COVID-19 and the impact of diabetic and obese patients during confinement

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ABSTRACT

Objective: Identify aspects related to obesity and diabetes according to clinical and social factors combined with physical conditioning obstacles during the COVID-19 confinement routine. **Methods:** Database from PubMed/MEDLINE, Web of Science, Scopus, LILACS, Embase and grey literature (Google Scholar) was used, as well as PRISMA, and Downs and Black checklist for bias risk analysis. To summarize the results, two subtitles were defined in line with the research objectives. **Results:** Seventeen studies were included for qualitative synthesis analysis: twelve sectional cohort studies, four cross-sectional and one multicenter retrospective. Obese and diabetic patients increased comorbidities when infected by COVID-19, due to compromising pathological interaction followed by complications such as ketoacidosis, high hyperosmolarity infection, dyslipidemia and psychological disorders. Scientific findings show a higher level of hospitalization in Intense Care Units (ICU) for obese subjects compared to diabetics when infected by the new coronavirus. With lower physical activity and lack of motivation due to sedentary behavior, obese and/or diabetics show an adverse physical and mental prognostic during and after the end of pandemics. **Conclusion:** The specific understanding about immunomodulatory approach and enzymatic inhibitors is important for primary patient assistance. Multidisciplinary networks strategy must track individuals with a propensity to overweight and diabetes during social confinement, once it is difficult to keep glycemic and dyslipidemic control, which are unfavorable by anxiety, stress and the idea of economic bankruptcy.

Keywords: Coronavirus, Physical distancing, Obesity, Diabetes Mellitus.

INTRODUCTION

In the city of Wuhan (China), at the end of 2019, one of the world´s biggest pandemics took place[1]. The main strategy to control the increase of transmissibility[1,2] was social distancing (SD). However, humankind faced unexpected obstacles such as the adaptation to the new set of routines and the challenge to develop new habits[2].

Meanwhile, in underdeveloped and developing countries, the issues to control COVID-19 concerned the poor instruments and infrastructure of hospitals[2,3]. Among other factors, the interdisciplinary interaction of professionals who faced not only the deficit of equipment but a scenario of viral transmissibility and constant plus progressive mutability that none of them had ever gone through, adding a total social behavior change, resulting from an uncontrolled pandemics[2,3,4,5].

Studies have shown, during the current year of 2020, that although asymptomatic patients tasted a quick recovery, the impact of the disease caused panic in the population of different countries, even to the people that overcame the worst stage of the infection, due to the hypothesis of a possible new contamination[5,6,7].

Similarly, is uncertainty regarding guidelines related to medications to treat COVID-19 and its possible side effects, even in convalescent patients. The potential infection of these individuals had become a question mark, generating panic among the population, who sought accuracy and/or evidence in quantitative test data reverse-transcriptase-polymerase-chain-reaction (qRT-PCR)[6,8]. Equal are the uncertainties about the differences regarding the effectiveness of supporting treatments such as immunopharmacotherapy, for COVID-19 inpatients, once the analysis of lipidic factors and the inhibition of cytokine synthesis seem to be the target for a promising and preventive therapeutic prognosis[9,10].

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Obese and diabetes mellitus (DM) patients seem to be a fragile target for COVID-19 contamination. High levels of fatty acids and glucose, low immunity and aspects related to the classic access way, through the connection of the virus with the angiotensin 2 (ACE-2) enzyme are complications in favor of serious comorbidities development and mortality[9]. Studies show that at least 20% of obese and diabetic patients under severe conditions, were checked-in in Intense Care Unit (ICU) in different hospitals. Research conducted with 48 COVID-19 inpatients in ICUs states that 23 (48%) were obese and 8 (18%) were diabetics[11]. Another research with 103 COVID-19 patients revealed that 49 (47,5%) of the inpatients were overweight and 21 (20%) diabetics[12].

Health professionals' and scientists' concerns are relevant due to the high level of infection and contingency policies to control COVID-19. In one hand there are the imperative strategies to fight the spread of pandemics, taking into account all different facilitating factors of a high rate of transmissibility, in the other hand, there are the factors that facilitate contamination of COVID-19 [7,13,14]. Therefore, the aim of this research was to identify aspects related to obese and diabetes, according to clinical and social factors, transmissibility and issues to maintain the physical conditioning routine during confinement.

METHODS

A systematic review of literature was performed between July 5th, 2021 and September 5th of 2021. A protocol was organized including an evaluation report with the different scientific studies.

Eligibility Criteria

First selection criteria focused on studies related to the COVID-19 pandemic, published in three different languages: Portuguese, English and Spanish. Regarding the design, this review included, for its qualitative analysis, only cohort studies, cross-sectional and control cases. Concerning the subject of interest, studies must have presented the metabolic factors about obese and diabetes, considering clinical factors that led to commitment due to COVID-19.

In the same way, factors related to the impact of SD, economic and social aspects and the behavior of obese and diabetic individuals during the pandemic, taking into consideration aspects related to functional and psychic disorders and hospitalization outcomes.

Epidemiologic research, report cases, clinical experiments and clinical laboratory studies were allowed according to the researcher's interests. These studies had the purpose only of enriching and possibly being useful for comparison against the results from studies included in the qualitative analysis. Also, methodological studies containing search strategies in scientific literature and methods for the development of reviews. Other writings found in editorials, personal opinions, comments, newspapers, letters, booklets and abstract meetings were not included in this research.

Information sources

For the literature search, a flow diagram based on the PRISMA checklist was used[15]. Studies could be published in Portuguese, English or Spanish. The descriptors were used in *Ciência da Saúde* from *Biblioteca Virtual em Saúde* Lilacs (DeCS) to obtain keywords in Web of Science, Scopus, PubMed/ MEDLINE, *Literatura Latino-Americana* and from *Caribe em Ciências da Saúde* (*LILACS*), Embase and *literatura cinza* (Google Scholar).

Search Strategy

The descriptors selected were Coronavirus, Physical Distancing, Obesity and Diabetes Mellitus, associated with Boolean operators "AND" and "OR", in order to find studies more in line with the pre-established subject. For all websites, the same search strategy was used. "Coronavirus" OR "Physical Distancing" OR "Obesity" OR "Diabetes Mellitus".

Selection Process

The authors extracted the most relevant data from the studies. Both authors collected information about the selected research such as: author and publishing year, place of data extraction, type of institution, objective, study design, number of subjects, risk factors and main results. After the studies compilation, they were checked in order to organize all data from the selected research. Worth mentioning that in cases where the information was

unclear or in the hypothesis of missing data about the study design, the authors would be contacted for more clarification. Reference manager *EndNote* X9.1.22. (http://endnote.com/training/mats/enuserguide/eng/enguide-full.pdf) was used in the first step of the selection process.

