

METABOLIC SYNDROME IN CHILDHOOD DURING THE COVID-19 PANDEMIC

*Maria Eduarda Sanches Novaes Dinis de
Carvalho*

Graduate Program in Medicine, Universidade
Anhanguera-Uniderp
University for the Development of the State
and Region of the Pantanal UNIDERP
Campo Grande/ MS
<https://orcid.org/0009-0001-0764-8614>

Mariana Dorneles Nogueira da Silva

Graduate Program in Medicine, Universidade
Anhanguera-Uniderp
University for the Development of the State
and Region of the Pantanal - UNIDERP
Campo Grande/ MS
<https://orcid.org/0009-0007-6041-9988>

Jeslen Soares de Almeida

Graduate Program in Medicine, Universidade
Anhanguera-Uniderp
University for the Development of the State
and Region of the Pantanal UNIDERP
Campo Grande/ MS
<https://orcid.org/0009-0002-2765-5173>

Isabelle Rocha das Neves Norte

Graduate Program in Medicine, Universidade
Anhanguera-Uniderp
University for the Development of the State
and Region of the Pantanal - UNIDERP
Campo Grande/ MS
<https://orcid.org/0009-0002-7487-2517>

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).



Paolla Abruceze Gonçalves Sbardelote
Graduate Program in Medicine, Universidade
Anhanguera-Uniderp
University for the Development of the State
and Region of the Pantanal - UNIDERP
Campo Grande/ MS
<https://orcid.org/0000-0003-2091-8479>

Abstract: The Metabolic Syndrome (MS) is a set of metabolic risk factors related to obesity, insulin resistance, dyslipidemia and arterial hypertension, which increase the possibility of cardiovascular events and general mortality. Additionally, MS is a risk factor for complications from COVID-19. While some of the arguments are speculative, an increase in childhood obesity rates during the COVID-19 pandemic is a realistic scenario. The coronavirus pandemic has led to laws and policies that include school closures, lockdown and social distancing laws and recommendations to control the pandemic, which has caused an increase in time spent on screens and this factor has contributed to the decrease in physical activity and increase consumption of unhealthy food.

Keywords: Metabolic Diseases. Pediatric Obesity. Social isolation.

INTRODUCTION

The Metabolic Syndrome (MS) can be defined as a compilation of metabolic risk factors related to obesity, insulin resistance, dyslipidemia and arterial hypertension, which increase the possibility of cardiovascular events (SBEM, 2021) and general mortality (SBC, 2005).

This condition was for decades considered a disease of adults, it is increasingly frequent at early ages due to increased rates of childhood obesity (SPSP, 2019). Metabolic Syndrome is a public health problem in modern society, being considered the great challenge of the century by the Brazilian Society of Pediatrics (SBP, 2017).

According to WHO data (2016), approximately 41 million children under 5 years of age were affected by overweight or obesity in the world. In Brazil, data from the IBGE (2020) indicate that 26.8% of the adult population was obese in 2019. Oliveira et al., (2020) estimated that one in three

Brazilians has MS, a prevalence of 38.4% in the population. In the pediatric group, the prevalence of this syndrome ranges from 2.2 to 52.1% (SBP, 2017). This large variation occurs because there is no consensus on its definition, as there is an estimate of more than 40 concepts for pediatric MS; most are adaptations of the criteria for adults (SBP, 2017).

The consequences of MS for the health of the child are diverse, such as fatty liver disease, obstructive sleep disorders, enlargement of the carotid intima-medial layer, arterial stiffness and type 2 diabetes mellitus that increase cardiovascular risk (SBP, 2017).

There are also psychological repercussions such as low self-esteem, body rejection and eating disorders caused by the stigma of obesity (BRAZIL, 2021).

A major study projected the impact of the COVID-19 pandemic on the prevalence of childhood obesity in the United States. Declines in energy expenditure as a result of canceled physical education classes and less physical activity may increase the risk of childhood obesity. Regarding the non-COVID-19 context, the scenarios evaluated during the pandemic were associated with an increase in body mass index scores and prevalence of childhood obesity (AN, 2020).

