COVID-19 and obesity in childhood and adolescence:

a clinical review

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Introduction

World surprise by a severe pneumonia caused by a new corona virus

Pandemic three months later

Develop severe condition in children with comorbidities

Comorbidities: chronic kidney and lung diseases, malignancies, diabetes, obesity, sickle cell anemia, immune disorders, chromosomal abnormalities, heart disease, and congenital malformations

Aim of review: identify factors increase severity of covid 19 and help for better care

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Severe acute respiratory syndrome coronavirus 2 & COVID-19

Incidence and severity in children and adolescents

Inhabitancy and mortality in children and adolescents

Transmission and incubation period

Common and rare symptoms of covid 19

Laboratory and radiographic findings

Reason for lower severity of covid 19 in pediatrics

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Pathophysiology of obesity and its relationship with COVID-19

The relationship between obesity and viral diseases

particular interest to this area during the H1N1 epidemic

3rd most prevalent factor in children admitted to ICU

most prevalent comorbidity in children and adolescents

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COVID-19 and risks related to obesity

difference between the BMI of patients with mild/moderate conditions vs severe ones

the independence of BMI as a risk factor?

the risk of requiring invasive mechanical Ventilation and obesity

higher rates of ICU admission or death than patients with NL weight

obesity as an independent risk factor for severity of COVID-19

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COVID-19 and risks related to obesity

The effects of pediatric obesity on COVID-19 are not yet adequately studied

Three main risk factors link obesity to COVID-19 for adults

obesity predisposes to high mortality due to COVID-19 in young patients

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In the next slides each comorbidity will be covered in detail…

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Insulin resistance and dyslipidemia

Higher hyperinsulinism risk in younger patients: a high prevalence associated with obesity

leading to dyslipidemia, HTN, NASH, micronutrients deficiencies, increased oxidative stress and hyperuricemia

during immune response to coronavirus, beta cells working at their upper limit

SARS-CoV-2 can also lead to rupture of beta cells

insulin resistance leads to impairing the vasoprotective and anti-inflammatory effects of nitric oxide

endothelial dysfunction and atherosclerosis

Respiratory system

obesity :the most important risk factor for necessity of respiratory support in pediatrics

Normal respiratory physiology is usually

impaired in obese patients.

less oxygen saturation66 and worsening clinical presentation due to the lower lung volume of obese patients

some comorbidities linked to obesity contribute to a higher risk of pneumonia like asthma and obstructive sleep apnea

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Cardiovascular system

Cardiac anatomy changes linked to obesity is recognized in children

Obese children have higher BP, which increases potential endothelial injury

Obese children who who treated with ACE I or ARB have increased expression of ACE-2, increasing their susceptibility to coronavirus

In obese children: thickening of intima layer of arteries, Endothelial

Dysfunction, Hardening of the arteries, impaired nitrogen

performance and chronic oxidative stress

changes linked to the severity of COVID-19:inflammation of endothelium, myocarditis, multiple organ failure, severe acute respiratory syndrome, and VTE

Subclinical inflammation

After coronavirus contamination,most patients develop immune defense mechanisms and this happens in a modulated way, that the host organism is not harmed

However, some patients trigger an uncontrolled process, causes tissue damage and damage of several organic functions, especially respiratory area

Obese patients have chronic subclinical inflammation that CRP & IL-6 prove this process

adipokines with inflammatory properties, produced by adipose tissue and also the drop in adiponectin, which has anti-inflammatory properties

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Coagulation

Obese people with COVID-19 are at increased risk of developing coagulopathy associated with poor clinical outcomes

Chronic inflammation increases in thrombin generation and enhanced platelet activation, increasing the risk of thrombosis

Severe infections and sepsis :leading cause of DIC, and proinflammatory and immune activation observed in severe COVID-19 is likely sufficient to trigger DIC

Renal system

Obesity causes several structural, metabolic& hemodynamic changes in the kidneys, leading lesser functional reserve of this organ

Ectopic deposition of fat in renal sinus is responsible for increasing its weight and volume

increase renal plasma flow and GFR, greater absorption of water and Na by proximal tubules, glomerular stress, and tubular hypertrophy

increase in body weight and consequent reduction in urinary pH predispose to urinary lithiasis

obesity can favor the appearance of some types of neoplasia in renal tissue

increase secretion of IL-6 and TNF-alpha(amplifying inflammation +progression of renal fibrosis)

