

Medicometric Portrait of Dr. Subhas Mukherjee, Late Recognized Pioneer of Historic Creation of India's First and World's Second IVF Baby

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ABSTRACT

Dr. Subhas Mukherjee (Mukhopadhyay), Bengalee Physician cum Medical Scientist, is a pioneer of IVF in India, a late recognized pioneer of Asia's as well as India's first and world's second test tube baby. This bibliometric study draws a painful story of late recognition and of defeat in the competition for the Nobel prize. It also analyses on his biographical facts and his 99-publications published during the period of 1957-1981 with 124 co-authors. He has 22 single authored and 73 multi-authored papers. His highest publication is 10.5 (54.55%) per year during 1972-76 when his age range was 42-46 years and second highest productivity is 21(21.21%) papers per year during 1967-71 when his age was between 37-41 years. He generated the highest papers 16 in collaboration with his closet collaborator D L Podder, during the period 1972-76. He mostly preferred *Proc. Ind. Sc. Cong. (25 papers)* for his publications. The most frequently used key terms *Human (19)* times followed by *Human Chorionic Gonadotrophin (HCG) (12)*, *Rats (10)*, *Infertility (8)*, *Pregnancy (7)*. Finally, it shows that data set does not follow Bradford distribution.

Keywords: Scientometric, Medicometric, Subhas Mukherjee (Mukhopadhyay), Human test tube baby, IVF, Asia's first IVF baby, Reproductive physiology, Kolkata.

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INTRODUCTION

Subhas Mukherjee (Mukhopadhyay), a Kolkata-based physician from West Bengal, India, is recognized as the pioneer of India's first and world's second human test tube baby using *in vitro* fertilization (IVF). The first test tube baby in India, Kanupriya Agarwal aka "Durga" in 1978 was born 67 days after the world's first test tube baby created in United Kingdom.

The calling "MAA" (mother, in English) is very sweet to hear. Every woman eagerly waits to hear this call. Every baby utters first "MAA" from the labor room where a baby sees first the light of the day. "Maa or Mother" is a woman who gives birth to a baby. A mother is a creator, nurse, protector, teacher, disciplinarian, friend, a Goddess (a Lady), selfless, loving and affectionate beings/human beings, a peaceful and fearless shelter, etc. who has no alternative in the world. Mother's love and affection is never marketed around the world and values of mothering or dues to mother is never paid back.

Motherhood is women's birthright. In reality, *all mothers are women but all women are not mothers*. It causes for some physical or emotional problems and malpractices in the woman and man, or a couple. Nowadays, infertility is one of the burning problems in our society as well as to major couples. In case of human, infertility is disability to conceive pregnant i.e., a married woman cannot get pregnant or conceive for full term. Above mentioned factors are the causes of infertility (Infertility, 2023).

A childless couple is still now treated as a curse in some societies as "infertile" or "fruitless", in other language, "Bandhya" (unproductive) in India. All are used as slang indicators. They are also identified as "unclean" and "untouchable". So, they could not take participation in social festivals; it is a bad customary in our societies. Day by day, number of childless couples is being tremendously increased throughout the country. Childless home is full of sadness, frustrations and seems empty.

IVF

IVF, "*in vitro* fertilization", is one of the fertility treatments. In Latin, "*in vitro*" means "inside the glass" and that may be "Biker" or "Test Tube". *In vitro* fertilization (IVF) is the most common and most effective type of Assisted Reproductive Technology (ART) to conceive pregnancy (Keci, 2010; Bhattacharya and Bhattacharyay, 2022). In other words, IVF technology is a



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mother-Making-Machinery (3M) with the creation of Test Tube/ IVF Baby as a whole. Mukherjee's IVF method is known as combined and preferred technique of "in vitro fertilization and cryo-preservation of human embryos".

To make childless couple happy or home full of joy, or curse free, Dr. Mukherjee, the first Asian Bengalee doctor from Calcutta (presently Kolkata) discovered the easiest and most successful way of producing a test tube baby using *in vitro* fertilization (IVF). It can get some women their right of motherhood.

IVF treatment may be of two ways: using either self eggs or donor eggs or sperms (Pristyn Care, 2023) and even is able to conceive a woman using pre-reserved sperm of a dead husband (Eai Somay, 2023).

Mukherjee vs. Edwards

Dr. Mukherjee and Dr. Edwards started working on infertility related issue in the 1950s and 1960s respectively. Their aim was to find a way of fertilizing human eggs outside the body and then it is pushed into mother's womb/ uterus (Keci, 2010). Mukherjee's method was different from Edwards. Though, Mukherjee had no knowledge of such parallel research in UK. Besides, Mukherjee had no proper documentation of his work. While Dr. Edwards had documented every step right from animal studies, Dr. Subhas was in lack of documentation. In science, no claims can be proved without proper documents (Narayan, 2010).

Dr. Mukherjee created baby "Durga" was born in Calcutta, 67 days after the birth of test-tube baby "Louise" in England, produced by Robert Edwards, English physiologist, and pioneer in reproductive medicine, and *in Vitro* Fertilization (IVF) in particular (Laxmi, 2018). It should be noted that in the 1960s, Edwards and his collaborator Patrick Steptoe began working on artificial fertilization, and after eight years of work they developed "*in vitro* fertilization" technique. Now, IVF is a scientific gift to those who are unable to conceive naturally, and since 1978, millions of babies have been born this way (Nosowitz, 2013). The IVF baby, Louise Joy Brown, was born on July 25, 1978 at Oldham General Hospital in Britain. Her parents, John and Lesley Brown, had been tried for nine years to have a child (Kolata, 2013).

Since, Robert Edwards produced baby using IVF 67 days before of Dr. Mukherjee's "Durga", it was considered to be the first test tube baby and Dr. Mukherjee has been overtaken by him only for the period of nearly 3 months. Dr. Edwards was also awarded the Nobel Prize in Medicine in 2010 for his success. Despite Subhas Mukherjee lost test tube baby race to Robert Edwards by 67 days only, their achievement in same line is equally important for mankind. Dr. T C Anand Kumar documented later and proved it that Dr Subhas Mukherjee was the pioneer of IVF and architect of first test tube baby in India as well as second in the world. A report of Dr. Mukherjee's research documentation has been attached in the editorial book of Prof. Sunit Mukherjee and Dr.

S. C Lodha, "Architect of India's First Test Tube baby by Dr. Subhas Mukherjee" (Mukherjee and Lodh, 2001). From the history of IVF techniques, it may be noted that technique of Dr. Mukherjee was much advance technique of fertilization and most easy technique of ovum removal than others (Keci, 2010; Dhawale, 2014).

