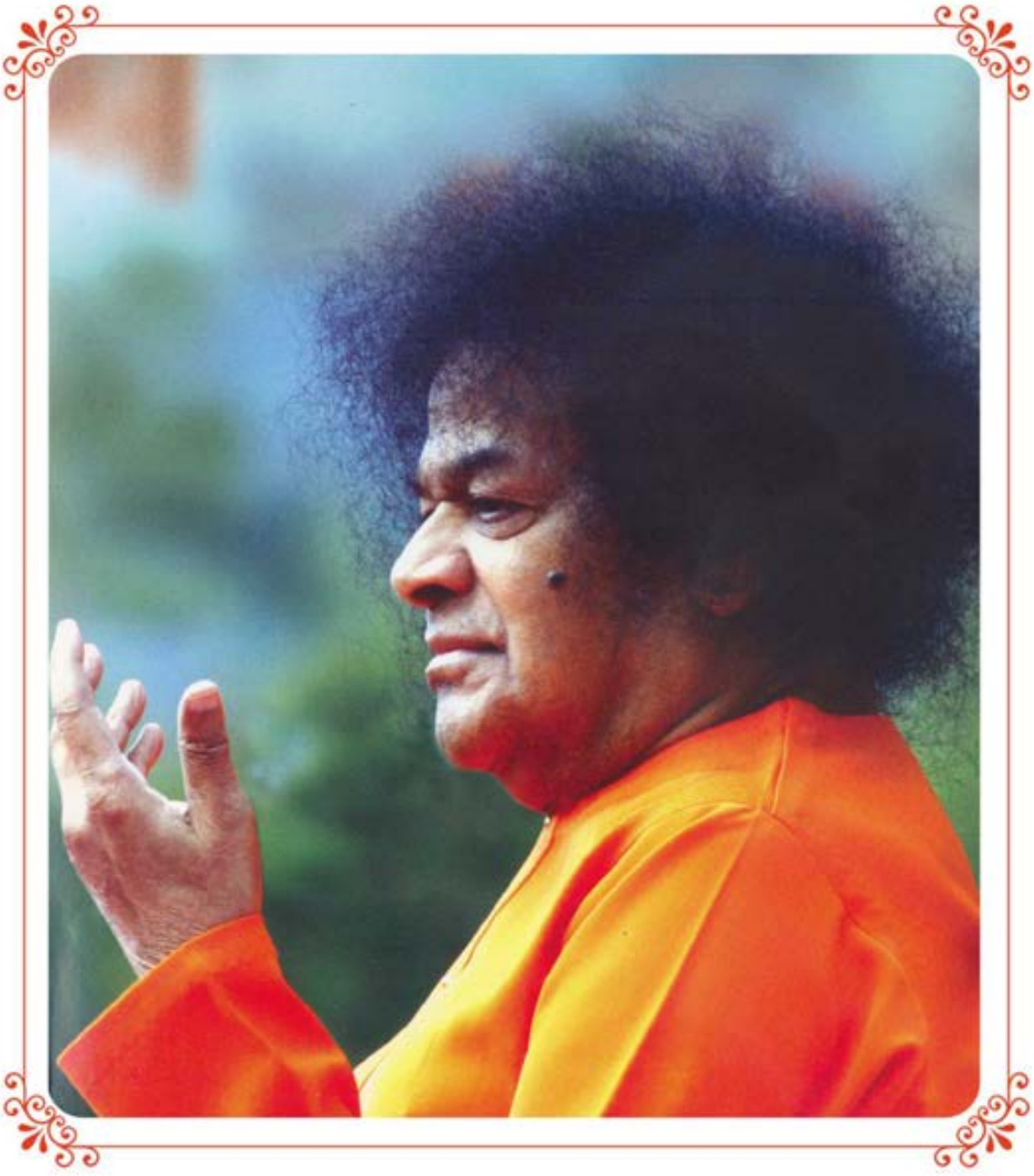
Annual Report

2012 - 2015

Madras Diabetes Research Foundation



THIS REPORT IS PLACED AT
THE DIVINE LOTUS FEET OF
BHAGAWAN SRI SATHYA SAI BABA

Dr.REMA'S LEGACY LIVES ON

Dr. Rema Mohan

(1954-2011)

Vice-President, MDRF

During the year 2011, MDRF suffered an irreparable loss through the untimely demise of Dr Rema Mohan, founding Vice-President and Chief of Ocular Research. Dr Rema, who had been ailing for a while, passed away on the 25th of March, 2011 at her residence in Chennai.

Dr Rema, born on the 3rd August, 1954 was one of the first ophthalmologists in India to devote her life to the field of diabetic retinopathy. After her undergraduate and postgraduate medical studies, she underwent training in diabetic retinopathy at the Hammersmith Hospital, London, under the world famous expert in diabetic retinopathy Dr Eva Kohner. Through her subsequent work, initially at the Diabetes Research Centre, Chennai and later on at Dr Mohan's Diabetes Specialities Centre and MDRF, she helped to establish diabetic retinopathy as a subspecialty in the country. She also trained several ophthalmologists in the subspecialty, many of whom are currently working at DMDSC and MDRF. The Indira Eye Institute for Diabetes, India's first exclusive eye institute devoted to diabetic retinopathy, is an eloquent testimony to her vision and commitment to the field.

One of the first ophthalmologists in India to obtain a Ph.D, Dr Rema made seminal contributions in basic science with her work on human retinal endothelial cells which she set up in culture for the first time in the country. Her pioneering epidemiological studies on diabetic retinopathy and on genetics of this condition are widely quoted internationally. She published over 100 papers on diabetic retinopathy, in addition to authoring chapters in textbooks. She received numerous awards for her work including the prestigious Dr. C.N. Shroff Award from the All India Ophthalmology Society. MDRF has particular reason to be indebted to Dr Rema, for it was her vision that helped establish the Kallam Anji Reddy Centre of MDRF in the Women's Biotech Park at Siruseri.

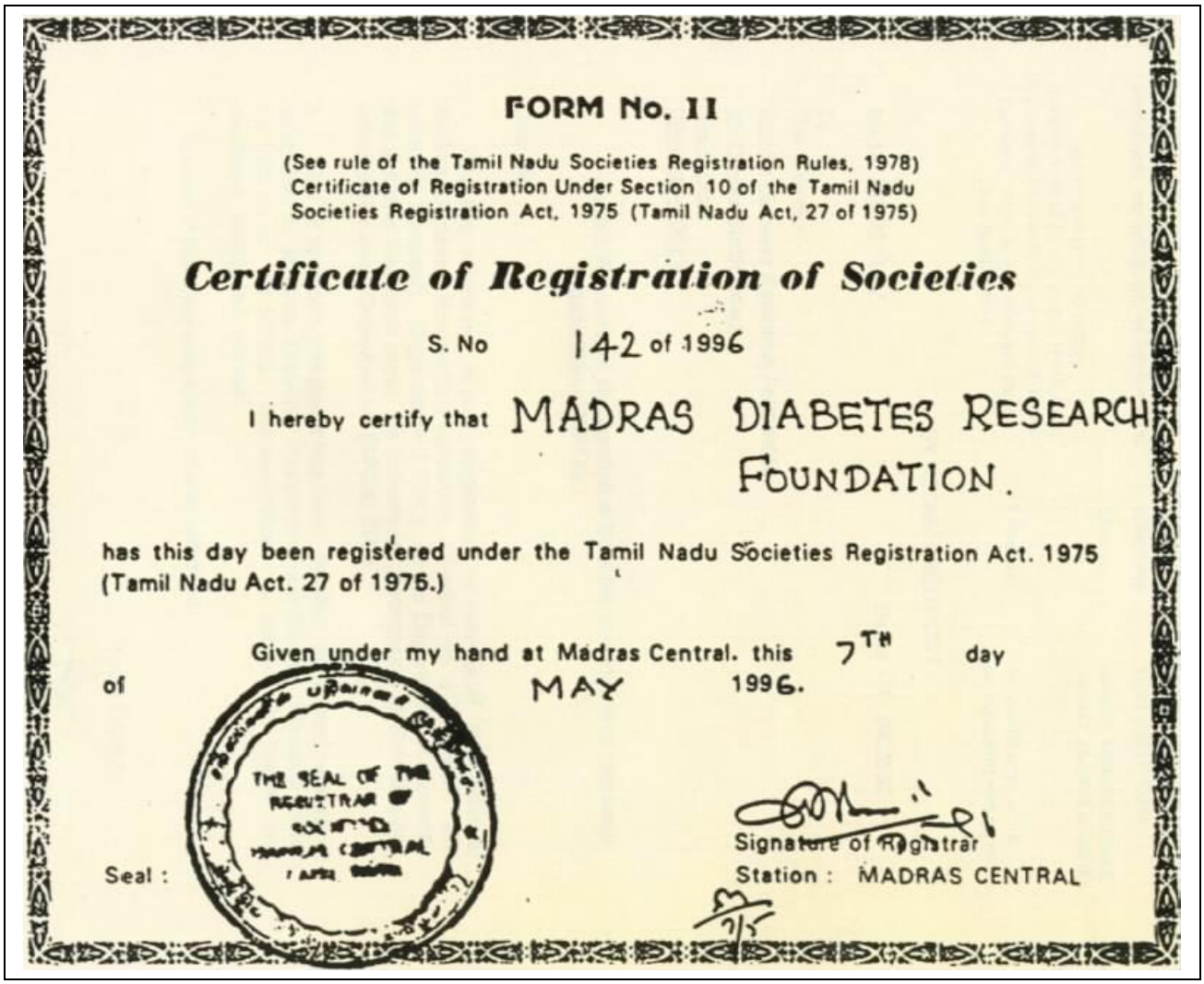
Kindhearted, magnanimous and highly spiritual, she devoted a lot of her time and money to charity. She was instrumental in setting up the Sai Rural Diabetes Specialities Centre at Chunampet. Her pioneering work in tele-ophthalmology helped to provide free eye care services to thousands of poor people in Kanchipuram district. She also ran free eye camps in association with the Sathya Sai Organization, through which free laser and cataract surgeries were performed.

An able administrator and strict disciplinarian, she contributed immensely to the growth of Dr Mohan's Group of Institutions. We at MDRF will always miss her but look forward to her blessings from above as we progress on the path lit up by her……

OUR GRATEFUL THANKS TO

Late Padma Bhushan Dr. K. ANJI REDDY
Chairman, Dr. Reddy's Laboratories and
Dr. Reddy's Research Foundation,
Hyderabad.

FOR ALL HIS SUPPORT TO MDRF WHICH HELPED US TO GROW TO WHAT WE ARE TODAY



FORM No. 11

(See rule of the Tamil Nadu Societies Registration Rules, 1978)
Certificate of Registration Under Section 10 of the Tamil Nadu Societies Registration Act, 1975 (Tamil Nadu Act, 27 of 1975)

Certificate of Registration of Societies

S. No 142 of 1996

I hereby certify that MADRAS DIABETES RESEARCH FOUNDATION.

has this day been registered under the Tamil Nadu Societies Registration Act. 1975 (Tamil Nadu Act. 27 of 1975.)

Given under my hand at Madras Central. this 7TH day of MAY 1996.

Seal :

Signature of Registrar
Station : MADRAS CENTRAL

THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY

Post Bag No. 1200,
40, Anna Salai, Guindy,
Madras - 600 032.

PROCEEDINGS OF THE REGISTRAR, THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, MADRAS 32.

PRESENT: Thiru P.A.KHAJA KALEEL RAHMAN, B.Com., B.L., REGISTRAR.

RC.No.ACI(1)/14214/96 Dated: 17.7.96

Sub: ACADEMIC - The Tamilnadu Dr.M.G.R. Medical University, Madras - M.V.Diabetes Specialities Centre and Madras Diabetes Research Foundation, Madras 14 - Recognition of Department of Diabetology to conduct research leading to Ph.D - Orders issued.

Ref: Letter dated 10.4.96 of the Director and Head, M.V.Daibetes Research Foundation, Madras 14.
2.This University's Lr.No.ACI(1)/14214/96, dt: 11.7.96.
3.From the Director and Head, M.V.Diabetes Specialities Centre and Madras Diabetes Research Foundation, Madras 14 dated 16.7.96.

ORDER:

The request of the Director and Head M.V.Diabetes Specialities Centre and Madras Diabetes Research Foundation, Madras 14 for grant of recognition for conducting research leading to the award of Ph.D. Degree in the Department of Diabetology at the M.V.Diabetes Specialities Centre and Madras Diabetes Research Foundation, Madras 14 was examined in detail. In this connection an Inspection Commission was appointed and it submitted its report after inspection on 30.5.96. The report was placed before the Governing Council in its 65th meeting held on 28.06.96.

2) In pursuance to the resolution No.13 passed by the Governing Council in its 65th meeting held on 28.06.96 this University is pleased to grant

/PTO/

Grams: MEDICLAVE Telex: 041-6273/MUTY Fax: 91-44-2353698 Phone Nos.: 2353574, 2353576-79

recognition to the Department of Diabetology for conducting research leading to the award of Ph.D. Degree Course at the M.V.Diabetes Specialities Centre and Madras Diabetes Research Foundation, Madras 600 014.

3) The M.V.Diabetes Specialities Centre and Madras Diabetes Research Foundation, Madras 600 014 and its Research candidates shall abide by the provisions of the Tamilnadu Dr.M.G.R. Medical University, Madras Act, 1987 (Tamil Nadu Act 37 of 1987) and by the Statutes, Ordinances, Regulations and Rules of the Tamilnadu Dr.M.G.R. Medical University.

4) The receipt of this Proceedings may be acknowledged.

P.A.KHAJA KALEEL RAHMAN,
REGISTRAR.

To

The Director and Head,
M.V.Diabetes Specialities Centre and
Madras Diabetes Research Foundation,
44, Royapettah High Road,
Royapettah,
Madras 600 014....

/ TRUE COPY /

ASSISTANT REGISTRAR.

Nm.22/7.

UNIVERSITY OF MADRAS

University Centenary
Centenary Building,
Chepauk. Chennai – 600 005.

No.AII/KM/MDRF.DBMBPH.D./2K1/ 2349 Date: 20 AUG 2001

From:

The Registrar I/c,
University of Madras.

To:

The Director,
Madras Diabetes Research Foundation,
6-B (Old No.35), Conran Smith Road,
Gopalapuram, Chennai – 600 086.

Sir,

Sub: Madras Diabetes Research Foundation – Department of Biochemistry and Molecular Biology – Grant of Recognition for conducting research leading to Ph.D. Degree – Reg.

I am to inform you that as per the decision of the Syndicate dated 04.08.2001 the Department of Biochemistry and Molecular Biology of Madras Diabetes Research Foundation, Chennai – 600 086 is recognised for conducting research leading to Ph.D. Degree in Biochemistry and Molecular Biology.

Kindly acknowledge receipt of this letter.

Yours faithfully,

REGISTRAR-I/c.

Copy to:
The Section officers Ph.D. and D-2 Sections.

World Health Organization
Regional Office for South-East Asia
World Health House, Indraprastha Estate, Mahatma Gandhi Marg, New Delhi-110 002, India www.searo.who.int
Tel: 91-11-2337 0804, 2337 0809–11 Fax: 91-11-2337 0197, 2337 9366, 2337 9507

In reply please refer to: N8/72/2

Your reference:

Dr V. Mohan
Chairman
Dr Mohan's Diabetes Specialities Centre
No 6 Conran Smith Road
Gopalapuram
Chennai- 600 086, India

24 March 2008

Dear Dr Mohan,

Subject: **Designation of Dr Mohan's Diabetes Specialties Centre, Chennai, as a WHO Collaborating Centre for Noncommunicable Diseases Prevention and Control (WHO CC NO 220)**

I have pleasure in informing you that the World I lealth Organization, after consultation with your Government, has designated Dr Mohan's Diabetes Specialities Centre, Chennai, India as a WHO Collaborating Centre for Noncommunicable Diseases Prevention and Control. As previously agreed, you will be the Head of the Centre. The terms of reference of the Centre are attached. Should there be any changes in the future that might affect this arrangement, I should be grateful if you would inform me without delay.

The designation of Dr Mohan's Diabetes Specialities Centre, Chennai, India as a WHO Collaborating Centre for Noncommunicable Diseases Prevention and Control will be effective for a period of four years as from the date of this letter. Unless a redesignation has been officially approved and notified before that date, the designation of Dr Mohan's Diabetes Specialities Centre, Chennai, India as a WHO Collaborating Centre will automatically lapse. It is in this context that I invite you to contact the WHO Department with which you usually collaborate to discuss a potential redesignation no later than six months prior to the end of this period of designation. Either party may however revoke the designation in any year by giving notice of its intention three months before the end of that year.

I am enclosing a note [Appendix A] concerning the use of the WHO name, emblem and flag by WHO Collaborating Centres. In this regard, we draw your particular attention to the fact that the use of the WHO name and emblem in letterheads as described in the attached note may only be made by your Centre during the period(s) it is officially recognized by this Organization as a WHO Collaborating Centre.

I look forward to our successful cooperation.

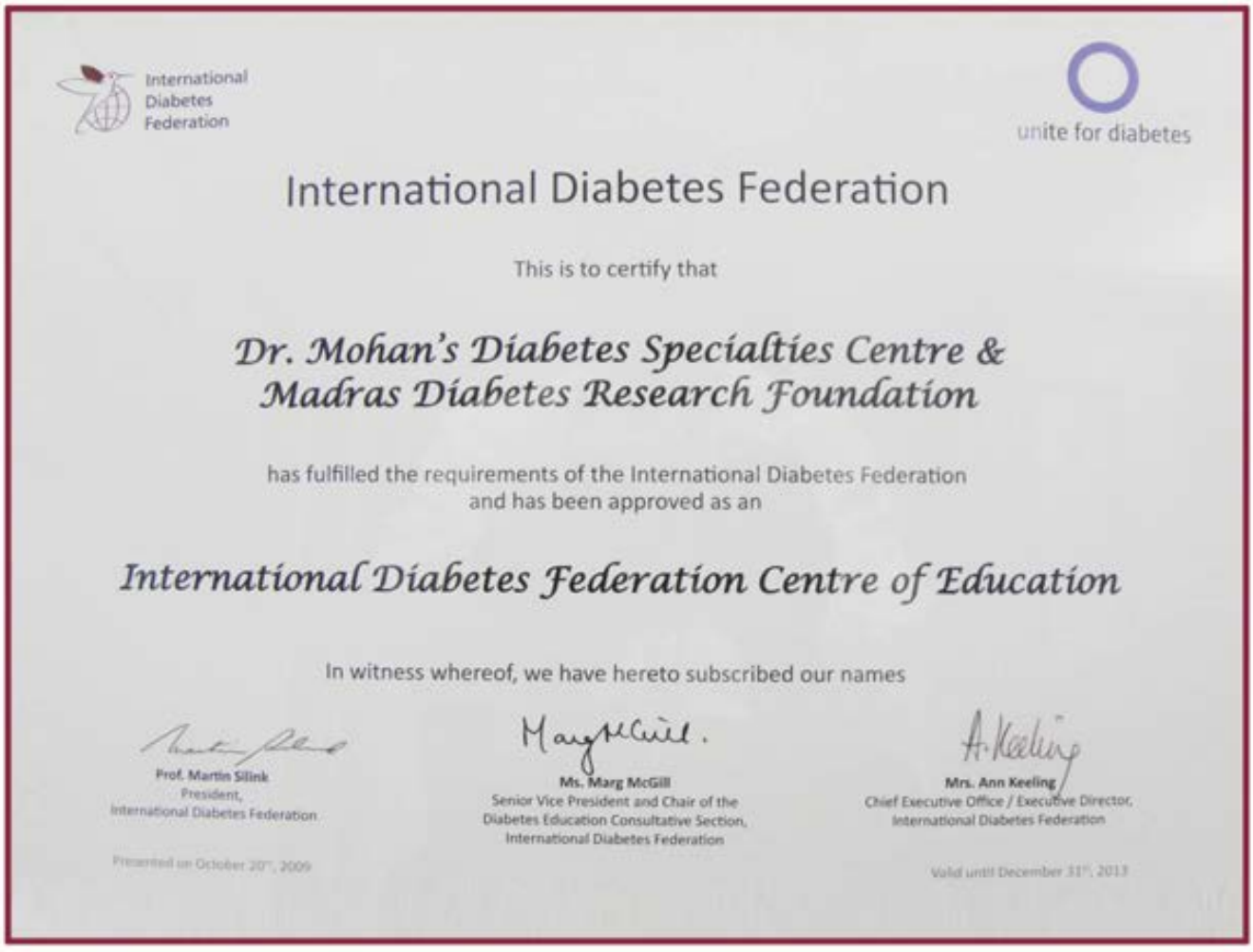
Yours sincerely,

MH 24.3.08

Samlee Plianbangchang, M.D., Dr.P.H.
Regional Director

Encl: As stated

cc: The Secretary, Department of Health, Ministry of Health & Family Welfare, Government of India, Nirman Bhawan, New Delhi.
cc: The Joint Secretary (IH Division), Ministry of Health & Family Welfare, Government of India, Nirman Bhawan, New Delhi.
cc: The WHO Representative to India, Nirman Bhawan, New Delhi



International Diabetes Federation

unite for diabetes

International Diabetes Federation

This is to certify that

Dr. Mohan's Diabetes Specialties Centre & Madras Diabetes Research Foundation

has fulfilled the requirements of the International Diabetes Federation
and has been approved as an

International Diabetes Federation Centre of Education

In witness whereof, we have hereto subscribed our names

Prof. Martin Silink
President,
International Diabetes Federation

Presented on October 20th, 2009

Ms. Marg McGill
Senior Vice President and Chair of the
Diabetes Education Consultative Section,
International Diabetes Federation

Mrs. Ann Keeling
Chief Executive Office / Executive Director,
International Diabetes Federation

Valid until December 31st, 2013

FIU FLORIDA INTERNATIONAL UNIVERSITY

December 16, 2015

Padma Shri Dr. Viswanathan Mohan, M.D., FRCP (London, Edinburgh, Glasgow, Ireland), Ph.D., D.Sc., D.Sc (Hon. Causa), FNASc, FASc, FNA, FACP, FACE, FTWAS, MACP
Director and Chief Diabetologist
ICMR Advanced Centre for Genomics of Diabetes
Dr. Mohan's Diabetes Specialities Centre & Madras Diabetes Research Foundation
No. 6B, Conran Smith Road, Gopalapuram,Chennai 600 086, India.

Dear Mohan,

In life, as you know well, there are certainties and uncertainties. One of the fully apparent certainties is the advancement and continued evolution of the Madras Diabetes Research Foundation (MDRF). I first became aware of MDRF, what it was trying to accomplish and what it hoped to become back in 2002. At that time, I considered it a very competent, albeit somewhat in its beginning phases, organization that was a delight to work with. This delight was based on the ease with which I and others were able to work with you and your staff. It was, and continues to be, a very creative environment.

MDRF's growth and accomplishments since 2002 are astonishingly impressive. It now is an international force addressing many critical dimensions of the rapidly increasing worldwide diabetes epidemic. The breadth and depth with which the organization addresses its purpose and mission are both highly unusual and critically important. It has highlighted the growing diabetes situation in India in a manner that cannot be ignored. This is an invaluable contribution.

It has been especially delightful to see the progress made in doctoral students completing their degrees. The level of PhD productivity exceeds that of many established academic departments. It is invaluable that some who have earned this degree from the University of Madras through MDRF are now themselves directing doctoral students. These scientists represent an important increment to what is available to continue India's ability to address its diabetes epidemic.

On a personal note, it has indeed been a pleasure to have been able to work with you and others at MDRF over the past several years through the National Seminars and associated activities. As you know, there have been several different dimensions to my career. My association with MDRF in general, and you in particular, is the dimension that has given me the most pleasure and the one I am most proud of. I look forward to continued interaction with you and MDRF.

Best regards

O. Dale Williams, MPH, PhD, FAHA, FSCT
Professor and Chair, Department of Biostatistics
Director, Integrated Biostatistics and Data Management Center

ROBERT STEMPEL COLLEGE OF PUBLIC HEALTH AND SOCIAL WORK
INTEGRATED BIOSTATISTICS AND DATA MANAGEMENT CENTER • DEPARTMENT OF BIOSTATISTICS
11200 S.W. 8th Street, AHC5-461, Miami, FL 33199 • Tel: 305.348.7914

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH Department of Nutrition

HARVARD MEDICAL SCHOOL

BRIGHAM AND WOMEN'S HOSPITAL

Frank B. Hu, MD, PhD
Professor of Nutrition and Epidemiology

December 23, 2015

Dear Dr. Mohan,

I would like to offer my sincere congratulations to the achievements that MDRF has made in 2015 under your leadership. I had the great honour to receive the "**24th DMDSC Gold Medal Oration Award**" at Second Dr. Mohan's International Diabetes Update 2015" held from 31st July to 2nd August 2015 in Chennai. The meeting was a great success, bringing together hundreds of diabetologists, nutritionists, educators, and researchers across India to tackle diabetes as one of the most important public health challenges in India and many other parts of the world. After the meeting, I had the pleasure to visit MDRF and was impressed by the advanced research facility, dedicated research staff, and a wide range of national and international research projects. In 2015, we have continued our collaborations on a NIH-funded randomized intervention trial to test the effects of substituting brown rice for white rice on diabetes risk factors among Chennai participants. The intervention was successfully completed and a manuscript is being prepared by colleagues at Harvard and MDRF for submission to a peer-reviewed journal. We look forward to our continued collaborations and wish you and our colleagues at MDRF a healthy, enjoyable and fruitful 2016.

Best Wishes for the New Year!

Sincerely,

Frank B. Hu, MD, PhD
Professor of Nutrition and Epidemiology
Harvard T.H. Chan School of Public Health
Professor of Medicine
Harvard Medical School

AZIENDA OSPEDALIERO - UNIVERSITARIA
Città della Salute e della Scienza di Torino

SEDE LEGALE: Corso Bramante, 88/90 - 10126 Torino **Centralino:** tel. +39.011.6331633 **P.I./Cod. Fisc.** 10771180014
www.cittadellasalute.to.it

Presidi Ospedalieri - Molinette, Dermatologico S. Lazzaro, S. Giovanni Antico Sede - centr.: tel. +39.0116331633
- Centro Traumatologico Ortopedico, Istituto Chirurgico Ortopedico Regina Maria Adelaide - centr.: tel. +39.0116933111
- Infantile Regina Margherita, Ostetrico Ginecologico S. Anna - centr.: tel. +39.0113134444

Dipartimento Medicina Generale e Specialistica
Presidio Molinette
S.C. Medicina 1U
Direttore Prof. M. Porta
Reparto/segreteria
tel. 011.633.5499/5540 - **fax** 011.633.4515

Prot. n°

del

Titolario

Turin, 14 December 2015.

Dr. V. Mohan
MDRF
No 4, Conran Smith Road,
Gopalapuram,
Chennai - 600 086,
India

Dear Mohan,

Re: Dr. Mohan's International Diabetes Update 2015.

It was a real privilege for me to attend the International Diabetes Update 2015 last July-August. Not only was it an occasion to review one's knowledge of the problems that revolve around diabetes. It was a refreshing experience looking at such problems through your inquisitive yet compassionate eyes.

For many years we have known each other and, when I first visited your Centre in 2004, I was impressed by how well organized and pragmatic, yet forward looking everything was, from both clinical and research points of view. I honestly considered your clinic an example to be followed by most institutions in the developing as well as developed world.

Eleven years later, my feelings have not changed. You have moved tremendously forward. Your activity is genuinely aimed at alleviating the burden imposed by diabetes on the Indian people. Your institution offers high quality epidemiology to assess and monitor the size of the problem, updated treatments with innovative approaches by telemedicine to reach those who cannot travel. Again, many others should learn.

Even more, your center has reached nationwide dimensions and your events attract decision makers from the top levels of the government, without whose commitment it is impossible to deploy effective prevention and treatment policies.

I wish you and your team the gift to maintain your enthusiasm and ability to pursue such important goals. You fully deserve it and many people with diabetes will benefit, in India and outside.

With best regards,

Prof. Massimo Porta, MD PhD

Baker IDI
HEART & DIABETES INSTITUTE

15th December, 2015.

Dr. V. Mohan,
Chairman and Chief Diabetologist,
Dr. Mohan's Diabetes Specialities Centre,
WHO Collaborating Centre for Non Communicable Diseases Prevention & Control,
IDF Centre of Education,
President and Chief of Diabetes Research,
Madras Diabetes Research Foundation,
ICMR Advanced Centre for Genomics of Diabetes,
No:6B, Conran Smith Road,
Gopalapuram,
Chennai, 600086,
INDIA.

Dear Dr. Mohan,

This is a message of congratulation to you and the productive research team at the Madras Diabetes Research Foundation (MDRF).

When one looks at the international diabetes scene, Chennai stands out as one of the very important cities for innovation in diabetes education, care and research, and, in particular, translation of research.

Dr. Mohan's Diabetes Specialities Centre is a wonderful model and one of the leading institutions internationally. It brings together all of these attributes and the research activities of MDRF are contributing to a better understanding of diabetes management globally, with particular relevance to developing countries.

Our team looks forward very much to further association with MDRF with respect to both collaboration and gaining a better understanding as how to handle diabetes worldwide, now one of the greatest epidemics in human history.

Yours sincerely,

Professor Paul Zimmet AO (Order of Australia) MD PhD FRACP FRCP (London),
Director Emeritus – Baker IDI Heart and Diabetes Institute,
Honorary President – International Diabetes Federation.

Baker IDI Heart and Diabetes Institute
Level 4, 99 Commercial Road, Melbourne, Victoria 3004, Australia
T +61 3 8532 1818 F +61 3 8532 1718 E paul.zimmet@bakeridi.edu.au W www.bakeridi.edu.au

UNIVERSITY OF CALIFORNIA, SAN DIEGO

UC SD

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RIVERSIDE SAN DIEGO

SAN FRANCISCO SANTA
BARBARA SANTA CRUZ

JAMES F. SALLIS, PH. D.
DISTINGUISHED PROFESSOR AND CHIEF
DIVISION OF BEHAVIORAL MEDICINE
DEPT. OF FAMILY MEDICINE AND PUBLICHEALTH

UC SD SCHOOL OF MEDICINE
9500 GILMAN DRIVE, 0628
LA JOLLA, CALIFORNIA 92093-0628

OFFICE: (619) 260-5535
FAX: (619) 260-1510
E-MAIL: jsallis@ucsd.edu

December 2015

IPEN and MDRF: A Growing Collaboration

IPEN is the International Physical activity and Environment Network. IPEN encourages research on built environments and physical activity in all countries, and we are coordinating two international studies with partial funding from the US National Institutes of Health. We are extremely pleased that MDRF is leading the Indian component of the IPEN Adolescent study. Appropriately, the study is named BE Activ India!

BE Active India! is following the international protocol that includes survey measures of built environment and physical activity, accelerometer-based measures of physical activity, GPS monitoring of a subsample so we can see where adolescents are active, and observations of the walking environments. MDRF is adding valuable data on biomarkers related to diabetes and cardiovascular disease risk. About 600 adolescents are being recruited from diverse neighborhoods throughout Chennai.

In August I was pleased to visit Chennai to participate in Dr Mohan's International Diabetes Update 2015. I was honored to present evidence from the IPEN Adult study and emphasize the important role of built environments in health, especially their relevance to both prevention and treatment of diabetes. It should be a priority to design cities and neighborhoods so people can safely and comfortably walk for both transportation and leisure.

We had several meetings with the BE Activ India! team, which has talented leadership and dedicated staff. It was particularly interesting to me to use the observation measure we developed to assess how pedestrian-friendly street environments are in the busy and complex streets of Chennai. Comparing these results across countries will be fascinating.

Not only has IPEN welcomed Dr Anjana and the BE Activ India! team into the IPEN family, but now I feel truly a part of Madras Diabetes Research Foundation and the family of Dr. Mohan's Institutions. We share the goals of creating healthier places that will make it easier for people to be healthier.

Sincerely yours,

James F. Sallis, Ph.D.
Director and Co-Founder, IPEN
http://sallis.ucsd.edu

DIABETIC ASSOCIATION OF PAKISTAN
&
WHO COLLABORATING CENTRE, KARACHI

Prof. A. Samad Shera
T.I., S.I. FRCP
Honorary President, IDF
Head, WHO Collaborating Centre
Member, WHO International Expert Panel on Diabetes
National Co-ordinator for Diabetes Control
Secretary General, DAP

5-E/3, Nazimabad,
Karachi-74600 (Pakistan)
Phone : +92-21-36616890
Fax : +92-21-36680959
E-mail : dapkhi@cyber.net.pk
Website : www.dap.org.pk

It gives me immense pleasure to send this message to Dr V. Mohan and his team on the occasion of the Annual report of the Madras Diabetes Foundation.

I am proud of my long association with Dr Mohan and in recent years with his highly talented illustrious daughter Anjana. Her article "Incidence of Diabetes and Prediabetes and Predictors of Progression Among Asian Indians: 10-Year Follow-up of the Chenai Urban Rural Epidemiology Study(CURES)" from the Madras Diabetes Research Foundation and Dr Mohan's Diabetes Specialties Centre, Chennai, India, Published in the August 2015 issue of Diabetes Care reflects the high quality of research being carried out by Dr Mohan's dedicated team of researchers based at the Madras Diabetes Research Foundation and his Diabetes Specialties Centre, Chennai, India.

I would like to convey my highest regards and congratulations to my very dear friend Mohan and his research team including his daughter Anjana, for their tremendous contribution in the prevention and treatment of Diabetes - a condition which is a public health priority specially in developing countries like India and Pakistan with limited resources.

I very much look forward to our continuing collaboration and friendship.

Prof A. Samad Shera
Honorary President, International Diabetes Federation (IDF)
Head, WHO Collaborating Centre for "Treatment, Education
& Research in Diabetes and Diabetic Pregnancies"
National Coordinator for Diabetes Control Programme
Secretary General, Diabetic Association of Pakistan
Founder President of the Diabetes in Asia Study Group (DASG)

WHO Collaborating Centre
For Treatment, Education & Research in Diabetes & Diabetic Pregnancies

Barbara Davis Center for Childhood Diabetes
Satish K. Garg, M.D.
Professor of Medicine and Pediatrics • Director, Adult Program • Endowed Clinical & Research Chairs
Editor-in-Chief, Diabetes Technology & Therapeutics
Phone: 303-724-6713 • Fax: 303-724-6784
E-mail: satish.garg@ucdenver.edu

December 15, 2015

Dear Madras Diabetes Research Foundation,

I have known Dr. V. Mohan for many years. He has been awarded several prestigious titles and commendations, including the Padma Shri, one of India's highest civilian awards. His research and work at the Madras Diabetes Research Foundation has been essential for the growing population of people with type 1 and 2 diabetes in India. He has initiated several clinics in and around India to improve diabetes outcomes. In addition to his research, which has been published in several leading peer-reviewed journals, he also serves as one of the *Diabetes Technology & Therapeutics* International Associate Editors, where he submits commentaries and peer-reviews articles.

He is a well-respected and highly published leader in the field of diabetes and someone I am honored to call a colleague and a friend. I congratulate Professor Mohan for all his achievements and wish him good luck in his future endeavors.

Regards,

Satish K. Garg, MD
Professor of Medicine & Pediatrics
University of Colorado School of Medicine
Director, Adult Program
Endowed Garg Clinical and Research Chairs
Editor-in-Chief, *Diabetes Technology & Therapeutics*

University of Colorado Denver • 1775 Aurora Court, A140, Aurora, CO 80045
Phone: 303-724-2323 • Fax: 303-724-6779 • Web: www.barbaradaviscenter.org

WARWICK
MEDICAL SCHOOL

MADRAS DIABETES RESEARCH FOUNDATION

The Madras Diabetes Research Foundation has had yet another strong year filled with accomplishments that are impressive in any academic institution but they are also of great importance in the context of a growing burden of diabetes in India and many other developing countries worldwide. Given the scale and importance of the public health problems posed by diabetes, a very determined and focussed effort is needed to discover solutions through research and to translate these discoveries into real solutions applied sometimes in challenging conditions in Chennai and beyond. I can only pay tribute to the dedication, hard work and passion of those working in MDRF and their collaborators for going the extra mile in this way, which must be an inspiration to others worldwide. In Europe, Americas and in Australia, research and development tends to be done in Universities or in research institutes that receive government funding. The achievements of MDRF are also a testament to the self-reliance, resilience and hard work of all who work in MDRF and for the remarkable and dedicated leadership of Dr Mohan, Dr Anjana and Dr Unnikrishnan and others. However, I know they are not ones to rest on their laurels and will continue to strive to improve diabetes care for their patients through research. I wish MDRF every success in the next year and beyond.

Sudhesh Kumar

Sudhesh Kumar
Dean
Warwick Medical School
Medical School Building
The University of Warwick
Coventry CV4 8UW United Kingdom

Tel: *+44 (0)24 765 74869*
Fax: *+44 (0)24 765 74871*
Email: *Sudhesh.Kumar@warwick.ac.uk*

UNIVERSITY *of* CALIFORNIA, SAN DIEGO
SCHOOL OF MEDICINE

VA San Diego Healthcare System
3350 La Jolla Village Drive
San Diego, CA 92161

Dec 20, 2015

Dear Mohan,

I would like to take this opportunity to congratulate you and your entire team at the Madras Diabetes Research Foundation for the exemplary basic science and clinical research work that you have been doing through the years to advance the cause of diabetes worldwide. The quality of your work is reflected in the number of research papers which have been published in prestigious national and international journals. I would like to wish you and the MDRF team many more years of successful research and hopefully through the work of institutions like yours, one day we will see a potential cure for diabetes.

With best regards,

Sunder Mudaliar, MD, FRCP (Edin), FACP, FACE
Clinical Professor of Medicine
University of California, San Diego
Staff Physician, VA San Diego Healthcare System

3350 La Jolla Village Drive
San Diego, CA 92161

Phone: 858-642-3152
Fax: 858-642-6242

SCHOOL OF MEDICINE
Vivian A. Fonseca, MD
Professor and Chief, Section of Endocrinology
Tullis-Tulane Alumni Chair in Diabetes

December 17, 2015

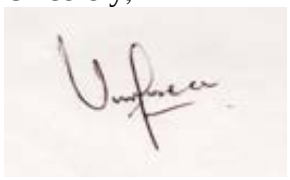
Dr V Mohan
Madras Diabetes Research Foundation

Mohan

I am very pleased to see the annual report of the Madras Diabetes Research Foundation showing so much research which is outstanding not just in quantity but in quality. The latter is clear from the publications in high impact journals and your many international presentations.

Diabetes is a big challenge in India and more research is needed to find local solutions. The work of your foundation will go a long way toward that goal. I wish you all the best for the future.

Sincerely,



Vivian Fonseca

CONTENTS

Dr. V. Mohan
President

Dr. R.M. Anjana
Vice President

PREFACE

It gives us great pleasure to write this preface to the MDRF Annual Report for the years 2012 to 2016. At the outset, we are happy to state that MDRF has now entered the 20th year of its existence and it continues to be at the forefront of diabetes research in India. This Annual Report provides a brief overview of the activities of the Foundation over the last 4 years.

During the period under review MDRF has made strides in several areas of research. The landmark ICMR-INDIAB Study has now been completed in 15 states and MDRF is the National Collaborating Centre for this massive nationwide study on diabetes, perhaps largest in the world. Our Genomics department continues to make exciting discoveries and apart from the studies on type 2 diabetes and our participation in a couple of GWAS studies, the important contribution from this department has been a breakthrough in the Genomics of MODY (Maturity Onset Diabetes on Young) where new types of MODY have been described (first in the world) and these are currently under publication.

The Cell and Molecular Biology department and the Research Biochemistry department have completed the Global serum miRNA profiling and new miRNA's association with pre-diabetes and type 2 diabetes in Indians have been described. Other studies in relation to early biomarkers of beta cell dysfunction are under way.

The Food and Nutrition Dietetics Research (FNDR) department continues to have carried out several improvements in the Food Frequency Questionnaires (FFQ) in the EpiNu software and the validation of Glycemic Index methodology, new high fibre rice called Dr. Mohan's High Fibre Rice was discovered in our laboratory in collaboration with M/s. Texcity in Coimbatore. Studies on the dietary advanced glycation end products are under way.

A state of the art Physical activity assessment program has been established and a new physical activity questionnaire has been developed for India which is appropriate both for urban and rural India.

.....Conti...

Extensive studies on the prevalence and clinical phenotyping of Gestational Diabetes Mellitus (GDM) has been completed and the Women in INdia with Gestational Diabetes Strategy" (WINGS) project has been successfully completed in collaboration with the International Diabetes Federation, Belgium.

An Indo-Danish program on Gut microbiota to dissect out the etiology of type 2 diabetes and micobiome connection was funded and is in progress.

Our Translational Research Department continues to do well and the D-CLIP prevention study has been completed, as has the ORANGE study and several other studies in relation to Mobile Health have been started.

The Epidemiology Department meanwhile has completed the first incidence studies in India with the unique 10 year follow up of the now famous CURES study and this has provided accurate data on the incidence of diabetes and pre diabetes in India.

The importance of the 1 Hour value in the OGTT has been confirmed by long term follow up studies at the centre. Other studies have reported on the importance of regularity of follow up in preventing complications.

Our Basic Science departments continue to do well and various good quality publications have come out.

During the period of study a total of 280 papers have been published in prestigious journals including Nature Genetics, New England Journal of Medicine, Lancet, Diabetes, Diabetes Care etc. The educational activities of the Foundation are progressing well and 16 students have received the Ph.D. We also had more than 35 international students working on the various period of time.

We would like to conclude by saying a big "Thank you" to all our staff and students who are the heart and soul of the Foundation. Thanks are also due to all our donors, collaborators and other well-wishers without whose support and blessings we could not have reached where we are today. A special world of appreciation to Dr. K. Gokulakrishnan for compiling the material for the Annual Report.

DR. V. MOHAN
President

DR. R.M. ANJANA
Vice-President

Madras Diabetes Research Foundation,
Chennai, September 2016

Vision

Working towards prevention and cure of diabetes and its complications

Mission

- To carry out basic and clinical research of international quality and to set new standards in the diagnosis and treatment of diabetes and its complications.
- To provide a world-class training environment for basic and clinical scientists in the field of diabetes and its complications.
- To improve the lives of people with diabetes by translating research into community action.

