



## Wolf-Hirschhorn syndrome

Wolf-Hirschhorn syndrome is a condition that affects many parts of the body. The major features of this disorder include a characteristic facial appearance, delayed growth and development, intellectual disability, and seizures.

Almost everyone with this disorder has distinctive facial features, including a broad, flat nasal bridge and a high forehead. This combination is described as a "Greek warrior helmet" appearance. The eyes are widely spaced and may be protruding. Other characteristic facial features include a shortened distance between the nose and upper lip (a short philtrum), a downturned mouth, a small chin (micrognathia), and poorly formed ears with small holes (pits) or flaps of skin (tags). Additionally, affected individuals may have asymmetrical facial features and an unusually small head (microcephaly).

People with Wolf-Hirschhorn syndrome experience delayed growth and development. Slow growth begins before birth, and affected infants tend to have problems feeding and gaining weight (failure to thrive). They also have weak muscle tone (hypotonia) and underdeveloped muscles. Motor skills such as sitting, standing, and walking are significantly delayed. Most children and adults with this disorder also have short stature.

Intellectual disability ranges from mild to severe in people with Wolf-Hirschhorn syndrome. Compared to people with other forms of intellectual disability, their socialization skills are strong, while verbal communication and language skills tend to be weaker. Most affected children also have seizures, which may be resistant to treatment. Seizures tend to disappear with age.

Additional features of Wolf-Hirschhorn syndrome include skin changes such as mottled or dry skin, skeletal abnormalities such as abnormal curvature of the spine (scoliosis and kyphosis), dental problems including missing teeth, and an opening in the roof of the mouth (cleft palate) and/or in the lip (cleft lip). Wolf-Hirschhorn syndrome can also cause abnormalities of the eyes, heart, genitourinary tract, and brain.

A condition called Pitt-Rogers-Danks syndrome has features that overlap with those of Wolf-Hirschhorn syndrome. Researchers now recognize that these two conditions are actually part of a single syndrome with variable signs and symptoms.

### Frequency

The prevalence of Wolf-Hirschhorn syndrome is estimated to be 1 in 50,000 births. However, this may be an underestimate because it is likely that some affected individuals are never diagnosed.

For unknown reasons, Wolf-Hirschhorn syndrome occurs in about twice as many females as males.

## Genetic Changes

Wolf-Hirschhorn syndrome is caused by a deletion of genetic material near the end of the short (p) arm of chromosome 4. This chromosomal change is sometimes written as 4p-. The size of the deletion varies among affected individuals; studies suggest that larger deletions tend to result in more severe intellectual disability and physical abnormalities than smaller deletions.

The signs and symptoms of Wolf-Hirschhorn are related to the loss of multiple genes on the short arm of chromosome 4. *NSD2*, *LETM1*, and *MSX1* are the genes that are deleted in people with the typical signs and symptoms of this disorder. These genes play significant roles in early development, although many of their specific functions are unknown. Researchers believe that loss of the *NSD2* gene is associated with many of the characteristic features of Wolf-Hirschhorn syndrome, including the distinctive facial appearance and developmental delay. Deletion of the *LETM1* gene appears to be associated with seizures or other abnormal electrical activity in the brain. A loss of the *MSX1* gene may be responsible for the dental abnormalities and cleft lip and/or palate that are often seen with this condition.

Scientists are working to identify additional genes at the end of the short arm of chromosome 4 that contribute to the characteristic features of Wolf-Hirschhorn syndrome.

## Inheritance Pattern

Between 85 and 90 percent of all cases of Wolf-Hirschhorn syndrome are not inherited. They result from a chromosomal deletion that occurs as a random (de novo) event during the formation of reproductive cells (eggs or sperm) or in early embryonic development. More complex chromosomal rearrangements can also occur as de novo events, which may help explain the variability in the condition's signs and symptoms. De novo chromosomal changes occur in people with no history of the disorder in their family.

A small percentage of all people with Wolf-Hirschhorn syndrome have the disorder as a result of an unusual chromosomal abnormality such as a ring chromosome 4. Ring chromosomes occur when a chromosome breaks in two places and the ends of the chromosome arms fuse together to form a circular structure. In the process, genes near the ends of the chromosome are lost.

In the remaining cases of Wolf-Hirschhorn syndrome, an affected individual inherits a copy of chromosome 4 with a deleted segment. In these cases, one of the individual's parents carries a chromosomal rearrangement between chromosome 4 and another chromosome. This rearrangement is called a balanced translocation. No genetic material is gained or lost in a balanced translocation, so these chromosomal changes usually do not cause any health problems. However, translocations can become unbalanced as they are passed to the next generation. Some people with Wolf-Hirschhorn syndrome inherit an unbalanced translocation that deletes genes near the

end of the short arm of chromosome 4. A loss of these genes results in the intellectual disability, slow growth, and other health problems characteristic of this disorder.

