WORLD WIDE JOURNAL OF
MULTIDISCIPLINARY RESEARCH AND
DEVELOPMENT

Balaji More
Associate Professor, Head-
Clinical Trial and Training
Centre, Mahatma Gandhi
Medical College and Research
Institute, Sri Balaji
Vidyapeeth (Deemed to be
University), Puducherry,
India.

Chintan Doshi
Associate Professor,
Department of Pharmacology,
Pacific Institute of Medical
Sciences, Udaipur, Rajasthan,
India.

Anju More
Professor, Department of
Anatomy, Shree Lakshmi
Narayana Institute of Medical
Sciences, Puducherry, India.

Correspondence:
Balaji More
Associate Professor, Head-
Clinical Trial and Training
Centre, Mahatma Gandhi
Medical College and Research
Institute, Sri Balaji
Vidyapeeth (Deemed to be
University), Puducherry,
India.

Publication trends in Indian Journal of Pharmacology: Journey through the last decade

Balaji More, Chintan Doshi, Anju More

Abstract
Background: Scientific journals are a means for dissemination of research to a large community of researchers. The proportion of peer-reviewed articles published in a certain area of research can provide interesting insights on research trends in that subject. We reviewed publication trends and type types of publications in Indian Journal of pharmacology (IJP) 2010 to 2019.
Aims and objectives:To evaluate the trends of publication on various sub-specialty topics in the Indian Journal of Pharmacology.
Methods: We examined the articles published in IJP from 2010 to 2019 from for total number of publications and its types (Original articles, reviews, letter to editor, book reviews). Descriptive statistical analysis was conducted as per requirement.
Results: Total number of articles published in IJP in the last decade were 1378. The types of articles were: original research articles 675 (48.98%), Letter to editor (173 (12.55%), Short Communication (133(9.65%), Adverse drug reactions 1319.65%), (Review articles 122(8.85%), and book reviews 21 (1.52%). The maximum and minimum number of articles were published in the year 2011 and 2018 respectively. The average number of original research article published per year were 56 articles. Maximum and minimum number of original research articles were published in the year 2012 (100 articles) and 2019 (29 articles) respectively. It was observed that there were highest number of articles on experimental pharmacology 406 (60.14%), followed by Clinical pharmacology 148 (21.92%), molecular pharmacology 73 (10.81%), teaching methodology 20 (2.96%), pharmacoeconomics 15 (2.22%) and pharmacogenetics 13 (1.92%). Higher trend of case study publication was seen between 2013 to 2010 in the range of 22 to 34 publications. Maximum number of short communications were published in the year 2011 (26 articles). Maximum number of book reviews were published in the year 2011 (5 articles). Highest number of articles 39 on adverse drug reactions were published in 2015. The percentage of articles published on drug-drug interaction, teaching methodology, pharmacy related, and miscellaneous topics were 1.3%, 1.67%, 0.67% and 1.0% respectively.
Conclusion: This study showed the decrease in research publications in the recent years in IJP. The original research publications lead in specific publication types. Maximum and minimum number of original research articles were published in the year 2012 (100 articles) and 2019 (29 articles) respectively. Highest research number of publication are done in on the central nervous system followed by cardiovascular system. There is a growing interest in central nervous system research in the last decade.

Keywords: Publication, Review article, trends, pharmacology, original research.

1. Introduction

Over the last seven decades, there has been remarkable developments in the field of pharmacology.(1) The evolution of modern pharmacology commenced form extraction pure molecules, preclinical development and clinical development to today era of biotechnological product. It has led to division of pharmacology into different sub-specialties. The changing regulatory environment, systematic drug development, large number of courses/students, and technology advancements has contributed in publications on various sub-specialties of pharmacology education. Scientific research publication complements in teaching and training, clinical service and patient care. There could be critical trends in the publication patterns during the evolutionary process in pharmacology

research that needs to be evaluated.