MDRF'S GROWTH: 1996-2015

- March 1996: Inception of Madras Diabetes Research Foundation (MDRF).
- June 1996: MDRF affiliated to the Tamil Nadu Dr. MGR Medical University, Chennai.
- June 1996: Recognized by the Tamil Nadu Dr. MGR Medical University, Chennai for conducting Ph.D courses in the field of Diabetology.
- November 1996: Recognised as a Scientific and Industrial Research Organisation (SIRO) by Department of Scientific & Industrial Research (DSIR), Ministry of Science and Technology, Government of India.
- September 1997: MDRF allotted 2 rooms at the new hospital premises of Dr. Mohan's Diabetes Specialities Centre (DMDSC).
- December 1998: Land acquired for MDRF adjacent to the Dr. Mohan's Diabetes Specialities Centre hospital building.
- February 1999: Memorandum of Understanding (MOU) signed between the University of Minnesota, USA and MDRF for research on diabetes.
- July 1999: Collaboration with the University of Alabama at Birmingham, USA for studies on cardiovascular risk factors.
- November 2000: MOU signed with the University of Wales for implementation of the 'Tele-Diabetic retinopathy' and other research projects.
- November 2000: Inauguration of the Genetics Department and Department of Cell and Molecular Biology.
- April 2001: Recognised by the Tamil Nadu Dr. MGR Medical University, Chennai for conducting Ph.D courses in the field of Ophthalmology.
- August 2001: Recognised by the University of Madras, Chennai for conducting Ph.D courses in Biochemistry and Molecular Biology.
- September 2001: Inauguration of a separate building for the MDRF – the S.S. Jhunjhnuwala Diabetes Research centre by Dr. N.K. Ganguly, Director General, Indian Council of Medical Research (ICMR).

- January 2002: Received training grant in collaboration with University of Alabama at Birmingham (UAB) from the National Institutes of Health (NIH), USA on Diabetes and Cardiovascular Epidemiology.
- July 2002: MDRF recognized by the World Health Organization (WHO) and the Indian Council of Medical Research as a Sentinel Site for non-communicable diseases (NCDs).
- March 2003: First MDRF-UAB "National Seminar on Diabetes and Cardiovascular Epidemiology" in collaboration with University of Alabama, Birmingham supported by the National Institutes of Health, USA.
- April 2003: "National Workshop on Diabetes Education" in collaboration with Prince of Wales Hospital, Australia.
- May 2003: "National Workshop on Guidelines for Management of Type 2 Diabetes" at the MDRF conducted by the Indian Council of Medical Research (ICMR) and World Health Organization (WHO), New Delhi
- September 2004: Inauguration of the 'PACE' (Prevention Awareness Counselling and Evaulation) Diabetes Project by Dr. Alan Cherrington, President, American Diabetes Association (ADA).
- March 2005: Release of the "ICMR WHO National Guidelines for Management of Diabetes".
- September 2005: Developed a simplified Indian Diabetes Risk Score (IDRS) for detecting undiagnosed diabetes in India.
- March 2006: MDRF/WDF Rural Diabetes Project launched with the support of the World Diabetes Foundation (WDF), Denmark to track the burden of diabetes in the rural India and to make innovative health care available, accessible and affordable to rural population using telemedicine facilites.
- July 2006: Inauguration of the MDRF-ICMR Advanced Centre for the Genomics of Type 2 diabetes by Dr. N.K. Ganguly, Director General ICMR.
- July 2006: Developed and released the unique 'Epi-Nu' Nutritional Epidemology software for the first time in India.

- January 2007: Inauguration of the MDRF/WDF rural diabetes project-telemedicine facility [supported by the Indian Space Research Organization (ISRO)] by Prof. Martin Silink, President, International Diabetes Federation (IDF).
- July 2007: Setting up of the Glycemic Index Testing Centre for foods in collaboration with Prof. Jeya Henry and Dr. Helen Lightowler of the Oxford Brookes University, UK.
- August 2007: Established the MDRF-Emory Global Diabetes Research Centre as part of a collaboration between MDRF and Emory University at Atlanta, USA.
- September 2007: Tenth Anniversary of MDRF Celebrated.
- September 2007: Inauguration of MDRF's second Research Centre set up in the Golden Jubilee Women's Biotech Park at Siruseri in the outskirts of Chennai, called the "Kallam Anji Reddy Centre" after Dr. K. Anji Reddy, Chairman, Dr.Reddy's Laboratories.
- March 2008: Dr. Mohan's Diabetes Specialities Centre designated as the "'WHO collaborating centre for non-communicable diseases prevention and control".
- August 2008: The Department of Community Medicine rechristened as the Department of Translational Research.
- September 2008: The Department of Research Grants established.
- September 2008: The Department of Transcriptomics and Molecular Immunology (TMI) established.
- June 2009: The Food Science Lab established.
- October 2009: MDRF recognized as the "IDF Centre of Education" by the IDF, Brussels, Belgium.
- December 2010: MDRF and Department of Science and Technology (DST) jointly organized the INSPIRE (Innovation in Science Pursuit for Inspired Research) Science Camp program.
- January 2011: MDRF research publications recognized in the prestigious Nature journal in the article entitled "Diabetes in India".
- February 2011: MDRF under the aegis of ICMR- Advanced Centre for Genomics of Type 2 Diabetes and in collaboration with University of Minnesota, USA conducted successfully the third hands-on "Workshop on Advanced Techniques in Genomics of type 2 diabetes".

- February 2011: MDRF announced MDRF Intramural Research Funding (MIRF) for young scientists with innovative projects
- July 2011: First MDRF Honour Lecture Award given to Prof Chinmoy Sankar Dey.
- September 2011: MDRF and the Vellore Institute of Technology (VIT) signed Memorandum of Understanding aimed at promoting diabetes research and training in India
- November 2011: MDRF and DMDSC conducted "Diabetes Fest" to promote Diabetes Prevention through adoption of healthy diet and lifestyle choices.
- March 2012: Implementation of ICMR-India DIABetes (ICMR-INDIAB) Study rest of India Component supported by Department of Health Research (DHR), Indian Council of Medical Research (ICMR), New Delhi.
- November 2012: Inauguration of Gestational Diabetes Mellitus Project 'WINGS'.
- June 2013 : Launch of "Dr.Mohan's Atlas of Indian Foods"
- July 2013 : Launch of "Dr.Mohan's High Fibre Rice & High Fibre Rice Rava
- Dec 2013: Launch of Next Generation MODY genetic test
- March 2014: Novel genetic polymorphisms associated with type 2 diabetes identified in Indians through GWAS studies
- Dec 2014: Inauguration of the new Bio Repository at MDRF Siruseri
- August 2015: Inauguration of the Dr.Rema Mohan High Throughput Sequencing lab at Siruseri

RESEARCH CENTRES ESTABLISHED BY
MADRAS DIABETES RESEARCH FOUNDATION

1. S.S. JHUNJHNUWALA DIABETES RESEARCH CENTRE OF MDRF AT GOPALAPURAM

It was the expressed wish of late Shri. Shyam Sundar Jhunjhnuwala, an industrialist based at Hong Kong, to support and encourage pioneering research in the field of diabetes in India. Because of the Jhunjhnuwala family's generous donation, our dream to have a separate building for Madras Diabetes Research Foundation became a reality. The S.S. Jhunjhnuwala Diabetes Research Centre was inaugurated on the 2nd September 2001. We thank the Jhunjhnuwala family for their magnanimous donation to MDRF.

Shyam Sundar Jhunjhnuwala Diabetes Research Centre of MDRF at Gopalapuram, Chennai

Mr. S.S. Jhunjhnuwala's sons Mr. Suryakumar Jhunjhnuwala and Mr. Grishkumar Jhunjhnuwala & Mrs. Jhunjhnuwala standing near the bust of Late Shri. S.S Jhunjhnuwala.

2. KALLAM ANJI REDDY CENTRE OF MDRF AT SIRUSERI

The late Padma Bhushan Dr. K. Anji Reddy, Founder and Chairman of the Dr. Reddy's Laboratories and Dr. Reddy's Research Foundation, Hyderabad was one of our greatest supporters and well wishers. A philanthropist by nature, Dr. Anji Reddy was instrumental in establishing the drug discovery program on diabetes in India. In recognition of his constant support to MDRF and honouring his R & D capacity building efforts in India, The state of the art research centre of MDRF at Siruseri has been named as 'Kallam Anji Reddy Centre'. We remember Dr. Anji Reddy with gratitude and continue to be indebted to him for his constant support and encouragement.

Kallam Anji Reddy Centre of MDRF at Siruseri

Late Padma Bhushan Dr. K. Anji Reddy
Chairman, Dr. Reddy's Laboratories and
Dr. Reddy's Research Foundation, Hyderabad.

3. RESEARCH CENTRE OF MDRF AT LLYODS ROAD:

4. RESEARCH CENTRE OF MDRF, UTSAV FLATS, AT GOPALPURAM:

These two MDRF Research centers were established (near by the Gopalapuram campus) to get the support facilities from the hospital wing (DMDSC) to perform state-of-the-art clinical and biochemical techniques and computing skills, making it one of the most advanced centers for diabetes research in Asia. This close collaboration facilitates an easy access to patients, samples and their families for follow up studies.

LIST OF OUR DONORS & SPONSORS

(2012-2015)

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1	Aachi Spices And Food Pvt Ltd
2	Abbott Healthcare Pvt Ltd
3	Aditya Food Industries
4	Amneal Pharma
5	Arogya World's
6	Arthur L Holden
7	Basf South Eat Asia Pte Ltd
8	Britannia Industries Limited
9	Cadila Pharma Ltd
10	Cardiff University
11	Cashew Export Promotion
12	Centre For Chronic Disease Control
13	Diabetes Supplies Centre
14	Dr.G. Balakrish Nair
15	Dr.Mohan's Diabetes Education Academy
16	Dr.R.M.Anjana
17	Dr.V.Mohan
18	E.I.D Parry (India)Ltd
19	Eli Lilly And Company (India) Pvt Ltd
20	Emory University, Atlanta, Usa
21	Good Brands For A Health Life Pvt Ltd
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S. No.	Particulars
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29	Itc Limited Foods Division
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52	Public Health Foundation Of India
53	Quintiles Research Pvt Ltd
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60	The University Of Oklahoma Health Sciences Center
61	Tilda Hain India Private Limited
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64	Veralight Inc
65	Vision Mission Foundation
66	Westat Inc.Rockuille
67	Xcleris Labs Limited

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   Former DG, ICMR and Adviser, Translational Research Institute, National Institute of Immunology.
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   Secretary, Department of Biotechnology (DBT), NewDelhi.
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   Vice Chancellor, University of Hyderabad.
5. **Dr. Partha Pratim Majumder**
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   Prof. of Molecular Medicine, St John's Research Institute, Bangalore.
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   Former Director, National Institute of Nutrition, Hyderabad.
9. **Dr. Ramesh Bhonde**
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    Director, DNA Fingerprinting and Diagnostics [CDFD], Hyderabad.
11. **Dr. G. Padmanabhan**
    NASI-Platinum Jubilee Chair, Indian Institute of Science, Bangalore.
12. **Dr. D. Karunagaran**
    Department of Biotechnology, Indian Institute of Technology, Madras.
13. **Dr. C.C. Kartha**

Scientist, Rajiv Gandhi Centre for Biotechnology [RGCB], Thiruvananthapuram.

14. **Dr. M. Radhakrishnan Pillai**

    Director, Head, Dept of Molecular Medicine and Cancer Biology, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram.

15. **Dr D. Balasubramanian**

    Director of Research, LV Prasad Eye Institute, Hyderabad.

16. **Dr. Subbiah Arunachalam**

    Distinguished Fellow, Centre for Internet & Society, Chennai.

17. **Dr. Gopal Pande**

    Scientist, Center for Cellular and Molecular Biology, Hyderabad.

INSTITUTIONAL HUMAN ETHICS COMMITTEE [IHEC]

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   Former Deputy Director, Tuberculosis Research Centre, Chennai
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   Consultant Diabetologist, T.Nagar, Chennai
3. **Dr. M. Balasubramanyam, (Member Secretary)**
   Senior Scientist, Madras Diabetes Research Foundation
4. **Dr. R. Ramakrishnan (Expert Epidemiology & Statistician)**
   Scientist (Deputy Director S.G.), National Institute of Epidemiology
5. **Dr.Radha Venkatesan (Expert-Genetics)**
   Madras Diabetes Research Foundation
6. **Dr. Annabelle Rajaseharan (Expert-Clinical Pharmacology)**
   Professor of Pharmacology, Adhiparasakthi Institute of Medical Sciences & Research, Melmaruvathur
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   Chetput, Chennai
9. **Dr. C.R Anand Moses, (Expert-Medicine)**
   Professor & Head, Institute of Diabetology, Chennai Medical College and Govt. General Hospital, Chennai
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    YR Gaitonde Centre for AIDS Research and Education, Taramani, Chennai
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    Advocate, High Court, Chennai
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13. **Dr. (Mrs). Purna Shankar (Social Worker)**
    Scientist and Social Worker, Chennai
14. **Mr. T.Shankar (Lay Person Nominee)**
    Executive, Management Solutions, Chennai

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   Madras Veterinary College, Chennai

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   Expert Consultant, CPCSEA

3. **Dr. V. Thiagarajan**
   Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Chennai

4. **Dr. Gandhishwari**
   Dept. of Biotechnology, Loyola College, Chennai

5. **Dr. V. Mohan**
   Madras Diabetes Research Foundation, Chennai

6. **Dr. M. Balasubramanyam**
   Madras Diabetes Research Foundation, Chennai

7. **Mrs. R. Guha Pradeepa**
   Madras Diabetes Research Foundation, Chennai

8. **Dr. K. Gokulakrishnan**
   Madras Diabetes Research Foundation, Chennai

9. **Dr. M.R. Srinivasan**
   Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Chennai

Who's Who at MDRF

MANAGEMENT

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President

Dr. R. M. Anjana
Vice-President

Dr. I. Ranjit Unnikrishnan
Director

Dr. M. Balasubramanyam
Dean of Research Studies &
Assistant Director

SCIENTISTS

Dr. M. Balasubramanyam
Cell & Molecular Biology

Dr. Radha Venkatesan
Molecular Genetics

Dr. Poongothai
Clinical Trials

Dr. Guha Pradeepa
Research Grants

Dr. M. Deepa
Epidemiology

Dr. Shanthirani
Clinical Epidemiology

Ms. Sudha Vasudevan
Food & Nutrition Research

Dr. Ranjani Harish
Translational Research

Dr. K. Gokulakrishnan
Research Biochemistry

Dr. Nagaraj Manickam
Vascular Biology

Dr. Shiny Abhijit
Cell & Molecular Biology

Dr S. Kanthimathi
Genetics

Dr. Priya Maria Miranda
Epidemiology

Dr. Shobana S
Food & Nutrition Research

Dr. D. Bodhini
Genetics

Dr. A. Amutha
Epidemiology

Dr. Ruchi Vaidhya
Post Doctoral Fellow-Food & Nutrition Research

ADMINISTRATION SUPPORT FROM DMDSC

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Vice President
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Maintenance

Mr. S. Apparswamy
Deputy Manager
House Keeping

Mr. M. Vasanthakumar
Assistant Manager
Facility

DEPARTMENT OF DIABETOLOGY

"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health." — Hippocrates

Continuous acquisition of knowledge on the treatment and prevention of diabetes and its complications, and the dissemination of that knowledge to patients thereby enabling them towards self-management are the cornerstones in the management of diabetes"

Chairman & President MDRF
Prof. V. Mohan

Vice President,
Jt. Managing Director, Consultant & Research Officer
Dr. R. M. Anjana

Vice Chairman, Consultant & Research Officer
Dr. I. Ranjit Unnikrishnan

Asst. Director,
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Dr. P. S. Jagadish
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Dr. Lovelena Munawar
Dr. B. Parthasarathy
Dr. Vidya Jaydeep
Dr. S.Uthra
Dr. Swarnapradha
Dr. challaboina Swetha

The department is headed by **Dr. V. Mohan** MD, FRCP (London, Edinburgh & Glasgow), Ph.D, DSc, FNASc, whose interests in diabetology span over three decades. Dr Mohan's clinical team consists of 44 well trained diabetologists who take care of more than 3,60,000 patients registered at our centre.

The department of diabetology aims at the development of novel approaches to the early diagnosis, treatment, and prevention of diabetes. The department emphasizes on providing clinicians with basic science and research expertise for the enhancement of clinical care and medical research in India.

The department also engages in educating the general physicians and international students about diabetes management and prevention. offers specialized training in diabetes and its complications to doctors, nurses, lab technicians and other paramedical personnel through varied and innovative courses, most of which are being offered for the first time in India. This department is unique in the country to be actively involved in increasing the awareness of diabetes and its complications

and promoting its prevention both at the clinic and at the community level. This is the need of the hour in the Indian context as Indians are very vulnerable to diabetes owing to the unique metabolic and genetic susceptibility. The department also provides assistance to basic scientists in translating their novel findings into clinical practice. A brief description of the activities of the department is provided below.

Vision

To provide evidence based knowledge on diabetes and its complications and their determinants.

Mission

To assess the prevalence of diabetes and its various complications, both in urban and rural areas and also to study further about the associated markers for atherosclerosis and insulin resistance; to explore avenues and implement strategies for prevention of diabetes through various research projects.

Current Activities of the Department

Neonatal Diabetes Mellitus in Indian Children

Neonatal diabetes mellitus (NDM) is a rare form of diabetes which is diagnosed before 6 months of age. NDM is of two types - Transient Neonatal Diabetes (TNDM) and Permanent Neonatal Diabetes (PNDM). In PNDM, the condition will persist throughout life, whereas in the case of TNDM, the diabetes may remit before the child's first birthday, but it may relapse again in early adulthood.

NDM is a monogenic form of diabetes, that is, it is due to a single gene defect. These disorders usually affect the insulin secretion from the pancreatic beta cell. Patients with NDM are Glutamic Acid Decarboxylase (GAD) antibody negative which would help to differentiate them from type 1 diabetes patients who are usually GAD antibody positive. We found that 20% of NDM patients had mutation

of ABCC8 in the sulphonylurea receptor (SUR) gene, 9.3% had mutation of KCNJ11 gene and 5% had mutation in Insulin (INS) gene. However in 65% we were unable to detect any mutation.

The clinical application of the genetic screening of neonatal diabetes is that many of these children can be switched over from lifelong insulin injections to anti-diabetic tablets (sulfonylureas) with improved glucose control. It is therefore important to screen all children with neonatal diabetes for these mutations. A separate **website for neonatal and monogenic forms of diabetes** has been set up by the Madras Diabetes Research Foundation in an attempt to develop a national registry for neonatal diabetes and other monogenic form of diabetes (www.neonataldiabetes.in).

Studies on Diabetes in the Young

Young diabetes is an interesting entity for several reasons. First, it is a heterogenous group of disorders comprising of type 1 diabetes, type 2 diabetes, maturity onset diabetes of the young [MODY] and fibrocalculous pancreatic diabetes [FCPD], along with other rare syndromes and subtypes. Second, individuals who develop diabetes at a young age are at high risk of developing chronic diabetic complications, on account of the long duration of hyperglycemia to which their organs are exposed. Third, control of diabetes in the young is quite challenging on account of the hormonal and emotional changes of adolescence, pregnancy and other similar reasons. For this reason, MDRF has ventured to undertake a study of diabetes occurring in individuals less than 25 years of age. There are more than 4000 young patients (Dr. Mohan's Diabetes Specialities Centre) registered from 1990 to 2015 in the database of the sister institution of MDRF. After accurately classifying these individuals according to type of diabetes, exhaustive studies will be undertaken on the presence of diabetes complications, atherosclerosis markers and so on. Accurate diagnosis of

diabetes will help in providing the correct treatments to these patients. Detecting risk factors for micro- and macrovascular complications will help to institute appropriate preventive measures to enable these young patients to live a full and productive life in spite of diabetes.

ICMR Young Diabetes Registry

In order to quantitative and classify the burden of young diabetes in India, the Indian Council of Medical Research [ICMR] has initiated the Young Diabetes Registry (YDR). The protocol of ICMR's Task Force project on "Registry of People with Diabetes with Young Age at the Onset" would be implemented through the three different units during phase II viz: Coordinating Units, ICMR Regional Collaborating Centres and Collaborating Centres. This is a purely voluntary registry to which clinicians treating young people with diabetes can contribute, simply by sending in their patients' clinical details to the co-ordinating centres. MDRF has been selected as one of the Regional Collaborating Centre for the study.

Primary objective:

To understand:

1. the magnitude of problem
2. disease pattern or types including the geographic variation
3. incidence and prevalence rate of complications

Secondary objective:

The registry is aimed to

1. Facilitate research in the areas of basic, clinical (including patterns of care and survival), epidemiological, genetic and molecular levels.
2. Help promoting awareness about the magnitude of problem among professionals, public health partners.
3. Help in Diabetes Monitoring Programme.
4. Assist in the development of management guidelines.

5. Develop human resources in diabetes epidemiology.

Our aim was to recruit both private and government centres. We met the Health Secretary, Government of Tamilnadu and requested his help to get government Hospitals and clinics to get involved, after explaining the ICMR-Young Diabetes Registry to him. He issued a letter directing all the government hospitals to report to the Registry. We have so far recruited 23 private hospitals/clinics and 5 government hospitals to give baseline proforma for the Young diabetes Registry.

As one of the Collaborating Centre [CC No.003]- MDRF, we have received 2373 cases of young diabetic patients registered from 1st January 2000 till August 2012 (in Phase I) with the age onset of diabetes ≤25 years who satisfied the criteria to be included in the ICMR Young Diabetes Registry. According to the geographic region, we were advised to confine our activities to Chennai city alone, in the interest of being able to define a denominator.

Each reporting centre was contacted in person and explained about the protocol of the registry. The baseline proformae were detailed along with the instructions to fill up, to the concerned doctor/diabetes educator/dietician. Every month we made a call to each reporting centre and enquired about the forms filled in by them. If they had filled forms with them, a representative from the collaborating centre went to the reporting centre and collected the forms. At the time of collecting the forms, all the doubts and queries raised by the person in charge, regarding filling baseline proformas were clarified. The forms collected were entered electronically into the software developed by our centre for easy access of the dataset for preparing reports.

From Phase I, data sets of approximately over 5500 subjects are available with information on diabetes type, complication, mode of treatment, etc being collected through the questionnaire approach. The demographic, personal information would be obtained through the questionnaire approach and also the information on follow up would be collected in follow up proforma. All the Collaborating Centres would obtain the data from their respective Reporting

Centres.

The research activities under the project would help to facilitate research in the areas of basic, clinical (including patterns of care and survival), epidemiological, genetic and molecular levels and help to promote awareness about the magnitude of problem and also assist in the development of the diabetes monitoring programme.

MDRF as one of the Collaborating Centre [CC No.003], have so far received 3315 cases of young diabetic patients registered from 1st January 2000 till November 2015 (Phase I & II) with the age onset of diabetes ≤25 years who satisfied the criteria to be included in the ICMR Young Diabetes Registry.

Beta cell function in youth with type 2 diabetes and its association with atherosclerosis (2011 – 2014) DST No: SR/SO/HS-0135/2009

Type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) are rapidly emerging epidemics all over the world; together CVD and diabetes account for 30% of all global deaths. With over 69 million people with diabetes India has now the second largest number of people with diabetes in the world. Unfortunately both the diabetes and CVD epidemics now affect the youth of the country and people with diabetes are at two to four fold higher risk of developing CVD of which the best surrogate marker are the indices of atherosclerosis. The proposed type 2 diabetes case control study aims to enroll 450 youth in Chennai (150 with incident Type 2 Diabetes in youth (T2DM-Y), 150 with prediabetes and 150 normal controls from the community to assess the independent associations of beta cell dysfunction and insulin resistance (IR) with T2DM-Y and to describe the prevalence of, and risk factors for, early atherosclerosis in T2DM-Y

Objective 1: In a population of incident T2DM-Y (newly diagnosed cases in the past one year), prediabetic, and age and sex matched normoglycaemic Asian Indian youths aged <25 years, to assess the independent associations of beta

cell dysfunction (measured by disposition index- DIo), and insulin resistance (measured by 1/fasting insulin and HOMA-IR), with prediabetes (IGT or IFG), T2DM-Y and early atherosclerosis (measured by carotid intima-media thickness, and flow-mediated dilatation).

Objective 2: To determine the relative contributions of body fat distribution, oxidative stress, inflammatory markers, and adipokines in explaining the association between beta cell dysfunction and IR with prediabetes (IGT or IFG), T2DM-Y and atherosclerosis.

Summary of the project

Participants for this study were selected from those registered at Dr.Mohan's Diabetes Specialties Centre population. Type 2 diabetes in youth (T2DM-Y) cases (n=82) were recruited within 18 months of diagnosis, and they were diagnosed either confirmed by a 75g oral glucose tolerance test (OGTT), or based on the past medical history, drug treatment for diabetes and met the following criteria: onset before age 25 years, good response to oral hypoglycemic agents and C-peptide levels of ≥ 0.6 pmol/ml.

Normoglycemic participants (NGT) were selected from the general population of Chennai from residential colonies, which is an ongoing community project which covers almost the whole of Chennai City. Controls were age and sex matched individuals with normal glucose tolerance (n=31) and Youth with prediabetes (IFG and IGT) (n=83) were also selected.

OGTT with glucose and insulin measures at 0, 30, 60, 90 & 120 minutes, anthropometry, and abdominal CT scan were performed after consenting all cases and controls.

New observations:

a) Participants with prediabetes had a more drastic decline in DIo than an increase in HOMA-IR when compared to normal glucose tolerant participants, suggesting an early and significant change in the β-cell dysfunction disrupting glucose metabolism. These points to a predominant role played by β-cell dysfunction in the pathogenesis of prediabetes and

T2DM-Y in our population who were relatively lean compared to Europeans.

b) DIo derived by OGTT measurements were 9-fold lower in our T2DM-Y when compared to NGT.

c) We realized after starting this study that pre-diabetes is a condition which is difficult to obtain large numbers in India due to the rapid conversion rate to diabetes. This scenario is even more accentuated in the youth – the age group of 10 -25 years which we had attempted to study. Hence, studying the numbers we had estimated in the proposal, within the time frame mentioned, was difficult and the eventual numbers of prediabetes were smaller than we had originally proposed. However, statistically this may not be a matter of concern as the study is still adequately powered as this was planned as a case-control study with a matched design. The Pre-diabetes group could have been merged with the incident cases but since no other study from India had reported on relative roles of beta cell function and insulin resistance in youth onset diabetes, we decided to keep the pre-diabetes group separate to understand the changes across three categories and the role of various risk factors.

Innovations:

a) When compared to other risk factors like BMI, waist circumference and insulin resistance, β-cell dysfunction occurring early in the natural history may be a key factor in pathogenesis of T2DM in Asian Indians. The role of β-cell dysfunction as an important contributing factor to the early development of T2DM was evident even with the smaller numbers studied.

b) A relatively simpler surrogate OGTT protocol could provide estimates of insulin sensitivity and β-cell function which could be detected in high risk youth at an early stage. It can also be used in large-scale epidemiological studies where the use of doing clamp studies may not be feasible.

c) Even though the final sample size (particularly prediabetes) is lower than planned due to conditions beyond our control, this study is still unique in

the fact that we attempted to study role of β-cell dysfunction and insulin resistance across stages of dysglycemia in a young population.

Projects done by Ph.D. students under the guidance of Prof. V. Mohan

1. Regional differences in the level of glycemic control among diabetic subjects in India

Chandrika V.

A large majority of subjects with diabetes have inadequate control of diabetes. Inadequate glycemic control is an important implications, not only in terms of quality of life, and occurrence of various complications but also in terms of the cost of care. Capturing data on glycated hemoglobin, a marker of glycemic control, will help to map the epidemiology of diabetes and monitor its progression.

The study will focus on the analysis of HbA1c and other related parameters by utilizing the region wise epidemiological data collected as part of "INDIAB" phase-I programme. The main goal of the study is to assess the diabetes control among self reported diabetic subjects from urban and rural areas of 3 states i.e., Tamilnadu (South), Mahasrastra (West), and Jharkand (East) and 1 union territory Chandigarh (north). Additional objectives are to assess the HbA1c in relation to duration of diabetes, metabolic syndrome and to determine the frequency distribution of HbA1c in Indian population and also to monitor the quality control issues with glycated haemoglobin levels.

2. Obesity Reduction and Awareness of Non-communicable diseases through Group Education- ORANGE

Sonya J.

Childhood obesity has become a burden worldwide and its impact is all the more relevent in developing countries like India where a significant number of the population belongs to the younger age group. Obesity leads to health implications like type 2 diabetes mellitus, dyslipidemia, hypertension and

metabolic syndrome which are increasingly becoming common among children and adolescents. Moreover childhood obesity has been found to have strong association with higher risk of morbidity and mortality in adult life.

ORANGE is a huge epidemiological project carried out in Chennai on children and adolescents (6-18 years) aiming to screen for obesity, diabetes, pre-diabetes, hypertension, dyslipidemia and metabolic syndrome. The screening was carried out for 2 years and about 20614 subjects have been screened in this project. The goal of this project is to find whether metabolic disorders are an epidemic among children and adolescents in urban South India. This study will provide valuable community based data from children and adolescents on obesity, diabetes, pre-diabetes, dyslipidemias, hypertension and metabolic syndrome and helps to develop risk scores which are not currently available for children.

The study is one of the first of its kind conducted in India and offers a gold mine of data and samples to be explored further to understand the precise scenario of the biochemical profile in the urban and rural Indian population. The study could provide an insight about the management, development and implementation of standard diabetes care quality measures that will help to track progress and guide efforts to improve levels of diabetes control.

3. To assess the level of depression and optimism in subjects with diabetes and intervention of depression in a large clinic population in South India

Bhavani Sundari

Depression is a common illness worldwide, with an estimated 350 million people affected. Depression is different from usual mood fluctuations and short-lived emotional responses to challenges in everyday life. Especially when long-lasting and with moderate or severe intensity, depression may become a serious health

condition. It can cause the affected person to suffer greatly and function poorly at work, at school and in the family. At its worst, depression can lead to suicide. Suicide results in an estimated 1 million deaths every year. Diabetes is associated with increased risk of developing depression. In addition, risks of debilitating complications and mortality are all compounded when cardio-metabolic and mental illnesses co-exist and/or are uncontrolled.

Depression affects 12.1 – 15.1% of adults and diabetes affects over 60 million people in India. Therefore the absolute number of those affected with both conditions is sizable and constitutes a ground of elevated risk. Negative thoughts are found to be one of the causes for depression apart many factors such as family history, diet, chronic stress, illness etc., whereas optimism is a positive inner psychological resource which protects individuals.

Study design and methods:

Subjects with diabetes, both type 1 and type 2 diabetes will be selected from Dr. Mohans Diabetes Specialty Center, Chennai (large clinic population) and will be assessed for Depression and Optimism. PHQ-9 and Optimism - Pessimism scale are the tools that will be used. Depression and diabetes care will be integrated in a sub-sample of 120 subjects based on the TEAMcare approach. Subjects with diabetes and depression will undergo continuous intervention for 1 year and will be followed up for another year to understand if there is any improvement in A1c, Blood pressure, LDL – cholesterol and Depression. Adherence to diet and exercise is better when the depression decrease during the intervention phase will be studied. The cost of care for diabetes and depression getting treated, including the cost of travelling to the hospital will also be studied.

Inclusion Criteria for intervention of depression and diabetes:

Clinic-attending diabetes subjects. 35 years of age or older. Depressive symptoms (PHQ-9 ≥ 10). At least one poorly-controlled CVD risk factor (e.g., HbA1c ≥ 8.0%, SBP ≥ 140 mmHg, or LDL-c ≥ 130 mg/dl)

Patients will be excluded from the intervention trial if:

Patient reports a very high suicide risk or if the PHQ is >23 indicating severe depression or patients who score 2 or more in item 9 in PHQ9. If a person is already under psychiatrists care or using antipsychotic or mood stabilizer medication. Diabetes secondary to uncommon cause, documented CVD event in the past 12 months. End stage renal disease, Pregnancy or breast feeding. Alcohol or drug abuse.

Expected outcome:

This study provides insights into the depression among different profile of diabetes sample, both clinical as well as demographic as it covers a large sample.The role of optimism as a moderating relationship between the depressive moods and diabetic condition will be highlighted and can be used for further clinical practice. The food and drug compliance and its relation to diabetic status and depression status can provide insights to address this major issue in diabetes self care. Adding depression management as an integrated care of diabetes management can add value in delivering optimal health care to the community. This will bring about a new dimension to Diabetes care.

4. Prevalence of stress in subjects with type-2 diabetes and interventions for stress in clinic population

Ms.Vidyulatha Ashok

Diabetes is a chronic health condition proving to be a major health challenge, on the international and national level. The increase in prevalence of diabetes is mainly due to lifestyle changes, as a result of urbanization, globalization, and physical inactivity. Apart from these, stress also plays and important role, in the etiology, and management of diabetes, thereafter. Stress is defined as “non specific response of the body to any demand”, leading to the activation of the sympathetic adrenal medullary system. There are no large scale studies which have looked at the prevalence of stress in a clinic population. This study focuses on the prevalence of stress in the population of people with type 2 diabetes,

along with the effects of behavioral intervention through pranayama and biofeedback using galvanic skin response. An in-depth study of personality traits, could provide useful insights in the perception of stress. This study which aims at looking at the above mentioned variables, could give a new dimension to psychosocial care in diabetes.

Aim of the study:

- To study the prevalence of stress and explore the scope of intervention in the type 2 diabetes population.

Primary objectives:

- To study the prevalence of stress, using a structured stress questionnaire in a clinic population of patients with type 2 diabetes selected from Dr. Mohans' Diabetes Specialties Center, Chennai.

- To study the effects of Pranayama (controlled breathing exercise) and biofeedback, in achieving relaxation, in individuals with type 2 diabetes from a sub group of the above mentioned patients.

Secondary objectives:

- To study specific personality traits, such as Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism among individuals with type 2 diabetes.
- To measure the following immunological markers like Interleukin-6, tumor necrosis factor alpha (TNFa) and neuroendocrine markers like Cortisol.
- To measure the stress level by means of a new tool - The Stress mobile.

5. Clinical and genetic studies on Gestational diabetes mellitus

Ms. Bhavadarani Balaji

Gestational Diabetes Mellitus (GDM) is defined as any degree of glucose intolerance identified for the first time in pregnancy. There is evidence to show that women with GDM are at increased risk of morbidity and mortality. Moreover, they are at increased risk for the development of type 2 diabetes in the future and indeed almost 50 -70% of GDM women develop diabetes within 5 years after delivery. GDM is also associated with risk of macrosomia, neonatal hypoglycemia, shoulder dystocia and congenital anomalies to the foetus. Despite the risk that GDM poses to pregnant women and to their offspring, it still remains a neglected area in diabetes and maternal health initiatives. GDM offers an important opportunity for the development, testing and implementation of clinical strategies for diabetes prevention not only in the mother but in her offspring.

A number of different screening procedures and criteria are being followed for diagnosis of GDM. Diagnosis of GDM continues to be a dilemma. The recent International Association of Diabetes Pregnancy Study Group (IADPSG) criteria recommends doing fasting, 1 hour, 2 hour glucose (i.e 3 samples) to diagnose GDM. The older World Health Organization (WHO) criteria was simpler as it required either fasting or 2 hour value for diagnosis. Moreover the cut points are different.

Inconsistent diagnostic criteria and lack of standard protocols means that collecting data on women with GDM could be challenging. It can lead to poor outcomes for mother and child. Moreover there is inadequate data on the risk factors and genetic factors associated with GDM.

Aims and objectives:

1. To determine the best screening criterion for GDM based on feasibility, acceptability and scientific evidence.
2. To compare the prevalence of GDM based on the International Association of Diabetes Pregnancy Study Group (IADPSG) and the World Health Organization (WHO)1999 criteria.

3. To evaluate the GDM Model of Care developed through the WINGS project
4. To determine the postpartum glucose tolerance status among women with gestational diabetes mellitus (GDM) recruited under the GDM model of care.
5. To study the genes involved in GDM.
6. To study the role of biomarkers in predicting GDM.

Study 1: Screening for GDM:

The aim of this study was to determine which screening criterion for GDM was the best to based on feasibility, acceptability and scientific evidence. 1040 pregnant women visiting rural and urban health centres in Chennai and neighbouring district were screened for GDM. Blood samples are taken from pregnant women visiting the collaborating centres. The samples included both venous and capillary samples in fasting, non-fasting and 1 hour and 2 hours after 75 g glucose load and HbA1c. Fasting capillary blood glucose [CBG] level was determined using a glucose meter. The blood samples are analysed at a centralized lab and the results compared. In addition genetic sample was drawn for genetic studies. 1400 women participated in the study and all 6 samples were collected and analysed.

Study 2: Prevalence of GDM:

The IADPSG criteria were introduced in the year 2010 and has found fairly wide acceptance. However, there have been some reports that it may lead to inflated prevalence rates of GDM. In this study, we report on the prevalence of GDM in urban and rural Tamil Nadu in southern India using the IADPSG criteria and compare the same with prevalence rates obtained if the World Health Organization (WHO) 1999 criteria were used.

Study 3: Model of care for GDM:

The GDM model of care was developed and supported through a partnership between the International Diabetes Federation (IDF), the Madras Diabetes

Research Foundation [MDRF] in Chennai, India, and the Abbott Fund with the aim to develop a standardized approach to GDM care that is feasible and effective for implementation in resource constrained settings. The aim of this study was to evaluate the effectiveness of the model of care in pregnant women with GDM in order to tackle the growing burden of GDM.

Study 4: Postpartum follow up of GDM women:

Through this study, we aimed to determine the frequency of dysglycemia in the early postpartum period, and to identify risk factors predicting postpartum dysglycemia in Asian Indian women with GDM followed prospectively throughout their pregnancies.

Study 5: Genetics of GDM:

Evidence is also accumulating that susceptibility to GDM has a genetic component. Studies have shown clustering of type 2 diabetes mellitus (T2DM) and impaired glucose tolerance in families with GDM and evidence for higher prevalence of T2DM in mothers of women with GDM. Recently, replication of T2DM-associated genes identified in various GWASs has been carried out in GDM patients in different Asian populations from Korea, China, and Malaysia, but there are no data for Asian Indians, to the best of our knowledge. This study was designed to investigate whether the SNPs that have previously shown association with GDM in other populations are also associated with GDM in this south Indian population. To our knowledge, this is the first major study of genetic susceptibility of GDM in Asian Indians.

Study 6: Biomarkers for GDM:

Protein renin receptor plays a significant role in the assembly and function of the enzyme known as vacuolar H+-ATPase, an ATP-dependent proton pump, transporting protons across plasma membranes and that disruption of this enzyme's function leads to the development of GDM . A recent study showed that elevated s(Pro)RR concentrations in early pregnancy might predict the development of GDM later in pregnancy. However, there is lack of data on s(Pro)RR and GDM among Asian Indians. The aim of this study

was to determine the association of s(Pro)RR levels with GDM in Asian Indian women.

6. Dietary profile of a rural south Indian population and its association with components of the metabolic syndrome

Sowmya. N.

Aims:

To assess the dietary profile of a rural south Indian population using a validated food frequency questionnaire.

To compare the dietary intakes of the study participants with national and international recommendations for the prevention of chronic diseases.

To compare the food and nutrient intake of the study participants with the urban population.

To evaluate the association between dietary intakes of the study participants and components of the metabolic syndrome.

Brief description of the study:

Participants in the study were recruited from the rural component of the Chennai Urban Rural Epidemiological Study (CURES), which was conducted in 42 villages in Kancheepuram district of Tamil Nadu state in Southern India. In these 42 villages, 27012 adults aged ≥20 years were eligible for the study. Out of this, every third participant (n = 9004) was recruited for detailed dietary assessmentand of these, 7331 completed the dietary assessment (response rate 81.4%). Anthropometric and clinical measures including height, weight and waist measurements were collected using standard methods.Blood pressure was recorded in the sitting position in the right arm to the nearest 1 mm Hg using the electronic Omron™ Blood Pressure Monitor.Fasting capillary blood glucose was assessed using a hand-held glucose monitor. Detailed dietary assessment was done using a modified, previously validated interviewer-administered, meal-based, semi-quantitative FFQ to estimate the usual food intake over the past one year and to identify diet-related risk factors of metabolic syndrome (MS).

Significance of the study:

A high prevalence of MS has been reported in urban India, which has been linked to physical inactivity, high intake of refined grain, and the type of cooking oil used. However, data on the dietary correlates of MS are sparse, especially from rural populations. Nation-wide surveys have focused primarily on nutritional deficiencies and have not investigated the dietary profiles of populations with regard to prevention of non communicable diseases. Hence, the present study investigates the dietary profile of a rural South Indian population and its association with components of the metabolic syndrome. The findings would provide insights into diet disease relationships and help to formulate practical dietary guidelines.

7. Standardization of Parboiling Practices and Its Influence on the Glycemic Properties of High Fibre White Rice

M. Mohamed Jakir

Aims:

1. To study physicochemical, cooking and structural properties of commercially available specialty rice varieties
2. To investigate the effect of parboiling on physicochemical and cooking properties of high fibre white rice
3. To investigate the effect of parboiling on structural properties of high fibre white rice
4. To investigate the effect of parboiling on glycemic properties (*in vivo*) of high fibre white rice

Methods:

High fibre white rice will be evaluated for various types of parboiling processes with relevance to glycemic index. The better parboiling processes will be shortlisted based on the result of dietary fiber, rapidly and slowly digestible starch, and estimated glycemic index parameters. The shortlisted parboiling processes will be further studied for physicochemical, structural, cooking and

glycemic properties. The optimally parboiled process satisfying all above parameters will be further tested for its glycemic property and response in *in vivo.*

Significance:

Indian diets derive 60-80% of daily calories from carbohydrates. Rice (polished white rice) alone contributes to 75% of carbohydrate calories. The newly evolved high fibre white rice (mainly as non-digestible polysaccharide) if replaced with the current intake of white rice, could offer immense health benefits. High fiber white rice optimally parboiled with lower GI could reduce dietary glycemic load, increase in the dietary fibre of the diets. Such diets if habitually consumed could positively influence insulin sensitivity, lipid profile and glycemic response, all of this could help population at risk to prevent diabetes and those who have manage diabetes better. Hence the burden due to diabetes can be drastically reduced with the improvement in the quality of cereal staple in the Indian diets.

8. A randomized control trial of mobile health technology for the prevention of type 2 diabetes (mDiab)

Shruti Muralidharan

The prevalence of type 2 diabetes in India has increased considerably over the years and to a great extent this has been attributed to modifiable risk factors such as physical inactivity, obesity, and changing dietary patterns. Earlier prevention trials that have focused on these modifiable risks have shown a huge impact on decreasing the incidence of type 2 diabetes. However these trials were mostly face to face, resulting in the intervention reaching a limited number of people. The growth of mobile phone users worldwide provides a promising avenue for its application in the field of type 2 diabetes prevention. Mobile technologies provide the potential advantage of being able to reach out to a much larger section of the population within a stipulated timeline. Mobile health technology therefore is the use of mobile devices including mobile phones,

PDAs, tablets, remote sensors and diagnostic devices in disseminating healthcare services and information.

The objectives of this study are to implement and evaluate the effectiveness, and sustainability of a reality TV based diabetes prevention program administered through a mobile phone application in a randomized control trial design. The content of the reality TV based diabetes prevention program is based on the Diabetes Community Lifestyle Improvement Program (D-CLIP) curriculum. This study will contribute to existing knowledge by i) giving an understanding of the effectiveness of translating research using mhealth technology backed by scientific evidence in real life settings to a wider audience, ii) acceptance of mhealth for diabetes prevention in India and iii) whether this could be used as a sustainable approach to diabetes prevention.

