Official Publication of

Indian Society for Medical Statistics (ISMS)

# ISMS Bulletin

**October 2024**

Editorial Office
**Department of Biostatistics**
National Institute of Mental Health and Neuro Sciences
Bengaluru - 560 029

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**Indian Society for Medical Statistics (ISMS)**
**Regd. Office: Dept. of Biostatistics, AIIMS**
**New Delhi - 110 029, India**

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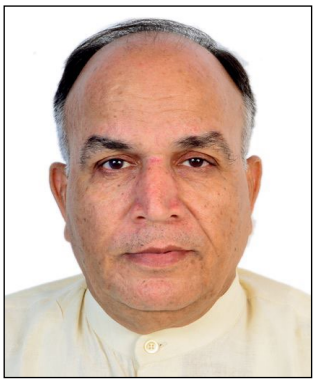
# Contents


| Sl. No. | Content | Page No. |
|---|---|---|
| I | Message from the ISMS President | I |
| II | Message from the ISMS General Secretary | III |
| III | Message from Editor's Desk | IV |
| IV | Editorial Board Members | V |
| 1 | Obituary to Prof. Arvind Pandey | 1 |
| 2 | Obituary to Prof. K R Sundaram | 4 |
| 3 | Challenges Faced by Medical Statisticians in India During Lockdown | 6 |
| 4 | Multilevel Modeling in Biomedical Research: Theoretical Foundations and Practical Applications | 13 |
| 5 | National Statistics Day Celebrations - 2024 at ICMR-NIIH, Mumbai | 21 |
| 6 | Report of 41st Annual Conference of ISMS-2023 - MG University, Kottayam, Kerala | 26 |



## Message from the ISMS President

Dear Esteemed Members,
Greetings from Mahakal Nagari, Ujjain!

This year being the last year (2024) of my president ship of a term of two years (2023-2024), I will be completing my term as President of the Indian Society for Medical Statistics (ISMS) by the end of this year. From the core of my heart, I express my thanks and gratitude to each and every esteemed member of the Indian Society for Medical Statistics (ISMS) again for providing me the opportunity to serve as the President. It is a privilege and pleasure to serve as President of the ISMS more so after completing more than three decades of long service at All India Institute of Medical Sciences, New Delhi, and superannuating on 31st July 2021 as Senior Professor of Biostatistics & Adjunct Faculty at Clinical Epidemiology Unit. This opportunity provided me a chance to work closely with our esteemed General Secretary, Dr. B. Binukumar, and other esteemed office bearers. I am grateful to Lord Shri Mahakal and Maa Har Siddhi Devi to keep me blessed and make me able to be academically active at International Centre for Health Research, RD Gardi Medical College, Ujjain, for last more than two years.

The ensuing 42nd annual conference (ISMSCON-2024) of the Indian Society for Medical Statistics (ISMS) is being held at my Alma Mater, Department of Statistics, Institute of Science, Banaras Hindu University (BHU), Varanasi, Uttar Pradesh, India, during 21-23 November 2024. I duly thank the organisers to take this responsibility and help the society. This conference is being organised completely offline. The theme of the conference is, “Recent Advances and Trends of Statistics Practices in Medical Science”. Pre-conference workshops on prominent topics (Statistics in Evidence Based Clinical Practice; & Artificial Intelligence in Medical Sciences) are planned on 20th November 2024. Absolutely, capacity building is crucial for young members, especially in rapidly evolving fields like clinical biostatistics. Continuous education and training in innovative applications of biostatistical methods can help them stay updated with the latest advancements and enhance their skills. This can be achieved through such workshops and online courses. Empowering the youth with these skills will not only boost their individual careers but also contribute to the overall progress in the field of biostatistics, public health, and clinical practice. I would appeal to all the members of our society to participate in ISMSCON-2024 as well as its pre-conference workshop being held during 20-24 November 2024. Along with academic-feast, participation in ISMSCON-2024 will also provide ample opportunity to move around and have a feel of fast developing and growing Banaras/ Varanasi/ Kashi.

As I emphasized in the previous issue of the ISMS bulletin, building a strong network among esteemed members is essential for the growth and development of any professional community like ours. Mutual respect, love, and care are foundational values that nurture a supportive and collaborative environment. By fostering these values, especially toward younger colleagues, we can create a culture of mentorship and encouragement that can propel collective progress.

Moreover, drawing inspiration from esteemed senior professional colleagues, including late Prof. Arvind Pandey and late Prof. C M Pandey, may help in maintaining high standards of dedication and professional excellence. Their legacy can motivate current and future generations to strive for impactful contributions in our fields. Embracing these principles ensures that professional growth is aligned with personal values, leading to a more fulfilling and harmonious professional life.

Absolutely, prompt and effective communication is vital for maintaining a strong and engaged professional community. Thanks to our General Secretary, Dr. B. Binukumar, and Treasurer, Dr. C. Ponnuraja, to follow the goal in this regard. Keeping in view of the importance of a duly updated website of the society, due efforts are being continued in this regard. Thanks to everyone involved in this regard especially General Secretary, Dr. B. Binukumar; and Web-Coordinator, Dr. Prasanna Samuel. Also, our ISMS Bulletin Editor, Dr. Binu V.S., is trying hard to ensure its timely publication. Using this opportunity, I request each and every member of the ISMS family to extend their help and cooperation in every activity of the society. Our collective efforts and dedication will ensure the continued growth and success of our community. Let us work together, support one another, and contribute to the advancement of our profession.

Finally, I would also like to express my thanks and gratitude to the Organising Committee members of ISMSCON-2022 & ISMSCON-2023, Governing Council Members, and Special Committee Chairs & Members, for their continuing support and encouragement.

A joint sincere effort by all of us is a key to achieve our goals regarding our profession and esteemed professionals.

Thanks and warm regards,
**Prof. S. N. Dwivedi**
*President, ISMS*

## Message from the ISMS General Secretary

Dear esteemed members,
Greetings from the ISMS Secretariat!

I am immensely pleased to know that the ISMS Bulletin Editorial Board is bringing out an issue of the Bulletin before the 42nd Annual Conference of the Indian Society for Medical Statistics (ISMSCON-2024). I take this opportunity to congratulate the Editorial team on publishing it.

Also, I request that members of the society contribute scientifically and further by sharing a brief report of the events or activities undertaken in their institutes to publish in the ISMS Bulletin regularly. We should encourage, especially the youngsters, to utilize this platform to exchange thoughts and ideas and discuss the knowledge gained with the fellow professionals. Eventually, with a handful of issues in Bulletin, we can work hard to have a scientific journal under the banner of the ISMS.

I am sure that the forthcoming issue of the Bulletin contains a handful of resource materials that benefit our members and will be educative and enlightening for us.

**Dr. B. Binukumar**
*General Secretary, ISMS*

## Message from Editor's Desk

Dear ISMS Members,
Warm greetings from the Editorial Board of ISMS Bulletin!

The Editorial Board of ISMS Bulletin have the great privilege of releasing the second issue of ISMS Bulletin in the year 2024. The first issue was released in February 2024 and in this issue, we managed to get one technical note and a scientific publication.

Recently we lost two of our senior members Prof. Arvind Pandey and Prof. K R Sundaram, both were former President of ISMS. Their contributions to the ISMS are great and everlasting. I thank Prof. S. N. Dwivedi for providing obituary notes on these two eminent academicians.

Despite repeated requests, we could get only one technical note and one scientific publication for this issue of ISMS. We request all members for their full cooperation and support in publishing future issues of Bulletin and encourage all members to share with us any material related to the field of Biostatistics and our Society for publication in the Bulletin.

I take this opportunity to express my deep sense of gratitude to the ISMS Secretariat and the Editorial Board members for their wholehearted support and for taking the time to volunteer to publish this issue of the ISMS Bulletin.

**Dr. Binu. V.S, Ph.D**
*Editor, ISMS Bulletin*

# Editorial Board Members – ISMS Bulletin

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**Dr. Amrutha Jose**
Scientist C
ICMR-National Institute of Immunohaematology
Mumbai

# Obituary

**Prof. Arvind Pandey,**
Ph.D., FSMS, FAMS, FSMMCS
(02 January 1955 – 02 June 2024)

It is with immense grief that we inform members of the Indian Society for Medical Statistics (ISMS) and Population Sciences communities about the passing of Professor Arvind Pandey – an internationally acclaimed epidemiologist cum population scientist. Prof. Pandey was born in a small village, Baraipur, which is adjacent to Sarnath, Varanasi, U.P. He was the eldest of four siblings in a family of educators and writers. Throughout his childhood, like every other child, he enjoyed outdoor sports, with passion for hockey and long-distance running. Since his childhood, he inherited a cool, polite and helping attitude. He is survived by his wife, Mrs. Urmila Pandey; two children - son, Mr. Kuldeep Pandey; and daughter, Mrs. Anju Mishra. By the grace of God, both of his children are married, blessed with kids and well settled.

Prof. Pandey completed his high school education in Sarnath but sports remained the primary part of his early days. After that, he moved to the prestigious Banaras Hindu University (BHU) where he had completed his bachelor's and master's degrees in science. He continued to run his own version of a mini marathon during those days. After his M.Sc., he was determined to pursue a Ph.D. in statistics from BHU, which he did on stochastic modelling of birth spacing under the esteemed guidance of (Late) Prof. S. N. Singh. The formative years at BHU paved the foundation for academia and research, as well as some special friendships including with me, which continued for the rest of his life. He will continue to be missed especially by his friends/students.

