

# Spectrum of Neuropharmacology Research and Global Contributors: A Pharmacology Journal Survey During 2002

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A large number of global population suffers from any one of the disorders of nervous system [1]. This resulted in investigation of pathophysiological factors behind the various neurological disorders and their complications, leading to the development of drugs and treatment modules. 'Neuropharmacology deals with the action of drugs upon various parts and elements of nervous system [2], which broadly constitute pharmacotherapy of psychiatric disorders, epilepsies, migraine, Alzheimer's disease, Parkinson's disease, pain, drug / alcohol addiction and neurodegenerative disorders. Generally, all the drugs acting on the central nervous system (CNS) produces either stimulation or depression by modifying some steps in chemical synaptic transmission. In fact, these drugs were the first to be discovered and are still widely used group of drugs [3]. Recently, the molecular understanding of multi-subunit structures of receptors or transmitters and availability of cell based screens to identify receptor sub type selective drugs have improved the therapeutic specificity and minimized the side effects of drugs [4].

The quantitative analysis of geographical distribution of research publications gives an indicator about scientific productivity of individual nations [5, 6]. Such studies are called as bibliometric or scientometric analysis, recently served as tools for identifying the global authorities in various fields of research [7]. However, similar scientometric studies are not available with regard to neuropharmacology. Hence, we had planned in this study to reveal about spectrum of neuropharmacology research and geographical contributors of such research. Indeed, the younger aspirants wish to know the latest trends and leading nations in neuropharmacology research. One of the ways to find this information is to search the scientific database. Another easy way to find this information more accurately is, analyzing the original research papers published under neuropharmacology section in any peer reviewed pharmacology journals. Our earlier study (unpublished) indicated neuropharmacology as the most popular branch for pharmacology researchers and Journal of Pharmacology and Experi-

mental Therapeutics (JPET) published the highest number of papers in neuropharmacology (30.4%) division during the year 2001, when compared with at least two internationally reputed pharmacology journals i.e., British Journal of Pharmacology and European Journal of Pharmacology. Subsequently, this finding has given us an impetus for exploring the spectrum of neuropharmacology research and to identify the leading geographical contributors, by referring the research articles published at least in one year under neuropharmacology division of JPET 2002.

Twelve issues of JPET published from January to December 2002 were obtained from JIPMER Central library. The research papers published under neuropharmacology section were manually evaluated for research activity (subfields) and country of origin. About 157 papers were analysed out of 174 published papers due to some practical difficulties and the number of papers selected would be adequate to draw the data and valid conclusions. This analysis revealed that there are at least eleven subfields of neuropharmacology research (Table 1) and seventeen geographical contributors (Fig 1). The highest number of papers were published with regard to (1) Receptors in CNS (glutamate, dopamine, vasopressin, adenosine, cannabinoids, n-ACh, vanilloid, GABA etc.), (2) Neurotransmitters in CNS (neurotensin, endocannabinoids, excitatory amino acids, acetylcholine, nicotinic acid, dopamine, protein kinase A, cAMP, gastrin, etc.), (3) Opioids (endogenous ligands, binding sites, dependence, receptors analysis, etc.). Less number of papers were published in the area of evaluation of brain regions, learning and memory, stress and neurotoxicity. An average number of papers were published in analgesia, neuroprotection, morphine and ethanol behavioral effects. The papers which do not belong to ten subfields were placed in miscellaneous.

Majority of papers reported about evaluation of receptor functions in brain, and neurotransmitters and opioids indicates a boom in basic and molecular aspects rather than direct disease oriented research. Scientists have shown interest in mapping distribution of receptors

and finding suitable ligands using immunological, histochemical, and radioisotopic methods. In fact, the molecular cloning technique has become a common tool in understanding CNS receptors. The events involved in release of transmitters from the presynaptic terminals have been extensively studied. However, the papers about neuroprotection or toxicity, alcohol or morphine dependence, spinal cord injury and stress indicates research related to clinical conditions. An average number of papers were published with regard to treatment of pain with opioids, indicating renewed interest in opioids with lesser side effects in the relief of various painful conditions.

Researchers from 17 countries contributed for various subfields of neuropharmacology research. The USA researchers contributed significantly highest number of papers (70%) followed by France (7%), Germany (4.5%), Canada (4.5%), Netherlands (4%). Minimum number of papers are contributed by Portugal, Israel, Finland, Italy and etc.

The USA researchers reported about neurotransmitters in brain (acetylcholine, neurotensin, excitatory amino acids, endocannabinoids, nicotinic acid, dopamine, protein kinase A, cAMP, etc.), receptor mediation (n-ACh, Dopamine, CB<sub>1</sub>, NK<sub>1</sub>, GABA, 5HT<sub>7</sub>, etc.) in brain, opioids-induced analgesia & pain modulation, neuroprotection, apoptosis, behavioral studies and depression. The French researchers contributed papers about receptors in brain (D<sub>2</sub>, NK<sub>1</sub>), stress related disorders, neuroprotection, evaluation of antiparkinsonism drugs. Germany researchers reported about receptor mediation in brain (opioids, vanilloids), neuroprotection, and mediators of pain. Canadian researchers reported about morphine analgesia, opioid receptors, and neurotransmitters. The Netherlands researchers reported about receptors in brain (CB<sub>1</sub>, opioids) and neurotransmitters in brain. Researchers of UK, Spain and Japan reported about receptor evaluation in brain (5HT<sub>1A</sub>, ACh, opioids), neurotransmitters (dopamine), neuroprotection (NMDA receptors), analgesic activity and trans-