Increased insulin production and insulin resistance contribute to mesangial

expansion and renal fibrosis

Coronavirus can cause: acute kidney damage/acute tubular necrosis/thrombotic effects secondary to endothelial dysfunction

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Gut microbiota

Intestinal microbiota: a complex ecosystem with thousands of bacterial phyla and species throughout GI(mostly anaerobic).

can be influenced by eating , habits or diseases such as obesity

correlation between gut microbiota ratio in obese children suggesting intestinal dysbiosis

some hospitalized patients were treated with probiotics in order to regulate microbiota balance and reduce risk of infection secondary to bacterial translocation

Immune system

Obesity in childhood: changing concentrations of cytokines and proteins and the number and function of immune cells

This imbalance leads to a pro-inflammatory state : onset or exacerbation of several diseases such as asthma, allergy, atopic dermatitis, & sleep apnea

Nutrition and immunonutrients

Nutrients :stimulating the cell-mediated response/ modifying the balance between pro-inflammatory and anti-inflammatory cytokines/ attenuating depletion of tissue nutrients

some nutrients are fundamental for adequate response to coronavirus: vitamins A, C, D, and E; omega 3 fatty acids and the minerals zinc and iron

Obesity has peculiarities that may impair immune response, because diet often has characteristics that can lead to “hidden hunger.”

This is because, despite eating above energy needs, quality is not adequate; numerous studies point to vitamin and mineral deficiencies in those with excess weight

Hypovitaminosis D stands out, not only linked to insufficient intake, but also, and mainly, to the displacement of part of the organic pool to adipose tissue due to the lipid affinity of vit D.

sedentary lifestyle is characteristic of obese children, causing the practice of physical activities outdoors --- which would increase exposure to sun and skin formation of vitamin D- to be reduced in this group

Inadequate proportion of omega-3/omega-6(present in vegetable oils)

, common in obese children, leads to loss of modulation of immune response, which may contribute to exacerbation of inflammatory reactions, in addition to aggravating cardiometabolic risks.

Vit E supplementation increases resistance to infections, including influenza viruses

VA deficiency impairs Th2 response, which culminates in a lack of IL-4 and fails to induce IgA, impairing salivary IgA response to influenza virus infection, and intestinal response to cholera toxin

Deficiency in vit C impairs cytotoxic capacity of neutrophils and T-lymphocytes. Vit C supplementation appears to be able to prevent and treat respiratory and systemic infections.

obese children are at risk for iron and zinc deficiency anemia due to low iron bioavailability of the diet

Zinc deficiency is related to decreased production of cytokines and interferon- by leukocytes, atrophy of the thymus and other lymphoid organs, and changes in the proportion of lymphocytes

Psychosocial repercussions of COVID-19 on obesity

School closures for 2 months associated with a 10% drop in physical activity in two subsequent months of summer in a study at US.

in addition to predisposing to weight gain and abdominal adiposity, sleep disorders have other health repercussions, such as insulin resistance, deterioration in food quality, poor school performance, and sedentary lifestyle.

Living with stress during COVID-19 pandemic, in addition to bringing risks of deterioration of immunity, may have consequences for pediatric health, in particular for nutritional and emotional areas such as worsening of sleep quality, increase in food consumption, activates brain reward centers that raise interest in highly palatable foods (sugar, salt, and lipids), increases emotional instability, and worsens quality of life, drop in adherence to immunization programs, due to the fear of taking children to vaccinate

Final considerations and complications for treatment

Non-obese children are usually asymptomatic and even less susceptible to the infection(telemedicine have been proposed for them)

for those who develop the most severe forms, the coexistence of obesity can hinder therapy and worsen prognosis, since the inflammatory condition is as severe as in adults.

equipment may not adequately adapt to the obese patient and the greater difficulty of intubation of obese patients, which may lead to the occurrence of lesions and longer periods of hypoxia while the procedure is being completed.