The launchpad at BHU sent him to the International Institute for Population Sciences (IIPS) in Mumbai, Maharashtra, as a lecturer of biostatistics in the early 1980's. At IIPS, Prof. Pandey was not only quick to establish his academic and research credentials but also forged his presence as an able mentor and guide to many students. A few years later, new opportunity came knocking and Prof. Pandey travelled to the University of North Carolina (UNC), Chapel Hill as a post-doctoral fellow via a Rockefeller Foundation Research Grant. At UNC, he conducted novel research and published several peer-reviewed papers in eminent journals in collaboration with and under the guidance of (Late) Prof. C. M. Suchindran. After a successful post-doctoral fellowship, Prof. Pandey decided to return to India and joined back IIPS. He started as a lecturer at IIPS, but in due course, he became Professor because of his sincere hard working and academic credentials. Throughout the 1990's he dedicated his energies to teaching, researching, mentoring, and guiding students from all over the country on varying topics under population sciences and public health.

Prof. Pandey moved to New Delhi in the year, 2000 as Director of the NIMS-National Institute for Medical Statistics (fka Institute for Research in Medical Statistics), Indian Council of Medical research (ICMR). For the update, NIMS is presently named as ICMR-National Institute for Research in Digital Health and Data Science (ICMR-NIRDHDS). Prof. Pandey contributed immensely through starting several researches and training programs including Ph.D. program at NIMS. He was instrumental as principal investigator/ chair/ co-chair of related technical committees in numerous national level studies including

various rounds of National Family Health Survey (NFHS), and burden estimates of HIV. Also, he could successfully establish the Clinical Trial Registry of India (CTRI) at NIMS. He used to encourage and help his scientific colleagues to get focussed involvement in research; sometimes he brought the project himself but handed over to his colleagues. His involvement as co-guide/ doctoral committee member could also help PhD students of Department of Biostatistics, All India Institute of Medical Sciences (AIIMS), Delhi. Because of his tremendous contributions, after super-annuation from NIMS, he was promoted to the position of Additional Director General of ICMR retrospectively. In other words, he superannuated as the Additional Director General of ICMR. After superannuation, Prof. Pandey continued as a National Chair of Medical Statistics, at ICMR, for almost five years. He continued till recently to join virtually all the meetings including those in the ministry and ICMR/ AIIMS and provide technical assistance in the studies/ thesis.

Prof. Pandey participated in knowledge sharing at various international fora like the Population Association of America, and Inter-national Statistical Institute. He supported technically to the international agencies like World Health Organization (WHO), Geneva; WHO-South-East Asia Regional Office, New Delhi; United States Agency for International Development (USAID); and also with Ministry of Health and Family Welfare; Central Statistical Organization (CSSO); Department of Health Research; Indian Council of Medical Research; Population Foundation of India; and Dept of Science & Technology, Govt. of India, to name a few of his associated institutions.

Prof. Pandey had many awards / recognitions to his credit like Young Scientist Award of the Indian Science Congress Association (1985); Fellowship of the Rockefeller Foundation for advanced training in Biostatistics/ Population Studies, at University of North Carolina at Chapel Hill, USA (1986); Prof. Ramakumar Memorial Oration of University of Kerala (2011); Prof. George Simon Memorial Oration of the Indian Association for the Study of Population (2012); Prof. S.K. Bhattacharya Memorial Oration of the Indian Society for Medical Statistics (2014); and Prof. PV Sukhatme National Award (2020).

Prof. Pandey had a long association with the Indian Society for Medical Statistics (ISMS). He was ISMS Bulletin Editor for five years (1994-1998). He was elected as a fellow of the society (FSMS) in 1998. He organised 20th annual conference of ISMS in the year 2002 as Organising Secretary. Prof. Pandey served as President of ISMS for two years, 2009-2010. In addition, he also worked as Member of FSMS Committee, Executive Committee, Governing Council, Award Committee, Education Committee, and others. Apart from the ISMS, Prof. Pandey was actively involved in other professional associations as well. For Indian Association for the Study of Population (IASP), he was General Secretary for two years (1996-1998); Executive Committee Member (1998-2000); Vice-President for four years (2000-2004); President for four years (2006-2010); and Board of Trustees for six years (2016-2022). Also, he served as Chief - Editor, Editor, Editorial committee member for the IASP's journal, Demography India.

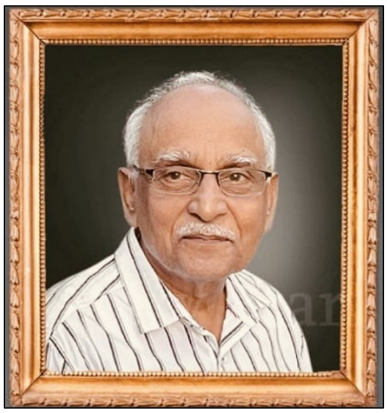
More than a teacher, a researcher, or a guide, Prof. Pandey was a sanctuary for many and provided a caring presence in the lives of many. His time and energies revolved around the well-being of the people in his circle as he genuinely cared about them. A renowned biostatistician and a well-known population scientist, Prof. Pandey was a towering personality in his field. Being sincere and loyal to his duties, Prof. Pandey was always respectful to his teachers, colleagues and friends. His sudden demise has been a big shock to his students, colleagues, friends, his

close relatives and family members. It has been a great loss to disciplines he was greatly involved with, that is, biostatistics and population sciences. His demise will be deeply mourned by everyone.

The Indian Society for Medical Statistics (ISMS) will always remember Prof. Arvind Pandey for his significant contributions towards its mission and objectives, and also for his love and devotion to the profession. His unexpected departure has caused a vacuum in the ISMS family. We pay our sincere tributes to him. He will ever remain in our hearts.

**Prof. S.N. Dwivedi**
*President, ISMS*
*dwivedi7@hotmail.com*

# Obituary



**Prof. KR Sundaram**
Ph.D., FSMS
(31 October 1943 – 28 September 2024)

It is with immense grief that we inform members of the Indian Society for Medical Statistics (ISMS) about the passing of Professor KR Sundaram, a reputed biostatistician cum epidemiologist. Professor Sundaram, fondly called 'Mani' by his family, was born and raised in Ernakulum, Kerala. Statistics and playing football were his early passions and statistics remained a constant till the very end. He discovered his love for travel at a young age and his curious and exploratory nature took him first to all parts of the country for education and work, and then to various parts of the world. He was witty and fun loving, and a special favourite amongst children. He has left an enduring legacy of his passion for work and for life itself. Since his childhood, he inherited a cool and polite attitude. He is survived by his wife, Mrs. Nalini Sundaram; and two daughters Mrs. Usha Ravi and Mrs. Priya Rajive. By the grace of God, both of his daughters are married, blessed with kids and well settled along with their spouses.

Prof. Sundaram went to the prestigious University of Kerala, Thiruvananthpuram, Kerala, and completed his graduation and post graduation degrees in science. After his M.Sc., he joined temporarily as lecturer in one of the colleges affiliated to his Alma Mater, University of Kerala. Later, he shifted to Delhi as research officer at Institute for Research in Medical Statistics (later renamed as National Institute for Medical Statistics (NIMS)), ICMR. For the update, NIMS is presently renamed as ICMR-National Institute for Research in Digital Health and Data Science (ICMR-NIRDHDS). Prof. Sundaram finally moved as Faculty at independent Biostatistics Unit, All India Institute of Medical Sciences (AIIMS), New Delhi, in 1976. He played major role in renaming of Biostatistics Unit as Department of Biostatistics in 1986, fulfilling a long felt need for such department. Throughout his stay at AIIMS, he dedicated his energies to teaching, researching, mentoring, and guiding students on varying topics under clinical and public health. His involvement as Guide/ co-guide/ doctoral committee member could help numerous MD/ MS/ MCh/ PhD students of All India Institute of Medical Sciences (AIIMS), Delhi. Prof. Sundaram also supported not only Faculty of AIIMS, New Delhi, but also Ministry of Health and Family Welfare; Department of Health Research; Indian Council of Medical Research; Nutrition Foundation of India; and Dept of Science & Technology, Govt. of India.

Since he joined AIIMS, Prof. Sundaram was determined to pursue a Ph.D. in biostatistics, which he could complete in 1991, the year I joined as faculty there. I was fortunate to attend his viva-voce examination. It may be worthwhile to mention here that he has emerged as first child of the department named Ph.D. He worked on modelling of growth and development of children. At AIIMS, Prof. Sundaram was not only quick to establish his academic and research credentials but also forged his presence as an able mentor and guide to many students/ faculty. He completed his Ph.D. a little late, but in due course, he became Professor through a rare single time change in recruitment rules because of his sincere hard working and academic credentials. Prof. Sundaram was a very humble and helping personality; and

often liked by everyone including faculty and students. He superannuated as Senior Professor and Head of the Department of Biostatistics, AIIMS. He also served as Sub-Dean, AIIMS, New Delhi; and also as Adjunct Faculty, Clinical Epidemiology Unit, AIIMS, New Delhi. His stay at AIIMS paved the way for academia and research, as well as some special friendships including with me, which continued for the rest of his life. He will continue to be missed especially by his friends/ students.

After superannuation from AIIMS, New Delhi, Prof. Sundaram moved near to his native place, Kochi, in the year, 2005. He again joined a second inning of his academic career as Head, Department of Biostatistics, at the Amrita Institute of Medical Sciences and Research Centre (AIMS), Kochi, Kerala. There, he was also involved as Chief Coordinator of the postgraduate course titled Master of Science in Clinical Research. As expected, Prof. Sundaram contributed immensely through starting several training programs at AIMS, Kochi. Also, he continued participating in various meetings in Delhi including those in the ministry and ICMR, and provided technical assistance in the studies.

Prof. Sundaram had a long association with the Indian Society for Medical Statistics (ISMS). He served as General Secretary (1993-1995). As a Treasurer (1993-1995), I had to closely work with him regarding the final registration of our society (ISMS) in Delhi involving official address as Department of Biostatistics, AIIMS, New Delhi.

