

# TMAO

Know your risk™ for gut dysfunction.



metabolic

## What are gut bacteria and why are they important?

The internal lining of your digestive tract is populated by trillions of microorganisms. The bulk of these microorganisms are bacteria that live in your intestines. These bacteria perform important physiological roles in the human body, yet each person has a unique composition. Gut microbes produce essential vitamins and help us to digest food. They also form a barrier between the contents of the intestine and our bloodstream, continually combating invasive and disease causing bacteria.

## What is TMAO?

TMAO, or trimethylamine N-oxide, is a byproduct of gut bacteria metabolism. When certain types of bacteria in the gut digest food components found in red meat, eggs, and full-fat dairy products, they release a compound called TMA (trimethylamine), which your liver converts to TMAO. TMAO has been shown to affect how cholesterol accumulates in tissues, like the artery wall. Abnormally elevated levels of TMAO are associated with increased risk for developing atherosclerotic heart disease, having a heart attack, stroke, and even death.

## What causes increased TMAO levels?

Higher TMAO levels mostly reflect the gut microbial composition in an individual. However, chronic dietary exposures can influence gut microbe composition. Food products high in phosphatidylcholine, choline, or L-carnitine (red meat, eggs, and full-fat dairy products) provide the material needed for gut bacteria to initiate TMAO production. Chronic ingestion of these foods has been shown to increase levels of TMAO. For example, vegans and vegetarians do not regularly eat food products high in L-carnitine and consequently produce little TMAO.

## Why should I check my TMAO levels?

You should check your TMAO levels to determine if your gut bacteria are contributing to your risk for heart disease, and whether more aggressive dietary efforts to reduce foods rich in TMAO precursors may be beneficial.

## When should my TMAO levels be checked?

TMAO has been associated with enhanced cardiovascular disease risks in both large-community based populations, and individuals with one or more risk factors for heart disease. Your TMAO levels should be checked to see if enhanced global preventive efforts may be needed, or if your diet is right for you.

## How do I prepare for the TMAO test?

It is recommended for you to fast overnight in preparation for the TMAO test. You should not take the TMAO test while on antibiotics and should avoid eating fish or other seafood the day before taking the test.

## What can I do to lower my TMAO levels?

In order to limit the production of TMAO and encourage healthier gut bacteria consider eating a diet rich in green leafy vegetables and fiber, and speaking with your medical provider about the benefits of probiotic supplements. In addition, consider limiting your consumption of the following foods rich in TMAO precursors:

- Full-fat dairy products such as whole milk, eggs, yogurt, cream cheese, and butter.
- Red meat products such as beef, pork, ham, lamb and veal (both unprocessed and processed).
- Dietary supplements or energy drinks that contain phosphatidylcholine/choline or L-carnitine.

It is important that you talk with your medical provider to develop a diet plan that works for you.

**The TMAO test can help assess gut dysfunction and cardiovascular risk.**

## RELATIVE RISK

TMAO  
( $\mu\text{M}$ )

<6.2 Low

6.2-9.9 Moderate

$\geq 10.0$  High

 **ClevelandHeartLab**<sup>®</sup>  
Know your risk.