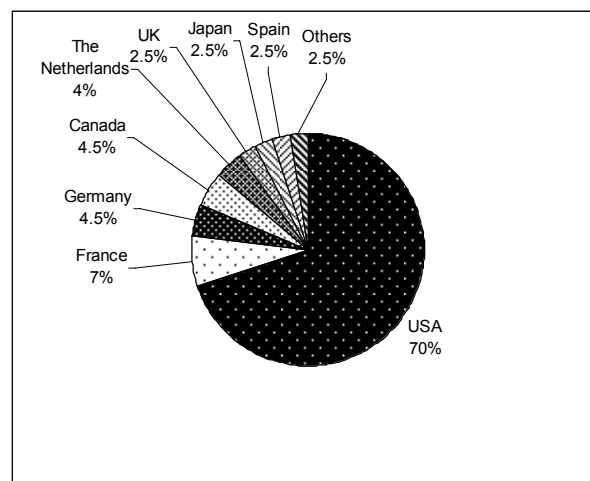


Fig 1. Geographical contributors of neuropharmacology research as reported in a pharmacology journal during 2002. Others: Korea, Belgium, Italy, Australia, Portugal, Israel, Finland, Austria, Venezuela.

portation across blood brain barrier. Researchers from other countries reported about neuroprotection, neurotransmitters (nicotine, gastrin), receptors in brain (adenosine, dopamine) and anticonvulsants.

Recently, the bibliometric studies have gained significance in characterizing subject fields and leading nations [8]. Many young scientists take up a carrier in neurosciences because of its wider horizon and opportunities [9]. Our study also supports this hypothesis. The highest number of papers published under neuropharmacology indicates the vast area of research potential together with the large number of geriatric population suffering from neurological disorders and health policies of countries. The USA reported the highest number of neuropharmacology papers. The interest shown by American researchers might be in response to majority of global population suffering from neurological disorders, in addition to its growing geriatric population and the research potential of the field [1]. It seems, the USA possesses trained man power, laboratory facilities, liberal public or private funds and conducts regular symposia or conferences to attract the researchers from other countries. Research contribution from France indicated solving the problems associated with mental stress, memory deficit, evaluation of receptors functions and neurotransmitters. Germany research contributions indicated analgesia associated with opioid receptors and neuroprotection. Canadian researchers stressed on morphine-induced analgesia and evaluation of its receptors. The Netherlands researchers revealed about basic aspects of receptor mediation and binding studies in brain. Studies on novel macromolecular target sites for development of drugs acting on CNS may produce agents for treating depression, anxiety and epileptic disorders. Researchers from other countries indicated about basic mechanisms associated with neuropathy.

The general pharmacology journals act as a medium for presentation of less specialized aspects of pharmacological research. Reputed journals receive overwhelming number of papers and for the ease of readers' attention; papers are published under different sections.

Table 1. Spectrum of neuropharmacology research as published in a pharmacology journal during 2002.

Subfields of Neuropharmacology Research	% of papers (n=157)
(1) Receptors in CNS (glutamate, dopamine, vasopressin, adenosine, cannabinoids, n-ACh, vanilloid, GABA, etc.)	19.7
(2) Neurotransmitters in CNS (neurotensin, endocannabinoids, excitatory aminoacids, acetylcholine, nicotinic acid, dopamine, protein kinaseA, cAMP, Gastrin, etc.)	14
(3) Opioids (endogenous ligands, binding sites, dependence, receptors analysis, etc)	11.5
(4) Analgesia (pain modulation, nociception, spinal, etc.)	9
(5) Neuroprotection	5.7
(6) Morphine (tolerance, analgesia, neurotransmission etc.)	4.5
(7) Ethanol behavioral effects (dependence etc.)	3.2
(8) Mapping brain regions	2.5
(9) Learning and memory	2
(10) Stress and neurotoxicity	1.3
(11) Miscellaneous	26.6

Such journals reveal about frontiers of research and approaches of pharmacologists towards any field of research. Moreover, these journals can help the young researchers in knowing about the latest insights of the research and to find the laboratory and country of choice where they can further advance in their field of interest. During 2002, JPET published about 595 papers and reported about ten divisions of pharmacological research and it was also found that the highest number of papers were published in neuropharmacology (29.24%) followed by other divisions namely cardiovascular pharmacology (13.6%), cellular & molecular pharmacology (13.6%), pharmacokinetics (12.7%), inflammation & immunology (9.4%), gastrointestinal & hepatic pharmacology (7.2%), toxicology (4.7%), behavioural pharmacology (4.4%), endocrine & reproductive pharmacology (2.4%) and chemotherapy (2.2%). This is the first report about scientometric analysis of neuropharmacology research papers published in a reputed pharmacology journal.

It can be concluded from this study that the neuropharmacology research is spread over by eleven subfields and contributed by seventeen countries. The most popular subfields are (1) receptors in CNS (2) neurotransmitters in CNS and (3) opioids. USA is the most favourable destination for young researchers who wish to advance further in neuropharmacology division.

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