



## Endothelial Glycocalyx Dysfunction

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You may look—and even feel—healthy on the outside, but inside your microvascular system, a completely different situation could be developing.

Over time, a transparent shield that lines all blood vessels—called the endothelial glycocalyx—can become damaged due to poor diet, lack of exercise, genetics, stress, and more. With damage,

vital organs are starved because delivery of nutrients, hormones, and oxygen is obstructed ... and the cleansing of waste and carbon dioxide from organs becomes compromised. The body sends early warning signs that alert of glycocalyx and vascular damage.

These early warning signs all point to Endothelial Glycocalyx

**Dysfunctions:**

**Type 2 Diabètes**  
**Auto-immune diseases**  
**Pre-diabètes**  
**Obesity-Weight Loss**  
**High Blood Pressure**  
**Heart Diseases**  
**Lung Diseases**  
**Blood Clots**  
**Enlarged Prostate/Erectile Dysfunction**  
**Severe PMS**  
**Cold Hands and Feet**  
**Leg Cramps**  
**Skin Problems (Ulcers)**  
**Sleep disorders**  
**Hair Thinning**  
**Fatigue**  
**Neuropathy**  
**Nerve damage from Motor Vehicle Accidents or Work-Related Injuries**  
**Scar Tissue buildup, surgeries, old sports injuries etc.**  
**Infertility**  
**Leaky Gut Syndrome**  
**Memory Loss - Dementia**  
**Certain Eye Problems**  
**Hearing Loss**  
**Slow Wound Healing**  
**Stroke(s)**  
**PTSD**  
**Neurological disease conditions**

Organ starvation (blood) is one reason that declining health and diseases begin in the

body. When the capillaries begin to lose their function, vital organs do not receive the nutrients needed to be healthy... the silent spiral of health decline begins.

Scientific research reveals that

Endothelial Glycocalyx Dysfunction begins a spiral of organ starvation that can dangerously progress to several diseases and conditions:

- Hypertension
- Type 2 Diabetes
- Heart Disease
- Mental Illness
- Kidney Disease
- Stroke
- Dementia
- Septic Shock
- Inflammatory Disorders
- Cancer Metastasis
- Long Haul COVID-19 Complications

Diabetes (see overview of Diabetes stats – end of this document)

Caused by High Blood Glucose Level

A healthy microvascular system is important for transport of glucose from blood to organs.

High blood glucose damages (micro) vascular system and causes blindness, kidney failure, heart attack and stroke.

Heart Disease

Loss of Pump Function of Heart

Loss of microvascular density causes heart attack

Insufficient number of capillaries per heart muscle fiber impairs heart pump function (heart failure).

Stroke

Blood Clot in Brain Artery Causing Brain Damage

Damage to vascular wall causes blood clots.

Microvascular damage causes White Matter Lesions with poor neurological prognosis.

## Septic Shock

### **Loss of Circulation Blood Volume Causes Drop in Blood Pressure**

Can lead to Impaired organ blood flow resulting in acute kidney failure, reduced lung function, heart attack, stroke and brain damage

Leaky micro vessels result in loss of blood plasma volume to tissue space.

Damaged vascular wall causes increased blood clotting and inflammation.

## Hypertension

### **Blood Pressure is Higher than Accepted Level**

Hypertension is associated with loss of microvascular density.

Hypertension increases cardiovascular risk (heart attack, stroke, kidney failure).

## Kidney Disease

### **Impaired Production of Urine Causing Increased Blood Volume and Hypertension**

Damage of microvessels causes leakage of blood proteins into urinary space, damage of renal filtration units and kidney failure.

## Dementia

### **Early Cognition Impairment: Neurological Complication**

Healthy microvascular system is essential to maintain intact neuro-vascular unit and support normal neurological function.

