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Letter to Director

Agricultural neuroscience as a novel concept of relevance for the medical sciences

La neurociencia agrícola como nuevo concepto relevante para las ciencias médicas

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Dear Director,

The reading of the recent Letter to the Editor by Salazar-Rodríguez and Mondéjar-Rodríguez,(1) published in the *Revista Médica Electrónica*, was particularly stimulating due to its treatment of neuroeducation as a pedagogical strategy in higher medical education. These authors emphasize the role of emotions, motivation, and critical thinking in the acquisition of knowledge, which opens an opportunity to reflect on how neuroscience can be applied in educational and clinical practice.(1) Having previously worked in the field of environmental neuroscience,(2) health sciences and the

perception of climate change among agricultural communities,[3] I wish to propose in this Letter to the Editor the concept of agricultural neuroscience as a novel interdisciplinary category of significance for training, research, and medical praxis, particularly in rural contexts.

Agricultural neuroscience may be defined as an emerging field that integrates neuroscientific knowledge with the challenges and particularities of the agricultural environment and is structured around three fundamental axes, namely: a) the mental health and well-being of individuals engaged in agricultural labor; b) neuroethology and the welfare of animal production; and c) the neurotoxicological impacts of agrochemical exposure in both humans and animals. Next, and based on the reviewed literature, key foundational concepts are shown, which relate to the central emerging field of agricultural neuroscience.

Agricultural neuroscience. Interdisciplinary field that studies the interactions between the nervous system and the agricultural environment, including human, animal, and environmental health.

Environmental neuroscience. Study of the effects of the natural environment and its alterations on the human brain, behaviour, and perception.

Neuroethology. Branch of neuroscience that investigates the neural mechanisms underlying animal behaviour in real ecological contexts.

One welfare. Integrative approach that links human, animal, and environmental welfare as interdependent dimensions of health and sustainability.

Occupational neurotoxicology. Subdiscipline that analyzes the impact of environmental toxins, such as pesticides, on the central and peripheral nervous system of workers.

Rural neuroeducation. Application of neuroscientific principles to teaching and learning in rural contexts, emphasizing socio-territorial relevance.

A foundational element of this proposal stems from environmental neuroscience.[2] This discipline elucidates perception, emotion, and neurocognitive states in response to environmental disturbances, *e.g.*, prolonged droughts, affecting urban and rural areas worldwide.[2] This perspective has been particularly valuable in analyzing the neuro-emotional repercussions experienced by farmers confronting climate change and the transformation of productive landscapes, manifesting in symptoms such as distress, affective dissociation, and psychological fatigue.[2,3]

In parallel, the welfare of farm animals is currently examined from cognitive and neurobehavioral standpoints. Larrondo et al.,[4] adopting the One Welfare approach (an extension of the concept of One Health), have demonstrated that phenomena such as the COVID-19 pandemic or prolonged drought can simultaneously impact the mental health of rural workers and the behaviour of livestock animals. The authors advocate for the joint consideration of human and animal health, including environmental interventions that aim to mitigate caregiver stress and enhance animal welfare.[4]

A further critical axis of agricultural neuroscience concerns occupational neurotoxicology. There is substantial evidence of adverse neurocognitive effects arising from chronic pesticide exposure in farming populations. Lucero and Muñoz-Quezada,[5] in their review of the neurological health of agricultural workers in Chile, documented impairments in memory, executive functions, and depressive symptomatology associated with organophosphate and carbamate pesticide exposure.[5] Similarly, Finhler et al.[6] in an international systematic review reported sustained attention deficits, executive dysfunction, bradykinesia, and reduced cognitive performance among agricultural workers, with potential long-term neurodegenerative consequences. These findings suggest that the medical sciences ought to incorporate appropriate theoretical and methodological tools to address such emerging concerns.[6]

From this perspective, agricultural neuroscience, as an emerging integrative field, provides a platform to understand the impact of the agricultural environment on the nervous systems of humans and animals, develop preventive and educational strategies in rural health, and design public health policies informed by neuroscientific evidence and local relevance.

In terms of biomedical and health science education, adopting the agricultural neuroscience approach may modernize the training of healthcare professionals working in rural areas. This approach fosters a more nuanced understanding of the socio-productive and ecological contexts related to problematics of health interest, a view that aligns with Salazar-Rodríguez and Mondéjar-Rodríguez's recommendation[1] in the sense that a neuroeducation-informed medical curriculum facilitates the development of integrated skills and critical thinking. Moreover, including environmental and agricultural neuroscience perspectives within medical curricula may better prepare practitioners to operate within complex rural realities, with social sensitivity and ecosystemic awareness.

Finally, Agricultural Neuroscience fosters articulation between disciplines that have hitherto mainly remained disconnected, such as environmental health, occupational health, clinical neuroscience, rural epidemiology, animal ethology, agricultural sciences, and climatology. In this regard, it represents a valuable opportunity to strengthen the preventive, psychosocial, and environmental components of contemporary medical science. I therefore advocate for its gradual integration into biomedical and health sciences education, as well as into interdisciplinary research and rural outreach initiatives. In conclusion, agricultural neuroscience should be regarded as an emergent framework of strategic value for rural public health, health professional training, and interdisciplinary scientific inquiry in agricultural environments. Its progressive inclusion in health science curricula and academic research may enhance the preventive, psychosocial, and ecosystemic approach of 21st-century medical practice.

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