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ISMS Bulletin

Official Publication of
Indian Society for Medical Statistics (ISMS)

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

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Message from the President

Dear Members,

Season's Greetings. As I complete my second year as President of ISMS by the end of this year, I wish to thank the members of Indian Society for Medical Statistics (ISMS) for electing me as the First elected President through an election process to serve as President and to be a part of the society that not only gives knowledge back, but allows friendships to be created within the medical Statistics fraternity. I followed the footsteps of some great leaders of ISMS. This organization was formed by individuals who were motivated and persistent in pursuing a goal of success for Medical Statistics. I am keeping that tradition going.

This year was a challenge for myself and governing council as we continue to develop and improve our society to benefit our members in spite of hardship caused by pandemic. Several opportunities are available throughout the year to meet for education as well as networking with individuals within our society as well as with other academic bodies. Networking is an important part of our society that provides several opportunities to come in the way of members. ISMS have a wealth of knowledge, and when combined with the networking opportunities, will help to create long term relationships which will be priceless.

For our current members and perspective members I request to help ISMS to grow without limits. We will stay focused on remaining as a benefit to our members while also staying current with International standards and requirements. I invite each of you to participate in the activities and growth of ISMS and most important become involved

Thank you members for your continued participation and enthusiasm in our society affairs. Finally, I'd like to give a special shout-out of appreciation to the, Organizing Committee members of ISMSCON-2020, Special Committee Chairs and members for their tireless work on behalf of the ISMS.

Thank you all!
Wishing you a good and successful 2021, and looking forward to seeing you in the conference

Regards,
Dr. P. Venkatesan
President, ISMS

Message from the General Secretary- ISMS

Dear Members,

We as a vibrant society is in the 38th year of its existence. Our membership is nearing to thousand and we have members from diverse institutions and industry. Now Medical statistics is passing through a very challenging situation than ever before with new regulations from National Medical Commission in medical school employment, wide opportunities in interfacing with other disciplines but demand for quality human resources. We have job opportunities in industries and research organisation much more than ever before and same time we have tough competition from emerging disciplines like data sciences, disease informatics, bioinformatics etc. This definitely demand proper mentoring of our young students and scholars by senior members of the society.

I am sure this issue of ISMS bulletin will be having news items, academic notes and other very useful materials for members.

Thank you very much to the Editor and Editorial board for bringing out the bulletin.

Kind Regards
N. Sreekumaran Nair, PhD, FSMS
General Secretary, ISMS

Editor's Desk

Dear Members,

A warm Greetings to all. Hope all ISMS members and their families are safe. We have been forced to stay indoors and physically distanced ourselves from others by the prevailing COVID19 pandemic. Most of us tuned to the concept of remote work from home. This also brought opportunities to study this pandemic and focus readiness to future situations. On behalf of the editorial team, I sincerely appreciate all members for their contributions to this bulletin. The path we have passed to bring this issue of bulletin, which has many indescribable stories. We encourage all to communicate any noteworthy content related to our field and society for the publication in the bulletin.

This issue of the bulletin emphases range of information related to statistics to address wider readers. We are happy to bring the highlights on Padma Vibhushan Professor C R Rao and his association with ISMS on his 100th birth anniversary by Prof. BL Verma. I thank him for doing an excellent collation in a limited space. Recent past, we have noticed the changing status of statistics professions in medical academia. We must accept the changing scenario and prepare ourselves with prudent research skills to accommodate the future needs. On this direction, this issue also includes contributed articles and technical notes along with news and events. I appreciate our senior members' services to a cause greater than self.

Dr. K Thennarasu, *PhD*, *PDF*, *FSMS*
Editor, *ISMS Bulletin*

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Birth Centenary Celebrations of Statistics' Doyen

Padma Vibhushan Professor C R Rao - Some Highlights on His Life Sketch and Academic Contributions in Statistics

(With special reference to his patronage for ISMS)

Narrated by

Prof. B L Verma, Ph D, FAMS FSMS

A living legend of statistics, Professor C R Rao turned 100 on 10th September this year. As is known, he is widely recognized as a pioneer in the world of statistics who laid down the foundation of modern statistics. This celebrated personality in statistics, whose work has influenced not just statistics but has had far-reaching implications in fields as varied as economics, genetics, anthropology, geology, national planning, demography, biometry and health, still continues to contribute to his fields of work, quite actively.

Rao's 100th Birthday has been celebrated world over by his students as well as by various national & international statistical agencies, like – Government departments, universities, institutes and professional organizations / societies in different forms. This year despite Covid19 pandemic, series of online conferences and symposia have taken place in his honour as part of his 100th Birthday celebrations across the globe. According to his daughter, Tejaswini Rao – a former Professor of Nutrition in US, at least 10 such events have been held in his honour in India alone. Such events are still being organized in his honour during his birth centenary year.

Professor C.R. Rao and the ISMS

It is distinct honour for the *Indian Society for Medical Statistics (ISMS)* to have been associated with this world-renowned scholar in statistics since long. We have been indeed, exceptionally fortunate in receiving his patronage and blessings, almost since inception of our Society. Following sections briefly elicit on how ISMS came into being and our association with this living legend of statistics.

I) ISMS – Why & How?

In early 1980s, we - as group of 3 faculty members, namely - me, Dr R N Srivastava (deceased) and Dr G D Shukla (deceased), while working in specialities of Biostatistics, Community Medicine and Psychiatry respectively at Maharani Laxmi Bai Medical College & Hospital, Jhansi, in Uttar Pradesh (India), had a serious concern for poor quality of statistics in medicine. At that time we had realized that, even in this era of precision and accuracy, there exists an element of mutual mistrust and scare between medical and statistical experts that has often hampered the working and progress of both, by rendering them distant neighbours. The former viewed the latter as more of evil than necessity – an undue interference by a non medical person, while the latter often felt neglected, ignored and by-passed by the former. We thought, this has been mainly because of a lack of common platform for the mutually beneficial dialogues between them.

Before early 80s, there were little opportunities in our country for cross fertilization with each others' ideas and viewpoints. Our literature search, at that time, did not reveal existence of any professional Society in the discipline of medical statistics in the whole of South East Asia. Thus, we found, there is a crying need for making medical men more objective and statisticians more pragmatic. Realizing a professional Society in this part of the globe will help in developing medical statistics and

increase quality of its applications in health research, we thought of forming a professional Society in the speciality in 1983.

A country–wide meeting, at Jhansi (UP) on 10-12 November 1983, in form of a 'National Symposium on Statistics in Medicine' of active biostatisticians and also of medical professionals - known for their support to biostatistics in medical teaching, research and consultancy, was called for the purpose. This large group, besides their scientific deliberations during its 3 day program, also discussed & explored formation of a national professional Society in the speciality in a ½ day Special Session. This group on 12 November 1983, finally agreed to form the ***Indian Society for Medical Statistics*** with Late Dr R N Srivastava as its Founder President, me as its Founder General Secretary and Late Dr G D Shukla as its Founder Treasurer.

ii) Professor CR Rao's Association and His Patronage to ISMS:

After formation of the Society on 12 November 1983, we concentrated on its ground work and expansion of its activities. We then approached Professor C R Rao and requested him for becoming Life Member of our Society. He very kindly agreed to our request immediately and wrote a hand-written letter to us. He is thus, Life Member of ISMS (vide his Life Membership no.: 840143/LM) with effect from the year 1984. When Society got some shape, we started its Fellowship Program – somewhere in 1984, and approached him again for his consent to elect him as our first Fellow.