## Inflammatory Disorders

### **Rheumatoid Arthritis, Vasculitis, Allergies, Glomerulonephritis, Autoimmune Diseases, Scleroderma, and Atherosclerosis**

Attack of microvascular system by inflammatory cells results in loss of capillaries.

Increased capillary permeability causes tissue edema.

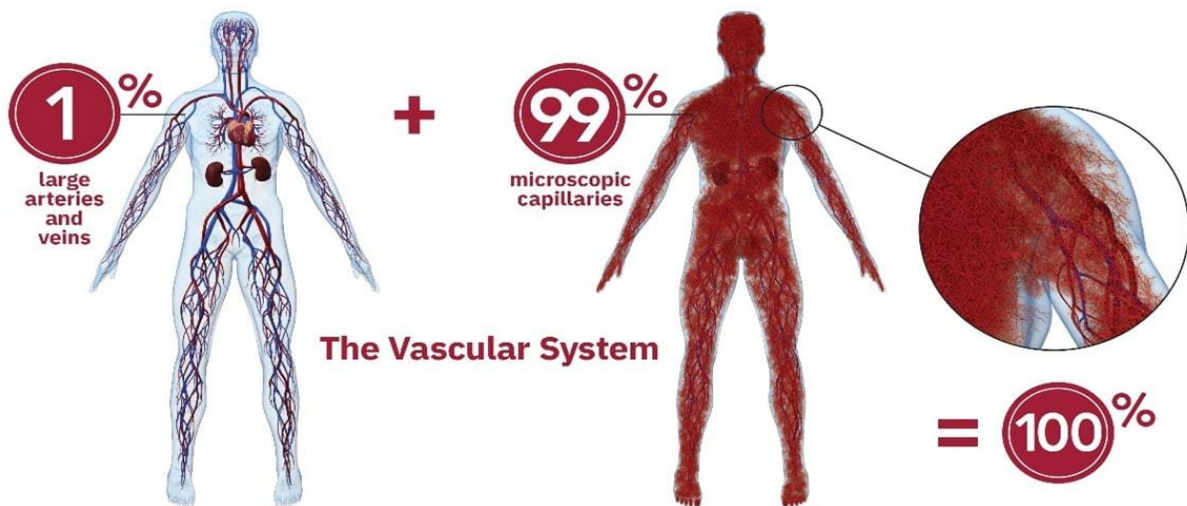
## Cancer Metastasis

### **Uncontrolled Growth of Tumors**

Leaky micro vessels allow tumor cells to enter the vascular system and redistribute to different parts of our body, causing tumor metastasis (secondary tumors)

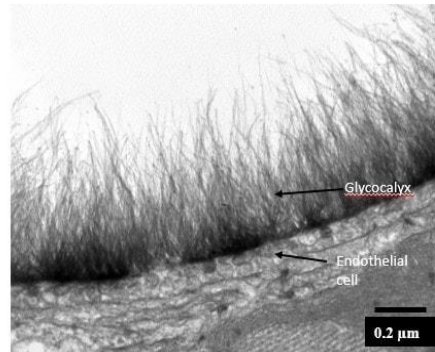
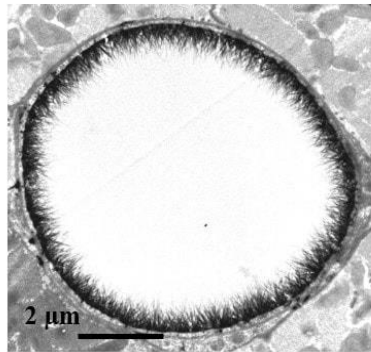
## Vascular Diseases Begin with Organ Starvation

Your organs are healthy when they are nourished with vital nutrients and oxygen, while waste and carbon dioxide are removed. Every heartbeat is an opportunity for replenishment.