9. Assessment of risk factors associated with obesity in adolescents and effect of a school-based pilot intervention program in reducing adolescent obesity (*ORANGE PHASE 2 & 3*)

Mehreen Begum TS

Obesity in adolescents has reached epidemic proportions in India which has led to serious public health consequences. India has one of the world's largest adolescent and youth population which accounts to nearly 21% of the total population. Our country is rapidly undergoing epidemiological, nutrition, socio-economic and lifestyle transition, which contribute to the problem of obesity. Obesity is therefore linked with the development of many Non-Communicable Diseases (NCDs) in addition to exposure to other risk factors like tobacco, unhealthy diet, lack of physical activity and stress. Therefore, this study will be done to characterize different types of phenotypes associated with obesity and increase education and awareness on healthy behavior in school settings.

Metabolic abnormalities:

Children from the ORANGE (Obesity Reduction and Awareness of Non-communicable diseases through Group Education) Phase I study who are currently adolescents will be followed up to ascertain their glucose and cardio-metabolic risk status and the overweight/obese adolescents will be additionally screened for maturity onset diabetes in youth (MODY) genes, inflammatory markers, Intima Media Thickness (IMT), Ultra sound (USG) abdomen for fatty liver and assessment of polycystic ovarian syndrome (PCOS) in adolescent girls. In addition, new adolescents in those communities will also be screened for the above.

Information, Education & Communication:

In select schools in Chennai, we plan to generate awareness and educate children of classes VI and VII on healthy eating habits, on the importance of physical activity in schools and after school hours through regular physical activity and prevention of obesity and diabetes with the involvement of peer leaders and teachers.

This study would serve as a model to study the feasibility and viability of a well-planned NCD prevention program as a co-curriculum for school children in India. The longitudinal follow up will help explore the obesity risk factors among Indian adolescents in greater detail and may help identify mechanisms and early markers of adult disease.

10. Influence of Nutritional Factors on Chronic Disease Epidemiology in Urban South Indians

Mrs. Lakshmi Priya

Aims:

- To identify from the scientific literature about the trend in dietary patterns and nutritional factors over the last decade both in the developing and developed nations.

- To collect the current dietary profile of Chennai urban population in a cohort epidemiological study using the validated Food Frequency Questionnaire.
- To assess the trend in the dietary pattern of Chennai urban adults over the last decade to observe the changes in diet and its impact on the risk factors of metabolic syndrome.
- To assess the influence of dietary habits on incidence of diabetes and co-morbidities.
- To delineate the feasible healthier diet pattern and as a pilot intervention trial with urban adults to show the effect of such healthier dietary pattern in the diseases risk reduction.
- Translate from the healthier dietary patterns to develop evidence based dietary guidelines to prevent and manage type 2 diabetes and co-morbidities.

Brief details about CURES Cross sectional study:

In the earlier CURES study conducted in the year 2001-2003 every 10th subject from phase 3 of the original 26,001 individuals were considered for dietary assessment with validated FFQ (n=2121) 81.6% response rate and this dietary data was considered as baseline for the CURES cohort followed up for 1000 person years. All necessary anthropometric, biochemical and clinical measurements were obtained both at baseline and follow up period after 10 years using standardized protocols.

Significance:

This cohort study for the first time in India will help to identify the healthier dietary pattern to prevent and manage type2 diabetes and co-morbidities. Based on this will emerge the new dietary guidelines and if implemented may prove to be an 'evidence based' strategy to reduce the burgeoning burden of diet related non-communicable diseases in India.

11. The role of dietary fat in the prevention and management of metabolic syndrome and type 2 diabetes

Mookambika Ramya Bai. R

Aim:

1. To identify current evidence from national and international epidemiological studies with regards to quality and quantity of dietary fat and its association to metabolic syndrome and type 2 diabetes
2. Effect of nuts supplementation as a good source MUFA and its impact of glycemic and lipid profile of subjects with type 2 diabetes
3. To test the effect of phytosterol supplementation in the diet in reducing the inflammatory status of overweight obese subjects.
4. To investigate the insulin sensitivity of liver, muscle and adipocyte cell systems treated with different types of cooking oils (traditional and blended).
5. To develop a questionnaire using visual analog scale (VAS) to evaluate the sensory profile of commonly consumed Indian dishes (a maximum of 50 foods) prepared with sunflower, Canola and the proposed cost effective nutritionally balanced new blended oil.

Method:

Literature search will be carried out using PubMed, Science direct etc to identify the relevant national and international studied on the role of quality and quantity of fat in addition to the food sources. Nuts rich in MUFA are lacking in the diets of people with diabetes and hence a study to evaluate the effect of home grown cashew nuts supplementation will be assessed using biomarkers including inflammatory markers. Similarly plant sterol enriched dairy drink and its effect on biomarkers among the population at risk for diabetes will also be studied. Mechanistic study will also be planned to understand the effect of various cooking oils on insulin response using cell lines. Based on the findings from the pilot intervention studies mentioned above and the cell line study a unique cooking oil blend containing optimally balanced fatty acids will be prepared and

tested for sensory attributes and a feeding trial will be designed accordingly to see the effect.

Significance:

Edible cooking oils are the 2nd major source of our daily calories next to cereal staples. Few studies from MDRF had already shown that the most popular oil in this region -sunflower low in MUFA may be associated with the risk of metabolic syndrome and type 2 diabetes. Hence, if the newly developed blended oil could prove to be beneficial then this has greater implications to plan the dietary strategy to mitigate the burden of growing epidemic of chronic diseases such as diabetes and cardiovascular diseases.

12. Metabolic changes after weight loss

Dr Chandru Sundaramoorthy

A recent national survey the Indian Council of Medical Research: India diabetes (ICMR INDIAB) study has confirmed that India has 62.4million people with diabetes. According to IDF by 2030 this will increase to 100 million. The WHO has estimated that the rate of obesity is increasing with at least 400 million people around the world are obese. The ICMR INDIAB study has confirmed that India has more than 139 million people with overweight and obesity. Asian Indians with increased waist circumference and waist hip ratio indicating greater degree of central obesity and insulin resistance develop type 2 Diabetes and coronary artery disease earlier compared to European individuals at a younger age group .Obesity is associated with so many adverse health conditions including Type 2 Diabetes Mellitus, Systemic Hypertension, Coronary Artery Disease, Dyslipidemia, Metabolic Syndrome, Venous Stasis Disease, Degenerative Join Disease, Gastrointestinal Reflux Disorder Obstructive Sleep Apnea, Fatty Liver certain types of cancers and others . Over weight and obesity ultimately leads to disability, depression, worsened quality of life and increased health care expenditure .Weight loss leads to decrease in morbidity and mortality due to reduction in the blood pressure, Insulin resistance, LDL

cholesterol and Triglyceride levels, inflammatory cytokines, Oxidative stress and improvement in Cardio Pulmonary function, mobility and Physical fitness

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Weight loss has multiple beneficial effects on body metabolism; it can lead to remission of type 2 Diabetes, reduction of blood pressure and cholesterol, reduction of various types of cancer, reduction in over all mortality, reduction in sleep apnea, improvement in quality of life and mobility. Most of the data on the studies involving voluntary weight loss is available among Caucasian population which was done in western countries and USA. There is a lacuna in knowledge and pause of data on weight loss among Asian Indians and very minimal data is available on voluntary weight loss through bariatric surgery or Dietary modification and its outcomes among Asian Indians. Hence an interventional study is designed to determine the long term outcomes of bariatric surgery and Dietary modification along with exercise in obese Diabetic or non-Diabetic Asian Indians. We would like to study in detail about the metabolic changes that occurs during weight gain and weight loss after intervention.

The main objective of this study will focus on **Metabolic Changes after Weight Loss** through Bariatric Surgery or Dietary Modification and physical activity in obese Asians Indians with or without type 2 diabetes

OCULAR RESEARCH UNIT

Dr. R.Rajalakshmi
Head Medical Retina

Dr. V. Prathiba
Head of Glaucoma

Ophthalmologists

Dr. R. Rajalakshmi
Dr. V. Prathiba
Dr. M. Usha`
Dr. S. Arulmalar
Dr. Kannan Bala

Visual disability from diabetes is a significant public health problem and the need of the hour is to assess the burden of different aspects of eye problems seen in diabetes. With this in view the Ocular Research Unit at MDRF was established in 1996 by **Late Dr.Rema Mohan,** to study the retinal diseases seen in diabetes. Research undertaken at this unit covers a whole range of clinical, biochemical, genetic, epidemiological and experimental aspects of eye diseases in diabetes. Research activities include studying the prevalence and associated risk factors of DR and intricacies of molecular mechanisms involved in retinal neovascularization, which can pave the way for future therapeutic measures for this important medical problem. The unit has established a cell model system with culturing facilities for endothelial cells of retina for the first time in India. Screening for different polymorphorism and genetic markers for diabetic retinopathy are also under progress. This department has extended its research activities by starting Ph.D programme in ophthalmology since 2003, and 3 students have successfully completed their doctorate (Ph.D) degrees with Dr.M.Rema as the mentor.

Vision

i. To determine the prevalence/incidence of diabetes related eye problems in the population and in the clinical population.

ii. To assess the impact of therapy for diabetic retinopathy and to study molecular mechanisms using post-mortem retina endothelial cells.

Mission

To provide excellence in diabetes related eye research by dissemination of information on the burden, cause, prevention and management among eye researchers through research and education.

State of Art Facilities available at the Department of Ophthalmology:

1. Automated Ophthalmic Chairs with Snellen Visual Acuity Testing
2. ETDRS (Early Treatment Diabetic Retinopathy Study) Charts for Visual Acuity Testing
3. Non-Contact Tonometry and Applanation tonometry for intraocular pressure measurement
4. Slit lamps for Anterior segement examination
5. Carl Zeiss mydriatic fundus cameras for digital retinal colour photography
6. Topcon non-mydriatic fundus cameras for Tele-ophthalmology
7. Remidio Fundus on phone camera for Diabetic retinopathy screening
8. 'A' scan, Corneal pachymeter
9. Humphrey Automated Perimetry for fields testing
10. Zeiss Spectral Domain Optical Coherence Tomography
11. Fundus Fluorescein Angiography
12. Zeiss Visulas Laser System for Retinal Laser Photocoagulation
13. Ophthalmic fully equipped operation theatre
14. Phacoemulsification system for cataract surgery

Research Projects recently completed in Eye department (2012-2015)

1. **Prevalence of Diabetic retinopathy in young onset diabetes** (YDS Study)

   The purpose of the study was to assess the prevalence and risk factors of diabetic retinopathy (DR) in young onset diabetes (DM) (people with onset of diabetes below the age of 25 years). In this study, 300 patients with young onset diabetes (150 type 1 DM and 150 young onset type 2 DM) underwent complete clinical and biochemical assessment and a 4 field digital retinal color photography using a Carl Zeiss fundus camera in the eye department. DR grading was done by the ophthalmologist using the modified Early Treatment Diabetic Retinopathy Study (ETDRS) grading system. The prevalence of DR was 53.3% (duration of diabetes: 12.4±7.4years) in type 1 diabetes and 52.7% (duration of diabetes: 11.8±8.3 years) in early onset type 2 diabetes respectively. This study showed that over half of the people with young-onset diabetes, regardless of type, had retinopathy within 10-12 years of diabetes duration.

2. **Retinopathy in Pre-diabetes**

   In the Diabetes Community Lifestyle Improvement Program (D-CLIP) sub-study on retinopathy in prediabetes, over 350 people with impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) or both, underwent digital fundus photography at the eye department to look for the presence of DR in pre- diabetes. Early retinopathy changes (presence of microaneurysms only) were seen in 5.3% of the people with prediabetes.

3. **CAMRA Study (Comparison Among Methods of Retinopathy Assessment)** 2014 (MDRF- University of EMORY Collaborative project)

   The objective of the study was to assess and compare various screening methods, nonmydriatic fundus photography, smartphone fundus photography, and mydriatic fundus photography to detect and grade diabetic retinopathy (DR). Patients were recruited at department of ophthalmology, DMDSC and MDRF, Chennai, India. 300 people with varying duration of diabetes, underwent fundus photography with all 3 cameras. The sensitivity and specificity of the smartphone camera and the nonmydriatic camera in the detection of DR were assessed and

compared. Compared to standard 7-field mydriatic fundus photography, the sensitivity of smartphone fundus photography for detection of sight-threatening DR (STDR) was 0.59 (95% CI 0.46-0.72), and that of non-mydriatic fundus photography was 0.54 (0.40-0.67). This study demonstrated the relative efficacy of 3 photographic modalities to detect DR in a retina specialty center in India as a proof of concept. We found smartphone fundus photography to be a reasonably good cost-effective new alternative for detection of STDR.

4. **Validation of a new cost-effective indigenous smartphone based device (Fundus on phone) for diabetic retinopathy screening-** 2014-2015**.**

Annual retinal assessment is advisable for all people with diabetes for early detection of diabetic retinopathy (DR). Cost effective screening options are the need of the hour. This study utilized a novel, indigenous, sleek and cost-effective smart phone based device for retinal colour photography. Retinal imaging by 'fundus on phone' camera was validated against the conventional 7 field digital fundus photography using a high end fundus camera, both for screening of DR as well as detect DR of varying severity. 301 patients (602 eyes) with type 2 diabetes underwent standard seven-field digital fundus photography with both cameras at our ophthalmology department. Grading of DR was performed by two independent retina specialists using modified ETDRS grading system. The sensitivity and specificity for detecting any DR by FOP was 92.7% and 98.4% respectively and the kappa (κ) agreement was 0.90 (95%CI-0.85-0.95 p<0.001) while for sight threatening DR (STDR), the sensitivity was 86.9%, specificity 93.1% and κ agreement was 0.80 (95%CI 0.71-0.89 p<0.001), when compared to conventional photography. We found that retinal photography using the FOP camera is a cost effective method for screening and diagnosis of DR and STDR with high sensitivity and specificity and with substantial agreement with conventional retinal photography.

Current Ongoing Research projects in the Department of Ophthalmology

1. **Diabetic Retinopathy Assessment for Type 1 diabetes (DRAFT) Study** 2015-2016. (Supported by Queen Elizabeth Diamond Jubilee Trust and Helmsley's Trust)

   This is a 18 month project to assess the prevalence of retinopathy in type 1 diabetes in South Indians and testing the feasibility and utility of a cost-effective smartphone based digital fundus camera for screening of DR among patients with T1D in an outpatient diabetic clinic. The purpose of the study is to increase the awareness about DR in T1D among the parents and people with T1D, ensure they have retinal examination done regularly on an annual basis and to establish peer to peer and family support groups for people with T1D and their families. Adolescents and adults with type 1 diabetes undergoing treatment at DMDSC will undergo digital retinal colour photography and ophthalmic consultation at the eye department and the same patients will be followed up again with screening for retinopathy after 1 year.

2. **Vitamin D Diabetic Retinopathy Study (VDDRS).** 2015-2016 (MDRF- University of EMORY Collaborative project).

   The study, the Vitamin D Diabetic Retinopathy Study (VDDRS), aims to assess if there is any association between Vitamin D deficiency and diabetic retinopathy in the Asian Indian population. This retrospective study would evaluate the serum 25 hydroxy vitamin D (25(OH)D) levels with presence and severity of DR in people with type 2 diabetes. Additionally, a comparison will be made to assess if serum 25(OH) D levels differ significantly between patients with retinopathy in type 1 versus type 2 diabetes. VDDRS will be utilizing de-identified electronic medical record data of Dr. Mohan's Diabetes Specialties Centre (DMDSC) (DEMR). Data of patients aged 18 to 89 years old, who have undergone clinical, biochemical and ophthalmic assessment at Dr. Mohan's Diabetes Specialties Centre (DMDSC), within a three-year period (2012- mid 2015) will be used. Clinical data, medical history and anthropometric values like age, gender, height, weight, blood pressure, type of diabetes and duration of diabetes, diabetes management regimen, etc

have been collected from DEMR. Biochemical parameters- hemoglobin A1c, serum urea, serum creatinine, serum 25(OH)D, and urine microalbumin levels have been collected from DEMR. The severity of DR grading is based on using modified version of Early Treatment of Diabetic Retinopathy Study (ETDRS) system.

3. **Diabetic Retinopathy Self-Assessment and Self-Reporting Awareness Project**-2015-2016

   This study is to discern if patients who undergo fundus photography are able to identify if they have diabetic retinopathy (DR) by looking at their own retinal photographs by comparing it against a normal digital retinal colour photograph. Known diabetic patients with varying disease duration will undergo a minimal 2 field retinal colour photography (including a retinal photograph of the posterior pole) of both eyes. A simple questionnaire will be orally administered to them, to document details regarding their duration of diabetes, their educational qualification, profession, and socioeconomic status. A normal fundus photograph would be shown to them and then their fundus photographs will be shown to them. Patients will have to mention if they observe any variations (like small red dots, big red spots, yellow spots, whitish spots, large red patches, etc), in their own fundus photograph in comparison to the normal fundus photograph. The findings mentioned by the patient will be entered into a grading form. The patients will have to mention if they have DR or not. The retinal diagnosis by the ophthalmologist will be taken as the gold standard for final comparison and analysis.

4. **CURES Incidence Eye study:**

   The main objectives of the Chennai Urban Rural Epidemiology Study (CURES) Incidence Eye study, are to estimate the incidence and progression of diabetic retinopathy (DR). The study population comprises individuals participating in the ten-year follow-up of the Chennai Urban Rural Epidemiology Study (CURES), the landmark epidemiological study on diabetes and its complications conducted on a representative population in

Chennai, the largest city in South India. All subjects undergo vision acuity testing, intraocular pressure estimation, slit lamp examination and gonioscopy. Automated perimetry is performed to screen for Glaucoma. Retinal color photography is then taken after pupil dilatation. Diabetic Retinopathy is graded in the color fundus photographs according to Early Treatment Diabetic Retinopathy Study (ETDRS) criteria.

Other ongoing projects

1. Dr. R. Rajalakshmi, is a part of the National Task Force for Diabetic Retinopathy prevention of Blindness 5 year National Project by the Public Health Foundation of India.
2. All ophthalmologists are involved in the tele-ophthalmology DR screening.
3. The Modules for the Certificate Course on Diabetic Retinopathy (CCDR), a joint effort of by the Public Health Foundation of India, Dr. Mohan's Diabetes Education Academy and Aravind Eye Care System were being prepared.

DEPARTMENT OF CELL AND MOLECULAR BIOLOGY

"The cell and molecular biology oriented route offers unique opportunity for identifying novel drug targets and newer therapeutic measures for metabolic disorders

Our Team:

Dean of Research Studies & Senior Scientist

Dr. M. Balasubramanayam

Scientist

Dr. Shiny Abhijith

PhD Students

Mr. Balakumar Mahalingam

Mr. Prabu P

Mr. Sathishkumar C

Mr. Regin B.S.

Mrs. Srividhya R

Mr. Ramesh Kumar G

Mr. Avinash Soundarajan

Research Staff

Mr. Aswath

Animal house supervisor

Mr. Prabhu Durairaj

The Department of Cell and Molecular Biology was started in 1999 with the objective to study and investigate the New Biology insights on the pathogenesis of diabetes and its complications at the cell and molecular levels. The department is under the supervision of Dr. M. Balasubramanyam who has been actively involved in research in diabetes and its complications for nearly 3 decades. The department is involved in studying cell and molecular signatures with special reference to insulin secretion, insulin action and vascular function. Research at this department integrates physiological and pharmacological approaches with biochemical & molecular biological techniques (transcriptomics, proteomics, epigenetics, miRNA, RNAi, metagenomics) to study and delineate the mechanisms underlying development and progression of diabetes, its complications and cardiovascular diseases.

Vision

The department aims to evolve as a **'Centre for Cellular and Molecular Medicine' (CCMM)** with state-of-the-art facilities for preclinical research, biomarker(s) identification, high-throughput cell-based assay systems, and to offer world-class higher learning, contract research and consultancy work.

Mission

i. To perform cutting-edge research, identify novel drug targets related to insulin secretion, insulin sensitization and vascular function and to reveal prognostic and diagnostic biomarkers that will pave way for the development of newer therapeutics.

ii. To enhance research capacity building with special reference to higher education and human resource development in the country in the area of research specialization.

Facilities

Some of the novel facilities available at the department include:

- Cell line(s) repository to study insulin secretion, insulin sensitization and vascular functional defects using specific target cells
- Standardised technology to culture and perform signaling studies using human skeletal muscle cells and subcutaneous/visceral fat adipocytes
- Standardised techniques to perform mRNA and miRNA profiling using real-time PCR and transfection methodology using Amaxa necleofection.
- Standardization of diet-induced diabetic rats (high-fat and high-fructose) and ability to conduct pre-clinical studies in relation to insulin resistance, diabetes and diabetic complications
- Methodology for glucose uptake, lipolysis, gluconeogenesis, Ca2+ uptake, Comet Assay, telomere length & AGE determinations, studies related to ER stress and mitochondrial dysfunction, Confocal-based fluorescence measurements
- Certain miRNAs were identified by microarray analysis as potential biomarkers related to the insulin signalling defects in patients with type 2 diabetes 6.
- Novel methodologies were standardized to assess the cellular levels of endoplasmic reticulum (ER) stress and advanced glycation status.
- In the context of the need for non-invasive, point of care (POC) medical devices for diabetes risk monitoring, a skin collagen AGE-fluorescence based POC

device was evaluated and reported as a promising screening tool for diabetes in the general population.

- Global serum miRNA profiling is attempted to address the panel of miRNAs as risk factors for prediabetes and type 2 diabetes

Unique Research Advancements from the Cell and Molecular Biology Department

Circulating MiRNAs of 'Asian Indian Phenotype' Identified in Subjects with Impaired Glucose Tolerance and Patients with Type 2 Diabetes.: Several omics technologies are underway worldwide with an aim to unravel the pathophysiology of a complex phenotype such as type 2 diabetes mellitus (T2DM). While recent studies imply a clinically relevant and potential biomarker role of circulatory miRNAs in the etiology of T2DM, there is lack of data on this aspect in Indians--an ethnic population characterized to represent 'Asian Indian phenotype' known to be more prone to develop T2DM and cardiovascular disease than Europeans. We performed global serum miRNA profiling and the validation of candidate miRNAs by qRT-PCR in a cohort of subjects comprised of normal glucose tolerance (NGT), impaired glucose tolerance (IGT) and patients with T2DM. Our study revealed 4 differentially expressed miRNAs (miR-128, miR-130b-3p, miR-374a-5p, miR-423-5p) in subjects with IGT and T2DM patients compared to control subjects. They were positively or negatively correlated to cholesterol levels, HbA1C, HOMA-IR and fasting insulin. Interestingly, circulating level of miR-128 and miR-130b-3p were also altered in serum of diet-induced diabetic mice compared to control animals. Among the altered circulating miRNAs, miR-128 had never been described in previous studies/populations and appeared to be a 'New Lead' in Indians. It was positively correlated with cholesterol both in prediabetic subjects and in diet-induced diabetic mice, suggesting that its increased level might be associated with the development of dyslipedemia associated with T2DM. Our findings imply directionality towards biomarker potential of miRNAs in the prevention/diagnosis/treatment outcomes of diabetes.

Exploring novel mechanisms of insulin resistance and Type 2 diabetes using miRNA and RNAi technologies

The nutshell finding of this study is that miRNAs contribute to the disease mechanism(s) underlying insulin resistance and type 2 diabetes and our study gave directionality for the identification novel drug targets. *This is by far the first report in India on differentially expressed 'myomiRs' in human skeletal muscle not only from patients with Type 2 diabetes but also in prediabetic individuals* (Figure 2). Microarry study revealed that certain muscle-specific miRNAs (myomiRs) were downregulated in skeletal muscle not only from Type 2 diabetes patients but also in prediabetic subjects. The downregulation of myomiRs in skeletal muscle from diabetic subjects compared to controls was also validated in real-time PCR experiments. *A sub-study also revealed impairment of an immunomiR viz., miR-146a which links subclinical inflammation, insulin resistance and poor glycemic control in patients with Type 2 diabetes.*

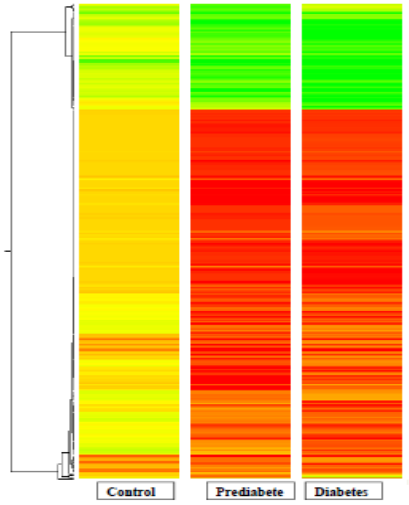
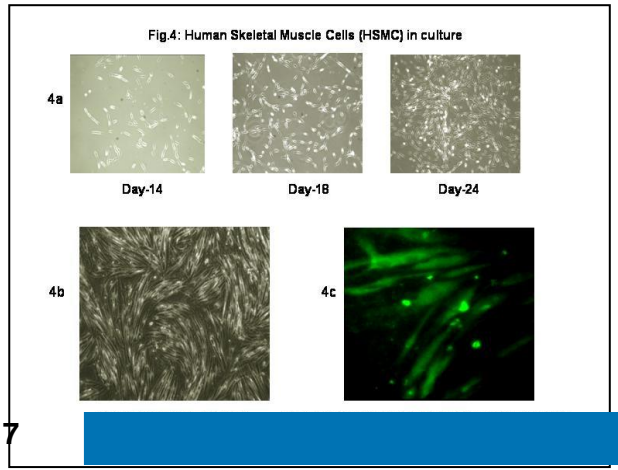


Figure: Human skeletal muscle microarray- Cluster diagram showing differentially expressed miRNAs in control, pre-diabetes and diabetic individuals

Gene expression profiling in target tissues (skeletal muscle / fat) to identify genetic factors contributing to the predisposition of Type 2 diabetes

Human Skeletal Muscle Cell (HSMC) culturing for insulin signaling studies and identification of novel drug targets: As a prerequisite to several molecular investigations, a) standardization of skeletal biopsy procedure, b)



standardization of skeletal muscle culturing, c) characterization of skeletal muscle culture, d) standardization of glucose uptake in human skeletal muscle cells (HSMCs) were accomplished at the Cell and Molecular Biology department of the Madras Diabetes Research Foundation, Chennai.

To our knowledge, our study is of its first kind in the country. The advantage here is that muscle cells from different individuals [healthy individuals, subjects with impaired glucose tolerance (prediabetes) and patients with Type 2 diabetes] can be grown and studied under controlled experimental conditions, minimizing the influence of environmental factors. Therefore, these cells are a useful tool to search for primary defects in skeletal muscle insulin signaling aspects. Intrinsic defects in insulin receptor signaling and down-stream molecular players could be identified and the mechanisms of these abnormalities will be subjected to in-depth molecular investigations. A pilot study indicated that insulin-stimulated glucose transport in patients with type 2 diabetes was 55% lower compared to that in control subjects. *Pilot microarray studies utilizing human subcutaneous and visceral fat biopsies also revealed differentially expressed genes and their functional defects in patients with Type 2 diabetes.*

High-fructose diet is as detrimental as high-fat diet in the induction of insulin resistance and diabetes mediated by hepatic/pancreatic endoplasmic reticulum (ER) stress.

In the context of high human consumption of fructose diets, there is an imperative need to understand how dietary fructose intake influence cellular and molecular mechanisms and thereby affect β-cell dysfunction and insulin resistance. While evidence exists for a relationship between high-fat-induced insulin resistance and metabolic disorders, there is lack of studies in relation to high-fructose diet. Therefore, we attempted to study the effect of different diets viz., high-fat diet (HFD), high-fructose diet (HFS), and a combination (HFS + HFD) diet on glucose homeostasis and insulin sensitivity in male Wistar rats compared to control animals fed with normal pellet diet. Investigations include oral glucose tolerance test, insulin tolerance test, histopathology by H&E and Masson's trichrome staining, mRNA expression by real-time PCR, protein expression by Western blot, and caspase-3

activity by colorimetry. Rats subjected to high-fat/fructose diets became glucose intolerant, insulin-resistant, and dyslipidemic. Compared to control animals, rats subjected to different combination of fat/fructose diets showed increased mRNA and protein expression of a battery of ER stress markers both in pancreas and liver. Transcription factors of β-cell function (INSIG1, SREBP1c and PDX1) as well as hepatic gluconeogenesis (FOXO1 and PEPCK) were adversely affected in diet-induced insulin-resistant rats. The convergence of chronic ER stress towards apoptosis in pancreas/liver was also indicated by increased levels of CHOP mRNA & increased activity of both JNK and Caspase-3 in rats subjected to high-fat/fructose diets. Our study exposes the experimental support in that high-fructose diet is equally detrimental in causing metabolic disorders.

Improvement of glucose tolerance and insulin sensitivity by probiotic strains of Indian gut origin in high-fat diet fed C57/BL/6J mice

Diabetes and obesity are characterized by glucose intolerance, fat deposition, inflammation and dyslipidemia. Recent reports postulated that distinct gut microbiota alterations were observed in obese/diabetic subjects and modulating gut microbiota beneficially through specific probiotics could be a potential therapeutic option for type 2 diabetes/obesity. Therefore, we attempted to study the efficacy of probiotics of Indian gut origin (Lactobacillus plantarum MTCC5690 and L. fermentum MTCC5689) along with a positive control, L. rhamnosus (LGG) on glucose/lipid homeostasis in high fat diet induced diabetic animal model. C57BL/6J male mice were divided into 7 groups (n= 6 per group) comprising feeding on: 1) Normal Pellet Diet (NPD), 2) High Fat Diet (HFD), 3) HFD with LGG , 4) HFD with MTCC5690, 5) HFD with MTCC5689, 6) HFD with Metformin and 7) HFD with Vildagliptin for a period of 6 months. Biochemical markers, glucose tolerance, insulin resistance and GLP-1 were assessed by standard protocols. Gut integrity was measured by intestinal permeability test. Transcriptional levels of tight junction proteins (TJPs) were probed in small intestinal tissues while inflammatory signals studied in visceral adipose tissue. Mice fed with HFD became insulin resistant, glucose intolerant, hyperglycemic and dyslipidemic. Diabetic mice were characterized to exhibit

decreased levels of GLP- 1, increased gut permeability, decrease in the gene expression patterns of intestinal tight junction markers (Occludin and ZO-1), increased proinflammatory gene markers (TNFα& IL6) in visceral fat along with decreased mRNA expression of FIAF and adiponectin. Probiotic interventions (most prominently the MTCC5689) resisted insulin resistance and development of diabetes in mice under HFD feeding and beneficially modulated all the biochemical and molecular alterations. The standard drugs such as metformin and vildagliptin also offered similar benefits. Native probiotic strains MTCC 5690 and MTCC 5689 appear to have potential against insulin resistance and type 2 diabetes with mechanistic mode of actions.

Altered immunometabolism at the interface of increased endoplasmic reticulum (ER) stress in patients with type 2 diabetes.

The mechanism of perturbed immune function in patients with T2DM is poorly understood. Recent studies imply a role for ER stress in linking immune-system alterations and metabolism. Here, we investigated whether ER stress markers and its downstream effector signals are altered in patients with type 2 diabetes along with proinflammatory augmentation. In our study, gene and protein expression of ER stress markers (GRP-78, PERK, IRE1α, ATF6, XBP-1 and CHOP) was elevated significantly ($P < 0.05$) in PBMCs from T2DM patients compared with control subjects. The mRNA expression of both the proinflammatory cytokines (TNF-α and IL-6) and oxidative stress markers (p22(phox), TXNIP, and TRPC-6; $P < 0.05$) was also increased in PBMCs from patients with T2DM. SOCS3 mRNA expression was reduced significantly ($P < 0.05$) in diabetes patients. mRNA expression of most of the ER stress markers from PBMCs correlated significantly and positively with poor glycemic control, dyslipidemia, IR, and inflammatory and oxidative stress markers. Chronic ER stress in PBMCs from patients with T2DM was evident from the increased caspase-3 activity ($P < 0.01$), which is an executioner of apoptosis. Along with an impairment of miR-146a levels, the downstream targets of miR-146a, viz., IRAK1 and TRAF6 mRNA levels, were also elevated significantly ($P < 0.01$) in

patients with T2DM. There was an inverse relationship among miR-146a levels and ER stress markers, inflammatory markers, and glycemic control. We demonstrate evidence of increased ER stress markers with impaired miR-146a levels and increased proinflammatory signals in patients with type 2 diabetes.

SEAP activity serves for demonstrating ER stress induction by glucolipotoxicity as well as testing ER stress inhibitory potential of therapeutic agents.

Endoplasmic reticulum (ER) stress is emerging as a unifying paradigm and one of the underlying mechanisms in the genesis of diabetes and its complications. While this has prompted the development of ER stress inhibitors, there is a limitation in monitoring of ER stress in vitro and in vivo by reliable methodologies. We validated the secreted alkaline phosphatase (SEAP) activity as a surrogate marker of ER stress in mouse β-TC6 cells exposed to glucolipotoxicity or tunicamycin and studied insulin secretion along with alterations in ER stress markers. SEAP activity assay was measured using the Great EscAPe SEAP kit, insulin levels were determined by Mercodia reagents and mRNA expression of ER stress markers was quantified by real-time PCR. SEAP activity in β-cells was significantly decreased (indicating increased ER stress) on exposure either to glucolipotoxicity or tunicamycin. This was accompanied by an increased mRNA expression of ER stress markers (GRP-78, PERK, IRE1α, ATF6, XBP-1, and CHOP) and decreased insulin secretion. Treating the cells with phenylbutyric acid normalized SEAP activity, decreased mRNA expression of ER stress markers and improved insulin secretion. Interestingly, cells exposed to different classes of anti-diabetes agents or compounds such as resveratrol resisted ER stress. Methylglyoxal also induces ER stress and this was counteracted by aminoguanidine. Out study demonstrates SEAP activity as a novel ER stress monitoring assay to investigate the therapeutic value of agents with ER stress inhibitory potential. Future studies should focus on the exercise of adopting this reporter assay for high-throughput screening mode of drug discovery.

Programming stem cells towards pancreatic beta cells / insulin secreting cell types with a special focus on physiological and functional characterization

Diabetes mellitus is a metabolic syndrome characterized by increased levels of blood glucose. Type 1 and type 2 diabetic patients suffering from defective insulin secretion rely on lifelong substitution with exogenous administration of insulin. Therefore, the curative therapy for diabetes mellitus mainly implies replacement of functional insulin-producing pancreatic β cells, with pancreas or islet-cell transplants. Pancreatic islet transplantation has demonstrated that long-term insulin independence may be achieved in patients suffering from diabetes mellitus type 1. However, because of limited availability of islet tissue and shortage of donor organs, new sources of insulin producing cells that are responsive to glucose are required. Development of pancreatic beta-cell lines from rodent or human origin has progressed slowly in recent years. Current experiments for ex vivo expansion of beta cells and in vitro differentiation of embryonic and adult stem cells into insulin producing beta-cell phenotypes led to promising results. Nevertheless, these cells have been shown to lack important characteristics of mature beta cells and generally display reduced insulin secretion and loss of proliferative capacity. Moreover, efficient generation of mature pancreatic β-cells with complete functional capabilities has not yet been accomplished. Therefore, much better understanding of the mechanisms that regulate expansion and differentiation of stem/progenitor cells is necessary. While several protocols for differentiating embryonic stem cells/adult mesenchymal stems cells to pancreatic beta cells have been well studied, what is lacking is the physiological and functional characterization of these cells. Therefore, this study is aimed at differentiating human embryonic stem cells/adult mesenchymal stem cells towards programming of pancreatic beta cells and characterizing them for functional read-outs with a focus on beta-cell biology. While most studies conducted to-date only concentrated on glucose responsive insulin secretion as a functional read-out, we plan to study a battery of functional assays along with glucose responsive secretion which include: Calcium dependency, K+ dependency, ATP:ADP ratio levels, Mitochondrial depolarization, Resistance to oxidative stress, ER stress, Telomerase activity, DNA repair activity, Epigenetic markers etc. The differentiated and the programmed β-like cells obtained from human embryonic stem cells and adult mesenchymal stem cells respectively, will be maintained in culture and tested for the physiological and molecular functions on Day 0, Day 7 and Day 15.

Moreover, these cells will be stored in liquid nitrogen for a period of 1-3 months and then cultured and tested for the above physiological and functional intricacies. The innovative functional characterization approach planned in this study would position the differentiated and programmed beta cells as highly qualified cell products for transplantation purposes and replacement therapy for diabetes.

Molecular biomarker role of chemokines in Diabetic Retinopathy: Discovery of new molecular entities with adequate clinical activity for diabetic retinopathy (DR) remains one of the key research priorities in ophthalmology. The study of chemokines/chemokine receptor signaling in retinal microvasculature in diabetes (holistically planned utilizing clinical samples, pre-clinical animal models and cell culture studies) in this project is expected to provide new insights into the role of chronic inflammation as well as pave way for a new therapeutic approach for diabetic retinopathy. MCP-1 and Cathepsin-D – new biomarkers for diabetic retinopathy: Our pilot study demonstrated increased serum levels of MCP-1 in the natural history of diabetes and its progression to NPDR and PDR. Compared to control subjects, patients with NPDR and PDR exhibited significantly ($p<0.001$) increased levels of MCP-1. Our pilot studies also revealed a serendipitous finding in that cathepsin-D levels were significantly increased in patients with type 2 diabetes and also with NPDR and PDR compared to control subjects. While elevated expressions of cathepsins and diminished levels of their inhibitors have been observed in several human cancers, our study is the first of its kind to report elevated levels of cathepsin-D in the context of diabetic retinopathy. Both MCP1 and cathepsinD levels were positively correlated with poor glycemic control in the study subjects. The association of increased levels of MCP-1 in diabetic patients as well as in patients with NPDR and PDR was seen persistent even after adjusting for all the confounding factors, implying a definite biomarker role of MCP-1 in the natural history of diabetic retinopathy.

MicrobDiab - Studies of interactions between the gut Microbiome and the human host biology to elucidate novel aspects of the pathophysiology and pathogenesis of type 2 Diabetes

Studies to dissect out the relationship among Gut microbiota, Inflammation, adipokine and metabolic hormonal alterations and Type 2 diabetes: The connection between gut microbiota and energy homeostasis and inflammation and its role in the pathogenesis of diabetes and its complications are increasingly recognized. Metabolic pathways are functionally integrated with immune responses, and studying the relevance of the innate immune system for the pathogenesis of diabetes is a thrust area of research investigation. Information derived from several studies reveal that intestinal homeostasis and inflammation are driven by cellular elements and innate-type soluble mediators that mediate both processes, with several cytokines/chemokines exhibiting opposing roles, depending upon the specific setting and disease phase. Similarly, alterations in adipokines and metabolic hormones were reported in aubjects with different levels of glucose tolerance and intolerance. There is lack of holistic data on the above parameters in the Indian context. Therefore, we decided to take advantage of probing the **'panel of cytokines', 'panel of adipokines' and 'panel of metabolic hormones'** using the Luminex multiplex Array.

Mentoring Projects done with the Young Scientist, Dr.Shiny Abhijit

Coordinated augmentation of NFAT and NOD signaling mediates proliferative VSMC phenotype switch under hyperinsulinemia: Although hyperglycemia has been demonstrated to play a significant role in the vascular disease associated with type 2 diabetes, the mechanisms underlying hyperinsulinemia mediated vascular dysfunction are not well understood. We have analyzed whether hyperinsulinemia could activate NFAT (Nuclear factor of activated T cells) signaling and thereby influence vascular smooth muscle cell (VSMC) migration and proliferation, a major event in the progression of atherosclerosis. Human aortic VSMCs upon chronic insulin treatment exhibited increased expression of NFATc1 both at the mRNA and protein levels. The mechanistic role of NFAT in VSMC migration and proliferation was examined using

11R-VIVIT, a cell permeable NFAT specific inhibitor, where it reduced the insulin effect on VSMC, which was further substantiated by over expression or silencing of NFATc1gene ($p < 0.05$). This study also report for the first time the role of NFAT in NOD (Nucleotide oligomerization domain) mediated innate immune signaling and its significance in insulin effect on VSMCs. mRNA expression of NOD was up regulated when cells were treated with insulin or ligands whereas pretreatment with 11R-VIVIT reversed this effect ($p < 0.05$). Our study uphold the clinical significance as we observed an increased mRNA expression of NFATc1 in monocytes isolated from patients with type 2 diabetes which correlated positively with insulin resistance and glycemic load ($p < 0.05$). This study suggests that targeted NFAT inhibition can be an effective strategy to coordinately quench insulin induced proliferative and inflammatory responses along with innate immunity alterations in vascular smooth muscle cells, which underlie atherosclerosis.

Hyperinsulinemia-induced vascular smooth muscle cell (VSMC) migration and proliferation is mediated by converging mechanisms of mitochondrial dysfunction and oxidative stress: Atherosclerosis is one of the major complications of diabetes and involves endothelial dysfunction, matrix alteration, and most importantly migration and proliferation of vascular smooth muscle cells (VSMCs). Although hyperglycemia and hyperinsulinemia are known to contribute to atherosclerosis, little is known about the specific cellular signaling pathways that mediate the detrimental hyperinsulinemic effects in VSMCs. Therefore, we investigated the cellular mechanisms of hyperinsulinemia-induced migration and proliferation of VSMCs. VSMCs were treated with insulin (100 nM) for 6 days and subjected to various physiological and molecular investigations. VSMCs subjected to hyperinsulinemia exhibited increased migration and proliferation, and this is paralleled by oxidative stress [increased NADPH oxidase activity, NADPH oxidase 1 mRNA expression, and reactive oxygen species (ROS) generation], alterations in mitochondrial physiology (membrane depolarization, decreased mitochondrial mass, and increased mitochondrial ROS), changes in mitochondrial biogenesis-related genes (mitofusin 1, mitofusin 2, dynaminrelated protein 1, peroxisome proliferator-activated receptor gamma coactivator 1-alpha, peroxisome

proliferator-activated receptor gamma coactivator 1-beta, nuclear respiratory factor 1, and uncoupling protein 2), and increased Akt phosphorylation. Diphenyleneiodonium, a known NADPH oxidase inhibitor significantly inhibited migration and proliferation of VSMCs and normalized all the above physiological and molecular perturbations. This study suggests a plausible crosstalk between mitochondrial dysfunction and oxidative stress under hyperinsulinemia and emphasizes counteracting mitochondrial dysfunction and oxidative stress as a novel therapeutic strategy for atherosclerosis.

DEPARTMENT OF MOLECULAR GENETICS

"Genetic risk factors have the potential to predict right from the womb"

Executive Scientific Officer & Head

Dr. Radha Venkatesan

Scientists

Dr. S. Kanthi Mathi

Dr. D. Bodhini

Dr.M.Chidambaram

Dr. K. Balamurugan

Ph. D Students

Ms. K. Jahnavi

Ms. Liju Samuel

Mr. V. Gnana Prakash

Mr. S.Gopi

Ms. B. Kavitha

Research Assistants

Ms. P. Gayathri

Mr. N. Sathish

Ms. A. Nithya

Ms. N. Chitra

The department of molecular genetics was established in December 1999 with the goal of unravelling the genetics of diabetes and its complications, cardiovascular diseases and obesity. The department carries out research on molecular and functional genomics supported by competitive funding from various agencies including the ICMR, DBT and DST. The department has published many papers in peer reviewed journals like Nature Genetics, Human Genetics, Clinical Genetics, Metabolism, Journal of Clinical Endocrinology & Metabolism, Diabetic Medicine, Diabetes Care, Metabolism Clinical and Experimental, Eye, American Journal of Cardiology, Diabetes etc.

