Neurodevelopmental toxicity in the mouse neocortex following prenatal exposure to acetamiprid

Nao Kagawa [1], Tetsuji Nagao [1]

Affiliations expand

PMID: 30047162 DOI: 10.1002/jat.3692

Abstract

Acetamiprid (ACE) belongs to a widely used class of pesticides known as neonicotinoids. ACE binds selectively to insect nicotinic acetylcholine receptors and was previously considered relatively safe in mammalian species; however, recent studies have demonstrated ACE-mediated toxicity related to vertebrate nicotinic acetylcholine receptor activation. The potential for neurotoxicity following exposure to ACE in utero is unknown. Therefore, we evaluated the effects of repeated prenatal ACE exposure (5 mg/kg, oral doses administered to pregnant dams) on neurogenesis, neuronal distribution and microglial activation in the dorsal telencephalon on embryonic day (E)14 and in the neocortex on postnatal day 14. Immunohistochemical and morphological analyses on E14 revealed hypoplasia of the cortical plate and decreased neurogenesis in mice exposed to ACE from E6 to E13, whereas newborn ACE-exposed mice showed an abnormal neuronal distribution in the neocortex. Additionally, ACE-exposed mice showed increased numbers of Iba1-immunoreactive and amoeboid-type microglia as well as an increased M1/M2 microglial ratio. These findings suggest that prenatal ACE exposure induces neurodevelopmental toxicity and increases microglial activation in the developing brain.

Keywords: microglia; neocortex; neonicotinoids; neurogenesis; neuronal distribution.

Similar articles

The neonicotinoids acetamiprid and imidacloprid impair neurogenesis and alter the microglial profile in the hippocampal dentate gyrus of mouse neonates.

Nakayama A, Yoshida M, Kagawa N, Nagao T.

J Appl Toxicol. 2019 Jun;39(6):877-887. doi: 10.1002/jat.3776. Epub 2019 Jan 29.

PMID: 30693975

Bisphenol A exposure induces increased microglia and microglial related factors in the murine embryonic dorsal telencephalon and hypothalamus.

Takahashi M, Komada M, Miyazawa K, Goto S, Ikeda Y.

Toxicol Lett. 2018 Mar 1;284:113-119. doi: 10.1016/j.toxlet.2017.12.010. Epub 2017 Dec 14.

PMID: 29248573

Maternal administration of bisphenol A alters the microglial profile in the neocortex of mouse weanlings.

Kagawa N, Nagao T.

Congenit Anom (Kyoto). 2020 Sep;60(5):142-146. doi: 10.1111/cga.12370. Epub 2020 Apr 7.

PMID: 32223001

Human exposure to neonicotinoid insecticides and the evaluation of their potential toxicity: An overview.

Han W, Tian Y, Shen X.

Chemosphere. 2018 Feb;192:59-65. doi: 10.1016/j.chemosphere.2017.10.149. Epub 2017 Oct 27.

PMID: 29100122 Review.

A critical review of neonicotinoid insecticides for developmental neurotoxicity.

Sheets LP, Li AA, Minnema DJ, Collier RH, Creek MR, Peffer RC.

Crit Rev Toxicol. 2016 Feb;46(2):153-90. doi: 10.3109/10408444.2015.1090948. Epub 2015 Oct 29.

PMID: 26513508 **Free PMC article.** Review.

See all similar articles

Cited by

Statement on the toxicological properties and maximum residue levels of acetamiprid and its metabolites.

EFSA (European Food Safety Authority); Hernandez-Jerez A, Coja T, Paparella M, Price A, Henri J, Focks A, Louisse J, Terron A, Binaglia M, Guajardo IM, Mangas I, Guajardo IM, Ferreira L, Kardassi D, De Lentdecker C, Molnar T, Vianello G.

EFSA J. 2024 May 15;22(5):e8759. doi: 10.2903/j.efsa.2024.8759. eCollection 2024 May.

PMID: 38751503 **Free PMC article.**

Molecular Docking Analysis at the Human α7-nAChR and Proliferative and Evoked-Calcium Changes in SH-SY5Y Cells by Imidacloprid and Acetamiprid Insecticides.

Guzman-Vallejos MS, Ramirez-Cando LJ, Aguayo L, Ballaz SJ.

Neurotox Res. 2024 Feb 20;42(2):16. doi: 10.1007/s12640-024-00697-0.

PMID: 38376791

Noninvasive imaging of rat-derived microglia and its reactivity to inflammatory molecules via acoustic impedance microscopy.

Lee CLM, Yap PS, Umemura K, Shintani T, Kobayashi K, Hozumi N, Yoshida S.

J Med Ultrason (2001). 2024 Jan;51(1):29-37. doi: 10.1007/s10396-023-01379-8. Epub 2023 Nov 16.

PMID: 37971564 **Free PMC article.**

Neurocytotoxicity of imidacloprid- and acetamiprid-based comercial insecticides over the differentiation of SH-SY5Y neuroblastoma cells.

Ramirez-Cando LJ, Guzmán-Vallejos MS, Aguayo LG, Vera-Erazo FD, Ballaz SJ.

Heliyon. 2023 Apr 28;9(5):e15840. doi: 10.1016/j.heliyon.2023.e15840. eCollection 2023 May.

PMID: 37180892 **Free PMC article.**

Effects of insufficient serine on health and selenoprotein expression in rats and their offspring.

Liu Y, Wang J, Wang Q, Han F, Shi L, Han C, Huang Z, Xu L.

Front Nutr. 2022 Sep 14;9:1012362. doi: 10.3389/fnut.2022.1012362. eCollection 2022.

PMID: 36185664 **Free PMC article.**

See all "Cited by" articles

Publication types

Research Support, Non-U.S. Gov't

MeSH terms

Animals

Animals, Newborn

Cell Cycle / drug effects

Female

Insecticides / toxicity*

Male

Mice, Inbred ICR

Microglia / drug effects*

Microglia / pathology

Neocortex / drug effects*

Neocortex / embryology

Neocortex / growth & development

Neonicotinoids / toxicity*

Organogenesis / drug effects*

Pregnancy

Prenatal Exposure Delayed Effects / chemically induced*

Substances

Insecticides

Neonicotinoids

acetamiprid

Related information

Cited in Books

PubChem Compound (MeSH Keyword)

LinkOut - more resources

Full Text Sources

Wiley

Other Literature Sources

scite Smart Citations

Miscellaneous

NCI CPTAC Assay Portal