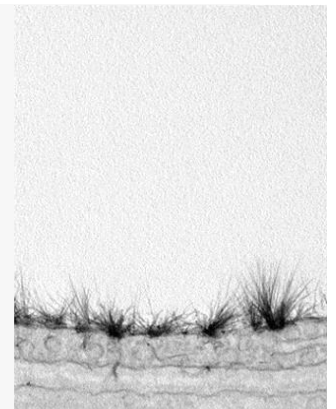
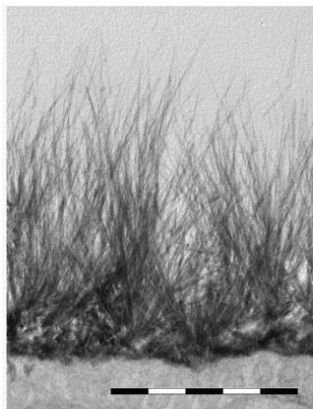


- This replenishment—an exchange of nutrients and waste removal—takes place in the capillaries of your microvascular system.
- The human body's microvascular system is immense. The endothelial glycocalyx is both the largest surface organ at 10,000 square feet, and the longest organ in the body at 60,000 miles end-to-end.
- With every beat, the heart pumps blood through the microvascular system, which nourishes the trillions of cells that make up your organs. Deterioration in the microvascular system—comprising more than 99% of the contact area between the blood and the organs—has long been overlooked as the starting point of several health conditions, which lead to life-threatening diseases.

- Only recently, have we been able to look at the 99%. In the past, science has focused on the visible 1% of the total vascular system—the larger blood vessels.
- Without a continuous delivery of nutrients and removal of waste, organs starve, and you are at greater risk of heart disease, stroke, high blood pressure, diabetes, kidney disease, dementia (Alzheimer's), inflammatory disorders, and cancer metastasis.



*van den Berg, Vink & Spaan, Circulation Research 2003, 92: 592-594*

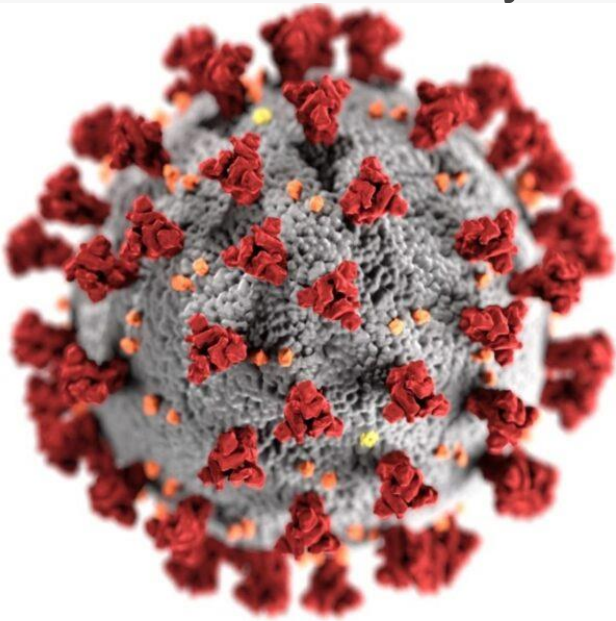


(LEFT) Cross-section of a capillary blood vessel in a rat heart muscle shows extensive dimension of the glycocalyx in a healthy blood vessel.

(RIGHT) High magnification showing the dimension of the glycocalyx is several folds the thickness of the endothelium.

**Healthy**  
**Unhealthy**

# Study Reveals COVID-19 Patients Suffer Severe Damage to the Endothelial Glycocalyx



## Study Reveals COVID-19 Patients Suffer Severe Damage to the Endothelial Glycocalyx

A new study using [GlycoCheck](#) from Microvascular Health Solutions reveals that COVID-19 patients have severe damage to microcirculation and the endothelial glycocalyx. The study, [Microvascular Dysfunction in COVID-19 Patients: MYSTIC Study](#), was released by Angiogenesis.