Data collection and listing process

PICO[16] strategy was used in this research, Where "P" refers to the population of interest – subjects evaluated in the studies, "I" represents the experiments that contemplate the observations of interest; "C" means the comparisons and interventions of interest and "O" represents the results that are intended to measure or find.

In this manner, the population of interest included studies with obese and diabetic individuals during the COVID-19 pandemic. The intervention embraced the strategies applied and the behavior of obese and diabetics patients during the social confinement of pandemics. The comparison does not apply once this is not a comparative study. Regarding the result, it was a search about the different issues and impairments of obese and diabetics patients during pandemics, as well as clinical, social, economic and physical activity routine aspects during confinement.

A selection process was developed using a bibliographic search diagram adapted from PRISMA-2020 through the following steps: abstract reading, COVID-19 non-related studies, studies that did not present aspects related to coronavirus risks, different population, methods and results not elucidated between obese, diabetics and outcomes.

After double-checking the criteria and acquiring the studies to be evaluated, the selected papers were organized in topics inserting two relevant matters to the research objective:

- Obesity risks for chronic diseases during COVID-19 pandemic social confinement;
- Clinical implications and physical conditioning strategies applied in social confinement during COVID-19 pandemic in diabetic patients.

Bias evaluation throughout the different studies

Information was checked regarding their coverage, selection bias factors, measurement, misunderstanding and strength of the study. The observation was also made in concern to the direction of studies, evidence strength, effect magnitude and internal validity. Among the different methods evaluated, the time of incubation of COVID-19 was analyzed as well as the similarity and/or procedures used to choose the observation groups once the outcomes should be in line with the presented objectives and the information collected in a similar way. Subsequently, the verification of the proposals of the different research according to the objectives of the related study. The different guidelines that allowed a larger information about the proposals of the initial protocol of the present study, were also observed. Therefore, the characteristics of the investigation were maintained, analyzing the particularities, reliability and similar data validity in all selected studies. For all study designs: cohort, case control and cross-sectional, the level of bias was evaluated through an adaptation of the Downs and Black[17] scale. It is worth mentioning that this scale aims to assess observational studies, once the purpose is to rate studies not related to randomized clinical trials.

The score of each study was placed as follows: a minimum of 13 points to be selected, not considering the design. Although the maximum score for case-control studies was set at 28 points, according to the scale criteria, and 22 points for both cohort and cross-sectional.

RESULTS

Studies Selection

According to the selected databases, 10,825 studies were identified. The first cut removed 8,280 duplicated papers, and 2,545 were taken for analysis. An embracing evaluation of the title and abstract excluded 2,516 studies, resulting in 29 for the first stage of the research. However, the search in grey literature, on Google Scholar, allowed 2 more in the first stage, resulting in a total of 31 for full reading. At this stage, PICO strategy was applied, as well as a detailed analysis of methods and results of the different studies.

Therefore, 14 studies were excluded from the analysis due to the following factors: five (5) presented a population different from the one defined in the pre-protocol, three (3) did not have enough

detail in the method section, four (4) showed an irrelevant study design, and two (2) where the data associating obesity, diabetes and the results were not clear to the desired level. After the exclusion, 16 studies were added to the qualitative synthesis, according to the diagram of bibliographic research in Figure 1. Consecutively, the selected studies were submitted to the bibliometric descriptors analysis to evaluate the frequency and interaction of the descriptors contained in the studies. Therefore, the keyword analysis allowed a retrospective assessment of the quality of the selection process, as shown in Figure 2.

Studies characteristics

Among the 17 selected studies for qualitative analysis, 7 (41.2%) were retrospective cohort, 6 (35.3%) prospective cohort and 4 (23.5%) cross-

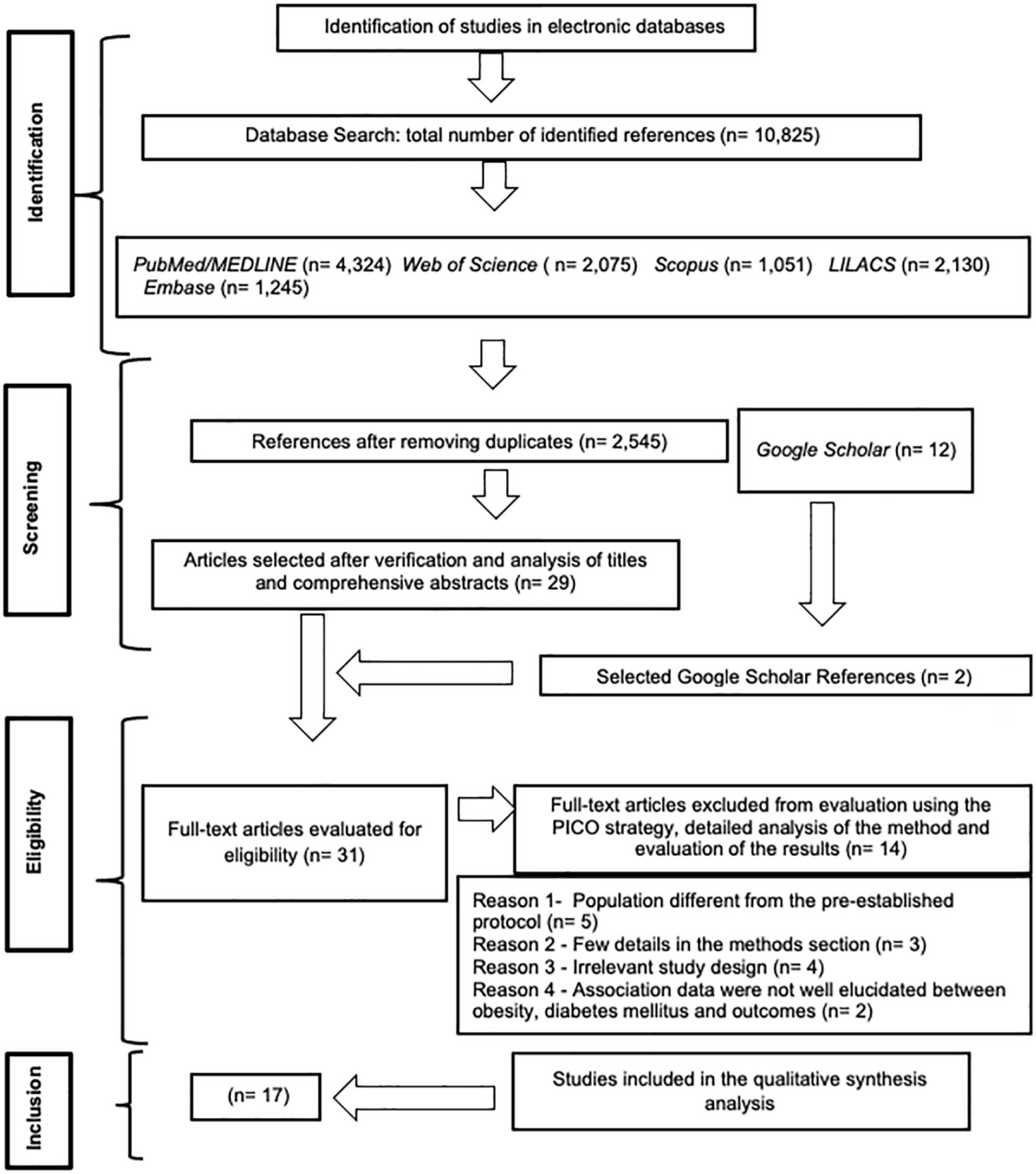

Figure 1. Diagram of bibliographic search adapted from PRISMA 2020.