Late Recognition

Dr. T C Anand Kumar, Director of Institute for Research in Reproduction (IRR), Indian Council of Medical Research (ICMR) along with Dr. Indira Hinduja was produced the second scientifically documented human test tube baby in the world as well as India's first official test tube baby. The second baby "Harsha Chawda", was born on 16 August, 1986 at the ICMR's IRR in collaboration with KEM Hospital Mumbai. This work was published in the *ICMR Bulletin* in 1986; and in the *Journal of in vitro Fertilization and Embryo Transfer* in 1988. Public knew that Dr. Anand had credited the first IVF baby of India. (Mukherjee and Mehta, 2020). The Official credit of this achievement went to Dr. Anand. Unfortunately, Dr. Mukherjee has already been died in 1981. In 1997, Kumar invited Kolkata to participate in a Science Congress. All the research documents of Mukherjee were handed over to him. From then, he studied Mukherjee's handwritten notes, published and unpublished research papers, and met Durga's parents for discussion about the matter. After all these, he became convinced that who was actually entitled to get the credit of the India's and world's second test tube baby. Immediately, Dr. Anand delivered the *Subhas Mukherjee Memorial Oration at the 3rd National Congress on Assisted Reproductive Technology and Advances in Infertility Management* held in Kolkata on February 8, 1997. Not only that, Dr. Anand also started movement for recognition of the Mukherjee's work of test tube baby in the medical research community in India and abroad. Immediate later, Dr. Anand published a paper in the "Current Science, vo. 72, No. 7, 10 April, 1997, pp. 526-531" as a historical note entitled "Architect of India's first test tube baby: Dr Subhas Mukherjee (16 January 1931 to 19 June 1981)" (Kumar, 1997). Thus, as a true and honest scientist, he gave due credit to Dr Subhas Mukherjee and later, Dr. Subhas was considered to be the "Architect of India's First Test Tube Baby" (Mukherjee and Lodh, 2001 Mukherjee S., 2016). Dr. Anand tried for 13 years to prove it. Subhas got recognition for his strong movement along with Prof. Sunit Mukherjee, the closed assistant of Dr. Mukherjee's research work; and Mrs. Nomita Mukherjee, life partner of the scientist. Finally, the Indian Council of Medical Research (ICMR) eventually recognized Mukherjee's work (Kabi, 2022; Wikipedia, the free encyclopedia, 2023). In 2002, ICMR acknowledged his contributions with regard to the work on IVF and included it in their document "*National Guidelines for Accreditation, Supervision and Regulation of ART Clinics in India*" (Laxmi, 2018).

Now, Mukherjee's method of combining *In vitro* fertilization and cryo-preservation of human embryos is the currently preferred

technique of medically assisted reproduction. Dr. Mukherjee is also considered to be the Indian father of IVF-Cure for Infertility (Laxmi, n. d.). This is a great blessing of medical science.

Bibliometric and Medicometric

Bibliometrics is an essential tool in Library and Information Science research. This tool is represented with the terms 'bibliometric', scientometric, webometric, biobibliometric etc. Bibliometric study is a mathematical or statistical analysis of bibliographical information or bio-data along with bibliographical data of an author's or a scientist's publications. Biobibliometric study includes biography and publications of a scientist either living or dead brought out during one's life time (Koley, 2023). In this study, the word 'medicometric', coined by the author of this study, is used for the medical scientist or medical teacher. There are so many bibliometric or biobibliometric studies were carried out by the different information scientists in India (Kalyane and Sen, 1996; Dutta, 2019; Koley and Sen, 2006, 2016, 2021; Koley, 2023).

Definitions

Scientometric: 'Scient' is taken from the term Scientist. Study on and about a scientist using statistical methods or mathematical metrics is "scientometric".

Medicometric: Similarly, 'Medico' means a medical practitioner or teachers or student or medical scientist. Study on and about a medical scientist using statistical methods or mathematical metrics is "Medicometric."

This study covers life story of Dr. Subhas Mukherjee, and his research works, publications throughout his life. He created his epoch-making discovery of test tube baby in association with Prof. Sunit Mukherjee, a cryobiologist, Jadavpur University; and Dr. Saroj Kanti Bhattacharya, a gynecologist, Calcutta Medical College. He was the first physician in Asia and second in the world after the British physicians Patrick Steptoe and Robert Edwards. Dr. Mukherjee and his team worked with "*In vitro* fertilization (IVF)" and created a test tube baby that is "Durga" (alias Kanupriya Agarwal) on 3 October 1978. Her mother's name was Mrs. Bela Agarwal. (Keci, 2010; Mukherjee and Lodh, 2001; Kumar, 1997).

Rate of fertility

From the following data sheet of fertility for last 10 years, it is observed that fertility rate in 2014 is 2.37. Gradually, year to year it declines and reached to 2.14 in 2023. In other words, fertility power among Indian women decreases day by day. Physical or emotional problems, some mal practices are the reasons behind it.

According to the observation from the Table 1 and graphical presentation (Figure 1), diminishing fertility rate is inversely

indication of increase of infertility. Dr. Mukherjee had brilliant success in treating patients with problems of infertility through the technique "*in vitro* fertilization (IVF)" (Dhawale, 2014).

IVF success rate in india

According to the patient's age, success rate of IVF treatment is as follows (Fertilityworld, 2021):

Success rate of IFV treatment varies according to the age of infertile women who are unable to conceive through other methods. This is shown in Table 2. However, with the advancement in medical technologies and IVF techniques, the success rate of IVF is consistently going to upward. In this case, infertile women younger than 35 are considered ideal candidates of IVF. Success rate using their self eggs or sperms for the procedure is nearly 80% to 95%. The IVF success rate unexpectedly falls down when the woman is over 35 years old. If a woman uses donor eggs for the procedure, chances of conceiving with IVF is most likely better. Surprisingly, if the quality of women's own eggs is poor, she may be advised to use donor eggs to increase the chances of a success of IVF procedure (Pristyn Care, 2023; Fertilityworld, 2021).

Factors Impact the Success of IVF

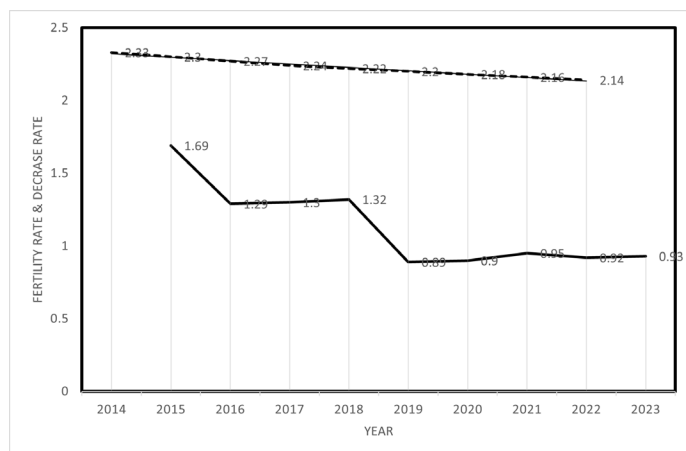
The success of IVF procedure differs depending on various factors such as the woman's age, history of a successful pregnancy, type of fertility issues, quality of eggs or sperms and embryos, use of donor eggs or sperms, use of prescribed medicines on time, making uterus ready, uterine or fallopian tube blockage, lifestyle of the patient, etc (Fertilityworld, 2021; Pristyn Care, 2023).