The data in this study clearly show severe reduction of microcirculation and the endothelial glycocalyx in patients with COVID-19 and underscores the importance of healthy microcirculation and capillaries.

**“The capillaries are protected by a micro-thin gel-layer called the endothelial glycocalyx,” reports Bob Long, CEO of Microvascular Health Solutions. “The only product clinically shown to restore, regenerate, and protect the glycocalyx is Endocalyx.”**

The study’s finding has fueled the hypothesis that COVID-19 is actually a vascular illness and that systemic leakiness and impairment of the endothelial glycocalyx might play a central role in the development of acute respiratory distress syndrome (ARDS) and multi-organ failure.

Capillaries are lined with the endothelial glycocalyx, and when they are in good health the glycocalyx enables delivery of essential oxygen and nutrients to all vital organs. When microcirculation is severely impaired, as is the case for critically ill COVID-19 patients, lung function is significantly reduced, and mechanical ventilation is required for them to breathe.

The study was overseen by University Hospital Munster in Germany and compared three groups:

- 1) **COVID-19 patients without need for mechanical ventilation**
- 2) **COVID-19 patients requiring mechanical ventilation**
- 3) **Control group of healthy people**

The study reveals:

**Up to 95% of the smallest capillaries —the tiniest part of microcirculation—have been severely damaged in patients *on mechanical ventilators*. For perspective, about 100 capillaries would fit inside a human hair.**

**Up to 65% of the smallest capillaries have been severely damaged in patients *who are not on ventilation*.**

With such a large percentage of the smallest capillaries having been severely damaged, oxygen cannot be transported from the lungs to the rest of the body.

[This study](#) was possible because of the new ground-breaking GlycoCheck medical device from Microvascular Health Solutions. GlycoCheck testing is non-invasive. A video microscope camera is placed under the tongue where micro vessels are representative of the entire body. In just minutes, 100,000 vessels are measured, with 1,000 measurements calculated per vessel. There are over 100 million calculations from the test.

The GlycoCheck test measures the interaction of red blood cells with the surface of the endothelial glycocalyx, expressed as the **perfused boundary region (PBR)**. Increases in PBR reflect damage to the glycocalyx and this parameter was developed by Dr. Hans Vink, PhD, a glycocalyx research pioneer on the team who has studied the glycocalyx for more than three decades.

**Dr. Vink considers PBR to be the “canary in the coal mine” that reveals if the glycocalyx has become thin and damaged.**

GlycoCheck combines the PBR measurement with density of capillaries, and capillary recruitment capacity, which is how capillary density increases at higher levels of blood flow. Together, these three measurements analyze microvascular health and objectively report a single systemic MicroVascular Health Score™.

The glycocalyx becomes damaged because of several risk factors such as aging, genetics, obesity, stress, pollution, smoking, and vaping. Researchers in hospitals worldwide are using GlycoCheck technology to link a damaged glycocalyx with heart disease, kidney disease, stroke,



hypertension, diabetes, and other conditions. With the publication of this ground-breaking study, we now know COVID-19 can also be linked to a severely damaged glycocalyx.

Endothelial glycocalyx [research using GlycoCheck](#) is being conducted by more than 90 hospitals in Africa, Asia, Australia, China, Europe, Japan, Russia, and the United States. Most recently, GlycoCheck has been recognized by MedTech Outlook as one of the Top 10 Breakthrough Medical Testing Devices for 2020.

**“With Endocalyx, it’s not too late to restore the endothelial glycocalyx,” says Long.**

**“It’s estimated that over 80% of people of all ages are exposed to risks associated with breakdown of the microvascular system. Risk factors include aging, genetics, obesity, stress, pollution, smoking, vaping, and many additional risk factors.”**

Early warning signs of poor microcirculation include high blood pressure, diabetes, slow wound healing, fatigue, memory loss, erectile dysfunction, severe PMS, cold hands and feet, and more.