The longitudinal study Avon of Parents and Children carried out with 5,235 obese children suggests that obese children aged between 9 and 12 years have a higher cardiovascular risk than when they reach 15-16 years (LAWLOR, 2010). However, those who normalized their weight in adolescence have this reduced risk (SBP, 2017). Improving BMI in adulthood can reduce the risk of morbidity and mortality, even so childhood obesity will have consequences on that person's health. (WHO, 2017).

In the scenario of the COVID-19 pandemic, the consequences of MS and the comorbidities

involved are even worse, as they increase the risk of complications and the severity of the disease caused by SarsCoV-2 and increase hospitalizations. (BRAZIL, 2021). Therefore, this study aims to present a narrative review of MS in childhood during the COVID-19 pandemic, analyzing the progression or modification of the natural history of the disease in children during this period.

MATERIALS AND METHODS

The proposed literature review aims to analyze the relationship between metabolic diseases and pediatric obesity, taking into account social isolation as a possible aggravating factor for the onset of these diseases in children and adolescents.

For this, a search for scientific articles was carried out in electronic databases: PubMed, Scopus and Web of Science, using the keywords "Metabolic Diseases", "Pediatric Obesity" and "Social Isolation". In addition, reports and information from government agencies, such as the Ministry of Health and IBGE, and from specialized organizations, such as ABESO, were analyzed.

The criteria for inclusion of articles will be: (1) publications in Portuguese, English or Spanish; (2) articles published between 2010 and 2023; (3) studies with samples of children and adolescents with obesity or metabolic diseases; (4) studies that address the relationship between social isolation and obesity or metabolic diseases in children and adolescents.

A critical reading of the selected articles was carried out, extracting relevant information for the review. A synthesis of the obtained results was made and a discussion of the findings in relation to the existing literature.

Finally, we drew up a conclusion pointing out the possible practical implications of the results found, such as the development of public policies aimed at preventing obesity and

metabolic diseases in children and adolescents during the period of social isolation.

RESULTS

The term Metabolic Syndrome describes a set of risk factors of metabolic origin, based on insulin resistance, that contribute to the development of cardiovascular diseases (PENALVA, 2008; SBEM, 2021). So far, there is no single universally accepted standard to define this syndrome, but those of the World Health Organization (WHO) and the National Cholesterol Education Program (NCEP) are currently the most accepted worldwide (SBEM, 2021). In Brazil, there is still one more reference for these parameters, which are those stipulated by the Brazilian Consensus on Metabolic Syndrome.

In pediatrics, there is no unified criterion for the definition of MS, most references only adapt the proposed parameters for adults (SBP, 2017). In addition, its definition has limitations such as blood pressure criteria, anthropometric and lipid profiles that vary according to age (DAMIANI et al., 2011).

But, according to the Brazilian Society of Pediatrics (2017), abdominal obesity and insulin resistance are the main components of MS, which is classified by age by the International Diabetes Federation (IDF) in the age group of 6 to 10 years, 10 up to 16 years old and over 16 years old. The diagnosis of MS in children younger than 10 years is not recommended. At this age, there must only be guidance on the need for weight loss and lifestyle changes (SBP, 2017; ABESO, 2007; DAMIANI et al., 2011).

For the age group above 10 years, the standards used to define MS are the measurement of the abdominal circumference (WC) up to the 90th percentile plus at least 2 clinical characteristics such as triglycerides greater than or equal to 150mg/dl, HDL-cholesterol below 40mg/dl, high blood

pressure (SBP \geq 130 mmHg or DBP \geq 85mmHg) and fasting blood glucose greater than 100mg/dl (ABESO, 2007; SBP, 2017; SPSP, 2017). However, according to Damiane et al. (2011) the most important aspect of MS in pediatrics is not the specific diagnosis of MS, but the risk factors that characterize this syndrome that may be present from an early age, adding risks for cardiovascular diseases, as MS is the number of these threats (DAMIANI et al., 2011).

Waist circumference measurement is an indication of central adiposity, (SBP, 2019) considered by Damiani et al. (2011) the best clinical parameter to define the level of abdominal obesity in children with abdominal circumference $>$ p90 for age is essential for the diagnosis of MS. But, alone, this measure is an important predictor of risk for CVD, DM, SAH and dyslipidemia, components of the metabolic syndrome (DAMIANI et al., 2011; SBP, 2019).

