The LMNA gene provides instructions for making several slightly different proteins called lamins. The two major proteins produced from this gene, lamin A and lamin C, are made in most of the body's cells. These proteins are made up of a nearly identical sequence of protein building blocks (amino acids). The small difference in the sequence makes lamin A longer than lamin C.

Lamins A and C are structural proteins called intermediate filament proteins. Intermediate filaments provide stability and strength to cells. Lamins A and C are supporting (scaffolding) components of the nuclear envelope, which is a structure that surrounds the nucleus in cells. Specifically, these proteins are located in the nuclear lamina, a mesh-like layer of intermediate filaments and other proteins that is attached to the inner membrane of the nuclear envelope. The nuclear envelope regulates the movement of molecules into and out of the nucleus. Lamins A and C are also found inside the nucleus, and researchers believe the proteins may play a role in regulating the activity (expression) of certain genes.

The lamin A protein must be processed within the cell before becoming part of the lamina. Its initial form, called prelamin A, undergoes a complex series of steps that are necessary for the protein to be inserted into the lamina. Lamin C does not have to undergo this processing before becoming part of the lamina.

Health Conditions Related to Genetic Changes

Charcot-Marie-Tooth disease

Emery-Dreifuss muscular dystrophy

More than 130 mutations in the LMNA gene have been identified in people with Emery-Dreifuss muscular dystrophy, a condition that affects muscles used for movement (skeletal muscles) and the heart (cardiac muscle). This condition is characterized by joint deformities called contractures, which restrict the movement of certain joints; muscle weakness and wasting that worsen over time; and heart problems, including an increased risk of sudden death.

Most of the LMNA gene mutations that cause Emery-Dreifuss muscular dystrophy change single protein building blocks (amino acids) in lamins A and C, which alters the structure of these proteins. The effect of LMNA gene mutations within cells is unclear. Abnormal versions of lamins A and C may alter the activity of certain genes or weaken the structure of the nucleus, making cells more fragile. Researchers
continue to investigate how LMNA mutations affect skeletal muscles and cardiac muscle, leading to the characteristic features of Emery-Dreifuss muscular dystrophy.

Familial partial lipodystrophy

Several mutations in the LMNA gene have been found to cause familial partial lipodystrophy type 2 (also known as familial partial lipodystrophy, Dunnigan type), a rare condition characterized by an abnormal distribution of fatty (adipose) tissue in the body. Adipose tissue is lost from the arms, legs, and hips, and excess fat is deposited in the face, neck, and abdomen. The abnormal fat storage is related to changes in the development and function of adipocytes, which are the fat-storing cells in adipose tissue. The effects of LMNA gene mutations on adipocytes are not well understood. Studies suggest that these mutations may weaken the nuclear envelope, ultimately leading to the premature death of these cells and leaving the body unable to store and use fats properly. These abnormalities of adipose tissue alter hormone production and affect many of the body’s organs. However, it is unclear why the changes cause fat to be lost in some parts of the body and stored abnormally in others.

Hutchinson-Gilford progeria syndrome

A specific mutation in the LMNA gene has been found in most patients with Hutchinson-Gilford progeria syndrome, which is a condition that causes the dramatic, rapid appearance of aging beginning in childhood. This mutation changes a single DNA building block (nucleotide) in the gene. Specifically, the mutation replaces the nucleotide cytosine with the nucleotide thymine at position 1824 (written as C1824T). This mutation is also sometimes noted as Gly608Gly or G608G, which refers to the position in the lamin A protein affected by the mutation. Although the C1824T mutation is not predicted to change an amino acid, it alters the way the gene’s instructions are used to make a protein. The C1824T mutation leads to an abnormal version of the lamin A protein called progerin, which is missing 50 amino acids near one end. The location of this mutation does not affect the production of lamin C. Other mutations in the LMNA gene have been identified in a small number of people with the features of Hutchinson-Gilford progeria syndrome.

The mutations responsible for this disorder result in an abnormal version of prelamin A that cannot be processed correctly within the cell. When the altered protein is incorporated into the lamina, it disrupts the shape of the nuclear envelope. Over time, a buildup of this altered protein appears to damage the structure and function of the nucleus, making cells more likely to die prematurely. Researchers are working to determine how these changes lead to the signs and symptoms of Hutchinson-Gilford progeria syndrome.

LMNA-related congenital muscular dystrophy

At least 15 mutations in the LMNA gene have been reported to cause LMNA-related congenital muscular dystrophy (L-CMD), a rare condition characterized by skeletal
muscle weakness and atrophy beginning very early in life. Most of the mutations associated with this disorder change single amino acids in lamin A and lamin C, while a few add or remove a small number of amino acids from these proteins.

The mutations that cause L-CMD lead to the production of abnormal lamin A and lamin C proteins. These malfunctioning proteins alter the structure of the nuclear envelope in ways that are not well understood. Researchers are working to determine how these changes affect muscle cells and lead to muscle weakness and atrophy in people with L-CMD.

Some of the mutations identified in people with L-CMD seem to be unique to this disorder, while others have also been reported in people with other LMNA-related conditions, such as Emery-Dreifuss muscular dystrophy (described above). It is unclear why certain mutations can cause different disorders in different people.

