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Review Article

Covid-19 Pandemic and Metabolic Aging

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Abstract

In contrast to chronological aging, biological aging or metabolic aging is a relative age of cells and tissues and the damage they've accumulated over years. Comparison of one's basal metabolic rate (BMR) to the average BMR of one's chronological age group gives the Metabolic age. Higher metabolic age of younger population is a serious concern and a key factor that leads to metabolic disorders in all age groups. Slower metabolism is a symbol of older age. Higher metabolic age indicates poor metabolism and higher risk of getting diseases and health complications later in life. Therefore, aging faster metabolically can severely impact chronological age. People with obesity and diabetes suffered the most due to current ongoing Covid-19 pandemic. Data suggest that SARS-CoV-2 patients with concomitant metabolic diseases had higher risk of worse prognosis and mortality. Lowering metabolic age can thus reduce the risk of getting age related health conditions and mitigate morbidities caused by pandemic like Covid-19. Therefore, maintaining healthy metabolic age in all age groups is required in the current unprecedented times. The aim of the review is to raise the prime concerns and to improve the population health outcomes by reducing the metabolic age.

Keywords: Covid-19; Metabolic Aging; Chronological Aging; Obesity; Diabetes

Introduction

Metabolism is a phenomenon by which the living state of a being is maintained through chemical processes in the body and are required to break down and synthesize energy in animals. Basal Metabolic Rate (BMR), is the amount of energy one needs, to keep up with the body's normal functions while at rest. To calculate BMR, Harris-Benedict equation uses several variables like height, weight, age and sex. It is one of the measures that defines the status of health of an individual and guide people about their weight, calorie intake and expenditure. For women and men, BMR is calculated as

BMR (women) = 655.1 + (9.6 × weight in kg) + (1.8 × height in cm) - (4.7 × age in years)

BMR (men) = 66 + (13.7 × weight in kg) + (5 × height in cm) - (6.7 × age in years)

Chronological aging is intimately linked with metabolic age of an individual. Chronological age is a count of years that one lives according to calendar years. Metabolic age defines how well an individual is doing with respect to the other individuals in the same chronological bracket by comparing one's BMR to the others in the same age group. Since, energy metabolism slows down with chronological age, two individuals at the same chronological age and height could have different metabolic age having different individual risk profiles.

When metabolic age is less than expected, it suggests good health but metabolic age greater than one's actual age indicates how one is aging faster as opposed to expected in terms of the metabolic pathways functioning in body. Therefore, lowering metabolic age to remain fit and to age "closer to chronological age" is important.

Role of metabolic aging during Covid-19 pandemic

Metabolic syndrome (MS) is a cluster of risk factors that escalate chances of facing metabolic conditions including heart disease, diabetes, abdominal obesity, high fat level in blood, low HDL cholesterol and high blood pressure in all age groups. All these conditions are suggestive of low metabolism and thus, greater metabolic age which generally increase with chronological aging. Instabilities in fat distribution and metabolite levels also suggest faster metabolic aging [1].

The Covid-19 pandemic which is going on for approximately last two years is caused by the respiratory virus SARS-CoV-2. Metabolic conditions including diabetes mellitus and obesity have emerged as an important risk for ventilation and mortality in Covid-19 [2,3] patients. Diabetic and obese individuals with BMI ≥ 40 kg/m^2 are the ones infected primarily and faced severe complications and death from SARS-CoV-2 infection [4-8]. New form of diabetes mellitus that started in Covid-19 patients suggests a bidirectional link between Covid-19 and metabolic diseases [9]. CoviDiab project started a global registry of patients with diabetes mellitus related to COVID-19. It has been seen that Covid-19 patients with Diabetes mellitus, diabetic ketoacidosis and hyper osmolarity required very high doses of insulin to control blood levels of glucose [9]. The main entry receptor for SARS-CoV-2 is ACE2 (Angiotensin-converting enzyme 2) and is found in many key metabolic organs and tissues, namely adipose tissue, pancreatic β-cells, small intestine and kidneys [9]. It has been noted that patients with metabolic diseases witnessed worse outcomes with Covid-19 infection than healthy individuals. Patients with inferior metabolic control poses greater risks of microvascular and macrovascular diseases. Patients who died from Covid-19 [10] suffered from pulmonary vascular endothelialitis, thrombosis and angiogenesis. Such studies helped clinicians in delivering focused therapies and improved treatments for reducing inflammation and coagulability [10] in Covid-19 patients and also suggested that metabolic diseases potentiate the severity of Covid-19 and also highlighted potential pre-existing metabolic frailty [9].

