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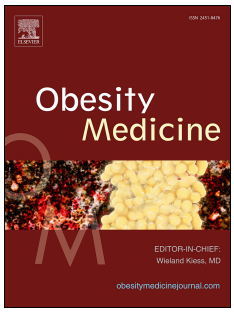
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Obesity risk during collective quarantine for the COVID-19 epidemic.

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Running title: quarantine and obesity

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Abstract

In March 2020, when COVID-19 epidemics involved several countries, the WHO defined the infection as a pandemic. Government adopted measures to prevent the diffusion of infection; i.e. quarantine and isolation. One of the consequences of quarantine-induced stress is a change in lifestyle and eating habits leading to obesity. The present commentary briefly analyzes the effects of quarantine on obesity.

Key-words: quarantine; COVID-19; obesity; stress; lifestyle; gender

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In March 2020, when COVID-19 epidemics involved several countries, the WHO defined the infection as a pandemic. (Li 2020) Government adopted measures to prevent the diffusion of infection; i.e. quarantine and isolation. (WHO, 2020a)

"Quarantine" refers to the separation of persons (or communities) who have been exposed to an infectious disease. "Isolation" refers to the separation of persons who are infected. (Mattioli and Ballerini Puviani, 2020a; WHO, 2020a)

The present commentary briefly analyzes the effects of quarantine on obesity.

Little is known about the effects of quarantine on obesity, although everyone agrees that this corresponds to a period of severe stress and stress can be linked to an increased risk of obesity. (Mattioli and Ballerini Puviani, 2020a; Abbas et al, 2020) One of the consequences of quarantine stress is a change in lifestyle and eating habits. (Mattioli et al, 2020b) Laitinen and coworkers (2002) reported that stress-related eating (defined as trying to make oneself feel better by eating or drinking in a stressful situation) was significantly associated with obesity, mainly in women. There may be a gender-specific response to stress in which women are more likely to use food to deal with stress, whereas men are more likely to use other oral behaviors such as alcohol consumption or smoking as strategies to cope with stress. (Conway et al, 1981)

Modern women have multiple roles that are both time- and energy-consuming. These lead to an increase in psychosocial stressors (e.g. anxiety, depression and marital stress), which are known to increase the overall cardiovascular risk. Furthermore, women rarely follow a healthy lifestyle based an adequate diet, regular physical activity and weight management because are both costly and time consuming. Adherence to healthy lifestyle is strongly influenced by socio-economic level, social role, and education (Sciomer et al, 2019; Mattioli et al, 2017)

During quarantine, due to the anxiety caused by the hypothesis of a future food shortage, people buy large quantities of packaged and long-lasting food rather than fresh food.

(Brooks et al, 2020) Foods with a long shelf life have a high content of salt, sugar or trans fats which increases the risk of obesity. In addition some people developed the desire to consume a specific kind of food, a behavior defined as "food craving". Food craving is a "*multidimensional experience as it includes cognitive (e.g., thinking about food), emotional (e.g., desire to eat or changes in mood), behavioral (e.g., seeking and consuming food), and physiological (e.g., salivation) aspect"* (Rodríguez-Martín and Meule, 2015) The desire for carbohydrates increases the production of serotonin which has a positive effect on mood, and this effect is proportional to the glycemic index of food. (Rodríguez-Martín and Meule, 2015; Mattioli et al 2020c) During the quarantine, patients suffering from obesity experienced immense stress that made them more vulnerable to a sedentary lifestyle and unhealthy nutrition, thus predisposing them to further weight gain. Furthermore, the next economic downturn will also lead to greater consumption of unhealthy foods as it is cheaper. This will lead to a further increase in the prevalence of obesity, especially in the weaker sections of society. (Mattioli et al, 2020b; Mediouni, 2020; Torres and Nowson, 2007) Growing evidence has reported an important role of obesity in Covid-19's prognosis. (Torres and Nowson, 2007; Abbas et al, 2020)

What are the consequences of quarantine-related stress on the immune system and on health? Dantzer et al. (2018) summarized the relationship between resilience and immunity, where resilience is the Janus face of vulnerability factors in response to stressing conditions. While, short-term stress enhances immune protection, the humoral and cellular immune responses are suppressed by long-term stress.