However, Professor Rao's advice to us was – this opportunity should first be given to Professor P V Sukhatme and he (himself) should be elected to the Society's Fellowship thereafter. When we communicated this to Professor Sukhatme, he never agreed to this proposal – saying that Professor C R Rao is to be elected Fellow first and then, he will agree to the proposal. Thus, Professor C R Rao is the first Fellow of ISMS (elected in the year 1984). I recollect – initially he was also on our Fellowship Committee – the most prestigious body of the Society.

Further, in the year 2019, ISMS honoured Professor Rao by unanimously electing him for its Lifetime Achievement award. Out of the 12 awards, this is the most prestigious Award of the Society. This Award is now due to be formally presented to him by the Society.

Professor CR Rao's Brief Life-Sketch and

Some Highlights of His Academic Contributions in Statistics

Professor Rao was born on 10 September 1920, in a small town in South India, called Hoovina Hadagali (now, it is in District Bellary of the Karnataka State).He was 8th child (out of total 10 children: boys 6 and girls 4) of his parents. On 9 September 1948, he was married to Bhargavi (28 April 1925 – 24 July 2017).

He earned his Master's Degree (in1st Class, 1st Rank, with Honors) in Mathematics from Andhra University in 1940. During his job hunting, he casually visited ISI, Kolkata - an Institute established by Professor PC Mahalanobis in 1931, and people around there said that the Statistics was a subject of the future. He joined a course on 'training in statistics', offered by the ISI, Kolkata in January 1941. Professor Rao received his MA Degree in Statistics (in1st Class, 1st Rank, with Gold Medal) from Calcutta University in 1943. He was the first amongst first 5 persons to have received Master Degree in Statistics from any Indian University. Professor Ronald A Fisher – who is known to be the Father of Statistics, was his Ph D Guide (1946 -1948) on the Thesis topic entitled "Statistical Problems of Biological Classifications". In 1965, he received his Sc.D. Degree from Cambridge University on his overall contributions to statistical theory and applications.

Positions Held at ISI, Kolkata and in USA:

Professor C R Rao entered ISI, Kolkata, in 1949 when Professor P C Mahalanobis offered him Professorship as well as Headship of the Research & Training School of the Institute. He was Head and later, Director of the Research & Training School of the Indian Statistical Institute for a period of over 40 years. In1972, he succeeded Professor P C Mahalanobis as Director of the Institute. He took mandatory retirement from ISI, Kolkata, in 1979 at the age of 60 years and moved to USA. He thus, spent around 3 &½ decades at ISI, Kolkata, while working in different capacities.

Professor Rao held several important positions, such as - Director of the Indian Statistical Institute, Jawaharlal Nehru Professor and National Professor in India, University Professor at the University of Pittsburgh and Eberly Professor & Chair of Statistics and Director of the Centre for Multivariate Analysis at the Pennsylvania State University in US. This Centre, established at his initiative serves as a meeting place for research workers in multivariate analysis from all over the world.

Contributions in Development of Statistics in India:

Professor C.R. Rao played an important role, under the direction of P.C. Mahalanobis, in setting up State Statistical Bureaus in different States of India and in developing a network of statistical agencies at the district level for collection of data. Together with CSO and NSS, India has now one of the best national statistical systems. Professor Rao developed research and training programs and produced outstanding students which put India not far from the centre of the statistical map of the world, and earned for ISI, the name of Indian School of Statistics. During this period, he also directed the training programs at the International Statistical Education Center, which led to the development of statistics in the South East Asia Region. Further, he founded the Indian Econometric Society, which has been active in promoting quantitative studies in economics for planning purposes.

Research Contributions:

His research areas include estimation theory, statistical inference, linear models, multivariate analysis, combinatorial design, orthogonal arrays, biometry, statistical genetics, generalized matrix inverses and functional equations. He is the author of 14 books. He has published nearly 400 papers in high impact journals - with around 270 papers appearing in journals after his retirement from ISI, Kolkata. Besides being an exemplary teacher, he has supervised over 50 students in their doctoral research. He received 38 Honorary Doctoral Degrees from different universities from 19 countries..

Contributions to the Statistical Theory & Practice:

Professor C. R. Rao is among the world leaders in statistical science over the last six decades. His researches, scholarships and professional services have had a profound influence on theory and applications of statistics. He has developed statistical estimation theory in small samples, extending the scope of statistical methods in practice. Among his best-known discoveries are the Cramer–Rao bound and the Rao–Blackwell theorem - both related to the quality of estimators, Fisher–Rao theorem, Rao distance, and orthogonal arrays. Some other technical terms - bearing his name appearing in specialized books include Rao's F and U tests in multivariate analysis, Rao's Quadratic Entropy, Cross Entropy and Rao-Rubin, Lau-Rao, Lau-Rao-Shanbhag and Kagan- Linnik-Rao theorems on characterization of probability distributions. Other areas he worked, include multivariate analysis, estimation theory and differential geometry.

Awards & Medals to Professor CR Rao:

His major awards & medals are : Padma Vibhushan (2001) by the Government of India, Guy Medal in Gold (2011) of the Royal Statistical Society, India Science Award 2010 (the highest award in scientific field by Government of India), International Mahalanobis Prize (2003) of the International Statistical Institute and Srinivasa Ramanujan Medal (2003) of the Indian National Science Academy. President George W. Bush, on 12 June 2002, honored him with the National Medal of Science - the highest award in U.S. in the scientific field. Other important awards include: Lifetime Achievement Award (2019) of the Indian Society for Medical Statistics, Mahalanobis Centenary Gold Medal of the Indian Science Congress, Wilks Memorial Award (1989) of the American Statistical Association, Guy Medal in Silver (1965) of the Royal Statistical Society, S. S. Bhatnagar Award (1963) of Council of Scientific and Industrial Research and JC Bose Gold Medal of the Bose Institute.

Finale:

It is not possible indeed, to describe, in a few paragraphs, what Professor C R Rao has contributed to the theory & practice of Statistics in past 6 decades. Here, I have briefly given some highlights only on his life-sketch and his academic contributions. The matter included here is mostly based on the Google search., For a detailed coverage on life-sketch as well as academic contributions of Professor C R Rao, readers are suggested to refer to the: ISMS Bulletin, Volume 24,No.2,(September 2015 Issue).

Note: I am fortunate to have been called upon by the Editor – ISMS Bulletin, to write a brief note on this great personality in Statistics. For this, I express my gratitude to the Editor.

The author Prof. B.L Verma is a Founding Member & Past President of ISMS and Former Professor of Biostatistics, M L B Medical College & Hospital, Jhansi -284 128 (India) and can be reached at blverma49@gmail.com

Contributed Article

WHY COUNT REGRESSION MODELS...?

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Researchers in biological, behavioral science, epidemiology, insurance, etc. are likely to gather information on different variables as a continuum rather than a categorical one. Many a time, the research questions on outcome involve count variables such as, number of cigarettes smoked per day, number of children born to a women, number of hospital days, number of depressive symptoms, number of hospital readmissions for the patients with heart failure, etc. Essentially, a count variable reflects the number of occurrences of an event, generally over a period of time and it always assumes it's values to be either a zero or a positive integer (i.e. 0, 1, 2, 3, etc.).