Recent preeminent evidence from the scientific publications and health care providers experience forms the basis of evidence-based medicine (EBM). In the grading of evidence, randomized controlled trials, systematic reviews, and meta-analysis studies are at the highest levels in the evidence pyramid.(2)

Publications in Indian Journal of Pharmacology (IJP) are the reflection of modern pharmacology practices evolving in healthcare. IJP publications depict the trends in terms of quantity (proportions), quality, type (preclinical/clinical), thrust areas, etc., of pharmacology followed by health-care professions both nationally and internationally. With identical pharmacology research principles, teaching and research institutes from medical and pharmacy streams contribute their research to IJP. (3)

Evaluating publishing trends in scientific journals is one means of comprehending the progress of a subject and identifying potential gaps in particular research areas. Factors impelling publication of manuscripts in reputed IJP has not been evaluated in the past. Therefore, this study was conducted with an objective to evaluate the trends of publication on various sub-specialty topics in the IJP.

Scientific publications are a platform to disseminate scientific discovery and newer knowledge. They are the reflection of the research and education in the subject, which can be considered as a scale of achievement and assured academic standard. In a broader sense, these publications serve as a key indicator that provides information of the individual skills, orientation of the involved research team, organizational resources and its contributing factors, focus areas of interest and scope of development.(4)

The new advancement and computer-assisted learning in the field are also marked as proteomics, genomics, and metabolomics in drug discovery and development, hence need to incorporate into our subject/field.(3)Different countries are progressing at different pace in the field of healthcare as reflected in the publication trends. The annual number and percentage of scientific publication in orthopedics journals has significantly increased in China, there is still huge gap as compared to USA and Japan in the field of orthopedics in terms of quantity and quality.(5) Several researchers have studied the trends of publications in different fields.(6) However, not much data exist on the trends of publication in Pharmacology.

Indian Journal of Pharmacologyhas a wide readership base with no particular inclination towards any one specialty of pharmacology. As expected, highest number of readers are from India, followed by U.S.A., Egypt, United Kingdom and China.(7) We postulated that all subspecialties of pharmacology should have a comparable share in the publication in the IJP during last decade. This paper is an attempt to review recent trends of publication types in IJP. It is not an assessment of the quality of journal articles themselves but rather a quantitative look at recent publication trends in IJP. The insights derived for this study would provide us an idea regarding the distribution of studies published across various sub-specialties.

2. Materials and Methods

This was a cross-sectional study to evaluate the publication trends in the IJP over the last decade. The IJP website was accessed between October 2019 and March 2020 and we included all issues, which were available online over the last 10 years (2010 to 2019). Two authors independently reviewed the contents of each issue and classified the articles under different categories. They were classifiedas original article, Review article, Letter to editor, Book review, Case study, short communication. The original articles were further sub-classified as: Experimental pharmacology, Molecular pharmacology, Clinical pharmacology, Pharmacoeconomics and Pharmacogenetics. The Clinical pharmacology were further divided as interventional and observational studies. Editorials were excluded in this study.

The number/frequency of publications by these pharmacy institutes was counted issue wise and its percentage to total publications issue wise and year wise was calculated. Articles were categorized as editorial, educational forum, research article and review article, letter to the editor, drug watch, short communication, and book review. Research articles were further classified whether preclinical (animal studies) or clinical (human). Preclinical research was further categorized based on the investigational product whether a plant product/extract or chemical/synthetic product.

The articles were also categorized based on the therapy area involved in the research: Gastrointestinal, Endocrine, Excretory system, Skin, Musculoskeletal (included analgesics), Reproductive system, Anti-cancer, Respiratory system, Antimicrobial and vaccine.

Further, the articles were categorized based on Teaching methodology, Drug interaction, ADR, Pharmacy related topics. The articles were also categorized depending on the whether a plant product/extract or chemical/synthetic product was studied.

