

## Current Status in Medical Genetics: Bangladesh Perspective.

Zinnat Ara Yesmin<sup>1</sup>, Latifa Nishat<sup>2</sup>, Md. Abdullah-Al-Sayeeef<sup>3</sup>, Devjani Banik<sup>4</sup>, Md. Mohiuddin Masum<sup>5</sup>

<sup>1</sup>Assistant Professor, Department of Anatomy, Bangabandhu Sheikh Mujib Medical University.

<sup>2</sup>Assistant Professor, Department of Anatomy, Bangabandhu Sheikh Mujib Medical University.

<sup>3</sup>Lecturer, Department of Anatomy, Faridpur Medical College.

<sup>4</sup>Lecturer, Department of Anatomy, Institute of Public Health (IPH).

<sup>5</sup>Assistant Professor, Department of Anatomy, Anwer Khan Modern Medical College.

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### ABSTRACT

**Background:** Tremendous advancement in medical sciences especially in diagnosis, changes the concept of pathophysiology and management of disease. Sophisticated technologies now permit new methodology and high-quality preparations ensuring greater accuracy in molecular and genetic diagnosis. Currently, the genetic laboratories and clinics are prominent worldwide including Bangladesh in conducting more accurate diagnosis as they offer specialized laboratory testing and comprehensive diagnostic evaluation in addition to genetic counseling. The aim of this study is to see the current status of medical genetics in Bangladesh. **Methods:** This was a descriptive study, conducted by analyzing the online available literature on genetic study in Bangladesh, information obtained by visiting the genetic laboratories of different institution and searching their websites as well as through personal communication with the respective personnel of the institutes of Bangladesh. **Results:** The spectrum of genetic diseases, genetic services, academic programs in Medical Genetics, genetic counseling and research in genetics conducted in Bangladesh were described in this study. It is an effort to observe the present situation. Though a beginning has been made, the genetic services, counseling and research in the area of medical genetics still not up to the mark. Research in gene therapy and stem cell therapy does almost not exist. **Conclusion:** Basic knowledge and training in genetics for medical staff should meet the national demands.

**Keywords:** Medical genetics, current status, Bangladesh.

### INTRODUCTION

Advances and breakthroughs in genetic science are continually in the news, attracting great interest because of the potentials for diagnosis and eventually treating disease.<sup>[1]</sup> Sophisticated technologies now permit new methodology and high-quality preparations ensuring greater accuracy in genetic diagnosis. Currently, the genetic laboratories and clinics are prominent worldwide in conducting more accurate diagnosis as they offer specialized laboratory testing and comprehensive diagnostic evaluation in addition to genetic counseling. Molecular basis of all human diseases is the current focus of interest in medicine. It is evident that most diseases have either major or minor genetic cause as well as environmental

components responsible for the disease condition with varying degrees of influence and interactions among them.<sup>[2]</sup> A complete concept of human genetics and disorders needs anthropological, ethnological, sociological, cultural and as well as religious dimensions of human history and civilization along with scientific knowledge of genetics.<sup>[3]</sup> With the discovery of DNA, genetic services have dramatically increased in quality and scope. Genetic disorders and their prevention have become one of the principal challenges of this time.<sup>[4]</sup>

Bangladesh is a small and densely populated country in South Asia, bordering Myanmar, India, Nepal and Bhutan, and has about 167 million population.<sup>[5]</sup> Bangladesh is accepted as a developing country economically and socially in March 2018 by the United Nations Economic and Social Council.<sup>[6]</sup> Being a developing country, Bangladesh spends about only 3% of its Gross Domestic Product (GDP) on health and provides totally free or highly subsidized health services to the economically deprived groups through public health system.<sup>[7-8]</sup> Private health expenditure

#### Name & Address of Corresponding Author

Dr. Zinnat Ara Yesmin  
Assistant Professor,  
Department of Anatomy,  
Bangabandhu Sheikh Mujib Medical University

constitutes more than two-thirds (72.1%) of the total health expenditure.<sup>[8]</sup> The health services are available as a public service which is provided by the Government of Bangladesh under the Ministry of Health and Family Welfare as well as a private service which is provided by various private organizations in addition to individual practices. Besides these, both the public and private sectors have contributed to the e-Health infrastructure throughout the country.<sup>[9-10]</sup>

