

COVIDAge Risk Calculator™ Biometrics and their Relative Contributions to Overall COVIDAge – 07 Aug 2020

Biometric	Rationale for Selection	COVIDAge Contribution	References
Date of Birth (Chronological ages 15-100 yrs old)	<p>Chronological age is a major determinant of risk for COVID-19 complications. Age affects these other biometrics:</p> <ul style="list-style-type: none"> • All ‘Underlying Conditions’ • ‘AngioDefender Score or %FMD’ 	<p>Provides baseline COVIDAge.</p> <p>Contributions of the other biometrics are added to or subtracted from it.</p>	<p>CDC COVID-19 Response Team (Mar 27, 2020 MMWR). Severe outcomes among patients with coronavirus disease 2019 (COVID-19) – United States, Feb 12-Mar 16, 2020. MMWR; 69(12):343-346. https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6912e2-H.pdf</p> <p>Dufort E. (2020). An update for NYS healthcare providers on COVID-19, Apr 23, 2020; NY State Dept of Health. (Case Fatality Rate ≈ 0.5%). https://coronavirus.health.ny.gov/april-23-weekly-update-healthcare-providers</p>
Gender (M/F)	<p>Gender affects these other biometrics:</p> <ul style="list-style-type: none"> • Blood pressure • Waist Circumference 	<p>An independent biologic effect of gender on COVID-19 complication risk has not yet been confirmed.</p>	<p>Du <i>et al</i> (2020). Predictors of mortality for patients with COVID-19 pneumonia caused by SARS-CoV-2: A prospective cohort study. Eur Respir J; 55:2000524 https://doi.org/10.1183/13993003.00524-2020</p> <p>Ji <i>et al</i> (2020). Prediction for progression risk in patients with COVID-19 pneumonia: the CALL Score. Clin Infect Dis, ciaa414. https://doi.org/10.1093/cid/ciaa414</p>
Underlying Conditions:	<p>These ‘Underlying Conditions’ all have major independent direct effects on the risk for complications from COVID-19 infection.</p>	<p>Age-dependent (older < younger):</p>	<p>CDC COVID-19 Response Team (Apr 3, 2020 MMWR). Preliminary estimates of the prevalence of selected underlying health conditions among patients with coronavirus disease 2019 – United States; Feb 12-Mar 28, 2020. MMWR; 16(13):382-386. https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6913e2-H.pdf</p> <p>Henry <i>et al</i> (2020). Chronic kidney disease is associated with severe coronavirus disease 2019 (COVID-19) infection. Int J Urol Nephrol; 52:1193-1194. https://doi.org/10.1007/s11255-020-02451-9</p> <p>Alqahtani <i>et al</i> (2020). Prevalence, severity and mortality associated with COPD and smoking in patients with COVID-19: A rapid systematic review and meta-analysis. PLoS ONE; 15(5):e0233147. https://doi.org/10.1371/journal.pone.0233147</p>
+/- Chronic kidney disease		+7 to +37 yrs	
+/- Coronary/Peripheral vascular disease		+6 to +31 yrs	
+/- Chronic lung disease		+4 to +20 yrs	
+/- Immunocompromised		+4 to +22 yrs	
BMI* (Body Mass Index; 18.5 to 60 kg/m ²)	<p>Obesity has a major direct effect on the risk for complications due to COVID-19 infection and a significant indirect effect as a contributor to cardiovascular disease (CVD), which, in turn, increases the risk for these complications.</p>	<p>-5 to +24 yrs</p>	<p>Petrilli <i>et al</i> (2020). Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. <i>BMJ</i> 2020; 369. https://doi.org/10.1136/bmj.m1966</p> <p>Sanchis-Gomar <i>et al</i> (2020). Obesity and outcomes in COVID-19: When an epidemic and pandemic collide. Mayo Clin Proc; 95(7):1445-1453. https://doi.org/10.1016/j.mayocp.2020.05.006</p> <p>De Konig <i>et al</i> (2007). Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. Eur Heart J; 28:850-856. https://academic.oup.com/eurheartj/article/28/7/850/2887789</p>
Waist Circumference* (23-55 in; 58-140 cm)			
Smoking (0-40 cigarettes/day)	<p>Smoking is a major contributor to CVD risk, which, in turn, directly increases the risk for COVID-19 complications. There is conflicting evidence for a direct effect of smoking on these risks.</p>	<p>+0 to +12 yrs, depending on the # cigarettes/day</p>	<p>Liu <i>et al</i> (2020). Analysis of factors associated with disease outcomes in hospitalized patients with 2019 novel coronavirus disease. Chinese Med J; 133(9):1032-1038. https://doi.org/10.1097/CM9.0000000000000775</p> <p>Van Zyl-Smit <i>et al</i> (2020). Tobacco smoking and COVID-19 infection. Lancet; 8:664-665. https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(20)30239-3/fulltext</p>
Blood Pressure* (Systolic blood pressures 80-179 mmHg)	<p>Hypertension has a major direct effect on the risk for complications due to COVID-19 infection and an indirect effect because of its significant role in contributing to CVD.</p>	<p>Men:</p> <ul style="list-style-type: none"> • Untreated: -5 to +5 yrs • Treated: +0 to +8 yrs <p>Women:</p> <ul style="list-style-type: none"> • Untreated: -8 to +8 yrs • Treated: -2 to +14 yrs 	<p>Zhou <i>et al</i> (2020). Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet; 395:1054-62. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30566-3/fulltext</p> <p>Lippi <i>et al</i> (2020). Hypertension in patients with coronavirus disease 2019 (COVID-19): a pooled analysis. Polish Archives Int Med; 130(4):304-309. https://doi.org/10.20452/pamw.15272</p>