The most basic assumption for many of the statistical procedures is that the data follows a normal distribution. Perhaps, the dissimilarity between the actual distribution and the assumed distribution may lead to wrong inferences. Most of the times, the count variables do not follow Gaussian distribution and they are positively skewed in nature.

Many researchers have assumed the count variable as continues and have modeled them using linear regression. The linear regression holds certain assumptions such as normality of error and homogeneity of variance. Usually, the empirical distribution of count variable leads to violate these assumptions. Hence, the use of linear regression for modeling count data may result in inefficient, inconsistent and biased estimates (Long, 1997). It can even result in negative expected values, which are impossible for a count variable. To overcome the problem of violation of assumptions, transformations are also employed. But transformations are unlikely to work as the range of count variable is often very narrow. Moreover, the transformations make the results difficult to interpret. Sometimes, logistic regression is used after converting the counts into binary variable. The use of logistic regression leads to loss of information (as the counts are converted to binary variables), reduction in power and sometimes, results in unreliable estimates (Gardner, Mulvey, & Shaw, 1995). Hence, the nature of count data emphasizes the requirement of count specific models which reflect the true nature of the data.

Poisson regression

Poisson regression is the standard model used for modeling count data. The Poisson regression approach models the data under GLM frame work, assuming a Poisson distribution for the response variable. The choice of Poisson distribution restricts the count variable to take only nonnegative values. The Poisson distribution is basically used to explain the occurrence of rare events.

In Poisson regression model, the response variable is defined as the number of occurrence of an event which follows a Poisson distribution with a mean function, which in turn depends on the independent variables. Under Poisson assumption, the events are generated from a Poisson process (Hilbe, 2011) i.e., the occurrence of events in a given time period is independent of one another. For example, the occurrence of seizure for a patient is independent of the previous occurrence of seizure. The Poisson regression models the mean count, λ_i

$$E y_i | x_i = \lambda_i = exp\ x_i'\beta = e^{\sum_{j=1}^{k} \beta_i x_{ij}} \quad ;i=1, 2, 3, \ldots, n \quad j=1,2,3, \ldots,k$$

The exponential link function always restricts the expected count to be non-negative. The Poisson regression can be written in linear form by taking logarithmic transformation as $ln(\lambda_i)$, i.e.,

$$ln(\lambda_i) = x_i'\beta = \sum_{j=1}^{k} \beta_i x_{ij}$$

Inheriting the properties of Poisson distribution,

the Poisson regression model assumes that the conditional mean is equal to the conditional variance, i.e., $E(y_i|x_i) = V(y_i|x_i)$

This assumption is called as equidispersion. Since the variance changes with the change in mean, the Poisson regression is heteroskedastic in nature (Cameron & Trivedi, 1998). The adherence of Poisson regression to the equidispersion assumption limits its application in real life situations as the count data are usually overdispersed [$E(y_i \mid x_i) < V(y_i \mid x_i)$]. The reverse scenario, underdispersion hardly occurs in real life situations. Overdispersion causes Poisson regression in estimating spuriously significant relationship as it underestimates the standard error. Though it is less useful, further methodological developments occurred in the area of count data modeling are based on Poisson regression.

Negative binomial regression

Quasi Poisson and Negative Binomial (NB) regression are the two methods which effectively handle overdispersion. Quasi Poisson regression is a simple procedure which scales the standard errors in order to avoid the overestimation of significance of the independent variables. This procedure improves the inference without the need of specifying the distribution of the response variable. NB regression is a more flexible approach to conquer the occurrence of overdispersion. It can effectively handle the extra Poisson variance occurring in the data due to either unobserved heterogeneity (effect of omitted covariates) or dependency between the events (Long, J.S. 1997).

The underlying distribution for NB regression can be derived as a Poisson-gamma mixture distribution (Hilbe, 2011). Unobserved heterogeneity and dependency between the events are the main source of overdispersion in count data. In NB regression, the unobserved heterogeneity is introduced in the model through a multiplicative random factor.

The NB distribution can be derived by specifying the distribution of the count variable as,

$$p\,(Y_i=y_i) = \frac{e^{-\lambda_i}\lambda_i^{\,y_i}}{y_i!}$$

The variation in $\tilde{\lambda}_i$ is due to both the observed heterogeneity introduced by the deterministic function of regressors and the unobserved heterogeneity introduced by the random factor. Let $\tilde{\lambda}_i = \lambda_i v_i$ where λ_i is function of independent variables i.e., $exp\ (x_i'\beta)$ and v_i random variable, assumed to be uncorrelated with the independent variables For mathematical convenience, the v_i is assumed to follow a gamma distribution with mean $E(v_i)$ =1 and variance $V(v_i)=\alpha^{-1}$

The pmf of NB distribution has the form,

$$p\ (y_i\ x_I) = \frac{\Gamma(y_i+\alpha^{-1})}{\Gamma(y_i+1)\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\lambda_i}\right)^{\alpha^{-1}}\left(\frac{\lambda_i}{\alpha^{-1}+\lambda_i}\right)^{y_i}$$

The same Poisson-gamma mixture distribution can also be derived assuming dependency between the events. The mean and variance of the NB distribution can be written as, $E(y_i)=\lambda_i$ and $V(y_i) =\lambda_i\alpha\lambda_i^{\,2}, \alpha > 0$. The variance of NB distribution is a quadratic function of the mean. Hence, the conditional variance of the NB regression is always greater than conditional mean.

Though the incidence of underdispersion is exceptionally less likely to occur, there are several existing models to handle this situation namely, generalized Poisson, Double Poisson, Conwey-Maxwell Poisson, etc. Conversely from Poisson model, these models have an additional parameter to handle the deviation from equidispersion.

Another concern in modeling count data is the incidence of zero counts. Sometimes, the observed data can be zero inflated. The zero inflation may be described as the excess incidence of zeros, which are outside the predictive capability of standard count regression approaches like Poisson or NB regression. Hurdle and zero inflated regressions are the two prominent models which can be employed for zero inflated data in lieu of standard approaches. In contrast with Poisson and NB regressions, these models assume two separate origins for count data; a binary and count origin, which make them superior to Poisson and negative binomial regression in capturing the excess zeros.

Illustrative example

Regression models for count data has been demonstrated using a dataset named 'epil' obtained from the r package '*MASS*'. The data contain the information of 59 epilepsy patients who have under gone either control or experimental (progabide) treatment. The number of seizers experienced after the treatment for four successive two-week periods is taken as the outcome and base line seizer count, treatment and were used as the predictors.

The suitability of linear regression has been assessed by fitting to the data followed by testing the assumption. The Shapiro-Wilk test performed to test the normality of error (W = 0.768, p = < 0.001) and Breusch - Pagan test performed to test the homogeneity of variance (χ^2 = 30.681, p = <0.001) showed deviation from the assumptions. The skewed discrete nature of the response variable resulted in linear regression to violate the assumptions. Hence the linear regression may not be appropriate and the results may not be valid (table 1).