Vision

To find genes that cause/ predispose to diabetes using genomic techniques and to understand the molecular basis of diabetes and related traits in order to form a rational platform for the improved diagnosis and treatment of patients.

Mission

To contribute to the discovery, identification and characterisation of the genes involved in monogenic and polygenic forms of diabetes and their intermediate phenotypes.

Facilities

The department is equipped with state-of-the-art equipment that includes

- ***Sequenom MassARRAY*** a high throughput platform for SNP genotyping, DNA methylation and gene expression analysis.
- ***Illumina iScan microarray*** is used for gene scan, gene finding, SNP analysis, methylation and gene expression studies.
- ***ABI 3500 & 310 Gene Sequencer*** automated eight and single-capillary genetic analyzer respectively for sequencing and fragment analysis applications. This is the golden standard for finding the novel gene variants.
- ***Sequencing detecting system (RT-PCR)*** for allele discrimination assays and for gene expression studies
- ***Microplate Luminometer*** - luminescence detection system for expression studies including reporter assays
- ***Electroporator*** for express delivery of nucleic acids, vector constructs into cells.

Current Activities of the Department

Our main thrust area aims at gene discoveries in diabetes mellitus. There are ***seven ongoing projects*** currently on various aspects of genetics of diabetes. The molecular basis of genes that are implicated in insulin secretion and insulin resistance are being studied. In addition to these known genes, identification of novel genes is being carried out using GWA studies. The major ongoing activities in the department are:

- Novel gene discovery pertaining to Maturity Onset Diabetes of the Young (MODY) in India using exome sequencing approach. 2 new genes have been discovered by us with the collobration of Genentech Inc. USA and Medgenome, India. This is an unique contribution which is one of its kind in the country.

- A gene chip (MDRF- Medgenome Chip) has been designed by us with 29 genes, which includes 13 MODY genes and genes implicated in NDM and syndromes. Genetic testing for all the MODY subtypes being performed using next generation sequencing method (exome sequencing) for the suspected MODY patients.

- Identification of known and novel mutations causing monogenic forms of diabetes such as Maturity Onset Diabetes of the Young (MODY) and neonatal diabetes using Sanger sequencing method and understanding the functional significance of our novel and significant findings. This department has been recognized as a referred center by ICMR for genetic diagnosis of monogenic diabetes in India.

- Functional characterisation of mutations identified by us are being carried out to understand the mechanism of gene action in monogenic diabetes.

- Identification of novel genes for microvascular complications of diabetes using whole genome approach is currently in progress.

- Finding novel genes that are responsible for causing type 2 diabetes and its complications using high throughput technology.

- Metagenomic studies of gut microbiota in type 2 diabetic subjects are being caried out in colloboration with Novo Nordisk Foundation Center, Denmark and other centres of India – THSTI, TCS.

- Study on the molecular genetic basis of genes that are implicated in insulin secretion and insulin resistance.

- Identification of genetic determinants of diabetic nephropathy in south Indian population.

- Study on the genomics of Gestational Diabetes Mellitus (GDM) in South Indian Women.

- Offering diagnostic molecular genetic testing in order to improve the management of MODY and neonatal diabetes. A website "NEONATAL AND MONOGENIC DIABETES REGISTRY INDIA" ***http://www.neonataldiabetes.in*** has been created in this regard. Through this website doctors can get a neonatal or a MODY case registered in this website and also request the MODY and NDM genetic testing for their patients.

- Provides shared access to specialized technical resources and expertise in relation to genomics of diabetes, thereby recognised as a nodal centre through out the country.

- Training offered to scientific personnel leading to capacity building and development of basic infrastructure for carrying out genomic research related to diabetes.

Ongoing Projects :

1. *DBT Project:* DBT Programme support for research in diabetes: "Search for susceptibility genes for type 2 diabetes in Indians" (2008-2013)

Investigators : Dr. Radha Venkatesan and Dr. V. Mohan

OBJECTIVE 1

To investigate, in the CURES population at Chennai, (with a plan to later extend to other populations and regions in India) the role of recently described novel genes such as Transcription factor 7-like 2 (TCF7L2) gene, Adiponectin Receptor gene and Carboxyl Ester Lipase (CEL) gene that have been shown to be good candidate genes for type 2 diabetes in Europeans.

- the rs10885390T/A polymorphism of *TCF7L2* gene and rs12733285 C→T polymorphism of the *ADIPOR1* gene was significantly associated with type 2 diabetes among the study subjects.

OBJECTIVE 2

To evaluate the functional implications of the significant SNPs which were identified in the previous project by functional studies such as transfection assays and cloning, wherever relevant.

- Transcriptional transactivation assays indicates the presence of Thr394Thr (G→A) polymorphism in PGC1a could not cause any functional impacts on transactivation function. Results are not comparable and showed statistically not significant association when analysed with control PGC1a expression.

OBJECTIVE: 3

To perform genome wide scan using 400 microsatellite markers spaced at 10cM in order to identify novel susceptible Type 2 diabetes gene in Indians based on study of families with several affected members.

- The Principal Component Analysis (PCA) was performed to understand the population structure. The Principal Components were estimated based on the genotype data from 56037 SNPs which was obtained by performing pilot GWAS on 48 samples. Between the 24 cases and 24 controls, no population stratification was detected. Our results show distinctive difference in South Indian population compared to the others. It was closer to CEPH compared to Japanese and Han Chinese population. Further refinement in the analysis will throw more light on the different aspects of South Indian population.

2. *ICMR Project :* "Genetic Analysis of Maturity Onset diabetes of young (MODY) and neonatal diabetes in India" (2010-2013)

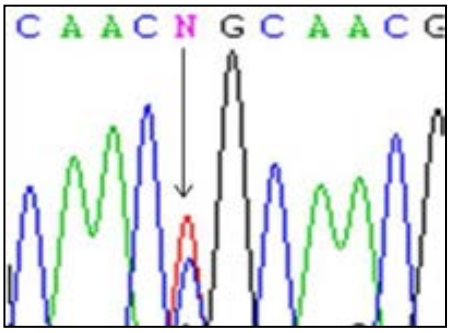
Investigators : Dr. Radha Venkatesan, Dr. S. Kanthi Mathi and Dr. V. Mohan

The objective of the project is

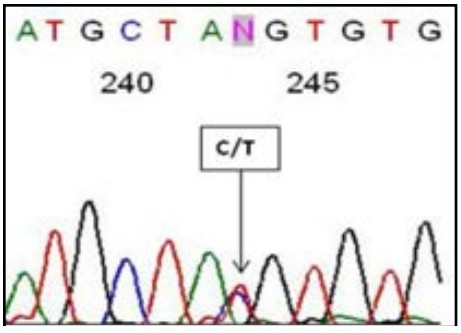
- Screening and analysis of genes implicated in MODY in India
- Screening and analysis of genes implicated in neonatal diabetes in India

Genes related to Maturity Onset Diabetes of the Young, Early Onset type 2 diabetes and neonatal diabetes were studied in this research project. So far, a total of 48 MODY mutations [12- MODY1, 4- MODY2, 23- MODY3, 8- MODY5 and 1-MODY12] were identified in clinically diagnosed MODY patients. We also identified 20 mutations (9.3%) in *KCNJ11* gene, 43 mutations in *ABCC8* gene (20%) and 10 mutations in insulin gene (5%) in patients with neonatal diabetes and hyperinsulinemia, from various hospitals in India. However in 65% of the NDM patients we were unable to detect any mutation. In total, 18 mutations has been identified in different genes (*EIF2AK3, INSR*, *WFS1*, *SLC2A2*) implicated in various monogenic syndromes. Overall, 37 novel mutations has been identified in this project (13 in MODY, 19 in NDM and 5 in patients with monogenic syndromes).

Discovery of the mutations like C42R, R201C and Arg50Cys in *KCNJ11* and V86A, Pro254Ser and Gln1224His in *ABCC8* gene in our NDM patients made it possible to switch over nine children from insulin treatment to oral sulfonylurea drugs.



Cys42Arg (C42R) mutation in *KCNJ11* gene



Arg201Cys(R201C) mutation in *KCNJ11* gene

We have created a website “NEONATAL AND MONOGENIC DIABETES REGISTRY INDIA” http://www.neonataldiabetes.in. Through this website doctors can get a neonatal or a MODY case registered in this website and also request the MODY and NDM genetic testing for their patients.

3. ***ICMR Project:*** **"Diabetes: Genetic Susceptibility in the Asian Indian Population". MDRF- University of Minnesota, USA., collaboration project (2011-2013)**

Investigators : Dr. V. Mohan and Dr. Radha Venkatesan (MDRF)
Dr. Myron Gross Dr.Nathan Pankratz, Dr.Dan Stram and
Dr. Kenneth Beckman (University of Minnesota, USA)

The aim of the project is identification of genetic risk factors for type 2 diabetes in the Asian Indian population using targeted sequencing of genes implicated in GWAS. The long term objective of the project is to establish international research collaboration which will subsequently interact in the performance of future genome-wide association study (GWAS) and exome sequencing studies.

GWAS identified SNPs were mainly selected for the study. Nearly 40 gene loci comprising of 3.7 MB region from the previously published GWAS were sequenced in 100 young onsets T2D and 100 age matched controls using HiSeq2000 (Illumina Inc., San Diego, CA). The subsequent sequencing and Bioinformatics analyses have yielded nearly 16,000 variants of which some of them are novel and others are known SNPs. From the 16,000 variants identified in sequencing, about 200 SNPs were evaluated in a second population comprising of 1000 young onsets T2D and 1000 age matched controls for validation of the initial finding and their association with early onset T2DM by using Sequenom.

4. ***DST Project*** **: "Replication of Novel type 2 diabetes genes in Early onset type 2 diabetes" (2011-2014)**

Investigators : Dr. Radha Venkatesan
Dr. V. Mohan

New strategies in the form of Genome Wide Association Study (GWAS) have empowered investigators to find novel disease genes. Earlier studies from our centre as well as other groups have identified important differences in the genetics of T2DM

in India. As the recently identified new diabetes genes have not been studied in Indians, it is important to undertake such studies. Therefore our main objective in the present study is to perform an association study of the newly identified diabetes genes in our young Indian in comparison with late onset type 2 diabetes. This study could help us to explain the increased the susceptibility of Indians to diabetes and solve the puzzle of the Asian Indian phenotypes. The main objective of the project is to understand the role of recently discovered type 2 genetic variants and also other known gene variants which are implicated in young onset type 2 diabetes in T2DM-Y of Asian Indians. Eighty four SNPs were genotyped in 800 young onsets T2D and 800 age matched controls by using Sequenom.

5. ***DBT Project:*** **"MicrobDiab - Studies of interactions between the gut Microbiome and the human host biology to elucidate novel aspects of the pathophysiology and pathogenesis of type 2 Diabetes" (2013-2017)**

Investigators : Dr. V. Mohan (PI), Dr. Radha Venkatesan (Co-PI),
Dr. M. Balasubramanyam (Co-PI) and Dr. R. M Anjana (Co-PI)
Prof. Oluf B Pedersen, (PI), Prof. Torben Hansen, (Co-PI)
Dr. Henrik Vestergaard (Co-PI) (University of Copenhagen, Denmark)

The incidence of Type 2 Diabetes (T2D) increases at a pandemic scale and is accompanied by severe organ damages, which results in enormous costs on the health care systems and lowers the quality of life and life expectancy of millions of people in India and Denmark. Recent research indicates that altered gut microbiota composition and function may be involved in the pathogenesis of T2D and its co-morbidities. Therefore, there is a strong rationale to explore whether interactions between the gut microbiota as evaluated at the collective microbial genome level (the microbiome) and the host biology can provide novel insights into the pathophysiology and pathogenesis of pre-diabetes and T2D.

Overall objectives:

To identify gut microbiome signatures in Indian and Danish study participants which associate with pre-diabetes and T2D thereby enabling development of novel biomarkers for early diagnosis of people at high risk of progression to overt T2D.

Specific Objectives:

1. Perform extensive phenotyping of 150 glucose tolerant individuals and 150 persons with pre-diabetes and 150 T2D patients from India and Denmark, respectively; a total of 900 individuals.
2. Identify phenotype-specific gut microbiome profiles at microbial gene and taxa levels.
3. Characterize both common and ethnic specific gut microbiome patterns, and examine how they associate with the glucose tolerance state, insulin sensitivity, insulin secretion, inflammation markers, blood metabolomics, circulating microbial non-coding RNA and blood group markers.
4. Develop and validate microbiome markers that discriminate between individuals having the various degrees of glucose tolerance.

We have obtained demographic details, family history, food habit questionnaire, dietary record sheet, physical activity details from each study subjects. Whole blood, serum (fasting), serum (2hr), incretin, buffy Coat, plasma, saliva, urine and stool were collected for biochemical analysis. We standardized the INRA method in our lab and we have isolated bacterial genomic DNA from fecal samples for 16S Sequencing.

6. Role of *CNDP* gene variants in diabetic nephropathy (funded by DST under WOSA & MDRF under MIRF)

Investigators : Dr. D. Bodhini
Dr. Radha Venkatesan (Mentor)

Background and objectives:

Several genome-wide linkage studies have shown an association between diabetic nephropathy and a locus on chromosome 18q which harbors the genes *CNDP1* and *CNDP2*. Genetic variants in these genes have been linked to nephropathy in other populations. Carnosinase encoded by these genes degrades carnosine (β-alanyl-L-histidine) and has been ascribed a renal protective effect. Based on this background, this study was carried out to assess whether genetic variants in the *CNDP1* and *CNDP2* genes are associated with diabetic nephropathy in south Indian population. The study will also evaluate whether there is any correlation between the genetic factors and the levels of carnosinase.

Results:

Sequencing of the promoter and the entire coding region of the *CNDP1* and *CNDP2* genes in subjects with nephropathy (DN) and normal glucose tolerant subjects (NGT) revealed 24 genetic variants. The SNPs identified by sequencing were genotyped in NGT, DN and DM (type 2 diabetic subjects without nephropathy) groups using the Sequenom MassARRAY genotyping platform. The D18S880 variant found in *CNDP1* gene was genotyped by fragment analysis.

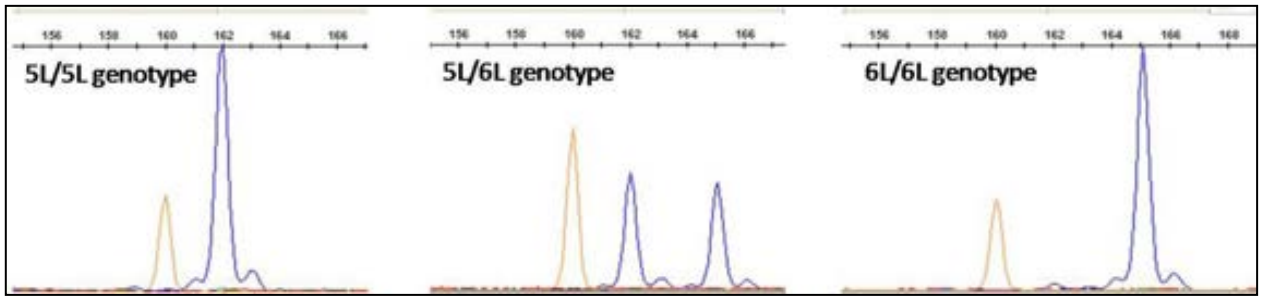


Fig. 1 Genotyping of D18S880 variant in the *CNDP1* gene by fragment analysis

Among the genotyped variants, the D18S880 microsatellite marker in *CNDP1* showed significant association with nephropathy. The D18S880 marker was found to have 5, 6 and 7 leucine (L) repeats and the 5L allele was found to be the major allele. Logistic regression under a recessive model showed that the odds ratio for DN was 0.85 (95%CI: 0.74-0.98; p= 0.031) for the 6L/6L genotype when compared with the 5L/5L and 5L/6L genotype after adjusting for potential confounders such as age, sex, BMI, HbA1c, duration of diabetes, systolic blood pressure and smoking

(**Fig. 2**). The finding gains importance as the D18S880 Leucine repeat is present in the signal peptide region of *CNDP1* gene which might play a regulatory role in the secretion of carnosinase. Measuring the levels of carnosinase in a sub-sample of subjects based on the genotyping results is underway. Evaluation of the correlation between the genotype and carnosinase levels will give a better picture on the role of this variant in diabetic nephropathy.

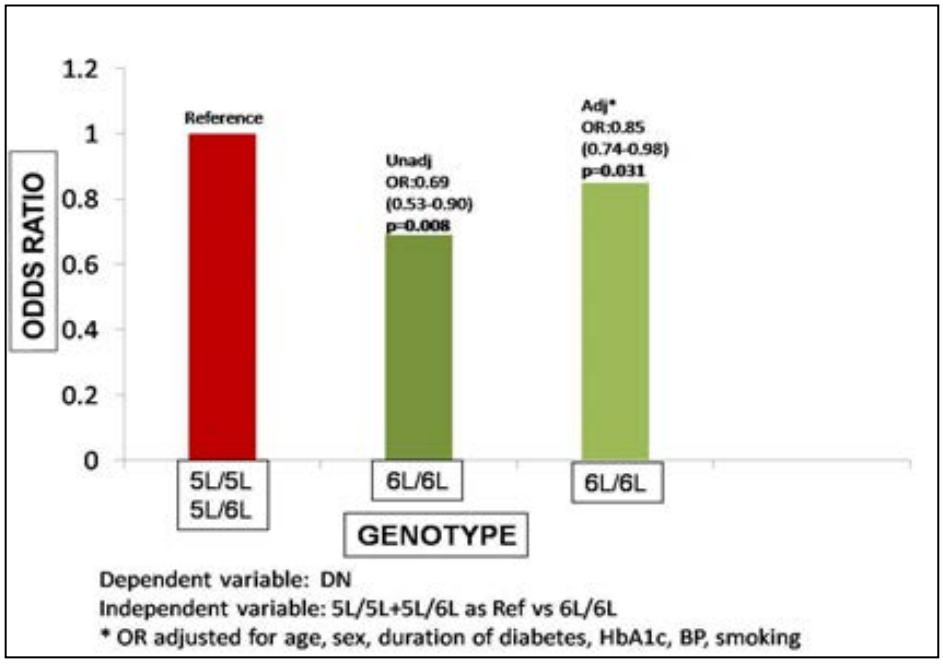


Fig. 2 Logistic regression analysis for association of D18S880 variant with DN

7. Identification and characterization of functional polymorphisms in the physiological dysglycemic peptide pancreastatin in an Indian population – DST Project (2014-2017)

Investigators : Dr. Radha Venkatesan (MDRF)
Dr.Nitish R Mahapatra (IIT Madras)

Identification of the natural variants of the dysglycemic pancreastatin peptide and to predict its association with type 2 diabetes disease states in an Indian population.

Department Intramural Projects - funded by MDRF under MIRF

1. **Identification of genetic determinants of diabetic nephropathy in south Indian population**

Investigators : Dr. D. Bodhini
Dr. Radha Venkatesan (Mentor)

Background and objectives:

GWA studies for nephropathy in type 2 diabetes in other populations have identified several novel loci for DN. The newly identified loci in these studies have not been replicated in Indian population. Hence, this study was designed to test the role of the newly discovered loci for DN through GWA studies and other known genetic variants for DN in south Indian population.

Results:

Six variants from *AUH, ELMO1, HMGA2, LIMK2, RPS12* and *SASH1* genes which were selected based on their association with nephropathy through genome wide association studies failed to show any association with nephropathy in this study. Some of the genetic variants shown to be associated with DN through case-control association studies in other populations were also replicated. Amongst them, the GG/GT genotype of rs12255372 SNP of the *TCF7L2* gene showed significant association with DN (OR: 2.02; 95% CI: 1.16-3.51, p=0.013) and DM (OR: 1.94; 95% CI: 1.36-2.78, p=0.0002) when the GG genotype was taken as reference. However, the allele/ genotype frequency was not significantly different between the DM and DN groups showing that the association of rs12255372 polymorphism in the *TCF7L2* gene with DN is not independent of diabetes (Communicated to *Annals of Human Genetics*).

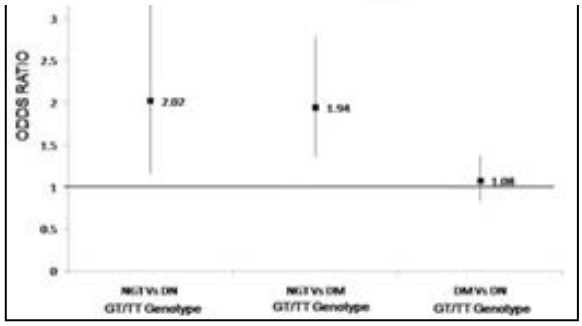


Fig. 3 Logistic regression analysis for association of rs12255372 *TCF7L2* variant with DN and DM

2. "Genomics of Gestational Diabetes Mellitus in South Indian Women"

Investigators : Dr. S. Kanthi Mathi

Dr. Radha Venkatesan

Background:

Evidence is also accumulating that susceptibility to GDM has a genetic component. Several studies including GWAS and meta-analysis reports have provided evidence that GDM and T2DM may share similar risk factors and genetic background. Recently, replication of T2DM associated genes identified in various GWA studies, have been carried out in GDM patients in different Asian populations from Korea, China and Malaysia but there is no data in Asian Indians, to be best of our knowledge. Though the genetics of T2DM has been extensively studied in the Asian Indians using different approaches such as (candidate gene and GWAS), GDM which is probably one of the early indicators of future occurrence of T2DM in women, has not been well studied in India. The methodology adopted for genotyping will be Sequenom MassARRAY. Identification of genetic variants associated with GDM will contribute to our understanding of the pathophysiology of GDM and to the development of prevention strategies. Moreover, the recognition of individuals with a genetic predisposition may help in prevention of recurrence of T2D in the future in these individuals through targeted intervention.

Objectives:

1. To study all the SNPs that has previously shown association with GDM in other populations.
2. To evaluate whether the recently identified SNPs that have shown association with T2D in our population (south India) also show association with GDM.

Results:

Among the various SNPs genotyped, rs7754840 and rs7756992 SNPs of *CDKAL1* gene were found to be associated with GDM in this south Indian population.

3. "Screening for HNF1B gene deletions in Indian Diabetic Patients with Renal Abnormalities"

Investigators : Dr. S. Kanthi Mathi

Dr. Radha Venkatesan

Background:

HNF1B gene (chr 17q12) plays a major role in kidney development and nephron differentiation and is also a critical regulator of a transcriptional network that controls the specification, growth and differentiation of the embryonic pancreas. Mutations in the transcription factor gene *HNF1B* have been known to cause Maturity-Onset Diabetes of the Young (MODY5 or *HNF1B*-MODY) which is associated with progressive non-diabetic renal dysfunction. The kidney disease may appear before the impairment of glucose tolerance. This has been recognized also as a discrete clinical syndrome, called RCAD (renal cysts and diabetes syndrome). By direct DNA sequencing method, so far, we have identified four different *HNF1B* gene mutations in 50 unrelated diabetic patients with renal abnormalities. Thereby, only ~8% of the clinically classified MODY5 subjects have HNF1B gene mutations. Earlier studies have shown *HNF1B* whole gene deletions accounts for 50% of *HNF1B*-MODY and most of them occurred de novo.

Objectives:

To investigate the prevalence of whole or partial *HNF1B* gene deletion mutations in this cohort of 50 Indian diabetic patients with various renal abnormalities.

Results:

The partial or whole gene deletion was tested using Multiplex ligation probe amplification assay (MLPA) in all study subjects (Figure 1). The fragment analysis revealed heterozygous whole gene deletion of exons 1-9 [Met1_Trp557del] in two unrelated patients. This is the first major study of *HNF1B*-MODY from India and shows that about 4% of diabetic subjects with renal abnormalities seen at a diabetes centre harbour whole gene deletion mutation.

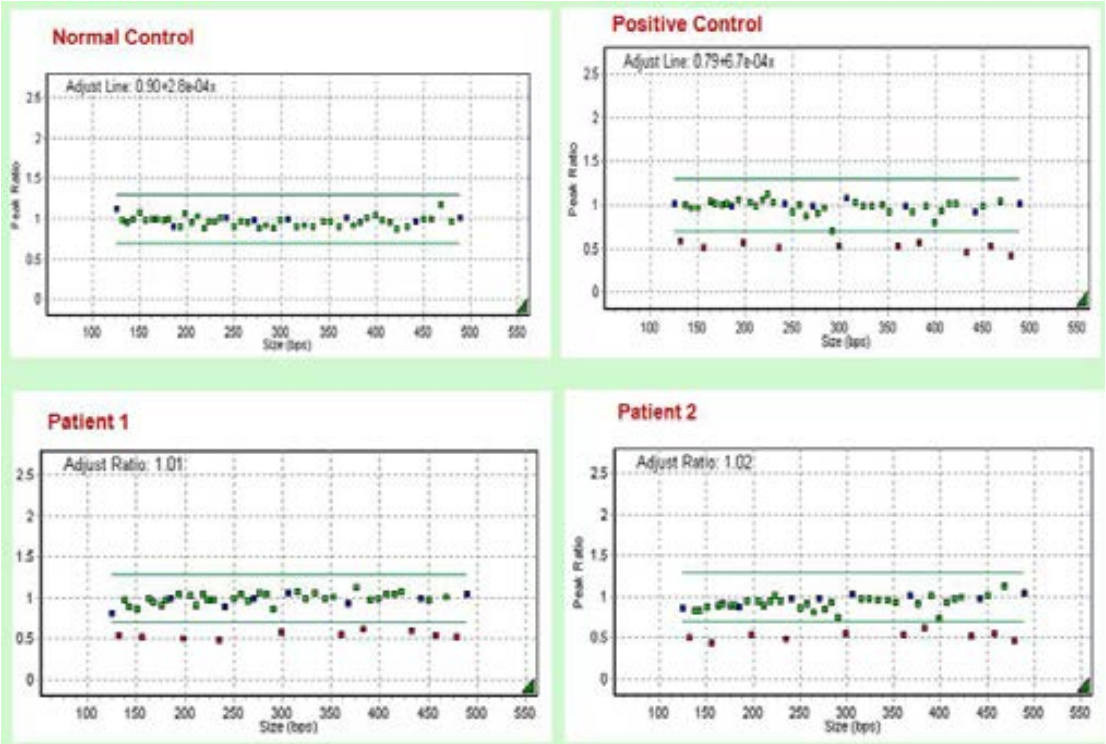


Figure 1: MLPA analysis of patients with whole *HNF1B* gene deletion. The horizontal bars within each panel are the boundaries for normal dosage ratios. Probes detected below this threshold indicate a deletion.

4. **"Functional characterization of the novel ABCC8 gene mutations in congenital hyperinsulimic patients in India**

Investigators : Mr. K. Balamurugan
Dr. Radha Venkatesan

Background:

Neonatal Diabetes Mellitus (NDM) is a monogenic form of diabetes and usually occurs within 6 months from birth.Infants with NDM produce insufficient amount of insulin by beta cells leading to an increase in blood plasma glucose and diabetes. NDM can be mistakenly diagnosed as a type 1 diabetes, but usually the latter occurs later than the first 6 months of life. Mutation in *ABCC8* and *KCNJ11*, which encode the ATP sensitive potassium channel subunits sulfonylurea receptor1 (SUR1) and inward rectifier potassium channel Kir6.2 respectively, are the most common cause of the disease. K-ATP channels are critical for coupling metabolic signal to electric signal in order to control insulin secretion in pancreatic beta cells. Structurally *ABCC8* gene consists of 39 exons (1581 amino acids) and it has two important nucleotide binding ATP domains namely NBD1 and NBD2. Mutations in these domains reduce the ATP/ADP binding sensitivity leading to a diseased condition. Recently, functional studies have demonstrated that these *ABCC8* and *KCNJ11* mutations cause diabetes by reducing the sensitivity of the K-ATP channel to ATP thereby preventing insulin secretion.

Objectives:

ATP - sensitive potassium channels in pancreatic β - cells couple cell metabolism to electrical activity to control insulin secretion. In this study we have examined the clinical and functional effect of novel *ABCC8* gene mutations located intracellular region in cytosol of topological domain associated with congenital hyperinsulinisms.

Results:

We identified five different novel mutations in the *ABCC8* gene encoding SUR1 protein causing congenital hyperinsulinism in Indian children. *In vitro* experiments showed a significantly decreased intensity of plasma membrane staining for L724P, L1454R mutants in SUR1 and improper cellular localization for V21fsX77, I89fsX98 and P206fsX267 mutants when compared to the wild type SUR1 in Cosm6 cells. The V21fsX77, I89fsX98 and P206fsX267 mutants in SUR1 showed completely reduced response to diazoxide ($P<0.01$), Where as L1454R and L724P showed an impaired gating function and slightly lowered response to potassium channel opener diazoxide. Our results suggest that the substitution of MODY13 mutations in ABCC8 gene which impairs potassium ATP channel gating function and reduced diazoxide drug response by a loss of function mechanism.

List of workshops conducted in the Department of Molecular Genetics (2012-2015):

- *"International workshop on Advanced Techniques in Genomics"* in collaboration with University of Minnesota, U.S.A., held between January 27th -30th, 2015 at MDRF, Siruseri centre.

- *"Workshop on Advanced Techniques in Genomics of Type 2 Diabetes"* in collaboration with University of Minnesota, U.S.A., held between January 21st - 24th, 2014 at MDRF, Siruseri centre.

We conducted two hands-on training programme in collaboration with University of Minnesota, U.S.A. Forty one delegates participated in these workshops who were at the level of Professors, doctors, Senior lecturers from University departments, PhD research scholars (in biological sciences) and post graduate students of various Universities. Dr. Myron Gross and Dr. Kenneth Beckman of University of Minnesota, U.S.A along with Dr. Daniel Stram, University of Southern California, U.S.A gave a series of lecturers and hands-on training in Sequenom MassARRAY, Illumina Microarray and statistical analysis to delegates. The other techniques (DNA sequencing etc) were trained by the junior faculties of MDRF.

WORKSHOP ON ADVANCED TECHNIQUES IN GENOMICS OF TYPE 2 DIABETES
(21st -24th January, 2014)

INTERNATIONAL WORKSHOP ON ADVANCED TECHNIQUES IN GENOMICS

(27th -30th January, 2015)

Genetics Team

DEPARTMENT OF RESEARCH BIOCHEMISTRY

"To study the influence of diabetes and CVD on biological molecules and identify biochemical risk markers that can serve as biomarkers for early detection of diabetes and CVD."

Scientist:

Dr. K.Gokulakrishnan

PhD Students:

Mr Gautam Kumar Pandey

Ms Kaviya Anand

Biomarkers Research Lab

Asian Indians have a greater predisposition to coronary artery disease [CAD], diabetes and insulin resistance. 'Pre-diabetes'/ impaired glucose tolerance [IGT] is a term used to differentiate individuals with high risk for developing diabetes and is an intermediate stage between normal glucose tolerance [NGT] and overt diabetic subjects. Recently it has been shown that the pre-diabetic stage is also an enhanced risk for CAD.

Our department is working mainly on the novel adipocytokines in relation to impaired glucose tolerance, obesity and their role in insulin signaling mechanisms and also elucidating the role of inflammation on macrophage-adipose tissue interaction. We are also engaged in research related to studying the biomarker role of miRNAs in relation to insulin action and vascular functions.

Vision

To study the influence of diabetes and cardiovascular disease (CVD) on biological molecules and identify biochemical risk factors that can serve as markers for diabetes and CVD.

Mission

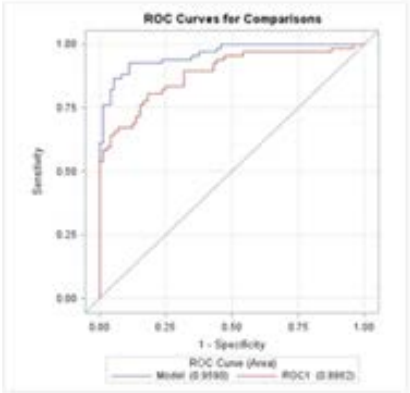
To identify new biomarkers associated with diabetes and its complications.

Current Activities of the Department:

A multidisciplinary approach is needed to understand the pathogenesis of type 2 diabetes: Understanding the integrated pathophysiology, initiating the development of insulin resistance and progressive beta cell deterioration should broaden our capacity to identify novel therapeutic targets for the prevention and/or treatment of T2DM. So we need to apply a multidisciplinary approach to study the pathogenesis of T2DM. As a prerequisite to study the proteomics & genomics of type 2 diabetes, we have standardized in-house, the culturing of human adipose tissue (subcutaneous fat) to study the modulations in various adipokines which contributes to the pathogenesis of insulin resistance, obesity and T2DM in Asian Indians.

a. **Serum adiponectin is a useful biochemical marker for differentiating type 1 and type 2 diabetes :** An accurate classification of diabetes is necessary for optimal treatment. For those with type 1 diabetes [T1DM], prompt classification is necessary to prevent more severe consequences surrounding uncontrolled blood glucose in the immediate post-diagnosis period and to allow a clinician to immediately start insulin and counsel regarding its proper use.

Figure: ROC curve showing performance of adiponectin among subjects with T1DM and T2DM for unadjusted and adjusted models



Unadjusted

Adjusted for age, sex, BMI, waist, hypertension, HbA1c, serum cholesterol, serum triglycerides, HDL cholesterol and LDL cholesterol

Adiponectin cutpoint	Sensitivity	Specificity	PPV	NPV	Accuracy	LR +ve	LR -ve
4.5	83.6	70.8	72.7	82.3	77.0	2.9	0.2
4.7	80.6	76.4	76.1	80.9	78.4	3.4	0.3
4.9	80.6	77.8	77.1	81.2	79.1	3.6	0.2
5.1	80.6	80.6	79.4	81.7	80.6	4.1	0.2
5.3	77.6	83.3	81.3	80.0	80.6	4.7	0.3
5.4	76.1	84.7	82.3	79.2	80.6	5.0	0.3
5.5	71.6	84.7	81.4	76.3	78.4	4.7	0.3

Hence, a tool to simplify classification is needed. Recently we showed that serum adiponectin is a useful biochemical marker for differentiating T1DM and T2DM among young Asian Indians, a population which is currently the epicenter of the global diabetes epidemic and adiponectin cut-point of 5.1µg/ml had an excellent ability to discriminate T1DM from T2DM [Gokulakrishnan et al 2013].

b. **Evaluating a role for Retinol Binding Protein-4 (RBP-4) as a biomarker in patients with T2DM:** One of my research focuses is on studying adipose tissue biology with special reference to a novel adipokine, RBP-4, which appears to be an important mediator of insulin resistance. We propose to look at whether RBP-4 along with modulations in other adipokines contributes to the pathogenesis of insulin resistance, obesity and T2DM in Asian Indians.

Figure: Mean levels of RBP4 in subjects with different grades of glucose intolerance

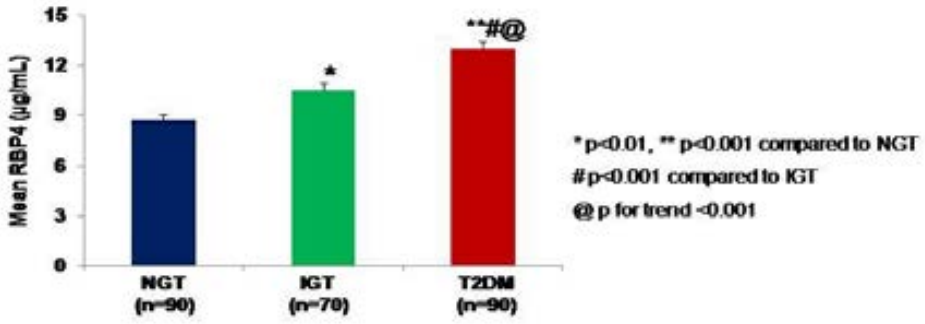
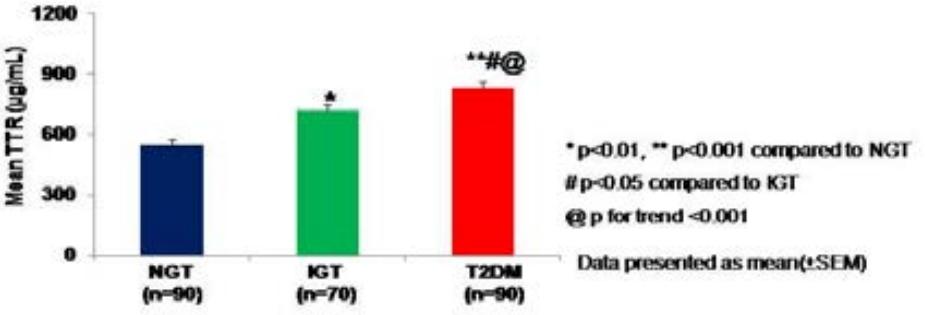


Figure: Mean levels of TTR in subjects with different grades of glucose intolerance



we report that in Asian Indians, the circulatory levels of RBP4 and TTR are higher with increasing severity of glucose intolerance. Both RBP4 and TTR showed a significant association with obesity and T2DM and RBP4 additionally with insulin resistance. Further studies that address the precise mechanisms of the interrelationship of RBP4/TTR and T2DM, could aid in newer therapeutic measures for insulin resistance and type 2 diabetes. Prospective studies are needed to clarify the mechanisms of synthesis, secretion and accumulation as well as the etiological role of RBP4 in metabolic disorders.

c. **Exploring the emerging biomarkers for early detection of beta cell dysfunction**: Recent studies indicate that Asian Indians may be susceptible to early decline in beta cell function even during stages of mild dysglycemia. While the link between beta cell dysfunction and type 2 diabetes is very well established, there are few markers, ie., Betatrophin and secreted frizzled-related protein 4 (SFRP4) are emerging as newer biomarkers for early beta cell proliferation and beta cell dysfunction respectively. We are currently exploring their role in assessing the early beta cell dysfunction.

d. **Exploring the beneficial legacy effect of lifestyle intervention on adiposity and inflammation in overweight/obese people with prediabetes - A Randomized Control Trial:** This study is in collaboration with Emory University, we at MDRF implemented a randomized controlled trial, the Diabetes Community Lifestyle Improvement Program. While lifestyle intervention has been shown to offer persistent metabolic benefits, there are insufficient data on its influence on biomarkers such as adipokines and cytokines. We are currently investigating the biomarkers of adiposity (adiponectin, leptin) and proinflammation (tumour necrosis factor alpha [TNF ά], Interleukin -6 [IL-6]) and gut hormones in overweight/obese people with prediabetes randomized either to 4 months of intensive lifestyle management or standard care and followed till 12 months. The results from this study can form a basis for future translational research whereby these biomarkers can play an important role in prevention and intervention trials.

e. **Soluble (Pro) Renin Receptor in relation to Gestational Diabetes Mellitus:**

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with first recognition during pregnancy. Most women with GDM are asymptomatic and

GDM may go unnoticed for a considerable length of period. Hence it is recommended that early screening for GDM should be done since interventions, such as diet, exercise and medications (when indicated), if started early could improve maternal and fetal outcomes. In this context, use of biomarkers that can identify women with GDM would be useful. Recently the soluble pro-renin receptor [s(Pro)RR] has been shown to predict the development of gestational diabetes mellitus (GDM). We therefore investigated the association of s(Pro)RR levels in Asian Indians with GDM to see whether it can be used as a marker of GDM . This study shows the following findings. First, mean levels of the s(Pro)RR were significantly higher in subjects with GDM. Second, s(Pro)RR showed a significant correlation with fasting plasma glucose and glycated hemoglobin. Third, in the logistic regression, s(Pro)RR had a significant association with GDM even after adjusting for age, BMI, fasting and 2hr plasma glucose, HbA1c and family history of type 2 diabetes. Fourth, a s(Pro)RR cut-point of 23.3 ng/ml had a sensitivity of 68% and specificity of 70%, for identifying GDM.

Use of biomarkers such as s(Pro)RR can be used as an initial screening test to identify women who may need more definite diagnosis testing and thus help to substantially reduce the number of women who need to undergo definite testing. If it is also possible to detect women at higher risk of GDM early in pregnancy using such biomarkers, it could possibly help to improve the outcomes of women with GDM, although these would need longitudinal studies.

Grants Received by the Department

Sl No.	Title of Project	Funding Agency	Duration
1.	Evaluating a 'biomarker' role for Retinol Binding Protein-4 (RBP4) in patients with type 2 diabetes	DBT	3 Years
2.	Evaluation of long term effect of lifestyle intervention on adiposity, inflammation and gut hormones among overweight and obese adults	NIH/NHLBI	1 Year
3.	An evaluation of clinical and molecular biomarkers in adolescents in relation to insulin resistance and obesity	ICMR	3 Years
4.	Evaluation and Molecular Profiling of Adiponectin Isoforms in Type 2 Diabetes - DST-SERB Young Scientist Award	DST - SERB	3 Years
5.	Exploring secreted frizzled-related protein 4 (SFRP4) – An early biomarker of beta cell dysfunction in type 2 diabetes	MIRF - MDRF	1 Year

CONTRACT RESEARCH PROJECTS WITH PHARMA INDUSTRY:

S.No	Project	Sponsor
1.	Development of the cell based assay for GLP-1 receptor agonist activity	Amneal Pharma, USA

DEPARTMENT OF CLINICAL TRIALS

Senior Scientist & Head of the Department
S.Poongothai

Consultant Diabetologist & Clinical Trial Officer
Dr. Kasthuri Selvam

Medical Officer (Clinical Trials)
Dr.Indu Raja

Research Officer
Ms.K.Karkuzhali

Senior Research Pharmacologist
Mr.P.Nandakumar

Sr. Clinical Research Co-ordinator
Ms.S.Phebegeniya

Clinical Research Coordinator and Pharmacist
Mr.Lalith Kumar

Clinical Research coordinator and Pharmacist
Mr.Mohamed Salman Faris

Clinical Research coordinator
Mr. K.Viswanathan

Research Assistant
Ms.K.Kavitha

Data entry operator
Ms.G.Lakshmi

Senior Phlebotomist
Mr.G.Muniyandi

If necessity is the mother of invention, scientifically developed production is the mother of scientific research— Arthur Edwin Kennelly

The dept is headed by Dr.S.Poongothai whose interests in clinical trial span over two decades. The department consists of medical officers, regulatory specialists, recruiters, study co-ordinators phlebotomist and data entry operator to provide service of world class standard to the study subjects that have agreed to actively participate.

The department of clinical trial aims at the development of new class of drug for the management of diabetes and its complications. The department emphasizes on world class clinical research service by strictly following the ICH-GCP and ICMR guidelines.