Personal Life

Subhas Mukherjee was born in a Brahmin family to Dr. Satyendra Nath Mukherjee, well-known radiologist and Mrs. Jyotsna Devi, on 16 January 1931 at his maternal uncle's house at Hazaribagh in Bihar (now in Jharkhand), India. His grandfather Mr. Aghornath Mukherjee was a well-known lawyer. They were the successor of Krittibas Ojha, the translator of the epic "the Ramayana" in Bengali language (Mukherjee and Mehta, 2020; Mukherjee S., 2016). He studied in the Khelat Chandra Memorial School at Bhagalpur in Bihar for few years, where Bibhutibhusan Bandyopadhyay was a Bengali language teacher for some time at that time (Mukherjee S., 2016; Paul, 2022). Meanwhile, Subhas got married Namita in 1960 and they had no children of their own. It is known that "Namita's contribution was to assist Subhas in his research work after sacrificing her other interest" (Mukherjee S., 2016). So far, they avoided issue of their own baby in order to not hamper Subhas's research work. As a woman and wife, Namita's sacrifice, no doubt, is to be proud of Indian's women as well as Bengalees (Calcuttans) and Subhas's IVF procedure is returning motherhood, the birthright to women. They can be said scientific-parents in this respect.

Table 1: Fertility rate (children born/woman) in India: 2014-2023.

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fertility Rate	2.37	2.33	2.30	2.27	2.24	2.22	2.20	2.18	2.16	2.14
Decline rate	-	1.69%	1.29%	1.30%	1.32%	0.89%	0.90%	0.95%	0.92%	0.93%

**Figure 1:** Graphical presentation of diminishing fertility rate in India.**Table 2: Success rate of IVF treatment by age.**

Infertile women's age	Success Rate of IVF (%)
Below 35	80%
35-37	70%
38-40	60%
40-42	40%
Above 43	20%

Academic Careers

Subhas passed Matriculation in the first division from Bow Bazar High School, Calcutta and I. Sc. from Surendra Nath College. He completed B.Sc. (Hons) in Physiology from the Presidency College, Calcutta University (now Presidency University) and his MBBS degree from the National Medical College (formally Calcutta Medical College) in 1955. He stood first in Obstetrics and Gynaecology, and obtained "Himangini" Scholarship and College Medal. He received the first Ph D degree in Reproductive Physiology (mainly in Biomedical changes in normal and abnormal pregnancy) under the guidance of Prof. Sachidananda Banerjee, the then head of the Department of Physiology, Presidency College, Calcutta in 1958 (Mukherjee S., 2016; Mukherjee and Lodh, 2001; Mukherjee and Mehta, 2020). In 1961, he got a Colombo Scholarship and he again started his post doctoral research work in Reproductive Endocrinology at the Clinical Endocrinology Research Unit, Edinburgh, UK under the renowned reproductive physiologist Prof. John A. Loraine and awarded second Ph D Degree in 1967 (Mukherjee and Lodh, 2001; Mukherjee and Mehta, 2020).

Research and Discoveries

Dr. Subhas started his research career in 1957. His research interest in research areas were *pharmacological methods of inducing ovulation and spermatogenesis, first on animals and later on human beings; luteotropic effects of DHEA and testosterone in rats and humans; menstrual cycle*, etc. He developed bioassays and biochemical methods to demonstrate the presence of HCG (Human Chorionic Gonadotrophins) like substance in the non-pregnant human endometrium and speculated on its possible role in fetal development. He also worked on a method of *in vitro* fertilization that was used successfully on a patient with damaged fallopian tubes (Mukherjee and Lodh, 2001). The remarkable and unique techniques used by Dr. Subhas Mukherjee were Human Menopausal Gonadotropin (HMG) for ovarian stimulation; Cryopreservation of the human embryos; and first use of a minimally invasive transvaginal approach for the retrieval of the oocytes (Mukherjee and Mehta, 2020). Dr. Mukherjee created such techniques are treated as the standard approach for modern day IVF and are routinely used in various IVF centers India and abroad.

In addition, he also has research contributions on other areas such as *nutrition; cellular origin of HCG; reproductive and endocrinology research* other than in the field of IVF; the *use of testosterone in management of female infertility; and emotional stress and Polycystic Ovarian Disorder or Stein Levanthal Syndrome* (Mukherjee and Mehta, 2020). Research works on these areas were also published in different journals.

Research Implications

In 1978, Dr. Subhas Mukherjee used his revolutionary techniques, "Cryo-Preservation" to preserve human embryo (Vibha, 2022) for creation of the first test-tube baby of India, "Durga" on 3rd October 1978, at Belleview Clinic in Calcutta. Then, he was a Professor of Physiology at Bankura Sammilani Medical College. He completed his works in association with Prof. Sunit Mukherjee, Department of Food Technology and Biochemical Engineering of Jadavpur University, and Dr. Saroj Kranti Bhattacharya, Associate Professor of Gynecology and Obstetrics at Calcutta Medical College. The delivery of IVF-baby was the epoch-making discovery in 20th century in medical research in India. For his blessing, at the age of diminishing fertility rate, women become mother of a baby and save their generation. In addition, many other babies were born after IVF babies created by Mukherjee and Anand. For example, Mrs. Saphla Rani Bhatia delivered a son at the age of 55 years in

February 2014 (Dhar, 2016); on June 8, 2015, Punji Patel, Mumbai became a mother delivering her son at the age of 60 (Dhar, 2015); Mrs. Rajo Devi (aged 70), a resident of Alewa village in Hisar, gave birth her daughter in 2008 and interestingly Mrs. Daljinder Kaur, a 72-year-old woman from Amritsar, Punjab also delivered baby successfully on April 19, 2016 (Dhar, 2016) that so far, it has been broken the record of Mrs. Devi for being mother at the age of 70. With help of the invention of Mukherjee's combinations of in vitro fertilization, and cryopreservation of human embryos technique in medically assisted reproduction, more than 5 million test tube babies worldwide see the lights of day (Bhat, 2020) after the birth of Louis Brown (Britain), and Durga (India) in 1978 (Bhat, 2020; Dasari and Gopalakrishnan, 2021). Some doctors say that "While the law doesn't stipulate a cut-off age for couples who can undergo IVF, guidelines issued by the Indian Council of Medical Research recommend that the combined age of the couple should not exceed 110. But doctors and patients regularly disregard the guidelines. (Dhar, 2015)." Recently, newspaper readers were witnessed such an event happened in the life of a rural woman (at age 48), resident of Rampurhat in the district of Birbhum in West Bengal. She was under IVF treatment for past few years due to disability to natural conceive and at that time, sperms of her husband was collected and preserved in a laboratory at Kolkata. Unfortunately, her husband died two years back in COVID. With her stong desires to be a mother after her husband's death, she gave birth to a baby through IVF using the same sperms on 11 December, 2023 at Rampurhat Medical College and Hospital with the legal support in regard to the case. It is a great success of IVF procedure. But, It is very sadful that her family members are not by her side (Chottopadhyay, 2023; Eai Somay, 2023). However, it proves that still now people are socially unconscious about the facts whether it is blessings or cruse of medical science for mankind.

Future research

Nowadays, there are so many IVF centers opened around the country. Over 2,500 fertility clinics are working successfully in India (ETI, 2023) using Mukherjee's ease IVF technologies. This mother-making- machinery (i.e., IVF) is capable to conceive the couples from younger to older who are unable to conceive naturally and other methods, even after multiple failures in fertility treatment in different IVF centers. It is also possible to be a mother using sperms of dead husband through this method (Eai Somay, 2023). With the path of Dr. Mukherjee, several women enjoy motherhood and the mothers are smiling. Though, the purpose of "Mother's Day" or "Children's Day" is different, an appeal may be forwarded to all to remind him in such "Days".