Classified by body mass index (BMI) or by measuring waist circumference, obesity is a chronic disease of multifactorial etiology caused by a set of genetic, environmental and psychological aspects (ROCHA et al., 2017), characterized by the accumulation of fat body (SBP, 2019). Excess weight is a disorder that affects the patient's quality of life and brings several health risks, such as cardiovascular, neuroendocrine and psychological disorders, related to a high morbidity and mortality rate (OLIVEIRA et al, 2014).

WHO estimates indicate that in 2025 there will be an arithmetic progression in the number of cases of childhood obesity, and there may be approximately 75 million obese children in the world (BRAZIL, 2019). In Brazil, it is estimated that 1 in every 3 children aged 5 to 9 years old are overweight, which corresponds to approximately 7.2 million children and adolescents with obesity, 3% of Brazilian children under 5 years old are

already obese and 18.3% are at risk of being overweight (BRAZIL, 2021).

In childhood, excessive adiposity came from a combination of genetic, environmental and behavioral factors and is a strong predictor of obesity in adulthood (WHO, 2016). In addition, it is related to early inflammatory and atherosclerotic processes, glycemic, lipid and blood pressure changes, which can lead to early CVD in adult life. It also has a negative impact on the immune response and is a risk factor for lower limb injuries (SBP, 2019).

The 2nd edition of the Physical Activity Guidelines for Americans (2018) recommends 60 minutes or more of moderate to vigorous exercise daily among children. However, more than three-quarters (76%) of children in the United States do not engage in the recommended daily level of physical activity in the guidelines, and nearly half (47%) of children in the United States exceed 2 hours a day in sedentary behavior. Physical education (PE) is part of the school curriculum in most states and contributes to children's daily physical activity. It is particularly important for those who are obese or do not have access to opportunities for physical activity in their home environment (USDHHS, 2018).

In Von Hippel et al. (2007) reported the effects of school versus non-school environments on overweight in childhood. The author's question was whether the non-school environments experienced during summer vacation contribute more to BMI gain in childhood than when school is in operation, and he described that BMI gain was faster during summer vacation than during the school year.

In a systematic review carried out by Francke et al. (2014), included seven studies examining school versus summer weight gain in children with an emphasis on racial/ethnic disparities. Of the seven studies, six found "accelerated" weight gain during the

summer, particularly among black, Hispanic, and previously overweight children and adolescents.

Wang et al. (2015) noted that during summer vacation children consumed less vegetables and more added sugar and watched more television, but were also more active, but the authors did not assess racial differences in these effects.

The COVID-19 pandemic has led to resolutions including school closures, lockdown and social distancing laws. Recommendations to control the COVID-19 pandemic increase children's screen time (JASON et al., 2020).

Furthermore, screen time is traditionally related to sedentary behavior and poor diet, which may promote risk factors for obesity and cardiovascular disease. During isolation, screen time has been used to promote activities such as online fitness classes, mobile exercise apps, or video games that have a physical activity component.

According to Saliba and Cushieri (2021), there were inequalities in the impact that obese or overweight patients had on their routines, as the increase in sedentary lifestyle, unregulated diet and social distancing prevented the chance of losing weight. The objectives of this study were to analyze the impact of the COVID-19 blockade on behavior changes in an obese pediatric patient and to explore the association between the new lifestyle and parental education level.

To illustrate, statistical data from the studies by Valensize et al. (2021) presented characteristics of 40 obese and overweight pediatric patients at a clinic in Messina (Italy). In this study, weight, height, BMI were collected; and other biochemical parameters, such as total cholesterol, HDL, LDL, triglycerides, transaminases, glycemia and insulinemia. After confinement, all patients were contacted to obtain some information

about food, physical activity and changes in sedentary lifestyle in automatic with the level of education of parents.