In order to avoid discrepancies, the authors evaluated the documents together at the same time and recorded the publication category by consensus. If there was a difference of opinion between the two authors, the senior author was consulted and articles classified accordingly.

The number/frequency of publications by afore mentioned subspecialties will be counted issue wise and its percentage to total publications issue wise and year wise was calculated.Descriptive statistical analysis was carried out on the collected data on different parameters. We focused mostly on a graphical representation of the data rather than statistical calculations. Microsoft Excel 2007 was used to draw graphics and to analyze yearly quantitative distributions of different articles.

3. Results

Total number of articles published in Indian Journal of pharmacology in the last 10 years were 1378. The types of articles were: original research articles 675 (48.98%), Letter to editor (173 (12.55%), Short Communication (133(9.65%), Adverse drug reactions 1319.65%), (Review articles 122(8.85%), and book reviews 21 (1.52%). The maximum and minimum number of articles were published in the year 2011 and 2018 respectively. The change in publication trend from 2010 to 21019 is depicted in figure 1.
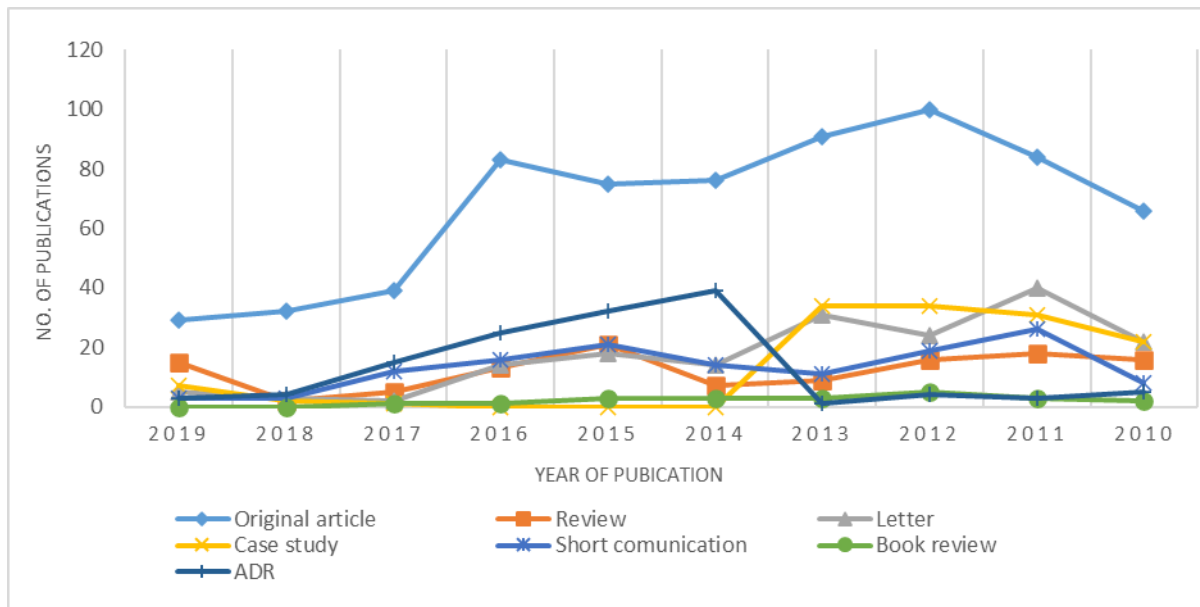
Fig. 1: The change in publication trend based on type of article from 2010 to 2019.

The average number of original research article published per year were 56 articles. Maximum and minimum number of original research articles were published in the year 2012 (100 articles) and 2019 (29 articles) respectively. Maximum and minimum number of review articles were published in the year 2015 (28 articles) and 2010 (2) respectively.

When the original articles were sub-categorized based on the type of study, it was revealed that there were highest number of articles on experimental pharmacology 406 (60.14%), followed by Clinical pharmacology 148 (21.92%), molecular pharmacology 73 (10.81%), teaching methodology 20 (2.96%), pharmacoeconomics 15 (2.22%) and pharmacogenetics 13 (1.92%).