The department also involved in collaborative research on mental health and diabetes. This department is unique to have trained care co-ordinators who are actively involved in providing behavioural and life style counselling to the patients who have chronic stress along with diabetes and other metabolic disorders. This is the one of the most essential requirements in the stressful life as Indians are very vulnerable to both diabetes and chronic stress. A brief description of the activities of the department is provided below.

VISION:

1.To provide a world class environment for conducting state of the art Clinical Research

2. Serve as a national resource centre of international standard in the design, conduction, analysis, Interpretation and dissemination of clinical trials

MISSION

Providing service of world class standard to the study subjects that have agreed to actively participate in facilitating pharmacology based clinical research in diabetes and its complications and to the pharmaceutical companies involved in drug discovery and development in the areas of diabetes and its complications aiding them in various phases of clinical trials to ensure the proper evaluation of new therapies prior to their actual launch into the market.

ACTIVITIES OF THE DEPARTMENT

Till date the department has conducted hundred and twenty two national and international trials to its credit. All the 122 trials were ICH-GCP compliant, controlled and essentially double-blinded clinical trials from all the major diabetes-focused pharmaceutical companies across the globe. The department has also been ranked as the Global top recruiter for ten of the 122 trials. A consistently low screen failure rate of < 5% and a high Quality Control (QC) score serve as an indicator of the thorough understanding of the process of clinical research that the department possess. The low drop-out rate serves both as a measure of the dedication of the workforce in ensuring that any trial undertaken is followed through successfully to its completion and the level to which the clinical trial team takes rapport-building with the study subjects involved in a clinical trial seriously. These factors account for MDRF being preferred as a nodal centre by many pharmaceutical companies involved in drug trials. Audited for about 10 times by the external agency and sponsors to see the compliance with the GCP guidelines and adherence to the study protocol.

FACILITIES OF THE DEPARTMENT

Located in a large tertiary care teaching hospital with medical and surgical facilities related to diabetes care; what began as a department geared at conducting Phase III clinical trials, has expanded into a Clinical Research Department that is versatile and comprehensive with the capacity to conduct trials in all phases of clinical development of pharmaceutical products. The department interfaces with companies involved in drug discovery and development in the areas of diabetes and its complications aiding them in various phases of clinical trials to ensure the proper evaluation of new therapies prior the actual launch of a drug into the market. Our research strength has also been growing in new areas such as Combined Pharmacokinetic-dynamic assessment; Insulin Clamp Studies (Normoglycemic and hyperglycemic clamps); Phase I Studies.

BRIEF SUMMARY OF PAST PROJECTS

COMPLETED TRIALS (n= 122)

S.NO		SPONSOR
1	***Normopan***	*SF Natural Remedies*
2	Diabecon	**Himalayan Pharmeuctical**
3	Gemfibrozil	**Parke Davis**
4	Creon	**Solvay Pharmaceuticals**

1.Normopan **SF Natural Remedies**
2. Diabecon **Himalayan Pharmeuctical**
3. Gemfibrozil **Parke Davis**
4. Creon **Solvay Pharmaceuticals**
5. Glucobay **Bayer**
6. Reclide **Dr.Reddy's**
7. Glyboral **USV**
8. Rosiglitazone **Dr.Reddy's**
9. Repaglinide **Novo Nordisk**
10. Combination Therapy with Human Insulin and Sulphonylureas In Indian NIDDM Patients - **Novo Nordisk**
11. Rosiglitazone **Torrent**
12. NN2344 – 1185 **Novo Nordisk**
13. Cardace **Hoechst**

14. Novomix (GCP) **Novo Nordisk**
15. DCBT **Dalmia Centre for Biotechnology**
16. Cogent DB **Cybele Herbal Laboratories**
17. Novolet **Novo Nordisk**
18. Sit-100 **Lilly**
19. Hyponidd **Charrak Pharma**
20. Doxasozin **Hoechst Pharma**
21. Diamicron MR **Serdia Pharma**
22. F3Z - IN-IONL **Lilly**
23. Human Insulin Zinc Suspension (Lente) **Wochardt**
24. GOURDIN **Pfizer**
25. NN622-1343 **Novo Nordisk**
26. ASDIAB **Novo Nordisk**
27. CL3-21403-010-IND **Serdia Pharma**
28. BI/PM/001/IND **Biocon**
29. Oral Insulin **Hemisphere**
30. POLO **Johnson & Johnson**
31. BI/NPH/001/IND **Biocon**
32. BI/REG/001/IND **Biocon**
33. Clinical Evaluation of the Efficacy and Safety of Atorvastatin+ Fenofibrate **Cipla**
34. NMITLI-DM-FN-01 **SPAARC**
35. F3Z-IOOI-IOL **Lilly**
36. Effect of Essentiale in Diabetic Subjects with Non-alcoholic fatty liver
37. Efficacy of Atorvastatin +Niacin with Atorvstatin in patients with Dyslipidemia- **LUPIN**
38. Pegvisomant **Pfizer**
39. LAF 237 **Novartis**
40. LAF 237(Extension Study) **Novartis**
41. CLAF 237A239 & CLAF237A2329E1 **Novartis**
42. INSULIN GLARGINE(rDNA origin) **Wochardt**
43. DREAM **Aventis & Mcmaster**
44. EPI-DREAM **Aventis & Mcmaster**
45. EXENATIDE **Lilly**
46. MK-0431 **Merck**

47. FAITH **USV**
48. ROSUVASTATIN **Investigator driven study**
49. LY333531 MBBR **Lilly**
50. LY333531 MBCW **Lilly**
51. MBCV **Lilly**
52. SYR-322-SULF-007 **Takeda**
53. SYR-322-MET-008 **Takeda**
54. SYR-322-TZD-009 **Takeda**
55. SYR-322-PLC-010 **Takeda**
56. SYR-322-INS-011 **Takeda**
57. 01-05-TL-322OPI-001 **Takeda**
58. 01-06-TL-322OPI-002 **Takeda**
59. MK 0524 A **Merck**
60. Survey of Burden of illness (BOI) in Indian patients with Neuropathic Pain **Pfizer**
61. DIATHEA **TAFE Stanes**
62. ADVANCE **Serdia & George Institute**
63. VILDAGLIPTIN MONOTHERAPY **Novartis**
64. Control on Pre-Clinical Artherosclerotic Markers in Type II Diabetes **Johnson & Johnson**
65. NN 1998 – 1682 **Novo Nordisk**
66. H7U-MC-IDAW **Lilly**
67. H7U-MC-IDAV(a) **Lilly**
68. AGI-1067(ANDES) **AtheroGenics**
69. VIAJECT-06 J **Biodel**
70. DREAM-ON **Aventis & Mcmaster**
71. EPI-DREAM ON **Aventis & Mcmaster**
72. ACTIV X 0104-003 **AtheroGenics**
73. POLYCAP **CADILA, St.John's and McMaster**
74. F3Z-MC-IOOY **Lilly**
75. F3Z-MC-IOPE **Lilly**
76. NMITLI-DM-FN-02 **SPAARC**
77. ICON-39 **BMS**
78. NN2211-1572 **Novo Nordisk**

79. NNC 0113-0217	**Novo Nordisk**
80. BMS- 477118	**BMS**
81. CLF2301210601	**Fournier**
82. MBDL	**Lilly**
83.**VIAject 07**	Biodel
84.**Rosiglitazone**	GSK
85. Dutogliptin/PHX1149T	**Phoenix**
86. CACZ88512207	**Novartis**
87. NN-1250-3585	**Novo Nordisk**
88. IN-105	**BIOCON**
89. Soluble Insulin	**SIAC**
90. CLAF 237B2201	**Novartis**
91. RO5073031	**Roche (the study was terminated)**
92. CACZ885I2202	**Novartis**
93. AVE0010	**Sanofi-Aventis (Metformin)**
94. Pf-04971729	**Pfizer**
95. CLAF 237B2224	**Novartis**
96. BI 1356.20	**Boehringher**
97. AVE0010	**Sanofi-Aventis (Basal Insulin)**
98. AMR01-01-0016	**Amarin**
99. NN1250-3725	**Novo Nordisk**
100 .PolycapTM	**Cadila**
101. SK-0403-2.01US	**KOWA**
102. EFC-10781	**Sanofi-Aventis**
103. Select Simple	**Johnson & Johnson**
104. SYR-012	**Takeda**
105. TIPS K	**Cadila**
106. ORIGIN	**Sanofi-Aventis & PHRI**
107. LC-005	**LG life sciences**
108. LC-006	**LG life sciences**
109. SIBA	**Novo Nordisk**
110. AS32010G000-291	**EISAI pharma**

111. DUAL	**Novo Nordisk**
112 ALTITUDE	**Novartis**
113. HARMONY	**GSK**
114 . BI 1245.36	**Boehringher**
115. TEENs	**Sanofi-Aventis**
116. BI 1245.28	**Boehringher**
117. i Pro™2	**Medtronics**
118. ORIGINALE	**PHRI**
119. TECOS	**Duke University & Merck**
120. ADVANCE –ON	**George Institute**
121. BI 1245.25	**Boehringher**
122. TRC 150094	**Torrent Research Centre**

Currently the department is involved in 12 global Phase II and III trials.

TWELVE ONGOING PROJECTS:

- Heart Outcomes Prevention Evaluation **(HOPE)-3**
- A Randomized, Multicenter, Double-Blind, Parallel, Placebo-Controlled Study of the Effects of JNJ-28431754 on Cardiovascular Outcomes in Adult Subjects With Type 2 Diabetes Mellitus (The **CANVAS Trial**: **CAN**agliflozin Cardio**V**ascular **A**ssessment **S**tudy)
- Liraglutide Effect and Action in Diabetes: Evaluation of cardiovascular outcome Results A Long-term, Multi-centre, International, Randomised Double-blind, Placebo-controlled Trial to Determine Liraglutide Effects on Cardiovascular Events **(LEADER)**
- **CLAF237A23156:** A 5-year study to compare the durability of glycemic control of a combination regimen with vildagliptin & metformin versus standard-of-care monotherapy with metformin, initiated in treatment-naïve patients with type 2 diabetes mellitus.

❖ A randomized double-blind placebo-controlled trial for the evaluation of a ***Polycap, low dose Aspirin*** and ***Vitamin D*** supplementation in primary prevention –**The International Polycap Study (TIPS)-3**
❖ A Multicentre, International, Randomized, Parallel group, Double Blind study to evaluate Cardiovascular safety of Linagliptin versus Glimepiride in patients with Type 2 Diabetes Mellitus at high Cardiovascular risk (**CAROLINA).**
❖ Efficacy and safety of liraglutide in combination with metformin versus metformin monotherapy on glycaemic control in children and adolescents with type 2 diabetes A 26-week double-blind, randomized, parallel group, placebo controlled multi-centre trial followed by a 26-week open-label extension **(ELLIPSE)**
❖ NIH R01 project titled, "**INDEPENDENT STUDY" INtegrating DEPrEssioN and Diabetes treatmENT (INDEPENDENT) Study**
❖ A Phase III, Multicentre, Randomized, Parallel Group, Double Blinded and Control Group Clinical Trial to Assess the Effectiveness of Biochaperone PDGF-BB In the Treatment of Chronic Diabetic Foot Ulcer."
❖ A Proepective, Radnomized,Open-label Comparison of a Long Acting Basal Insulin Aanalog LY2963016 to Lantus in Adult Patients with Type 2 Diabetes Mellitus: The ELEMENT 5 study

Projects being done by Ph.D. students under the Co-guidance of Dr.S.Poongothai

1) Prevalence of stress in subjects with type-2 diabetes and interventions for stress in clinic population-Ms.Vithulatha

Diabetes is a chronic health condition proving to be a major health challenge, on the international and national level. The increase in prevalence of diabetes is mainly due to lifestyle changes, as a result of urbanization, globalization, and physical inactivity. Apart from these, stress also plays and important role, in the etiology, and management of diabetes, thereafter. Stress is defined as "non specific response of the body to any demand", leading to the activation of the sympathetic adrenal meduallary system. There are no large scale studies which have looked at the prevalence of stress in a clinic population. This study focuses on the prevalence of stress in the population of people with type 2 diabetes, along with the effects of behavioral intervention through pranayama and biofeedback using galvanic skin response. An in-depth study of personality traits, could provide useful insights in the perception of stress. This study which aims at looking at all the above mentioned variables, could give a new dimension to psychosocial care in diabetes.

2) **To assess the level of Depression and Optimism in subjects with diabetes and intervention of depression in a large clinic population in South India- Ms.Bhavani**

Depression is a common illness worldwide, with an estimated 350 million people affected. Depression is different from usual mood fluctuations and short-lived emotional responses to challenges in everyday life. Especially when long-lasting and with moderate or severe intensity, depression may become a serious health condition. It can cause the affected person to suffer greatly and function poorly at work, at school and in the family. At its worst, depression can lead to suicide. Suicide results in an estimated 1 million deaths every year.

Diabetes is associated with increased risk of developing depression. In addition, risks of debilitating complications and mortality are all compounded when cardio-metabolic and mental illnesses co-exist and/or are uncontrolled.

Depression affects 12.1 – 15.1% of adults and diabetes affects over 60 million people in India. Therefore the absolute number of those affected with both conditions is sizable and constitutes a ground of elevated risk. Negative thoughts are found to be one of the causes for depression apart many factors such as family history, diet, chronic stress, illness etc., whereas optimism is a positive inner psychological resource which protects individuals.

3) **Assessment of psychosocial factors in young diabetes and subjects without diabetes- Dr. Bareendharan**

Diabetes in older children and adolescents poses serious physical, mental, and emotional challenges. Striking a balance among hypoglycemia/hyperglycemia, growth/development, and other life factors is not easy for health care providers, patients, or families. In addition, personal, family, or environmental conditions present before the onset of diabetes may compound the delicate balance needed to maintain good glycemic control. Therefore, there is a great need, especially at the time of initial diagnosis, to assess the developmental, behavioral, and psychosocial history of children with diabetes and their families. This study will determine the specific psychosocial factors affecting young diabetes and subjects without diabetes and will measure the cognitive dysfunction, quality of life, anxiety disorders and prevalence of Depression in young subjects with and without diabetes.

SOPs introduced

15 SOPs are in place for smooth functioning of the clinical trials department.

QUALITY AND SPONSOR AUDITS CONDUCTED

S.No	STUDIES AUDITED	AUDITED BY	YEAR OF AUDIT
1	A Phase III, Multicentre, Randomized, Parallel Group, Double Blinded and Control Group Clinical Trial to Assess the Effectiveness of Biochaperone PDGF-BB In the Treatment of Chronic Diabetic Foot Ulcer	GCP audit by ADOCIA	August 2015

Monitoring visits done by Dr.S.Poongothai and Mr.Nandakumar for INDEPENDENT study

S.No	SITE Name	Monitored by	Venue and the year
1	Visakhapatnam	Dr.Poongothai	Nov 2014
2	Delhi	Mr.Nandakumar	Feb 2015
3	Visakhapatnam	Dr.Poongothai and Mr.Nandakumar	April 2015
4	Delhi	Dr.Poongothai	June 2015

DEPARTMENT OF CLINICAL TRIALS

DEPARTMENT OF RESEARCH OPERATIONS

Dr. R. Guha Pradeepa

We work towards intensifying collaboration with institutes of similar interests in the field of diabetes to facilitate optimum fund utilization and seamless research.

Senior Scientist & Head of the Department
Dr. R. Guha Pradeepa

Scientist
Dr. Mansi Gauniyal

Senior Research Officer
Ms. K.S. Chella

Project Coordinator
Mr. Nirmal Elangovan

Senior Secretary
Ms. A. Sunitha

The department plays a very important role in the development of scientific research through liaising with other departments by assisting in proposal writing to obtain national and international grants to carryout collaborative research of international standards and formulation of reports of projects. This division also coordinates multicentre international projects. In addition helps in enhancing knowledge regarding the burden of diabetes and its complications to researchers and educating the community on the same. Workshops and seminars on non-communicable diseases (NCDs) with particular reference to diabetes and its complications are also organized for the benefit of young researchers and scientists.

Vision:

To create an outstanding climate of support for grant writing and dissemination of results on research activities conducted by the institute in the area of diabetes and its complications to the scientific and lay community.

Mission:

- To liaise with the different departments at the MDRF to facilitate proposal writing
- To disseminate results on research activities in the field of diabetes and its associated complications through publications in journals and medical textbooks and conducting workshops and seminars.
- To enhance knowledge regarding diabetes among the community through the quarterly magazine entitled the ‘Diabetes Monitor’ and articles in the newspaper.

CURRENT ACTIVITIES OF THE DEPARTMENT

(i) The Indian Council of Medical Research –ICMR-India Diabetes INDIAB Study

National PI : Dr.V.Mohan

MDRF Co-PIs: Dr.R.M.Anjana, Dr.R.Guha Pradeepa, Dr.M.Deepa, Dr.Ranjit Unnikrishnan, Mrs.Sudha V

Funding agency: Indian Council of Medical Research, New Delhi

Duration: 2008-2015

MDRF initiated one of the largest epidemiological studies done in the world in the field of diabetes called as the "ICMR – INDIAB Study". This study is funded by Indian Council of Medical Research (ICMR) and the Government of India and will screen 124,000 people in all the 28 States, National Capital Territory of Delhi and 2 Union Territories in India. This study is a cross-sectional, door-to-door survey to estimate the prevalence of diabetes and pre-diabetes in individuals aged 20 years and above. The methodology consists of a triple stage sampling procedure, covering villages, small towns and the metros. This will be thus representative of the whole of India. The first phase of the study which has been completed in 4 States of India, Tamil Nadu, Maharashtra, Jharkhand and Chandigarh on 16,073 people has already provided authentic epidemiological data on diabetes, hypertension, dyslipidemia and obesity in the country till date. Currently the North East component, which includes 8 north eastern states is under progress [n=32,000]. In the states of Assam, Mizoram, Arunachal Pradesh, Tripura, Manipur and Meghalaya, 23,847 people have been studied till date. Phase 2, includes 17 states, National Capital territory of New Delhi and 1 union territory [n=76,000] and is also under progress. The study has been completed in 5 states (Andhra Pradesh, Bihar, Gujarat, Karnataka and Punjab) [n=20,072]. Thus till date valuable epidemiological data on diabetes, hypertension, dyslipidemia and obesity has been collected on **59,992/1,24,000** individuals from the ICMR-INDIAB study. This study initiated by MDRF will provide accurate and reliable data on the current state of diabetes and prediabetes not only in whole nation but also at the regional and state level for first time in India.

Till date **EIGHT** articles have been published from Phase I of the study

[Activity - Epidemiology Department]

(ii) Clinical Research Training for NCD studies in India

PI : Dr.V.Mohan

Co-ordinator: Dr.R.Guha Pradeepa

Funding agency: NIH Fogarty International Center

Duration:2011-2016

Madras Diabetes Research Foundation (MDRF), in collaboration with the University of Alabama at Birmingham (UAB), USA has taken the initiative to train epidemiologists and community health specialists in Prevention and Control of NCDs both within and outside India. This project is a NIH grant funded by Fogarty international center. The primary objective of the programme is to encourage capacity building in India and to develop strategies for prevention of NCDs in general and diabetes and cardiovascular diseases in particular. In order to plan strategies for prevention of NCDs at the national and international level, the International Seminar on 'Prevention and Control of Non-Communicable Diseases (NCDs)' and Intensive training program were conducted for the past thirteen years**.** Since the initiation of this programme in 2003, over 420 young researchers and students have been trained during the intensive training course and 1350 epidemiologists and community health specialists from 25 states across India including the North eastern states and from various countries including Bhutan, Maldives, Nepal, Srilanka, Thailand, Vietnam and USA have been trained in epidemiology of NCD.

Apart from the seminar and workshop, through this collaboration, between 2011 and 2015, eight MDRF researchers have undergone short-term training in the US institutions (Florida International University, Florida, University of Minnesota, Minnesota, Genentech, San Francisco, Harvard School of Public Health, Boston and University of Florida, Gainsville) for a month. They underwent intensive training in laboratory procedures, data management, general research methods, research ethics, genomics, and biostatistics.

[Activity – Research Operations]

(iii) Exploring the prevalence & association of vitamin B12 and vitamin D deficiency in individuals with different degrees of glucose intolerance among urban south Indians

PI : Dr.R.Guha Pradeepa

Co-PIs: Dr. R.M. Anjana, Dr.K.Gokulakrishnan, Dr.Deepa Mohan, Dr.C.S.Shanthirani, Dr.V.Mohan

Funding agency: Research Society for the Study of Diabetes in India (RSSDI)

Duration: 2014 -2016

South Asia in general and India in particular is emerging as the epicenter of the cardio-metabolic (CMD) pandemic. The prevalence of prediabetes and diabetes is increasing in epidemic proportions in developing countries, particularly in India. Recent studies have demonstrated correlations with low levels of vitamin B 12 (cobalamin) and Vitamin D (25-hydroxy) concentrations and the development of type 2 diabetes. Hence, this project aims to establish the frequency of vitamin B12 and vitamin D deficiency in an urban south Indian population and compare the circulating levels of vitamins B12 and vitamin D, folate and homocysteine in subjects with different grades of glucose tolerance from the ongoing Chennai Urban Rural Epidemiology [CURES] follow-up study (900 NGT, 300 IGT and 300 T2DM subjects). In addition, this project will also evaluate the association of various cardiometabolic risk factors with Vitamin B12 and vitamin D deficiencies. This study is currently under progress.

[Activity – Departments of Clinical Epidemiology & Clinical Laboratory]

(iv) World Health Organization (WHO) Collaborating Centre for Non-communicable diseases- Prevention & Control (2008-15)

PI : Dr.V.Mohan

Duration: 2008 -2015

Non Communicable Diseases (NCDs) have emerged as the leading cause of morbidity and mortality worldwide. MDRF carries out research on diabetes and other NCDs like hypertension, obesity, dyslipidemia and cardiovascular diseases. The institution has contributed to national programmes in NCDs with particular reference to diabetes, thus plays a leading role in health care, research, education and capacity building in diabetes and other NCDs. The objectives of the WHO Collaborating Centre is to provide continuous surveillance of NCDs, and also their prevention and control. Collaboration with WHO has been established at both regional and national levels for many years. Thus MDRF and Dr.Mohan's Diabetes Specialities Centre, with its track record of work on NCDs has been designated as a WHO Collaborating Centre for Prevention and control of NCDs.

(v) International Diabetes Federation Centre of Education (2009-2015)

PI : Dr.V.Mohan

Acknowledging the specialized education and training undertaken in diabetes and its complications by Dr.Mohan's Diabetes Specialities Centre [DMDSC] and Madras Diabetes Research Foundation [MDRF], the IDF has declared our centres as an 'IDF CENTRE OF EDUCATION since October 2009. Dr. Mohan's Diabetes Specialities Centre and the Madras Diabetes Research Foundation was one among 6 centers all over the world to be designated as the IDF centre of Education for a period of 4 years. As an IDF Centre of education our institutions will work closely with IDF to extend and offer our diabetes education services globally particularly to other developing countries where such facilities are currently not available. This will help narrow the gap between the current recognized best practices in diabetes education and the actual management offered to people with diabetes in many developing countries.

2. Coordinating Projects/Training Programmes

a) The Indian Council of Medical Research -India Diabetes (ICMR- INDIAB) Task Force Project

b) Establishment of a Centre for Prevention and Control of Diabetes and Cardio-metabolic Diseases in South Asia [COE-CARRS]

c) **B**uilt **E**nvironment and Physical **Activ**ity – **India** (**BE ACTIV INDIA!)** study -adolescent component"

d) Clinical research training for NCD studies in India in collaboration with FIU and UAB

3. Organizing workshops/seminars

From November 2011 to December 2015 the department was actively involved in the organization of the below mentioned seminars/workshops:

a) MDRF-UAB-FIU International Seminar on Prevention of Non communicable disease

➔ ***The Tenth MDRF-UAB-FIU International Seminar*** on "Prevention of Non Communicable Diseases was organized at the Madras Diabetes Research Foundation, Chennai between the 10th to 12th February, 2012

➔ ***The Eleventh MDRF-UAB-FIU International Seminar*** on "Prevention of Non Communicable Diseases was organized at the Madras Diabetes Research Foundation, Chennai between the 15th to 17th February, 2013

➔ ***The Twelfth MDRF-UAB-FIU International Seminar*** on "Prevention of Non Communicable Diseases was organized at the Madras Diabetes Research Foundation, Chennai between the January 31st to 2nd February, 2014

➔ ***The Thirteenth MDRF-UAB-FIU International Seminar*** on "Prevention of Non Communicable Diseases was organized at the Madras Diabetes Research Foundation, Chennai between the 23rd to 25th January, 2015

b) MDRF-UAB-FIU Intensive training programme

Four MDRF-UAB-FIU Intensive interactive training programmes were organized between November 2011 and December 2015 on Clinical Research methods which were as follows:

➔ The eighth intensive interactive training program was held on 8th & 9th February, 2012.

➔ The ninth intensive interactive training program was held on 13th and 14th February, 2013.

➔ The tenth intensive interactive training program was held between January 29th -31st, 2014.

➔ The eleventh intensive interactive training program was held between January 21st -23rd, 2015.

c) Introductory lectures for the Postgraduate Diploma in Diabetes

This is a 2 year part-time distance learning course consisting of 6 modules conducted by Cardiff University, UK in collaboration with our Institution. Each academic year starts in February with students attending initial introductory lectures, at various international locations with the course then continuing online. The first introductory lectures were conducted at our centre on 15th and 16th February, 2014. Nearly 30 international and national students participated in this introductory lecture. Distinguished international and national faculty mentored the students by giving lectures and training on various aspects related to the course. This is a landmark course to help physicians to improve their knowledge of diabetes and improve their Clinical skills.

d) Dr. Mohan's International Diabetes Update

The main aim of this diabetes update was to provide insights into the basics as well as latest advances in diabetes management in an interactive manner. Distinguished International and National Faculty participated in this event. The scientific sessions during the Diabetes Update meeting included Orations, Plenary Sessions, Meet the Expert sessions, Debates, Open discussion forums, case-study illustrations and panel discussions.

❖ The **First Dr. Mohan's International Diabetes Update** was held between 11th to 13th July, 2014 - More than 1000 doctors were benefitted from this update. More than 80 National and 11 International faculty in the field of diabetes shared their knowledge in their fields of expertise.

- The **Second Dr. Mohan's International Diabetes Update** was held between 31st July to 2nd August, 2015 - More than 1800 doctors were benefitted from this update. 110 National and 9 International faculty in the field of diabetes shared their knowledge in their fields of expertise.

d) International Update on Gestational Diabetes Mellitus

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Madras Diabetes Research Foundation organized an International Update on Gestational Diabetes Mellitus on 26th and 27th of September 2015 at Chennai under the auspices of the International Diabetes Federation (IDF). This Update also showcased the learnings from the WINGS (**W**omen in **In**dia with **G**DM **S**trategy) project. The programme provides community based interventions for women with GDM in low resource settings and was piloted in Tamil Nadu in India involving more than 2,100 women. The Update brought together the world's experts in Gestational Diabetes from different parts of the world. Representatives from several national and international societies participated in this update. Over 300 delegates representing physicians, obstetricians and gynaecologists attended the International Update on GDM.

4. Educating community on diabetes

Between November 2011 and December 2015, sixteen issues of the Diabetes Monitor (a quarterly magazine) and innumerable lay press articles have been published by the department. The issues of the Diabetes Monitor magazine is available at
http://drmohansdiabetes.com/index.php/media-news/diabetes-monitor/

PROJECTS DONE BY PH.D. STUDENTS UNDER THE GUIDANCE OF DR.R.GUHA PRADEEPA

1. **Association of Vitamin D and Vitamin B12 in different glucose tolerant subjects in urban south India**

Ms.Jayashri R

Vitamin B12 and D deficiencies have been a well known health problem, however this subject does not seem to have attracted attention to the same extent as other micronutrients like iron, and vitamin A. Vitamin B12 deficiency is associated with wide-ranging multi-system abnormalities, including megaloblastic anaemia, neurological disorders and birth defect. In addition, biochemical and clinical

vitamin B12 deficiency has been demonstrated to be highly prevalent among patients with diabetes mellitus. Several cross sectional and clinic based studies in the west have documented an increased frequency of vitamin B12 deficiency among type 2 diabetic patients ranging from 5.8% to 33%. Metabolically significant vitamin B12 deficiency will result in disruption of the methylation process and accumulation of intracellular and serum homocysteine. Many studies found significant elevation of plasma homocysteine levels in type 2 diabetes. In addition, vitamin D has long been recognized as important regulators of serum calcium and bone health. Studies have reported that circulating levels of vitamin D may be inversely related to the prevalence of diabetes, insulin resistance and metabolic syndrome. Though Indians are known to be more insulin resistant and more susceptible to diabetes and cardiovascular disease, there are no studies that have systematically evaluated these risk factors in an Indian population. The results from this study help to evaluate whether modulations in vitamin B12, vitamin D, folate, homocysteine and other risk factors contribute to the pathogenesis of insulin resistance, prediabetes and type 2 diabetes among urban south Indians.

2. Elucidating the role of metabolic syndrome, insulin sensitivity, inflammatory markers, and adipokines with elevated 1-hr plasma glucose during an OGTT among individuals with normal glucose tolerance

Pramod Kumar T.A

Inflammation play a crucial role in the pathogenesis of Type 2 Diabetes, relating diabetes to a number of commonly coexisting conditions thought to originate via inflammatory mechanisms. One potential implication of many studies suggests a relation between inflammation and diabetes is that inflammatory markers may be used to refine diabetes prediction thus better target individuals for lifestyle. The oral glucose tolerance test (OGTT) is widely used to identify the high-risk individuals who may benefit from life style modification .However data obtained from population studies suggest that 1hr plasma glucose concentration after the ingestion of a 75gms oral glucose load provide a better predictor for future Type 2 diabetes than fasting or 2-hour Post load Glucose. Hence early identification of individuals with elevated 1hr value would prevent the conversion of prediabetes to diabetes. Furthermore studying the metabolic syndrome, insulin sensitivity inflammatory markers, adipokines and with elevated 1-hr plasma glucose postpone onset of diabetes and its related complications. The information derived from this study could have profound clinical and basic implications in multiple ways - in developing approaches for detecting individuals at risk, in establishing molecular correlations and prognosis, and in understanding pathogenesis. The results from this study can form a basis for future translational research whereby not only stratifying the NGT

individuals into lower to medium to high risk groups but also as an independent predictor of future prediabetes or diabetes in those with NGT.

ON-GOING PROJECTS AND RESEARCH PROJECTS IN THE PIPELINE

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
ICMR-India Diabetes Study [ICMR-INDIAB] North East Component	Indian Council of Medical Research ,India	Dr. V. Mohan Dr. R.M. Anjana Dr.R.Guha Pradeepa Dr.M.Deepa Dr.Ranjit Unnikrishnan Mrs.Sudha V	2010-2016
The Indian Council of Medical Research -India Diabetes (ICMR- INDIAB) Task Force Project (Phase II)	Indian Council of Medical Research ,India	Dr. V. Mohan Dr. R.M. Anjana Dr.R.Guha Pradeepa Dr.M.Deepa Dr.Ranjit Unnikrishnan Mrs.Sudha V	2013-2016
Exploring the prevalence & association of vitamin b12 and vitamin d deficiency in individuals with different degrees of glucose intolerance among urban south Indians	Research Society for the Study of Diabetes in India (RSSDI)	Dr.R.Guha Pradeepa Dr.K.Gokulakrishnan, Dr.Deepa Mohan, Dr.C.S.Shanthirani, Dr.V.Mohan	2014-2016

Clinical Research Training for NCD studies in India	NIH Fogarty International Center	Dr. V. Mohan Dr.R.Guha Pradeepa	2011-2016
Built Environment and Physical Activity – India (BE ACTIV INDIA!) study - adolescent component”	MDRF	Dr. R.M. Anjana Dr.R.Guha Pradeepa Dr.Ranjani Harish	2014-2016

DEPARTMENT OF EPIDEMIOLOGY

Sr.Scientist & Head
Dr. Deepa. M

Research Associate & Post Doctoral Fellow
Dr. Priya Maria Miranda

Executive - Projects
Mr. Parthiban. K
Mr. Sathish Raj.S
Mr. Suresh.T
Mr. Nandakumar.M
Mr. Dhanasekar.L
Mr. Vijayabaskar.S
Ms. Hemavathy.S
Ms. Anitha.M
Ms. Mohaneswari.D

Junior Executive - Projects
Mr. Antony.J.V
Mr. Kumar.M
Mr. Saravanakumar.P
Mr. Saravanan.R

Quality Manager
Mr. Baskar

Quality Supervisor
Mr. Shaik.Moin Basha
Mr. Vivek.K

The Department of Epidemiology supervised by Dr.M.Deepa was started in 1996 with the objective of studying the distribution and determinants of diabetes in the population. The first study, the Chennai Urban Population Study (CUPS) looked at Intra urban differences in diabetes with respect to socioeconomic status. This resulted in 34 publications and three PhD. This was later followed by the CURES, the Chennai Urban Rural Epidemiology Study, which was a sample survey for diabetes in Chennai city. Several national and international publications evolved from this study, which also bought in recognition and collaboration with renowned universities, both within India and abroad. This study also saw the section maturing into a department and was followed by several other national and international studies which are described below.

Vision:

To provide solid evidence based knowledge on diabetes, its determinants and methods of control in the populations that would provide a basis for health action.

Mission

To work towards developing a strong data base on the epidemiology of diabetes and to develop methods for population based management of the disease.

Field Supervisor
Mr. Xavier Suresh
Mr. Suresh Kumar.S
Mr. Arul Pitchai. S
Mr. Nagaraj.G.M
Mr. Velmurugan.D
Mr. Shobana.G
Mr. Shanmugam
Mr. Kumaresh

Research Assistant
Ms. Kalaivani.D
Ms. Rajalakshmi.M
Ms. Tamilselvi.S
Mr. Senthil Kumar
Ms. Mythili

Lab Technician
Ms. Revathy.M
Mr. Maria Vasantha kumar
Ms. Sivarani.V
Ms. Gajalakshmi.R
Mr. Karthik.E
Ms. Akila.N
Ms. Bhuvaneshwari.R
Ms. Ezhil Arasi

Sr. Technician in Biobank
Ms. Sri Devi.K

Field Assistant
Ms. Yuvarani

Senior Data Entry Operator
Ms. Nirmala.N

Data Entry Opearator
Ms. Kavitha.M
Ms. Suganthi.G
Ms. Gandhimathi.R
Ms. Bharathi.G

EPIDEMIOLOGICAL PROJECTS:

(i) Indian Council of Medical Research – India Diabetes study (ICMR- INDIAB):

The ICMR-INDIAB study is the national study on diabetes in India and to date, it is the largest epidemiological survey undertaken by MDRF. The ICMR-INDIAB study is a cross-sectional, community- based survey of adults of either sex, aged 20 years and above, from all the 28 states, National Capital Territory (NCT) of Delhi and 2 union territories (UTs) namely Chandigarh and Puducherry in the mainland of India. This study, conducted in collaboration with the Indian Council of Medical Research (funders), aims at determining the nationwide prevalence of diabetes and prediabetes, by estimating the statewise prevalence of the same. Each state, the National Capital territory and the Union territories studied will have an urban component (towns) and a rural component (villages). A stratified multi-stage sampling design, [similar to the one employed in the National Family Health Survey - 3 (NFHS - 3)] was adopted for this study.

The study was initiated in a phased manner. Phase I (a), consists of three states namely Tamil Nadu, Maharashtra, Jharkhand and one Union Territory namely Chandigarh located in the south, west, east and north of the country, respectively. This phase has been completed in 2008 to 2010. In Phase I (b), which is now ongoing, includes 8 north eastern states of India namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura (two states, yet to complete – Nagaland & Sikkim). In Phase II, the rest of India is planned to be sampled. So far, five states have been completed –

Punjab in the north, undivided Andhra Pradesh and Karnataka in the south, Gujarat in the west and Bihar in the east. The results of this study will help to throw light on the health burden due to diabetes in India and also to plan measures for both control and prevention of diabetes.

Phase 1 results of the study has been published and the key findings include the following: (i) Projections for the whole of India would be 62.4 million people with diabetes and 77.2 million people with prediabetes; (ii) Only about 50% of the population of the four regions of India studied have heard of a condition called diabetes and knowledge and awareness about diabetes in India, particularly in rural areas, is poor; (iii) Prevalence rates of both abdominal and generalized obesity are high in India and extrapolated to the whole country, 153 million and 135 million individuals have abdominal and generalized obesity respectively; (iv) The prevalence of dyslipidemia is very high in India, with over three-fourth (79%) of the general adult population have dyslipidemia with no urban rural difference observed in any of the four regions, translating to 560 million individuals with dyslipidemia, which calls for urgent lifestyle intervention strategies to prevent and manage this important cardiovascular risk factor; (v) Nearly a third of the population in the four regions studied was sedentary, which translates to 234.5 million individuals with sedentary behaviour in India.

(ii) Chennai Urban Rural Epidemiology Study (CURES):

The Chennai Urban Rural Epidemiology Study (CURES), is one of the largest epidemiological study in Chennai (n=26,001, representative sample), with the aim to determine the prevalence of diabetes, diabetes complications and other related risk factors. CURES, started in 2001, have been a tremendously productive study, generating over 140 papers thus far with few more in the pipeline. Key findings of this study include the reporting on the secular trend of diabetes in the Chennai city, development of an Indian Diabetes Risk Score for identifying undiagnosed diabetes, cardiovascular disease and metabolic syndrome, and derivation of an (generalized and abdominal) obesity cut-point for South Asian Indians.

The **CURES Incidence study**, a ten follow-up of the cohort, provides the first population based data on the incidence of diabetes and prediabetes as well as the predictors of progression from normal glucose tolerance to various stages of dysglycemia in the Asian Indian population. The incidence rate of diabetes among individuals with prediabetes in our cohort was 78.9 per 1,000 person-years, which is one of the highest reported in a large ethnic group This study confirms that the progression from prediabetes to diabetes occurs much faster in Asian Indians than in other ethnic groups. The results show that advancing age, positive family history of diabetes, 2-hour plasma glucose, glycated haemoglobin, low HDL cholesterol, and physical inactivity predict progression from normal glucose tolerance to dysglycemia. Through this study, we have commented on the five most important risk factors (obesity, physical inactivity, unfavorable diet risk score, hypertriglyceridemia and low HDL cholesterol) that could explain 80% of all incident cases of diabetes in the Asian Indian population. This information will be of considerable use in planning, implementing and evaluating effective strategies for the prevention of diabetes in this region.

(iii) Prospective Urban and Rural Epidemiology (PURE) Study:

The Prospective Urban and Rural Epidemiological (PURE) study, is a prospective cohort study that will track changing lifestyles, risk factors and chronic disease using periodic standardized data collection in urban and rural areas of 17 countries (3 high-income, 10 middle-income, and 4 low-income countries): The sample size included 156,424 persons from 628 urban and rural communities in 17 countries. The main objective of this study is to determine whether variations in the structure of urban and rural societies lead to differences in lifestyle, including nutrition, physical activity patterns and psychosocial stress and whether these in turn lead to the development of risk factors for cardiovascular diseases. MDRF is one of the five centres in India where the study is being carried out with the baseline sample of 5,241 (2,741 urban and 2,500 rural subjects) aged 35–70 years.

The PURE cohort is followed up periodically to investigate associations between social, behavioural, genetic, and environmental factors and cardiovascular diseases in these 17 countries. During the follow-up, fatal and non fatal clinical events and risk factors for cardiovascular disease were being monitored. This study has reported on the cardiovascular risk and events, as although the risk-factor burden was lowest in low-income countries, the rates of major cardiovascular disease and death were substantially higher in low-income countries than in high-income countries. The high burden of risk factors in high-income countries may have been mitigated by better control of risk factors and more frequent use of proven pharmacologic therapies and revascularization.

(iv) Center of Excellence (COE) – Center for cardiometabollic risk reduction in South Asia (CARRS) Surveillance study:

The surveillance study for Cardio-metabolic Diseases (CMD) risk factors in South Asia is a collaborative effort between Madras Diabetes Research Foundation (MDRF) and Public Health Foundation of India (PHFI), New Delhi (India); Emory University, Atlanta (USA); All India Institute of Medical Sciences (AIIMS), New Delhi (India) and Aga Khan University, Karachi (Pakistan). The primary aim of this study is to develop a model surveillance system for CMD and its risk factors which can be adopted for continuing surveillance by countries in South Asia. The secondary aim is to measure the incidence of CMD, morbidity and mortality associated with CMD and prevalence of risk factors for CMD among adults aged 20 years and above, permanently residing in well-defined urban communities.

The study design is a hybrid multi-centre model with two cross-sectional surveys 3 years. The cohort I of CARRS study, recruited representative cohorts of three metropolitan urban cities, namely Chennai, Delhi and Karachi and 4,000 participants in each site stratified by gender and age. The three follow-ups of the cohort I was completed with a representative sample of each city, 16,288 subjects aged ≥20 years (Chennai: 6906, Delhi: 5365 and Karachi: 4017). This surveillance model is proposed to generate data on prevalence and secular trends; help study the complex life-course

patterns of CMDs, and provide a platform for developing and testing interventions and tools for prevention and control of CMDs in South-Asia.

Key findings from this study included the following: (i) Six in ten adults in large South Asian cities have either diabetes or prediabetes (one in every five adults had diabetes and two out of every five adults had prediabetes); (ii) High prevalence of tobacco use in the South Asian region, particularly among men, highlights the urgency to address this serious public health problem; (iii) Socio-economic status (SES) and cardiovascular disease patterns are heterogeneous, suggesting customized interventions for different SES groups may be warranted; (iv) One in 12 individuals living in two of India's largest cities (Delhi and Chennai) have evidence of chronic kidney disease (CKD), with features that put them at high risk for adverse outcomes.

The Asian Indian living in Chennai through CARRS, were compared with Asian Indians aged 40-84 years living in the greater San Francisco and Chicago areas from the U.S. Mediators of Atherosclerosis in South Asians Living in America (MASALA) study (2010-2013). The results showed that the age-adjusted diabetes prevalence was higher in India (38%) than in the U.S. (24%), whereas, the age-adjusted prediabetes prevalence was lower in India (24%) than in the U.S. (33%). The results indicated the possible changes in the relationship between migration and diabetes risk and highlight the growing burden of disease in urban India.

Dr Priya Miranda

Scientist,
Dept. of Epidemiology
ICMR-India Diabetes Study: ICMR- INDIAB Core Group [Phase I-IV]
&
Diabetology: Advanced therapies in the treatment of diabetes in India - Clinical Islet transplantation & Research

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Research Focus in a nutshell

- Prevention and control of diabetes and obesity and
- Advanced therapies in the treatment of diabetes in India - Clinical Islet Transplantation & Research.