Prof. Sundaram was elected as a fellow of the society (FSMS) in 1996. Also, he served as President of ISMS for two years, 2003-2004. In addition, he also worked as Member of FSMS Committee, Executive Committee, Governing Council, Award Committee, Education Comm-ittee, and others. Professor K R Sundaram Young Research Scholar Award is already in place since 2013 through an endowment received from his family. As a mark of respect, the society (ISMS) honoured him with the Life Time Achievement Award (2023). Being sincere and loyal to his duties, Prof. Sundaram was always respectful to his colleagues and friends. His sudden demise has been a big shock to his students, colleagues, friends, his close relatives and family members. It has been a great loss to disciplines he was greatly involved with, that is, biostatistics and epidemiology. His demise will be deeply mourned by everyone.

The Indian Society for Medical Statistics (ISMS) will always remember Prof. K.R. Sundaram for his significant contributions towards its mission and objectives; and also for his love and devotion to the profession. His unexpected departure has caused a vacuum in the ISMS family. We pay our sincere tributes to him. He will ever remain in our hearts.

**Prof. S.N. Dwivedi**
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# Challenges faced by Medical Statisticians in India during Lockdown

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## Abstract

Statisticians help researchers to design their studies, analyse their data, and help them interpreting the findings. So, in the process statisticians interact a lot with researchers. With lockdown and social distancing practices the method of interaction changed and it was challenging for a statistician to understand the study or dataset or convey the results efficiently without a face-to-face interaction with the researcher. As many researchers utilized the time during lockdown on research activities statisticians became busy during the lockdown. They faced multiple challenges and difficulties, as their method of interaction had changed, also they had to learn newer technologies to have meaningful interaction. This study describes the challenges faced by statisticians during lockdown which otherwise go unnoticed. The findings help to understand how statisticians have faced the challenges of online consultations and how they rose up to the situation and adapted to newer methods of communications to facilitate meaningful interaction with researchers. This new mode of interaction could be part of future research collaboration practices and could be helpful to both the clinicians and the statisticians.

## Introduction

The theory and application of statistics spreads across many disciplines and making sense of the data from medical and biological sciences is the work of biostatisticians. They play a key role in the initial stages of proposal - in identifying primary outcomes, formulating primary hypotheses, proposing a study design with the appropriate sample size and power calculations, writing statistical analysis plans, also in carrying out statistical analyses and interpreting results. So, they spend considerable time with clinical researchers to gain insight about the study and related processes and terminologies, objectives and the study parameters. Since they are not from biological or medical sciences background, this interaction equips the biostatistician to a great extent to understand the study and the data. A statistician needs to also devote considerable time to convey the findings of the study to the researcher so that the researcher could express the results in the clinical language. The importance of involvement of statisticians in medical research have been stressed upon (Dobson, 1983; Altman et al., 2002; Li et al., 2018). Importance of interaction is also iterated by Adams-Huet & Ahn (2009) as, "*A brief consultation with a statistician will not be adequate to address the issues. The interaction with a statistician to construct the statistical section is not usually one meeting, email, or phone call. It is a process that will help you think through the design of your study. Additionally, the exchange of ideas is beneficial to the statistician who will better appreciate the clinical research question. The discussions with a statistician could lead to changes in study design, such as proposing a smaller, more focused study design to collect preliminary data*."

As Coronavirus tightened its grip on the world, many countries have declared restrictive measures, such as lockdown or stay at home orders to contain the spread of the pandemic. Most of the offices were shut down after the declaration of lockdown across the world. Many researchers utilized the time during lockdown to work upon previously collected data and to prepare manuscripts, many others planned studies related to Corona Virus Disease (COVID-19. This definitely kept the statisticians busy during the lockdown.

With restrictions of lockdown and social distancing practices, many of the researchers were unable to meet the statistician in person. It could have been challenging for a statistician to understand the processes, terminologies or the dataset without a detailed face to face interaction with the researcher, especially in multi-disciplinary studies or studies involving large and/or multiple datasets. They also could have faced difficulties to convey the results to researchers over phone or email or video call. Equally challenging would have been the interaction with clinicians due to the fear of infection, as the health care institutes functioned all through the pandemic. However, the challenges faced by statisticians who work in the medical field, and interact with medical researchers have not been addressed. This study tries to understand such challenges faced by statisticians during lockdown.

## Methods

Data for this study was collected from registered members of a society for medical statisticians in India. Data as well as informed consent were collected through free online survey platform, Google forms. Members were informed and requested to take part in the survey through e-mail. The online questionnaire explained the study, and that participation in the study was completely voluntary. The participants were assured of confidentiality, and identifiable information were not collected.

Data for this study was collected in May 2020 during the lockdown. Questionnaire for the study was prepared by the researchers in English, and its contents were examined by peers and experts. Filling up of the questionnaire took approximately 8-10 minutes. The structured questionnaire collected details about method of interaction adopted in statistical consultations, participant's preferred method of interaction, challenges or difficulty faced, level of satisfaction and willingness to adapt to new methods of interaction. Statistical consultation in this study meant data analysis, designing a study, sample size calculation and reviewing protocols. Data was analysed using the software SPSS (IBM SPSS Version 28) and level of significance was fixed at 0.05.

## Results

Registered members of a society for medical statisticians were invited to take part in the study through e-mail, and the response rate was 52%. 106 statisticians responded to the mail and took part in the survey, two of them did not consent. Most of the participants were males (64%). Most of the participants were employed in Government institutes (42%), 30% were employed in Private institutions or medical colleges about 13% in Multi-National Companies (MNCs) and 5% in universities; about 10% of the participants were freelance consultants and research scholars. Experience of the participants in statistical consultation ranged from 1 to 35 years with a median of 15 years (IQR 5-25). Majority of the participants (90%) had statistical consultations during lockdown, number of consultations ranged from 2 to 50 (median 8, IQR 3-20). Majority of those who had statistical consultations during lockdown were working from home (66%).

Only those participants who had statistical consultations during lockdown were considered for the analysis (n=94, 90%). Majority of the participants preferred and also interacted face to face with the researcher during both the initial and final stages of consultation.

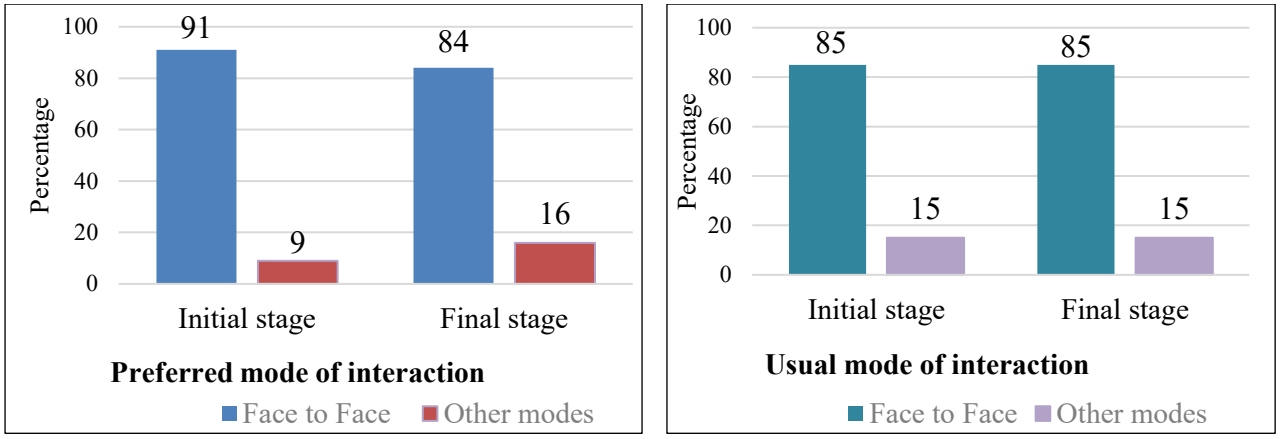


Figure 1: Preferred as well as usual method of interaction

However, a change has been noticed in the statistician-researcher interaction during statistical consultations in lockdown. Majority of the participants reported that researchers explained study through e-mails, phone calls or video calls (75%) during lock down, majority of the participants also had reported difficulty in understanding the study or data during lockdown (71%). "*Lack of clear explanation by the researcher", "lack of clarity of the researcher*" were cited as the most common reason for difficulty in understanding the study. It is known that the way clinical researchers pose their study and research questions differ greatly, while some present it with clarity, some would lack it. It is known to have a significant impact on the level of interaction between statisticians and researchers (McGinn, 2010).

Majority of the participants reported using e-mail, phone calls, video calls or elaborate written description of results to convey the findings of the study during lockdown. It is to be noted that none of the participants had mentioned explanation of results in written format (report) as a way of communication prior to lock down, though some had reported writing brief descriptions of results. Participants recounted that they usually explained on paper during face-to-face interaction; and that they could easily gauge if the researcher has understood the concept. Many participants have felt that such effective communication was not achievable during lockdown. The methods of interaction before and during lockdown were compared using McNemar-Bowker test.