sectional. About the countries where the selected studies for qualitative analysis were carried out, the distribution was as follow: 1 (5.8%) in France, 2 (11.7%) in Brazil, 2 (11.7%) in the United States, 2 (11.7%) in Italy, 3 (17.6%) in Spain, 3 (17.6%) in India and 4 (23.5%) in China, according to Table 1.

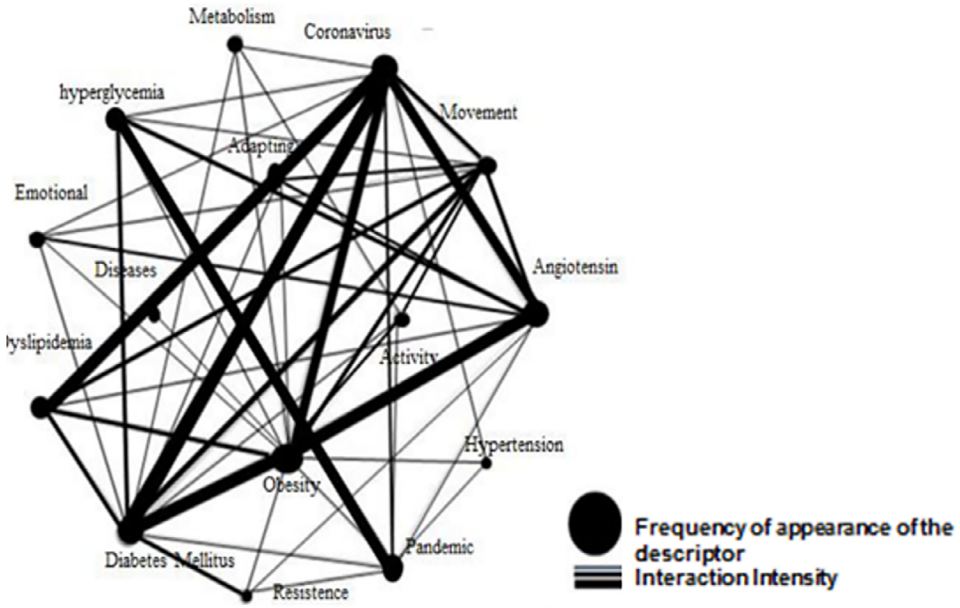

Figure 2. Interaction analysis of the most relevant keywords. Software Sitkis (Schildt, 2002).

Table 1
Characteristics of studies included in the qualitative synthesis

Author / Year	Country	Sample number (n)	Population
Zhu et al. (2019) [1]	China	n= 4	Patients with COVID-19
Barrasa et al. (2020) [11]	Spain	n= 48	Patients with COVID-19
Kalligeros et al. (2020) [12]	USA	n=103	SARS-COV-2 infected patients
Atkinson et al. (2005) [22]	USA	n=502	Obese patients
Tang et al. (2020) [25]	China	n= 183	Patients with Covid-19
Sonza et al. (2021) [31]	Brazil	n= 1845	Patients with Covid-19
Bezerra et al. (2020) [32]	Brazil	n= 16.440	Adult patients in DS state
Simonnet et al. (2020) [40]	France	n= 124	Patients with Covid-19
Guo et al. (2020) [42]	China	n=174	SARS-COV-2 infected patients
Preito-Alhambra et al. (2020) [45]	Spain	n= 44.709	Patients with Covid-19
Zhu et al. (2020) [46]	China	n= 7.337	Patients with Covid-19
Ghosh et al. (2020) [57]	India	n=150	Diabetic patients
Khare et al. (2020 [58]	India	n=143	Diabetic patients
Khader et al. (2020) [59]	India	n=1.510	Diabetic patients
Fernández et al. (2020) [60]	Spain	n=307	Patients before and during SD
Tornese et al. (2020) [61]	Italy	n=307	Diabetic patients
Dover et al. (2020) [62]	Italy	n=1.776	Diabetic patients

Absolute sum of data regarding the number of studies and the score achieved for the bias risk

In the Downs and Black scale, comparing the achieved score (AS)/maximum score (MS) from the 6 cohort prospective studies, three of them presented 16 points out of a maximum of 22 points- 16(AS)/22(MS), with a relative frequency (RF) of 72.7% and 3 studies reached 13 points-13 (AS)/22(MS), with RF of 59.1%. Among the 6 studies of the retrospective cohort, four presented 13 points out of the 22 maximum score-13(AS)/22(MS), with RF of 59.1%, one research achieved 16 points-16(AS)/22(MS), with RF of 72.7% and one with 17 points, with RF of 77.3%. There were four cross-sectional studies, where two managed to achieve 16 points-16(AS)/22(MS), with RF of 72.7% and two with 13 points-13(AS)/22(MS), with RF of 59.1%. Through qualitative analysis, one retrospective multicenter study was selected and the achieved score was 13 points 13(AS)/22(MS), with RF of 59.1%, according to Table 2.

Synthesis of the results

During the COVID-19 pandemic, with the reduced level of sports activity added to the lack of motivation due to sedentary behavior, studies suggest an unfavorable prognostic to the physical and mental health of the population during the post-pandemic stage. The transmissibility of the virus and the mutable epidemiological scenario have set feelings of apprehension and panic among the different populations. Obesity and diabetes are complications that suit the classic access way where the virus has an affinity with the gene of the angiotensin 2 (ACE-2) enzyme in situations of low levels of immunity. Therefore, the diagnosis of cardiovascular alterations coming from obesity facilitates the new coronavirus contamination, where the thrombotic factors and abnormal coagulations were identified in individuals with COVID-19.