Covid-19 case studies in higher metabolic age patients

Case studies discussed below suggest that metabolic aging is one of the key parameters to determine the occurrence of metabolic disorders and could be helpful in reducing the severity in Covid-19 infection and also is a subject of immediate relevance. A study done in China on Covid-19 patients mentioned 25.1% prevalence of at least 1 comorbidity among 1.590 patients tested positive for Covid-19 infection. Among these fraction of patients, 8.2% had diabetes, 16.9% had hypertension, and 57.3% had other cardiovascular diseases [11].

In Italy, 1 comorbidity in 13.2% Covid patients, 2 comorbidities in 19.3%, 3 or more in 64% patients were found. Among common comorbidities observed in dead patients, hypertension (66.2%), type 2-diabetes (29.8%), and ischemic heart disease (27.7%) were the most common conditions [12,13]. The fraction of diabetes and hypertension were about twofold higher in ICU/severe cases than in non-ICU/severe counterparts [13]. Other conditions like impaired innate immunity, decreased epithelial barrier function, dysregulated inflammatory responses, increases neutrophils/lymphocytes ratio, unbalance of the coagulative cascade, increased level of cytokines (IL-6, TNF-alpha, SF, CRP) also led to worst outcomes [14] in Covid-19 patients.

In NYC, US patients suffering from Covid-19 were analysed based on BMI, further categorized by age. Out of 3615 patients, 21% had a BMI ≥ 30-34 kg/m^2 and 16% had a BMI ≥ 35 kg/m^2[15]. In a retrospective analysis of 112 Covid-19 patients in Wuhan, China, BMI was calculated of 2 groups- critical and general. The BMI of critical group was ~ 25.5 kg/m^2 as compared to the general group with a lower 22 kg/m^2. Further classification into survivor and non-survivor groups showed drastic difference in the BMI values. In the survivor group, 18.85% had a BMI ≥ 25 kg/m^2 as compared to the exceedingly high 88.24% in the non-survivor group [16]. A similar study was conducted in France in 124 patients admitted for SARS-Cov2. Obesity (BMI ≥ 30 kg/m2) and severe obesity (BMI ≥ 35 kg/m^2) were there in 47% and 28% of the total cases respectively2.

Budding data related to SARS-CoV-2 is indicating the importance of obesity in influencing clinical outcomes. The impact of obesity in SARS-CoV-2 patients aged <60 years was highlighted recently. Out of 3.615 subjects who tested positive, the patients with a BMI between 30 and 34 were 2.0 (95% 1.6-2.6,) and 1.8 (95% CI 1.2-2.7,) times more likely to be admitted to an acute department and ICU, compared to individuals with a BMI < 30 [15,17]. However, the comprehensive mechanisms interacting between the virus-induced local inflammation and secondary reactive damage induced from excessive cytokine storm in patients with comorbidities have not been fully clarified.

Conclusion

Excessive fat accumulation occurs in obesity. It is one of the leading causes of deaths and a risk factors related to metabolic aging, causing 2.8 million deaths worldwide every year according to World Health Organization (WHO). It is calculated as Body Mass Index (BMI). An individual is overweight if BMI is higher than or equal to 25 kg/m^2 and is obese if BMI is more than or around 30 kg/m2. Obesity has become a central focus of many diseases which includes viral infections as well including H1N1 [18].

SARS-CoV-2 patients with concomitant metabolic diseases are at higher risk of mortality. It has been noticed that diabetes or metabolic diseases may develop severity upon Covid-19 infection suggesting clinical management should provide appropriate treatments to Covid-19 patients keeping these points in mind. It also requires an early diagnosis of metabolic and cardiovascular diseases. Rigorous monitoring of the glucose levels in Covid-19 patients is necessary and required based on studies that highlights the relationship between coexisting metabolic diseases and unfavourable prognosis. Additionally, assessment of the coagulation axis and an evaluation of inflammatory markers in metabolic patients infected with SARS-CoV-2, should be considered. As specific therapies for SARS-CoV-2 are still not available, these considerations have major implications in public health especially for countries affected by a high incidence of metabolic disorders.

This data suggest that maintenance of metabolic age is required in disease conditions including Covid-19 and suggest its importance in this unprecedented time. Factors like consumption of healthy diet, regular physical exercise and better sleep play an important role in energy metabolism and for weight reduction and hence, leads to low metabolic age. Hence, lowering metabolic age can lower the risk of getting age related health complications and has significance during pandemics like Covid-19. As a result, maintaining ones' metabolism and therefore, their metabolic age is of great significance.

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Conflicting of Interests

The author declares no potential conflicts of interest.

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