Table 1. Linear regression fitted to predict the factors predicting number of Seizures experienced after treatment

Variable	Coef.	SE	p value
Age in years	0.183	0.085	0.032
Base line seizure count	0.361	0.020	<0.001
Treatment (progabide)	-0.689	1.042	0.509

As the linear regression is not suitable for the present count data, Poisson and NB regressions have been fitted (table 2). The equidispersion assumption of Poisson regression has been tested using a test for overdispersion. The results (z = 2.709, p = 0.003) showed that the Poisson regression violated the equidispersion assumption and the data was overdispersed. The comparison of Poisson and NB regression models depicts that the Poisson regression underestimated the standard errors thereby overestimated the significance of the predictors. For instance, Poisson regression showed a significant effect of treatment on the seizure count where as it was not significant under NB regression fit. The NB regression has corrected the spurious significance of the predictors by estimating larger standard errors. Even in the presence of overdispersion the estimated coefficients were quite similar with the NB fit. The exponential of regression coefficients of Poisson and NB regression can interpreted in terms of Incidence Rate Ratio (IRR).

Table 2. Poisson and NB regressions fitted to predict the factors predicting number of Seizures experienced after treatment

Variable	Poisson			Negative binomial		
	Coef.	SE	p value	Coef.	SE	p value
Age in years	0.022	0.004	<0.001	0.018	0.0082	0.030
Base line seizure count	0.023	0.001	<0.001	0.027	0.0018	<0.001
Treatment (progabide)	-0.152	0.048	0.002	-0.188	0.1017	0.065

Conclusion

There are numerous situations in biomedical and behavioural research where the count regression models are apt to be used and the need cannot be ignored. The count are observed with various features such as overdispersion, under-dispersion, zero inflation, censoring, etc. There does not exist a universal model that can handle all types of count data. The count data has to be modelled using appropriate count regression models in order to extract the actual relationship in the data.

Referecnes

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Technical Note

EVIDENCE OR BIAS: ASSESSMENTS OF BIAS IN EVIDENCE BASED MEDICINE

Mr. Palash K Malo[1], Dr. B. Binukumar [2]

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In the health-care industry, systematic reviews of studies on randomized controlled trials (RCTs) are considered the standard basis for evidence-based decision making (Jansen et al., 2011). Many systematic reviews have utilized the meta-analysis approach for evidence synthesis. Meta-analysis is a statistical procedure to integrate the quantitative results of several independent and comparable studies. Researchers undertake a meta-analysis to investigate the effectiveness of an intervention or a treatment for a disease condition in comparison with placebo. In order to this, the results from the independent and comparable trials are combined to provide a précised single estimate. All studies included for the analysis compare the same intervention with the same comparator. The validity of a meta-analysis depends on whether all relevant randomized trials have been identified or not. Incomplete evidence produces a misleading result, yielding a narrow confidence interval for an inappropriate treatment decision.

The validity of an included study for a meta-analysis may be considered to have two dimensions. The first dimension is whether the study is asking an appropriate research question; and this dimension is closely connected with the applicability of a study's findings. This is often described as 'external validity'. The second dimension is whether it answers the research question 'correctly' or not, that is, in a manner free of bias, and is often described as 'internal validity'.

Bias in meta-analyses

A **bias** is a systematic error, or deviation from the true effect, in results or inferences. Biases can lead to underestimation or overestimation of the true intervention effect. Biases can vary in magnitude and even a particular source of bias may vary in direction.

Sources of bias in meta-analyses

If the included studies are a biased sample then it will be reflected in the mean effect computed by the meta-analysis. Several lines of evidence show that studies that report relatively high effect sizes are more likely to be published than studies with lower effect sizes. The biases that might have influenced the identification of relevant trials are collectively known as **reporting bias**. It is a broad encompassing term used to describe a group of biases that includes publication bias, citation bias, language bias, and time lag bias.

Publication bias is the failure to include all relevant trials because they had not been published and were, therefore, not accessible. Trials are not published for a variety of reasons. If a trial failed to show a statistically significant difference between the treatment group and placebo group, or showed that placebo was superior to the treatment, it is less likely to have been submitted or even accepted for publication. Studies with large samples would have been more likely to be published, and publication could have been influenced by who funded the study or even the identity of the research group.

Language bias is the selective inclusion of studies published typically only in English, because those published in any other language are not easily accessible. Most research papers in prominent journals are written in English and members of the search team may not have been able to translate studies published in other languages. Therefore, studies published in languages other than English will probably have been omitted from the meta-analysis.

When relevant trials were identified their reference lists would have been examined for

other potential studies. Due to the nature and direction of the results, a study may have been cited more. The tendency for those studies more frequently cited to be identified may result in **citation bias.**

Time lag bias is the hasty or delayed publication of a trial, which may have influenced whether it was included in a meta-analysis or not. For example, if the topic was of great medical interest it may be published sooner. However, if the results of a trial were inconclusive, its publication may have been delayed. Publication may also be delayed if the paper is not accepted by the journal of first choice or revision was required.

Other types of bias might also influence the results of a meta-analysis. Trials published in journals or databases that are not easily accessible will lead to **location bias**. **Multiple publication bias** would occur if a trial was published more than once, increasing the chance of the trial being identified and included in the meta-analysis. The choice of outcomes that are reported can be influenced by the results, potentially making published results misleading. Such an **outcome reporting bias** may occur if the results of a trial were not as expected or were undesirable.

Methods to detect reporting bias

Funnel plots have been proposed as a simple graphical test that can detect reporting bias in a meta-analysis. A funnel plot is a simple scatter plot of the treatment effect estimates (horizontal axis) against sample size or precision (vertical axis) for the trials included in a meta-analysis. The scatter of points is expected to be symmetrical centrally around the total overall estimated effect resembling a funnel. Moreover, the plot is based on the precision in the estimation of the underlying treatment effect which increases as the sample size of individual studies increases, and thus, giving the shape.

In the presence of reporting bias the funnel plot will be skewed and asymmetrical in shape. The results from small studies will scatter widely at the bottom of the graph, with the spread narrowing among larger studies. The plot may detect bias but may not be possible to identify which biases are present. Publication bias need not lead to asymmetry in funnel plots. Unfortunately, funnel-plot asymmetry has often been equated with publication bias without consideration of its other possible explanations. Asymmetry in the funnel plot may occur for other reasons – firstly, including poor methodological design in the trials (failure to conceal the allocation process); secondly, differences in methodological quality wherein smaller studies tend to be conducted and analyzed with less methodological rigor than larger studies; thirdly, true heterogeneity in intervention effects wherein substantial benefit may be seen only in patients at high risk for the outcome which is affected by the intervention and these high risk patients are usually more likely to be included in early, small studies. Finally, it is of course possible that an asymmetrical funnel plot arises merely by the play of chance, that is, the funnel plot is inappropriate for heterogeneous meta-analyses.

Some authors have argued that visual interpretation of funnel plots is too subjective to be useful. For investigating reporting bias, assessment of symmetry in a funnel plot may be unreliable when the number of trials is sparse. Also, the problem with funnel plots is that some effect estimates (e.g. odds ratios and standardized mean differences) are naturally correlated with their standard errors, and can produce spurious asymmetry in a funnel plot.

Statistical test for funnel plot asymmetry

Formal statistical tests have been proposed to test for asymmetry in a funnel plot. The **Begg and Mazumdar** adjusted rank correlation test based on Kendall's τ. It is a direct statistical analogue of the visual funnel graph for detecting publication bias. This test identifies the existence of publication bias by determining if there is a significant correlation between the effect estimates and their variances.

