(4):461-70.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/16134031>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2814423/>
- McDonald-McGinn DM, Emanuel BS, Zackai EH. 22q11.2 Deletion Syndrome. 1999 Sep 23 [updated 2013 Feb 28]. In: Pagon RA, Adam MP, Ardinger HH, Wallace SE, Amemiya A, Bean LJH, Bird TD, Ledbetter N, Mefford HC, Smith RJH, Stephens K, editors. *GeneReviews*® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2017. Available from <http://www.ncbi.nlm.nih.gov/books/NBK1523/>  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/20301696>
- McDonald-McGinn DM, Gripp KW, Kirschner RE, Maisenbacher MK, Husted V, Schauer GM, Keppler-Noreuil KM, Ciprero KL, Pasquariello P Jr, LaRossa D, Bartlett SP, Whitaker LA, Zackai EH. Craniosynostosis: another feature of the 22q11.2 deletion syndrome. *Am J Med Genet A.* 2005 Aug 1;136A(4):358-62.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/16001439>
- McDonald-McGinn DM, Sullivan KE. Chromosome 22q11.2 deletion syndrome (DiGeorge syndrome/velocardiofacial syndrome). *Medicine (Baltimore).* 2011 Jan;90(1):1-18. doi: 10.1097/MD.0b013e3182060469. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/21200182>
- Paylor R, Glaser B, Mupo A, Ataliotis P, Spencer C, Sobotka A, Sparks C, Choi CH, Oghalai J, Curran S, Murphy KC, Monks S, Williams N, O'Donovan MC, Owen MJ, Scambler PJ, Lindsay E. Tbx1 haploinsufficiency is linked to behavioral disorders in mice and humans: implications for 22q11 deletion syndrome. *Proc Natl Acad Sci U S A.* 2006 May 16;103(20):7729-34. Epub 2006 May 9.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/16684884>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1472513/>
- Robin NH, Shprintzen RJ. Defining the clinical spectrum of deletion 22q11.2. *J Pediatr.* 2005 Jul;147(1):90-6.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/16027702>
- Shprintzen RJ. Velo-cardio-facial syndrome: 30 Years of study. *Dev Disabil Res Rev.* 2008;14(1):3-10. doi: 10.1002/ddrr.2. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/18636631>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2805186/>
- Sullivan KE. The clinical, immunological, and molecular spectrum of chromosome 22q11.2 deletion syndrome and DiGeorge syndrome. *Curr Opin Allergy Clin Immunol.* 2004 Dec;4(6):505-12. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/15640691>

- Vorstman JA, Morcus ME, Duijff SN, Klaassen PW, Heineman-de Boer JA, Beemer FA, Swaab H, Kahn RS, van Engeland H. The 22q11.2 deletion in children: high rate of autistic disorders and early onset of psychotic symptoms. *J Am Acad Child Adolesc Psychiatry*. 2006 Sep;45(9):1104-13.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/16926618>
  - Yagi H, Furutani Y, Hamada H, Sasaki T, Asakawa S, Minoshima S, Ichida F, Joo K, Kimura M, Imamura S, Kamatani N, Momma K, Takao A, Nakazawa M, Shimizu N, Matsuoka R. Role of TBX1 in human del22q11.2 syndrome. *Lancet*. 2003 Oct 25;362(9393):1366-73.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/14585638>
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