

# MYH7 Gene

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Contributor: Lily Guo

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## 1. Introduction

The *MYH7* gene provides instructions for making a protein known as the beta ( $\beta$ )-myosin heavy chain. This protein is found in heart (cardiac) muscle and in type I skeletal muscle fibers. (Skeletal muscle are the muscles used for movement.) Type I fibers, which are also known as slow-twitch fibers, are one of two types of fibers that make up skeletal muscles. Type I fibers are the primary component of skeletal muscles that are resistant to fatigue. For example, muscles involved in posture, such as the neck muscles that hold the head steady, are made predominantly of type I fibers.

In cardiac and skeletal muscle cells, the  $\beta$ -myosin heavy chain forms part of a larger protein called type II myosin. Each type II myosin protein consists of two heavy chains (produced from the *MYH7* gene) and two pairs of regulatory light chains (produced from several other genes). The heavy chains each have two parts: a head region and a tail region. The head region, called the motor domain, interacts with a protein called actin, which is important for cell movement and shape. The long tail region interacts with other proteins, including the tail regions of other myosin proteins.

Type II myosin generates the mechanical force that is needed for muscles to contract. It is integral to muscle cell structures called sarcomeres, which are the basic units of muscle contraction. Sarcomeres are composed of thick filaments made up of type II myosin and thin filaments made up of actin. The overlapping thick and thin filaments attach to each other and release, which allows the filaments to move relative to one another so that muscles can contract. In the heart, regular contractions of cardiac muscle pump blood to the rest of the body. The coordinated contraction and relaxation of skeletal muscles allow the body to move.

## 2. Health Conditions Related to Genetic Changes

### 2.1. Familial hypertrophic cardiomyopathy

Mutations in the *MYH7* gene are a common cause of familial hypertrophic cardiomyopathy, accounting for up to 35 percent of all cases. This condition is characterized by thickening (hypertrophy) of the cardiac muscle. Although some people with familial hypertrophic cardiomyopathy have no obvious health effects, all affected individuals have an increased risk of heart failure and sudden death.

Most *MYH7* gene mutations that cause familial hypertrophic cardiomyopathy change single protein building blocks (amino acids) in the  $\beta$ -myosin heavy chain protein. The altered protein is likely incorporated into the thick filament, but it may not function properly. It is unclear how *MYH7* gene mutations lead to the features of familial hypertrophic cardiomyopathy.

### 2.2. Laing distal myopathy

At least six mutations in the *MYH7* gene have been found to cause Laing distal myopathy. This condition causes progressive muscle weakness, particularly affecting the arms and legs. Most of the mutations result in changes in the tail region of the  $\beta$ -myosin heavy chain. Some of these mutations change single amino acids, while others delete a single amino acid from the heavy chain. Changes in the *MYH7* gene probably disrupt the normal function of type II myosin in muscle cells. Specifically, researchers suspect that mutations alter the structure of the tail region of the  $\beta$ -myosin heavy chain. The altered tail region may be unable to interact with other proteins, including the tail regions of other myosin proteins. It is unclear how these changes in the structure and function of myosin lead to progressive muscle weakness in people with Laing distal myopathy.

## 2.3. Left ventricular noncompaction

At least 30 *MYH7* gene mutations have been found to cause left ventricular noncompaction, which occurs when the lower left chamber of the heart (left ventricle) does not develop correctly. The heart muscle is weakened and cannot pump blood efficiently. These cardiac abnormalities can result in a wide range of outcomes from a complete lack of symptoms to sudden cardiac death. Other signs and symptoms include an irregular heart rhythm (arrhythmia), shortness of breath (dyspnea), and heart failure.

It is unclear how *MYH7* gene mutations cause left ventricular noncompaction. During normal development before birth, cardiac muscle gets compacted, becoming smooth and firm. *MYH7* gene mutations likely lead to changes in this process, resulting in a left ventricular cardiac muscle that is not compacted but is thick and spongy. This abnormal cardiac muscle is weak and cannot contract effectively, causing the varied signs and symptoms of left ventricular noncompaction.

## 2.4. Myosin storage myopathy

At least six mutations in the *MYH7* gene are involved in myosin storage myopathy. This condition causes muscle weakness and is characterized by the formation of protein clumps, which include type II myosin, within type I skeletal muscle fibers. The *MYH7* gene mutations that cause myosin storage myopathy change amino acids in the tail region of cardiac  $\beta$ -myosin heavy chain. Researchers suggest that these mutations impair the proper formation of thick filaments. The abnormal proteins accumulate in type I skeletal muscle fibers, forming the protein clumps characteristic of the disorder. It is unclear how the gene mutations lead to muscle weakness in people with myosin storage myopathy.