Let (x_i, v_i), $i=1, 2, \ldots, n$, be the estimated effect sizes and sample variances from n studies.Then the standardized effect sizes are calculated as,

$$y_i = \frac{x_i - \bar{x}}{z_i^{1/2}}$$

where $\bar{x}=\frac{\sum_{i=1}^{n} x_i v_i^{-1}}{\sum_{i=1}^{n} v_i^{-1}}$ and $z_i = v_i - \left(\sum_{j=1}^{n} v_j^{-1}\right)^{-1}$ are the variance - weighted average effect size and the variance of $(x_i-\bar{x})$ respectively. Now, to construct the adjusted rank correlation test, correlate the standardized effect sizes, y_i with the sample variance, using Kendall's rank correlation procedure and examine the p value for inference.

Begg and Majumdar (1994) assume that the sampling distribution of x_i is normal, $x_i \sim N(\Theta, v_i)$ where Θ is the common effect size to be estimated. They argued that the normality assumption is reasonable because x_i is "*invariably a summary estimate of some parameter, and posses an asymptotic normal distribution in most circumstances*".

Egger's regression asymmetry test for publication bias incorporates statistical hypothesis testing with the null hypothesis as symmetry exists against the alternative hypothesis that asymmetry exists. The test detects funnel plot asymmetry by determining whether the intercept deviates significantly from zero in a regression of standardized effect estimates against their precision. Here, the standardized effect size is defined as; $y_i = \frac{x_i}{v_i^{1/2}}$ the precision as $s^{-1} = \frac{1}{v_i^{1/2}}$ and the weight as $w_i = \frac{1}{v_i}$ Moreover, y is assumed to be a standard normal variate. Using weighted simple linear regression with weights w and an intercept, is fitted to s^{-1} This test of funnel plot asymmetry has relatively low power and is prone to type II errors (Egger et al., 1997). This shows that, even though Egger's test does not provide evidence of funnel plot asymmetry, publication bias may still exist. In a comparison to the Begg and Mazumdar test, Egger et al., (1997) stated that "*the linear regression approach may be more powerful than the rank correlation test*" and "*in some situations power is gained by weighting the analysis*".

Many authors have proposed alternative tests for funnel plot asymmetry. Tang (2000), Macaskill (2001), Deeks (2005) and Peters (2006) proposed linear regression of treatment effect estimate against the total sample size or a function of the total sample size. Harbord (2006) suggested a test based on the score (O−E) and score variance (V) of the log odds ratio. Further, Schwarzer (2007) proposed rank correlation test using mean and variance of the non-central hypergeometric distribution. Later Rucker (2008) proposed a test based on arcsine transformation of observed risks, with explicit modelling of between-study heterogeneity.

When the heterogeneity variance is less than 0.1, it is recommended to use one of the tests proposed by Harbord (2006), Peters (2006) or Rucker (2008). Moreover it is recommended to use tests for funnel plot asymmetry when there are at least 10 studies included in the meta-analysis. Since the tests typically have relatively low power, bias cannot be excluded even when a test does not provide evidence of funnel plot asymmetry. If there is an evidence of small-study effects, that is, "*a tendency for estimates of the intervention effect to be more beneficial in smaller studies*", researcher should consider sensitivity analyses to investigate how the results of meta-analysis change under different assumption. Thus, publication bias may be seen as one of many possible causes of small-study effects.

Explanations for heterogeneity in the meta-analysis may be investigated more formally using **meta-regression** to investigate associations between study characteristics and intervention effect estimates. For example, we might investigate evidence that studies in which reported allocation concealment is unclear or inadequate tend to result in more beneficial treatment effect estimates. Similarly, year of publication, proportion of male/female participation, dosage of drugs, location of the study been conducted etc. may also be considered as the study characteristics. However, it may not be possible to provide a definitive explanation for funnel plot asymmetry and to identify a particular study characteristic as the cause of heterogeneity.

Sources of bias in clinical trials

The reliability of the results of a randomized trial depends on the extent to which potential sources of bias have been avoided. Randomization prevents selection bias in allocating intervention

to participants. Selection bias is described as the systematic differences between baseline characteristics of the groups that are compared. In other words, selection bias would occur if there is a systematic difference between patients recruited to the trial and those who were not recruited, because this would mean that the sample was not representative of the patient population. Whereas, if there is a systematic difference between participants in how they are assigned to treatment groups, then it is referred to as **allocation bias**. It would have occurred in a situation if the researchers had allocated those patients who they thought would show the greatest benefit from treatment to the intervention group because they wished to show that it was more effective than the control treatment. If each participant had the same probability of being allocated to intervention or control then allocation bias would have been minimized. Stratified randomization of participants based on demographic and disease severity would minimize the systematic differences in confounding factors between treatment groups at baseline, not necessarily eliminated. Sequence generation is a rule for allocating interventions to the participants based on some stochastic process; and the process of implementing the schedule of random assignment from those involved in enrolment into the trial by preventing foreknowledge of the forthcoming allocations is called allocation concealment. If successfully accomplished, it prevents these two biases.

Performance bias refers to systematic differences between groups in the care provided, or in exposure to factors other than the interventions of interest. After enrolment into the study, blinding or masking of study participants and personnel may reduce the risk that knowledge of which intervention was received, rather than the intervention itself, affects outcomes. Effective blinding can also ensure that the compared groups receive a similar amount of attention and diagnostic investigations. Blinding of outcome assessors may reduce **detection bias**, the systematic differences between groups in how outcomes are determined.

Attrition bias refers to systematic differences between groups in withdrawals from a study leading to incomplete outcome data. The reasons for withdrawals or incomplete outcome data in clinical trials are (a) situations in which some participants are omitted from reports of analyses, despite outcome data being available to the researcher; and (b) situations in which outcome data are not available.

Within a published report those analyses with statistically significant differences between intervention groups are more likely to be reported than non-significant differences. This sort of '*within-study publication bias*' is usually known as **selective reporting bias**, and considered as one of the most substantial biases affecting results from individual studies (Chan 2005).

Analysis strategies for addressing risk of bias

It is usually not viable to know to what extent biases have affected the results of a particular study. The results of a study may in fact be unbiased despite a methodological flaw, it is more appropriate to consider risk of bias. However, differences in risks of bias can help to explain variation in the results of the studies included in a systematic review. Therefore, it is important to assess risk of bias in all studies in a review irrespective of the anticipated variability in either the results or the validity of the included studies.

There are many tools to assess risk of bias. The Cochrane Collaboration's tool for assessing risk of bias is the widely used tool which has six specific domains and each domain includes one or more specific questions to be answered as '*Yes*' indicating low risk of bias, '*No*' indicating high risk of bias and '*Unclear*' indicating insufficient details have been reported. Essentially, this tool covers six domains of bias: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias.

A less popular tool is the Jadad scale (Jaded et al., 1996) which independently assesses the methodological quality of a clinical trial. It is a five-point scale (i.e. a clinical trial could be assessed from zero to five points) based on only three questions. Each question has to be answered with

either a *yes* or a *no*. Each *yes* would score a single point, each *no* zero points. It does not take into account allocation concealment (Higgins et al., 2011). Berger (2006) and the Cochrane Collaboration Handbook (2008) criticized the Jaded scale for being over-simplistic and emphasized too much on blinding.