## Interaction during the initial stage

Majority of the participants (85%) had reported that study was explained by researchers face to face before lockdown, only 25% reported similar interaction during lockdown. (See Table 1, and Figure 2)

Table 1: Changes in the method of interaction during the initial stage.

| Method of interaction-Explanation of study by researcher | Before lockdown | During lockdown | Test statistic[$] | p-value |
|---|---|---|---|---|
| | Number (%) | | | |
| Face to Face alone | 25 (27) | 7 (8) | 61.0 | 0.001 |
| Email / Phone | 11 (12) | 51 (54) | | |
| Face to Face + email / phone | 55 (58) | 16 (17) | | |
| Video call | 3 (3) | 20 (21) | | |

*$ - McNemar-Bowker test*

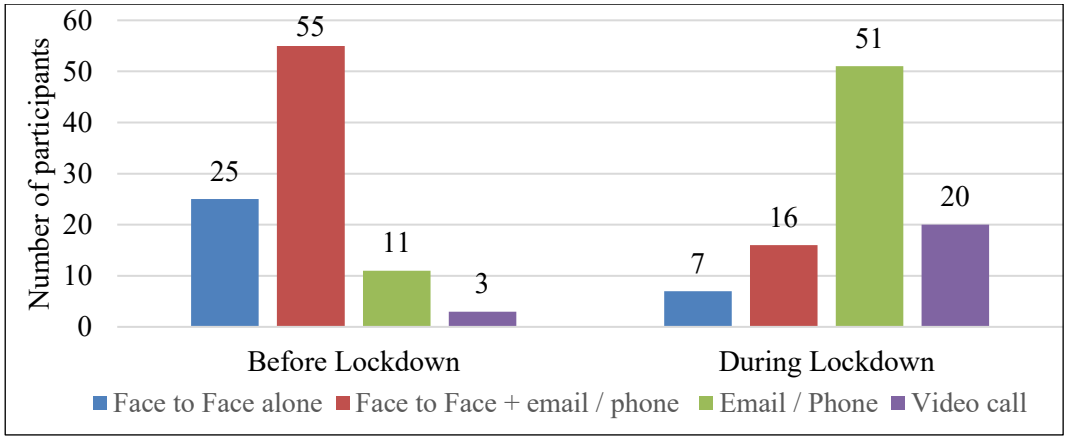


**Figure 2:** Changes in the method of interaction during the initial stage: explanation of study by researcher.

## Interaction during the final stage

Majority of the participants (88%) explained the results to the researcher face to face (in person) before the lockdown, but only 14% of the participants had reported this mode of interaction during lockdown. Many participants (60%) had reported that during lockdown they had started writing elaborate explanations of the results (report), whereas only a few participants reported writing brief descriptions before lockdown (11%). Data was not analysed due to scarce data distribution. (See Table 2 and Figure 3)

**Table 2:** Changes in the method of interaction during the final stage.

| Method of interaction – Explanation of results by statistician | Before lockdown | During lockdown |
|---|---|---|
| | Number (%) | |
| Face to Face | 17 (18) | 1 (1) |
| Face to Face + email / phone | 30 (32) | 7 (8) |
| Face to Face + reports* | 36 (38) | 5 (5) |
| Email / phone | - | 22 (23) |
| Reports* + email / phone | 10 (11) | 56 (60) |
| Video calls | 1 (1) | 3 (3) |

** Brief descriptions before lock down, but elaborate reports during lockdown*

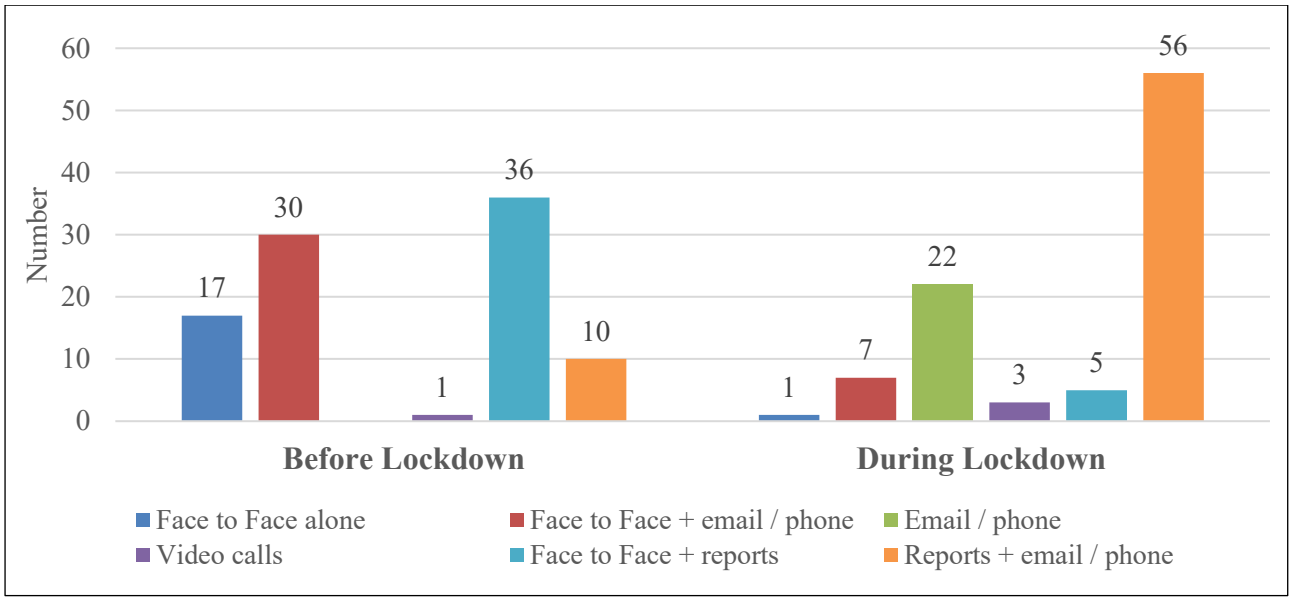


**Figure 3:** Changes in the method of interaction during the final stage: explanation of results by statistician.

The results indicated that the method of interaction have changed due to lockdown, an obvious shift from face-to-face interaction to writing up of explanations of results.

Majority of the participants reported that they had to invest more effort and time into making the researcher understand the results (68%). This could be because of the amount of work involved to write elaborate reports explaining major details of a statistical output. This is a mammoth task in itself, as it had to be written in a style and language that is understandable to the researcher and using less statistical terminologies – necessitating good writing skills. Added to this, majority of the participants were working from home and had issues related to connectivity, system, software, increased workload, deadlines and extended working hours as well as discomfort due to non-ergonomic infrastructure at home and distractions occur at home environment.

Though their preferred and familiar method of interaction was not possible during lockdown, majority of the participants could effectively communicate the findings to researcher (86%), and were also satisfied with the communication. The average satisfaction score was 7 on a 10-point VAS (mean & median =7, SD=2.16, Range:1-10). It was also encouraging to note that majority of the participants did not ask any researcher to return after lockdown or insisted on a meeting post lockdown to understand the study or data (72%) or to explain the findings (67%) (Figure 4).

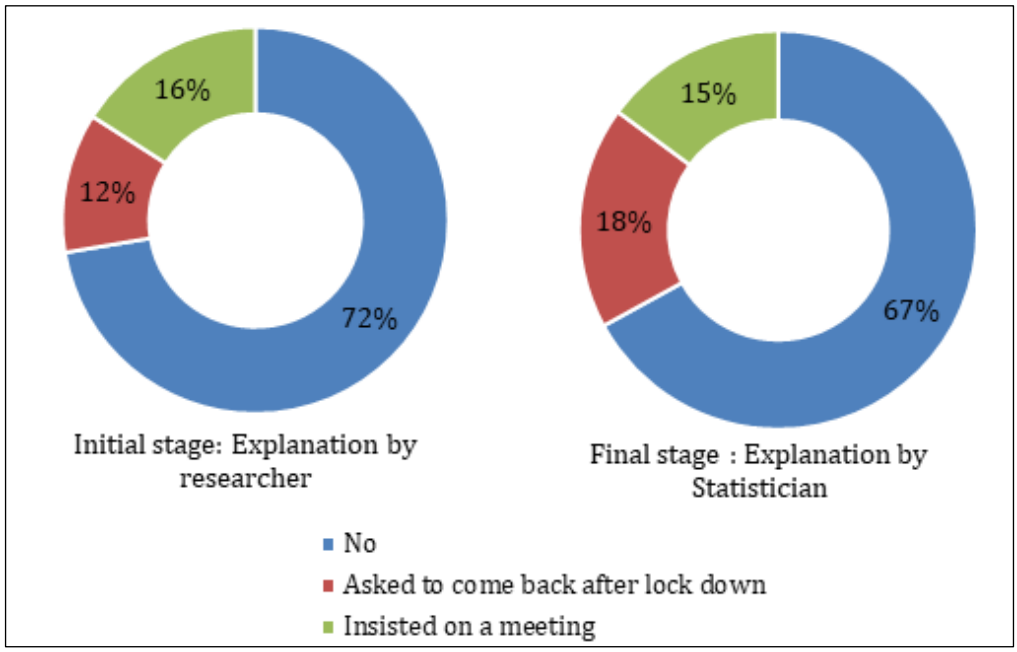


**Figure 4:** Ability to work in spite of challenges and difficulty in interaction during lockdown
(Did you send back any researcher or asked to come back after lockdown?).

It was inspiring to note that majority of the participants (87%) were willing to accept the changes and embrace the challenges, leaving their preferences and other difficulties behind. It is to be noted that about two-third of the participants (65%) had to master the use of new methods of interaction such as video conferencing, conference calls etc during the lockdown to facilitate effective communication. It is also heartening to note that about two-third of them (60%) asserted that they would prefer such interactions in future.

None of the findings mentioned above were significantly different between younger and older participants (≤ 40 years vs. > 40 years) or between male and female participants.

## Discussion

Biostatisticians generally interact a lot with clinical researchers to understand the study, its objectives and parameters, as well as to explain the findings. The interaction used to be face to face (in person) most of the time. This interaction equips biostatisticians to understand the study and helps them to further contribute to the research. However, the COVID-19 pandemic and the restrictive measures taken up thereafter word wide, had hindered the interaction between clinical researchers and biostatisticians. This could have an indirect impact on medical research in two ways (i) statisticians fail to comprehend the study's methodology, data, or researcher's needs (or the researcher is unable to communicate this to the statistician) and (ii) statisticians fail to effectively communicate the findings and their interpretation (or the researcher is unable to understand the results) because of hindered interaction between statistician and researcher. This could create dissemination of wrong information. No studies have assessed the challenges or difficulties faced by medical researchers or statisticians in statistical consultations during the pandemic.

## Strengths and limitations

As per our knowledge, the challenges faced by medical statisticians during the pandemic had not been addressed so far. Questionnaire used in the study were examined by the experts though validity was not established. Registered members of a society for medical statisticians were invited to take part in the study, so statisticians who were non-members were not part of the study. Response rate of the survey was only 52%. Despite these limitations, this study throws light on the challenges faced by medical statisticians during lockdown when medical researchers were using the lockdown to their advantage and were engaged in research activities.