## 3. Other Names for This Gene

- beta-myosin heavy chain
- MGC138376
- MGC138378
- MPD1
- MYH7\_HUMAN
- MyHC-beta
- myhc-slow
- MYHCB
- myosin heavy chain (AA 1-96)
- Myosin heavy chain 7
- Myosin heavy chain, cardiac muscle beta isoform
- Myosin, cardiac, heavy chain, beta
- myosin, heavy chain 7, cardiac muscle, beta
- myosin, heavy polypeptide 7, cardiac muscle, beta
- SPMD
- SPMM

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## References

1. Armel TZ, Leinwand LA. Mutations in the beta-myosin rod cause myosin storage myopathy via multiple mechanisms. *Proc Natl Acad Sci U S A*. 2009 Apr 14;106(15):6291-6. doi: 10.1073/pnas.0900107106.
2. Bashyam MD, Savithri GR, Kumar MS, Narasimhan C, Nallari P. Molecular genetics of familial hypertrophic cardiomyopathy (FHC). *J Hum Genet*. 2003;48(2):55-64. Review.
3. Daehmlow S, Erdmann J, Knueppel T, Gille C, Froemmel C, Hummel M, Hetzer R, Regitz-Zagrosek V. Novel mutations in sarcomeric protein genes in dilated cardiomyopathy. *Biochem Biophys Res Commun*. 2002 Oct 18;298(1):116-20.
4. Dong X, Fan P, Tian T, Yang Y, Xiao Y, Yang K, Liu Y, Zhou X. Recent advancements in the molecular genetics of left ventricular noncompaction cardiomyopathy. *Clin Chim Acta*. 2017 Feb;465:40-44. doi:10.1016/j.cca.2016.12.013.
5. Finsterer J, Stöllberger C, Towbin JA. Left ventricular noncompaction cardiomyopathy: cardiac, neuromuscular, and genetic factors. *Nat Rev Cardiol*. 2017 Apr;14(4):224-237. doi: 10.1038/nrcardio.2016.207.
6. Kamisago M, Sharma SD, DePalma SR, Solomon S, Sharma P, McDonough B, Smoot L, Mullen MP, Woolf PK, Wigle ED, Seidman JG, Seidman CE. Mutations in sarcomere protein genes as a cause of dilated cardiomyopathy. *N Engl J Med*. 2000 Dec 7;343(23):1688-96.

7. Keren A, Syrris P, McKenna WJ. Hypertrophic cardiomyopathy: the genetic determinants of clinical disease expression. *Nat Clin Pract Cardiovasc Med*. 2008 Mar;5(3):158-68. doi: 10.1038/ncpcardio.1110.in: *Nat Clin Pract Cardiovasc Med*. 2008 Nov;5(11):747.
8. Marston SB. How do mutations in contractile proteins cause the primary familial cardiomyopathies? *J Cardiovasc Transl Res*. 2011 Jun;4(3):245-55. doi:10.1007/s12265-011-9266-2.
9. Meredith C, Herrmann R, Parry C, Liyanage K, Dye DE, Durling HJ, Duff RM, Beckman K, de Visser M, van der Graaff MM, Hedera P, Fink JK, Petty EM, Lamont P, Fabian V, Bridges L, Voit T, Mastaglia FL, Laing NG. Mutations in the slow skeletal muscle fiber myosin heavy chain gene (MYH7) cause late-onset distal myopathy (MPD1). *Am J Hum Genet*. 2004 Oct;75(4):703-8.
10. Oldfors A. Hereditary myosin myopathies. *Neuromuscul Disord*. 2007 May;17(5):355-67.
11. Pegoraro E, Gavassini BF, Borsato C, Melacini P, Vianello A, Stramare R, Cenacchi G, Angelini C. MYH7 gene mutation in myosin storage myopathy and scapulo-peroneal myopathy. *Neuromuscul Disord*. 2007 Apr;17(4):321-9.
12. Perrot A, Schmidt-Traub H, Hoffmann B, Prager M, Bit-Avragim N, Rudenko RI, Ustupbaeva DA, Kabaeva Z, Imanov B, Mirrakhimov MM, Dietz R, Wycisk A, Tendera M, Gessner R, Osterziel KJ. Prevalence of cardiac beta-myosin heavy chain gene mutations in patients with hypertrophic cardiomyopathy. *J Mol Med (Berl)*. 2005 Jun;83(6):468-77.
13. Rodríguez JE, McCudden CR, Willis MS. Familial hypertrophic cardiomyopathy: basic concepts and future molecular diagnostics. *Clin Biochem*. 2009 Jun;42(9):755-65. doi: 10.1016/j.clinbiochem.2009.01.020. Review.
14. Tajsharghi H, Thornell LE, Lindberg C, Lindvall B, Henriksson KG, Oldfors A. Myosin storage myopathy associated with a heterozygous missense mutation in MYH7. *Ann Neurol*. 2003 Oct;54(4):494-500.
15. Van Driest SL, Jaeger MA, Ommen SR, Will ML, Gersh BJ, Tajik AJ, Ackerman MJ. Comprehensive analysis of the beta-myosin heavy chain gene in 389 unrelated patients with hypertrophic cardiomyopathy. *J Am Coll Cardiol*. 2004 Aug;44(3):602-10.
16. Villard E, Duboscq-Bidot L, Charron P, Benaiche A, Conraads V, Sylvius N, Komajda M. Mutation screening in dilated cardiomyopathy: prominent role of the beta myosin heavy chain gene. *Eur Heart J*. 2005 Apr;26(8):794-803.

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