Research using GlycoCheck links poor microcirculation to heart disease, stroke, kidney disease, dementia, septic shock, inflammatory disorders, compromised immunity, and cancer metastasis.

**With the results of this study, COVID-19 is now linked to a damaged endothelial glycocalyx.**

## Global statistics on diabetes

Comment by Eberhard Standl, Forschergruppe Diabetes eV at Munich Helmholtz Centre, Germany For the EAPC Diabetes and CVD Educational Programme

01 Apr 2019

Topic(s):

*Risk Factors and Prevention*

Diabetes is on the rise across the globe as reported in the most recent 8th edition of the IDF Diabetes Atlas 2017.(1)

According to the IDF statistics, presently every seven seconds someone is estimated to die from diabetes or its complications, with 50% of those deaths (4 million in total per year) occurring under the age of 60 years. (1) This is against the background of a global diabetes prevalence of 8.8% (95% confidence interval 7.2-11.3%) of the world population in 2017, standardized for the age group 20-79 years.

The prevalence is expected to further increase to 9.9% (95% CI 7.5-12.7%) by the year 2045. In total numbers, this reflects a population of 424.9 million (95% CI 346.4-545.4 million) people with diabetes worldwide in 2017 with an estimate of a 48% increase to 628.6 million people (95% CI 477.0-808.7 million) for the year 2045. Global numbers of diabetes prevalence have continuously risen from 151 million in 2000, when the IDF Diabetes Atlas first was launched, to 285 million in 2009 and to 382 million in 2013. Disturbingly in this context, some 50% of all individuals with diabetes are undiagnosed, especially in developing countries.(1)

The figures given in the IDF Atlas fit well with the estimates of an international consortium reporting worldwide trends in diabetes since 1980 based on a pooled analysis of 751 population-based studies with 4.4 million participants. (2) According to this group global age-standardised diabetes prevalence increased from 4.3% (95% CI 2.4-7.0) in 1980 to 9.0% (7.2-11.1) in 2014 in men, and from 5.0% (2.9-7.9) to 7.9% (6.4-9.7) in women.

Moreover, it was estimated that the number of adults with diabetes in the world had increased from 108 million in 1980 to 422 million in 2014 (28.5% due to the rise in prevalence, 39.7% due to population growth and ageing, and 31.8% due to interaction of these two factors). Besides the growth and aging of the world population in general, the global obesity epidemic has turned out to be a key factor for the rise of diabetes incidence together with the immense progress of multifactorial cardiovascular risk management and successful revascularisation therapy of people with diabetes also contributing to the expansion of the worldwide diabetes population. (1-6)

In addition to overt diabetes, the IDF Atlas estimates another 352.1 million (95% CI 233.5 - 577.3 million) people worldwide to have a pre-stage of diabetes, called Impaired Glucose Tolerance (IGT), a figure which is anticipated to rise to 531.6 million (95% CI 353.8-883.9 million) in 2045. (1)

In the latter group, the manifestation of overt diabetes could actually be prevented in most people by appropriate measures, along with most of the severe complications of diabetes at the heart, the brain, the eyes, the kidneys, and the feet.

On a global scale, diabetes hits particularly “middle-aged” people between 40 to 59 years of age which causes serious economic and social implications. Furthermore, diabetes affects especially low and middle income countries, as 77% of all people with diabetes worldwide live in those countries. Table 1 (modified from the IDF Diabetes Atlas 2017) summarizes the growing burden of the global diabetes epidemic. (1-4)