The articles when categorized based on the systemic therapy wise: Central nervous system (CNS) 150 (22.22%), cardiovascular system (CVS) 112 (16.59%) Gastrointestinal 68 (9.94%), Endocrine 64 (9.36%), Excretory system 46 (6.73%), Skin 45 (6.58%), Musculoskeletal 41 (5.99%), Reproductive system 28 (4.09%), Anti-cancer 27 (3.95%), Respiratory system 20(2.95) Antimicrobial 15 (2.19%) and vaccine 5 (0.73%). The change in publication trend different system from 2010 to 2019 have been illustrated in Figure 2.
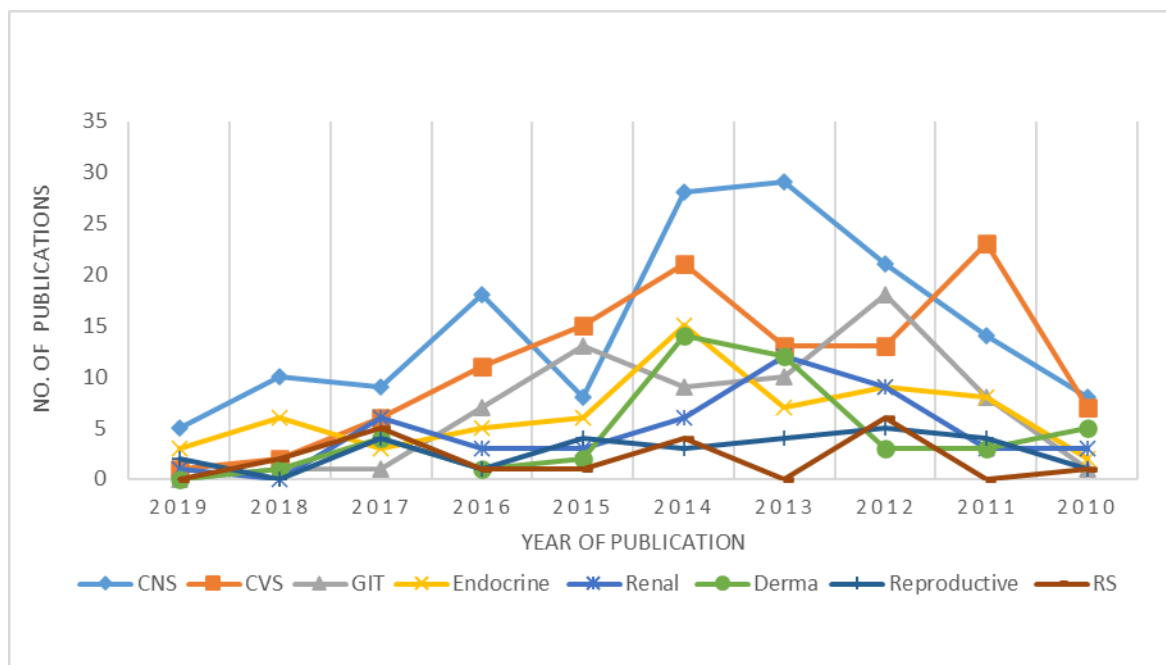

Fig. 2: The change in publication trend based on different system wise from 2010 to 2019.

In original research articles 218 (32.29%) these research manuscripts studied *in vitro*, *in vivo* screening of phytochemical constituents of indigenous plant extracts or formulations for its pharmacological activity and 70 (10.37%) these manuscripts evaluated synthetic or small molecules for their clinical efficacy and safety or pharmacological activity in experimental studies.