Nursing care also is more difficult : control procedures such as blood pressure measurement and cardiac auscultation are more difficult and more errorprone, more risk of bedsores during ICU stay

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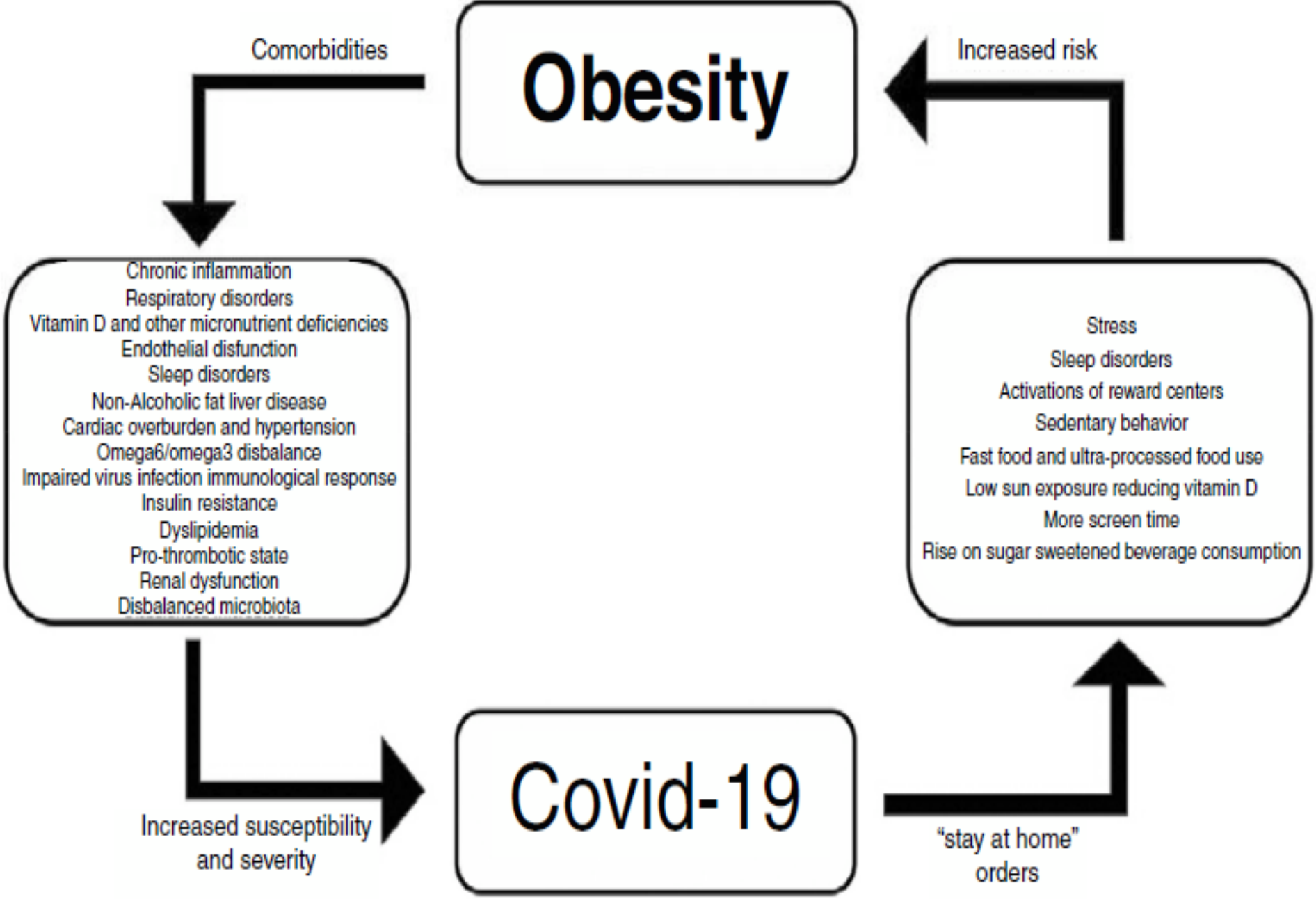

Figure 1 Interrelationships between obesity and COVID-19.

obesity in childhood and adolescence can be considered a risk factor for greater susceptibility and severity of COVID-19

It is associated with nutritional, cardiac, respiratory, renal, and immunological alterations, which may potentiate the complications of SARS-CoV-2 infection.

The need for social isolation can have the effect of causing or worsening obesity and its comorbidities. pediatricians must be aware of this issue

health professionals, when faced with the care of children with COVID-19, carry out the assessment of nutritional status in order to diagnose overweight; be concerned with guidance on care, in periods of isolation, with the general state of health, including the areas of nutrition, immunization, and psychosocial aspects; trace comorbidities associated with obesity, ensuring that treatment is not interrupted; screen immunonutrients levels to assess the need for supplementation; and determine, when necessary, referral to hospital units suitable for the care of obese children.