The issues for diaphragm muscle excursion in obese make it even harder the process of rehabilitation

Table 2
Downs and Black score scale

Author / Year	Type of study	Downs and Black Scale SO / MS	Relative frequency (%)
Zhu et al. (2019) [1]	Prospective Cohort	16/22	72.7
Barrasa et al. (2020) [11]	Prospective Cohort	13/22	59.1
Kalligeros et al. (2020) [12]	Retrospective Cohort	13/22	59.1
Atkinson et al. (2005) [22]	Retrospective Cohort	17/22	77.3
Tang et al. (2020) [25]	Prospective Cohort	16/22	72.7
Sonza et al. (2021) [31]	Cross-section and multicentric	16/22	72.7
Bezerra et al. (2020) [32]	Cross-section	13/22	59.1
Simonnet et al. (2020) [40]	Retrospective Cohort	13/22	59.1
Guo et al. (2020) [42]	Retrospective Cohort	16/22	72.7
Preito-Alhambra et al. (2020) [45]	Prospective Cohort	13/22	59.1
Zhu et al. (2020) [46]	Retrospective and multicentric	13/22	59.1
Ghosh et al. (2020) [57]	Retrospective Cohort	13/22	59.1
Khare et al. (2020 [58]	Prospective Cohort	16/22	72.7
Khader et al. (2020) [59]	Cross-section	16/22	72.7
Fernández et al. (2020) [60]	Prospective Cohort	16/22	72.7
Tornese et al. (2020) [61]	Retrospective Cohort	13/22	59.1
Dover et al. (2020) [62]	Cross-section	13/22	59.1

and, post-COVID-19 contamination, turns it into an overwhelming prognostic. The risks for COVID-19 contamination were increased in all categories of BMI above normal standards and, in the same manner, hospitalizations in ICU. Different patients with both diagnoses of obesity and diabetes, with cardiologic alterations, are treated with inhibitors of the angiotensin (IECA) conversion enzyme and the angiotensin receptor blocker (ARB), allowing critical relation through bonds between ACE-2 and COVID-19. Important strategies are the prophylactic immunomodulators recommendations to be developed in contemporary scientific studies, once they support the balance between glucose and lipids. On the other hand, the fear and mental stress together with SD make it even harder access medication and new prophylactic recommendations related to physical exercises and adequate diets.

DISCUSSION

Risks of obesity for chronic diseases and its limitations and complications during the confinement of pandemics.

Musculoskeletal and heart diseases have a strong correlation with an individual´s lifestyle. Sedentary behavior is a relevant predictor of chronic degenerative diseases once there is a negative correlation between the number of calories consumed plus total time spent with physical exercises and the incidence of cardiovascular diseases[18,19]. Consequently, sedentarism must be understood as a multifactor phenomenon, simultaneously embracing cultural, social and biological aspects that promote obesity.

Previous scientific studies have confirmed the changes developed by obesity, as well as the chronic metabolic syndromes and multifactor coming from an uneven burning of calories and feeding, which intensifies the growth of adipose cells in the organism[20]. Authors have presented the statistics between viral strains that are more virulent originated from obesity and its prolonged dissemination, increasing death rates during a pandemic of influenza[21]. In 2005, another study presented the possibility of an association between adenovirus (Adv36) and obesity plus subsequent breathing infections that contribute to the increase of adiposity in humans as well as other species[22].

Another complex matter is the complexities that exist in interactions related to the etymology of metabolic syndromes (MS), once it embraces factors related to the environment, genetics, diet and disorders of the human metabolism itself[23]. In adults, the diagnosis is already established and it relies on scientific fundamentals with metabolic abnormalities, including dyslipidemia, hyperglycemia, hypertension and cardiovascular changes[24]. In the last two decades, congenital cardiovascular diseases have been observed among the adult population, and those with chronic cyanosis are at high risk of thrombotic events, promoting a negative prognostic when infected by COVID-19, once it presents a different abnormality in coagulation – severe to unusual[14]. A retrospective cross-sectional study pointed out a longer time of prothrombin, partially activated thromboplastin, abnormal results of coagulation and a large increase of dimer D and fibrin degradation product in COVID-19 inpatients[25]

According to the World Health Organization, people over 60´s and those who show underlying medical conditions, such as chronic respiratory disorders, cardiovascular disease, diabetes and cancer (over 40 years old) are patients at risk of contamination by COVID-19[26]. Reduced immune function leaves the human body defenseless and allows exacerbation of pathological immune responses and infections [27]. Obesity is a pathology that presents greater associations with a chronic condition that predisposes to atheroma plaque and greater instability to cardiovascular diseases[28].

One of the predictors for cardiac impairment is the low level of physical activity, once the routine of physical exercises reduces the accumulation of visceral fat, and the strategy of regular physical activities, after the COVID-19 quarantine, tends to generate a better prognosis, both for heart disease patients as well as greater encouragement for a better lifestyle [28,29,30].

The quarantine, the limitation of social interaction and the low level of outdoor activities had an enormous impact on emotional exhaustion and motivation, as well as the difficulty of adapting to new circumstances and lifestyle[27]. In Brazil, the routine of physical exercises interfered with motivation, frequency and periodization of exercises. In a recent study, with 1,845 individuals, 80% were in SD.

Researchers investigated the practice of physical exercise before and during the pandemic, when the characteristics related to frequency, duration and motivation were influenced by confinement[31]. Therefore, these results were favorable to future scientific research in order to reorganize programs and strategies to be taken at home and avoid possible negative consequences from sedentary behavior.

The preventive guidelines related to confinement routine such as schools, universities and home lockdown may have established a contradictory idea regarding prevention related to COVID-19[32]. When attempting to prevent its spread, it enabled the emergence of situations such as stress, anxiety, boredom and even a predisposition to alcohol consumption, plus a variety of physiological disorders[33,34], where the variables associated with the sedentarism due to pandemic, led to an increase of food consumption. When people start to eat more food, there is a straight correlation with obesity and with circumstances of greater vulnerability to COVID-19[32,33,35].

There is a strong impact on the relationship between obesity and lung disorders[36]. A recent study reports the different methods to assess diaphragmatic mobilization and the subsequent difficulties in establishing adequate parameters on the excursion of the diaphragm muscle in obese individuals[37]. As a result, individuals with BMI above thirty (>30) must take into account the difficulties of rehabilitation and the immunological factors that present themselves in a devastating way, as well as the high rates of comorbidities and mortality[36].

In light of the aforementioned considerations, obesity can be a significant cause of mortality in patients with COVID-19. This statement presents consistency factors due to the reduction of lung functions, the limited diaphragmatic dynamics and the metabolic and immunological risks that favor complications and compromise risks[12,21]. Researchers identified results for COVID-19 in a sample of 489,269 individuals, with a percentage of 33% of people with normal weight, 43% overweight and 24% obese[38]. Outcomes showed risks for increased COVID-19 in all categories above adequate weight (≥ 25.0 kg/m^2): for overweight, 25.0–29.9 kg/m^2, hazard ratio 1.40 (95% CI 1.14–1.70; P = 0.002); obesity 30.0 and 34.9 kg/m^2, 1.73 (95% CI 1.36–2.20; P = 0.001); grade II obesity, 35.0–39.9 kg/m^2, 2.82 (95% CI 2.08–3.83; P = 0.001); grade III obesity, when ≥40.0 kg/m^2, 3.30 (95% CI 2.17-5.03; P = 0.001)[38]. A study carried out in Italy identified patients hospitalized with COVID-19, where a percentage of 65.2%: 33.7% of patients were overweight and 31.5% were obese[39].