Higher trend of case study publication was seen between 2013 to 2010 in the range of 22 to 34 publications, whereas there were nil publications between 2014 to2016. Again,

the Case study publication resumed between 2017 to 2019 but are a slower pace in the range of 1 to 7 articles per year. Maximum number of short communications were published in the year 2011 (26 articles). In the last two years, the short communication publication have been significantly reduced to just 3 articles per year.

Maximum number of book reviews were published in the year 2011 (5 articles). In an average about 3 book reviews were published for 2011 to 2017. However, in the last two years, there were none book reviews published.

Maximum number articles 39 on adverse drug reactions were published in 2015. Between 2010 to 2014 about 1 to 5 articles and between 2015 to 2018 around 15 to 39 articles were published. There was dip in 2019 wherein only 5 articles were published.

The percentage of articles published on drug-drug interaction, teaching methodology, pharmacy related, and miscellaneous topics were 1.3%, 1.67%, 0.67% and 1.0% respectively.

4. Discussion

Scientific writing and publication is the end result of research that indicate comprehensiveness of the research carried out, peer-reviewed and accepted by the scientific body.(8) Publication is a critical channel of disseminating scientific research work as it helps in communicating the novel insights and knowledge. It also is a pathway of fulfilling specific job necessities by employers, professional accreditation in the form of continuing medical education, promotion to an academic position, and enhancing prospect of success in research grant application.(8)

Pharmacology has beheld implausible advancement over the last 7 decades and its scope has evolved to such an extent that it has led to subdivision of the subject into various sub-specialties. Similarly, the research and publication trends have evolved to large extent. We can comprehend the varying trends in that research and development, and growth of specialty by assessment of the publication trends in a particular subject. Investigating publishing trends in reputed journals is important tool to understand the advancement and growth of a specialty.(6)

In the past,Chetna Desai and B. Dinesh Kumar have evaluated the temporal trends of pharmacology publications in IJP by pharmacy institutes, however there was lack of knowledge on the overall trends.(1) Hence, we conducted a descriptive analysis to understand the evolution of research and publications in the pharmacology by evaluating the publication trends in the Indian Journal of Pharmacology (IJP) over last decade.

Over five decades Indian Pharmacological Society has published IJP (ISSN 0253–7613) an official publication which is a Peer-reviewed open access biomedical specialty periodical in India.(9)The first issue of the journal came out in 1969 and ever since, it continues its publication. IJP publishes original research articles, reviews, research letters and correspondences. Publications in IJP are from the biomedical fraternity involving pharmacological aspects. Researchers from medical and pharmacy health-care profession contribute their science to IJP.

This study revealed total number of articles published in IJP over last 10 years were 1378. As expected, the most common type of papers were original research articles 48.98%. An original research paper is the one based on original research that produces newer insights, which can be obtained observations and experiments. (10) There are several limitations to have a good quality original research article such as inadequate expertise and minimal funds to conduct medical research, shortage of time. In the recent years, most researchers perform small studies, which can be questionnaire-based surveys in one institution or retrospective clinical data analysis of one or more department or institute. At times, clinicians try to get an audit of a technology or Knowledge, Attitude and Practice Surveys published as an original article. In the absence of clearly defined criteria of the categories of research, authors demand that their research be treated as original because it is the requirement for faculty promotion.(10)

In this study, these were 12.55% letter to editor. The letter to the editor plays a dual role in the literature. It serves a corrective critical function but also has the capacity to spread and share knowledge.(11)

The percentage of short communication in this study were 9.65%. A short communication article is involving a novel and original scientific study, but without discussion and, consequently, conclusion. It is generally it something novel and of scientific relevance addressing some knowledge gap or unmet need, but with lot of uncertainties (unknown pharmacological mechanism of action). Maximum number of short communications were published in the year 2011 (26 articles). In the last two-year the short communication publication have been significantly reduced to just 3 articles per year.