Identifying/developing and validating simple screening tools for diabetes and obesity

Blood glucose meters advocated in self-monitoring of diabetes are portable and relatively inexpensive. We evaluated the use of capillary blood glucose for screening for gestational diabetes mellitus in resource constrained settings (Acta Diabetologia 2015, accepted for publication). We also participated in a study looking at the role of altered circulating levels of retinol binding protein 4 (RBP4) and transthyretin (TTR) in relation to insulin resistance, obesity and glucose intolerance in Asian Indians. (Endocrine Practice 2015, accepted for publication; this work also won best oral presentation at RSSDI 2014). There is a need for simpler formulae based predictors of body fat [%] in Asian Indians suitable for routine clinical and epidemiological studies capable of predicting body fat [%] measured via duel-energy X-ray absorptiometry (DXA) and computerized tomography [CT]. We propose to develop and evaluate the comparability of two new body fat percent (BF%) formulae for Asian Indians, the “Indian BF% formulae (IBF): IBF-Anthro and IBF-CT” against duel-*energy X-ray absorptiometry (DEXA)* (BF%-DXA, gold standard) (preliminary work won best poster at Diabetes India 2013).

Identifying Glycaemic markers predicting progression to Pre-diabetes and T2DM among Asian Indians with NGT

1-hour plasma glucose (1HrPG) concentration during an oral glucose tolerance test (OGTT) is a known predictor of cardiovascular disease and chronic kidney disease. We recently reported on the usefulness of 1-hour plasma glucose [1HrPG] cut points of ≥143mg/dL and ≥155mg/dL during an OGTT as predictive cut points for future prediabetes and diabetes respectively (Priya et al, Diabetes Technol Ther. 2013). We characterized the NGT subgroups based on their 1-hour plasma glucose (1HrPG) concentration during an OGTT and studied β-cell function and insulin sensitivity in these subgroups (Priya et al, Diabetes Technol Ther., 2015). Present we aim to study the association between the 1HrPG cut-offs among NGTs at baseline comparing baseline versus follow-up beta-cell function and insulin sensitivity and the progression to prediabetes and diabetes at follow-up (Funding source: MIRF-Project 2015).

Prevention of childhood and adult obesity

Obese adolescents have a 70% to 80% chance of developing adult obesity. Via the Obesity Reduction and Awareness and Screening of Non communicable diseases through Group Education in Children and Adolescents (ORANGE) project we carried out cross-sectional study on 18,955 children (aged 6-11 years) and adolescents (aged 12-17 years) across 51 schools (31 private (n = 14252). By the IOTF criteria the prevalence of overweight/obesity was found to be significantly higher in private (21.4%) compared to government schools (3.6%), higher among girls (18%) compared to boys (16.2%), and higher among adolescents (18.1%) compared to children (15.5%). Prevalence of hypertension was 20.4% among obese/overweight and 5.2% among non-obese (OR 4.7, 95%CI: 4.2-5.3, p<0.001) (Indian Pediatrics. 2014; 51:544-549). Raw data from the ORANGE study on age, gender, height, weight and body mass index (BMI) was shared and used to construct IAP growth charts on height, weight and BMI charts for growth assessment of children 5-18 years of age and to define overweight and obesity in children (5-18 years) at the

adult equivalent of 23 and 27 cut-offs (Indian Pediatrics. 2014). Currently work is underway to construct weight, height and BMI centiles for children (5-17 years) in South, India using the Lambda-Median-Standard Deviation (LMS) method both for growth assessment and comparison with National and International standards.

Advanced therapies in the treatment of diabetes in India – Clinical Islet transplantation

Islet preparations that fall below this critical islet mass or that are awaiting a suitable recipient/tissue-typing are stored indefinitely using cryopreservation in liquid nitrogen. We studied recovery, cell death, and cell composition of post-thaw cultured human islets provided by the Clinical Islet Transplant Program, Edmonton, Canada. We examined islets processed using media prepared in accordance with Pre-Edmonton protocol versus the Edmonton protocol. While the Edmonton protocol in general preserved the islets better, culture duration adversely affects islet survival and quality. This indicates a need for further research on more optimal cryopreservation and culture techniques (Priya et al, Islets 2013). We currently propose to carry out a situational analysis and feasibility study evaluating the cost-to-benefit ratio of setting-up a clinical islet transplantation program in India.

DEPARTMENT OF FOODS, NUTRITION AND DIETETICS RESEARCH

"The doctor of the future will no longer treat the human frame with drugs, but rather will cure and prevent disease with nutrition." - Thomas Edison 1903

"We look how one's daily diet influence lives."

Honorary Senior Advisors
Dr Kamala Krishnaswamy
Former Director, NIN, Hyderabad, India

Dr. N G Malleshi
Former Head, Department of Grain Science Technology, CFTRI, Mysore

Sr. Scientist & Head of the Department
Ms Sudha Vasudevan, MSc

Jr. Scientist Food Research
Dr Shobana Shanmugam, PhD

Food Quality Analysis Lab
Mr K K Balasubramaniam, MSc
Ms Poovizhi, MPhil
Mr Jakir M, MSc (PhD Student)

Research Associate
Dr Ruchi Vaidya, PhD

Research Nutritional Biochemist
Mookambika Ramya Bai, MPhil

Nutrition Research Data Analyst
Lakshmipriya N, MSc

Sr Research Nutritionists
Geetha G, MSc
Gayathri R, MSc
Vijaylakshmi P, MSc

Research Dietitians
Kalpana N, MSc
Kavita V, BSc
Gayathri N, BSc
Divya S, BSc

Research cook
Prema A

The Department of *Foods, Nutrition and Dietetics Research* under the supervision of Ms. Sudha Vasudevan came into being in the year 2004 with the primary objective to study and evaluate the nutrition determinants of chronic diseases such as diabetes and heart diseases through epidemiological and intervention studies. Cross-sectional and cohort studies in the southern region as well as national study to assess the populations' dietary habits in relation to diabetes prevalence, incidence and associated components of metabolic risk are being carried out. The department routinely conducts Glycemic Index (GI) testing of foods, a validated method to assess their glycemic property. FNDR in MDRF is the only Centre in the country to conduct such GI testing after validating its methodology with one of the internationally recognized GI testing Centres. The department handles GI testing for R&D projects funded by both national and international Government agencies as well as food industrial clients manufacturing GI related products. The Department has further grown and is now equipped with more sophisticated infrastructure in the past few years particularly the 'Food Quality Analysis Lab' to handle detailed macronutrient analysis. This further made possible to conduct intervention trials and enhanced the precision of

both acute and chronic feeding trials of various diets with known nutrition composition and their effects on glycemic, insulinemic and lipemic markers to delineate the nutritional factors associated with diabetes risk in particular. Further these applied research studies helped to translate and evolve with unique evidence based healthier food choices being identified or developed. The highlights of such products in the last 3 years are Dr. Mohan's High Fibre Rice and Dr Mohan's Atlas of Indian Foods.

Vision:

"To build Foods and Nutrition research on par with international standards and develop 'science based' health foods be available, accessible and affordable to people in general for healthier lifestyle".

Mission:

To conduct well designed nutrition epidemiological studies and food based clinical intervention trials to identify the research needs outcomes to further process and develop scientifically proven healthy foods.

CURRENT ACTIVITIES OF THE DEPARTMENT

A. PROJECTS (2012-2015)

I. NUTRITION EPIDEMIOLOGY

Altered lifestyle factors such as diet and physical activity are the key modifiable risk factors to halt the growing epidemic of diabetes and prediabetes in India. Hence large epidemiological studies planned and executed had an arm on dietary assessment. Food Frequency Questionnaire was for the first time developed and validated to assess the dietary intake and dietary habits of the Chennai urban population to understand the potential impact of diet on the risk of diabetes. Other key goals are to generate new hypotheses about diet and disease, to produce evidence that supports or reflects existing hypotheses and to assess the strength of diet-disease associations. The department has

undertaken many such valuable epidemiological studies last few years are given below:

1. CURES Cohort Study (10 yr follow up)

The baseline survey of CURES was performed between 2001 and 2003 on 26,001 individuals of both genders aged 20 years and above. At baseline, details pertaining to demography, socio-economic status, medical and family history of diabetes, physical activity, tobacco and alcohol use were elicited using a structured, and Dietary details were assessed using a validated meal-based semi-quantitative food frequency questionnaire (FFQ). The same participants were followed up for 10 years. All necessary anthropometric, biochemical and clinical measurements were obtained both at baseline and follow up period using standardized protocols. The diet data was further analyzed to study the changes in the diet over this period and its relation to incidence of diabetes. The expected study outcomes include identifying an evidence based healthy dietary pattern among the study population to prevent and manage type 2 diabetes and co-morbidities. In future this evidence will help to develop evidence based dietary guidelines and strategies to reduce the burgeoning burden of diet related non-communicable diseases in India.

Status: Methodology completed, Analysis ongoing

Funded by: Chennai Willingdon Corporate Foundation, Chennai

2. Indian Council of Medical Research–India Diabetes (ICMR–INDIAB)

Funded by: Indian Council of Medical Research

The Indian Council of Medical Research–India Diabetes (ICMR–INDIAB) study designed, being conducted to assess the prevalence rates of diabetes and its associated risk factors including dietary profile of Asian Indians covering all 28 states, the National Capital Territory of Delhi, and two of the union territories in the mainland of India. Our earlier meal based FFQ was further improved to accommodate all regional dietary choices in the FFQ and further validated with biomarkers. Every fifth study participant's detailed dietary intake was collected

with this FFQ. To improve the precision and accuracy of diet data collection, a unique visual atlas of real foods' images with the portion sizes were used. This atlas enabled the participants' recall with greater precision.

Phase I of the study included 3 states and 1 union territory namely Tamil Nadu, Maharashtra, Jharkhand and Chandigarh. Data quality checking and data entry was completed.

Phase II comprises of the 8 North-Eastern states out of which 4 states the data collection has been completed and these are Assam, Arunachal Pradesh, Tripura and Mizoram. Manipur and Meghalaya data collection is over and the data quality checking is underway. The remaining 2 states Sikkim and Nagaland are yet to commence.

Phase III included 17 remaining states and 1 union territory and capital territory Delhi. Among these states 5 states the dietary data has been collected and these states are: Bihar, Karnataka, Andhra Pradesh, Gujarat and Punjab. Currently the data quality checking is ongoing.

Status: Data collection and entry of 13 states completed.

3. Nutrition shift and type 2 diabetes in rural Tamil Nadu: disease perceptions, etiology, and solutions

Funded by: Population Medicine department, University of Guelph, Canada

The scope of this study was to provide unique EpiNu database linked online FFQ data entry module to Mr. Mathew Little Phd research project work which was conducted at rural villages Anchetty and Peraiyur, Tamilnadu, India. This project was aimed to provide food and nutrient intake of the study participants.

Prior to the start of the study, research team of Mr. Mathew Little was technically trained for both FFQ collection and online entry, by the department trained research nutritionists. Technical support was rendered by MDRF team till the study completion.

Status: Completed

II. NUTRITION INTERVENTION TRIALS

The department conducts the effect of various dietary intervention trials on the risk reduction of diabetes in normal healthy individuals / overweight and obese and those with non-communicable diseases such as diabetes. The thrust dietary areas and components include health foods and functional ingredients on glycemic response and other biomarkers like inflammatory markers, lipid profile, etc. Both short term and long term such intervention trials are carried out after getting the approval from the Institutional ethical Committee and the consent of the participants.

Projects Completed (2012-2015)

1. Continuous Glucose Monitoring Trials

The continuous Glucose Monitoring system (CGMS^{TM}) is an innovative instrument that records interstitial glucose value every 5 minutes providing a detail view of the glucose profile, to show potentially when and to what extent the dietary intervention affects the glycemic excursion. The other major advantage with this new technology is that the monitor can be worn unobtrusively, allowing the subjects to continue his/her daily living. The CGM is mostly used for therapeutic purpose and for the first time in the country at our center we have used this instrument to provide a unique insight about diet and 24 hr glycemic response. We have so far completed 3 CGM studies the details are as given below;

i)Brown Vs White rice:

Funded by: Heinz Nutrition Foundation of India.

Statistical analysis was supported by Harvard School of Public Health.

Fifteen overweight Asian Indians without diabetes aged 25–45 years participated in a randomized crossover study. Test meals (non-isocaloric, ad libitum) were identical except for the type of rice and the addition of legumes (50 g/day) were provided for 5 consecutive days. Glucose profiles were assessed using the Medtronic mini med (Northridge, CA) iPro_2 continuous glucose monitoring

device. Fasting serum insulin was measured prior to and at the end of each test diet. There was significant 20% reduction in the 24 hr glycemic response in brown rice compared to white rice as estimated by incremental area under the curve (IAUC). Fasting insulin reduced by half after the 5 days of feeding with brown rice.

Status: Completed and scientific findings have been published in peer reviewed journal.

ii) **High fibre rice Vs. White rice:**

Funded by: Inhouse

In a randomized cross-over design, 18 obese (body mass index ≥25kg/m^2) non-diabetic subjects aged 25-45 years were provided iso-caloric (~2000 kcal/ day) BPT white rice (BPWR) (commonly consumed white rice) and a unique, specially developed high fibre (as resistant starch) white rice (HFWR) based diets on 2 non-consecutive days to compare the 24hr glycemic response. The 24 hr incremental area under the curve (IAUC) for HFWR showed around 20% reduction compared to regular white rice and also showed a significant reduction in the 24 h glycemic response. Replacing regular white rice with this unique HFWR may help to reduce the 24 hr glycemic response among obese Asian Indian adults who are at a higher risk of developing type 2 diabetes. This rice shares good sensory and cooking properties similar to regular white rice and good for those who cannot tolerate brown rice.

Status: Completed and presented as e-poster at Advanced Technologies and Treatments for Diabetes Conference at Vienna, 2014

iii) **Ragi Vs White rice:**

Funded by: ICMR-Adhoc

In a randomized cross-over design, 14 participants with normal BMI (body mass index <22.9 kg/m2) aged 20-45 years were provided iso-caloric (~2200 kcal/ day) finger millet and white rice based diets for 5 consecutive test days. The menu was identical on both the test diet days except for the rice and finger millet

component served in the meal. The study revealed no significant difference between ragi and white rice based diets.

Status: Completed, scientific manuscript preparation is underway.

3. **Substituting brown rice for white rice: Effects on diabetes risk factors in, India.**

   Funded by: National Institute of Health Fogarty R-O3

   Approved by: Indian Council of Medical Research, Ministry of Health and Family welfare, Government of India

Nearly half of daily energy (46.9%) intake came from refined grains, and white polished rice constituted over 75.8% of refined grain intake. Given the compelling evidence from observational studies of whole grains and type 2 diabetes, a randomized cross over trial to determine whether brown rice substitution at meals for 3 months was effective in lowering the type 2 diabetes risk. Fasting biomarker measurements including glucose, insulin, HbA1c, lipid profile, high-sensitivity C-reactive protein (hsCRP) were taken before and after the substitution. Glycemic index of brown rice and brown rice based dishes were further estimated to explain the effect of brown rice substitution for white rice.

Status: methodology completed and data analysis is ongoing

4. **Effects of common Indian cooking oils on insulin sensitivity-A cell based study**

   Funded by: Kaleesuwari Refinery Private Ltd (KRPL)

Recent studies from our centre have highlighted the association of different types of cooking oils on metabolic syndrome. Cooking oils with varying content of SFA, PUFA and MUFA were chosen for the study. The HepG2 liver cells, L6 skeletal muscle and 3T3 L1 adipocyte cells were cultured in a medium. The cooking oils were added to the medium at different time points. Insulin sensitivity was studied by insulin stimulated glucose uptake assay. The gene expression on enzymes involved in fatty acids synthesis, gluconeogenisis and fatty acid oxidation and these expressions were studied using realtime PCR. The study outcomes

showed that canola, cardialife, rice bran, soybean, mustard, coconut and olive might be beneficial for insulin resistant/type 2 DM subjects. Heating of sunflower oil might lose its beneficial properties.

Status: Completed and the scientific manuscript preparation is underway.

5. **Dietary phytosterol supplementation and their effects on Inflammatory status: A Intervention Trial Study among Overweight Obese South Indians**
   Funded by: BASF India Limited

Plant Sterols possibly ameliorate inflammatory markers, by imparting beneficial alterations in the membrane composition which may subsequently alter the immune response by influencing the synthesis and secretion of eicosanoids, leukotrienes, and prostaglandins. The aim of this study was to look at the effects of dietary phytosterols supplementation on the inflammatory status of overweight obese subjects. Pilot randomized feeding trial (Parallel design) with 150 overweight (includes both male and female) adults consumed vanilla flavored phytosterol enriched skimmed milk as test beverage and plain vanilla flavored skimmed milk as control beverage for 3 months. This study will be an exploratory intervention trial to demonstrate anti-inflammatory effects of phytosterol enriched milk

Status: Methodology completed and data analysis is ongoing

6. **Effect of cashew nut supplementation on glycemic status and lipid profile in type 2 diabetic subjects**
   Funded by: Cashew nut export promotion council of India (CEPCI)

Nuts are energy dense foods and the unique nutrient composition of nuts may confer metabolic benefits. Not many studies have been done on the health benefits of home grown cashew nuts commonly consumed nut in India. We aim to look at the effect of cashew nut consumption on the glycemic, status and lipid profile in the chosen type 2 diabetic subjects. A parallel arm randomized control

trial design was conducted with 300 adults with type 2 diabetes. The participants were provided 30g cashew nut for 3 months adjusted with their diabetic diet for total calories.

Status: Methodology completed, Analysis ongoing

Projects Ongoing (2015)

7. **Assessment of dietary Ages (dAGEs) and to evaluate the effect of dAGEs on inflammatory markers in subjects at risk for type 2 diabetes**

   Funded by: Department of Biotechnology

Dietary advanced glycation end products (dAGEs) and its effect on diet related non- communicable diseases are limited even at international level and no such studies are available at the national level. The present study aims to determine AGE content of the commonly consumed Indian foods and conduct a feeding trial in humans using high and low AGE diets to study its effect on metabolic risk factors. The dAGE content of commonly consumed foods identified from the Chennai urban dietary data of CURES study was further considered for dAGE estimation. Inter laboratory validation was carried out for the dAGE estimation between MDRF and Sastra University. Overweight participants (n=50) were identified and will be enrolled for the cross over intervention trial with low and high dAGE diets.

Status: dAGE content of common indian foods been done and the feeding trial to commence.

8. **Carbohydrate profiling of traditional and processed Indian foods with special emphasis on resistant starch and its health benefits - Evolution of Women Entrepreneurs**

   Funded by: Department of Science and Technology

Recent epidemiological evidence both from our earlier findings from CURES study and elsewhere in the country had shown that refined grains a major component of the Indian diets today (contributing half of the daily calories) are associated with attenuated risk for metabolic syndrome and diabetes. However

when further evaluated for those refined grains based food choices in the diets, it showed that urban adults still continue to consume traditional foods such as *idli, dosa, upma* etc., and not the so called westernized choices such as white bread and pizza. This suggested the need to determine the complete carbohydrate profiling including the quality of carbohydrates (measured by GI) of both the traditional and the contemporary processed Indian foods. Based on the GI of these foods a pilot feeding trial to study the effect of traditional whole grains such as whole wheat and unpolished millets based diets (iso-caloric) with the polished rice for the 24 hr glycemic response using continuous glucose monitoring will be conducted.

Status: Carbohydrate profile of both traditional and contemporary Indian foods completed. Glycemic Index testing of selected foods are also being done and the continuous glucose monitoring study is to be scheduled for further evaluation.

Projects Commenced (2015 onwards)

9. **Evaluation of Dr Mohan's low Glycemic index rice and development of its value added products for management of type 2 diabetes**

   Funded by: DBT BIPP to Dr. Mohan's Health Care Products Pvt Ltd (DMHCP) and MDRF-FNDR department is the R&D incubator for DMHCP in this project.

Studies by our group among urban adults have indicated that our diets have still not moved away from traditional meal choices to westernized choices but the quality of these foods choices have drastically changed (to refined grains such as polished rice) and associated with an increased risk for type 2 diabetes. Recently, our group has shown that the average adults in Chennai consumed about 250g/day (uncooked rice) of polished white rice of high glycemic nature which is devoid of many important functional constituents like dietary fibre and other micro nutrients. Further research also showed that the perceptions of the urban consumer for healthier staple options such as brown rice are poor. Consumers continue to demand polished white rice. With this background the R & D work carried out in collaboration with Texcity Biosciences Pvt Ltd, resulted in

the discovery of Dr Mohan"s High Fibre (DMHF) Rice variety for commercialization. DMHF rice has already been clinically proven for its high fibre content and lower GI value compared to regular white rice varieties. In the current study, we aim to test the efficacy of DMHF rice for the population at risk and with type 2 diabetes through randomized intervention trials. This in turn may help to promote its adoption among larger sections of diabetic population as well as other high risk populations.

Status: Project has been awarded and the first milestone fund is awaited.

10. **A Pilot Study to Evaluate the Effectiveness of Transcultural Diabetes Nutrition Algorithm (tDNA) on Glycemic Control and Quality Of Life in Obese Indian Type 2 Diabetes Mellitus Patients Investigator Initiated Study**

    Funded by: Abbott Nutrition International, Mumbai, India

In India, it is observed that at least 2% of Indian population dies of diabetes and its complications every year and the deaths from diabetes are estimated to increase by 35% by 2015. Treatment of diabetes requires comprehensive care involving use of anti-diabetic medications and modification of diet and lifestyle provided by a multidisciplinary team (physicians, nurses and nutritionists). Dietary modifications that limit hyperglycemia following a meal are crucial in limiting the complications of diabetes. Hence the present study aimed to compare the effect of diabetes specific nutritional supplement with dietary counseling and physical activity as per tDNA-PATh Tool Kit versus standard of medical care (dietary counseling and physical activity) on HbA1c, FPG, PPG, lipid profile, BMI, waist circumference and quality of life using the tool 'Quality of Life Instrument for Diabetics' (QOLID) of type 2 diabetes mellitus patients over a period of 90 days. Randomized, open-label, comparative, single center, investigator initiated pilot study that will be conducted in 120 obese patients with type 2 diabetes.

III. FOOD RESEARCH

1. Glycemic Index (GI) Testing of Foods

Glycemic Index (GI) is a concept to classify different carbohydrate foods in the diet according to their effect on postprandial glycemic response. It is ranked on a scale of 100 being the GI of glucose. Our department in MDRF established GI testing facility after validating with the inter laboratory studies with certified GI testing laboratory at UK and evaluated over 100 foods since then. In the last 3 years additional 30 foods completed and another 10 foods ongoing for GI testing and this include foods both from the industry (proprietary) as well as from R&D projects funded by national and international Governmental funding agencies. Institutional Ethical committee approval has been obtained prior to the GI testing for foods as this testing is done with healthy human volunteers.

2. Nutrition profiling of household *Poha* and *Upma* recipes- Southern region & online recipe entry support to Delhi and Mumbai (north-western region)

Funded by: Pepsico Ltd

The scope of this study was to collect recipe and identify the variation in the nutritional profile of *Poha* and *Upma* across different recipe styles. This study was conducted in women from randomly selected households fulfilling domicile status of 10 years in Chennai. Detailed recipe for Rice flakes (*Poha*) and semolina (*Upma*) were collected from all the study participants. Participants were asked to demonstrate the preparation method and it was supervised by trained research dietitians. Total cooked weight and serving size were recorded to calculate nutrition profile of *Poha* and *Upma.* The second phase of the study was to provide online recipe entry support to North West regions. Study was conducted in collaboration with 3 leading independent nutrition research institutes in India (Chennai, Delhi and Mumbai).Exclusive online recipe entry module and online entry guide were provided to Delhi and Mumbai site to enter all the collected recipes and it was linked into EpiNu database. Nutrition profile was calculated for Chennai, Delhi and Mumbai households.

Status: Completed

2. **Preparation of convenience food products from finger millet and evaluation of their glycemic properties**
   Funded by: Indian Council of Medical Research- ICMR-Adhoc

Finger millet (Eleusinecoracana L.) (FM) known commonly as *'Ragi'* is rich in dietary fibre and the millet preparations are believed to be suitable for individuals with diabetes. However, there are no systematic studies to support this. Food products with lower glycemic property are in great demand. Hence the study aimed to develop FM based decorticated millet with lower polish (DFM), flakes (FMF), vermicelli (FMV) and extruded snack (FMES) (both FMV and FMES with 7-8% added soluble fibre) and their glycemic properties were evaluated using validated protocols.

Status: Study methodology completed. Manuscript under preparation.

3. **Effect of Irradiation on Shelf Life, Carbohydrate Profile and Glycemic Properties of Parboiled Indian Brown Rice Varieties**
   Funded by: Board of Research in Nuclear Sciences (BRNS)

Brown rice (BR) a whole grain is rich in micronutrients, phytonutrients, dietary fibre and has shown good promise in reducing glycemic response. However, the poor storage stability (insect infestation and rancidity) of BR is a limiting factor to popularize it. Reports have shown that gamma irradiation may extend the shelf life, and induce positive chemical changes in the starch. There exists paucity of information on the storage stability and glycemic properties of gamma irradiated Indian BR varieties. The study was aimed 1) to study the effect of irradiation on the storage stability of Indian brown rice varieties. 2) to evaluate the sensory attributes and cooking characteristics of irradiated Indian brown rice varieties. 3) to examine the effect of irradiation on the carbohydrate profile of Indian brown rice varieties and its relation to GI (Glycemic Index).

Study status: Methodology Ongoing

4. **Consortia Research Project on Biofortification in selected crops for nutritional security**

Funded by: Indian Council of Agriculture Research (ICAR)

The millet flour samples were sent by All India Co-ordinated small millet improvement project (AICSMIP) Centre, Bangalore. Little millet samples both in the raw and parboiled forms were processed to prepare unpolished and polished millet to examine the effect of polishing on the mineral (Fe) content, anti-nutrient levels and bioaccessability of Fe. The little millet was also germinated to examine the aforementioned effect. The major objectives were 1) to enhance the bio-accessibility of iron from finger millet, foxtail millet, little millet through processing technologies 2) to develop small millet based foods suitable for mid-day meal schemes 3) to determine the acceptability of small millet based foods in school children. White ragi has higher mineral content than other samples taken for analysis followed by little millet (JK8 variety) and Foxtail millet (Suryanandi SU). The aforementioned millets with higher mineral contents can be exploited for the development of foods suitable for mid day meal schemes. Wheat flour and the little millet flour (J-k8) had higher protein contents, hence may find utilization in development of protein rich foods for school children. White ragi has a lower fat content, hence may have better shelf life.

Study Status: Ongoing

FOOD AND NUTRITION TRANSLATION RESEARCH 'GO TO MARKET'

Development of Products (2012-2015)

1. Dr. Mohan's Atlas of Indian Foods

Indian Food Composition tables provide nutritional values for the edible uncooked food materials. Great challenge to translate these values to the cooked foods with various portion sizes. Both epidemiological studies aimed to assess the dietary habits of the population as well as at the clinical setting of dietary counselling suffer from lack of appropriate database on the nutritional values of the cooked Indian foods. This scenario is further compounded with the vast Indian culinary habits due to regional differences. Over last 7 years R&D work at

the department captured the frequently consumed most common Indian foods across regions of India both at rural and urban areas and short listed more than 200 such foods. Further assessment on the various portion sizes of these foods being consumed. Digital images of these foods were compiled for the standardized portions sizes such as s, m, l and XL etc. Further specific deep fried foods were chemically analyzed for their fatty acid composition. Thus evolved a unique innovative book, Dr.Mohan's Atlas of Indian Foods was launched in the year 2013. Atlas of Indian food is primarily a tool for assessing food intake and developed to assist individuals in estimating food intake to improve the quality of nutritional assessment, counseling and education in India. This Atlas is a tool boon not only to medical fraternity but also to beneficiaries such as patients, students and care givers of the families in the community. This Atlas contain colorful pictorial representation and main nutritive value for more than 200 commonly consumed foods in India from both commercial (outside eatery, fast foods, restaurants, hotels) and non- commercial (home) sources. Indian diets continue to be meal based and the foods in the atlas were chosen to include the most commonly consumed choices in the 3 main meals namely breakfast, lunch, dinner and other foods such as animal foods, snacks, fruits, nuts, beverages and sweets. It also contain information on edible portion weight, portion size (small, medium, large, extra large), portion tools such as cup, spoons, ladles, plates and description of foods.

2. Dr Mohan's High Fibre Rice

Partnered with agriculture scientists, both our department in MDRF and Dr Mohan's Health Care Products Pvt Ltd developed a hybrid rice namely Dr Mohan's High Fibre Rice (DMHF Rice) through classical breeding approaches, after intense biochemical screening of rice germ plasm of over 200 varieties in the *'white ponni'* lineage. It was developed by employing a conventional plant breeding method, "mutation breeding". Mutation breeding is an ancient plant breeding method adopted by plant breeders throughout the world from 1960s and more than 2250 crop varieties have been released globally for cultivation

and human consumption out of which 305 varieties have been developed in India. It is a rice variety (*Oryza sativa*), with 5 times higher dietary fibre content (even in its polished form) compared to regular white rice. It is very similar to other polished rice varieties in terms of appearance, cooking properties, taste and texture. It does not contain any additives or preservatives. The shelf life of the rice is 12 months and it can be stored in dry, air tight containers at room temperature. Dr Mohan's high fibre rice was launched in 2013 and it is the first of its kind in India. It contains lower GI compared to commercial white rice and serve as a healthier option for the type 2 diabetes patients. This rice has been introduced in the Tamil Nadu open market (all retail outlets and popular super markets) and also in the Dr Mohan's DSC outlets across DMDSC (expand) branches in India.

FNDR department as an incubator for health foods vertical Dr Mohan's Health care products Pvt Ltd. Almost 2300 Atlas of Indian foods, 19000kg of brown rice and 37000kg of High fibre rice has been sold during the year 2013-2015.

Products in pipeline:

Many value added products based on brown rice, DMHF rice and unpolished millets are under formulation. These products once developed will be clinically evaluated before being introduced in the open market through DMHCP. The list below need not be given.

Food Quality Assurance Laboratory (FQAL)

The Food Quality Analysis Lab is well equipped with state-of-art instruments to analyze composition of raw foods as well as finished products. The facility caters both to in house and also extends its services to food producers. The FQAL supports most of the FNDR projects by supporting the estimation of food composition in terms of proximates, dietary fibre, available carbohydrates, fatty acid profile, volatile contents, sodium and many such elements. The laboratory

measures almost 600-700 samples every year for the estimation of the above mentioned food composition. The laboratory is equipped with HPLC- High performance liquid chromatography, GC-Gas chromatography, Protein analyzer, fibre-tec for total dietary fibre estimation, lyophilizer, Flame photometer, UV spectrophotometer, pH meter, shaking water bath (Linear & Orbital) and Moisture Analyzer.

Modernization and expansion of R & D facilities of Madras Diabetes Research Foundation

Scheme: ICICI Bank (TI Program of World Bank)

This proposal focuses on establishing food processing facilities for production of evidence based health foods (low GI convenience foods, low fat bakery products, low calorie health beverage in particular) using rice, wheat and millets as major components, expansion of food quality analysis lab for analysing the proposed health foods and formulation of business development program for marketing the same. The objectives of the proposal includes 1) Establishing and expanding the food processing facilities at MDRF with necessary equipment and machinery which will facilitate the development of clinically proven, evidence based low Glycemic Index (GI) health foods such as ready-to-cook convenience foods, low fat, high fibre snacks, health beverages etc. 2) Up gradation of Food Quality Analysis Laboratory (FQAL) facilities to cater to the needs of product development and clinical evaluation of the proposed health products which are to be developed. 3) Establishing a bio-bank (liquid nitrogen facility) for storage of blood and other biological samples obtained from the epidemiological and intervention studies.

FOODS NUTRITION AND DIETETICS RESEARCH TEAM

FNDR - Nutrition and Dietetics Research Team

FNDR - Food Research and Food Analysis Team

DEPARTMENT OF TRANSLATIONAL RESEARCH

Genes may load the cannon, but it is always the environment that pulls the trigger" - Elliot Joslin

Taking research from bench to bedside and ultimately to the community. We implement programs for the betterment of the health of the community.

HOD & Senior scientist
Dr Ranjani Harish

Project Coordinators
Ms Vijaya Sukumar
Ms Lakshmi K

Project Executive
Mr Pandiyan D

Research Assistants
Mr Jagannathan N
Ms Mridula Kapil
Mr Satish Kumar D

Senior Data Entry Operator
Mr Ganesh M

Lab Technicians
Ms Eswari D
Mr Deva Irakkam P
Ms R Mona
Mr Selva Sundaram K
Ms Kavitha M

PhD Students
Ms Sonya J
Ms Mehreen Begum TS
Ms Shruti Muralidharan

Student Interns
Ms Sharfaa Junaid
Ms Martha Ryan
Ms Pranati Laxmi Panuganti

The department of Translational Research known as the department of Community Medicine until August 2008, was established in August 2004. Translational Research better describes the primary function of the department which is to translate current and previous research on diabetes and non-communicable diseases [NCDs] prevention and control into action at the community level. Translational research basically transforms currently available evidence based knowledge into useful measures for everyday clinical and public health practice. Presently under the supervision of

Dr. Ranjani Harish – Senior Scientist and Head, the department approaches diabetes and NCDs prevention in the community through primordial prevention, primary prevention, secondary prevention and tertiary prevention.

Vision: To promote health, to preserve health, to restore health when it is impaired, and to minimize suffering and distress

Mission: To promote, preserve and restore health by focusing on prevention strategies -

Etio-pathophysiology of Diabetes including knowledge of causation, dynamics of the disease and identification of risk factors and risk groups

Prevention strategies such as, availability of prophylactic measures, early detection measures, and continuous evaluation of implemented preventive measures and treatment measures

A brief description of the activities of the department is provided below.

CURRENT ACTIVITIES OF THE DEPARTMENT

Obesity Reduction and Awareness of Non communicable diseases (NCDs) through Group Education (ORANGE) – Phase II (ORANGE II study

Timeline: 2015 to 2017

The Phase I of ORANGE project was planned as a cross-sectional field survey that measured the prevalence of obesity in school children and adolescents. Additionally, the prevalence of glucose intolerance and other NCD risk factors in the community were studied which formed the groundwork for planning intervention studies to prevent obesity and NCD's in the Phase II of ORANGE study. The two components of the study are described below -

SCHOOL COMPONENT

The school-based intervention is being carried out among 2351 adolescent students belonging to 6th and 7th grades spread across ten schools for over a period of five months with the use of multi-pronged strategies to increase the knowledge and alter students' attitudes about healthy lifestyle practices. The program is based on the *social cognitive theory* and recognizes the influence of psychosocial, behavioral and physical factors. All the intervention/survey material developed for the project has been pilot-tested and modified as per the feedback received and administered by Public Health Foundation of India (PHFI) - *Health Related Information Dissemination Amongst Youth* (HRIDAY) group in their ongoing project in Delhi. A total of 1481 adolescents from six schools will be part of the control group who will be screened for anthropometric measurements and will not receive any intervention program. Anthropometric measurements and clinical markers

like acanthosis nigricans, double chin, hirsutism (females) and skin tags will be assessed twice (at baseline and post intervention) in both the intervention and control school students.

At the end of the activity classes and the end of the intervention period (month 6), the teachers and peer leaders of the intervention group will be invited to participate in focus group discussions to measure program acceptability and obtain feedback that can be used to continue improving the program.

COMMUNITY COMPONENT

A total of 1519 children and adolescents aged 6-19 years who were screened as part of the community component of **O**besity **R**eduction **A**nd **N**on communicable disease awareness through **G**roup **E**ducation (ORANGE-I) during 2008-2011 are being followed up to assess the prevalence of obesity, dysglycaemia, metabolic syndrome, dyslipidemias, polycystic ovary syndrome (PCOS), fibrocalculus pancreatic diabetes (FCPD) and cardiometabolic risk factors.

Every child will be selected for an ultra sound abdomen (USG) scan for fatty liver and PCOS. The criteria for the same being high risk children and adolescents who fulfil one or more of the following: i) prediabetes and/or type 2 diabetes ii) abnormal lipids iii) abnormal insulin levels iv) abdominal and/or generalized obesity v) Ferriman Gallwey score indicating PCOS in girls alone vi) abnormal thyroid and testosterone in girls.

Built Environment and physical ACTIVity – INDIA study (adolescent component) – (BE ACTIV INDIA! Study)

Timeline: 2015 to 2018

This project will be the first of its kind in India. Targeting novel methods to increase physical activity (PA) levels and consequently improve metabolic health in the population at large is the need of the hour. Our project is unique in that we are trying to use novel technology [accelerometry to measure PA; Global Positioning Systems (GPS) and Geographic Information System (GIS) methods to map the environment] to assess PA patterns, barriers and locations to examine the associations between physical activity (objectively measured by accelerometry and subjectively measured by questionnaires), the built environment and metabolic health (body weight/ glucose intolerance/ insulin resistance/ blood pressure/ lipid abnormalities) in adolescents aged 12-17 years in Chennai, South India.

The study is being conducted in Chennai city. Since the primary aim of the study is not to estimate prevalence rates, but to study associations, a single metropolitan area was selected. Chennai has 200 wards and three *Census Enumeration Boards* (CEBs) have been randomly picked from each ward. The CEBs is selected in such a way that they are atleast 1.5 kms apart from each other so as to ensure diversity in the built environment (BE). In each CEB, a single street is randomly picked and a household with an adolescent aged 12-17 years will be purposively selected by “door-to-door” recruitment. Thus a total of 600 adolescents will be identified from 600 CEBs.

Mobile health technology for the prevention of type 2 diabetes (mDiab Study)

Timeline: 2015 to 2018

mDiab is a multicenter (Chennai, Bengaluru and New Delhi) Randomized Control Trial that aims to implement and evaluate the effectiveness, cost-effectiveness, and sustainability of a reality TV based diabetes prevention program administered through a mobile phone application. The content of the reality TV based diabetes prevention program (DPP) is based on the D-CLIP curriculum.

The project will randomize 1500 “high-risk” individuals into intervention and control groups. The intervention group will receive the mHealth intervention which will deliver reality TV based diabetes education. This will be administered through the mobile phone app developed by Jana care Solutions Inc., Bengaluru. The control group will receive usual care as defined by a one-time consult with a dietitian followed by provision of a brochure on healthy living. The groups will be followed up for 6-8 months after the 3-4 months intervention to check for sustainability and outcomes. The expected outcomes from the study are i) 5% decrease in bodyweight ii) Improvement in cardio metabolic risk factors such as fasting and 2 hour glucose, HbA1c, insulin, lipid profile, iii) Improvement in behavioural and social variables such as increase in physical activity, improved quality of life (QOL) and adoption of healthier diet and lifestyle behaviours.

Arogya World’s mHealth Diabetes Prevention and Control Study

Timeline: 2015 to 2018

Building on the success of mDiabetes, a one-million person diabetes prevention text message program in India, Arogya World (www.arogyaworld.org) is embarking on the next phase – mHealth2.0. As part of mHealth2.0, Arogya World, a global health non-profit organization working to prevent non-communicable diseases (NCDs), is building a chronic disease prevention mobile ‘app’ or platform targeting Indian smart phone users and working professionals, helping them make lifestyle changes known to prevent chronic diseases. Madras Diabetes Research Foundation (MDRF) is a clinical partner in

this venture. The mobile app is a food tracker backed by the food atlas developed by the MDRF and also measures the Indian Diabetes Risk Score (IDRS) of the users.

Effectiveness of the App is being tested in a randomized control trial among Healthy Workplace employees in Bengaluru who consent to participate. Some of the consenting employees get the App (Experimental) immediately and others (Control) get it only after the study is over. The study will recruit 2000 – 3000 participants from workplaces. Individuals with normal glucose tolerance, pre-diabetics and those with diabetes will be eligible to participate in the study. All individuals will have to give their formal consent to participate in the study. In addition to behaviour change, biomarkers are being measured (blood and urine samples of the consenting employees will be obtained) at 3 time points – at baseline, when the six-month program ends, and after a six-month post-trial follow-up period. BMI, waist circumference and blood pressure are also being measured. The study is expected to complete in one year.

Comparison Among Methods of Retinopathy Assessment (CAMRA Study)

Timeline: 2013 to 2014

Fundus photography is a convenient though expensive tool for the assessment of diabetic retinopathy (DR). A new alternative is to use a smartphone camera. The purpose of this study was to compare the effectiveness of 3 fundus photography modalities to detect DR.

Three hundred diabetic patients (600 eyes) were recruited at a tertiary care center in Chennai, India. 3-field nonmydriatic (NM) photography was performed using the Nidek [NIDEK Co., Hiroishi, Japan] Model AFC-230. Next, the patient's eyes were dilated and photographs were taken using the iPhone 5 (Apple, Inc., Cupertino, CA), Filmic Pro software [Cinegenix LLC, Seattle, WA] and a 20D condensing lens using previously reported techniques. Then 7-field photography was taken with the Zeiss FF450 Plus [Carl Zeiss Meditec, Inc. Dublin, CA]. Photos were reviewed in a masked fashion by two retina specialists for presence and severity of DR. Presence of macular edema or a grade worse than severe nonproliferative DR was considered sight threatening (STDR). SP photography offers advantages such as connectivity, portability and low cost. The

SP was less sensitive for detection of DR compared with NM imaging. However, they performed similarly for detection of STDR. We determine that this technique of SP photography is inferior to NM fundus photos for screening of DR in this population. As SP technology and advanced optics improve, we feel that future technologies have potential to become reasonable alternatives to traditional fundus cameras in telemedical screening.

Ref: 5/4/8-8/11/NCD – II: An evaluation of clinical and molecular biomarkers in adolescents in relation to insulin resistance and obesity – 2012-2015

Timeline: 2012 to 2015

To study inflammatory markers in select adolescents from ORANGE colony cohort. Paper being written up. Data also presented at RSSDI 2014

Beta cell function in youth with type 2 diabetes and its association with atherosclerosis (Young Diab Study - YDS)

Timeline: 2008 to 2011

Participants for this study were selected from those registered at Dr.Mohan's Diabetes Specialties Centre. 'Cases' were type 2 diabetes mellitus (T2DM) participants who had age at onset below 25 years, good response to oral hypoglycemic agents, stimulated c-peptide > 6.0 pmol/ml, GAD antibodies negative and willing to give informed consent. Age and sex matched 'controls' were selected from another ongoing community project which covers the whole of Chennai city.

Oral glucose tolerance test (OGTT) with glucose and insulin measures at 0, 30, 60, 90 & 120 minutes, anthropometry, and abdominal CT scan were performed after consenting all cases and controls. When compared to other risk factors like BMI, Waist and insulin resistance, β-cell dysfunction occurring early in the natural history may be a key factor in pathogenesis of T2DM in Asian Indians. The role of β-cell dysfunction was an important contributing factor to the early development of T2DM which was evident from this study.

TEAM PHOTO

(From left to right) First row: Jagannathan N, Deva Irakkam P, Ranjani Harish, Mehreen Begum TS, Shruti Muralidharan. Second row: Sundaraselvan K, Ganesh M, Kavitha S, Mridula Kapil Verma, Easwari D Third row: Pandiyan D, Vijaya Sukumar, Mona R. Missing in this picture: Sathish Kumar D, Lakshmi K, Sonya J

DEPARTMENT OF VASCULAR BIOLOGY

The mission of the department is to foster innovative research to promote and optimize vascular heath and care for diabetes patients with vascular diseases

Scientist
Nagaraj Manickam

Research Scholars
Saravanakumar S
Isaivani J

The department is headed by **Dr. NAGARAJ MANICKAM,** Ph.D, who has been working in the field of kidney disease for the past ten years including six years of post-doctoral research experience at United States of America. The Department of Vascular Biology at MDRF was started in 2011, focusing on the micro and macro vascular complications of diabetes. The department aims at the identification of novel early biomarkers and signaling mechanisms associated with them in micro and macro vascular complications under differential glucose levels.

