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# Myelodysplastic Syndrome Causes, Risk Factors, and Prevention

Learn about the risk factors for myelodysplastic syndromes and what you might be able to do to help lower your risk.

## Risk Factors

A risk factor is anything that affects your chance of getting a disease such as cancer. Learn more about the risk factors for myelodysplastic syndromes.

- [Risk Factors for Myelodysplastic Syndromes](#)
- [What Causes Myelodysplastic Syndromes?](#)

## Prevention

There is no way to completely prevent myelodysplastic syndromes. But there are things you can do that might lower your risk. Learn more.

- [Can Myelodysplastic Syndromes Be Prevented?](#)

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# Risk Factors for Myelodysplastic Syndromes

- [Older age](#)
- [Sex](#)
- [Cancer treatment](#)
- [Genetic syndromes](#)
- [Familial MDS](#)
- [Smoking](#)
- [Environmental exposures](#)

A risk factor is anything that changes your chance of getting a disease such as cancer. Different cancers have different risk factors. Some risk factors, like smoking, you can change. Others, like your age or family history, can't be changed.

But having a risk factor, or even several, does not always mean that a person will get the disease, and many people get cancer without having any known risk factors.

There are several known risk factors for myelodysplastic syndromes (MDS).

## Older age

Older age is one of the most important risk factors for MDS. MDS is uncommon in people younger than 50, and most cases are found in people in their 70s or 80s.

## Sex

MDS is more common in men than in women. The reason for this is not clear, although it might have to do with men having been more likely to smoke or to be exposed to certain chemicals in the workplace in the past.

## Cancer treatment

Prior treatment with [chemotherapy](#)<sup>1</sup> (chemo) is another important risk factor for MDS. Patients who have been treated with certain chemo drugs for cancer are more likely to develop MDS later on. When MDS is caused by cancer treatment it is called *secondary MDS* or *treatment-related MDS*.

Some of the drugs that can lead to MDS include:

- Mechlorethamine (nitrogen mustard)
- Procarbazine

- Chlorambucil
- Cyclophosphamide
- Ifosfamide
- Etoposide
- Teniposide
- Doxorubicin

The risk of secondary MDS varies based on the type and doses of drugs. It might also be affected by the type of cancer the chemo is treating. Combining these drugs with [radiation therapy](#)<sup>2</sup> increases the risk further. People who have had [stem cell transplants](#)<sup>3</sup> (bone marrow transplants) can also develop MDS because of the very high doses of chemo they received. Still, only a small percentage of people who are treated with these medicines will eventually develop MDS.

## Genetic syndromes

People with certain inherited syndromes are more likely to develop MDS. These syndromes are caused by abnormal (mutated) genes that have been passed on from one or both parents. Examples include:

- Fanconi anemia
- Shwachman-Diamond syndrome
- Diamond Blackfan anemia
- Familial platelet disorder with a propensity to myeloid malignancy
- Severe congenital neutropenia
- Dyskeratosis congenita

## Familial MDS

In some families, MDS occurs more often than would be expected. Sometimes this is due to a known [gene mutation](#) that runs in the family, but in other cases the cause isn't clear.

## Smoking

[Smoking](#)<sup>4</sup> increases the risk of MDS. Many people know that smoking can cause cancer of the lungs, but it can also cause cancer in other parts of the body that don't come into

direct contact with smoke. [Cancer-causing substances in tobacco smoke](#)<sup>5</sup> are absorbed into the blood as it passes through the lungs. Once in the bloodstream, these substances spread to many parts of the body.

## Environmental exposures

Some environmental exposures have been linked to MDS:

- High-dose [radiation exposure](#)<sup>6</sup> (such as surviving an atomic bomb blast or nuclear reactor accident) increases the risk of developing MDS.
- Long-term workplace exposure to [benzene](#)<sup>7</sup> and certain chemicals used in the petroleum and rubber industries can also increase the risk of developing MDS.

## Hyperlinks

1. [www.cancer.org/cancer/managing-cancer/treatment-types/chemotherapy.html](http://www.cancer.org/cancer/managing-cancer/treatment-types/chemotherapy.html)
2. [www.cancer.org/cancer/managing-cancer/treatment-types/radiation.html](http://www.cancer.org/cancer/managing-cancer/treatment-types/radiation.html)
3. [www.cancer.org/cancer/managing-cancer/treatment-types/stem-cell-transplant.html](http://www.cancer.org/cancer/managing-cancer/treatment-types/stem-cell-transplant.html)
4. [www.cancer.org/cancer/risk-prevention/tobacco.html](http://www.cancer.org/cancer/risk-prevention/tobacco.html)
5. [www.cancer.org/cancer/risk-prevention/tobacco/carcinogens-found-in-tobacco-products.html](http://www.cancer.org/cancer/risk-prevention/tobacco/carcinogens-found-in-tobacco-products.html)
6. [www.cancer.org/cancer/risk-prevention/radiation-exposure/x-rays-gamma-rays.html](http://www.cancer.org/cancer/risk-prevention/radiation-exposure/x-rays-gamma-rays.html)
7. [www.cancer.org/cancer/risk-prevention/chemicals/benzene.html](http://www.cancer.org/cancer/risk-prevention/chemicals/benzene.html)