## Conclusions

This study showed that statisticians rose to the occasion and adopted newer methods of interaction with researchers, such as video conferencing, tele conferencing, writing up elaborate reports. Majority of them had to master the techniques of video conferencing during lockdown, had difficulties in grasping the study, and had to put in more effort to convey the findings. However, it is worthy to note that none of them had sent back researchers, or asked them to return after lockdown or insisted on a face-to-face interaction. It was inspiring to note that majority of the participants were willing to accept the changes and embrace the challenges, leaving behind their preferred and common method of interaction, even though they had to put in more efforts and spend more time for each consultation.

It is known that crises, difficulties and challenges often lead to innovation of newer methods and practices. The pandemic has disrupted the in-person interaction between researcher and statistician during consultation. Although challenging, this paved way to adopt newer ways to interact and continue the scientific collaborations. The authors strongly feel that researcher community would benefit from this new mode of interaction as it eliminates the need for in-person meetings and this mode of interaction would be part of future research collaboration practices.

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# Multilevel Modeling in Biomedical Research: Theoretical Foundations and Practical Applications

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## Abstract

Multilevel modeling (MLM) is an advanced statistical technique designed to handle the complexities of hierarchical data, which are frequently found in biomedical research. This article explores the theoretical background of MLM, and its practical applications in biomedical contexts, including clinical trials, longitudinal studies, and genetic research. It emphasizes the advantages of MLM in enhancing the accuracy and reliability of statistical analyses, which supports better evidence-based decision-making in healthcare. The article also discusses the challenges of using MLM and explores potential future research directions in this field.

## Introduction

Multilevel modeling (MLM) is a powerful statistical method designed to analyze data that has a nested or hierarchical structure, which is prevalent in biomedical research. These structures often involve multiple levels of observations, such as patients grouped within hospitals or repeated measurements taken from the same individuals. Traditional statistical methods often overlook these complexities, which can result in biased estimates and incorrect conclusions. By directly accounting for these hierarchical relationships, MLM allows researchers to study how factors operate at different levels, enhancing our understanding of individual-level characteristics within broader organizational or clinical settings.

### *Importance of MLM in Biomedical Research*

Multilevel modeling accounts for the hierarchical nature of data, enabling the simultaneous analysis of variations within groups and differences between groups. This is particularly important in biomedical research, where it is crucial to understand how individual-level characteristics interact within broader contexts to accurately assess treatment effects and identify risk factors (Snijders & Bosker, 2012; Goldstein, 2010). Biomedical data often involve nested structures, such as patients nested within doctors, which in turn nested within hospitals or repeated measures within individuals over time, and MLM effectively addresses the complexities of these dependencies (Leyland & Groenewegen, 2020). This article provides a detailed examination of the role of MLM in biomedical research, discussing key concepts, advantages, and applications in areas such as clinical trials, longitudinal studies, genetic research, and behavioral studies. Additionally, it addresses the challenges of applying MLM, future research directions, and the broader implications for medical statistics and healthcare practices.

## Fundamentals of Multilevel Modeling

### *Concept of Multilevel Modeling*

MLM is used to analyze data that have a hierarchical or nested structures (Snijders & Bosker, 2012). This method accounts for the dependencies among observations at different levels, such as patients grouped within hospitals (Singer & Willett, 2003). Understanding these data structures is critical when applying MLM, as it ensures the proper accounting for dependencies between

observations within and across levels. MLM allows for the simultaneous estimation of parameters at multiple levels of analysis, capturing both within-group variation and between-group differences. This provides a more accurate representation of complex relationships often found in biomedical data (Raudenbush & Bryk, 2002).

***Theoretical Framework of Multilevel Modeling***

MLM models are based on the principles of linear mixed effects models, which incorporate both fixed (common to all units) and random effects (specific to each group or cluster). A two-level multilevel model can be represented as:

$$Y_{ij} = \beta_0 + \beta_1 X_{ij} + u_{0j} + u_{1j} X_{ij} + \varepsilon_{ij} \quad \ldots (1)$$

where $Y_{ij}$ is the dependent variable for individual i in group j; $\beta_0$ is the fixed intercept; $\beta_1$ is the fixed slope for the predictor variable X; $u_{0j}$ is the random intercept for group j, accounting for between-group variability of X; $u_{1j}$ is the random slope for group j, reflecting variability in the effect of X across groups; and $\varepsilon_{ij}$ is the residual error term for individual i in group j.

The random effects $u_{0j}$ and $u_{1j}$ are typically assumed to be normally distributed: $u_{0j} = N(0, \sigma_u^2)$, and $u_{1j} = N(0, \tau_u^2)$ where $\sigma_u^2$ and $\tau_u^2$ represent the variances of the random effects (random intercept and slope respectively) at the group level. This model allows for the investigation of how individual-level predictors influence the outcome while also accounting for variability between groups, making it particularly suitable for biomedical research where data are inherently nested.

***Comparing MLM with Traditional Statistical Approaches***

Traditional statistical methods such as linear regression, often assume that the observations are independent. Hierarchical data often violates this assumption leading to biased estimates and incorrect inferences (Hox, 2010). MLM addresses this issue by modeling the nested structure of data, enabling researchers to examine how predictors operate at different hierarchical levels, i.e., at both individual and group levels. This distinction is critical in biomedical research, where the interaction between individual-level characteristics and contextual factors is often critical making accurate predictions and drawing valid conclusions.

***Mathematical Derivation of Multilevel Models***

To derive the multilevel model, we start from a basic linear regression model. The standard linear regression equation can be expressed as:

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i \quad \ldots (2)$$

where $Y_i$ is the dependent variable; $X_i$ is the predictor, $\beta_0$ is the intercept; $\beta_1$ is the slope; and $\varepsilon_{ij}$ is the residual error term. In the case of hierarchical data, we can extend this model by adding random effects. Then the equation becomes:

$$Y_{ij} = \beta_0 + \beta_1 X_{ij} + u_{0j} + \varepsilon_{ij} \quad \ldots (3)$$

where $u_{0j}$ is the random effect for group j, allowing the intercept to vary across groups. This adjustment accounts for the fact that different groups may have different baseline levels of the outcome.

In more complex cases in a two-level model, we can allow both the intercept and the slope to vary across groups, leading to the equation (1): i.e., $Y_{ij} = \beta_0 + \beta_1 X_{ij} + u_{0j} + u_{1j} X_{ij} + \varepsilon_{ij}$. This model allows for the examination of how the effect of the predictor X differs across groups, making it highly flexible for modeling real-world biomedical data that often exhibit such variability.

## Advantages of Multilevel Modeling in Biomedical Research

### *Handling Nested Data and Hierarchical Relationships*

MLM excels in handling nested data structures commonly found in various research fields, including biomedical research, behavioral sciences, and educational settings. It captures dependencies among observations within the same group, while also accounting for differences between groups (Leyland & Groenewegen, 2020). This ensures that analyses accurately reflect the structure of the data, enhancing the precision of statistical estimates and leading to robust conclusions.

### *Accounting for Variability at Multiple Levels*

One of the main strengths of MLM is its ability to partition variability into different levels, distinguishing between within-group and between-group differences (Gelman & Hill, 2007). The total variance in the outcome variable Y can be decomposed into within-group variance and between-group variance:

$$\sigma^2_{total} = \sigma^2_{within} + \sigma^2_{between} \quad \ldots (4)$$

This decomposition allows researchers to quantify how much of the total variation in the data is attributable to individual-level factors versus group-level factors. For example, in a healthcare study, MLM can help separate patient-level variability (e.g., individual responses to treatment) from hospital-level variability (e.g., institutional differences in treatment protocols). This fine-grained analysis enables researchers to make more accurate inferences, particularly when the data are collected from multiple levels of aggregation.

### *Enhancing Accuracy and Reliability of Statistical Analyses*

In biomedical research, where the results often inform critical clinical or public health decisions, the reliability of the findings is paramount. By incorporating both within-group and between-group variations, MLM enhances the accuracy and reliability of results. This method is particularly important in research areas, where the robustness of findings can influence clinical decisions and public health policies (Maas & Hox, 2005). MLM ensures that the findings are generalizable and applicable to different levels of analysis, thereby increasing the impact and utility of the research.

### *Estimating Group-Level Effects*

MLM can estimate the group-level effects, which are crucial in understanding how the characteristics of groups (e.g., hospitals, communities) impact individual-level outcomes. This capability is particularly valuable in public health research, where understanding the impact of community-level interventions or policies on individual health outcomes is essential (Diez-Roux, 2000). By modeling both individual and group-level predictors, MLM provides insights into the broader determinants of health.

### *Flexibility in Model Specification*

The flexibility of MLM allows researchers to incorporate a wide range of predictors and interactions, including both fixed and random effects. This flexibility is crucial in biomedical research, where interactions between individual-level and group-level factors often play a significant role in determining health outcomes (Singer & Willett, 2003). By accommodating complex relationships, MLM enables researchers to develop more robust models that accurately capture the dynamics of health and disease.

### *Application to Longitudinal Data*

MLM is particularly well-suited for analyzing longitudinal data, where repeated measures are taken from the same individuals over time. It accounts for the correlations among repeated measurements, providing a robust framework for studying changes over time, such as treatment response or disease progression. By considering both individual and group-level factors, MLM offers valuable insights into dynamic biomedical phenomena (Fitzmaurice et al., 2011).

## Applications of Multilevel Modeling in Biomedical Research

### *Clinical Trials and Treatment Effectiveness*

MLM is commonly used in clinical trials to assess treatment effectiveness across different patient groups or sites. It allows researchers to account for patient-level characteristics and contextual factors that may influence treatment outcomes. For example, in a trial assessing a new antihypertensive drug, MLM can model how treatment effects vary across hospitals while accounting for differences in patient demographics (Raudenbush & Bryk, 2002).