**Mandibuloacral dysplasia**

At least four mutations in the LMNA gene cause mandibuloacral dysplasia type A (MADA). This condition is characterized by a variety of signs and symptoms, which can include bone abnormalities; mottled or patchy skin coloring; and loss of fatty tissue under the skin, particularly affecting the limbs (type A lipodystrophy). The LMNA gene mutations that cause this condition change single amino acids in the lamin A and lamin C proteins. The most common mutation replaces the amino acid arginine at position 527 with the amino acid histidine (written as Arg527His or R527H).

The effects of LMNA gene mutations in this condition are not well understood. The amino acid changes may affect the structure of the lamin A or lamin C protein, or both, and alter how they interact with other proteins in the nuclear lamina. Some researchers speculate that these changes disrupt the nuclear envelope, making cells more fragile; however, it is unclear how the altered lamin proteins contribute to the signs and symptoms of MADA.

**Arrhythmogenic right ventricular cardiomyopathy**

**Familial atrial fibrillation**

**Familial dilated cardiomyopathy**

**Left ventricular noncompaction**

**Limb-girdle muscular dystrophy**

**Other disorders**

Mutations in the LMNA gene have been found to cause several other conditions. Health conditions that result from mutations in lamin proteins are known as laminopathies. These disorders often have overlapping signs and symptoms,
and in some cases different conditions can result from the same LMNA mutation. Researchers suspect that some laminopathies represent variants of a single condition instead of separate disorders.

In addition to the health conditions listed above, mutations in the LMNA gene cause atypical progeroid syndrome (APS); the features of this condition are similar to those of Hutchinson-Gilford progeria syndrome and mandibuloacral dysplasia. As in Hutchinson-Gilford progeria syndrome, children with APS look as though they are aging prematurely, although the signs and symptoms of APS usually begin slightly later. APS can also cause similar abnormalities in bone development and fat distribution as mandibuloacral dysplasia, although they are typically milder in APS.

Mutations in the LMNA gene have also been identified in newborns with a disorder called lethal restrictive dermopathy. Infants with this disorder have tight, rigid skin; underdeveloped lungs; and other abnormalities. They do not usually survive past the first week of life.

Researchers have not determined how mutations in the LMNA gene result in this diverse group of disorders, but the multiple roles of the nuclear lamina in cells may help explain the wide variety of signs and symptoms.

**Chromosomal Location**

Cytogenetic Location: 1q22, which is the long (q) arm of chromosome 1 at position 22
Molecular Location: base pairs 156,082,573 to 156,140,081 on chromosome 1 (Homo sapiens Updated Annotation Release 109.20200522, GRCh38.p13) (NCBI)

Credit: Genome Decoration Page/NCBI

**Other Names for This Gene**

- LMN1
- LMNA_HUMAN

page 4
Additional Information & Resources

Educational Resources

• Madame Curie Bioscience Database: Laminopathies: One Gene, Two Proteins, Five Diseases. https://www.ncbi.nlm.nih.gov/books/NBK6151/

• Molecular Cell Biology (fourth edition, 2000): Intermediate Filaments https://www.ncbi.nlm.nih.gov/books/NBK21560/

• National Human Genome Research Institute: The Genomic Services Research Program (GSRP): Study of People with Unexpected Genetic Results https://www.genome.gov/Current-NHGRI-Clinical-Studies/Genomic-Services-Research-Program

Clinical Information from GeneReviews

• Dilated Cardiomyopathy Overview https://www.ncbi.nlm.nih.gov/books/NBK1309

• Emery-Dreifuss Muscular Dystrophy https://www.ncbi.nlm.nih.gov/books/NBK1436

• Hutchinson-Gilford Progeria Syndrome https://www.ncbi.nlm.nih.gov/books/NBK1121

• LMNA-Related Dilated Cardiomyopathy https://www.ncbi.nlm.nih.gov/books/NBK1674

Scientific Articles on PubMed

• PubMed https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28LMNA%5BTI%5D%29+OR+%28lamin+A/C%5BTI%5D%29+OR+%28lamin+A%5BTI%5D%29+OR+%28lamin +C%5BTI%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D

Catalog of Genes and Diseases from OMIM

• LAMIN A/C http://omim.org/entry/150330

• RESTRICTIVE DERMOPATHY, LETHAL http://omim.org/entry/275210

Research Resources

• Atlas of Genetics and Cytogenetics in Oncology and Haematology http://atlasgeneticsoncology.org/Genes/GC_LMNA.html

• ClinVar https://www.ncbi.nlm.nih.gov/clinvar?term=LMNA%5Bgene%5D
Sources for This Summary