Research limitations

Dr. Subhas Mukherjee struggled to get late recognition as a creator of Asia's first and World's second IVF baby. After creating Asia's (India) first IVF baby "DURGA", Dr Mukherjee tried to

prove his great result of this research work at different scientific meetings, communities and also before an Inquiry Committee under the then Indian Medical Council (West Bengal Chapter) and the West Bengal Obstetrics and Gynaecology Association but all denied his claim. He was publicly harassed by the then West Bengal Government and India Government. Both the Governments did not allow sharing his achievement with the international scientific community. Eventually, he was transferred many times to different medical colleges to impede his research work and insult him. Finally, his claim of his achievement was dejected and he committed suicide before getting recognition. According to the words of India's first test tube, Kanupriya Agarwal (47) alies Durga, "My creator, Dr Subhash Mukherjee, had to face several challenges and criticisms. But with a focused mind, he created useful techniques within his own resources. He needs to be recognized" (Mascarenhas, 2022). Dr. Subhas Mukherjee is also known as "Scientific dad" of Durga (TNN, 2003). After long movement of Dr. Anand, Dr. Sunit Mukherjee and Mukherjee's wife Mrs. Nomita with proper documentation, he got recognition.

Professional Career, Injustice and Sad Demise

In 1967, he returned from Edinburgh and joined Sir Nil Ratan Sarkar (NRS) Medical College, Calcutta. During 1967-1975, he started teaching here as a Lecturer and subsequently became a Reader and Professor of physiology. Later he was transferred to Bankura Sammilani Medical College, Bankura, West Bengal, as a professor and became the Head of the Department. During this time, he successfully produced India's first test-tube baby "Durga on 3rd October, 1978." As she was born during the "Durga Puja", a famous festival in West Bengal, she was named "Durga".

He was invited to present his research findings at different scientific meetings. He presented on Fundamental work on the use of Testosterone in the management of female infertility at the International Conference on Physiological Sciences held in Paris in July, 1977. Dr. Subhas was invited by the Rotary club of Belur to speak on Test Tube Baby on 17th August, 1978. In the same year, his experiment discussed at the "Vth International Congress on Hormonal Steroids" held at New Delhi from 29th October to 4th November. This was shared with Professor John Biggers of the Laboratory of Human Reproduction, Harvard Medical School, USA; B. B. Sexena, Professor of Bio-Chemistry and Endocrinology of the Cornell University Medical School in the USA; and Kenneth Ryan, Professor of Gynecology of Havard. Dr. Mukherjee was invited by the Benaras Hindu University to speak on the subject of embryo transfer and talked before the famous scientist Udupa, the then director of Surgical Sciences at the Banaras Hindu University. He also was invited to speak on his technique of embryo transfer at Gauhati Medical College at the conference of the Gauhati Obstetrical and Gynecological Society, where he was awarded a "Manpatra" as a token of honour. He also met with Ambassador Marshall Green, Coordinator of

Population Affairs, US State Department, Washington on 6th November, 1978, and later with Kessel, Population Division, University of North Carolina, USA for discussion on his work as well as population problems. He made his major presentation on his research work and its findings at the *Indian Science Congress* in 1979 in Hyderabad (Kumar, 1997). A part from, several special programs for discussion on his research findings were also telecast Doordarshan TV Channel. Subhas was also invited to “3rd World Congress of Human Reproduction” held on 22nd to 26th March, 1981 for presentation on “Ovariotropic” and to Japan where he was invited to speak on IVF and ET. He could not attend both the programs (Mukherjee, 2016).

It should be noted that in 1978, Govt. of West Bengal formed an Inquiry Committee under the then Indian Medical Council (West Bengal Chapter) and the West Bengal Obstetrics and Gynecology Association for critically review and finding proofs on his research work. Subsequently, he submitted summarized report of his work with the signature of others two scientists. It is unfortunate that there was no expert in the field of human reproduction to understand his work. So, the committee denied his claim for his research work on the production of test tube baby. The committee said that it was unbelievable and absurd with the final verdict, “*Everything that Dr. Mukhopadhyay claims is bogus*” (Laxmi, 2018). He also heckled and humiliated by some professional bodies in some meetings in Calcutta. After that, the report has been published as a small paper in *Indian Journal of Cryogenics*, 3; 80, 1979. At that time, no country in the world was agreed to issue birth certificate for a test tube baby. Later, he was transferred by then Government intentionally to R.G. Kar Medical College, Calcutta in 1980, far away from his residence and eventually, in the next year, sent him to Regional Institute of Ophthalmology, Medical College, Calcutta. Here, all the opportunities for him were stopped so that he could not continue his research in reproductive medicine. Even despite knowing about his cardiac problem and disability in climbing stairs, he was transferred to that colleges where his subject department was at middle or top floor. So far, due to mental pressure, insults and defamation, he had to commit suicide on 18th June, 1981, reportedly writing in a note, “*I can't wait every day for a heart attack to kill me*” (Ramesh, 2023). It was a tragic and untimely demise of a doctor in India (Kumar, 1997; Mukherjee and Lodh, 2001; Mukherjee and Mehta, 2020) and a great loss in medical research. Just after his sad demise, his wife, Mrs. Namita Mukherjee applied to then Chief Minister on 4th July, 1981 for CBI enquiry against injustice and as an answer of it, she got a transfer order of “Late Dr. Subhas Mukherjee”, that was nothing but a inhuman behaviour. As closed witness of various kinds of harrasment, inhuman behaviour, injustice and his unsuspected death, she got shoked and later became paralysed. Mrs. Mukherjee died at the age of 78.

Honours and Acheivements

After his death, Dr. Mukherjee was awarded with honour to convey homage him through different purposeful functions, seminars, lectures, publication of books, articles, etc. (Mukherjee S., 2016; Mukherjee and Lodh, 2001; Mukherjee and Mehta, 2020; Change.org, 2021). Such as,

1982: The Indian Cryogenics Council began the “Dr. Subhas Mukherjee Memorial Oration”;

1985: Dr. Subhas Mukherjee Memorial Reproductive Biology Research Centre set up by Indian Cryogenics Council and Behala Balananda Bramachari Hospital, Jadavpur University at Behala, Calcutta, inaugurated by Prof. Ashok Mitre, IAS;

1991: Film Director, Late Tapan Sinha produced a Hindi film “Ek Doctor Ki Mout” (Death of a Doctor) on the short life and work of Dr. Mukherjee with the actors Pankaj Kapoor and Shabana Azmi. and it received National Film Award;

1994: A new Division of Memorial Reproductive Biology Research Centre inaugurated by Mr. Abdur Razzak Molla, Hon'ble West Bengal State Minister for Food Processing Industries;

1997: The paper “Architect of India's first test tube baby: Dr. Subhas Mukherjee” published by Dr. Anand in “Current Science” journal;

2001: Book entitled “Architect of India's First Test Tube Baby- Dr Subhas Mukherjee” under the editorial ship of Prof. Sunit Mukherjee and Dr. S. C. Lodh, published from the Dr. Subhas Mukherjee's Memorial Centre;

2002: After 21 years of his death, ICMR recognized his work for the first time and included in their document “*National Guidelines for Accreditation, Supervision and Regulation of ART Clinics in India*”;

2003: Indian Institute of Chemical Engineering arranged a reception ceremony for him at H L Roy Memorial Building in Jadavpur University, Calcutta;