Studies at high or unclear risk of bias should be given reduced weight in meta-analyses, compared with studies at low risk of bias (Spiegelhalter 2003). However, formal statistical methods to combine the results of studies at high and low risk of bias are not sufficiently well developed. The simplest approach to incorporating bias assessments in results is to present an estimated intervention effect based on all available studies, together with a description of the risk of bias in individual domains, or a description of the summary risk of bias, across studies. But this approach is discouraged when studies have different risks of bias. Therefore, the major approach to incorporating risk of bias assessments in Cochrane reviews is to **stratify studies** according to risk of bias to see the impact in results if studies at high risk of bias were included in analysis. Formal comparisons of intervention effects according to risk of bias can be done using **meta-regression**. Alternatively, **subgroup analysis** can be used to test for differences across subgroups.

When the primary analysis is based on all studies, summary assessments of risk of bias must be incorporated using the GRADE (*Grading* of Recommendations, Assessment, Development and Evaluations) system to ensure that judgments about the risk of bias, as well as other factors affecting the quality of evidence, such as imprecision, heterogeneity and publication bias, are appropriately taken into consideration in interpreting the results (Guyatt 2008).

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OUTLOOK OF BIOSTATISTICS

Introduction

Biostatistics is a specialized branch of the statistics field that collects and examines data related to living things. It combines elements of the medical field with that of math, statistics, and science, offering a wide array of different types of jobs in biostatistics. Individuals working in the field of biostatistics, known as biostatisticians, apply the fundamentals of statistics to research in the medical and public health sectors. This article is meant to orient new students in biostatistics and serve as a primer for prospective students in biostatistics towards the roles, jobs, and qualities required for a successful career in this field.

The main role of a biostatistician is to support other researchers. For example, a biostatistician would be involved in a study concerning a new or experimental treatment or in a project to determine the links between certain lifestyle factors and the prevalence of a certain disease. The field can be particularly reward for individuals who enjoy statistical analysis and are also interested in the medical field. Unlike departments of statistics, which are generally found in a university's college of arts and sciences, departments of biostatistics are found in a university's school of public health or school of medicine.

Educational Requirements for Careers in Biostatistics

At the very least, biostatisticians must have a bachelor's degree in statistics, biostatistics, or mathematics. However, most positions require a master's degree or doctorate degree. Obviously, it is necessary for biostatisticians to have a strong educational foundation and natural inclination for science and mathematics. Additionally, these individuals should also possess effective problem solving skills and communication skills. Biostatisticians also need to be flexible and able to work well as part of a team. Advanced degrees like a masters or a doctorate help students become specialized and give them more experience with conducting research and presenting results.

Prospective biostatisticians should have an aptitude for maths and biology. The field of Biostatistics can be rewarding, with a lot of opportunity and good compensation. How does one prepare for a career in biostatistics? There is no one “right path” to becoming a biostatistician, just as there is no one career path in biostatistics. Nonetheless, here are some general suggestions that should help someone considering a degree in biostatistics, whether starting such considerations in high school, college, or later on. High school students interested in biostatistics should study maths and science (biology) as part of their school curriculum. Taking training in technical writing and learning basics of programming can come in handy. Additionally, keeping eye out for undergraduate programs that offer biostatistics courses is recommended.

Undergraduate students need not worry about majoring in biostatistics; however, having a strong mathematical background is extremely helpful. Courses like Linear Algebra, Introductory Statistics, Probability and Calculus would be important precursors (sometimes requirements) for Post graduate courses in Biostatistics. Other important courses recommended for undergraduate students who are considering a career in biostatistics are biology, epidemiology, ecology, or other science courses. It is also useful to learn a programming language or statistical package. Furthermore, future biostatisticians should work on their communication skills: written and oral. The work of biostatistician involves a significant amount of writing. Having a good command over grammar is extremely helpful when communicating with other team members, it facilitates “understandability”. Having mastery over soft skills such as presentation and seminar delivery is also desirable. Students should work on developing a neutral accent and proper enunciation, which greatly improves oral communication. These skills are often never taught in courses explicitly, however, students should take opportunities to make oral

presentations to groups small and large, because only practice makes perfect.

Programs in Biostatistics

There are numerous universities that offer postgraduate and doctoral courses in biostatistics both in India and abroad. Some noteworthy universities for Biostatistics in India are listed below:

1. Manipal Academy of Higher Education – Manipal, Karnataka
2. National Institute of Mental Health and Neurosciences – Bengaluru, Karnataka
3. The Jawaharlal Institute of Postgraduate Medical Education & Research, Pondicherry
4. Banaras Hindu University, Varanasi, Uttar Pradesh
5. All India Institute of Medical Sciences, Delhi
6. Christian Medical College - Vellore, Tamil Nadu
7. KLE Academy of Higher Education & Research, Belagavi
8. Kavitha Memorial Degree and P.G. College – Andhra Pradesh
9. Kerala Veterinary and Animal Sciences University – Wayanad, Kerala
10. Mahatma Gandhi University – Kerala

The above is not an exhaustive list, however there are few other university also offers similar courses in the specialized area with different syllabus. Most colleges in India take students based on either an entrance exam or/ and merit. More information may be found on the respective university's website. Students who are interested in Doctoral and Post-doctoral courses in India require a fellowship (institute or external).

For those who have sights on universities abroad, there are a plethora of universities that offer various post graduate, doctoral and post-doctoral courses. A quick search online can list out them out. Post graduate courses often require a detailed Statement of purpose as well as relevant experience in the field. Additionally, many universities require qualifying GRE, TOEFL, IELTS, etc. with relevant transcripts and recommendation letters. Applying for Doctoral and Post-doctoral positions in university not only require the above mentioned, but also relevant research experience and publications. Furthermore, having professional contacts within the university with the researchers and Professors can help boost the chances of acceptance.

Types of Jobs in Biostatistics

Jobs in biostatistics are relatively diverse. Individuals can find jobs in a variety of different venues. Medical device manufacturers, pharmaceutical companies, and other research companies are among the most common organizations that hire biostatisticians. Additionally, public health organizations and government organizations also frequently work with biostatisticians. These jobs are typically considered to feature an office work setting; however, it is not unusual for these positions to require some work in a laboratory or a similar setting. Biostatisticians spend the greater part of their workdays in an office setting, typically working on a computer. Becoming familiar with specialized programs used to analyze statistics and lab results will be extremely useful for this field. They will often be required to collaborate with a team of scientists and researchers, meaning that they spend a great deal of their day interacting both in person and through phone and email. Some Biostatisticians that are employed by universities will spend a good portion of their time in a lab, as well as the classroom. Most of these professionals work full-time on a normal daytime schedule. If a particular project is nearing its deadline or is overdue, then overtime may be required.

Job Outlook for Biostatistics

The Bureau of Labor Statistics, USA predicts the job outlook for biostatistics to grow at a rate that is roughly average or 14 percent. Biostatisticians typically keep "office" work hours of 40 hours per week with minimal nights and weekends.

Biostatistics is a great option for individuals who have strong analytical skills and are interested in the medical field. While the types of jobs in biostatistics are relatively diverse, the availability of positions at present isn't abundantly numerous; however, the field may see a rise in need over the next several years.