In China, patients with BMI 30−35 kg/m^2 and ≥35 kg/m^2, mechanical ventilation was required three times more than in norm weight individuals[40]. In the United States, research with 103 patients aimed to investigate the associations between obesity and other chronic diseases with severe outcomes, including admission to the ICU and invasive mechanical ventilation (IMV). The study pointed out that 39% (41/103) of patients admitted to the ICU, 70.7% (29/41), required IMV. Severe obesity (grade II and III) was related to greater ICU admission and the prevalence in the unit, for patients categorized as obese (BMI 30.0-34.9 kg/m^2), was 47.5% (49/103)[12]. Patients categorized as obese and severely obese had an odds ratio (OR) for ICU admission of 5.39 (95% CI: 1.13-25.64 and tendency for IMV, patients with obesity (BMI = 30 -34.9 kg/m2; a OR: 6.85, 95% CI: 1.05-44.82), or severe obesity (BMI ≥ 35 kg/m^2; a OR: 9.99, 95% CI: 1.39-71,69)[12].

Therefore, it is worth mentioning that the relationship between COVID-19 and obesity was not clear at the beginning of the pandemic, and the reports and/or data corresponding to weight and height to verify the BMI of the 72,314 cases of patients in China were not informed by the 'Chinese Center for Disease Control and Prevention'[41]. Presently, the intention is to avoid a new pandemic from COVID-19, since the prognosis of obesity has been presented by scientific literature, once the pandemic of obese individuals is established in different urban areas of low, middle- and high-income countries, reaching women and men of all age groups[11,28,29].

Clinical implications and physical conditioning strategies used in diabetic patients during COVID-19 social confinement.

Diabetes is a multisystemic disease and scientific findings have been pointing out that this is one of the most common diseases. Its prevalence is not well understood, since Spain marked 18.75% of diabetics among patients with COVID-19, while in China, the prevalence pointed to 6.3% of people with diabetes infected by the virus[42]. A meta-analysis selected nine studies included 6,577 patients, and of

these, 3,933 (59.8%) were male, with 1,180 (30.3%) diabetics with COVID-19[43]. In another study carried out in Spain, with 121,263 individuals, the percentage of diabetics with COVID-19 was 9.8%[44]. In the US, 10% of diabetics with coronavirus in a sample of 7,162, and in the UK, a prospective cohort of 16,749 individuals with COVID-19 indicated 3,182 (19%) of people with diabetes. Most studies have shown that when the individual is diagnosed with diabetes and COVID-19, the severity of the virus is critical, and the case has to be treated with emergency[44,45,46].

Research has suggested a correlation between diabetes and COVID-19 through increased ACE expression[47]. ACE-2 is linked to the aminopeptidase membrane, which, in turn, degrades the peptide angiotensin - 2 (Ang II) into angiotensin 1-7, reducing the effects of Ang II in intercurrences, such as fibrosis, sodium retention and constriction of the blood vessels[48]. Diabetic patients with a cardiovascular impairment who administer ACE inhibitors and ARBs increase their cardiovascular circulation[49]. The binding of ACE-2 to proteins on beta coronavirus surfaces predisposes the severe acute respiratory syndrome (SARS) that causes COVID-19[48]. Patients treated with ACE inhibitors and ARBs may present a higher risk[49,50].

ACE-2 receptors are found in several organs, including endothelial cells of arteries and veins, cortical endothelial cells, nasal and buccal mucosa[51,52]. There are two factors that are determinants to define the pathophysiology of COVID-19 based on the evolution of the knowledge about how the infectious process of SARS-CoV-2 occurs: the access of the virus through ACE-2, at the ratio of ACE/ACE-2, as a pulmonary pathophysiological cause and the cytokine storm from acute respiratory distress syndrome (ARDS)[53]. Another study suggests an immunomodulatory approach to the overproduction of cytokines, offering a proposal for COVID-19 infections[10]. Therefore, it is important for specialized professionals to investigate the relationship between COVID-19 and the pre-diabetic individual, once there must be a measurement of the ways in which the disease can be acquired for a better understanding of how the beta cell is affected, about the characteristics that lead to the contamination of COVID-19 through ACE-2 and even the functioning of cytokines as a chemical messenger[54].

As for precautions, in addition to SD and the use of masks, to avoid COVID-19 in diabetic patients, the development of an appropriate glycemic control should be advocated, since there is no chemical prophylaxis indicated for diabetic patients with COVID-19[55]. Among other prophylactic measures, a balanced and healthy diet is recommended, with proteins, vegetables, fruits and, it is worth noting that vitamin D deficiency has shown relationships with mortality in COVID-19[55].

The variables must be considered, as well as the different categories of hyperglycemic patients with parameters to be analyzed and monitored[52]. However, mortality from COVID-19 increased in 2020, regardless of whether or not the individual had a diagnosis of diabetes[36].

Diabetes control seems to be the main factor for the patient to mitigate the severity of COVID-19, as a recent study indicated a reduced risk for patients who maintained balanced blood glucose levels for COVID-19 (RR = 0.14; 95% CI, 0.03-0.60; p = 0.008)[46]. Therefore, even though scientific findings do not present fully clarified arguments about the increased risk of contamination by SARS-CoV-2[44,53], the balance of glycemic levels pointed to a favorable and promising impact on better outcomes in diabetic patients infected with the new coronavirus[46]. One study also pointed out the relationships between COVID-19 and the possibility of precipitating diabetic ketoacidosis in a significant number of patients[56].

In addition, the process of adaptation to the pandemic of the new coronavirus predisposes a sedentary lifestyle. Lower levels of exercise and mental stress generated complications of hyperglycemia[57,58]. The SD presented other challenges to be overcome, such as access to health and the complexity of supplying insulin and medication[59]. Similar is the mental stress and weight gain acquired in confinement, which tends to facilitate the development of diabetes[29,30,56,58]. In contrast, studies carried out in Italy, the United Kingdom and Spain indicated reduced glycemic control even with the limitations of the DS, probably due to the time well spent on self-care[60,61,62].

The impact of chronic morbidity rates, the social guidelines of health and possible pathological complications are factors that, added to SD, can represent a disadvantage[63]. The current pandemic is a burden for obese and diabetic patients, who had to face the difficulties of a new adaptation. Therefore, a new behavior profile will be necessary and seems to require much more than establishing

social restrictions, but understanding the cultural reflexes of populations and defining new strategies to establish themselves in the current social condition and new habits.

