A Link Between Obesity and Coronavirus Disease 2019

Martinez-Colón GJ, Ratnasari K, Chen H, et al. SARS-CoV-2 infects human adipose tissue and elicits an inflammatory response consistent with severe COVID-19. bioRxiv 2021.10.24.465626; doi: https://doi.org/10.1101/2021.10.24.465626.

Adipose tissue has previously been shown to serve as a reservoir for influenza A virus as well as human immunodeficiency virus, and obesity is associated with unfavorable outcomes of influenza A virus infection [1]. Obesity is also a strong independent risk factor for coronavirus disease 2019 (COVID-19) infection, as well as for disease severity and associated mortality. Although obesity, especially with associated insulin resistance, is known to be a proinflammatory and hypercoagulable state, the reasons for the detrimental relationship between obesity and COVID-19 have remained undefined.

In order to examine the potential role of adipose tissue in severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and the pathophysiology of the inflammatory response in COVID-19, Martinez-Colón et al secured freshly obtained subcutaneous, visceral, pericardial, and epicardial tissues from individuals undergoing bariatric or cardiac surgery. In addition, they obtained multiple samples from autopsy material of patients who died with COVID-19. Stromal vascular cells (SVCs) were separated from mature adipocytes by collagenase digestion of these tissues.

The investigators demonstrated in vitro infection of SVCs and, by flow cytometry, that viral N protein expression was primarily restricted to macrophages. Angiotensin-converting enzyme 2 (ACE-2) expression was, however, very limited in SVCs, with its detection in only approximately 3% of macrophages and with none detected in other tissue types. The macrophages that were infectable were predominantly (85%) type C2, while >11% were C12. Infected C2 macrophages had enrichment of interleukin 10–associated signaling pathways as well as of chemokine and other pathways associated with the innate immune system. At the same time, there was reduced enrichment in host cell translation machinery. Both freshly isolated mature adipocytes and adipocytes differentiated in vitro culture were susceptible to infection. Genomic RNA and positive sense subgenomic RNA consistent with productive infection were detected. Preadipocytes were not infected but had undergone proinflammatory activation as associates of infected SVCs.

In vivo infection of adipose tissue was also demonstrated. SARS-CoV-2 was detected in epicardial, visceral, and subcutaneous adipose tissue as well as in lung, heart, and kidney. The highest concentrations were found in lung, followed by adipose tissue.

The investigators have provided evidence that contributes to our understanding of the relationship between obesity and COVID-19 risk. They demonstrated that SARS-CoV-2 primarily infects macrophages in SVCs and that it enters these cells by a means that appears to be independent of host cell ACE-2 expression. This leads to upregulation of proinflammatory pathways and secretion of cytokines and vascular factors by affected adipose tissues.

Schistosomiasis

The global number of people who required receipt of PC for schistosomiasis increased slightly in 2020 to 241.3 million, and 76.9 million (59.9 million school-age children [SAC] and 17 million adults) of these were actually given PC, for a coverage rate of 31.9%. The latter represents a 27.1% decrease from the 195.5 million treated in 2019; this is a consequence of the suspension of control measures in many countries due to the coronavirus disease 2019 (COVID-19) pandemic. Global PC coverage for SAC decreased from 66.8% to 44.9% in 2020. PC coverage for adults in 2020 was only 15.7%, with limited availability of free praziquantel being a major barrier to their treatment. Thirteen of the 33 countries that had implemented PC for schistosomiasis reached national coverage levels >75%.

More than 90% of people in the world who require PC for schistosomiasis live in the African Region. Among the 41 countries in that region with this requirement, 26 reported data to WHO in 2020. Treatment was administered to 55.2 million SAC, providing 46.6% coverage. Only 17 countries reported data on treatment of adults, 14.5 million of whom...
received PC, yielding a coverage rate of only 14.5%.

Two countries (Brazil and Venezuela) in the Region of the Americas have a schistosomiasis PC requirement; however, only Brazil, which treated 3274 individuals, submitted a report. The only endemic country in the South-East Region is Indonesia, which reported PC of 135 individuals, a coverage rate of only 0.6%.

No countries in the European Region have a PC requirement, while 4 (Egypt, Somalia, Yemen, and Sudan) in the Eastern Mediterranean Region do have a requirement. Unsurprisingly, Yemen did not implement PC for schistosomiasis in 2020, and a report from Sudan remains under review. Nonetheless, 4 million SAC received PC, representing achievement of a 75% threshold minimum coverage rate. Only Egypt reported treatment of adults, with 1.4 million receiving PC, yielding a regional coverage of 24.2%. Three countries in the Western Pacific Region have required PC for schistosomiasis, and all 3 (Cambodia, Laos, and the Philippines) reported to WHO. They indicated that 0.7 million SAC and 1 million adults were treated, yielding coverage rates of 58.3% and 58.6%, respectively.

Soil-Transmitted Helminthiasis

On a global scale, PC for STH in 2020 was given to 436.6 million children, including 94.6 million pre-school age children (pre-SAC) and 342 million SAC. PC coverage of SAC and pre-SAC was 46.8% and 32.6%, respectively. In addition, 98.3 million women of reproductive age received albendazole in lymphatic filariasis elimination programs, while 17 million pregnant women underwent deworming in maternal and child health services. The 75% PC coverage target was reached by 16 of 50 countries that implemented PC for STH in 2020. Among 29 of the 41 countries with a PC requirement that provided a report to WHO, Niger graduated to a post-treatment surveillance stage as a consequence of no longer requiring PC for STH.

The COVID-19 pandemic had a particularly adverse effect on PC for STH among pre-SAC in the African Region, with only 7.4 million treated in 2020 compared with 53.3 million in 2019. Coverage of SAC, however, decreased from 46.6% to 44.1%. This maintenance among SAC is apparently the result of school programs in which teachers were able to organize deworming in class despite repeated school closures in the face of the COVID-19 pandemic.

In the Region of the Americas, only 5 of 20 countries with STH PC requirements provided reports to WHO, and they indicated that 1 million pre-SAC and 1.4 million SAC received PC, for coverage rates of 5.8% and 3.3%, respectively. Six of 8 countries with PC requirements for STH in the South-East Asia Region provided reports indicating that >75.3 million pre-SAC and 233.1 million SAC were treated. The coverage rates of 49.7% and 53.1%, respectively, were among the highest of all regions despite a reduction of close to 20% compared with 2019. In the European Region, only Tajikistan among the 4 required countries reported, indicating that 2.1 million SAC were treated, for a regional coverage of 49.6%. In the Eastern Mediterranean Region, 2 of 8 countries reported and indicated that approximately 0.9 million pre-SAC (4.2% coverage) and 9 million SAC (23.2% coverage) were treated.

Looking Forward

As of January 2021, WHO had shifted their indicator targets for dealing with schistosomiasis and STH from coverage data, which is a process indicator, to elimination of morbidity, which is an impact indicator. In concert with this change, the targets are interruption of transmission of schistosomiasis in selected countries and elimination of both schistosomiasis and STH as public health problems in all endemic countries. For schistosomiasis, the latter target, more specifically, is elimination of moderate and heavy intensity infections.

WHO is recommending a renewed focus on women of childbearing age by optimization of their contacts with various health services with the aim of conducting deworming for schistosomiasis and STH. In addition, a website was designed to monitor the impact of control measures on STH in endemic countries [1].

Reference

1. World Health Organization Collaborating Centre for Diagnosis of Intestinal Helminths and Protozoa. Available at: www.whocc.ita116.unina.it

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