Obesity

Considerations for Obesity, Vitamin D, and Physical Activity Amid the COVID-19 Pandemic

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As the biomedical community races to disentangle the unknowns associated with severe acute respiratory syndrome coronavirus 2, the virus responsible for causing coronavirus disease, the link between diminished immune function and individuals with obesity raises important questions about the possibility for greater viral pathogenicity in this population. Increased adiposity may undermine the pulmonary microenvironment wherein viral pathogenesis and immune cell trafficking could contribute to a maladaptive cycle of local inflammation and secondary injury. A further challenge to those with obesity during the current pandemic may involve vitamin D deficiency or insufficiency. In the interest of personal and public health, we caution decision- and policy makers alike not to pin all hope on a proverbial "silver bullet." Until further breakthroughs emerge, we should remember that modifiable lifestyle factors such as diet and physical activity should not be marginalized. Decades of empirical evidence support both as key factors promoting health and wellness.

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Continuing escalation of the novel coronavirus disease (COVID-19) pandemic has fueled an unprecedented response by governments to slow the incidence of infection and mortality. As of April 8, 2020, real-time estimates from the Johns Hopkins University dashboard reported approximately 1.5 million COVID-19 cases worldwide, with the United States accounting for 28% (1). As expected, various sectors have embarked on large-scale efforts to develop targeted therapeutics, including monoclonal antibody therapy and vaccination; however, a complex road lies ahead before success can be reached at the population level. Amid the growing concern, many governments have taken action by implementing travel restrictions, school closures, and social distancing to mitigate the strain on public health care systems. Similar tactics have been effective at containing previous viral outbreaks, although a natural consequence of these changes is the disruption of daily routines. Nevertheless, there is urgent need to employ a multipronged approach to manage the crisis in both the short and long term.

Though COVID-19 is notoriously contagious, it also appears to be preferentially virulent among older (>60 years) adults with existing comorbidities, including obesity, hypertension, and diabetes. This would be expected, as overt and/or occult disease is known to increase vulnerability to infections. Still, many infected individuals do not succumb to the illness and, instead, fight the imposing effects of the virus. Depending of the severity of symptoms, some patients present with acute respiratory and/or cardiac distress necessitating mechanical ventilation and prolonged hospital stays. However, a further matter of priority involves the preservation of health among those not diagnosed with COVID-19. Whereas social distancing and "sheltering in place" readily limit person-to-person transmission, an undesired consequence of prolonged sedentariness is the propensity for systemic deconditioning, a dilemma that can readily undermine overall health and wellness.

As the biomedical community races to disentangle the unknowns associated with COVID-19, the link between diminished immune function and individuals with obesity raises important questions about the possibility for greater viral pathogenicity in this population (2). Given the prevalence of obesity among the US population, a meaningful proportion of individuals may be at an elevated risk for symptom complications following a positive COVID-19 diagnosis. Following the 2009 influenza A virus H1N1 pandemic, retrospective analyses specified obesity as a risk factor for symptom severity and mortality (3). Increased adiposity may undermine the pulmonary microenvironment (e.g., alveoli), wherein viral pathogenesis and immune cell trafficking could contribute to a maladaptive cycle of local inflammation and secondary injury. The spike glycoprotein residing on the membrane of the COVID-19 virus will likely be of central importance, as it is the key feature for host entry and is responsible for triggering the immune response (4). As work endeavors to resolve the challenges of COVID-19 therapies, understanding how individuals with obesity may respond differently to such treatments will be critical.

Though somewhat speculative, a challenge to those with obesity during the COVID-19 pandemic may involve vitamin D deficiency or insufficiency (5). Long recognized as the "sunshine vitamin," the biologically active form of vitamin D (1,25-dihydroxyvitamin D/calcitriol) has been implicated in various inflammatory, infectious, and pulmonary diseases. Indeed, experimental evidence has indicated calcitriol exerts protective effects from lipopolysaccharide-induced lung injury by modulating the expression

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of angiotensin-converting enzymes I and II (6). Considering the growing dispute over the proposed link between mortality and morbidity among COVID-19 patients and use of angiotensin-converting enzyme inhibitors and angiotensin receptor blockers (7), it seems prudent to also consider how interindividual variance in vitamin D status could be involved in pulmonary inflammation and viral pathogenicity. Interestingly, emerging data posit vitamin D could be an adjunct to manage the proinflammatory milieu or "cytokine storm" observed in COVID-19 patients (8). This, in turn, presents an attractive option, as the clinical implications of symptom severity and management appear to be exacerbated in the setting of hypertension and diabetes, both of which are typically connected to obesity.

Alternatively, physical activity, operationalized as energy expenditure attributed to skeletal muscle contractions, is a pragmatic approach to augment vitamin D status, particularly when performed outdoors. Habitual outdoor physical activity is known to promote vitamin D synthesis through the interaction between ultraviolet radiation and 7-dehydrocholesterol in the skin. Directives to limit social contact notwithstanding, even indoor physical activity may effectively improve vitamin D status through biological mechanisms beyond 7-dehydrocholesterol. Prospective analyses of community-dwelling older adults over a 2.6-year period showed a positive association between the change in serum vitamin D (25(OH) D) and physical activity assessed by accelerometry independent of sun exposure (9). Scott et al. (9) indicated the observed relationship may have been attributed to favorable changes in body composition via physical activity (i.e., ↓adiposity; ↑skeletal muscle mass). It is also worth noting that daily or weekly supplementation with vitamin D (D_2 or D_3) has been shown to offer protection from acute respiratory infections, particularly among individuals exhibiting vitamin D deficiency (<20 ng/mL) (10). However, among US adults, shifting attention to focus on a single micronutrient such as vitamin D should not be at the expense of other commonly underconsumed nutrients, including calcium, potassium, and dietary fiber. A diverse diet will help ensure a broad nutrient profile to aptly alleviate vulnerability to acute and chronic disease.

Assuredly, our collective understanding will evolve in response to the COVID-19 pandemic. However, in the interest of personal and public health, we caution decision- and policy makers alike not to pin all hope on a proverbial "silver bullet." Until further breakthroughs emerge, we should remember that modifiable lifestyle factors such as diet and physical activity should not be marginalized. Decades of empirical evidence have supported both as key factors promoting health and wellness. In times of crisis, whether it be real or perceived, there is something to be said about the benefits of empowering people to actively preserve their own health.o

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