Typical Job Responsibilities of a Biostatistician

Biostatisticians' primarily analyze data and generate statistics on living things collected during medical research studies to draw conclusions or make predications. They often collaborate with other statisticians and scientists to design and execute of research studies. Additional responsibility of monitoring for the integrity of research projects and clinical studies lies on their shoulders. They not only help in designing the study but also write research proposals and convey their findings to the scientific community.

Some Biostatisticians may also teach at universities while conducting their research. Additionally, they may even have to be hands on with performing fieldwork and collecting data. The specific responsibilities of a biostatistician vary depending on the exact type of job the individual is doing. However, some of the roles fit across careers. For example, a biostatistician in any position is involved in designing studies, gathering data, and analyzing the collected information. In relation to these roles, an individual must be able to define the specifics necessary to the given task or experiment. For example, it is the job of the biostatistician to determine the appropriate sample size, the most accurate method to collect data, and how to effectively measure the results.

Senior Biostatisticians often have enhanced job responsibilities that help manage the department or workgroup's budget and collaborative concerns. Such responsibilities often include: Ensuring that systems and methods of design, planning, data analysis, modeling and projections, associated documentation and development meet the goals of the workgroup and stakeholders, assisting and mentoring team members, engaging in decision making at project level, establishing valid and efficient statistical protocols, exercising initiative in handling complex special projects, composing scopes of work, statistical memos and reports, reporting on findings for analysis and conclusions to internal and external meetings and conferences, supporting team members' statistical research by providing mentoring, contributing to computational aspects of statistical scientific content for internal and external stakeholders, and lastly buy not limited to providing assistance for data representation and interpretation for internal and external publications.

What Is the Job Demand for Biostatisticians?

The job demand for Biostatisticians is expected to grow 22% in the next 10 years, which is much faster than other professions. These kinds of statisticians are increasingly needed in the medical field, particularly in the pharmaceutical industry where they can help conduct research and run clinical trials for innovative medicines and health technologies. Through jobs for biostatisticians vary from role to role and across industries such as biological and agricultural science, business and economics, physical and social sciences as well as engineering, many responsibilities are similar.

Qualities required for a Job in Biostatistics

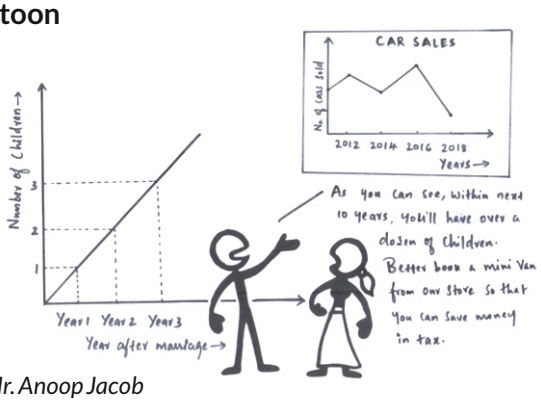
Some of the important qualities required for a job in Biostatistics:

1. Have a reasonable command on statistics, mathematics, and computers
2. Understanding data extraction, storage, initial analysis, and delivery to users
3. Effective communication skills to participate in the planning stages of research, as well as the data collection and interpretation stages
4. To be able to lead the implementation, analysis and interpretation of studies within the scope of the project
5. Have knowledge to link and develop complex databases with data analysis programs

6. Develop analysis plans and methodologies, as well as conduct analysis of datasets
7. Develop new algorithms, statistical techniques, and visualization approaches so that workgroup, and stakeholders can implement findings
8. Provide statistical expertise and peer teaching to internal and external partners
9. Construct and critique scientific manuscripts and grant applications
10. Prioritize tasks within a given framework; meet agreed-upon milestones and timelines independently and collaboratively

This article is written by Mr. Aakash Bajaj, who is a PhD Scholar of Biostatistics at NIMHANS, Bengaluru-29. The information compiled from various sources and the opinions expressed in this publication are those of the author. They do not reflect the views of the ISMS or its members.

Cartoon



By Mr. Anoop Jacob

NEWS & EVENTS

ISMSCON-2020

Dear colleagues,

Indian Society for Medical Statistics is hosting the 38th Annual Conference of the society (ISMSCON-2020) completely on online platform during December 10-12, 2020. The Society Secretariat and members take full responsibility of hosting this conference and in that sense, it is going to be an unique experience for each one of us to successfully organize the conference.This conference will offer an opportunity to discuss recent developments in Medical statistics, Epidemiology, Big data analytics, Data science, Bioinformatics and related areas. We will try our best to create opportunity to interact with colleagues and friends through new experience of the digital world. We invite your active participation and deliberation in ISMSCON-2020 and make it a lively ever memorable virtual experience under the banner of ISMS.

ISMSCON-2020 Pre-conference workshops

9 December, 2020

Virtual Mode

Pre-conference workshop 1	**Time: 09.00 am – 12.00 pm**
Non-inferiority Trials: Designs and Sample Size Calculations	
Faculty Dr. L. Jeyaseelan Professor of Biostatistics, CMC, Vellore, India Dr. Shrikant Bangdiwala Professor of Health Research Methods, Evidence and Impact, McMaster University, Canada	
Pre-conference workshop 2	**Time: 02.00 pm – 05.00 pm**
Adaptive Designs in Phase III Trials	
Faculty Dr. Viswanathan Iyer Paraxel, Hyderabad, India	

HIGHLIGHTS OF ISMSCON-2019

The 37th Annual National Conference of ISMS was held at the All India Institute of Medical Sciences, Patna during 5-7, December 2019 along with two parallel Pre-Conference Workshops, on December 4, 2019. Prof.V.K Paul, member of the National Institution for Transforming India, the NITI Aayog, has inaugurated the ISMSCON-2020 The Organizing Chairperson and Organizing Secretary if ISMSCON-2019 were Prof. C M Singh and Prof. Sanjay Pandey respectively. Under their able leadership the conference activities went on well.

Preconference

Conference Secretariat: ISMSCON-2019

Inauguration: Day 1

Inaugural Address by Chief Guest

AWARDS

Prof. A. Indrayan receiving
Prof.SK Bhattacharya Oration award

Prof. Karan P Singh receiving *FSMS* award

Prof. Madhulekha Bhattacharya receiving *FSMS* award

Dr K.T Harichandrakumar receiving
Prof.R.N Srivastava award

PLENARY TALKS

CONTRIBUTED SESSIONS

CULTURAL PROGRAMME

POSTER SESSION

OBITUARY

Dr. S. Radhakrishna M Sc, Ph D, FSMS

[21 December 1935 - 27 September 2020]

Former President, Fellow & Life Time Achievement Awardee of the ISMS

Born on 21 December 1935, Dr. S. Radhakrishna acquired first class Master's Degree in Statistics from Presidency College, Madras, in 1956 and then, joined Tuberculosis Research Centre in December 1956. He established the Department of Statistics there and thereafter he was deputed by GOI on a WHO Fellowship to the London School of Hygiene and Tropical Medicine. During this deputation, he received training in applied medical statistics and acquired Ph.D. Degree. He went to London (MRC - Statistical Research Unit) again on a WHO Post Doctoral Grant for one year in 1974, and worked on the development of mathematical models to explain epidemiological trends in tuberculosis. On his return, he established the ICMR Regional Statistical Bureau with a mandate for applied research, consultancy and training. This later became the ICMR Institute for Research in Medical Statistics (Madras Chapter) and he was made its full time Director in 1980. Before his superannuation from ICMR in December 1995, he also worked at the ICMR (HQ) as its Additional Director General. After his retirement from ICMR, he served for 16 months as an Operational Research Coordinator (Short-term Consultant) in TB at the WHO SEA Regional Office at New Delhi,served as WHO Short Term Consultant in Philippines, Srilanka & Nepal, and as an Expert Committee Member on WHO Task Force on Routine Infant Vaccination and Child Survival. He was a Member of GOI RNTCP National Standing Committee on Operational Research and Chairman of GOI's Estimation of TB Disease Burden Committee.