2006: A memorial bronze statue of Dr. Mukherjee was set at the entry of academic building of Nilratan Sarkar Medical College and Hospital, Kolkata, inaugurated by Dr. Surjya Kanta Mishra, then Hon'ble Health Minister, West Bengal Government;

2007: Biography of Dr. Subhas Mukherjee was published in "Dictionary of Medical Biography" published by Greenwood Press in which the names of Calcutta based two doctors, Ronald Ross and U N Bramachari are also included;

2007: Brazilian Medical Society organized a reception celebration in honour of Dr. Subhas Mukherjee's achievement of IVF and "Dr. Subhas Mukherjee Memorial Reproductive Biology Research Centre" and Dr. T. C. Anand Kumar were also awarded with “Mementoes” each;

2011: "Life and Work" of Dr. Subhas Mukherjee was published in the literature journal "DAWN";

2011: Posthumous Honorary D.Sc. degree was given to Subhas by then Honorable Central Finance Minister, Sri Pranab Mukherjee in the Convocation of Indian Statistical Institute (an Organization of Central Government), Baranagar, Kolkata;

2011: Zee News TV Channel felicitated him offering the "Swastha Bharat Sanman" at Durba Hall of Hotel Taj Palace, New Delhi where he topped the list;

2011: Swami Bharat Chandra Kendra conveyed their tribute to Subhas;

2011: Dr. Sisir Majumder Institute of History, Sociology, Philosophy of Science and Health Sciences showed honour him in a fascinating function in the School of Tropical Medicine;

[2011?]: Indian Medical Association (West Bengal Chapter) expressed their gratitude to Subhas;

[2011?]: Then chief of "India's Smile" group, a voluntary organization filled "a Public Interest Litigation" in High Court of Kolkata for CBI investigation for injustice Subhas. They also requested to give him posthumous "Bharat Ratna" award for his epoch-making contribution;

2012: Research Fellows Association, Saha Institute of Nuclear Physics organized a lecture program on Dr. Subhas as a token of reverential acknowledgement;

2012: Dr. Subhas Mukherjee Award was announced by ICMR in his memory;

2013: A tribute was given in the Bulletin printed on the occasion of 55th Foundation Day of Institute of Post Graduate Medical Education and Research (IPGMER);

2013: Dr. Mukherjee was congratulated in a seminar organized by Indian Society for Assisted Reproduction (ISAR) and Bengal Obstetrics and Gynecology Society (BOGS) in association with Institute of Reproductive Medicine;

2013: Later, the BOGS also arranged the first Dr. Subhas Mukherjee Memorial Lecture in The Oberio Grand Hotel, Kolkata where a Paper "ART- past, present and future" was delivered;

[2018?]: A statue of Dr. Mukherjee was installed in the School of Tropical Medicine; Kolkata by Hon'ble present Chief Minister Ms. Mamata Banerjee. She also ordered to create a "Chair" in his name;

2018: Big size statue of the Dr. Subhas Mukherjee was built near his birthplace at Sadar Hospital, Hazaribagh;

2020: ICMR-National Institute for Research in Reproductive Health, Mumbai, on the occasion of the Golden Jubilee Celebrations of ICMR-NIRRH, published a book entitled "Dr. Subhas Mukherjee: A visionary and pioneer of IVF" by Dr.

Smita D. Mahale, Director, ICMR-NIRRH and Dr. Rajvi H. Mehta, ex-student of ICMR-NIRRH and a clinical embryologist. In addition, this institute had undertaken a project to spread awareness about his achievements with the monetary support from Indian National Science Academy.

Nowadays, several social medias are focusing various programmes, writings, vedios to convey honour to Dr. Mukherjee.

Stong Supporters for his Recognition

There are three strong supporters in movement for recognition of Mukherjee's work.

Dr. T. C. Anand Kumar

He was publicly known as a producer of the India's first scientifically documented and officially recognized IVF baby "Harsha" (b. 1986). It was his due credit for the great achievement. Yet, he willingly and frankly, without any hesitation, announced that he had no credit in the India's first test tube baby after reviewing all the original papers, published and unpublished, hand writing notes of Dr. Mukherjee. To establish the actual true, he started movements in the medical research community in India and abroad. Even his confession was written in a paper and published it in the "Current Science, Vo. 72, No. 7, 10 April, 1997, pp. 526-531" as a historical note entitled "Architect of India's first test tube baby: Dr Subhas Mukherjee (16 January 1931 to 19 June 1981)" (Kumar, 1997). Thus, as a true and honest scientist, he gave due credit to Dr Mukherjee and for his selfless support, Dr. Mukherjee received recognition as the pioneer of India's first and world's second test tube baby. Dr. T. C. Anand passed away on 26th January, 2010.

Prof. Sunit Mukherjee

He was one of nearest friend cum scientist of Dr. Mukherjee's research team and professionally a Cryobiologist worked as professor of Food Technology and Biochemical Engineering department, Jadavpur University, and was a Secretary of Dr. Subhas Mukherjee Memorial Reproductive Biology Research Centre, Food and Nutrition Division, Behala Industrial Estate, Diamond Harbour Road, Kolkata. From the beginning, he had been acquainted with Subhas Mukherjee and devoted his entire life to prove the original creator of test tube baby was Dr. Subhas Mukherjee. He collected all the documents, notes, hand writing papers, unpublished and published papers and convinced and helped Dr. Anand for proper documentation of Subhas Mukherjee's research findings. Dr. Sunit as a true friend struggled to give him the crown of victory and to wipe out the scar of fraud which was laid upon Dr. Subhas Mukherjee and gave his friend the due credit as pioneer of IVF baby in India as well as abroad. After 20 years from the death of Dr. Subhas (d. 1981), the book "Architect of India's first test tube baby-Dr. Subhas Mukherjee" was published from Dr. Subhas Mukherjee

Memorial Reproductive Biology Research Centre in 2001 under the editorial ship of Prof. Sunit Mukherjee and Dr. S. C. Lodha. (Mukherjee and Lodha, 2001; Mukherjee S., 2016; Mukherjee and Mehta, 2020). In addition, Prof. Mukherjee also written a book entitled, “A Tale of Subhas-Namita-Sunit (Dovetailed in the creation of world’s second test tube baby)” in 2016 from Calcutta. Prof. Sunut Mukherjee died on Jan 4, 2020 at the age 89.

Mrs. Namita Mukherjee

Mrs. Namita, a school teacher, B.A (Honors) from London University and dual MA from Calcutta University, was the life partner of Dr Subhas Mukherjee. She suffered from disgrace for long time as Subhas Mukherjee was humiliated to establish his credit in production of Asia’s first test tube baby. She also sacrificed her own interest and cooperated Subhas for his research work and fought for getting recognition of her husband. She took leading role to set up “*Dr. Subhas Mukherjee Memorial Reproductive Biology Research Centre, Calcutta*” and in arranging Annual Memorial Lectures for which it was possible to bring Dr. Anand Kumar to Calcutta and introduce him research works of Dr. Mukherjee. Besides, she actively initiated to record the mane of the scientist in the history of medicine through placing his name in “*Dictionary of Medical Biography*”, published by Greenwood Publishers, 2009; edited by Welcome Centre for History of Medicine, London, Britain (Mukherjee S., 2016). After suffering from several physical illnesses, she died on 12th July 2014.