The reduction of the immune function is associated with a reduce protection against infection and with a exacerbation of pathological immune responses. (Dantzer et al, 2018) Thus, aged people or people with other chronic pathologies such as cancer, cardiovascular, neurodegenerative, or metabolic disease, are more susceptible to immune alterations induced by outbreak, with relevant clinical side effects. It is well known that obesity is

associated to a chronic, sterile, low-grade inflammation which contributes to the activation of atherosclerothic plaques, making patients affected by obesity more vulnerable to cardiovascular events. (Abbas et al, 2020; Nasi et al, 2019) (figure 1) Inflammatory markers were seen to increase by short-term as well as long-term stress. In both cases, an increase of cortisol and glucocorticoid hormones have been observed, however, acute stress is associated to a decrease of proinflammatory cytokines wheter chronic stress is associated to an increase of these biomarkers. (Cossarizza et al, 2020; Dantzer et al, 2018; Marsland et al, 2017)

The innate and adaptive immune response of the host against SARS-Cov-2 is crucial to control the infection. The uncontrolled inflammatory response causes tissue damages at local and systemic level, and it is widely accepted that the so-called “cytokine storm” is associated with the severity and the outcome of the COVID-19 . (Cossarizza et al 2020)

During quarantine, due to Governments limitation of outdoor exercise and social activities subjects reduced the physical activity. Regular physical activity reduces inflammation, and contribute to maintain normal weight and to reduce visceral fat accumulation. (Mattioli et al, 2020d, Nasi et al, 2019) Limited physical activity can be associated with several metabolic effects that would increase the cardiovascular risk. (Rahmati-Ahmadabad and Hosseini, 2020)

To prevent damages induced by physical inactivity, WHO (WHO 2020b) has published a guide for self-quarantine people without any symptoms or diagnosis of acute respiratory illness, containing practical advice on how to stay active and reduce sedentary behavior at home.

Staying active and maintaining a home-physical exercise routine will be important for mental and physical health. WHO suggest following on-line exercise classes, and using video- or app-guided aerobics training at home. (WHO 2020b)

The Internet and apps could also be helpful in weight management by monitoring diet and daily income.

Conclusions

We must be prepared for an increase in obesity following the pandemic, and this increase in obesity will be associated with an increase of the cardiovascular risk burden. It is mandatory to promote a healthy diet and physical activity at home. After the quarantine we must re-evaluate the metabolic and biometric parameters in obese subjects and we must also stratify the cardiovascular risk

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Declaration of competing interest.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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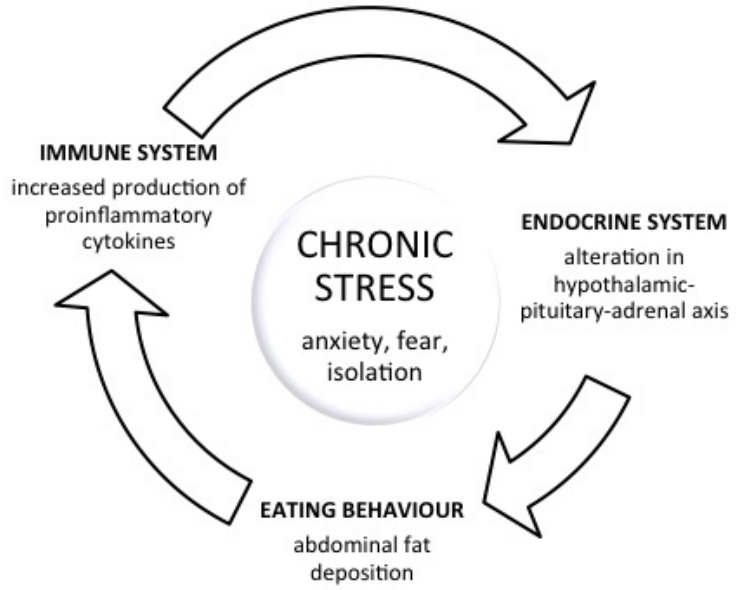
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Figure 1

Stress alter glucose metabolism, promote insulin resistance and influence multiple appetite-related hormones and hypothalamic neuropeptides

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IMMUNE SYSTEM
increased production of proinflammatory cytokines
CHRONIC STRESS
anxiety, fear, isolation
ENDOCRINE SYSTEM
alteration in hypothalamic-pituitary-adrenal axis
EATING BEHAVIOUR
abdominal fat deposition

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Highlights

- Quarantine and isolation are effective measures to reduce diffusion of infection and to prevent pandemic. However these conditions can induce depression, anxiety, anger, and stress.
- Quarantine forces people to stay at home with a subsequent reduction of outside exercise and physical activity
- Anxiety and stress are associated with unhealthy lifestyle involving both nutrition and physical activity leading to obesity

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