Dr.Radhakrishna has been recipient of M. N. Raju Oration Award from the ICMR for his contributions in medical statistics, the Ranbaxy-Robert Koch Award from the Tuberculosis Association of India and the Andhra State TB Award for his biostatistical contributions in tuberculosis. His contributions to the Indian Society of Medical Statistics (ISMS) have been tremendous. He has been actively associated with the Society through-out since its foundation at Jhansi (UP) in 1983. He has been amongst only a few in the country who played a great role in the establishment of this Society. He was elected a Fellow – ISMS, in early years of the Society. He served its President in 1991. He was recipient of Professor S K Bhattacharya Oration Award as well as Smt. Ramrati Lalima Sahai Award of ISMS and most prestigious ISMS Lifetime achievement award in 2017. Dr S Radhakrishna had a very hilarious and quite amusing personality. He was well respected person among his family and friends. After a brief illness he breathed last in the midnight of 27 September 2020. Dr Radhakrishna is survived by a son and a daughter. On behalf of ISMS, we members of ISMS condole his demise and pray God to give peace to the departed soul and courage & strength to the bereaved family members. May his soul rest in peace!!

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Indian Society for Medical Statistics

Minutes of the General Body (GB) Meeting held during 37th Annual National Conference at All India Institute of Medical Sciences, Patna

Venue: Auditorium, AIIMS, Patna
Date: December 6, 2019 Time: 5:30PM

The General Body meeting agenda - 2019

1. Welcome by President & Welcome to the newly elected President elect
2. Approval of minutes of the 2018 GC & GB meetings
3. Report of General Secretary
4. Report of Treasurer
5. Report of Editor
6. Report of Web co-ordinator
7. Award committee report
8. Nomination committee report
9. Search committee reports
10. Update on high power committee recommendations
11. Reconstitution of various committees
12. Professor R N Srivastava award
13. Venue for the 2020 annual conference
14. Vote of thanks by General Secretary

1. Welcome

President, Prof. P.Venkatesan, welcomed the members of the GC and extended a cordial welcome to the newly elected President Elect, Prof.L Jeyaseelan and GC members. President also expressed sincere thanks to all outgoing members and office bearers for their contributions to the activities of the Society.

Subsequently General Secretary, Prof. N Sreekumaran Nair took over agenda items one by one, as enlisted above. The General Secretary thanked the Organizing Team for hosting the 37th ISMS Annual Conference 2019, at AIIMS, Patna.

2. Confirmation of the Minutes of the Previous GC & GB Meetings 2018

The GB unanimously accepted and approved minutes of the GC and GB meetings held on 31st October & 1st November 2018 respectively at NIMHANS, Bangalore.

3. Report of the General Secretary

Prof. N. Sreekumaran Nair presented report of various activities, undertaken by the Society during the year 2019. Salient features of the report were are as follows.

ISMS General Secretary's Report to the GB meeting -2019

a) General communication to the members

Communicating with members- announcement, notifications of the society, various news items like conference, workshops, vacancies etc. which are relevant for the members, and other similar items to society members time to time.

b) Enrollment of new members

26 new life members have been enrolled till first week of December and membership certificates have been issued to all new members.

c) Updating membership list

Secretariat has updated membership list and all attempts have been made to update e-mail IDs in google group. At present we have 680 e-mail IDs in google group and 953 life members of the society. The membership directory has been updated on November 23, 2019 and has been uploaded to the ISMS website.

d) Providing materials for web updating

Minutes of GC, GB, copies of constitution, general communication for members etc.

e) Election of the President elect

Facilitated the conduct of election of President elect in communicating and providing necessary documents to various stake holders of election- election committee, candidates, web coordinators etc. Election results were announced from secretariat.

f) Prepared of Mementoes and certificates for the awardees.

g) Exploring location for 2020 annual conference

Secretariat worked out feasibility of institutions to host 2020 National conference and following institutions expressed interest.

1. ICMR- NIMS, New Delhi- Director Dr.Vishnuvardhana Rao
2. Prof. Kakade from Krishna Institute of Medicals Sciences, Karad, Maharashtra
3. Dr.Shubam Pandey, Himalayan Institute of Medical Sciences, Uttarakhand

h) Planning and implementing 2019 conference

Working with 2019 conference secretariat for the smooth conduct of conference. ISMS secretariat provided membership list, necessary documents for applying funding. After discussion GC approved the report.

4. Report of the Treasurer

Dr. B Binukumar, Treasurer, presented the audited report of the Society for the financial year 2018-2019. Copies of the report were also circulated among the members. Further, he presented the details of various deposits and current account balance as on 30th November 2019.

GB approved the report of the Treasurer.

5. Report of the Editor

Prof. K. Thennarasu, ISMS Bulletin Editor was not able to attend the meeting. However he sent his report and was recorded in the GB.

6. Report of the Web Coordinator

Web Coordinator, Prof. L. Jeyaseelan presented his report. He emphasized that web updating was smooth throughout the year. The GB appreciated the help of Web Coordinator Prof .Jeyaseelan and his team and approved the report.

7.Report of the Awards Committee

Prof. Arvind Pandey, Chairman of the Awards Committee could not attend the meeting. However, he prepared his recommendations (in consultation with members) and communicated these recommendations to the Secretariat. Based on the above recommendations, names of the award winners are given below:

1. **Smt. Suraj Kali Jain Award**
   No Applicant
2. **Prof. B.G. Prasad Award**
   Dr.Rajeev Kumar Malhotra, Cancer Institute, Delhi
3. **Prof. K.R. Sundaram Young Research Scholar Award**
   No applicant
4. **Smt. Saroj Shukla Travel Scholarship**
   No application
   GB approved all these Award Committee recommendations.

8.Report of the Nominating and Search Committee

Prof. B.L.Verma, Chairman of the Search Committee presented his report which has been approved by the GC to the Governing Body for approval.

a) ISMS: Recommendations of Search Committee for awards in 2019.

Name of the Award	ISMS Fellow & Life Member Recommended for the Award	Status of Consent of the Nominee	When the award shall be presented to awardee
1. Life Time Achievement Award	Professor C R Rao, Pennsylvania State University, USA	Consent received	Next year during the 2020 ISMS Conference
2. Professor S K Bhattacharya Oration	Professor K Srinivasan, Chennai	Consent received	Next year during the 2020 ISMS Conference
3. Smt. Ramrati Lalima Sahai Award	Professor C M Pandey, Lucknow	Consent received	Next year during the 2020 ISMS Conference
4. Professor A Indrayan Travel Grant	Professor D K Subbakrishna, Bangalore	Consent received	This year during the 2019 ISMS Conference

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