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Short Communication

COVID-19 and Lockdown: How Brain Structures Have Changed Due to Environmental Deprivation

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The brain of mammals, and therefore also of the human species, has evolved in close sync with the natural environment. Numerous studies in the literature have shown that the more an individual grows in an environment full of stimuli, the more the brain becomes plastic and resistant to any damage or cognitive decline.

Over the decades, scientific research has shown how the enriched environment has turned out to be one of the major protective factors for the physiological and cognitive decline of our brain, favoring the development of neuroplasticity [1].

With the recent Covid-19 pandemic, the habits of all of us have changed, especially during periods of lockdown. Fundamental factors for an enriched environment, such as sociability, physical activity, practicing hobbies, traveling, working in a group, have disappeared in this last year. This has had repercussions not only on a psychological level (with an increase in symptoms of a depressive nature, anxiety, post-traumatic stress disorder and sleep disorders; [2]) but also on a cognitive level, especially at the level of attention, concentration, executive functions and temporal disorientation [3].

Several studies in the literature have shown that some brain structures have changed due to environmental deprivation and the high level of stress perceived during this last year of the pandemic.

A 2020 study [4] compared pre- and post-lockdown brain scans of healthy subjects, showing an increase in brain volume in the amygdala, the dorsal area of the putamen, and the anterior ventral temporal cortex of the participants in the second scan. In particular, the modifications affected the amygdala, a key area in the integration of higher neurological processes such as emotions (especially fear) and in the learning and emotional memory systems [5].

The high degree of fear and stress, the forced isolation and the decrease of activities during the lockdown, would have led the participants to have a hyperactivity and a greater neural volume in these areas, with consequent difficulties on an emotional and cognitive level [4].

Functional alterations were also found at the prefrontal level [6]. The prefrontal cortex (PFC), an area of the brain responsible for our higher cognitive functions, plays a key role in analyzing the emotions that the amygdala associates with a stimulus.

The researchers hypothesized that the PFC, during this lockdown period, was affected by the hyperactivation of the amygdala which, by activating additional areas of our brain, inhibited it and made it not work optimally.

This could explain why many people during the lockdown were prey to emotion, fear and stress without being able to rationalize what happened and finding themselves in difficulty in carrying out complex cognitive operations.

Furthermore, a lower activation of PFC was also seen due to the lack of social interactions with other people, a sense of loneliness, reduced activities and interests [6].

The volume of the hippocampus and the level of activation of the substantia nigra and the ventral tegmental area (VTA) also underwent variations during the pandemic [7].

A Massachusetts Institute of Technology study explains that the isolation and loneliness you feel in these months share a neural basis with the food cravings we experience when we are hungry. There substantia nigra and VTA were all the more active the more desire for socialization and food was present in the participants, with an inverse relationship between the two factors [7]. Therefore, the more alone we are, the more we will be inclined to compensate for our emotional emptiness with food.

It was also observed that, precisely due to a poorly balanced diet associated with less physical activity and an increase in the sense of loneliness and stress related to lockdown, the hippocampus also underwent a decrease in volume [8] and brain-derived neurotrophic factor (BDNF), leading to difficulties in orientation, learning and memory [6].

Further studies will be needed to monitor further changes and whether those examined will remain stable over time or become invalid with the return to an environment rich in stimuli and social interaction.

The return to full mental and physical involvement with complex environments, in fact, could strengthen synaptic connectivity in terms of neurogenesis and optimization of pre-existing neuronal networks, making these cognitive difficulties purely transitory and not lasting over time.

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