# The Growing Burden of the Diabetes Epidemic

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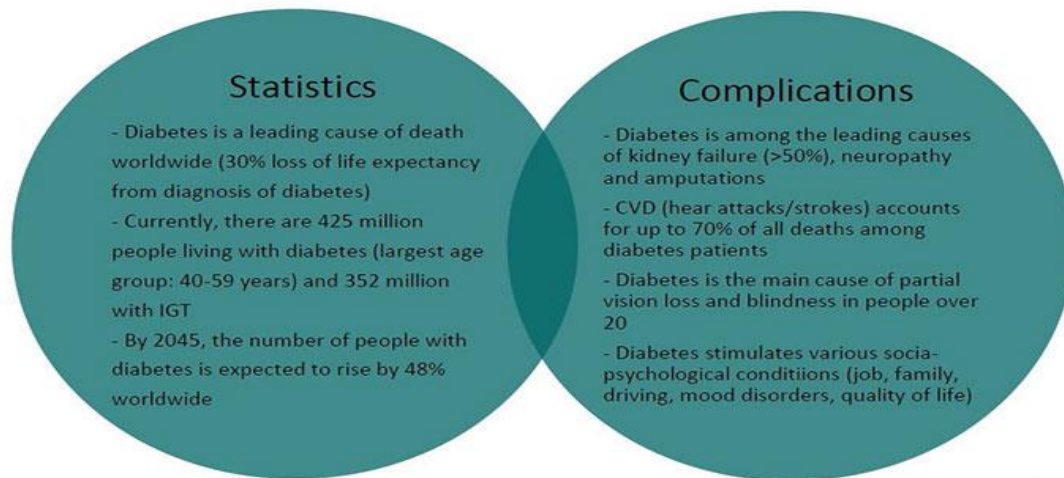


Table 1. International Diabetes Federation. IDF Diabetes Atlas, 8th edn. Brussels, Belgium: International Diabetes Federation 2017. <http://www.diabetesatlas.org>

Diabetes more or less equally affects both sexes with men having a small edge over women at younger age groups and women surpassing men at higher age groups. (1,2)

Depending on age groups, global diabetes prevalence is about 5% for the age group 35-39 years, 10% for the age group 45-49 years, 15% for the age group 55-59 years, and close to 20% starting at age group 65-69 years. (1) Diabetes prevalence numbers are largely determined by people with type 2 diabetes who comprise about 90% of the total population. These individuals are characterized by various degrees of relative insulin deficiency in conjunction with a wide spectrum of insulin resistance.

About five percent of the total diabetes population represents monogenic forms of diabetes, such as various subtypes of MODY (maturity-onset diabetes of the young) and other rare genetic conditions, another five percent encompass sub-forms of immune-mediated type 1 diabetes with a pronounced, if not absolute insulin deficit in the long run. (1) Reflecting the enormous therapeutic progress in the last thirty years, many people afflicted with type 1 diabetes today are able to live for almost a normal life span, although the disease usually starts at a young age, i.e. in children and adolescents. For the age group 0-19 years, the IDF Diabetes Atlas 2017 provides a global number of 1,106,500 people with type 1 diabetes with an annual incidence of 132,600 newly diagnosed cases. (1)

Mortality, though decreasing in the last thirty years, has remained at least twofold increased both in adult type 1 and type 2 diabetes compared with the general population. (3-6) Excessive death rates not only relate to cardiovascular causes that will be further discussed in other chapters of this programme, but also to non-cardiovascular causes such as cancer, renal disease, liver disease, pneumonia, septicaemia and other infections. (3-6) In contemporary global cohorts of type 2 diabetes, e.g. as studied in the TECOS trial, more than 50% of all deaths

is due to cardiovascular causes with sudden death being the most common cause, followed by combined death from myocardial infarction or stroke, and death from heart failure. (7) Particularly high death rates are unfortunately still reported for young onset type 1 diabetes (age group 0-10 years). They showed hazard ratios of 4.11 (95% CI 3.24-5.22) for all-cause mortality, 7.38 (3.65-14.94) for cardiovascular mortality, and 3.96 (3.6-5.11) for non-cardiovascular mortality in a recent assessment based on the National Diabetes Register in Sweden. (6)

The content of this article reflects the personal opinion of the author/s and is not necessarily the official position of the European Society of Cardiology

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