CONCLUSION

The need for human connection has turned out to be a crucial factor in our physical and mental health. The study suggests professionals who understand the immunomodulatory approach and enzyme inhibitors, not only for primary care for obese and diabetic patients, but also for specialized teams to monitor individuals with a predisposition to obesity and diabetes during SD. In addition, during the SD prevails difficulty in maintaining glycemic and dyslipidemic control and a pandemic adaptation, whose irregularities converge to a possible syndemic scenario and greater transmissibility through clinical and socioeconomic factors, such as anxiety, stress and the idea of economic bankruptcy.

REFERENCES

1. Zhu N, Zhang D, Wang W,Xingwang LI MD, BoYang MS et al. A novel coronavirus from patients with pneumonia in China. N Engl J Med. 2020; 387(9):727-733. https://doi.org/10.1056/NEJMoa2001017. https://www.nejm.org/doi/full/10.1056/nejmoa2001017
2. Johns Hopkins University. Coronavirus COVID-19 Global Cases by Johns Hopkins CSSE [Internet]. Johns Hopkins University; 2020. https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6
3. Read JM, Bridgen JRE, Cummings DAT, Ho A, Jewell CP. Novel coronavirus 2019-nCoV: early estimation of epidemiological parameters and epidemic predictions. medRxiv; 2020. https://www.medrxiv.org/CONTENT/10.1101/2020.01.23.20018549V2
4. World Health Organization. Pneumonia of unknown cause — China. January 5; 2020. https://www.who.int/csr/don/05-january-2020-pneumonia-of-unkown-cause-china/en/
5. Rothe C, Schunk M, Sothmann P, Bretzel G., Froeschl G, Wallraich C et al. Transmission of 2019-NCOV infection from an asymptomatic contact in Germany. N Engl J Med. 2020; 382(10):970-971. https://doi.org/10.1056/NEJMc2001468. https://www.nejm.org/doi/full/10.1056/NEJMc2001468
6. Callaway E, Cyranoski D. China coronavirus: six questions scientists are asking. Nature. 2020; 577(605-7.). https://www.nature.com/articles/d41586-020-00166-6
7. Das S, Anu K R, Birangal SR, Nikam AN, Pandey A, Mutalik S, et al. Role of comorbidities like diabetes on severe acute respiratory syndrome coronavirus-2: A review. Life Sci. 2020; 258:118202. https://doi.org/10.1016/j.lfs.2020.118202. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7397991/
8. Cavenett. detection of Wuhan coronavirus 2019 by real-time RT-PCR. Geneva: World Health Organization, January 13; 2020;5. https://doi.org/10.1017/CBO9781107415324.004
9. Glende J, Schwegmann-Wessels C, Al-Falah M, Pfefferle S, Qu X, Deng H, et al. Importance of cholesterol-rich membrane microdomains in the interaction of the S protein of SARS-coronavirus with the cellular receptor angiotensin-converting enzyme 2. Virology. 2008; 381(2):215-221. https://doi.org/10.1016/j.virol.2008.08.026. https://pubmed.ncbi.nlm.nih.gov/18814896/
10. Ciavarella C, Motta I, Valente S, Pasquinelli G. Pharmacological (or synthetic) and nutritional agonists of PPAR-γ as candidates for cytokine storm modulation in COVID-19 disease. Molecules. 2020; 25(9):1-15. https://doi.org/10.3390/molecules25092076. https://pubmed.ncbi.nlm.nih.gov/32365556/
11. Barrasa H, Rello J, Tejada S, Martín A, Balziskueta G, Vinuesa C et al. SARS-CoV-2 in Spanish Intensive Care Units: Early experience with 15-day survival in Vitoria. Anaesth Crit Care Pain Med. 2020; 39(5):553-561. https://doi.org/10.1016/j.accpm.2020.04.001. http://pubmed.ncbi.nlm.nih.gov/32278670/
12. Kalligeros M, Shehadeh F, Mylona EK, et al. Association of Obesity with Disease Severity Among Patients with Coronavirus Disease 2019. Obesity. 2019; 28(7):1200-1204. https://doi.org/10.1002/oby.22859. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7267224/
13. Wiese OJ, Allwood BW, Zemlin AE. COVID-19 and the renin-angiotensin system (RAS): A spark that sets the forest alight? Med Hypotheses. 2020; 144(August):110231. https://doi.org/10.1016/j.mehy.2020.110231. https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/en/covidwho-741425
14. Gallego P, Ruperti-repilado FJ, Schwerzmann M. Adults with congenital heart disease during the coronavirus disease 2019 (COVID-19) pandemic: are they at risk? Revista. 2020; 73(10):795-798. https://doi.org/10.1016/j.rec.2020.06.016. https://www.revespcardiol.org/en-adults-with-congenital-heart-disease-articulo-S1885585720302814
15. Page MJ, Moher D, Bossuyt PM, et al. PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. BMJ. 2021;372 (160):1-35. https://doi.org/10.1136/bmj.n160. https://pubmed.ncbi.nlm.nih.gov/33781993/
16. Santos CMCS, Pimenta CAM NM. A estratégia PICO para a construção da pergunta de pesquisa e busca de evidências. Latino-Am. 2007; 15(3):508-511. https://www.scielo.br/scielo.php?pid=s0104-11692007000300023&script=sci_abstract&tlng=pt

17. Downs SH, Black N. The feasibility of creating a checklist for theassessment of the methodological quality both of randomisedand non-randomised studies of health care interventions. J Epi-demiol Commun Heal. 1998; 52377-84. https://scholar.google.com.br/scholar?hl=ptBR&as_sdt=0%2C5&as_vis=1&q=The+feasibility+of+creating+a+checklist+for+theassessment+of+the+methodological+quality+both+of+randomisedand+nonrandomised+studies+of+health+care+interventions.&btnG

18. Pecanha T, Goessler KF, Roschel H, Gualano B. Social isolation during the COVID-19 pandemic can increase physical inactivity and the global burden of cardiovascular disease. Am J Physiol Circ Physiol. 2020;318(6):H1441-H1446. https://doi.org/10.1152/ajpheart.00268.2020. https://pubmed.ncbi.nlm.nih.gov/32412779/

19. Ferreira MS, Castiel LD, Cardoso MHC de A. A patologização do sedentarismo. Saude e Soc. 2012;21(4):836847. https://doi.org/10.1590/S0104-12902012000400004. https://www.scielo.br/j/sausoc/a/6Q55wRpd9mzzwXN9TqQFyXt/abstract/?lang=pt