Scope

This study is based on 99 publications of Subhas Mukherjee published. Out of them 95 papers have been published during 1957-1981, and date of publication for the remaining four papers could not be ascertained. It should also be noted that other 11 research papers of Dr. Mukherjee are still remained unpublished and complete manuscripts are not traceable (Mukherjee and Lodha, 2001). Only 99 published papers have been taken for this study.

METHODOLOGY

The list of publications of Subhas Mukherjee has been collected from Professor Sunit Mukherjee, a cryobiologist and a team member of the scientist. The relevant data from the list were compiled and inputted using MS-Word and MS-Excel for generating various indicators. For authorship count full credit was given to each author regardless of his position as the main author or co-author. Some other data were also retrieved from different web sources.

OBJECTIVES

The main objectives of this study are:

- to find out the year- and age-wise distribution of publications;

- to study the authorship pattern;
- to find the time span of authorship;
- to analyze the position of Mukherjee in the byline of authors;
- Scattering of research team and leading communication channels;
- to test Bradford’s law in respect to communication channel.

RESULTS AND DISCUSSION

Year-and age-wise distribution of papers

Table 3 shows the year- and age-wise distribution of papers of Mukherjee. He has 99 papers to his credit. Of 95 papers, he is the first author in 51 papers, second author in 7 papers, and third author in 8. He has produced 22 papers as single author. In all, he has published 15 papers as the co-author. Mukherjee’s first paper appeared when he was 27 years old and his productive life spanned 25 years. His productivity peaked in 1970, 1972, 1974 and 1975 when he was at the age of 40, 42, 44 and 45 respectively. It is also observed that the scientist published more than half of his papers ($N=55$) when he was 42 years. One paper had authorship pattern but no year of publication and three papers had no year and authorship pattern. Besides there were eight papers which had only year of publication but authorship pattern was not mentioned. Paper production could not be found during 1959-61, 1968-69 and 1979-80.

Quinquennium wise productivity

Table 4 provides the quinquennium-wise productivity of Mukherjee. He produced largest number of papers ($N=54$) during 1972-76 (54.55%), twenty-one during 1967-71 (21.21%), fourteen during 1962-66 (14.14%), four during 1957-61 (4.04%) and four papers had no year of publication. His highest productivity per year is 11 during 1972-76, followed by 4 during 1967-71. It peaked during 1972-76 touching 54 (54.55%). It is observed that it started to peak (Figure 2) from the second quinquennium (1962-66) and reached at the peak during the fourth quinquennium (1972-76).

Author productivity

Table 5 shows the authorship pattern. It appears that Mukherjee contributed maximum number of papers ($N=66$) with collaboration during his productive career. Only twenty-two papers ($N=22$) were produced without collaboration. Of the collaborative papers, 30 are two-authored, 23 three-authored, 08 four-authored, 02 each five-authored and six-authored. Eleven papers had no authorship pattern.

Time span of authorship

Table 6 represents the time span of authorship. Collaboration has resulted maximum two-authored papers, i.e., 30, naturally

Table 3: Chronological distribution of papers.

Year	Position in byline of authors				Publications		YM -b- ANM	YandA NM	TP	CT	AA (1931)	PA (1957)
	Single	1 st	2 nd	3 rd	MA	CA						
	Auth.	Auth.	Auth.	Auth.								
1957	1				1				1	1	27	1
1958		1			1				1	2	28	2
1962		1			1		1		2	4	32	6
1963	1				1		1		2	6		
1964			1			1	2		3	9	34	8
1965		1	1	1	1	2	1		4	13	35	9
1966		1			1		2		3	16	36	10
1967							1		1	17	37	11
1970	11	1			12				12	29	40	14
1971		5	3		5	3			8	37	41	15
1972	4	11		3	15	3			18	55	42	16
1973		3		2	3	2			5	60	43	17
1974	2	12	1		14	1			15	75	44	18
1975	1	8	1	1	9	2			11	86	45	19
1976		4		1	4	1			5	91	46	20
1977	1				1				1	92	47	21
1978	1	1			2				2	94	48	22
1981		1			1				1	95	51	25
YNM-b-AM		1			1				1	96		
YandA NM	-	-	-	-	-	-	-	3	3	99	-	-
Grand Total	22	51	7	8	73	15	8	3	99			

YNM-b-AM=Year not mentioned but authorship pattern mentioned; YM-b-ANM=Year mentioned but authorship pattern not mentioned; YandA NM=Year and authorship pattern not mentioned. TP=Total Papers; CT=Cumulative Total; AA=Author's Age; PA=Productive Age.

Table 4: Quinquennium wise productivity of Mukherjee.

Quinquennium	Age (years)	No. of Publications	Productivity per year	Percentage
1957-1961	27-31	2	0.4	2.02
1962-1966	32-36	14	2.8	14.14
1967-1971	37-41	21	4.2	21.21
1972-1976	42-46	54	10.8	54.55
1977-1981	47-51	4	0.8	4.04
YNM	-	4	-	4.04
Total		99	1.92	100.00

YNM=Year not mentioned.

with the maximum time span of 24 years. Twenty-three three-authored papers were published in a time span of 17 years and 8 four-authored papers in a time span of 12 years of his active productive carrier. Twenty-two non-collaborative papers were published in a time span of 22 years. Six-authored papers (N2)

were published in a time span of 2 years. Eight papers without authorship pattern were published in a time span of 6 years. Besides, 1 seven-authored paper was published in a time span of one year and no time span could be calculated for eight papers as years of publication were not mentioned.

Table 5: Authorship pattern.

Authorship Paper Type	Single	Two	Three	Four	Five	Six	Seven	Total
Non-collaborative	22	-	-	-	-	-	-	22
Collaborative	-	30	23	08	02	02	01	66
ANM	-	-	-	-	-	-	-	11
Total	-	-	-	-	-	-	-	99

Table 6: Time span of authorship pattern.

Authorship Patterns	Single	Two	Three	Four	Five	Six	Seven	YM-b-ANM	YandA NM
No. of papers	22	30	23	08	02	02	01	08	03
Time span	1957 to 1978	1958 to 1981	1962 to 1978	1965 to 1976	1973 to 1975	1972 to 1973	1975 to 1975	1962 to 1967	-
Time span in years	22	24	17	12	03	02	01	06	-

YM-b-ANM=Year mentioned but authorship not mentioned; YandA NM= Year and Authorship not mentioned.

Table 7: Position of Mukherjee in the byline of authors.

Authorship patterns	Position in the byline of authors				Total
	1 st position	2 nd position	3 rd position	PNK	
Two-authored	25	05	-	-	30
Three-authored	18	01	04	-	23
Four-authored	05	01	02	-	08
Five-authored	01	-	01	-	02
Six-authored	01	-	01	-	02
Seven-authored	01	-	-	-	01
Total	51	07	08	-	66
ANM	-	-	-	11	11
Grand Total	51	07	08	11	99

ANM=authorship pattern not mentioned; PNK= Position not known.

Rank in the byline of authors

Table 7 identifies the rank of Mukherjee in the byline of authors in his collaborative papers. He appeared as the first author in maximum number of papers (N51). He occupied the second in as many as 7 papers, third position in 8 papers. Position of 11 papers could not be ascertained.