The department also provides training to outside students in cell and molecular techniques. A brief description of the activities of the department is provided below.

Vision:

Our vision is to identify an early biomarkers as well as a novel drug targets for diabetic vascular complications.

Mission:

To execute experiments to identify an early biomarker for the progression of diabetic vascular complications.

To carry out experiments *in vitro/in vivo* models to unravel the molecular mechanisms involved in the pathogenesis of diabetic complications mainly chronic kidney disease and cardiovascular disease, and thereby exposing a novel therapeutic drug target.

Portfolio of current activities of the Department:

1. **Exploring novel biomarker and drug target: "Role of Sestrin, a TOR (Target of Rapamycin) inhibitor, in diabetic dyslipidemia" (DBT-RGYI-ongoing project)**

Atherosclerosis is the major cause of both morbidity and mortality among type 2 diabetes patients. Loss of insulin action in peripheral tissues, results in enhanced production of hepatic VLDL cholesterol despite adequate glycogen storage. Decreased clearance of VLDL and LDL cholesterol (dyslipidemia) from the circulation, results in increased deposition of these moieties in vascular tissues. In early phase of atherosclerosis, macrophage derived foam cells secrete various proinflammatory growth factors, cytokines, chemokines and proteolytic enzymes plays key role in vascular remodeling. Despite availability of lipid lowering drugs, additional drug strategies have been focused to suppress the inflammatory process and vascular remodeling to combat regression of atherosclerotic burden mediated under dyslipidemic condition. Persistent activation of TOR (Target of Rapamycin) signaling through down regulation of AMPK (Adenosine monophosphate kinase) has been shown to play an important role in vascular remodeling under atherosclerosis condition. Sestrin, highly conserved proteins accumulate in cells exposed to oxidative stress. Independent of its oxidoreductase activity, it inhibits TOR signaling through AMPK. We initiated the project to elucidate the relationship between dyslipidemia and insulin resistance with reference to Sestrin levels in diabetic patients associated with dyslipidemic

condition. To study the nexus between sestrin and dyslipidemia in vascular cells, the vascular smooth muscle cells are employed to dissect the molecular mechanism.

2. Asymmetric dimethylarginine (ADMA) in diabetic nephropathy and its role in hyper glycemia mediated stress signaling in kidney cells

Diabetic nephropathy is another major complication of diabetes mellitus. So far, there is no specific marker to detect the onset of diabetic nephropathy at an early stage. Serum creatinine and microalbuminuria have limitations in detecting diabetic nephropathy at an early stage. By the time, these parameters became abnormal, significant kidney damage has already been occurred. So it is more important to detect diabetic kidney injury at an early stage so as to prevent further damage. Asymmetric dimethylarginine (ADMA), an endogenous nitric oxide synthase inhibitor is mainly metabolized in kidney and its malfunction results in increased level of ADMA in serum. In addition to its usage as a biomarker, ADMA can also mediate cellular signaling which results in kidney fibrosis. We hypothesize that ROS may play an important role in regulating the metabolism of ADMA. So secondly, we are focusing on the molecular mechanisms by which ADMA mediates kidney injury. For this, we are using cell lines to study the role of ADMA in mediating kidney injury. To test this we are using different inhibitors to study the upstream and downstream pathways by which ADMA mediates its toxicity. This study could be helpful in detecting kidney injury at an early stage as well as in understanding the mechanism by which ADMA causes diabetic nephropathy which could be useful to plan therapeutic intervention at a later stage.

3. Netrin-1 and Endothelial dysfunction: Evaluating the role of Netrin-1 as biomarker in diabetes with chronic kidney disease.

Diabetic subjects have been shown to have higher risk of developing End Stage Renal Disease (ESRD), compared to non-diabetic subjects. Under diabetic condition, activation of endothelial cells by proinflammatory cytokines, adhesion molecules and oxidative stress results in vascular dysfunction. Decreased bioavailability of nitric oxide (NO) is one of the prime factors for endothelial cell dysfunction causing kidney cell injury. Recently axon guidance molecule, netrin-1, is shown to involve in the process of vessel branching and angiogenic processes in endothelial cells and also renders cardioprotection by activating eNOS (endothelial nitric oxide synthase) under I/R injury, apart from neuronal development. But, the status and association of netrin-1 in relation to diabetic nephropathy under high glycemic status is not known. Hence, our main objective is to measure and correlate the levels of netrin-1 in diabetic condition with and without microalbuminuria. The levels of netrin-1 will also be compared with Asymmetric dimethylarginine (ADMA), an endogenous competitive inhibitor of NO synthase and a prognostic risk factor for development of vascular complications. Also, we will be looking into the molecular mechanisms of netrin-1 in regulating high-glucose-induced endothelial dysfunction, interstitial fibrosis EMT and ECM accumulation in primary proximal tubular cells and glomerular endothelial cells. The outcome of the present study will elucidate the status, sensitivity and the molecular role of netrin-1 in high-glucose-induced endothelial dysfunction

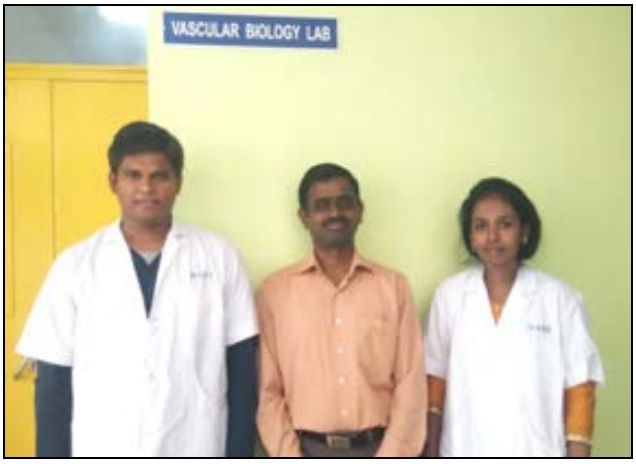
4. High Mobility Group Box protein 1(HMGB1): Novel Risk factor and a mediator of inflammation induced diabetic nephropathy.

Although diabetic nephropathy is not focused as an immune disease, emerging evidence suggest that inflammatory mechanisms play a critical role in the development and progression of Diabetic nephropathy. Inflammation contributes to the interstitial lesions in the diabetic nephropathy. But so far, there is no clear

mechanism on the stimulation of pro-inflammatory factors in mediating kidney injury in the diabetes condition. Recently people were started looking at High mobility Group Box1 (HMGB1), a non-histone nuclear protein with a molecular weight of 30 kDa which is highly conserved in sequence among species. HMGB1 is considered mainly as an alarmin which promote inflammation and activate innate and adaptive immunity. MAP kinases signaling pathway play a central role in the cell activation and proliferation in response to proinflammatory stimuli. HMGB1 increased p38 MAPK, ERK1/2 and JNK in endothelial cell lines. But the signaling pathways by which it stimulates these kinases are clearly not known. So our focus is to reveal the molecular mechanism by which it causes kidney injury. Also, it can be measured in the urine of kidney injured patients. So this can also be used as a biomarker in both serum and urine. This study will be useful to assess the progression of kidney disease and to would be another therapeutic target.

RESEARCH SUPPORT FOR THE PROJECTS:

S. No	Title	Funding Agency	Period
1	Asymmetric dimethylarginine (ADMA) in diabetic nephropathy and its role in hyperglycemia mediated stress signaling in kidney cells.	DST	2013-2016
2	Exploring a novel biomarker and drug target: Role of Sestrin, a TOR (Target of Rapamycin) inhibitor, in diabetic dyslipidemia.	DBT	2013-2016



DEPARTMENT OF PHYSICAL ACTIVITY RESEARCH

Dr. R.M.Anjana

Being physically active and staying fit and healthy will help you to get the most out of life, whatever your age.

Head of the Department
Dr. R.M.Anjana

Research Associate

Dr.R.Guha Pradeepa
Dr.Ranjani Harish

Research Fellow
Ms. K. Abishamala

Research Assistant
Ms. M.Ashwini
Ms. E. Reshma

Technicians
Mr. J. Robin
Mr. S. Vinoth Kumar
Ms. A. Suganya

Physical inactivity is one of the major modifiable risk factors for non-communicable diseases (NCDs) such as diabetes and obesity and is the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally. The Physical activity research department was established in order to create an active research environment to enhance physical activity research in India. The department is dedicated to promote physical activity and help individuals to enhance their health, fitness, and quality of life.

This department facilitates cutting edge research using advanced technologies to identify physical activity patterns among the population and further initiates awareness to habituate active living. The department works with international research centres and academic institutions to enable knowledge transfer and to propel research in a path that reaches the society through awareness and advocacy measures

Vision:

- To undertake scientific research to enhance the health and quality of life of communities through the promotion of active lifestyle.

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Mission:

- To conduct basic and applied scientific research related to the prevention and management of diabesity, understand linkages between physical activity and health-related outcomes (i.e., physical, metabolic, etc.) in adults, adolescents and children.
- To advance physical activity as a health priority through capacity building to support advocacy initiatives.

CURRENT ACTIVITIES OF THE DEPARTMENT

(i) Built **E**nvironment and Physical **ACTIV**ity – **INDIA** Study (**BE ACTIV INDIA**) - Adolescent Component.

PI : Dr.R.M.Anjana

Co-PIs: Dr.R.Guha Pradeepa, Dr.Ranjani Harish, Dr.Ranjit Unnikrishnan, Dr.V.Mohan

Funding agency: Madras Diabetes Research Foundation

Duration: 2014-2016

Physical inactivity is one of the major modifiable risk factors for NCDs. The benefits of physical activity (PA) in adolescents and youth are well established, with most global guidelines recommending at least 60 minutes of moderate to vigorous PA (MVPA) per day. Adolescence has been shown to be associated with a steep decline in physical activity in many populations; therefore, efforts to promote PA during this period are essential. Thus, the Physical Activity Research Department is currently studying the association of Built Environment [human made surroundings which include homes, schools, parks, pedestrian pathways, roads, and accessibility to facilities such as shops and hospitals as well as infrastructure such as water supply and electricity] and Physical Activity in relation to Metabolic health among adolescents aged 12-17 years through the BE ACTIV INDIA! Study. This study is the first of its kind in India and is part of the IPEN (International Physical Activity and Environment Network), an ongoing 19-country study on the effects of the BE on PA in adults and adolescents. This study aims to examine the associations between detailed measures of the neighbourhood and school built environment (Geographic Information System [GIS] and questionnaires) and physical activity and sedentary behavior (acclerometry and by questionnaires) with various metabolic parameters such as glucose intolerance, obesity, hypertension and dyslipidemia in 600 adolescents aged 12-18 years, undertaken by us in Chennai. The key factors that will be explored through the study are neighbourhood safety, crime safety, distance and access to locations, travelling from and to school and food patterns.

Results from this study will provide accurate information on the contribution of built environments to physical activity, obesity, and other health outcomes will help make evidence-based policy and planning decisions. These policies have the potential to significantly improve PA levels in the population in general as well as among adolescents with the ultimate aim of preventing NCDs.

ii) Development of physical activity questionnaire – MPAQ [long and short version]

Measurement of physical activity in epidemiological studies requires tools which are reliable, valid and culturally relevant. A number of PAQs have been described in the literature, most of which have been designed for use, and validated in, developed countries. Several factors mitigate against the use of these questionnaires in low and middle income countries like India. A major drawback of these PAQs in the Indian context, is the importance given to leisure time physical activity (LTPA). While LTPA contributes significantly to total physical activity in Western populations, studies from India show that less than 10% of the population performs any LTPA at all. Also, the use of many of these PAQs demands a certain level of literacy in the respondents, which may not be the case in developing countries like India. Hence, this department in collaboration with the Food, Nutrition and Dietetics Research department developed a physical activity questionnaire (PAQ) that would measure habitual, culturally relevant activities in various domains over a year and which would be valid for use in adults of different age groups with varying levels of activity in urban and rural settings in low and middle income countries like India - termed the ***Madras Diabetes Research Foundation- Physical Activity Questionnaire (MPAQ).*** The MPAQ has 4 main domains (work, General, Commutation and Leisure time activities).

The reliability and validity of MPAQ was assessed and reported that the interclass correlation coefficients (ICC) for total energy expenditure and physical activity levels were 0.82 and 0.73 respectively, between baseline and 1st month. The ICC between Global Physical Activity Questionnaire (GPAQ) and the MPAQ was 0.40 overall. The construct validity of the MPAQ showed linear association between sitting and Moderate and Vigorous Physical Activity (MVPA), and BMI and waist circumference independent of age and gender. The Spearman's correlation coefficients for sedentary activity, MVPA and overall PA for MPAQ against the accelerometer were 0.48 , 0.44 and 0.46 respectively.

Thus, it is evident that the MPAQ is an acceptable, reproducible and valid instrument, which captures data from multiple activity domains over the period of a year from adults of both genders and varying ages in various walks of life residing in urban and rural India.

Project done by Ph.D. student under the guidance of Dr.R.M.Anjana

Ms.Abishamala Kingsly (Deakin University, Australia)

Aspects of the built environment have been linked to physical activity (PA) and obesity among adolescents in many countries. However, it is not clear from the currently available data as to how much current levels of adolescent PA in India are linked to attributes of the built environment. The primary aim of this PhD is therefore to examine associations between the built environment and adiposity and PA among adolescents in Chennai, South India. This PhD study is nested within a larger study called the BE ACTIV India! Study. The BE ACTIV India!– Adolescent study is part of the IPEN (International Physical Activity and Environment Network) Adolescent study, that will pool data collected within diverse urban environments around the world.

The student's work includes collection of anthropometry measurements (such as height, weight, body fat and waist circumference), objective measurement of physical activity using accelerometers and subjective measurement of physical activity and built environment is done by administering questionnaires. The questionnaire includes elements such as:

1. Demographic variables
2. Distance to locations,
3. Access to destinations,
4. Physical training at school
5. Perceived barriers to PA
6. Self efficacy to PA
7. Decisions about PA
8. Enjoyment of PA
9. Social support for PA
10. Availability and frequency of use of exercise equipment
11. Perceptions about neighbourhood environment such as traffic, road and crime safety, access to destinations and aesthetics

DEPARTMENT OF CLINICAL EPIDEMIOLOGY

A wise man should consider that health is the greatest of human blessings, and learn how by his own thought to derive benefit from his illnesses. - Hippocrates

Head of Department
Sr.Consultant Epidemiologist
Dr. C. S. Shanthi Rani

Executive – Projects

Mr.Ashok Kumar .R
Mr. RahulaShankruthiyayan .T
Ms. Uma Sankari .G

Sr. lab Technician

Ms. Glinivenisha .K

Lab Technician

Ms. Lavanya .S
Ms. Baby .R

Research Assistant

Ms. Janani .S

The Department of Clinical Epidemiology was started in 2011. Clinical Epidemiology helps clinicians in finding answers to the various problems and limitations experienced in their profession through scientifically designed research. Clinical Epidemiology is focused on improving health through research involving patients and the health care system.

Vision:

To provide a bridge between health and social sciences to better understand and apply health services management and future clinical challenges.

Mission:

To improve clinical care by working in global partnership to produce high-quality clinical epidemiological research on diabetes, promote education, and strengthen translation of knowledge into clinical practice.

Current Activities of the Department

1. Novel low –cost technologies for diabetes screening and treatment: - DBT Project

The research project “Novel low –cost technologies for diabetes screening and treatment “was submitted in response to DBT’s call for indo –US joint proposals in the area of low cost diagnostics and medical devices. Several new technologies with a large potential impact on rapidly growing populations at risk for diabetes in low-resource settings are now on the cusp of availability. These include non-invasive technologies that measure tissue glycation through skin auto fluorescence (AF), and point of care (POC) HbA1c readers. These appear to be candidates not only for screening for diabetes risk. but also for guiding treatment with insulin/oral drugs monitoring the effectiveness of lifestyle changes. This proposal aims to test whether adding a non-invasive POC screening technology as a third stage in the stepwise screening approach will narrow the pool of individual recommended for more labor-intensive oral glucose tolerance test(OGTT),and thus represent a more efficient strategy for diabetes screening in India.

The objectives of this project include:

To test the efficiency of the POC devices in improving the sensitivity and specificity of the IDRS for identifying high risk individuals for diabetes at the community level. The tests used for this objective are the following point of care tests: POC HbA1c test and two non-invasive AGE tests.

To assess the accuracy of the combination of the IDRS and POC test against the combination of the IDRS and RCBG testing. The tests used for this objective are the following point of care tests: the HbA1c test, the non-invasive AGE tests an the RCBG test.

To compare the sensitivity, specificity and effectiveness of using a 3-step approach comprised of IDRS, OGTT and a non-invasive instrument –based AGE POC test to screen high risk individuals for diabetes .The tests used for this objective are the following point of care tests:, the non-invasive AGE tests, the RCBG test an the OGTT.

2. Noninvasive Type 2 Diabetes Screening: Clinical Evaluation of SCOUT DS in an Asian Indian Cohort

Grants received from Veralight Inc. were used for executing the research project, “A Non invasive approach to measuring the effects of diabetes” SCOUT DS is a non-invasive diabetes screening device that employs fluorescence and reflectance spectroscopy to measure changes in the dermis of the volar forearm, indicative of developing diabetes. A SCOUT measurement requires approximately 4 to 6 minutes of testing time and does not require fasting beforehand.

The main objective of this study is to evaluate the noninvasive, point-of-care diabetes screening device, Scout DS (VeraLight Inc., Albuquerque, NM) (SCOUT), in a native Asian Indian cohort. SCOUT, fasting plasma glucose (FPG), and hemoglobin A1c (A1C) were compared for detection of abnormal glucose tolerance (AGT) in a cohort of 256 subjects without previous diagnosis of diabetes or impaired glucose tolerance in Chennai, India. The finding of this study shows that the performance of SCOUT is similar to that of A1C, whereas FPG had a much lower sensitivity. SCOUT is an effective tool for AGT screening in Asian Indians.

Grants Received by the Department

1. Grants received from the Department of Biotechnology (DBT) for executing the research projects on “Novel low-cost technologies for diabetes screening and treatment” which was submitted in response to DBT’s call for Indo-US joint proposals in the area of low cost diagnostics and medical devices.

Principal Investigator: Dr.V.Mohan

Co-Investigators : Dr.M. Balasubramaniyam, Dr.R.Guhapradeepa & Dr.M.Deepa

Duration of project : 2 years

2. Grants received from Veralight Inc. for executing the research projects on "Noninvasive Type 2 Diabetes Screening: Clinical Evaluation of SCOUT DS in an Asian Indian Cohort". SCOUT DS is a non-invasive diabetes screening device that employs fluorescence and reflectance spectroscopy to measure changes in the dermis of the volar forearm, indicative of developing diabetes.

Principal investigator: Dr.V.Mohan

Co-Investigator : Dr.Sharad Bedi, Dr.S.Poongothai, Dr.R.M.Anjana, Dr.C.S.Shanthirani

3. Chennai Urban Rural Epidemiology Study (CURES):

Chennai Urban Rural Epidemiology Study (CURES), started in 2001, is a large epidemiologic study involving a representative population of Chennai with the main objective to estimate the prevalence of diabetes and its complications in urban Indians and to identify the risk factors for non communicable diseases (NCDs). CURES studied 26,001 individuals aged 20 years and above in Chennai. To date, more than 140 publications have resulted from CURES.

The **CURES follow up** is a prospective study (follow up study) which helps in measuring the incidence of the diabetes, pre diabetes, complications, mortality due to diabetes and this is a on-going study. The study populations for this study are from Phase II and Phase III of CURES. All the biochemical, anthropometric, and special tests done during the base line will be repeated for all the subjects who are involved in the follow up study.

Objectives of the CURES follow up study include the following:

1. To obtain data on the incidence of Diabetes
2. To determine the incidence of Prediabetes [IGT & IFG]
3. To assess the incidence of Metabolic Syndrome
4. To determine the incidence of diabetes complications like retinopathy, nephropathy , neuropathy, heart attacks and stroke
5. To assess the incidence of depression among the cohort.
6. To obtain the mortality rate in subjects with and without diabetes in Chennai

MDRF funded research projects entitled "**Chennai Urban Rural Epidemiology Study (CURES Follow up)"**

Principal Investigator : Dr.V.Mohan

Co-Investigators : Dr.R.M.Anjana, Dr.Ranjit Unnikrishnan

Duration of project : 4 years

4. Regularity of follow up, glycemic burden, and risk of microvascular complications in patients with type 2 diabetes: a nine-year follow-up study

This is a retrospective study with the main objective to assess the relationship between regularity of follow-up and risk of complications in patients with type 2 diabetes (T2DM) followed up for 9 years at a tertiary diabetes centre in India. We compared glycemic burden and incidence of diabetes complications (retinopathy, neuropathy, nephropathy, peripheral arterial disease, coronary heart disease) between 1,783 T2DM patients with ''regular follow-up'' (minimum of three visits and two HbA1c tests every year from 2003 to 2012), and 1,798 patients with ''irregular follow-up'' (two visits or less and one HbA1c or less per year during the same time period), identified from medical records.

The results of this study revealed that regular follow-up consisting of at least three clinic visits a year appears to confer significant benefits in terms of glycemic control, glycemic burden, lower risk and later development of retinopathy and nephropathy.

5. Postpartum development of Type 1 diabetes in Asian Indian women with Gestational diabetes

This is a retrospective study with the main objective of the postpartum conversion of Gestational Diabetes Mellitus (GDM) to different types of diabetes among Asian Indian women. Using data from electronic medical records, 1,345 women with GDM seen at a tertiary diabetes care centre for diabetes in Chennai in south India between 1991 and 2014 were evaluated for development of diabetes post partum. Three hundred and eighty eight (388) women progressed to diabetes of whom 29 (7.5%) developed T1DM and 359 (92.5%) developed T2DM.

The results of this study revealed that a small but significant proportion of women with GDM progress to T1DM post partum. Measurement of GAD antibodies in leaner women with more severe diabetes could help in identify women who are likely to develop T1DM and thus prevent their presentation with acute hyperglycemic emergencies.

6. Clinical profile of long-term survivors and non-survivors with type 2 diabetes (T2DM).

This is a retrospective study surveying 200,000 case records from DMDSC. From our database, we identified 238 patients with T2DM who had survived with .40 years of documented duration of diabetes (survivors).We then obtained data on 307 T2DM subjects who were matched for age at onset of T2DM and for gender with the survivor cohort but who had died of various causes before 40 years of duration (non-survivors) to compare the clinical profile of the survivors and non-survivors. Medical records of

both groups of patients were reviewed and the biochemical and clinical data were recorded.

The study showed that the long-term survivors had better control of glycemia and a better lipid profile, with lower total cholesterol, LDL cholesterol, and higher HDL cholesterol, and they also had lower systolic and diastolic blood pressures. All of these factors could have contributed to their longer survival.

7. "MicrobDiab" - Studies of interactions between the gut Microbiome and the human host biology to elucidate novel aspects of the pathophysiology and pathogenesis of type 2 Diabetes

The incidence of Type 2 Diabetes (T2D) increases at a pandemic scale and is accompanied by severe organ damages, which results in enormous costs on the health care systems and lowers the quality of life and life expectancy of millions of people in India and Denmark. Recent research indicates that altered gut microbiota composition and function may be involved in the pathogenesis of T2D and its co-morbidities. Therefore, there is a strong rationale to explorewhether interactions between the gut microbiota as evaluated at the collective microbial genomelevel (the microbiome) and the host biology can provide novel insights into the pathophysiologyand pathogenesis of pre-diabetes and T2D. The overall objective of the proposed project is to identify gut microbiome signatures in Indian and Danish study participants which associate with pre-diabetes and T2D thereby enabling development of novel biomarkers for early diagnosis of people at high risk of progression to overt T2D.

Objectives of the study:

1. Perform thorough clinical and biochemical phenotyping of 150 normal glucose tolerant (NGT) individuals and 150 persons with pre-diabetes and 150 T2D patients from India and Denmark, respectively; a total of 900 individuals.

2. Run next generation shot-gun sequencing and 16S rRNA gene marker studies (India and Denmark) of microbial DNA extracted from faecal samples of all individuals followed by gene-based taxonomic analysis to obtain measures of bacterial composition: gene count ,species, metagenom-species, genus, enterotype and phylum as well as of projected bacterial functions.
3. Analyze how the gut microbiome profiles as outlined above from the 3 subsets of participantsdiffer between Indian and Danish people and how they associate with body composition, whole body insulin sensitivity, fasting and stimulated insulin secretion, inflammation markers,blood metabolomics, circulating microbial non-coding RNA and blood group markers.
4. In Indians and Danes to identify microbiome biomarkers which with high accuracy discriminate between NGT, pre-diabetes and T2D.

The Indian study population consist of 450 subjects of Diabetics, pre-diabetics and normals. All clinical and physiological examination along with biochemical investigations will be carried out in Dr. Mohan's Diabetes Specialties Centre & Madras Diabetes Research Foundation, Chennai, India.

1. Grants received from the Department of Biotechnology (DBT) for executing the research projects on "MicrobDiab" - Studies of interactions between the gut Microbiome and the human host biology to elucidate novel aspects of the pathophysiology and pathogenesis of type 2 Diabetes" which was submitted to DBT's for Indo-Danish joint proposals in the area of gut microbiome profiles and associated biomarkers that confer risk of type 2 diabetes.

8. Assessment of Diabetic Retinopathy in Type 1 Diabetes in south Indians

Assessment of Diabetic Retinopathy in Type 1 Diabetes in south Indians is a project on patients with retinopathy may not have any early warning signs or symptoms to approach the

eye doctor. Screening for diabetic retinopathy is important for all patients with diabetes. The main aim of the study is to assess a program to screen for diabetic retinopathy in resource poor settings like India.

Objectives of the study:

1. To test out the feasibility, usability and utility of a digital camera model for screening of DR among T1DM patients in the T1DM weekly diabetic clinic OPD day.
2. To establish peer to peer and family support groups for patients suffering from T1DM and their families, which foster interactions with service providers
3. To advocate for inclusion of T1DM into Rashtriya Bal Swasthya Karyakram (RBSK).

The results of this study will inform policy makers, clinicians and health experts to implement meaningful action plans to increase awareness regarding retinopathy in type 1 diabetes and promote screening for diabetic retinopathy.

Grants received from the Department of Helmsley Trust/Public Health Foundation of India /Queen Elizabeth Diamond Jubilee Trust for executin the research project on “Assessment of Diabetic Retinopathy in Type 1 Diabetes in south Indians”.

DEPARTMENT OF BIOSTATISTICS

Dr. R. Guha Pradeepa,

"Translating research hypotheses into decision making"

Senior Scientist & Head of the Department
Dr. R. Guha Pradeepa

Senior Biostatistician

Ms. R. Subhashini

Biostatisticians

Dr. U. Venkatesan
Ms. C.Anitha

The Biostatistics Department of MDRF came into existence in 2006. Members of the department participate mainly as collaborative researchers with investigators from other departments within MDRF. They provide input in all phases (from the preparation to final report) of proposals including study design, feasibility, sample size requirements, data management, statistical analysis and interpretation.

Vision:

To improve the human health through excellence in the field of biostatistics in clinical, laboratory and prevention research.

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Mission:

- Leadership in applying biostatistics discipline in collaboration with other investigators in the plan, conduct, analysis, and interpretation of research studies.
- Organizing short courses on biostatistical techniques to meet the needs of researchers in clinical, laboratory and prevention research.

ACTIVITIES OF THE DEPARTMENT

A brief overview of the types of research performed by this department is given below.

Title of the project	Work done by Biostatistics department	Primary department
Indian Council of Medical research-India Diabetes (ICMR-INDIAB) Study	Sampling methods, identifying PSU, analysis of data	Biostatistics
ICMR- INDIAB STUDY- Physical Activity Questionnaire Validation (urban & Rural)	Validation and Reproducibility analysis	Epidemiology
ICMR- INDIAB STUDY- Physical Activity	Analysis of data	Research Operations
Continuous Glucose Monitoring Study on Brown, Minimally Polished & Fully Polished Rice	Analysis of data	Food and Nutrition Research
Incidence of Diabetes and Prediabetes and Predictors of Progression Among Asian Indians: 10-Year Follow-up of the Chennai Urban Rural Epidemiology Study (CURES)	Analysis of data	Clinical Epidemiology
Population attributable risk (PARp) for diabetes in an Asian Indian population-Ten-year follow-up of the Chennai Urban Rural Epidemiology Study	Analysis of data	Clinical Epidemiology
Causes and predictors of mortality in south Asians– 10 year follow-up of the Chennai Urban Rural Epidemiology Study	Analysis of data	Clinical Epidemiology
Regularity of follow-up, glycemic burden, and risk of microvascular complications in patients with type 2 diabetes: a 9-year follow-up study	Analysis of data from diabetes electronic medical record (DEMR)	Diabetology

Women in India with Gestational Diabetes Mellitus (GDM) strategy (WINGS)- Physical Activity	Analysis of data	Epidemiology
Type of vegetable oils used in cooking and risk of metabolic syndrome –CURES study	Analysis of data	Food and Nutrition Research
Effect of cashew nut supplementation on glycemic control among adult type II Diabetes	Analysis of data	Food and Nutrition Research
Effect of Brown Rice, White Rice, and Brown Rice with Legumes on Blood Glucose and Insulin Responses in Overweight individuals	Analysis of data	Food and Nutrition Research
Case study-comparing the 24 hour glycemic response of ragi and white rice based diet among Adults	SAS program and analysis	Food and Nutrition Research
Obesity Reduction and Awareness and Screening of Noncommunicable Diseases through Group Education in children and adolescents (ORANGE)	Data cleaning	Translational Research
Postpartum Development of Type 1 Diabetes In Indian Women with Gestational Diabetes	Analysis of data from diabetes electronic medical record (DEMR)	Diabetology
Stress and diabetes	Sample size calculation and analysis	Clinical Trials
Lifestyle factors and diabesity among adolescents and adults	Analysis of data	Translational Research
Risk factor control and development of diabetes complications in young T1DM and T2DM	Analysis of data	Epidemiology

COURSES/WORKSHOPS ORGANIZED

1. Short Course on 'Biostatistics'

A '**Course on Biostatistics'** was conducted at MDRF from October 7th to 9th, 2013**.** Fifteen researchers attended this course which covered Regression– Data analysis, Introduction to Population attributable risk (PAR) and hand on experience in analysis of data using statistical software. Dr.VS. Binu, Associate Professor, Department of Statistics, Manipal University, Manipal was the faculty for this course. At the end of this course, students/faculty were familiar with the fundamental concepts of Population attributable risk (PAR) analysis.

2. Systematic Review Workshop

A systematic review workshop was conducted at MDRF on June 11th and 12th, 2013. Twelve researchers attended this workshop which covered Identifying questions for conducting review, writing the protocol, reviewing the protocol etc., Faculty included Dr. N. Sreekumaran Nair, Prof of Biostatistics & Head, Department of Statistics, Manipal University, Manipal and Mr. Ravishankar, Department of Statistics, Manipal University, Manipal.

LIBRARY

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"Let knowledge grow more and more"

Senior Scientist & Head of the Department

Dr. R. Guha Pradeepa

Sr Librarian

Mr R Surendar

The Library of the Madras Diabetes Research Foundation was founded in 1996. It provides quality resources and innovative services to stimulate creativity, intellectual curiosity and to facilitate lifelong learning and research.

Vision:

To be the academic hub of advancing research, education and innovation.

Mission:

To provide comprehensive resources and services in support of the research, teaching and learning needs.

The MDRF Library is an invaluable resource for students, researchers and faculties of Medicine and Diabetes. The library's collection covers a range of Ocular Research, Cell & Molecular Biology, Molecular Genetics, Clinical Trials, Research Operations, Epidemiology, Foods, Nutrition Research, Translational Research, Research Biochemistry, Vascular Biology, Data Management & Biostatistics. The library has over the years built a healthy collection of over 1119 books, 950 bound volumes, 52 current subscription to journals, 731 working papers, and many other resources like thesis (22), student's project reports (57).

The library provides services such as free access to bibliographic and full text digital and printed resources, Online Public Access Catalogue (OPAC), Internet Search and Photocopy Service

Eprints@MDRF is the Open Access research outputs repository of Madras Diabetes Research Foundation. Research outputs of MDRF - journal papers, conference papers, reports, theses, patents etc. - are uploaded/self-archived by MDRF Librarian and scientists who do research on diabetes and related areas. Interested users can freely download and use documents as most of them are directly accessible and full-text downloadable. 'Request Copy' forms can be used for documents to which direct full-text download is restricted due to publisher embargo. (www.mdrf-eprints.in)

EDUCATIONAL ACTIVITIES

Ph.D. Program:

MDRF is recognized by the Tamil Nadu Dr. MGR Medical University and the University of Madras for conducting courses leading to the award of Ph.D. degree. Doctors with M.D. or post-graduate students with M.Phil or M.Sc are eligible to do their Ph.D course at the MDRF. The Madras Diabetes Research Foundation imparts training to doctoral students from clinical, paramedical and basic science backgrounds in an academic program linked with the Tamil Nadu Dr MGR University, Guindy, Chennai, and the University of Madras, Chepauk, chennai. The departments of Diabetology, Ophthalmology and Biochemistry are recognized by the "Tamil Nadu Dr. M.G.R. Medical University" and the department of Biochemistry and Molecular Biology are recognized by the "University of Madras" and Deakin University to conduct Ph.D courses. At present the foundation's 8 recognized guides for supervising Ph.D students are Dr. V. Mohan, Dr. M.Balasubramanyam, Dr. R. M. Anjana and Dr. Radha Venkatesan, Dr. K. Gokulakrishnan Dr. R. Guha Pradeepa, Dr. Nagaraj Manickam and Dr.S.Shobana. A total of 31 Ph.D. students are pursuing their Ph.D. at our center.

OUR SUCCESSFUL Ph.D STUDENTS [2012-2015]

MDRF SALUTES YOU!

Dr. Rajalakshmi

Prevalence and Incidence of Diabetic Retinopathy in Young Diabetic Subjects (Type 1, Type 2, MODY & FCPD).

Guide: Dr. M. Rema

Arun Shastry

Immunogenetic markers in Autoimmune Diabetes

Guide: Dr. V.Mohan

Ashok Ayyappa

Genetics of Type 2 Diabetes

Guide: Dr. Radha Venkatesan

S. Finny Monickaraj

Clinical significance and mechanisms of accelerated senescence in Type 2 diabetes: Studies involving 3T3L1 adipocytes and human fat depots

Guide: Dr. M. Balasubramanvam

Ramya Kandaswamy

Molecular genetics of adipogenesis in type 2 diabetes

Guide: Dr. Radha Venkatesan

M. Chidambaram

Identification of novel Type 2 diabetes genes in Asian Indians using Genome Wide Association

Guide: Dr. Radha Venkatesan

A. Amutha

Profile of diabetes in the young.

Guide: Dr. V. Mohan

J. Surendar

Role of inflammation in diabetes

Guide: Dr. V. Mohan

K. Indulekha

Role of systemic inflammation in diabesity.

Guide: Dr. V. Mohan

K. Jahnavi

Genetics of Monogenic diabetes such as MODY and neonatal diabetes.

Guide: Dr. Radha Venkatesan

K. Balamurugan

Functional genomic research on Type 2 diabetes of Asian Indians.

Guide: Dr. Radha Venkatesan

S.Raji

Molecular aspects of ER stress in β-cells.

Guide: Dr. M. Balasubramanyam

CURRENT PhD. STUDENTS AND THEIR RESEARCH TOPICS

B. Anuradha

Role of angiopoietins on diabetes vasculopathy.

Guide: Dr. V. Mohan

V. Vijayachandrika

Region, statewise, urban and rural differences in the level of glycemic control among diabetic subjects in india.

Guide: Dr. V. Mohan

J. Soniya

Prevalence of obesity, diabetes, pre-diabetes, dyslipidemia, hypertension and metabolic syndrome in children aged 6-19.

Guide: Dr. V. Mohan

Mookambika Ramya Bai R

Role of glycotoxins and its association with risk of type 2 diabetes

Guide: Dr V Mohan

T.S. Mehreen Begum

Assessment of risk factors associated with obesity in adolescents and effect of school - based pilot intervention in reducing adolescent obesity

Shruti Muralidharan

A randomized control trial of mobile health technology for the prevention of type 2 diabetes

Guide: Dr V Mohan

Bhavadharini Balaji

Clinical and genetic studies on gestational diabetes mellitus

Guide: Dr. V.Mohan

Vidyulatha Jayaram

Prevalence of stress in subjects with type 2 diabetes and interventions for stress reduction

Guide: Dr. V. Mohan

Lakshmi Priya

Influence of Nutritional Factors on Chronic Disease Epidemiology in Urban South Indians

Guide: Dr. V. Mohan

Bhavani Sundari B.

To assess the level of Depression and Optimism in subjects with diabetes and intervention of depression in a large clinic population in South India.

Guide: Dr. V. Mohan

Dr. Sundaramoorthy Chandru

Metabolic changes after weight loss in diabetic patients

Guide: Dr. V. Mohan

K. Abishamala

Neighbourhood Environment, Adiposity and Physical activity among Adolescents in Chennai,India.

Guide: Dr. R. M. Anjana

S. Aravind

Epigenetic factors in type 2 diabetes.

Guide: Dr. M. Balasubramanyam

M. Balakumar

Novel animal models of memory and insulin resistance

Guide: Dr. M Balasubramanyam

P. Prabu

Role of microRNA in type 2 diabetes and its complications

Guide: Dr. M. Balasubramanyam

C Sathishkumar

Gene expression alteration in Type 2 Diabetes with special reference to insulin resistance and inflammation, Studies focused on epigenetic aspects

Guide: Dr. M. Balasubramanyam

Regin.B.S

Clinical significance of advanced glycation end (AGE) products and invitro studies of AGE-RAGE signaling in relation to diabetes and its complications

Guide: Dr. M. Balasubramanyam

Srividhya. R

Programming stem cells towards pancreatic beta cells / insulin secreting cell types with a special focus on physiological and functional characterization

Guide: Dr. M. Balasubramanyam

Avinash.S

Title: Novel clinic-molecular insights in to the role of endocrine disruptors with special reference to Bisphenol A (BPA) in the etiology of diabetes/obesity.

Guide: Dr. M. Balasubramanyam

Ramesh Kumar. G

Role of gut microbiota derived metabolites in stress signaling, inflammation and insulin resistance in Type 2 diabetes

Guide: Dr. M. Balasubramanyam

Liju Samuel

Type 2 Diabetes – genetic susceptibility in Asian Indian population

Guide: Dr. Radha Venkatesan

Gnanaprakash V

Metagenomic studies of gut microbiota in type 2 diabetic subjects.

Guide: Dr. Radha Venkatesan

S.Gopi

Structural and Functional Studies of Genes Implicated In Monogenic Diabetes in Indian Patients

Guide: Dr. Radha Venkatesan

Kavitha. B

Functional Characterization of Transactivation Domain of *HNF1A* (MODY 3 Subtype of Type 2 Diabetes) Using Site Directed Mutagenesis

Guide: Dr. Radha Venkatesan

Charvi Nangia

Monogenic Diabetes Syndromes

Guide: Dr. Radha Venkatesan

Gautam Kumar Pandey

Exploring the role of Cardio-Metabolic risk factors in obesity and type 2 diabetes with special reference to RBP-4 and TTR

Guide: Dr. K.Gokulakrishnan

Kaviya. A

Biochemical & In Vitro Studies On Beta Cell Dysfunction In Type 2 Diabetes Mellitus

Guide: Dr. K.Gokulakrishnan

Isai Vani J

Studies on diabetic nephropathy: Role of Asymmetric dimethylarginine(ADMA) in the progression of diabetic nephropathy

Guide : Dr. Nagaraj Manickam

Saravanakumar S

AMPK$_{\alpha}$- Sestrin- mTOR Nexus in Macrovascular Complication under Diabetic dyslipidemic Condition

Guide : Dr. Nagaraj Manickam

R. Jayashri

Association of Vitamin B12 &VitaminD in Different Glucose intolerance

Guide: Dr. R. Guha Pradeepa

Pramod Kumar T.A

Elucidating the role of inflammatory markers, adipokines with elevated 1-hr plasma glucose during an OGTT among individuals with normal glucose tolerance

Guide: Dr. R. Guha Pradeepa

Short-term Internship Program:

Short-term Research Training Program: This six months' training programme on diabetes and its complications is conducted every year. The purpose of this short-term training program for undergraduate students, graduate students, and students in health-professional courses, is to provide exposure to opportunities inherent in research careers in areas relevant to diabetes. 10 students have completed this program so far.

Summer Internship Program:

This internship provides a 2-month, full-time summer training program targeted at under and post graduate students on yearly basis. The purpose of this summer diabetic internship is to develop and expand the research capacity among graduate students.

This program is designed to allow students to tailor their summer training to their own research interests, while providing a broad foundation in their area of concentration in the field of diabetes. This program provides an extraordinary opportunity to perform research in diabetes at MDRF. As indicated by the late Dr. Abdul Kalam, the former President of India, a great challenge in science today is: *'attracting youth to take up a science career'*. The Madras Diabetes Research Foundation (MDRF) contributes in its own way to this cause by the operation of the Summer Training program. This unique academic program is being co-coordinated by Dr. M. Balasubramanyam, Senior Scientist, MDRF. The training objective is referred to as 'EBBS' module (Exposing Biomedicine-Biotechnology opportunities to Students). During this training, students are exposed to various departments in MDRF viz., epidemiology, clinical trials, biochemistry, cell and molecular biology, genetics and tissue culture facility. They are also exposed to multi-disciplinary research opportunities with special reference to diabetes as a disease model. The training module includes specific experimental demonstrations, talks, interactive sessions and tips for taking up job and/or higher education opportunities. 35 students have completed this program so far.

MDRF STUDENT EXCHANGE PROGRAMMES:

Outbound Students from the MDRF:

Name	Particulars
Dr. R.M.Anjana	Training in International Physical Activity and the Environment Network (IPEN) adolescent protocol at San Diego, U.S.A, December 8th – 10th , 2014
Dr. Guha Pradeepa	Training in International Physical Activity and the Environment Network (IPEN) adolescent protocol at San Diego, U.S.A, December 8th – 10th , 2014
Dr Radha Venkatesan	Training and Colloboration on NGS and functional genomics at Genetech, USA, Sep, 2014 Metagenomics Approach to study Human Gut Microbiome in Type 2 Diabetes at The Novo Nordisk Foundation Center for Basic Metabolic Research, Metabolics Genetics – University of Copenhagen, Denmark (Dec 01 – 07, 2013)
Dr. K.Gokulakrishnan	NIH/Fogarty supported Chronic, Non-Communicable Diseases and Disorders Across the Lifespan NCD-LIFESPAN) training program (2012-2014)Emory University, Atlanta, USA
Dr. Ranjani Harish	Training in International Physical Activity and the Environment Network (IPEN) adolescent protocol at San Diego, U.S.A, December 8th – 10th , 2014
Dr. Shiny Abhijit	Stem cell technology and islet cell banking, University of Florida, USA
Mr. V. Gnana Prakash	Metagenomics Approach to study Human Gut Microbiome in Type 2 Diabetes at The Novo Nordisk Foundation Center for Basic Metabolic Research, Metabolics Genetics – University of Copenhagen, Denmark (Dec 01 – 07, 2013)
Ms.K.S.Chella	Short-term training on Database management and Biostatistics at Department of Biostatistics, College of Public Health and Social Work, Florida International University, Florida, USA, October 15th – November 15th, 2014.