Like the other developing countries, the numbers of genetic and non-communicable disorders (NCDs) are increasing day by day in this country.<sup>[11-12]</sup> There are about 1.3 to 1.5 million cancer patients in Bangladesh and approximately 0.2 million newly diagnose cancer cases each year.<sup>[13]</sup> Majority of the cancers are predominantly caused by the genetic abnormalities. These might be needed both cytogenetic and molecular genetics for diagnosis and a significant prerequisite for individualized treatment strategies.<sup>[14]</sup> Cancer genetics is increasingly integrated into the practice of modern medical oncology. The ability to distinguish a growing proportion of the 5% to 10% of all cancers that develop in individuals who have inherited a genetic mutation conferring heightened susceptibility to specific cancers may permit targeted efforts in cancer surveillance and prevention.<sup>[15]</sup> Nowadays, it has been a burning issue to incorporate the knowledge of genetics in both undergraduate and postgraduate levels of medical curriculum. Each specialized medical discipline must require the knowledge of genetics, individual and family counseling skills.<sup>[16]</sup> Although almost all known genetic disorders have been reported in Bangladesh and regional distribution for many conditions historically known, prevalence data and the mutation profiles are not well known for the majority. The underlying population genetic heterogeneity possessing significant challenges in this regard. In addition to the complexity and the magnitude of the population, the presence of disparity in economic and infrastructural resources at the level of population subgroups as well as individuals further complicates the health care delivery and access to genetic services.

During the last three to four decades, medical science experienced a spectacular advancement in molecular genetics. It includes the significant achievements in the Human Genome Project for gene mapping, which facilitates the precise diagnosis of some genetic disorders at the molecular level. As advancements in the understanding of genetics are influencing clinical management, the importance of genetics education for health care professionals is increasingly recognized worldwide.<sup>[17]</sup> So, the present study aims to observe the current status of medical genetics in Bangladesh.

## MATERIALS AND METHODS

The study is mainly based on analyzing online available literature on genetic study in Bangladesh. To find all possible sources of information on the issue, we conducted both formal and informal searches on WHO website, PubMed and Google Scholar etc. Besides these, the 'Genetic Research Lab' in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University (BSMMU) and the other departments of BSMMU were observed. However, the current status of genetics in the other institutions in Bangladesh was observed by visiting the institutions and also searching their websites as well as through personal communication with the respective personnel of the institution.

## RESULTS AND DISCUSSION

We analyzed the data under five aspects. These are presented below:

### **The spectrum of genetic diseases in Bangladesh**

Almost all the known reported genetic disorders are found in Bangladesh are diagnosed by the medical geneticists as well as clinicians. What has identified so far is just the tip of the iceberg. Most genetic diseases go undiagnosed and unidentified in this country from other fields have been reported such cases in the medical literature since their delineation. However, the data have been from limited institutions or individuals and the nationwide prevalence of most disorders is not known. Beta thalassemia is the most common genetic disorder and 7% of our population is thalassemia carriers.<sup>[18]</sup> Down syndrome is one of the very commonly encountered genetic diseases. The karyotyping diagnosis of the chromosomal abnormalities is reported in the Journal of Armed Forces Medical College, Bangladesh and they observed that the male and female ratio of the chromosomal abnormalities was 0.7:1. Most of the patients (32.1%) were in the age group of 10 years to 45 years, the percentage of consanguineous marriage is 2.3, the percentage of chromosomal aberrations is 19.8; of these, 15.2% involved autosomes, while only 4.6% involved gonosomes, trisomy 21 was detected in 9.1% patients and Philadelphia chromosome was found in 6.1% patients, Turner and Klinefelter syndrome were found in 3.8% and 0.8% patients respectively.<sup>[19]</sup> Islam et al. observed another important prevalence reports on cardio-vascular diseases.<sup>[20]</sup> The reports of their observation showed the prevalence of hypertension is 20-25%, coronary artery disease is 4-6%, rheumatic heart disease is less than 1 in 1000, congenital disease in 25-30 in 1000 live births, stroke 0.3-1.0% in adults. All these forms of diseases are somewhat linked with the genetic

abnormalities. So these numbers of prevalence give us an idea about the importance of cardio-vascular diseases majority caused by their alibi with genetic predisposition.