20. Oliveros E, Somers VK, Sochor O, Goel K, Lopez-Jimenez F. The concept of normal weight obesity. Prog Cardiovasc Dis. 2014; 56(4):426-433. https://doi.org/10.1016/j.pcad.2013.10.003. https://pubmed.ncbi.nlm.nih.gov/24438734/

21. Luzi L, Radaelle MG. Influenza and obesity: its odd relationship and the lessonsfor COVID-19 pandemic. Acta Diabetol. 2020; 57(6):759-764. https://doi.org/10.1007/s00592-020-01522-8. https://pubmed.ncbi.nlm.nih.gov/32249357/

22. Atkinson RL, Dhurandhar N, Davi A, Bowen RL, Israel BA, Albu JB et al. Human adenovirus-36 is associated with increased body weight and paradoxical reduction of serum lipids. Int J Obes. 2005; 29(9):281–286. https://www.nature.com/articles/0802830

23. Esposito K, Marfella R, Ciotola M, Palo C D, Giugliano F, Giugliano G et al. Effect of a Mediterranean-style diet on endothelial dysfunction and markers of vascular inflammation in the metabolic syndrome: a randomized trial. JAMA. 2004; 292:1440-1446. https://pubmed.ncbi.nlm.nih.gov/15383514/

24. Alberti KG, Zimmet P, Shaw J. Metabolic syndrome a new world-wide definition.A consensus statement from the lnternational Diabetes Federation. Diabet Med. 2006; 23(5):469-480. https://www.researchgate.net/publication/7098699_Metabolic_syndrome-a_new_worldwide_definition_A_Consensus_Statement_from_the_International_Diabetes_Federation

25. Tang N, Li D, Wang X SZ. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost. 2020; 18(4):844-847. https://onlinelibrary.wiley.com/doi/full/10.1111/jth.14768

26. WHO. Coronavirus. [internet]. https://www.who.int/health-topics/coronavirus#tab=tab_1. Published 2020. Acesso em 15 de maio 15, 2020.

27. Dantzer R., Cohen S, Russo SJ. Dinan TG. Resilience and immunity. Brain BehavImmun. 2018; 74:28 – 42. https://www.sciencedirect.com/science/article/pii/S0889159118304409

28. Nasi, M., Patrizi, G., Pizzi, C., Landolfo, M., Boriani, G., Dei Cas, A. et al. The role of physical activity in individuals with cardiovascular risk factors: an opinion paper from Italian Society of Cardiology-Emilia Romagna-Marche and SIC-Sport. J Cardiovasc. 2019; 20(10),:631–639. https://doi.org/10.1145/1390630.1390641. https://pubmed.ncbi.nlm.nih.gov/31436678/

29. Mattioli, A.V., Ballerini Puviani, M., Nasi, M., Farinetti, A. COVID-19 pandemic: the effects of quarantine on cardiovascular risk. Eur J Clin Nutr. 2020; 5:1-4. https://www.nature.com/articles/s41430-020-0646-z

30. Rahmati-Ahmadabad S, Hosseini F. Exercise against SARS-CoV-2 (COVID-19): Does workout intensity matter? (A mini review of some indirect evidence related to obesity). Obes Med. 2020; 19. doi:10.1016/j.obmed.2020.100245. https://pubmed.ncbi.nlm.nih.gov/32342019/

31. Sonza A, de Sá-Caputo D da C, Bachur JA, Araújo MGR, Trippo KV, Gama DRN et al. Brazil before and during covid-19 pandemic: Impact on the practice and habits of physical exercise. Acta Biomed. 2021;92(1):1-10. doi:10.23750/abm.v92i1.10803. https://pubmed.ncbi.nlm.nih.gov/33682804/

32. Bezerra ACV, Silva CEM, Soares FRG, Silva JAM. Factors associated with people's behavior in social isolation during the covid-19 pandemic. Cienc e Saude Coletiva. 2020; 25:2411-2421. https://doi.org/10.1590/1413-81232020256.1.10792020. https://www.researchgate.net/publication/341950183_Factors_associated_with_people%27s_behavior_in_social_isolation_during_the_COVID-19_pandemic

33. Traversy G, Chaput JP. Alcohol consumption and obesity: an update. Curr Obes Rep. 2015; 4(1):1-41. https://doi.org/10.1007/s13679-014-0129-4. https://pubmed.ncbi.nlm.nih.gov/25741455/

34. Hagerty SL, Williams LM. The impact of COVID-19 on mental health: The interactive roles of brain biotypes and human connection. Brain, Behav Immun - Heal. 2020; 5:100078. https://doi.org/10.1016/j.bbih.2020.100078. https://www.sciencedirect.com/science/article/pii/S2666354620300430

35. Atlantis E, Goldney RD, Wittert GA. Obesity and depression or anxiety. BMJ (Clinical Res ed). 2009; 339:b3868. https://www.bmj.com/content/339/bmj.b3868

36. Guzik TJ, Mohiddin SA, Dimarco A, Patel V, Savvatis K, Marelli-Berg FM et al. COVID-19 and the cardiovascular system: implications for risk assessment,diagnosis, and treatment options. Cardiovasc Res. 2020;(April), cvaa106. https://academic.oup.com/cardiovascres/article/116/10/1666/5826160

37. Nascimento IB, Fleig R. Mobility impact and methods of diaphragm monitoring in patients with chronic obstructive pulmonary disease: A systematic review. Clinics. 2020; 75:1-11. https://doi.org/10.6061/clinics/2020/e1428.

https://www.scielo.br/scielo.php?pid=S18075932202 0000100401&script=sci_abstract&tlng=en

38. Zhu Z, Hasegawa K, Ma B, Fujiogi M, Camargo CA, Liang L. Association of obesity and its genetic predisposition with the risk of severe COVID-19: Analysis of population-based cohort data. Metabolism. 2020; 112:154345. https://doi.org/10.1016/j.metabol.2020.154345

39. Busetto L, Bettini S, Fabris R, Serra R, Pra CD, Maffei P, et al. Obesity and COVID-19: an Italian snapshot. Obesity (Silver Spring). [Internet]. 2020 [acesso em 03 fev 2021]; 28(9): 1600-5. Disponível em: https://doi.org/10.1002/oby.22918.

40. Simonnet A, Chetboun M, Poissy J, Raverdy V, Noulette J, Duhamel A et al. High prevalence of obesity in Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. Obes SilverSpring. 2020; 8(7):1195-1199.