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Aster JC, Stone RM. Clinical manifestations and diagnosis of the myelodysplastic syndromes. UpToDate. 2017. Accessed at <https://www.uptodate.com/contents/clinical-manifestations-and-diagnosis-of-the-myelodysplastic-syndromes> on October 4, 2017.

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## What Causes Myelodysplastic Syndromes?

- [Inherited gene changes](#)
- [Gene changes acquired during a person's lifetime](#)

Some cases of myelodysplastic syndrome (MDS) are linked to known [risk factors](#), but most often, the cause is unknown.

Scientists have made great progress in understanding how certain changes in the DNA in bone marrow cells may cause MDS to develop. DNA is the chemical that makes up our *genes*, which control how our cells function. We usually look like our parents because they are the source of our DNA. But DNA affects more than the way we look.

Some genes control when our cells grow, divide into new cells, and die:

- Certain genes that help cells grow, divide, and stay alive are called **oncogenes**.
- Genes that help keep cell division under control, or cause cells to die at the right time are called **tumor suppressor genes**.

Cancers can be caused by gene mutations (defects) that turn on oncogenes or turn off tumor suppressor genes.

Usually mutations in several different genes inside bone marrow cells are needed before a person develops MDS. Some of the mutations most often seen in MDS cells

include those in the *DNMT3A*, *TET2*, *ASXL1*, *TP53*, *RUNX1*, *SRSF2*, and *SF3B1* genes. Some of these gene changes can be inherited from a parent, but more often they happen during a person's lifetime.

## Inherited gene changes

Researchers have found the gene changes that cause some rare inherited syndromes (like familial platelet disorder with a propensity to myeloid malignancy) linked to an increased risk of developing MDS. This syndrome is caused by inherited changes in the *RUNX1* gene. Normally, this gene helps control the development of blood cells. Changes in this gene can lead to blood cells not maturing like they normally would, which can increase the risk of developing MDS.

## Gene changes acquired during a person's lifetime

Often, it's not known why people without inherited syndromes develop MDS.

Some [outside exposures](#) can lead to MDS by damaging the DNA inside bone marrow cells. For example, tobacco smoke contains chemicals that can damage genes. Exposure to radiation or certain chemicals such as benzene or some chemotherapy drugs can also cause mutations that lead to MDS.

But sometimes the gene changes that lead to MDS seem to occur for no apparent reason. Many of these gene changes are probably just random events that sometimes happen inside a cell, without having an outside cause.

Gene changes inside cells can build up over a person's lifetime, which might help explain why MDS largely affects older people.

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## Can Myelodysplastic Syndromes Be Prevented?

- [Not smoking](#)
- [Avoiding exposure to radiation or certain chemicals](#)

There is no sure way to prevent myelodysplastic syndromes (MDS). But there are things you can do that might lower your risk.

### Not smoking

Since [smoking](#)<sup>1</sup> is linked to an increased risk of MDS, not smoking can lower the risk. Of course, people who don't smoke are also less likely than people who smoke to develop many other types of cancers, as well as heart disease, stroke, and other diseases.

### Avoiding exposure to radiation or certain chemicals

Avoiding known cancer-causing industrial chemicals, such as [benzene](#)<sup>2</sup>, might lower your risk of developing MDS.

Treating cancer with [radiation and certain chemotherapy drugs](#) can increase the risk of MDS. Doctors are studying ways to limit the risk of MDS in patients who get these treatments. For some cancers, doctors may try to avoid using the chemotherapy drugs that are more likely to lead to MDS. Some people, however, may need these specific

drugs. Often, the obvious benefits of treating life-threatening cancers with chemo and radiation therapy must be balanced against the small chance of developing MDS several years later.

## Hyperlinks

1. [www.cancer.org/cancer/risk-prevention/tobacco.html](http://www.cancer.org/cancer/risk-prevention/tobacco.html)
2. [www.cancer.org/cancer/risk-prevention/chemicals/benzene.html](http://www.cancer.org/cancer/risk-prevention/chemicals/benzene.html)

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