### **Genetic services in Bangladesh**

In Bangladesh, genetic services are mostly limited in contrast to industrial and agricultural sectors where genetics is being used in dealing with a wide range of plants, animals and micro-organisms. In the agriculture sector, tremendous progress has been made in genetic research on crops, fruits, flowers and vegetables. The sequencing of a whole genome has been made possible by using the bioinformatics and Bangladesh has made use of this technology to sequence the jute genome and the genome of *Macrophominaphaseolina*.<sup>[21]</sup> However, the pharmaceutical companies like the Incepta Pharmaceuticals have begun to manufacture and advertise insulin and export Europe and USA. Incepta has also signed an agreement with the International Centre for Genetic Engineering and Biotechnology (ICGEB) to obtain the technological know-how for manufacturing hepatitis B vaccine.<sup>[22-24]</sup>

But Bangladesh is facing the rising burden of genetic diseases related to disabilities and deaths. Further, general populations are not aware of developing genetic disorders. Trained human resources are one of the pre-requisite of genetic service, which is in a crucial need in the healthcare sector of the country. Compared to the agricultural sector, the healthcare sector of Bangladesh is lag behind in the field of genetics. Currently, in the field of medicine, genetics is limited to research works. Genetic research is almost restricted entirely too epidemiological research with very little involvement of laboratory facilities.

Among the very few genetic services available in Bangladesh, the most important is the forensic DNA test. This has become true with the establishment of National Forensic DNA Profiling Laboratory at the Dhaka Medical College Hospital. Since 2005, DNA finger-printing has been used for the paternity test, the criminal dispute in cases of rape and murder. Several private hospitals are also doing the variant extent of genetic tests for the diagnosis of various diseases like PCR and real-time PCR based diagnosis. Karyotyping is being done by the Anatomy and Pathology Department of BSMMU, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), Combined Military Hospital (CMH) Dhaka and some private hospitals. Some private laboratories have started molecular tests services and DNA Solution Limited is mentionable one among them. They provide molecular virology, molecular genetics, chromosome analysis, cancer panel test, tissue typing and DNA sequencing facilities.<sup>[25]</sup>

### **Academic programs in Medical Genetics**

It has been seen that approximately 1 in 10 patients seen in primary care is reported to have a disorder with a genetic component.<sup>[26]</sup> For this reason, the medical professionals should have enough knowledge about the genetics and molecular biology. It is widely recognized that physicians entering into medical practice in the 21st century will require more than a basic understanding of human genetics.<sup>[27]</sup> A study by Challen et al. revealed that European countries like Greece, Hungary, Italy, Lithuania, Poland and Spain have 40 hours, 12 to 18 hours, 70 hours, 88 hours, 230 hours for genetics in undergraduate medical education respectively.<sup>[28]</sup> The development of human genetics in Germany started in 1960 and now they prevent the majority of diseases by using medical genetics.<sup>[29]</sup> They believed that the strength of genetics lies in the prevention of disease, not in cure.

In Bangladesh there are many opportunities for being an expert geneticist shortly. Among the public universities, Dhaka University (DU), Islamic University (IU), Jessore Science and Technology University (JSTU), Khulna University (KU), Mawlana Bhasani Science and Technology University (MBSTU), Rajshahi University (RU), Shahjalal University of Science and Technology (SUST) and Chittagong University (CU) run Biotechnology and Genetic Engineering subject at bachelor level. Someone can also acquire Master's and M.Phil degrees in this subject from Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), DU, Khulna University KU, RU, CU and IU. Among the private universities, only Stamford University Bangladesh and University of Development Alternative (UODA) run this subject in graduate level.<sup>[30]</sup>

Taking into account the importance and potentials of the field of genetics, it is time to focus on genetic counseling services, genetic laboratory services, as well as the making of geneticists in Bangladesh. The recent curriculum for undergraduate medical education in Bangladesh, introduced in 2012, covers only a part of basic genetics in Anatomy includes only 4-hour.<sup>[30]</sup> The post-graduate curriculum of different disciplines have only the basic genetics to study that is insufficient to provide the students proper knowledge regarding molecular diagnosis as well as genetic research in their respective disciplines.

To produce genetic specialists, the Anatomy Department of BSMMU took an initiative to formulate a clinically, practically and research oriented curriculum for MS Anatomy residents and subsequently it might be a short course for students of other disciplines. Now the MS Anatomy course includes a basic genetics of 3 months duration and also has an advanced genetics of 6 months duration

that enables the students to research in the field of genetics.