Research team

Table 8 depicts the research team of Mukherjee. It reveals that the scientist has worked with 43 collaborators in his productive career and generated the highest number of papers i.e., 16 in collaboration with D L Podder, during the period 1972-76. Other closed two collaborators were Malay Chatterjee and K M Gun who

have produced 12 and 11 papers respectively. One collaborator E T Bell has produced seven papers. Three Collaborators have produced six papers each; two collaborators- five papers each; three collaborators-three papers each. A group of eleven collaborators have produced two papers each and another group of 19 collaborators-one paper each.

Communication channels

Table 9 shows the ranked list of channels of communication of Mukherjee's papers. He has used 41 communication channels to publish his 98 papers, and no communication channel is mentioned for one paper. Most of the papers are published in conference proceedings and journals. *Proc. Ind. Sc. Cong.*

Table 8: Mukherjee and his collaborators.

Serial No	Authors	Positions of authors															Papers		Total authors		Period	
		Single		Two		Three			Four			Five			Six to Seven		ANM	Main author	Co-authors	FYP	LVP	
		a	b	a	b	c	a	b	c	d	a	b	c	d	e	a						CA
1	Subhas Mukherjee	22	5	18	1	4	5	1	2	1	1	1	1	1	2	1	73	15	88	1975	1981	
2	D. L. Podder		8	1	1	4	1	1	1					1				16	16	1972	1976	
3	Malay Chatterjee			3	6	1	1	2										12	12	1971	1976	
4	K. M. Gun	1	1	4	2	1	1	2						1			1	10	11	1972	1977	
5	E. T. Bell	1	1	3	1	1	1	1									3	4	7	1962	1970	
6	Alok Bhattacharjee		3	2												1		6	6	1974	1976	
7	Chandra Shekher Mukherjee			1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	6	1971	1975	
8	John A Loraine				4	1	1	1										6	6	1962	1970	
9	B. N. Chakraborty	1	1	1						1	1	1	1	1	1	1	3	2	5	1973	1981	
10	Jayashree Basu					1	1	1	1	1	1	1	1	1	1	1	1	4	5	1972	1976	
11	Subrata Chakraborty		3															3	3	1974	1974	
12	Sunit Mukherjee		2	1														3	3	1974	1978	
13	D Chakraborty			1						1	1	1	1	1	1	1		3	3	1973	1976	
14	B. Sarkar		2														2	2	2	1971	1971	
15	B. B. Ghosh			2														2	2	1972	1972	
16	D. Dalui		1															2	2	1971	1972	
17	Indrani Sen									1	1	1	1	1	1	1		2	2	1971	1972	
18	J. R. Chatterjee					2												2	2	1974	1974	
19	Krishna Roy			1						1	1	1	1	1	1	1		2	2	1975	1976	
20	Pradip K. Gupta		2															2	2	1973	1975	
21	Rina Roy		1						1									2	2	1971	1976	
22	Satyen Sinha									1	1	1	1	1	1	1		2	2	1971	1971	
23	T. Das Gupta			2													2		2	1972	1972	
24	Kato Aal	1	1														1	1	2	1973	1974	
25-43	Others with one paper each		1			4	1	2	2	2	2	2	2	2	2	7	1	18	19	1958	1978	

Serial No	Authors	Positions of authors															Papers		Period				
		Two		Three		Four			Five			Six to Seven		ANM	Main author	Co-authors	Total authors	FYP	LYP				
		a	b	a	b	c	a	b	c	d	e	a	CA										
	Total (1-43)	30	29	23	21	27	7	8	8	8	8	3	2	2	3	15	-	88	124	212			
	ANM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	11					
	Grand total	30	29	23	21	27	7	8	8	8	3	2	2	3	15	11	99						

a=1st author, b=2nd author, c=3rd author, d=4th author, e=5th author; FYP=First Year Publication; LFP=Last Year Publication.

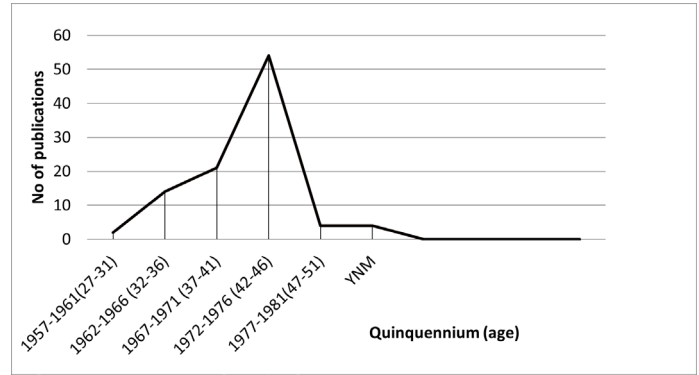


Figure 2: Graphical representation of quinquennium wise productivity.

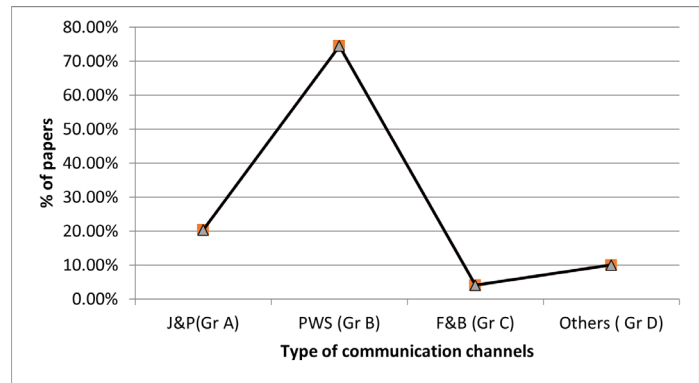


Figure 3: Percentage of papers published in channels of communications.

(N25), *Proceedings of the All-India Obstetrics and Gynecological congress*(N13), *Proceedings of All India Conference on Research in Reproduction and Fertility control Bombay*(N6) had been the most favorite communication channels of the scientist. *J. Endocrin. (Australia)* was his favorite journal where he published 4 papers during 1964 to 1965. His papers published are grouped into four categories (Figure 3) Journals and periodicals (20.41%), Conference proceedings, congress, symposium, workshop, etc. (74.49%), Festschrift / books/ thesis (4.08%) and others (1.02%). They emanated from India (N72), Australia (N4), London (N4), USA (N3), Copenhagen (N2), Edinburgh (N2), Berlin (N1), Geneva (N1), Paris (N1) and New York (N1).

Bradford's Law

Bradford's Law has three zones of communication channels (here 41). According to the law, in the first zone, 45 (34.34%) papers have been published in first 12 communication channels. The second zone contains 9 channels with 34 (34.69 i.e. 35%) papers and the third zone consists of 19 (19.38 %) papers published in 20 communication channels. Every zone of the law should have nearly 33% of the papers. Therefore, the data set of communication channels does not fulfill Bradford's Law.

Keywords

Table 10 depicts frequencies of keywords used in the titles of his papers. Among all, the key term *Human* has appeared as many

Table 9: Channels of communication.