A book review is a form of genuine critical description of a book analyzed based on content, style, and merit. It may serve as opinion, summary or scholarly insights regarding the book and has the potential to be an influential literary form.(12)We found that 1.52% book reviews were published in IJP. Maximum number of book reviews were published in the year 2011 (5 articles). In an average about 3 book reviews were published for 2011 to 2017. However, in the last two years there were none book reviews published. The process of publishing a successful scholarly book review requires the reviewer to appreciate the book review publication process and to be aware of the skills and strategies involved in writing a successful review.(12), (13)

There are substantial differences between countries in drug prescribing, and in the numbers of publications of research papers on therapeutic agents, especially dealing with adverse drug reactions. In our study, there were 9.65% articles published on adverse drug reactions, which included those on pharmacovigilance. Ferner and Aronson reported that 10.8% ADR articles were included in the adverse effects subcategory in their study.(14) There were substantial differences between countries, not explained by population, economic variation, overall publication rate on therapeutic agents, or the presence of large indigenous pharmaceutical companies. Many local cultural factors influence the ratio of papers on adverse reactions to all drug effects, so it may be difficult to improve their recognition and reporting by international efforts.(14)

Maximum and minimum number of original research articles were published in the year 2012 (100 articles) and 2019 (29 articles). This could be because of increased stringent criteria applied during peer review and high rejection rate. Peer review is at the most critical step in the selection processes of any scientific work for publication, not just medical journals but of all of science. It is helps in

grants allocations, academics promotion and prizes distribution.(15) Every article, which is submitted for publication in a particular journal, as per the ethical and the established criteria, must undergo a peer-review process.(16)

Generally, review articles is a form of publication that analyze or discuss research previously published by others, instead of reporting original new experimental results. An expert's opinion is valuable, but an expert's assessment of the literature can be more valuable. As readers may miss features that are apparent to an expert clinician-researcher when reading individual articles, review article provides the expert's explanation and assessment of the validity and applicability of individual studies. In our study revealed that, 8.85% review articles were published. There was surge in the review articles were published in the year 2015 (28 articles) but again it showed decreasing trend in 2010.

When the original articles were sub-categorized based on the type of study, it was revealed that there were highest number of articles on experimental pharmacology 60.14%. Most pharmacology departments have well-established animal house facilities and could be the reason for highest number of articles on experimental pharmacology. Moreover, experimental pharmacology is an integral part of drug development process.

There is increasing trend in the number of articles in the clinical pharmacology 21.92%. Clinical pharmacology articles includes drug efficacy and safety studies, rational prescribing, clinical trials of drugs, ADR monitoring, pharmacokinetics, pharmacodynamics, toxicity, drug interactions, prescribing, and pharmacotherapeutics.(17)However, the number of publication are relatively low as compared to the experimental studies. The research in clinical pharmacology could be enhance by collaborative studies with clinical subjects, public health or industry with pharmacology department.(17) Maximum number articles 39 on adverse drug reactions were published in 2015. Between 2010 to 2014 about 1 to 5 articles and between 2015 to 2018 around 15 to 39 articles were published. There was dip in 2019 wherein only 5 articles were published.

Pharmacology deals with the interplay between organisms and drugs and their molecular mechanisms. It plays a translational role in modern medicine, bridging basic research and the clinic. Molecular research has discovery of many potential drug targets and biomarkers that has led to significant contribution to the overall advancement of pharmacological sciences.(18) In this study, we found 10.81%molecular pharmacology publication, which indicate that huge gap in this area of research in India.

On sub categorization of original articles based on the system studied, the article distribution published in the descending order were CNS > GIT > Endocrine > Excretory system > Skin > Musculoskeletal > Reproductive system > Cancer > Respiratory system > Antimicrobial > vaccine. The maximum percentage of articles were published were on CNS 22.22%. The reason for highest number of publications in CNS could be large number of established animal models for evaluating the drug action in experimental studies.

The traditional ways of teaching pharmacology can become monotonous and lead to passive learning of the subject. To remain in the pace, pharmacology teaching needs modifications and experimentation.(19) Several research arepublished in various techniques of teaching and their impact. In IJP,2.96% on publication were based on teaching methodologies.