Some public and private institutions possess genetic technologies and some sophisticated equipment is involved in genetic research and services. Among them, BSMMU, International Centre for Diarrheal Disease Research, Bangladesh (ICDDR,B), BIRDEM, Centre for Advanced Research in Science (CARS), CMH, Dhaka and Lab Aid Hospital Limited, Dhaka are mentionable.<sup>[30]</sup> Thus, keeping the above facts in mind, a curriculum was formulated in the Department of Anatomy, BSMMU for MS Anatomy residents and students/residents of other disciplines which mainly include genetic diagnosis and laboratory methods, advanced genetics and counseling skills, clinical genetics and social, cultural and ethical issues in genetics. This multifaceted genetic curriculum will improve residents' attitude, knowledge and skills of genetics. Residents can also apply their knowledge in conducting advanced researches in the context of both normal human variation and human diseases as well as in improving an understanding of genetic testing, genetic counseling and other concepts.

### **Genetic counseling in Bangladesh**

Genetic counseling deals with the "human problems associated with the occurrence, or the risk of occurrence, of a genetic disorder in the family".<sup>[31]</sup> Genetic counseling is primarily a communication process- about medical facts, the contribution of heredity to certain conditions, the interpretation of test results and the options available. It also involves supportive counseling to enable patients to make decisions and to make the best possible adjustment to the presence or risk of genetic disease.<sup>[32]</sup>

In this regards, genetic counseling is also being considered as a significant part of medical genetics as this is the preventive aspect of medical genetics to make the family members aware of affected children as to what has happened and how to avoid repetition of such events in subsequent pregnancies by adopting prenatal diagnosis and presymptomatic treatment such as in thalassemia.<sup>[33]</sup> Since then, genetic counseling centers have been opening around the world extensively. Therefore, today's medical graduates and postgraduates must be expert at integrating genetic knowledge and science appropriately into all areas of medicine- the task can't be solely left for the clinical geneticists, who remain small in number.

As Genetic counseling is a very important part of genetic service, we have to improve the current knowledge of genetic counsellor by establishing the genetic curriculum in undergraduate medical education. Therefore, a 'Genetic Counseling Centre' has been established in the Department of Anatomy, BSMMU under a sub-project of Higher

Education Quality Enhancement Project (HEQEP). Postgraduate residents can observe and practice genetic counseling in this center using real or simulated cases. For the first time a well-accepted and evaluated genetic counseling format on AML was formulated in the department of Anatomy, BSMMU by a thesis research.<sup>[34]</sup> Besides this counseling center, some other private organization also provide genetic counseling support to different patients and their families. Among them Neurogen, a genetic testing laboratory provide counseling for autism and neuro-developmental disorders, neuro-degenerative diseases, cancers, rare and complex diseases as well as general genetic counseling to the patients.<sup>[35]</sup>

### **Genetic research in Bangladesh**

The 'Genetic Research Lab' in the department of Anatomy, BSMMU, Bangladesh has both conventional and advanced genetic equipments like Next-Generation Sequencing and real-time PCR (RT-PCR) etc. Some advanced researches in the field of human genetics is also going on in this laboratory.<sup>[30]</sup>

Among them profiling of mutations in BRCA1 and BRCA2 genes in female of breast cancer patients of Bangladesh, expression profiling of micro-RNAs in female breast cancer patients of Bangladesh, mutations in the beta-myosin heavy chain ( $\beta$ -MHC) and myosin binding protein C (MyBP-C) encoding genes in selected hypertrophic cardiomyopathy patient (HCM) in Bangladesh and epidemiological study of breast cancer patients of Bangladesh. A project on the gene profiling of acute myeloid leukemia (AML) to detect the mutation of NPM1 and GATA2 genes are also running in this lab. Recently a collaborative research work has been carried in the Department of Anatomy on 'metagenomics' with the University of Dhaka.

The researchers of the Genetic lab of ICDDR,B identify variants data and translates these variations into medically relevant information. They also provide expert analyses of nucleic acid sequence data for research applications. They design data architecture and develop database solutions for research projects, medical institutions and industries. Some research work was carried out on thalassemia and population genetics in the University of Dhaka.<sup>[30]</sup>

## **CONCLUSION**

This article mainly evaluates the current status of medical genetics in Bangladesh. It is an effort to observe the present situation. Though a beginning has been made, the genetic services, counseling and research in the area of medical genetic still not up to the mark. Research in gene therapy and stem cell therapy does almost not exist. Basic knowledge and

training in genetics for medical staff should meet the national demands.

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