*Example:* Consider a clinical trial evaluating the effectiveness of a new antihypertensive drug in multiple hospitals. The MLM can be expressed as follows:

$$Y_{ij} = \beta_0 + \beta_1(\text{Treatment})_{ij} + u_{0j} + \varepsilon_{ij} \quad \ldots (5)$$

where $Y_{ij}$ represents the blood pressure level of patient i in hospital j, $\beta_0$ is the Overall average blood pressure (baseline without treatment), $\beta_1(\text{Treatment})_{ij}$ is the effect of the treatment (change in blood pressure due to the drug), Random intercept, capturing differences in baseline blood pressure between hospitals, $u_{0j}$ is the random intercept, capturing differences in baseline blood pressure between hospital, and $\varepsilon_{ij}$ represents the residual error, representing individual variability within each hospital.

### *Longitudinal Studies and Growth Modeling*

In longitudinal studies, MLM can be used to model individual health trajectories over time. For example, in a weight-loss study, MLM can analyze changes in patients' weight while accounting for both individual characteristics and group-level influences, such as treatment settings (Fitzmaurice et al., 2011).

*Example:* In a longitudinal study assessing weight changes in a cohort of patients undergoing a weight loss program, the MLM can be specified as:

$$Y_{ijt} = \beta_0 + \beta_1(\text{Time})_t + u_{0j} + u_{1j}(\text{Time})_t + \varepsilon_{ijt} \quad \ldots (6)$$

where $Y_{ijt}$ is the weight of individual i in group j at time t, $\beta_0$ is the overall baseline weight (average starting weight across all groups), $\beta_1(\text{Time})_t$ is the fixed effect of time, representing the average weight change over time for all patients, $u_{0j}$ is the random intercept, accounting for the differences

in baseline weight across groups, $u_{1j}(Time)_t$ is the random slope, reflecting how the rate of weight change over time varies between groups, and $\varepsilon_{ijt}$ is the residual error term, representing individual-level deviations from the predicted weight. This model captures both the overall trend in weight change over time and group-level variations in the weight loss trajectory.

***Genetic Research and Heritability Studies***

MLM is also widely applied in genetic research, where the analysis of heritability and genetic factors requires accounting for the nested structure of data (Vinkhuyzen et al., 2013). By examining how genetic and environmental factors contribute to phenotypic variation, MLM enhances understanding in this field. For instance, in twin studies, MLM can model how genetic and environmental factors contribute to phenotypic differences, providing insights into heritability (Fitzmaurice et al., 2011).

*Example:* In a twin study assessing the heritability of a particular trait, the MLM is specified as:

$$Y_{ij} = \beta_0 + \beta_1(Genotype)_{ij} + u_{0j} + \varepsilon_{ij} \quad \dots (7)$$

where $Y_{ij}$ is the trait score for twin i in family j, $\beta_0$ is the fixed intercept representing the average trait score across all twins, $\beta_1(Genotype)_{ij}$ is the fixed effect of genotype indicating how trait scores change with genotype differences, $u_{0j}$ is the random intercept for family j accounting for shared environmental or genetic influences within families, and $\varepsilon_{ij}$ is the residual error for twin i in family j representing individual deviations not explained by the model. The random effects can help differentiate genetic influences from environmental factors, offering insights into the heritability of traits (Fitzmaurice et al., 2011).

***Behavioral Studies and Public Health Research***

In behavioral and public health research, MLM is used to study how both individual behaviours and contextual factors, such as community interventions, affect health outcomes (Diez-Roux, 2000). For instance, MLM can evaluate the impact of smoking cessation programs across different communities, accounting for both individual and community-level influences.

*Example:* In a study examining the impact of community interventions on smoking cessation rates, the MLM can be used to analyze individual-level data nested within communities:

$$Y_{ij} = \beta_0 + \beta_1(Intervention)_{ij} + u_{0j} + \varepsilon_{ij} \quad \dots (8)$$

where $Y_{ij}$ is the smoking cessation status for individual i in community j, $\beta_0$ is the fixed intercept representing the average smoking cessation rate across all individuals, $\beta_1(Intervention)_{ij}$ is the fixed effect of intervention indicating how the intervention impacts smoking cessation rates for individuals, $u_{0j}$ is the random intercept for community j accounting for community-specific factors that influence smoking cessation reflecting shared characteristics within the community, and $\varepsilon_{ij}$ is the residual error for the individual i in community j representing individual variations not explained by the model. This model accounts for both individual characteristics and community-level factors, providing a comprehensive understanding of the intervention's effectiveness (Diez-Roux, 2000).

***Education and Training Outcomes***

MLM is also used in educational research to evaluate the effects of teaching interventions on student performance. By accounting for both individual and classroom-level factors, MLM provides insights into how different teaching strategies impact learning outcomes (Singer & Willett, 2003).

*Example*: In a study examining the effectiveness of a new teaching strategy on student performance, the MLM is expressed as:

$$Y_{ij} = \beta_0 + \beta_1(\text{Teaching Strategy})_{ij} + u_{0j} + \varepsilon_{ij} \quad \ldots (9)$$

where $Y_{ij}$ is the test score for student i in classroom j, $\beta_0$ is the fixed intercept representing the average test score across all students in the study, $\beta_1(\text{Teaching Strategy})_{ij}$ is the teaching strategy indicating how the strategy influences the test scores of individual student, $u_{0j}$ is the random intercept for classroom j accounting for classroom-specific factors that may affect student performance, reflecting shared characteristics of students within the same classroom, and $\varepsilon_{ij}$ is the residual error for student i in classroom j representing individual variations in test scores not explained by the model. This model allows researchers to evaluate the impact of teaching strategies on student performance while considering the hierarchical structure of the data (Singer & Willett, 2003).

### *Generalized Linear Mixed Models (GLMM) for Non-Linear Outcomes*

Multilevel modeling is not limited to linear models. When the outcome variable is binary (e.g., disease presence/absence), count data (e.g., number of hospital visits), or follows other non-normal distributions, generalized linear mixed models (GLMM) are used. GLMM extends the multilevel framework to handle these non-linear outcomes by incorporating appropriate link functions, such as the logit function for binary outcomes (logistic regression) or the log function for count data (Poisson regression). This flexibility allows researchers to model a wide variety of data types within the multilevel structure, making it a powerful tool in biomedical research for addressing complex data scenarios, such as binary disease states, incidence rates, and survival analysis.

## Challenges and Future Directions

### *Implementation Challenges in Multilevel Modeling*

Despite its many advantages, MLM presents several implementation challenges. One of the primary difficulties is the need for sufficient sample sizes at each level of the hierarchy to ensure the reliability of the estimates. Small sample sizes at higher levels (e.g., groups or clusters) can lead to biased or unstable estimates of the random effects (Hox, 2010).

Additionally, researchers must carefully consider the choice of fixed and random effects, as incorrect model specification can lead to misleading conclusions. Proper understanding and interpretation of the random effects structure are crucial, especially in studies with complex hierarchies. Another challenge is the computational complexity of MLM, particularly for large datasets or models with multiple levels of nesting. Fitting multilevel models requires specialized software, such as R, SAS, or Stata, which can handle the iterative procedures needed for maximum likelihood estimation. As data structures become more complex, the computational demands of MLM also increase, potentially limiting its accessibility for some researchers.

### *Future Research Directions in Multilevel Modeling*

As biomedical research continues to evolve, there is a growing need for advancements in MLM techniques to handle more complex data structures, such as cross-classified models, multiple membership models, and dynamic multilevel models (Hox, 2010). Cross-classified models, for example, allow for the modeling of non-nested hierarchies, which are increasingly common in

biomedical studies where individuals belong to multiple groups (e.g., patients treated by multiple doctors or attending different clinics). Another promising direction for future research is the integration of MLM with machine learning techniques. Hybrid approaches that combine the interpretability of MLM with the predictive power of machine learning can lead to more accurate models for complex biomedical data, such as genomic data or electronic health records. These advancements will help researchers tackle the challenges of high-dimensional data while maintaining the hierarchical structure of MLM.

***Implications for Medical Statistics and Healthcare Practices***

MLM has significant implications for medical statistics and healthcare practices. By providing more accurate and reliable estimates of treatment effects and risk factors, MLM contributes to evidence-based decision-making in clinical and public health settings. For example, MLM can help identify which patient subgroups are most likely to benefit from a particular treatment, leading to more personalized healthcare interventions. Moreover, the ability of MLM to model contextual factors, such as hospital policies or community characteristics, can inform the design of more effective public health programs and interventions (Fitzmaurice et al., 2011). In the era of precision medicine and population health, MLM plays a crucial role in bridging the gap between individual-level data and broader societal influences, ultimately improving healthcare outcomes for diverse populations.

## Conclusion

Multilevel modeling is an essential statistical tool in biomedical research, offering a robust approach to analyse hierarchical data. By accounting for both individual and group-level variations, MLM enhances the accuracy of statistical estimates and supports more reliable conclusions. Its applications are broad, ranging from clinical trials and longitudinal studies to genetic and behavioral research. Despite challenges in implementation, ongoing advancements in MLM techniques and tools will continue to strengthen its role in advancing biomedical knowledge and improving healthcare practices.

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# National Statistics Day Celebrations - 2024 at ICMR-NIIH, Mumbai

**Date**: June 27th and 28th, 2024

**Venue**: Seminar Hall, ICMR-National Institute of Immunohaematology (ICMR-NIIH), Mumbai

The ICMR - National Institute of Immunohaematology (ICMR-NIIH), Mumbai, organized a vibrant celebration of National Statistics Day on June 27th and 28th, 2024. The event emphasized the critical role of statistics in healthcare and medical research while providing a platform for engagement, knowledge-sharing, and enjoyment for scientific and technical staff, students, and participants.