Sl. No.	Channels of communications	Total	%	Cum-%	FYP	LYP	Country
Group A	Journal and Periodicals (J and P) (20.41%)						
1	J. Endocrin.	4	4.08	4.08	1964	1965	Australia
2	Journal Applied Nutrition	3	3.07	7.15	1973	1975	USA
3	Indian Journal of Physiology.	2	2.04		1971	1972	India
4	Journal of Obst. and Gynae. of India.	2	2.04		1973	1976	India
5	Acta Endocrinological (Copenhagen) Suppl.	2	2.04		1965	1966	Copenhagen
6	Acta. Endocrin. (Kbh.) Suppl.	2	2.04	15.31	1962	1966	India
7	Bulletin of the Asiatic Society.	1	1.02		1970	1970	India
8	Indian J. Physiol and Pharmacology.	1	1.02		1958	1958	India
9	Indian J. Cryog.	1	1.02		1978	1978	India
10	Indian Journal of Physiology and Allied Sciences.	1	1.02		1975	1975	India
11	Indian Journal of Radiology.	1	1.02	20.41	1972	1972	India
Group B	Conference proceedings, Congress, Symposium, Workshop, etc. (PWS) (74.49%)						
12	Proc. Ind. Sc. Cong.	25	25.52	45.93	1970	1976	India
13	Proceedings of the All-India Obstetrics and Gynecological congress.	13	13.26	59.19	1972	1975	India
14	Proceedings of All India Conference on Research in Reproduction and Fertility control Bombay.	6	6.13	65.32	1970	1970	India
15	Proceeding of First All India Congress of Cytology and Genetics.	4	4.08	69.4	1971	1971	India
16	Proceeding of the V th Asia and Oceanic Congress of Endocrinology.	2	2.04		1974	1974	**
17	Proceeding of the 3 rd National Congress on Diabetes, Bombay.	2	2.04		1975	1975	India
18	Proceedings of the fourth All India Symposium of Indian Brain Research Association.	2	2.04		1972	1972	India
19	Proceedings of the International Congress of Endocrinology, London.	2	2.04	77.56	1964	**	London
30	3 rd World Congress of Human Reproduction. Berlin.	1	1.02		1981	1981	Berlin
20	44 th Annual General Meeting and Symposium on Malnutrition and Drug.	1	1.02		1975	1975	India
21	Int Congress on hormonal steroids, Delhi.	1	1.02		1978	1978	India

Sl. No.	Channels of communications	Total	%	Cum-%	FYP	LYP	Country
22	International Satellite symp. On work physiology and ergonomics, November, Calcutta.	1	1.02		1974	1974	India
23	Proc National Seminar on Nutrition Education, NCERT, New Delhi.	1	1.02		1974	1974	India
24	Proc of short-term training course on improved techniques of frog leg processing.	1	1.02		1975	1975	**
25	Proc. Int Conf. on family planning, New Delhi.	1	1.02		1972	1972	India
26	Proc. International Conference on family planning, proceedings.	1	1.02		1972	1972	**
27	Proc. International Congress of Physiological Sciences, Paris.	1	1.02		1977	1977	Paris
28	Proceeding of the Seminar on Population Crisis.	1	1.02		1974	1974	India
29	Proceedings of the Acta Endocrinological Congress, Geneva.	1	1.02		1962	1962	Geneva
31	Proceedings of the Asian Congress of Obst. Gynae.	1	1.02		1975	1975	**
32	Proceedings of the Endocrine Society of Great Britain.	1	1.02		**	**	London
33	Proceedings of the G (Gonadotrophin) Club Meeting.	1	1.02		1966	1966	Edinburgh
34	Proceedings of the International Symposium Fondazione Carloerb Millan.	1	1.02		1963	1963	**
35	Proceedings of the National Conference on Family Planning, New Delhi.	1	1.02		1975	1975	India
36	Proceedings of the Royal Society of Medicine.	1	1.02	94.9	**	**	London
Group C	Books/ Festschrift, Thesis, etc. (F and B) (4.08%)						
37	Hormone Assay and their Clinical application, edited by E. T. Bell, 2 nd ed. Livingstone Edingurgh.	1	1.02		1964	1964	Edinburgh
38	Hormone in Blood, Vol. I (p297), edited by C. H. Gray and A. L. Bagharach, Academic Press.	1	1.02		1967	1967	New York
39	First Ph D. Thesis, Calcutta University.	1	1.02		1957	1957	India
40	Ph. D. Thesis, Edinburgh University.	1	1.02	98.98	1963	1963	Edinburgh
Group D	: Others (1.02%)						
41	Association of India?	1	1.02	100	1975	1975	India
Total	(1-41)	98	100				

**could not be ascertained.

Table 10: Keyword frequency.

Keywords	Frequency
Human	19
Human chorionic gonadotrophin (HCG).	12
Rats	10
Infertility	8
Pregnancy	7
Luteinising hormone (LH)	6
Pregnant mares' serum gonadotrophin (PMSG).	6
Ovulation	5
Diagnosis	4
Human female	4
Menstrual cycles	4
Specific determination	4
Testosterone	4
Androgens	3
Diabetes mellitus	3
Endometrial gonadotrophin	3
Female Rats	3
Muscular exercise	3
Non pregnant human endometrial tissues.	3
Urinary gonadotrophic excretion.	3
Adrenoovarian adaptive mechanism.	2
Bangladesh	2
Clinico- experimental study/ investigation.	2
Cyclic activities	2
Endocrine functions	2
Female Infertility	2
Food population Equation.	2
Further observations	2
Gonadotrophin	2
Inadequate luteal phase	2
Infants	2
Male infertility	2
Normal menstrual cycle	2
Ovarian ascorbic acid depletion test.	2
Overtropic effect	2
PMSG	2
Purification	2
Rat ovarian Cholesterol	2
Sustained emotional stress	2
Urinary excretion	2
Uterine decidual	2
Young children	2

as 19 times followed by *Human chorionic gonadotrophin (HCG)* (12), *Rats* (10), *Infertility* (8), *Pregnancy* (7) and so on. It proves that his main focus is on human pregnancy or infertility and a result of such activities is production of India's first human test tube baby.

CONCLUSION

Dr. Subhas Mukherjee discovered the easiest and most successful way of producing a test tube baby. In fact, he was the first Asian discover for the process but never got his recognition during his lifetime. Most of the IVF centers around the world has been using his method because of its high success rate. For his discovery, many women become a mother to a baby and it brings a smile on the mother's face. After 40 years of his death, Dr. Mukherjee got proudly recognition by the present West Bengal Government for his test tube baby and the government has stated awards in his name. After a long procession for finding truth of Dr. Subhas Mukherjee's work, "India's first test tube baby", general people came to know him and his works from various reliable sources. Some people humbly appeal to the Government of India to confer Dr. Subhas, a deserved scientist, for either the "Bharat Ratna" or the "Padma Bibhushan" as posthumous award. Besides, they also demand to celebrate 3rd October, the birth day of Dr. Subhas Mukherjee as the "National Fertility Day" (Vibha, 2022; Change.org, 2021). Lastly, it should be mentioned that the first test tube "Durga" is now 47 years old, and mother to a nine-year-old-daughter. Both are leading a normal life. Dr. Mukherjee's discovery and Durga are inspirations to the infertile women.

ACKNOWLEDGEMENT

Thanks to Prof. Sunit Mukherjee, the very nearest associate of Dr. Subhas Mukherjee for sending me his two books on and about Dr. Subhas Mukherjee's work, collection of unpublished, published papers, hand writing notes along with notable events of / with Dr. Mukherjee, on request.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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