The results showed that there was an increase in meals during the COVID-19 lockdown and the result to illustrate the increase in the number of meals was 3.2 pre-lockdown versus 5 post-lockdown. It was also shown, in particular, how children whose parents completed primary education ate a greater and significant number of meals during confinement, compared to children whose parents completed secondary education. In addition, 95% of patients did little physical activity during confinement and 97.5% spent more time in sedentary activity. Even though the BMI values did not have significant differences, they did increase after the lockdown, as evidenced by the researcher with an average BMI result of 30.2 before the lockdown and 32.0 after the lockdown.

Brazendale et al. (2017) indicated that obesogenic behaviors such as sedentary lifestyle, increased screen time, poor diet and irregular sleep are when children follow a structured day. It is difficult to establish a clear framework for children during these unprecedented times. This can result in irregular sleep patterns and vastly prolonged screen times due to online classes and lectures offered, leading to weight gain and reduced levels of cardiorespiratory fitness (WANG, 2020).

Several studies have linked the consumption of processed foods, such as those high in saturated fat, sugar, and salt, with adverse health outcomes, including obesity and metabolic syndrome. Pietrobelli (2020) describes that the intake of French fries, red meat and sugary drinks increased significantly during the lockdown. This may have affected the children in many ways; however, specific aspects deserve further investigation.

While some of the arguments are

speculative, an increase in childhood obesity rates during the context of the COVID-19 pandemic was a realistic scenario. Children certainly have limited capacity to advocate for their needs and have suffered the most from the pandemic (CUSCHIERI, 2020).

These previous studies and their observations bolstered the argument that the COVID-19 pandemic, by restricting children from attending school, exacerbated risk factors for “weight gain associated with summer recess.” It is further postulated that homes were stocked during lockdown with ultra-processed, calorie-dense foods, an observation now strongly recommended by observations taken during a pandemic. (RUNDLE et al., 2020).

With school closures during the COVID-19 pandemic, children in the United States have lost the opportunity to participate in physical education classes and other physical school activities, e.g., recess, after-school athletic programs. They were also less likely to compensate for this in the stay-at-home regime, as parks and squares where they could do outdoor activities were closed (AN, 2020).

The COVID-19 pandemic has significantly affected traditional healthcare delivery systems, creating an urgency to act by creating alternatives to face-to-face consultations (O’HARA et al., 2020).

The chronic disease in question requires ongoing management and interruption of chronic care consultations for obesity delays treatment and can lead to poor outcomes (O’HARA et al., 2020).

A major problem of the pandemic was monitoring the treatment of metabolic syndrome, since social isolation restricted the activities of weight loss programs, led to a sedentary lifestyle, as a result of the closure of parks and gyms.

In addition, it strengthened the consumption of industrialized foods rich

in sodium, calories and sugar, in addition to aggravating emotional problems that are often present in obese individuals, such as depression, compulsion and anxiety (SBP, 2020).

One study has shown that the societal effects of COVID-19, if not addressed by timely, effective and targeted countermeasures, can lead to profound and long-term health and economic consequences on a much larger scale than the infection itself. The model predicted that even a 2-month school closure alone could result in an increase in the childhood obesity rate by 0.640 percentage points among US kindergartens. If school closures continued through the end of 2020, the transmission of COVID-19, the childhood obesity rate in the United States could further increase by 2.373%. If such an impact were universal among all US children ages 5 to 17, by March 2021, approximately 1.27 million new children would develop obesity under the COVID-19 pandemic than otherwise (AN, 2020).

Educating parents about food availability, convenience, and how to choose foods wisely, even within a budget, is an issue that needs to be addressed (CUSCHIERI; GRECH, 2020).

Obesity during pregnancy has been linked to childhood obesity, diabetes and cardiovascular disease. At the beginning of the COVID-19 pandemic, pregnant women were considered part of the vulnerable group and even forced to stay at home by some governments. The prevention of childhood obesity must be defined as a priority at the individual, community and population levels during this pandemic (CUSCHIERI; GRECH, 2020; CUSCHIERI, 2020; LEDDY et al., 2008;)

DISCUSSION

The Metabolic Syndrome (MS) is a condition characterized by the presence of multiple metabolic risk factors, such as

obesity, insulin resistance, dyslipidemia and arterial hypertension (Alberti et al., 2009). This syndrome increases the risk of developing cardiovascular disease (Grundy et al., 2005) and is associated with a higher risk of complications in cases of COVID-19 infection (Petrakis et al., 2020). Studies have shown that obese children are more likely to become obese adults (Sahoo et al., 2015). Therefore, it is crucial to address childhood obesity to prevent future complications, such as diabetes, high blood pressure, dyslipidemia, acute myocardial infarction (AMI) and stroke.