*ICMR-NIIH Statistics Day celebrations - 2024*

The celebrations began with the eagerly awaited department-wise ePoster competition, announced two weeks prior. Participants were given datasets and asked to create ePoster presentations applying statistical methodologies to real-world data, showcasing their analytical skills. The submissions highlighted the participants' understanding of statistics in medical research. After a detailed evaluation, the Department of Hematogenetics won first place, followed by the Department of Pediatric Immunology & Leukocyte Biology, and the Department of Hemostasis and Thrombosis.

Across the two days, the event featured various activities, including interactive statistics-themed stalls, a quiz competition, and a keynote lecture. The event brought together over 100 participants - scientists, technical staff, PhD students, and postgraduate students - emphasizing both theoretical and practical engagement. National Statistics Day 2024 was an engaging and successful celebration that left a lasting impact on attendees.

**June 27, 2024 (Day 1): Interactive Engagement with Statistics**

The celebrations kicked-off with participants gathering at ICMR-NIIH's Seminar Hall, where the opening activities centered on interactive statistics-themed stalls.

*Inauguration of Statistics Day celebrations-2024 by Dr V Babu Rao, Deputy Director, ICMR-NIIH*

Inaugurated by Dr. Babu Rao Vundinti, Deputy Director of ICMR-NIIH, the stalls offered fun and educational activities aimed at enhancing participants' problem-solving and analytical thinking skills through various statistical concepts:

- *Rubik's Cube Challenges:* Participants attempted to solve Rubik's cubes, encouraging critical thinking and drawing parallels between puzzle-solving and statistical problem-solving techniques.

- *Statistical Word Search:* A word search puzzle helped participants reinforce their knowledge of essential statistical terms and concepts.
- *Video Exhibits:* Short videos showcased practical applications of statistics in healthcare and everyday life, bridging the gap between theoretical knowledge and real-world relevance.
- *Spin-the-Wheel Game:* A popular activity where participants were quizzed on topics such as basic mathematics, probability, logic, basic science, and scrambled statistical terms.
- *Stacking the Cups:* This activity involved stacking cups in specific patterns as quickly as possible. It tested participants' hand-eye coordination, speed, and focus, highlighting the importance of precision - similar to statistical techniques where accuracy is crucial.

From 3:00 PM to 5:00 PM, participants eagerly engaged in these activities, which encouraged collaboration and hands-on learning in an informal yet educational setting. The wide range of activities fostered a fun learning environment, making statistics more approachable and memorable.
The day continued with a Quiz competition using the Kahoot application, where 32 participants formed teams and competed in answering statistics-themed questions.

*Participants in quiz competition*

The quiz questions ranged from basic statistical concepts to advanced topics in probability and data analysis, promoting camaraderie and healthy competition. Prizes were awarded to the top three teams for their excellent performance. Day 1 concluded with a short briefing session at 5:40 PM, setting the expectations and schedule for Day 2, which promised further academic engagement.

**June 28, 2024 (Day 2): Academic Excellence and Prize Distribution**

The second day of the event began with an eagerly awaited Guest Lecture by Dr. M. Vishnu Vardhana Rao, Former Director of ICMR-National Institute of Medical Statistics (NIMS).

Dr. Rao's lecture on "Harnessing Statistics for Health Research: A Tribute on National Statistics Day," offered insights into how statistics have revolutionized healthcare research. Dr. Rao highlighted the role of statistical methodologies in shaping medical interventions, disease surveillance, and health policy decision-making, supporting his points with several real-world case studies.

*Invited talk by the Chief guest, Dr. M. Vishnu Vardhana Rao, Former Director, ICMR-NIMS*

The lecture attracted over 100 participants, including scientists, technical staff, PhD students, and postgraduates, who gained a deeper appreciation for the transformative power of statistics in healthcare. Dr. Rao's talk resonated with the audience, who applauded his detailed explanations and practical examples.

Following the lecture, the Prize Distribution Ceremony recognized the outstanding efforts of participants from the previous day's ePoster and Quiz competitions. Dr. Manisha Madkaikar, Director of ICMR-NIIH, addressed the audience, stressing the importance of statistical methods in healthcare and research, while also emphasizing the growing reliance on data-driven decision-making in the field. Dr. V. Babu Rao also spoke, highlighting the crucial role of statistical techniques in advancing scientific knowledge and improving healthcare outcomes.

The ceremony honored the winners of the ePoster and Quiz competitions, with dignitaries presenting the awards. The ceremony concluded with a Vote of Thanks delivered by Dr. Amrutha Jose, who expressed appreciation to the guest speaker, participants, and the organizing team for their dedication and hard work in making the event a success.

**Closing Remarks: A Celebration of Statistics**

The National Statistics Day celebrations at ICMR-NIIH in 2024 were an undeniable success. The event provided a valuable platform for participants to engage with statistical concepts in a variety of ways - from interactive activities and competitions to formal academic lectures. By emphasizing the real-world applications of statistics in research and daily life, the event deepened participants' understanding and appreciation of this crucial field.

The enthusiastic participation of staff, students, and guests underscored the importance of statistics in modern healthcare research and policy-making. The event's success was a testament to the hard work of the organizing team and the active engagement of all participants. The 2024 celebration set a strong precedent for future events, reinforcing the role of statistics in driving scientific innovation and improving public health.

## ICMR-NIIH Statistics Day Celebrations: Day 1 (June 27, 2024)


Attendance marking

Dr Manisha R Madkaikar, Director (ICMR-NIIH) visiting the stalls

Fun activities: Rubik's cube solutions

Fun activities: Spin the wheel game

Fun activities: Statistical word search

Fun activities: Stacking the cups

Video exhibits: Applications of Statistics

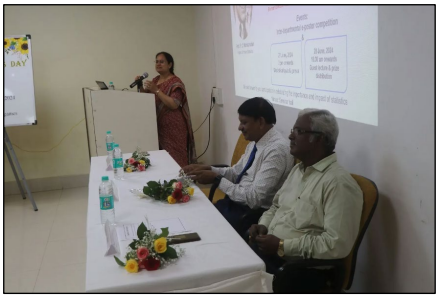
Participants in Kahoot-based quiz competition


Feedback from the stall visitors

## ICMR-NIIH Statistics Day Celebrations: Day 2 (June 28, 2024)

Welcome speech

Welcoming the Chief guest



Speech by Director, ICMR-NIIH

The audience listening to invited talk by M. Vishnu Vardhana Rao

Presenting memento to Chief guest

e-poster competition: First prize

Quiz competition: First prize

Vote of Thanks

The Gathering

# 41st Annual Conference of Indian Society for Medical Statistics

Hosted by Mahatma Gandhi University, Kottayam, Kerala.
During 2 - 4 November 2023

The 41st Annual Conference of the Indian Society for Medical Statistics (ISMS) was hosted by the School of Mathematics & Statistics jointly with the School of Data Analytics, Mahatma Gandhi University, Kottayam, Kerala during 2-4 November 2023. A National Conference on Emerging Developments in Medical Statistics and Biostatistics in the Era of Data Science was also organized as part of the ISMS Annual Conference in conjunction with the Ruby Jubilee Celebrations of the Mahatma Gandhi University, Kottayam.


*INAUGURATION OF ISMS CON 2023 BY PROF. DR. C. T. ARAVINDAKUMAR, VICE CHANCELLOR, M. G. UNIVERSITY*

The Conference was inaugurated at 9.30 am on 2-11-2023 by Prof. (Dr.) C.T. Aravinda Kumar, Vice Chancellor, Mahatma Gandhi University, Kottayam. The meeting was presided by Prof. Dr. S. N. Dwivedi, President, ISMS.


*Lighting the Lamp by Prof. Dr. P. G. Sankaran, VC, CUSAT, Kochi*

The Keynote address on 'Modeling and Analysis of Panel Count Data with Multiple Modes of Recurrence and its Applications in Medical and Biostatistical Contexts' was delivered by Prof. (Dr.) P. G. Sankaran, Vice Chancellor, Cochin University of Science and Technology, Kochi.


*Releasing the Book of Abstracts and Souvenir of ISMSCON 2023*

Prof. (Dr.) B. Prakash Kumar, Registrar, M.G. University released the Souvenir and Book of Abstracts. The Presidential Address was delivered by Prof. Dr. S. N. Dwivedi, President of Indian Society for Medical Statistics.


*Lifetime Achievement Award To Dr. Abhaya Indrayan*

Prof. Dr. B. Binukumar, General Secretary, ISMS, presented a brief Report of Activities of ISMS during the past. The various awards of ISMS was presented by Dr. S. N. Dwivedi and Dr. C.T. Aravinda kumar. The Organizing Secretary Prof. Dr. K. K. Jose welcomed the guests and delegates. Prof. Dr. C. Satheesh Kumar, President Kerala Statistical Association and General Secretary, ISPS and Director, School of Mathematical Sciences, University of Kerala felicitated the gathering. Prof. Dr. R. Sreekumar expressed a vote of thanks. It was followed by High Tea.


The first technical session in memory of the founder President Prof. S. K.Bhattacharya was held at 11.00 am. The Prof. S. K. Bhattacharya Oration on 'Machine Learning Based Statistical Approaches for Multi-Omics Data' was delivered by Prof. (Dr.) P. Venkatesan, Former Scientist F and Head of the Dept. of Statistics, National Institute for Research in Tuberculosis (ICMR-NIRT) Chennai in a session chaired by Prof. (Dr.) S. N. Dwivedi.

*A View of The Audience*

It was followed by the second technical session in memory of Prof. (Dr.) C. R. Rao, the legendary Statistician who passed away on 22 August 2023. There were two Plenary Speakers. The first speaker was Prof. (Dr.) Abhaya Indrayan, founder Professor and Head of the Department of Biostatistics, AIMS, New Delhi and Consultant to WHO and IMF. He delivered a very informative talk on 'Personalized Statistical Medicine'.