<p>Vitamin D level* (Serum Vit D [25(OH)D]; range: 12-36 ng/ml; 30-90 nmol/L)</p>	<p>Serum Vit D deficiency has been strongly and directly linked to poor outcomes from COVID-19 infection, likely consequent to induced endothelial dysfunction (EDF) and the lack of an optimal immune response to the virus.</p>	<p>-1 to +29 yrs</p>	<p>Raharusuna <i>et al</i> (2020). Patterns of COVID-19 mortality and Vitamin D: An Indonesian study. https://emerginnova.com/patterns-of-covid19-mortality-and-vitamin-d-an-indonesian-study/</p> <p>Kim <i>et al</i> (2020). Vitamin D and endothelial function. <i>Nutrients</i>; 12. https://doi.org/10.3390/nu12020575</p> <p>Ilie <i>et al</i> (2020). The role of vitamin D in the prevention of coronavirus 2019 infection and mortality. <i>Aging Clin Exp Res</i>. https://doi.org/10.1007/s40520-020-01570-8</p>
<p>AngioDefender Score or % Flow-mediated Dilatation (%FMD) (range: 0-25%; higher ↔ healthier blood vessels and lower CVD risk)</p>	<p>Studies suggest that since EDF, which %FMD measures, is involved in the pathogenesis of COVID-19 infection, pre-existing EDF is a significant factor for COVID-19 complication risk. It is also a well-established CVD risk predictor.</p>	<ul style="list-style-type: none"> • Subtracts up to 7-14 yrs when %FMD is high (age-dependent: more subtracted when older) • Adds up to 6-13 yrs when %FMD is low (age-dependent: more added when younger) 	<p>Varga <i>et al</i> (2020). Endothelial cell infection and endotheliitis in COVID-19. https://doi.org/10.1016/S0140-6736(20)30937-5</p> <p>Sardu <i>et al</i> (2020). Is COVID-19 an endothelial disease? Clinical and basic evidence. https://www.preprints.org/manuscript/202004.0204/v1</p> <p>Inaba <i>et al</i> (2010). Prediction of future cardiovascular outcomes by flow-mediated vasodilatation of brachial artery: a meta-analysis. <i>Int J Cardiovasc Imaging</i>. 26(6):631–640. https://pubmed.ncbi.nlm.nih.gov/20339920/</p>
<p>HbA1c* (4-9%)</p>	<p>Diabetes (HbA1c ≥ 6.5%) has a major direct effect on COVID-19 complication risk and an indirect effect because of its significant role in contributing to CVD.</p>	<p>-6 to +18 yrs</p>	<p>Wang <i>et al</i> (2020). Does comorbidity increase the risk of patients with COVID-19: Evidence from meta-analysis. <i>Aging</i>; 12(7):6049-6057. https://doi.org/10.18632/aging.103000</p> <p>Zhong <i>et al</i> (2016). HbA1c and risks of all-cause and cause-specific death in subjects without known diabetes: A dose-response meta-analysis of prospective cohort studies. <i>Sci Rep</i>; 6:24071. https://www.nature.com/articles/srep24071</p>
<p>Lipids* TG/HDL-C ratio (Serum Triglycerides/High Density Lipoprotein – Cholesterol; ratio range: 0-20, when using mg/dL)</p>	<p>Abnormal serum lipid levels are a component on 'metabolic syndrome' which is a major contributor to CVD. The latter, in turn, directly increases COVID-19 complication risk.</p>	<p>-3 to +10 yrs</p>	<p>Wakabayashi and Daimon (2019). Comparison of discrimination for cardio-metabolic risk by different cut-off values of the ratio of triglycerides to HDL cholesterol. <i>Lipids in Health and Disease</i>; 18:156. https://doi.org/10.1186/s12944-019-1098-0</p> <p>Chen <i>et al</i> (2019). Higher triglyceride to high-density lipoprotein cholesterol ratio increases cardiovascular risk: 10-year prospective study in a cohort of Chinese adults. <i>J Diabetes Investig</i>; 11:475-481. https://doi.org/10.1111/jdi.13118</p>

*Component of 'metabolic syndrome'

'CVD' = cardiovascular disease

'EDF' = endothelial dysfunction