During the COVID-19 pandemic, social isolation and restriction measures had a negative impact on children's eating habits and lifestyle, contributing to a possible increase in childhood obesity rates (Dumas et al., 2020). School closures and restriction of physical activities have led to a decrease in physical activity (Moore et al., 2020) and an increase in screen time, which can result in a sedentary lifestyle and increased consumption of unhealthy foods (Pietrobelli et al., 2020).

Obesity is associated with a chronic low-grade inflammatory state (Lumeng and Saltiel, 2011), which may contribute to the development of insulin resistance and dyslipidemia (Huang and Glass, 2010). Insulin resistance, in turn, is strongly related to the development of type 2 diabetes (Reaven, 2003). Obesity is also associated with changes in the lipid profile, with increased levels of triglycerides and reduced HDL cholesterol (Lumeng and Saltiel, 2011), factors that contribute to the development of cardiovascular diseases such as AMI and stroke (Grundy et al., 2005).

Given this context, it is crucial to address childhood obesity and MS during the COVID-19 pandemic. Prevention and proper management of obesity in childhood are essential to reduce the risk of developing metabolic and cardiovascular complications

in the future. Strategies that promote healthy eating habits and the regular practice of physical activity must be implemented (Dias et al., 2018). In addition, it is important to ensure access to health services for the early diagnosis and treatment of obesity and MS in children (Petrakis et al., 2020).

In short, the COVID-19 pandemic has exacerbated challenges related to childhood obesity and Metabolic Syndrome. The correlation between obesity in childhood and obesity in adulthood is well established (Sahoo et al., 2015), which reinforces the importance of addressing this issue early on.

Childhood obesity not only increases the risk of metabolic complications such as diabetes, high blood pressure and dyslipidemia, but also predisposes to cardiovascular events such as acute myocardial infarction (AMI) and stroke (Grundy et al., 2005).

Obesity is intrinsically associated with a chronic low-grade inflammatory state in the body (Lumeng and Saltiel, 2011). This inflammatory state contributes to the development of insulin resistance, an important factor in the pathogenesis of type 2 diabetes (Reaven, 2003).

In addition, obesity is directly related to changes in the lipid profile, such as increased triglycerides and decreased HDL cholesterol (Lumeng and Saltiel, 2011), factors that increase the risk of cardiovascular diseases, including AMI and stroke (Grundy et al., 2005).

During the COVID-19 pandemic, a sedentary lifestyle and the adoption of inappropriate eating habits contributed to the increase in childhood obesity rates (Dumas et al., 2020). School closures and restriction of physical activities have limited children's opportunity to engage in regular physical exercise (Moore et al., 2020). In addition, increased screen time and consumption of unhealthy foods can lead to excessive

weight gain and the development of obesity (Pietrobelli et al., 2020).

In the face of these challenges, it is critical to adopt effective approaches to prevent and treat childhood obesity during the pandemic. Strategies that promote the adoption of a healthy diet and the regular practice of physical activity must be emphasized.

It is essential to implement health policies that encourage the availability of nutritious foods and the restriction of ultra-processed foods, as well as the promotion of physical activities adapted to the restrictions of the pandemic. In addition, it is necessary to ensure continuous access to health services, allowing early diagnosis and proper management of childhood obesity and Metabolic Syndrome (Petrakis et al., 2020).

In short, the COVID-19 pandemic has presented additional challenges in the fight against childhood obesity and Metabolic Syndrome. The correlation between obesity in childhood and obesity in adulthood underscores the importance of early intervention.

Childhood obesity is associated with metabolic and cardiovascular complications, such as diabetes, hypertension, dyslipidemia, AMI and stroke. It is essential to adopt effective preventive and therapeutic strategies, promoting healthy habits and ensuring access to health services during the pandemic.