*Dr.Vishnu Vardhana Rao, ISMS Fellow Awardee*

The second talk was by Dr. M. Vishnu Vardhana Rao, former Director, National Institute for Medical Statistics (ICMR-NIMS), New Delhi. His talk as on 'Applications of Statistical Methods in Big Data Analytics and Artificial Intelligence'. This session was chaired by Prof. (Dr.) P. Karan Singh, Professor and Chair, Dept. of Epidemiology and Bio-statistics, Tyler School of Medicine, University of Texas, USA and Prof. N. Sreekumaran Nair, Professor and Head, Dept. of Biostatistics, JIPMER, Pondicherry.

The poster presentation session was held in the AN in the Convergence Academia Complex Auditorium.

*Poster Presentation Winners*

After lunch break, the third technical session in memory of Prof. P. P. Talwar, former President of ISMS was held online. It was chaired by Prof. (Dr.) Babu L. Verma. The speaker was Prof. Dr. Sanjay Zodpey, President Public Health Foundation of India (PHFI), New Delhi. He delivered the P. P. Talwar Lecture on 'Shaping the Agenda for Epidemiology in India'.

*A View Of The Audience*

The fourth technical session was a Plenary Session in memory of Prof. (Dr.) C. M. Pandey, former President of ISMS and President of International Epidemiological Association who passed away on 1 October 2023. It was chaired by Prof. Dr. Sairu Philip, Professor and Head, Dept. of Community Medicine, Govt. Medical College, Kottayam and Prof. (Dr.) L. Jayaseelan, MBR University of Medicine and Health Sciences, Dubai and former President of ISMS and Head of the Dept. of Biostatistics, C.M.C. Vellore. There

were three speakers. The first speaker was Prof. Dr. Roy Abraham Kallivayalil, former President of World Association for Social Psychiatry and Secretary General of World Psychiatric Association, Geneva. His talk was on 'Mental Health in an Unequal World: The Role of Social Determinants and Medical Statistics'. The second speaker was Dr. Johny Joseph, Senior Consultant Cardiologist and Director of the Caritas Heart Institute, Caritas Hospital, Kottayam. His talk was on 'Ten Learning Points in Research perspective of a clinician rooted in Community'. The next speaker was Prof. (Dr.) Aleyamma Mathew, Head of the Department of Cancer Epidemiology and Biostatistics, Regional Cancer Centre Thiruvanathapuram. Her talk was on 'Transition of Cancer and Related Epidemiological Research in the Populations of India'. It was followed by Tea break.

*Prof. Karan P. Sigh, University of Texas, USA delivers the Plenary Talk*

The fifth technical session was a Plenary session chaired by Prof. (Dr.) P. Venkatesan and Prof. Dr. K. K. Singh. There were two speakers. The first speaker was Prof. (Dr.) Karan P. Singh, Professor and Chair, Dept. of Epidemiology and Biostatistics, Tyler School of Medicine, University of Texas, USA. His talk was on 'Addressing Health Equity Challenges in Rural Communities'. The second speaker was Prof. (Dr.) C. Satheesh Kumar, former Head of the Dept. of Statistics and present Director of the School of Mathematical and Physical Sciences, University of Kerala. His talk was on 'Generalized Families of Logit Models and Their Applications in Biostatistics'.

The Annual General body Meeting of ISMS was held from 5.30 pm to 7.00 pm. Various issues facing Biostatisticians in Medical Colleges was discussed. It was followed by a Cultural Program and Banquet at Convergence Academia Complex Hall. All participants enjoyed the cultural program and delicious menu and expressed their appreciation.

*Memento To Dr. E. Sandhya After Mohiniyattam*

On 3-11-2023, the programs started at 9.00am with three parallel Technical Sessions in which 25 contributed papers were presented. The Dr. R. N. Srivastava Award paper presentations were held from 10.15 am to 11.00am.

After tea break, the Plenary session was held. There were three speakers namely, Prof. Dr. L. Jayaseelan, Prof. Dr. S. N. Dwivedi and Prof. Dr. N. Sreekumaran Nair. The session was chaired by Dr. C.B. Tripathi and Dr. K. K. Singh. Prof. Jayaseelan, MBR University of Medicine and Health Sciences, Dubai, UAE delivered his talk on 'Opportunities and Challenges in the Application of Artificial Intelligence in Biomedical Research'. Prof. Dr. S.N. Dwivedi delivered his talk on 'Statistics in Evidence Based Health Care: Prompting Points'. Prof. Dr. N. Sreekumaran Nair spoke on 'Multivariate Meta Analysis Methods in Evidence Based Medicine'. It was followed by two parallel sessions of Invited Talks by 6

experts. The invited speakers were Dr. Anil C. Mathew, Dr. Sebastian George, Dr. Brijesh P. Singh, Dr. K.T. Harichandrakumar, Dr. Preethi Sara George and Dr. A. K. Tiwari.

After Lunch Break, the AN session started at 2.00pm by three parallel Technical Sessions of contributed papers in which 26 scientists presented their research papers. After tea break, from 3.30 pm to 4.45 pm a Panel Discussion on Continuing Medical Education: The Growth and Development of Biostatistics Specialty in India, organized and moderated by Prof. Dr. B. L. Verma was held. There were 7 eminent speakers namely, Dr. B. L. Verma, Dr. Vishnu Vardhana Rao, Dr. L. Jayaseelan, Dr. P. Venkatesan, Dr. S. N. Dwivedi, Dr. Anil C. Mathew and Dr. V. Sreenivas. From 5.00 pm to 6.30 pm three parallel Technical Sessions of contributed papers were held and 25 young researchers presented their research papers.

*Dr. B. L. Verma in the Panel Discussion*


*Prof. S. N. Dwivedi during the Panel discussion*

At 8.00pm there was a Special Dinner for the delegates in Excalibur Hotel, Thellakom, Kottayam.

On 4-11-2023, there were three parallel Technical Sessions of contributed papers from 9.00 am to 10. 30 am and 27 young research scholars and post graduate students presented their research papers. It was followed by two parallel sessions of Invited Talks by 6 eminent experts from 11.00 to 12.30. The experts were Dr. Asokan M. Variyath., Dr. Ginto Jacob P., Dr. Joby K. Jose, Dr. Tinku Thomas, Dr. K.K. Jose and Dr. A. K. Mathai.

*Valedictory Function*

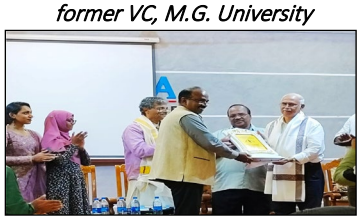
*Prizes For Best Paper Presentations*

The Valedictory Session was held from 12.30 to 13.30. The Chief Guest was Prof. (Dr.) Sabu Thomas, former Vice Chancellor of Mahatma Gandhi University Kottayam and Chairman, Trivandrum Research in Engineering, Science and Technology (TREST) Park, Thiruvananthapuram, Kerala.

*Prizes For Best Paper Presentations*

The Certificates and Prizes were distributed by Prof. Dr. Joby K. Jose, Professor of Statistics and Registrar, Kannur University. Dr. P. Venkatesan, Dr. C.B. Tripathy, Dr. C. Ponnuraja, and many student delegates shared their experience. Dr. Ancy Joseph welcomed the gathering.

*Presenting a memento to Prof. Dr. Sabu Thomas, former VC, M.G. University*



*Presenting Dr. P. P. Talwar Award of ISMS to Prof. Dr. K. K. Jose*

Prof. Dr. K. K. Jose expressed the Vote of Thanks. The Conference concluded with special lunch.

In summary there were 30 Plenary/ Keynote/Invited speakers. More than 50 senior scientists and 72 Young Scientists and research scholars attended and presented research papers. Eight industry people also participated. More than 145 postgraduate students attended the deliberations and workshops. In total about 325 people participated in the program.

On 1-11-2023 two Pre-conference Workshops were organized on the topics **(i) Bayesian Computing and MCMC Methods and (ii) Data Analytics and Machine Learning for Clinical Research.** About 75 each participated in these workshops.

# Pre-Conference Workshops held on 1 November 2023

## Bayesian Computing and MCMC Methods

**Venue:** Caritas Hospital Auditorium Thellakom

*Inauguration by Prof. L. Jayaseelan, MBR University for Medicine, Dubai*

Invited Speaker 1 - Dr. L. Jayaseelan, Former Professor & Head, Dept. of Biostatistics, CMC Velloor.

Invited Speaker 2 - Dr. Sebastian George, Professor & Head, Department of Statistical Studies, Kannur University, Kerala.

Invited Speaker 3 - Dr. B. Binukumar, Professor of Biostatistics, NIMHANS, Bengaluru.

Lab Demonstration - Mr. Jeswin P., Director, Biostatistics & Research, Caritas Hospital.

More than 100 delegates, research scholars and students attended this workshop.

## Workshop on Data Analytics and Machine Learning for Clinical Research

**Venue:** School of Data Analytics Hall M. G. University


*Inaugural Talk by Dr. B. Binukumar, NIMHANS, Bengaluru*

Invited Speaker 1 - Dr. Aleyamma Mathew, Professor of Epidemiology, Regional Cancer Centre, Thiruvananthapuram.

Invited Speaker 2 - Dr. Sajimon Abraham, Professor of Data Science & Business Intelligence, Mahatma Gandhi University, Kottayam.

Invited Speaker 3 - Dr. P. Venkatesan, Former Scientist F & Head, Dept. of Statistics, National Institute for Research in Tuberculosis, Chennai.

It was attended by over 100 participants including delegates and research scholars and postgraduate students from CMC Vellore, NIMHANS, NIE, Kannur University etc..

**Dr. K. K. Jose**
*Convener /Organizing Secretary*

*Local Organizing Committee and student artists with Dr. E. Sandhya after the Cultural Fiesta and Mohiniyattam*

# Department of Biostatistics

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