41. Wu Z. MJM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA. 2020; 323(5):1239–1242. https://doi.org/10.1001/jama.2020.2648. https://pubmed.ncbi.nlm.nih.gov/32091533/

42. Guo W, Li M, Dong Y, Zhou H, Zhang Z, Tian C et al. Diabetes is a risk factor for the progression and prognosis of COVID-19. Diabetes Metab Res Rev. 2020; e3319. https://doi.org/10.1002/dmrr.3319. https://pubmed.ncbi.nlm.nih.gov/32233013/

43. Sales-Peres SHC, de Azevedo-Silva LJ, Bonato RCS, Sales-Peres M C, Pinto ACS, Santiago JJF. Coronavirus (SARS-CoV-2) and the risk of obesity for critically illness and ICU admitted: Meta-analysis of the epidemiological evidence. Obes Res Clin Pract. 2020;14(5): 389–397. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7396969/

44. Singh AK, Gupta R, Ghosh A MA. Diabetes in COVID-19: prevalence, pathophysiology, prognosis and practical considerations. Diabetes Metab Syndr. 2020;14(4):303e10. https://www.sciencedirect.com/science/article/abs/pii/S1871402120300631

45. Preito-Alhambra D, Ballo E, Coma E, Mora N, Aragon M, PratsUribe A et al. Hospitalization and 30-day fatality in 121,263 COVID-19 outpatient cases. BMJ. 2020. https://doi.org/10.1101/2020.05.04.20090050. https://www.medrxiv.org/content/10.1101/2020.05.04.20090050v1

46. Zhu L, She ZG, Cheng X, Qin JJ, Zhang XJ, Cai J et al. Association of blood glucose control and outcomes in patients with COVID-19 and pre-existing type 2 diabetes. Cell Metab.2020; 31(6):1068e77. e3 https://www.sciencedirect.com/science/article/pii/S1550413120302382

47. Ma R, Holt R. COVID-19 and diabetes. Diabet Med. 2020; https://onlinelibrary.wiley.com/doi/full/10.1111/dme.14300

48. Vickers C, Hales P, Kaushik V, Dick L, Gavin J, Godbout K et al. Hydrolysis of biological peptides by human angiotensin-converting enzyme-related carboxypeptidase. J Biol Chem. 2002; 277:14838 – 14843. https://doi.org/10.1074/jbc.M200581200. https://pubmed.ncbi.nlm.nih.gov/11815627/

49. Verdecchia P, Angeli F,Mazzotta G, Reboldi G. Angiotensin converting enzyme inhibitors and angiotensin receptor blockers in the treatment of hypertension: should they be used together. Curr Vasc Pharmacol. 2010; 8:742 – 6. https://europepmc.org/article/med/20626343

50. Xu X , Chen P, Wang J, Feng J, Zhou H, Li Xuan et al. Evolution of the novel coronavirus from the ongoing Wuhan outbreak and modeling of its spike protein for risk of human transmission. Life Sci. 2020; 63(3):457-460. https://doi.org/10.1007/s11427-020-1637-5. https://link.springer.com/article/10.1007/s11427-020-1637-5

51. Hamming I, Timens W, Bulthuis MLC, Lely AT, Navis GJ van GH. Tissue distribution of ACE2 protein, the functional receptor for SARS coronavirus: a first step in understanding SARS pathogenesis. J Pathol. 2004; 203(2): 631–637. http://eprints.uanl.mx/5481/1/1020149995

52. Chen M, Shen W, Rowan NR, Kulaga H, Hillel A, Ramanathan Jr et al. Elevated ACE2 expression in the olfactory neuroepithelium: implications for anosmia and upper respiratory SARS-CoV-2 entry and replication. bioRxiv. 2020; 56: 2001948. https://doi.org/10.1101/2020.05.08.084996. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7263519/

53. Gupta R, Misra A. Contentious issues and evolving concepts in the clinical presentation and management of patients with COVID-19 infection with reference to use of therapeutic and other drugs used in Co-morbid diseases (Hypertension, diabetes etc). Diabetes Metab Syndr. 2020;14(3):251-254. https://pubmed.ncbi.nlm.nih.gov/32247213/

54. Goyal A, Gupta S GY. Proposed guidelines for screening o hyperglycemia in patients hospitalized with COVID-19 in low resource settings. Diabetes Metab Syndr. 2020;14(5):753-756. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7258830/

55. Jayawardena R, Sooriyaarachchi P, Chourdakis M, Jeewandara C RP. Ranasinghe P. Enhancing immunity in viral infections, with special emphasis on COVID-19:a revew. Diabetes Metab Syndr. 2020;14(4):367e82. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7161532/

56. Reddy PK, Kuchay MS, Mehta Y MS. Diabetic ketoacidosis precipitated by COVID-19: a report of two cases and review of literature. Diabetes Metab. 2020;14(5):1459e62. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7395228/

57. Ghosh A, Arora B, Gupta R, Anoop S MA. Effects of nationwide lockdown during COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in north India. Diabetes Metab Syndr. 2020;14(5):917e20. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7265851/

58. Khare J, Sushil J. Observational study on effect of lock down due to COVID 19 on glycemic control in patients with diabetes: experience from Central India. Diabetes Metab Syndr.2020 Nov-Dec;14(6)1571e. https://www.sciencedirect.com/science/article/pii/S1871402120303155

59. Khader MA, Jabeen T NR. A cross sectional study reveals severe disruption in glycemic control in people with diabetes during and after lockdown in India. Diabetes Metab Syndr. 2020; 14(6):1579-1584. https://doi.org/10.1016/j.dsx.2020.08.011. https://pubmed.ncbi.nlm.nih.gov/32858476/

60. Fernández E, Cortazar A, Bellido V. Impact of COVID-19 lockdown on glycemic control in patients with type 1 diabetes. Diabetes Res Clin Pr. 2020;166:108348. https://www.diabetesresearchclinicalpractice.com/article/S0168-8227(20)30600-8/fulltext

61. Tornese G, Ceconi V, Monasta L, Carletti C, Faleschini E BE. Glycemic control in type 1 diabetes mellitus during COVID-19 quarantine and the role of in-home physical activity. Diabetes Technol Ther. 2020;22(6):462e7. https://doi.org/10.1089/dia.2020.0169. https://www.liebertpub.com/doi/10.1089/dia.2020.0169

62. Dover AR, Ritchie SA, McKnight JA, Strachan MWJ, Zammitt NN, Wake D et al. Assessment of the effect of the COVID-19 lockdown on glycaemic control in people with type 1 diabetes using. Diabet Med. 2020; 2(2):10.1111. https://doi.org/10.1111/dme.14374. https://onlinelibrary.wiley.com/doi/10.1111/dme.14374

63. Bambra C, Riordan R, Ford J, Matthews F. The COVID-19 pandemic and healthinequalities. J Epidemiol Community Health. 2020; 74(11): 964-968. https://doi.org/10.1136/jech-2020-214401. https://jech.bmj.com/content/74/11/964

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IBN - Substantial contribution to the study design or data interpretation; Participation in the writing of the preliminary version; Participation in the review and approval of the final version; and Compliance with being responsible for the accuracy or completeness of any part of the study.

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