In addition, it is important to highlight that childhood obesity is not only an individual problem, but also a public health challenge. The COVID-19 pandemic has widened social and economic inequalities, disproportionately affecting the most vulnerable communities. These disparities can exacerbate childhood obesity, since access to healthy foods and opportunities for physical activity may be limited in low-income areas (Diniz et al., 2021).

In this context, comprehensive and

multidisciplinary public policies are needed to combat childhood obesity during the pandemic. It is essential to promote nutritional education in schools, involving both students and their parents or guardians, to encourage the adoption of healthy food choices.

That said, it is important to create environments favorable to the practice of physical activity, such as the availability of adequate and safe public spaces for the practice of sports.

The approach to the Metabolic Syndrome in childhood requires special attention from health professionals. Regular monitoring of metabolic risk factors, such as measuring blood pressure, lipid profile and blood glucose, is necessary in order to identify any changes early and intervene appropriately.

Non-pharmacological therapy, with emphasis on promoting a healthy lifestyle, must be the first line of treatment, including guidance on balanced eating, encouraging regular physical activity and reducing screen time.

In terms of pharmacological interventions, although there are some options available for the treatment of obesity in adults, their efficacy and safety in children are still limited and require adequate care and monitoring. Therefore, the initial approach must be based on changes in lifestyle, with the support of a multidisciplinary team composed of physicians, nutritionists, physical educators and psychologists.

Finally, it must be noted that the COVID-19 pandemic brought additional challenges in the fight against childhood obesity and Metabolic Syndrome. The correlation between obesity in childhood and obesity in adulthood highlights the importance of early and comprehensive interventions. Through strategies that promote a healthy lifestyle, including a balanced diet and regular physical activity, it is possible to prevent and treat childhood obesity, reducing

the risk of metabolic and cardiovascular complications in the future.

FINAL CONSIDERATIONS

The COVID-19 pandemic has brought to the fore additional concerns regarding the health of children and adolescents, especially with regard to obesity and metabolic diseases. The correlation between obesity in childhood and obesity in adult life, together with the negative implications of obesity, such as the development of diabetes, arterial hypertension, dyslipidemia and cardiovascular complications, highlight the need for actions aimed at preventing and controlling these problems during the period of social isolation.

The results found highlight the importance of developing comprehensive public policies that address childhood obesity and metabolic diseases, considering the particularities and challenges faced during the pandemic. It is essential to promote educational actions that encourage healthy food choices, providing information about nutrition and guiding both parents and children about the importance of a balanced diet. In addition, there is a need to facilitate access to healthy and affordable food, especially in low-income communities.

Another important aspect is the promotion of physical activity. During the period of social isolation, opportunities for physical activity may be limited, but it is essential to encourage the practice of exercises at home, whether through online classes, apps or other forms of physical activity adapted to the home environment. It is also necessary to create safe and suitable public spaces for sports, respecting social distancing measures.

A multidisciplinary approach is essential to tackle childhood obesity and metabolic diseases. Health professionals such as physicians, nutritionists, physical educators and psychologists must work together to provide adequate support and guidance. In

addition, it is important to integrate health policies with other areas, such as education, to promote a health-friendly environment in schools and ensure the continuity of educational actions even during the pandemic.

In conclusion, the COVID-19 pandemic has highlighted the need for measures to prevent and control obesity and metabolic diseases in children and adolescents. The implementation of public policies aimed at

promoting healthy eating, encouraging the practice of physical activity and creating favorable environments are essential to mitigate the negative effects of obesity during the period of social isolation. Investing in the health of children and adolescents today is to guarantee a healthier future for them and reduce the impact of these diseases in adult life.