- Bidault G, Vatier C, Capeau J, Vigouroux C, Béréziat V. LMNA-linked lipodystrophies: from altered fat distribution to cellular alterations. Biochem Soc Trans. 2011 Dec;39(6):1752-7. doi: 10.1042/BST20110675. Review. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/22103520
- Bonne G, Quijano-Roy S. Emery-Dreifuss muscular dystrophy, laminopathies, and other nuclear envelopopathies. Handb Clin Neurol. 2013;113:1367-76. doi: 10.1016/B978-0-444-59565-2.00007-1. Review. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23622360
- Carboni N, Mateddu A, Marrosu G, Cocco E, Marrosu MG. Genetic and clinical characteristics of skeletal and cardiac muscle in patients with lamin A/C gene mutations. Muscle Nerve. 2013 Aug;48(2):161-70. doi: 10.1002/mus.23827. Epub 2013 Jun 28. Review. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23450819
- Carboni N, Politano L, Floris M, Mateddu A, Solla E, Olla S, Maggi L, Antonietta Maioli M, Piras R, Cocco E, Marrosu G, Giovanna Marrosu M. Overlapping syndromes in laminopathies: a meta-analysis of the reported literature. Acta Myol. 2013 May;32(1):7-17. Review. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23853504 Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665370/
- De Sandre-Giovannoli A, Bernard R, Cau P, Navarro C, Amiel J, Boccaccio I, Lyonnet S, Stewart CL, Munnich A, Le Merrer M, Lévy N. Lamin A truncation in Hutchinson-Gilford progeria. Science. 2003 Jun 27;300(5628):2055. Epub 2003 Apr 17. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12702809
- Eriksson M, Brown WT, Gordon LB, Glynn MW, Singer J, Scott L, Erdos MR, Robbins CM, Moses T, Berglund P, Dutra A, Pak E, Durkin S, Csoka AB, Boehnke M, Glover TW, Collins FS. Recurrent de novo point mutations in lamin A cause Hutchinson-Gilford progeria syndrome. Nature. 2003 May 15;423(6937):293-8. Epub 2003 Apr 25. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12714972
- Garg A, Subramanyam L, Agarwal AK, Simha V, Levine B, D’Apice MR, Novelli G, Crow Y. Atypical progeroid syndrome due to heterozygous missense LMNA mutations. J Clin Endocrinol Metab. 2009 Dec;94(12):4971-83. doi: 10.1210/jc.2009-0472. Epub 2009 Oct 29. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19875478 Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2795646/
- Guénantin AC, Briand N, Bidault G, Afonso P, Béréziat V, Vatier C, Lascols O, Caron-Debarle M, Capeau J, Vigouroux C. Nuclear envelope-related lipodystrophies. Semin Cell Dev Biol. 2014 May;29:148-57. doi: 10.1016/j.semcdb.2013.12.015. Epub 2013 Dec 30. Review. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/24384368
• Muchir A, Bonne G, van der Kooi AJ, van Meegen M, Baas F, Bolhuis PA, de Visser M, Schwartz K. Identification of mutations in the gene encoding lamins A/C in autosomal dominant limb girdle muscular dystrophy with atrioventricular conduction disturbances (LGMD1B). Hum Mol Genet. 2000 May 22;9(9):1453-9.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/10814726

• Navarro CL, De Sandre-Giovannoli A, Bernard R, Boccaccio I, Boyer A, Geneviève D, Hadj-Rabia S, Gaudy-Marqueste C, Smitt HS, Vabres P, Faivre L, Verloes A, Van Essen T, Flori E, Hennekam R, Beemer FA, Laurent N, Le Merrer M, Cau P, Lévy N. Lamin A and ZMPSTE24 (FACE-1) defects cause nuclear disorganization and identify restrictive dermopathy as a lethal neonatal laminopathy. Hum Mol Genet. 2004 Oct 15;13(20):2493-503. Epub 2004 Aug 18.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15317753

• Novelli G, Muchir A, Sanguolo F, Helbling-Leclerc A, D'Apice MR, Massart C, Capon F, Sbraccia P, Federici M, Lauro R, Tudisco C, Pallotta R, Scarano G, Dallapiccola B, Merlini L, Bonne G. Mandibuloacral dysplasia is caused by a mutation in LMNA-encoding lamin A/C. Am J Hum Genet. 2002 Aug;71(2):426-31. Epub 2002 Jun 19.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12075506
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC379176/

• Petillo R, D'Ambrosio P, Torella A, Taglia A, Picillo E, Testori A, Ergoli M, Nigro G, Piluso G, Nigro V, Politano L. Novel mutations in LMNA A/C gene and associated phenotypes. Acta Myol. 2015 Dec;34(2-3):116-9.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/27199538
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4859074/

• Quijano-Roy S, Mbieleu B, Bönnemann CG, Jeannet PY, Colomer J, Clarke NF, Cuisset JM, Roper H, De Meirleir L, D'Amico A, Ben Gaou R, Nascimento A, Barois A, Demay L, Bertini E, Ferreiro A, Sewry CA, Romero NB, Ryan M, Muntoni F, Guicheney P, Richard P, Bonne G, Estournet B. De novo LMNA mutations cause a new form of congenital muscular dystrophy. Ann Neurol. 2008 Aug; 64(2):177-86. doi: 10.1002/ana.21417.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/18551513

Reprinted from Genetics Home Reference:
https://ghr.nlm.nih.gov/gene/LMNA

Reviewed: May 2018
Published: August 17, 2020

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services