### **Other Names for This Condition**

- 4p deletion syndrome
- 4p- syndrome
- chromosome 4p deletion syndrome
- chromosome 4p monosomy
- del(4p) syndrome
- monosomy 4p
- partial monosomy 4p
- WHS

### **Diagnosis & Management**

#### Genetic Testing

- Genetic Testing Registry: 4p partial monosomy syndrome  
<https://www.ncbi.nlm.nih.gov/gtr/conditions/C1956097/>

#### Other Diagnosis and Management Resources

- GeneReview: Wolf-Hirschhorn Syndrome  
<https://www.ncbi.nlm.nih.gov/books/NBK1183>
- MedlinePlus Encyclopedia: Epilepsy  
<https://medlineplus.gov/ency/article/000694.htm>

#### 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

- Encyclopedia: Epilepsy  
<https://medlineplus.gov/ency/article/000694.htm>
- Health Topic: Developmental Disabilities  
<https://medlineplus.gov/developmentaldisabilities.html>

### Genetic and Rare Diseases Information Center

- Wolf-Hirschhorn syndrome  
<https://rarediseases.info.nih.gov/diseases/7896/wolf-hirschhorn-syndrome>

### Educational Resources

- Disease InfoSearch: 4p partial monosomy syndrome  
<http://www.diseaseinfosearch.org/4p+partial+monosomy+syndrome/7618>
- MalaCards: wolf-hirschhorn syndrome  
[http://www.malacards.org/card/wolf\\_hirschhorn\\_syndrome](http://www.malacards.org/card/wolf_hirschhorn_syndrome)
- March of Dimes: Chromosomal Conditions  
<https://www.marchofdimes.org/baby/chromosomal-conditions.aspx>
- Orphanet: Wolf-Hirschhorn syndrome  
[https://www.orpha.net/consor/cgi-bin/OC\\_Exp.php?Lng=EN&Expert=280](https://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=280)

### Patient Support and Advocacy Resources

- 4p- Support Group  
<http://4p-supportgroup.org/>
- Chromosome Disorder Outreach  
<https://chromodisorder.org/>
- National Organization for Rare Disorders (NORD)  
<https://rarediseases.org/rare-diseases/wolf-hirschhorn-syndrome/>

### GeneReviews

- Wolf-Hirschhorn Syndrome  
<https://www.ncbi.nlm.nih.gov/books/NBK1183>

### ClinicalTrials.gov

- ClinicalTrials.gov  
<https://clinicaltrials.gov/ct2/results?cond=%22Wolf-Hirschhorn+syndrome%22>

## Scientific Articles on PubMed

- PubMed  
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28wolf-hirschhorn+syndrome%5BTIAB%5D%29+OR+%284p+deletion+syndrome%5BTIAB%5D%29+OR+%284p++syndrome%5BTIAB%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1800+days%22%5Bdp%5D>

## OMIM

- WOLF-HIRSCHHORN SYNDROME  
<http://omim.org/entry/194190>

## **Sources for This Summary**

- Battaglia A, Carey JC, South ST. Wolf-Hirschhorn Syndrome. 2002 Apr 29 [updated 2015 Aug 20]. 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/NBK1183/>  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/20301362>
- Battaglia A, Carey JC. Wolf-Hirschhorn syndrome and Pitt-Rogers-Danks syndrome. *Am J Med Genet.* 1998 Feb 17;75(5):541. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/9489803>
- Battaglia A, Filippi T, Carey JC. Update on the clinical features and natural history of Wolf-Hirschhorn (4p-) syndrome: experience with 87 patients and recommendations for routine health supervision. *Am J Med Genet C Semin Med Genet.* 2008 Nov 15;148C(4):246-51. doi: 10.1002/ajmg.c.30187.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/18932224>
- Bergemann AD, Cole F, Hirschhorn K. The etiology of Wolf-Hirschhorn syndrome. *Trends Genet.* 2005 Mar;21(3):188-95. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/15734578>
- Fisch GS, Battaglia A, Parrini B, Youngblom J, Simensen R. Cognitive-behavioral features of children with Wolf-Hirschhorn syndrome: preliminary report of 12 cases. *Am J Med Genet C Semin Med Genet.* 2008 Nov 15;148C(4):252-6. doi: 10.1002/ajmg.c.30185.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/18932225>
- Nieminen P, Kotilainen J, Aalto Y, Knuutila S, Pirinen S, Thesleff I. MSX1 gene is deleted in Wolf-Hirschhorn syndrome patients with oligodontia. *J Dent Res.* 2003 Dec;82(12):1013-7.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/14630905>
- South ST, Hannes F, Fisch GS, Vermeesch JR, Zollino M. Pathogenic significance of deletions distal to the currently described Wolf-Hirschhorn syndrome critical regions on 4p16.3. *Am J Med Genet C Semin Med Genet.* 2008 Nov 15;148C(4):270-4. doi: 10.1002/ajmg.c.30188.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/18932125>
- South ST, Whitby H, Battaglia A, Carey JC, Brothman AR. Comprehensive analysis of Wolf-Hirschhorn syndrome using array CGH indicates a high prevalence of translocations. *Eur J Hum Genet.* 2008 Jan;16(1):45-52. Epub 2007 Aug 29.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/17726485>

- Zollino M, Lecce R, Fischetto R, Murdolo M, Faravelli F, Selicorni A, Buttè C, Memo L, Capovilla G, Neri G. Mapping the Wolf-Hirschhorn syndrome phenotype outside the currently accepted WHS critical region and defining a new critical region, WHSCR-2. *Am J Hum Genet.* 2003 Mar;72(3): 590-7. Epub 2003 Jan 30.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/12563561>  
*Free article on PubMed Central:* <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1180235/>
  - Zollino M, Murdolo M, Marangi G, Pecile V, Galasso C, Mazzanti L, Neri G. On the nosology and pathogenesis of Wolf-Hirschhorn syndrome: genotype-phenotype correlation analysis of 80 patients and literature review. *Am J Med Genet C Semin Med Genet.* 2008 Nov 15;148C(4):257-69. doi: 10.1002/ajmg.c.30190. Review.  
*Citation on PubMed:* <https://www.ncbi.nlm.nih.gov/pubmed/18932124>
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