REFERENCES

1. ABESO. Associação Brasileira para o estudo da obesidade e síndrome metabólica. IDF Publica Definição de Síndrome Metabólica para Crianças. Junho, 2007. Disponível em: < <https://abeso.org.br/idf-publica-definicao-de-sindrome-metabolica-para-criancas/> >. Acesso em 06 set 2021.
2. AN, R. Projecting the impact of the coronavirus disease-2019 pandemic on childhood obesity in the United States: a microsimulation model. *Journal of Sport Health Science*, Saint Louis, v. 9, n. 4, p. 302-312, 2020.
3. BRASIL. Ministério da saúde. Secretaria de atenção primária à saúde. Em lançamento de campanha contra obesidade infantil, Ministério da Saúde anuncia 90 milhões para a prevenção e cuidado da doença. Brasília, DF, 2021. Disponível em: < <https://aps.saude.gov.br/noticia/13378> > Acesso em: 05 set. 2021.
4. BRASIL. Secretaria de Estado de Saúde. Obesidade infantil desafia pais e gestores. Goiânia, GO, 2019. Disponível em: < <https://www.saude.go.gov.br/noticias/81-obesidade-infantil-desafia-pais-e-gestores> > Acesso em: 05 set. 2021.
5. BRASIL. Secretaria de Estado de Saúde. Painel de casos de doença pelo coronavírus 2019 (COVID-19) no Brasil pelo Ministério da Saúde. Brasília, DF, 2021. Disponível em: < <https://covid.saude.gov.br/> > Acesso em: 07 set. 2021.
6. CUSCHIERI, S. COVID-19 panic, solidarity and equity—the Malta exemplary experience. *Journl Public Health (Bangkok)*, Springer, p. 1–6, jun. 2020.
7. CUSCHIERI, S.; GRECH, S. COVID-19: a one-way ticket to a global childhood obesity crisis?. *Journal Diabetes Metabolic Disorders*, v. 19, n. 2, p. 2027-2030, 2020.
8. DAMIANI, D.; KUBA, V. M.; COMINATO, L.; DAMIANI, D.; DICHTCHEKENIAN, V.; MENEZES FILHO, H. C. Síndrome metabólica em crianças e adolescentes: dúvidas na terminologia, mas não nos riscos cardiometabólicos. *Arquivos Brasileiros de Endocrinologia e Metabologia*, São Paulo, v. 55, n. 8, p. 576-582, 2011.
9. GONZÁLEZ-MUNIESA, P.; MÁRTINEZ-GONZÁLEZ, M-A.; HU, F. B.; DESPRÉS, J-P.; MATSUZAWA, Y.; LOOS, R. J. F.; MORENO, L. A.; BRAY, G. A.; MARTINEZ J. A. Obesity. *Nature Reviews Disease Primers*, v. 3, art. 17034, 2017.
10. IBGE. Instituto Brasileiro de Geografia e Estatística. Um em cada quatro adultos do país estava obeso em 2019; Atenção Primária foi bem avaliada. Out., 2020. Disponível em: < <https://agenciadenoticias.ibge.gov.br/agencia-noticias/2012-agencia-de-noticias/noticias/29204-um-em-cada-quatro-adultos-do-pais-estava-obeso-em-2019> >. Acesso em: 06 set. 2021.
11. LAWLOR, D. A.; BENFIELD, L.; LOGUE, J.; CULTIVO, K.; HOWE, L. D.; FRASER, A.; CEREJA, L.; WATT, P.; NESS, A. R.; DAVEY SMITH, G.; SATAR, N. Association between general and central adiposity in childhood, and change in these, with cardiovascular risk factors in adolescence: prospective cohort study. *BMJ*, v. 341, c62242010, 2010.