Pharmacoeconomics refers to the scientific discipline that compares the benefits of two different drug therapies.(20) The number of pharmacoeconomics publications is increasing rapidly worldwide. Several studies have examined trends in pharmacoeconomics publications in terms of publication numbers, journal placement, and the authors and universities involved in the research.(21), (22) In our study, there 2.22 % publications on pharmacoeconomics.

Our study reported 1.92% publication on pharmacogenetics. Pharmacogenomics refers to the scientific discipline that includes all disease areas of interest, spans in *vitro* studies to clinical trials, while focusing on the relationships between genes and drugs and the resulting phenotypes.(23)

In original research articles,32.29% of these research manuscripts studied *in vitro*, *in vivo* screening of phytochemical constituents of indigenous plant extracts or formulations for its pharmacological activity.Only 10.37% these manuscripts evaluated synthetic or small molecules for their clinical efficacy and safety or pharmacological activity in experimental studies. This could be because most of the synthetic or small molecules studies are carried out in the clinical subjects, which are, sponsored clinical trials.

In medical sciences, case reports are common methods of disseminating events or efforts in management of individual patients with previously unreported characteristics. Whereas as a qualitative methodology, case study research includesmore excessive complexity than a typical case report and generally consist of multidisciplinary data combined in creative ways. The comprehensiveness of case study description assists readers to comprehend the case and whether results might be applicable beyond that case scenario.(24)Higher trend of case study publication was seen between 2013 to 2010 in the range of 22 to 34 publications, whereas there were nil publications between 2014 to2016. Again, the Case study publication resumed between 2017 to 2019 but are a lower pace in the range of 1 to 7 articles per year.

In our study higher number 218 (32.29%) original research articles were based on *in vitro*, *in vivo* screening of phytochemical constituents of indigenous plant extracts or formulations for its pharmacological activity as compared to sysnthetic or small molecules 70 (10.37%) which mainly evaluated clinical efficacy and safety or pharmacological activity in experimental studies. This trend could be because of both cost and time effective phytochemical research, medicinal plants are resources of new drugs, and pharmacological properties of an herbal formulation depend on phytochemical constituents present therein. However, out data suggest that maximum of the phytochemical research is limited to screening activity in experimental studies and very limited evaluated in clinical studies.

The study findings reveal only 10.81% of the studies account for the molecular and cellular pharmacology studies. There is huge potential for enhancing research in the still need to the forefront of research by pharmacy institutes since 92% research by pharmacy institutes is

preclinical as per present data. Preclinical studies are an integral part of drug development process.(9)

Drug-drug and drug-dietary supplement interactions can lead to the development of ADRs. It is estimated that interactions are responsible for 3% to 5% of preventable ADRs in hospitals and contribute to hospital admissions and emergency room visits.(25)The percentage of articles published on drug-drug interaction in this study is relatively low 1.33%.

Interpreting the publication trends in this journal need to done with caution as contribution to a particular journal may not reflect the global scenario in a particular field. Several factors determine the contribution by researcher to a particular journal. These factors include publication fees, scope of research, marketing strategy of publication house, citations, indexing, and impact factor of the journal.(1)

This study findings may not reflect the most comprehensive and accurate trends of pharmacology research because of several limitations. Firstly, the operational definitions of we adopted were arbitrary. However, operational definitions that could be appropriate to literature search were unavailable. Secondly, we collected articles from a single journal that may reflect the trend in pharmacology research globally. In addition, it was not possible to read the full texts of all the published articles to give more details.

5. Conclusion

In the last decade, publishing scientific research has undergone a dramatic and rapid conceptual and clearly visible transformation. The trend of drug-drug interaction publication is also low which needs to be improved. The area of research that has significant potential and need a boost is the pharmacoeconomics and pharmacogenomics.

6. Acknowledgments

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