12. LEDDY, M. A.; POWER, M. L.; SCHULKIN, J. The impact of maternal obesity on maternal and fetal health. *Reviews in Obstetrics Gynecology*, v. 1, n. 4, p. 170–178, 2008.
13. NICOLA, M.; ALSAFI, Z.; SOHRABI, C.; KERWAN, A.; AL-JABIR, A.; IOSIFIDIS, C.; AGHA, M.; AGHA, R. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal Surgery*. Elsevier; London, v. 78, p. 185– 193, 2020.
14. O'HARA, V. M.; JOHNSTON, S. V.; BROWNE, N. T. The paediatric weight management office visit via telemedicine: pre- to post-COVID-19 pandemic. *Pediatric Obesity*, v. 15, e12694, 2020.
15. OLIVEIRA, C. L.; MELLO, M. T.; CINTRA, I. P.; FISBERG, M. Obesidade e síndrome metabólica na infância e adolescência. *Revista de Nutrição, Campinas*, v. 17, n. 2, p. 237- 245, 2004.
16. OLIVEIRA, L. V. A.; SANTOS, B. N. S.; MACHADO, Í. E. MALTA, D. C.; VELASQUEZ- MELENDEZ, G.; FELISBINO-MENDES, M. S. Prevalência da Síndrome Metabólica e seus componentes na população adulta brasileira. *Ciência e Saúde Coletiva*, [S. l.], v. 25, n. 11, nov., 2020.
17. ORGANIZAÇÃO MUNDIAL DA SAÚDE (OMS). Relatório da Comissão para Acabar com a Obesidade Infantil. Genebra, 2016.
18. ORGANIZAÇÃO MUNDIAL DA SAÚDE (OMS). Dicas de alimentação e nutrição durante a auto-quarentena. Europa: Regional escritório. 2020.
19. PENALVA, D. Q. F. Síndrome metabólica: diagnóstico e tratamento. *Revista de Medicina*, [S. l.], v. 87, n. 4, p. 245-250, 2008.
20. PIETROBELLI, A.; PECORARO, L.; FERRUZZI, A.; HEO, M.; FAITH, M.; ZOLLER, T.; ANTONIAZZI, F.; PIACENTINI, G.; FEAMBACH, S. N.; HEYMSFIELD, S. B. Effects of COVID-19 Lockdown on Lifestyle Behaviors in Children with Obesity Living in Verona, Italy: A Longitudinal Study. *Obesity (Silver Spring)*, [S. l.], v. 28, n. 8, p. 1382-1385, 2020.14
21. ROCHA, M.; PEREIRA, H.; MAIA, R.; SILVA, E.; MORAIS, N.; MAIA, E. Aspectos psicossociais da obesidade na infância e adolescência. *Psicologia Saúde e Doenças*, Lisboa, v. 18, n. 3, p. 713-723, dez., 2017.
22. RUNDLE, A. G.; PARK, Y.; HERBSTMAN, J. B.; KINSEY, E. W.; WANG, Y. C. COVID- 19-Related School Closings and Risk of Weight Gain Among Children. *Obesity (Silver Spring)*, v. 28, n. 6, p. 1008-1009, 2020.
23. SALIBA, K.; CUSCHIERI, S. Amidst the COVID-19 pandemic childhood obesity is still an epidemic-spotlight on obesity's multifactorial determinants. *Health Sciences Review*, v. 1, n. 100006, 2021.
24. SBEM. Sociedade Brasileira de Endocrinologia e Metabologia. A Síndrome metabólica. Abril, 2021. Disponível em: < <https://www.endocrino.org.br/a-sindrome-metabolica/> >. Acesso em: 05 set. 2021.
25. SBC. Sociedade Brasileira de cardiologia. Diretriz brasileira de diagnóstico e tratamento de síndrome metabólica. 2005.
26. SBP. Sociedade Brasileira de Pediatria. Tratado de Pediatria. 4 ed. Barueri: Manoela, 2017. SBP. Sociedade Brasileira de Pediatria. Manual de orientação obesidade na infância e adolescência. 3 ed. São Paulo: Manoela, 2017.
27. SBP. Sociedade Brasileira de Pediatria. Nota de alerta: Obesidade em crianças e adolescentes e COVID-19. 2020.
28. SPSP. Sociedade de Pediatria de São Paulo. Enfrentando a Obesidade Infantil. *Boletim da Sociedade de Pediatria de São Paulo*, ano 4, n. 2, mar./abr. 2019.
29. TUCKSON, R.V.; EDMUNDS, M.; HODGKINS, M. L. Telehealth. *New England Journal of medicine*, v. 377, n. 16, p. 1585-1592, 2017.

30. US DEPARTMENT OF HEALTH AND HUMAN SERVICES (USDHHS). Physical Activity Guidelines for Americans (PAG). 2a edição. 2018.

31. WFO. WORLD FEDERATION OF OBESITY. Global Atlas on Childhood Obesity. London, 2019. Disponível em: <<https://www.worldobesity.org/nlsegmentation/global-atlas-on-childhood-obesity>>. Acesso em: 06 set. 2021