Inbound Students:

World Diabetes Foundation Trainees (2012-2015)	
Ms.Nkengfack Jeanne Yaounde,Cameroon	Mr.Ozeer, Mauritius
Ms. Jingya Niu, China	Ms. Migani Binti Muganza Marie D.R. Congo,
Mr. Samih Mohamed Ahmed, Yemen	Ms.Regina Ogechukwa Nwosu Abuja, Nigeria
Dr. Wisam Al-Salami Iraq	Dr Ade Fatai Adeniyi Ibadan, Nigeria
Mr. Sushil Ambalal Patel Ahmedabad, Gujarat.	Dr. Langhu Micheal Ritha
Mr. Bunna Sok(WDF) Kampong Chang, Cambodia.	Ms. Nancy Charles Larco Haiti.
Mr. Ravonision Andrianant Tenaina Ferosoa, Antananarivo, Madagascar	Mr. Boniface Venance Mphumuhila Dar Es salaam- Tanzania
Ms. Josephine F. Gayeah, Nimba County, Liberia	Mr. Mario Marbungaran Pangihutan Hutapea, Jakarta, Indonesia
Mr. Seng Sokheng PhnomPenh, Cambodia.	Mr. Akiyemi Gbebga Bolarin Nigeria.

Special moments

Workshop on 'Multi-sectoral Partnerships for Health Promotion and Non-Communicable Disease (NCDs) Prevention in India'

MDRF in partnership with Public Health Foundation of India (PHFI) along with the Centre for Chronic Disease Control (CCDC), Health Related Information Dissemination Amongst Youth (HRIDAY) and supported by the World Health Organization (WHO) undertook an assessment of existing NCD related health promotion initiatives in India to identify the potential gaps, barriers and opportunities for promoting multi-sectoral participation in NCD prevention.

July 23, 2011

Regional Workshop On Multi-sectional Partnership For Health Promotion And Non Communicable Diseases Prevention In India

Panel discussion in progress after presentation of the experts.

July 23, 2011

MDRF's Research work recognized at Dubai at the world Diabetes Congress

The 21st Congress of the International Diabetes Federation (IDF) was held at Dubai, United Arab Emirates from December 4-8, 2011. Over 15,000 delegates from 172 countries attended this congress. The IDF had invited Dr.V.Mohan to deliver a Guest Lecture on " Clinical Profile of type 2 Diabetes in Asian Indians".

December 4, 2011

INDO-US INTERNATIONAL SYMPOSIUM ON PANCREAS

MDRF and MedIndia Hospitals organized an Indo - US Symposium on Pancreas- focusing on the exocrine and endocrine aspects of the pancreas on 7th and 8th January, 2012. It was inaugurated by Ms.Jennifer Mcintyre, U.S.Consul General, Chennai and Dr. Shashank R. Joshi, President, RSSDI, Dr. C. S. Pitchumoni, Chief of Gastroenterology, Hepatology and Clinical Nutrition, Saint Peter's University Hospital, New Jersey, and Dr. David C. Klonoff, Clinical Professor of Medicine, U.C. San Francisco were the Guests of honour. During the symposium, Dr. C.S. Pitchumoni was conferred the `MDRF Lifetime Contribution Award' and Dr.David Klonoff was conferred the '20th DMDSC Gold Medal Oration Award'.

January 7, 2012

INDO- US INTERNATIONAL SYMPOSIUM ON PANCREAS

During this symposium Dr.C.S. Pitchumoni, Chief of Gastroenterology, Hepatology and Clinical Nutrition, Saint Peter's University Hospital, USA was honoured and felicitated with the "Life Time Contribution Award" and "Medindia Oration Award" on his completion of 50 years of writing the first article on the pancreas in the year 1962

January 8, 2012

TENTH MDRF-UAB INTERNATIONAL SEMINAR ON "PREVENTION & CONTROL OF NON-COMMUNICABLE DISEASES"

Lighting of Kuthuvilaku by Ms.Jennifer Mcintyre, U.S Consul General, Chennai during the inauguration of the seminar.

Ms.Jennifer Mcintyre presenting the 7th MDRF-UAB Gold Medal Oration award to Prof. K.Srinath Reddy

Febuary 10, 2012

TENTH MDRF-UAB INTERNATIONAL SEMINAR

Delegates evaluating their study in Group work at the international seminar

Faculty members and stakeholders of various institutions who participated in the Nutrition workshop

Febuary 10-12, 2012

YOUNG INNOVATOR AWARD

Dr. R. M. Anjana receiving the '**Young Innovators**' Award from Dr. J. Radhakrishanan, Health Secretary,Government of Tamilnadu and Prof. D. Shantharam, Vice-Chancellor, The Tamilnadu Dr.M.G.R.Medical University.

January 19, 2013

"Is Metabolic Syndrome - a disorder of the brain?"

Prof. Undurti N. Das, Director, UND Life Sciences, gave a talk on "Is Metabolic Syndrome - a disorder of the brain?" on 7th January 2013. Clinicians and scientists from MDRF attended this lecture and benefitted from this.

January 7, 2013

ELEVENTH MDRF-UAB-FIU INTERNATIONAL SEMINAR ON "PREVENTION & CONTROL OF NON-COMMUNICABLE DISEASES"

Inauguration of the 11th international seminar by **Prof. D. Shantharam,** Vice-Chancellor, The Tamilnadu Dr. M. G. R. Medical University. **Dr. O. Dale Williams, Professor and Chair, Department of Biostatistics, Florida** International University, USA, **Dr. Ranjit Unnikrishnan, Vice Chairman, DMDSC, Dr. J. Radhakrishnan, Principal Secretary for Health, Government of Tamil Nadu,**

Dr. J. Radhakrishnan, Principal Secretary for Health, Government of Tamil Nadu, delivering the Presidential Address

February 15-17, 2013

ELEVENTH MDRF-UAB-FIU INTERNATIONAL SEMINAR

Intensive interactive training programme in progress

Faculty members from different institutions who participated in the Physical activity workshop

February 13-14, 2013

Eighth MDRF-UAB - FIU Gold Medal Oration Award

Presentation of Eighth MDRF-UAB-FIU Gold Medal Oration award to Prof. Ashok Kumar Das

February 15, 2013

Ranbaxy Science Foundation Award

Our Chairman Dr. V. Mohan receiving the Ranbaxy Science Foundation Award for Medical Research from Mr. Rudi Balling, Director, Luxembourg Centre for Systems. Biomedicine (LCSB), University of Luxembourg and Mr. Tsutomu Une, Chairman, Ranbaxy Laboratories Ltd.

Fellow of American College of Endocrinology (FACE) Award

Our Chairman Dr. V. Mohan received Career chievement Award from the Arizona Physicians Association on 3rd May 2013 and Fellow of American College of Endocrinology (FACE) Award from the American College of Endocrinology on 4th May 2013.

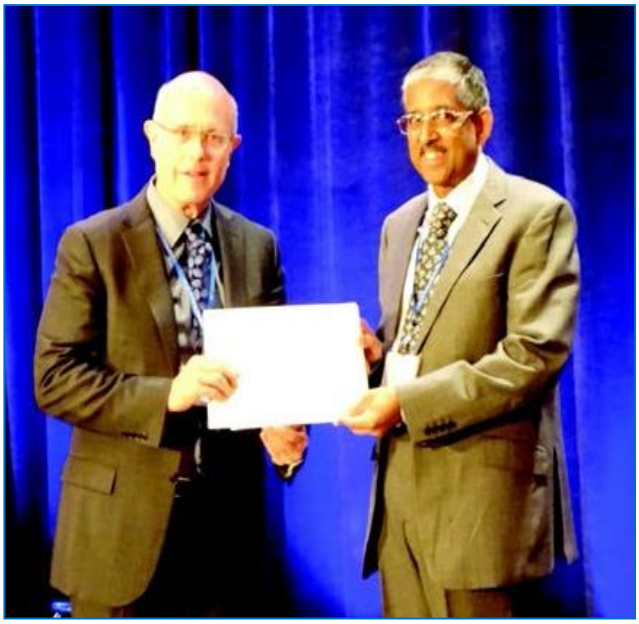
May 4, 2013

Launch of Dr. Mohan's Jeevan Dharini High Fibre Rice and High Fibre Rice Rava

Launch of **Dr. Mohan's Jeevan Dharini High Fibre Rice**
by
Prof. M. S. Swaminathan, Founder Chairman and
Chief Mentor, M. S. Swaminathan Research Foundation.
The first packet received by **Mr. Sarathbabu Elumalai,**
Founder and CEO, Food King.

July 17, 2013

Diabetes Technology Society Leadership Award



Dr. V. Mohan receiving the **Diabetes Technology Society Leadership Award** from Mr. David C. Klonoff, Editor-in-Chief, Journal of Diabetes Science and Technology at San Francisco, USA

Boehringer-Knoll Junior Lectureship in Diabetes Award

Dr. R.M. Anjana has been conferred the **Boehringer-Knoll Junior Lectureship in Diabetes Award** for her pioneering research work on diabetes particularly in the area of epidemiology of diabetes

November 6, 2013

'Best Diabetologist in India'

Dr. V. Mohan receiving the **'Best Diabetologist in India'** award from our Hon'ble Union Health Minister, Shri Ghulam Nabi Azad.

March 9, 2013

Dr. V. Mohan delivering the Presidential oration at the 41st Research Society for the study of Diabetes in India (RSSDI) Annual Conference at Noida

November 8, 2013

MDRF's Research Work Recognized at Melbourne World Diabetes Congress

A team of seven scientists from MDRF inculding Dr. V. Mohan, Dr. Ranjit Unnikrishnan, Dr. R.M. Anjana, Dr. R. Guha Pradeepa, Dr. Ranjani Harish, Mrs. Sudha Vasudevan and Dr. Gokulakrishnan participated in the Congress and a total of 14 abstracts were presented in the congress.

December 2-6, 2013

SCI GENOM Research Foundation Excellence in Science Award

Dr. V. Mohan has been awarded the SGRF Award for Excellence in Science by the SciGenom Research Foundation (SGRF).

Next Generation MODY Genetic test

Launch of Next Generation MODY Genetic test, co developed by Madras Diabetes Research Foundation and Med Genome labs on 12th December-2013.

December 12, 2013

'Ninth MDRF-UAB-FIU Gold Medal Oration Award'

Dr. Anura V. Kurpad receiving the 'Ninth MDRF-UAB-FIU Gold Medal Oration Award' from Ms. Jennifer A. McIntyre.

12th MDRF-UAB-FIU INTERNATIONAL SEMINAR ON 'PREVENTION AND CONTROL OF NON-COMMUNICABLE DISEASES' (NCDS)

Inauguration of the international seminar by Ms. Jennifer A. McIntyre. Also in photo (left to right): Dr. R. M. Anjana, Dr. Anura V. Kurpad, Dr. O. Dale Williams, Dr. R. Guha Pradeepa, and Dr. V. Mohan

January 31-February 2, 2014

12th International Seminar on NCDs

The 12th International Seminar on 'Prevention and Control of Non-Communicable Diseases (NCDs)' was organized at MDRF from 31 st January 2013 to 2nd February 2014 was inaugurated by Ms. Jennifer A. McIntyre, Consul General, U. S Consulate, Chennai. Dr. Anura V. Kurpad, Professor and Head, Division of Nutrition, St. John's Research Institute, Bangalore & President, Nutrition Society of India was conferred the 9th MDRF-UAB-FIU Gold Medal Oration Award. Dr. O. Dale Williams, Professor and Chair, Florida International University (FIU) and Dr. Cora Lewis, Professor of Medicine, University of Alabama (UAB) were also present during the function.

January 31, 2014

12th MDRF-UAB-FIU INTERNATIONAL SEMINAR ON 'PREVENTION AND CONTROL OF NON-COMMUNICABLE DISEASES' (NCDS)

Group work in progress

January 29, 2014

Intensive training course in progress

January 31- February 2, 2014

The World Academy of Sciences (TWAS) Fellowship Award

Our Chairman Dr V. Mohan was conferred the prestigious The World Academy of Sciences (TWAS) Fellowship Award at Muscat on 27th October 2014. He is the FIRST PRACTICING MEDICAL DOCTOR IN THE WORLD to be conferred this prestigious award.

October 27, 2014

MDRF Scientists participate in Research Society for the Study of Diabetes in India (RSSDI) Annual Conference

A team of scientists from MDRF participated in the Research Society for the Study of Diabetes in India (RSSDI) Annual Conference, Bengaluru and presented a total of around 20 abstracts.

November 21-23, 2014

Congratulations and Best Wishes to our Young Scientists

MDRF young scientists Drs Anjana, Gokulakrishnan and Ranjani bagged the best presentation awards in the Research Society for the Study of Diabetes in India (RSSDI) Annual Conference, Bengaluru. Dr Shiny received the Young Scientist Award at the International Conference on Free Radical Research, Lonavala.

January 27-30 2014 & November 21-23, 2014

Inauguration of the new Bio Repository at MDRF Siruseri with large freezer and liquid nitrogen facilities

HEARTIEST CONGRATULATUIONS

Our Vice Chairman Dr.Ranjit Unnikrishnan, has been awarded Fellowship of the Royal college of Physicians (FRCP), London following his FRCP (Glasgow) & FRCP (Edinburgh). This hat trick in a very short period is very phenomenal.

Dr. Coelho Memorial Lectureship

Dr. Ranjith Unnikrishnan was conferred the Dr. Coelho Memorial Lectureship in Experimental Medicine at the annual conference of ' Association Physicians of India' (API) conference held in Gurgaon, February 2015.

E. Merck Award

Dr R.M. Anjana was awarded the E. Merck Award at the annual conference of 'Association Physicians of India' (API) conference held in Gurgaon, February 2015

February 2015

Kuwait Medical Association (KMA) – IDF Oration Award

KUWAIT - IDF ORATION AWARD

Our Chairman Dr. V. Mohan delivered the KMA IDF oration award on 14th March 2015 in Kuwait.

March 14, 2015

BEST WISHES TO
Mr. C. Sathish Kumar, Senior Research Fellow

Mr. Sathish Kumar receiving ISCA Young Scientist Award from honourable Governor of Uttar Pradesh Mr. Ram Naik, in the presence of Mr. Suresh Prabhakar Prabhu, Union Minister for Railways and Mr.Vinod Tawde, Maharashtra Education Minister.

Inauguration of the 13th International Seminar

Mr. Philip A. Min, Consul General, U.S. Consulate, Chennai inaugurated the 13th MDRF-UAB-FIU International seminar on Prevention and Control of Non Communicable Diseases. Also in Photo (left to right): Dr. O. Dale Williams, Dr. V. Mohan, Dr. R. M. Anjana, Dr. R. Guha Pradeepa, Head, Research Operations, Dr. Ranjit Unnikrishnan, Vice Chairman, DMDSC, Dr. Cora Lewis and Dr. Myron Gross

Tenth MDRF-UABFIU Gold Medal Oration Award

Presentation of Tenth MDRF-UAB-FIU Gold Medal Oration Award to Prof. K. Vijay Raghavan

January 21, 2015

13th MDRF-UAB-FIU INTERNATIONAL SEMINAR ON "PREVENTION & CONTROL OF NON-COMMUNICABLE DISEASES"

January 23-25, 2015

Intensive interactive training programme in progress

The 13th International Seminar on 'Prevention and Control of Non-Communicable Diseases (NCDs)' organized at MDRF from 23-25 January 2015 was inaugurated by Mr. Phillip A. Min, Consul General, U. S Consulate, Chennai. Prof. K. Vijayraghavan, Secretary, Department of Biotechnology (DBT), Government of India, New Delhi was conferred the 10th MDRF-UAB-FIU Gold Medal Oration Award. Dr. O. Dale Williams, Professor and Chair, Florida International University (FIU), Dr. Cora Lewis, Professor & Associate Director for Research, Division of Preventive Medicine, University of Alabama at Birmingham (UAB), Birmingham, USA and Dr. Myron D. Gross, Professor, Department of Laboratory Medicine & Pathology, University of Minnesota & Director, Molecular Epidemiology & Biomarker Research Laboratory, Minnesota, USA were also present during the function.

UOM-MDRF WORKSHOP ON ADVANCED TECHNIQUES IN GENOMICS

An International workshop on the advanced techniques in genomics was conducted by MDRF in collaboration with University of Minnesota, U.S.A. This workshop is aimed at training and capacity building of researchers in advanced techniques in genomics such as Direct sequencing, MassARRAY and Microarray. The workshop also included a series of lectures on genomics and statistical analysis by eminent international scientists

High Throughput Screening (HTS) lab

Our chairman Dr. V. Mohan inaugurated the Dr.Rema Mohan High Throughput Sequencing lab at Siruseri on the 4th memorial of our beloved Managing Director, late Dr. Rema Mohan. This lab is devoted to research on diabetic eye diseases as a tribute to Dr. Rema Mohan who was a pioneer in the field in India

March 25, 2015

Congratulations to the most popular trio

Our Chairman & Managing Director, Dr. V. Mohan, Vice Chairman, Dr. Ranjit Unnikrishnan & Dr. R. M. Anjana, Joint Managing Director were awarded the Fellowship of American College of Physicians (FACP).

FRCP for Dr Anjana

Our Joint Managing Director Dr. R.M. Anjana was awarded the Fellowship of Royal College of Physicians FRCP (Glasgow) on 20th April, 2015.

April 20, 2015

Fellowship of Andhra Pradesh Akademi of Sciences to Dr. M. Balasubramanyam

Dr.M.Balasubramanyam, Dean of Research Studies & Senior Scientist has been elected as Fellow of the Andhra Pradesh Akademi of Sciences (FAPASc). Dr. Balasubramanyam attended the program of induction of new Fellows at Hyderabad and received the Fellowship Certificate and Memento from Dr.Ch.Mohan Rao (Director, CCMB & President, APAS). Dr. Balasubramanyam is one among the three scientists elected as Fellow of the Andhra Pradesh Akademi of Sciences this year, under the Medical Sciences category.

Glimpses of Dr. Mohan's International Diabetes Update 2015

July 31 – August 02, 2015

"RSSDI - NOVARTIS YOUNG INVESTIGATOR AWARD 2015"

Dr. R.M. Anjana has been awarded the prestigious "RSSDI-NOVARTIS YOUNG INVESTIGATOR AWARD 2015" in recognition of her outstanding research contribution to the field of Diabetes Complications

BEST WISHES TO Dr. R.M. ANJANA

Dr R.M. ANJANA received the Tamil Nadu Young Scientist Award by the Science City, Govt. of Tamil Nadu

MDRF – INSERM (France) Collaboration

Dr. Sophie Rome and colleagues from INSERM, France visited MDRF and delivered a talk on "Role of circulatory miRNAs in clinical medicine with special reference to type 2 diabetes“.

Nov 22, 2015

MDRF’s Research Work Recognized At Vancouver World Diabetes Congress

Nov 30 – Dec 04, 2015

MDRF scientists receive MIRF (MDRF Innovative Research Fund) support

Amidst 'Indian Science Rising' slogans and the country's 'brain-gain' setting, MDRF continues to support research scientists by offering them appropriate placements at MDRF in the multi-disciplinary areas related to the study of diabetes and its complications. While we encourage our scientists to write research grants and compete at the national and international levels, we realized the need for 'seed money support' for the researchers to start their initial phase of work because there has always been a big gap between the time at which the research proposal is submitted and the time at which a grant agency decides to support the proposal and release the grant. Many times, this time lapse or the 'incubation' period is a frustration to the scientists and many starts moving from place to place in India and a few even fly back abroad. Keeping this in view, Dr. V. Mohan, President, Madras Diabetes Research Foundation has announced the institution of MIRF (MDRF Innovative Research Fund) – an intramural research support.

It has been decided to support around 10 applications each year on a competitive basis and each successful research application will be supported by a grant of Rs.Two Lakhs. The guidelines for the MIRF support are as follows: a)The idea should be novel and innovative, b)Project should be easily doable within a period of 6 to 12 months, c)Budget should be mainly towards the consumables for existing equipments and preferably not for equipments unless it is for some very low-cost equipment or an accessory, d) The work should definitely lead to a publication as soon as its completion in an indexed journal cited in Pubmed and e) The pilot data should be directed to the development of a research proposal for funding from national/international agencies. The following 29 research projects are being supported from 2012-2015.

MIRF PROJECTS

Project No.	Title of the project	Name of the investigators & Co-investigators	Year of sanction
1	Prevelance of GCK - MODY mutations(MODY-2) in individual screened for fasting hyper glycemia	Dr. S. Kanthi Mathi **Mentor:** Dr.Radha Venkatesan	2012
2	Co-occurrence of two or more mutations/Gene Varients in HNF1A(MODY - 3) gene, their functional implecation and structural analysis	Mr. K. Balamurugan **Mentor:** Dr.Radha Venkatesan	2012
3	Exploring the relationship between Monocyte activation and glycemic control among subject with different degrees of glucose tolerance	Dr. Shiny Abhijit	2012
4	Metabolic Memory & Diabetic Nephropaty: Potential role for redox mechanism	Dr. Nagaraj Manickam	2012
5	Role of circulating cell free microRNAs in prediabetes and Type 2 Diabetes	Dr. Gokulakrishnan	2012
6	Exploring a role for Endoplasmic Reticulum stress markers in patients with type 2 diabetes	Ms. Raji **Mentor:** Dr.Balasubramanyam	2012
7	Role of Histone deacetylase (HDAC) activity in relation to insulin resistance and glycemic status in patients with Type 2 diabetes"	Mr.C. Sathish Kumar **Mentor:** Dr.Balasubramanyam	2012
8	Role of Toll Like Receptors in Diabetes	Mr.J.Surendar **Mentor:** Dr.V.Mohan	2012
9	Role of Systemic inflammation in Diabesity	Ms. K. Indulekha **Mentor:** Dr.V.Mohan	2012
10	Neutrophil dysfunction in the pathogenesis of diabetes mellitus – the role of nets (neutrophil extracellular traps)	Mr.Y S. Bibin **Mentor:** Dr.Balasubramanyam	2013
11	Genomics of Gestational Diabetes Mellitus in South Indian Women	Dr. S. Kanthi Mathi Mr.M.Chidambaram **Mentor:** Dr.Radha Venkatesan	2013

12	Identification of Genetic Determinants of Diabetic Nephropathy in South Indian Population	Dr. D.Bodhini Mr.M.Chidambaram **Mentor:** Dr.Radha Venkatesan	2013
13	Screening for *HNF1B* gene deletions in Indian Diabetic Patients with Renal Abnormalities.	Dr. S. Kanthi Mathi **Mentor:** Dr.Radha Venkatesan	2013
14	Screening for 6q chromosome abnormalities in children with Transient Neonatal Diabetes Mellitus (TNDM).	Ms.Jahnavi Suresh **Mentor:** Dr.Radha Venkatesan	2013
15	Molecular genetic evaluation of rare types of Maturity Onset Diabetes of Young (MODY) in Indian population.	Ms.Jahnavi Suresh **Mentor:** Dr.Radha Venkatesan	2013
16	Functional characterization of novel *ABCC8* gene mutations in neonatal diabetic patients in India.	Mr. K. Balamurugan **Mentor:** Dr.Radha Venkatesan	2013
17	Development and evaluation of brown rice based idli mix with a lower glycemic index	Dr. S. Shobana	2013
18	High Mobility Group box-1 (HMGB1): A Diagnostic and Prognostic Biomarker for Diabetic Microvascular Complication	Dr. Nagaraj Manickam	2013
19	Elucidating the Emerging Role of NOD and Innate Immunity in Insulin Resistance: Crosstalk between RAGE and NOD signaling	Dr. Shiny Abhijit	2013
20	Exploring secreted frizzled-related protein 4 (SFRP4) – An early biomarker of beta cell dysfunction in type 2 diabetes	Dr. Gokula Krishnan	2013
21	Detection of beta cell death in type 2 diabetes using circulating methylated DNA	Dr. Gokula Krishnan	2013
22	Role of Fibroblast growth factor 21 (FGF-21) in NAFLD subjects with and without type 2 diabetes	Dr. Mohamed Riazuddin Ahmed	2013
23	Common Variants in the CNDP2 Gene and risk of Nepbropathy in Type 2 Diabetes	Dr. D. Bodhini **Mentor:** Dr.Radha Venkatesan	2013
24	Prevalence of Vitamin B12 deficiency and its assocaiation	Dr.R.Guha Pradeepa **Mentor:** Dr.V.Mohan	2013

	with homocysteine in a South Indian Population		
25	Directed differentiation of human embryonic stem cells to insulin producing cells	Dr. Shiny Abhijit	2014
26	Baseline 1 Hour plasma Glucose(1HRPG) cut-offs among normal glucose tolerant individuals and its influence on baseline versus follow-up beta cell function, insulin resistance and incident prediabetes and diabetes at follow-up.	Dr. Priya Maria Miranda Dr. Amutha Anandakumar Dr .Ranjani Harish	2015
27	Pilot Study Initiation and seeking MIRF support: Clinical significance of Bisphenol A (BPA) in relation to glucose intolerance and obesity	Mr.Avinash Dr.M.Balasubramanyam	2015
28	IS ER stress amelioration underlies one of the molecular benefits of early insulin therapy in type 2 diabetes?	Ms. Raji **Mentor:** Dr.Balasubramanyam	2015
29	“Exploring early beta cell dysfunction, vascular complications and stem cell based beta cell regeneration in type 2 diabetes”	Dr. Nagaraj Manickam, Dr. Gokulakrishnan, Dr. Shiny Abhijit	2015

ON-GOING PROJECTS AND RESEARCH PROJECTS IN THE PIPELINE

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
ICOHRTA Training Grant	NIH, U.S.A	Prof. V. Mohan	2001- 2015
Chennai Urban Rural Epidemiology study(CURES)	MDRF & Chennai Willingdon Corporate Foundation	Prof. V.Mohan Dr.M.Rema	2002-2015
Development of Sentinel Health Monitoring Centers in India	WHO/Indian Council of Medical Research	Prof. V. Mohan Dr. R. Guha Pradeepa	2002-2012
Search for susceptibility genes for Type2 diabetes in Indians-Under support grant	DBT	Prof. V. Mohan Dr. Radha Venkatasen	2008-2013
Characterization of intracellular changes induced by prolonged treatment of vascular smooth muscle cells to hyperinsulinemia Implication on diabetic vascular complications	DBT	Dr. M. Balasubramanyam	2009-2012
ICMR-India Diabetes (INDIAB) Study (North East Component) 3yrs	ICMR	Prof. V. Mohan Dr. R.M. Anjana	2010-2016
ICMR - India Diabetes INDIAB Study Phase II rest of India (Excluding North East)	ICMR	Prof. V. Mohan Dr. R.M. Anjana	2012-2013

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
Chennai Urban Rural Epidemiology Study(CURES) – Follow up Study	MDRF	Prof. V. Mohan Dr.M. Rema	2010-2012
Urban Rural differences in risk factors and cardiovascular disease the PURE(Prospective Urban Rural Epidemiology) India Study	ICMR	Prof. V. Mohan	2011-2012
Novel low-cost Technologies for diabetes screening and treatment	DBT	Prof. V. Mohan	2010-2012
Centre of Excellence Centre for Cardio metabolic Risk Reduction in South Asia – CARRS	NHLBI, USA	Prof. V. Mohan	2010-2014
Registry of people with diabetes in India with young age at onset II	ICMR	Prof. V. Mohan	2012-2016
Genetic Analysis of Maturity Onset Diabetes of Young (MODY) and neonatal diabetes in India	ICMR	Dr. Radha Venkatasan	2010-2013

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
Replication of global findings on association of genomic variants with young onset of type 2 diabetes in Asian Indians	DST	Dr. Radha Venkatasan	2011-2014
Serum microrna profiling to explore biomarkers of prediabetes and diabetes	DBT	Dr. M. Balasubramanyam	2012 -2015
Role of nuclear factor of activated T cells (NFAT) in hyperinsulinemia mediated vascular smooth muscle cell proliferation and migration	DST	Dr. Shiny Abhijit	2011 - 2014
Evaluation and molecular profiling of adiponectin isoforms in type 2 diabetes	DST	Dr. K.Gokulakrishnan	2012 -2015
An evaluation of clinical and molecular biomarkers in adolescents in relation to insulin resistance and obesity	ICMR	Dr. K.Gokulakrishnan	2012 -2015
"Effect of irradiation on shelf life, carbohydrate profile and glycemic properties of parboiled Indian brown rice varieties"	BRNS	Dr.Shobana	2014-2017

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
"Evaluating a biomarker role for Retinol Binding Protein-4 (RBP4) in patients with type 2 diabetes	DBT	Dr. K.Gokulakrishnan	2013-2016
Microdiab: Studies of interactions between the gut Microbiome and the human host biology to elucidate novel aspects of the pathophysiology and pathogenesis of type 2 Diabetes"	DBT	Prof. V. Mohan Dr. Balasubramanyam Dr. R.M .Anjana Dr.Radha Venkatesan	2013-2017
"Molecular Biomarker role of chemokines in diabetic retinopathy"	DBT	Prof. V. Mohan Dr. Balasubramanyam Dr. R.M .Anjana	2014-2017
DBT - "Exploring a novel biomarket and drug target: Role of Sestrin, a TOR (Target of Rapamycin) inhibitor, in diabetic dyslipidemia (RGYI)	DBT	Prof. V. Mohan Dr.Nagaraj Manickam	2013-2016
DST Beta Cell Function in youth with type 2 diabetes and its association with atherosclerosis"	DST	Prof. V. Mohan Dr.Amutha Dr.Ranjani Harish	2011-2014
DST-"Carbohydrate profiling of traditional and processed Indian foods with special emphasis on resistant starch and its health benefits - Evolution of women entrepreneurs.	DST	Prof. V. Mohan Ms.Sudha Vasudevan	2011-2014

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
Asymmetric Dimethylarginine (ADMA) in Diabetic Nephropathy and its Role in Hyperglycemia mediated Signaling in Kidney cells"	DST	Dr.Nagaraj Manickam	2013-2016
Identification and characterization of functional polymorphisms in the physiological dysglycemic peptide pancreastatin an indianPopulation"	DST	Prof. V. Mohan Dr. Nitish R Mahapatra	2015-2017
DST - "Women Scientist Scheme A (WOS-A) entitled "Role of CNDPI gene variants in diabetic nephropathy" -3 yrs	DST	Dr.D.Bodhini	2012-2015
"Consortia for Research Platform (CRP) in "Biofortification in selected crops for nutritional security"	ICAR	Dr.Shobana	2014-2016
"Impact on lifestyle intervention on miRNA Biomarkers and glucose metabolism	ICMR	Prof. V. Mohan	2014-2017
ICMR - "Preparation of convenience food products from finger millets and evaluation of their glycemic properties"	ICMR	Dr.Shobana	2013-2015

Name of the project	Funding Agency	Name of the Principal Investigator/Project Co-coordinator	Period of Funding
" Habits: Reality - TV based Diabetes Prevention Program for India"	BIRAC	Prof. V. Mohan	2015-2017
Development of Instruments for implementation of the survey for Monitoring the National Non Communicable Diseases Targets, 2015-16 – Equipment Manual	ICMR	Prof. V. Mohan	2015
Research Society for the Study of Diabetes in India (RSSDI0	RSSDI	Dr.R.Guhapradeepa	2014-2015

LIST OF PUBLICATIONS

(2012-2015)

2015

1. Samaan Z, Lee YK, Gerstein HC, Engert JC, Bosch J, Mohan V, Diaz R, Yusuf S, Anand SS, Meyre D; EpiDREAM Genetics Investigators. Obesity genes and risk of major depressive disorder in a multiethnic population: a cross-sectional study. Journal of Clinical Psychiatry. 2015; 76:e1611-8.

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8. Venkataraman V, Anjana RM, Pradeepa R, Deepa M, Jayashri R, Anbalagan VP, Akila B, Madhu SV, Lakshmy R, Mohan V. Stability and reliability of glycated haemoglobin measurements in blood samples stored at -20°C. Journal of Diabetes and its Complications. 2015 Sep 30.

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10. Pradeepa R, Unnikrishnan R, and Mohan V. Diabetes Epidemic in India: The National Policy Imperatives.Chapter 6.In: Textbook of Chronic Noncommunicable Diseases. The Health Challenge of 21st Century. First Edition 2016. Narain JP, Kumar R (Eds.). Jaypee Brothers Medical Publishers (P) Ltd, New Delhi. 2015; p.81-92.

11. Khatib R, McKee M, Shannon H, Chow C, Rangarajan S, Teo K, Wei L, Mony P, Mohan V, Gupta R, Kumar R, Vijayakumar K, Lear SA, Diaz R, Avezum A, Lopez- Jaramillo P, Lanas F, Yusoff K , Ismail N, Kazmi K, Rahman O, Rosengren A, Monsef N, Kelishadi R, Kruger A, Puoane T, Szuba A, Chifamba J,

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20. Anjana RM, Deepa M, Mohan V. Response to Comment on Anjana et al. Incidence of Diabetes and Prediabetes and Predictors of Progression Among Asian Indians: 10-Year Follow-up of the Chennai Urban Rural Epidemiology Study (CURES).Diabetes Care 2015;38:1441-1448. Diabetes Care. 2015; 38:e147.

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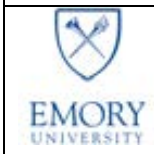
MDRF supports students selected under Joint Science Academies of India's Summer Research Fellowship (SRF) Programme

The three national Science Academies (Indian Academy of Sciences, Indian National Science Academy and The National Academy of Sciences, India) jointly offer two-month Summer Fellowships on a national level competition to enable students/teachers to work with scientists associated with the three Academies. Under the leadership of Dr. V. Mohan who is the Fellow of all the three Science Academies of India, MDRF is honored to be one of the participating institutions to support students/teachers under this program from time-to-time. In the year 2011, two students viz., Ms R. Sahana Ravi & Ms R. Anuradha from the Anna University were benefited from the summer training exposure at MDRF. Considering our commitment and mentorship role, the Joint Science Academies have attached 30 students to work at MDRF for their summer research training during the period 2012-15 (May – July).

RESEARCH COLLABORATIONS - INTERNATIONAL

	University of Alabama at Birmingham, USA
	Emory University, Atlanta, USA
	University of Copenhagen, Denmark
	Florida International University, Florida, USA
	Cardiff University, UK
	University of Warwick, UK
	University of Minnesota, Minneapolis, USA
	Deakin University, Melbourne, Australia
	McMaster University, Hamilton, Canad
	Harvard School of Public Health, Boston, USA
	INSERM, France

RESEARCH COLLABORATIONS - NATIONAL

	Indian Institute of Science, Bangalore
	All India Institute of Medical Sciences, New Delhi
	Indian Institute of Technology, Chennai
	St.John's Medical College, Bangalore
	MS Ramiah Medical College, Bangalore
	Nizam's Institute of Medical Sciences, Hyderabad
	Indian Statistical Institute, Kolkata
	Christian Medical College, Vellore.
	Veterinary College, Chennai
	Centre for Biotechnology, Anna University, Chennai

	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore
	National Institute of Nutrition (NIN), Hyderabad
	Tuberculosis Research Centre, Chennai
	PGIMER, Chandigarh
	Public Health Foundation of India, New Delhi
	National Chemical Laboratory, Pune.

AWARDS & ORATIONS CONFERRED BY OUR INSTITUTIONS

A. The DMDSC Gold Medal Oration Award

(*Instituted in 1994 in order to honour Distinguished Scientists in the field of diabetes*)

The earlier recipients of this award were:

1. **Prof.C.S.Pitchumoni** of the New York Medical College, New York, U.S.A.
2. **Prof.Graham Hitman** of the Royal London Hospital, London, U.K.
3. **Prof.John Turtle** of the Royal Prince Alfred Hospital, Sydney, Australia
4. **Prof.Ronald Klein** and **Prof.Barbara Klein** of the University of Wisconsin, Madison, U.S.A.
5. **Prof. Werner Scherbaum** of the University of Duesseldorf, Germany
6. **Prof.Knut Borch-Johnsen** of the Steno Diabetes Centre, Copenhagen, Denmark and
7. **Prof.David Owens** of the Llandough Hospital, Cardiff, Wales, U.K. and
8. **Prof. Salim Yusuf** of the McMaster University, Hamilton, Ontario, Canada.
9. **Dr. Stephen Colagiuri** & **Ms. Ruth Colagiuri** of the University of New South Wales, Sydney, Australia.
10. **Dr. Pierre Lefebvre** of the International Diabetes Federation (IDF), Belgium
11. **Dr. Nigel Unwin** of the Diabetes Unit, World Health Organization, Geneva
12. **Dr. Edward Horton** of the Joslin Diabetes Center, Boston, USA
13. **Dr. Yuji Matsuzawa** of the Osaka University Medical School, Japan
14. **Dr. C. B. Sanjeevi,** Associate Professor, Diabetes and Endocrinology Division,Head, Molecular Immunogenetics Group, Center for Molecular Medicine, Karolinska Institute, Karolinska Hospital, Stockholm, Sweden
15. **Prof. Martin Silink,** the President of International Diabetes Federation (IDF) and Professor of Pediatric Endocrinology, University of Sydney, Australia.

16. **Prof. Jean Claude Mbanya,** President of the International Diabetes Federation (IDF), from Cameroon, Africa.
17. **Prof. Allan Vaag,** of the Steno Diabetes Center, Denmark.
18. **Dr.K.M.Venkat Narayan**, of the Emory University, Atlanta, USA.
19. **Sir.Michael Hirst,** President Elect, International Diabetes Federation (IDF),Brussels, Belgium
20. **Dr.David Charles Klonoff,** Medical Director, MPHS Diabetes Research Institute, San Mateo, California.
21. **Dr. William Thomas Cefalu,** Associate Executive Director, Scientific Affairs and Chief Scientific Officer, Pennington Biomedical Research Center, Baton Rouge, Louisiana and Editor-in –Chief, Diabetes Care
22. **Dr. Satish Kumar Garg,** Professor of Medicine and Pediatrics & Director of Adult Diabetes Program and Editor-in –Chief, Diabetes Care, Diabetes Technology and Therapeutics
23. **Dr.S.M. Sadikot,** President Elect, International Diabetes Federation and President, Diabetes India
24. **Dr. Frank B.Hu,** Professor, Department of Nutrition and Epidemiology, Harvard T.H. Chan School of Public Health and Professor, Department of Medicine, Harvard Medical School, Boston
25. **Prof. Oluf Pedersen,** Professor, Department of Molecular Metabolism and Metabolic Genetics, University of Copenhagen, Denmark.

B. **MDRF Gold Medal Oration Award**

(Instituted in 2004, with the main objective of honouring distinguished scientists who have contributed significantly to research in the field of diabetes and its associated complications in the eye, kidney and other organs)

1. **Dr. Massimo Porta,** Associate Professor of Medicine of the University of Turin, Italy.

2. **Prof. Roy Taylor, Professor** of Medicine and Metabolism, University of Newcastle.

3. **Dr.K.K.Talwar,** Chairman, Board of Governors, Medical Council of India, New Delhi and Former Director, PGIMER, Chandigarh.

4. **Dr.G.Balakrish Nair,** Executive Director, Translational Health Science & Technology Institute, New Delhi.

5. **Dr.Sudhesh Kumar,** Deputy Dean, Warwick Medical School and Director, The Institute of Digital Healthcare in Warwick Manufacturing Group, University of Warwick, UK

6. **Prof. James F. Sallis,** Distinguished Professor and Chief, Division of Behavioral Medicine, Department of Family Medicine and Public Health, University of California, San Diego.

7. **Dr. Donald R.Coustan,** Director, Maternal-Fetal Medicine Division, Women & Infants Hospital of Rhode Island, USA

C. <u>MDRF Life Time Contribution Award</u>

(Instituted to honour an Indian medical scientist who has contributed significantly in the field of medicine)

1. **Dr.M.Viswanathan**, Director, M.V. Hospital for Diabetes and Diabetes Research Centre, Royapuram, Chennai
2. **Dr.Sam G.P.Moses,** Senior Physician and Diabetologist, Chennai
3. **Dr. M.S.Valiathan,** Honorary Advisor, Manipal Academy of Higher Education, Karnataka and President, Indian National Science Academy, New Delhi.
4. **Dr. R. Chidambaram,** Principal Scientific Adviser, Government of India and DAE Homi Bhabha Chair Professor, Bhabha Atomic Research Centre, New Delhi
5. **Dr.Robert Beaglehole**, Director, Department Of Health Promotion, Disease Prevention, Management and Surveillance, Noncommunicable Diseases and Mental Health Cluster and **Dr.Ruth Bonita Beaglehole,** Director, Office of the

Assistant Director General, Evidence for Information and Policy, World Health Organization , Geneva.

6. **Dr. N.K. Ganguly,** Director General, Indian Council of Medical Research (ICMR), New Delhi.
7. **Dr. B.K. Sahay,** Senior Consultant Physician and Diabetologist and Former Professor and Head, Department of Medicine Osmania Medical College, Hyderabad,
8. **Dr. C. Munichoodappa,** Managing Director, The Bangalore Hospital, Bangalore and
9. **Dr. V. Seshiah,** Chairman, Dr. V. Seshiah Diabetes Research Institute & Dr. Balaji Diabetes Care Centre.
10. **Dr.Arthur.J.Asirvatham,** Senior Consultant Diabetologist, Arthur Asirvatham Hospital and Prof. & Head, Dept of Diabetology, Madurai Medical College, Madurai.
11. **Dr.C.S.Pitchumoni,** Chief of Gastroenterology, Hepatology and Clinical Nutrition at Saint Peter's University Hospital in New Brunswick, New Jersey.

12.**Prof.Sidhartha Das**, Senior Professor, Post Graduate Department of Medicine, SCB Medical College, Cuttack, Odisha.

D. DMDSC Life Time Contribution Award

1. **Prof. Jean Claude Mbanya,** President of the International Diabetes Federation (IDF), from Cameroon, Africa.

2. **Prof. Ashok Kumar Das**, Senior Professor of Medicine & Medical Superintendent, Jawaharlal Nehru Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry.

3. **DR. A. Muruganathan**, Chairman, A.G. Hospital, Tirupur.

4. Dr. V. Seshiah, Chairman, Dr. V. Seshiah Diabetes Research Institute & Dr. Balaji Diabetes Care Centre.

E. DMDSC Award for distinguished humanitarian service.

Awarded in recognition of social services for the benefit of mankind.

1. **Mr.C.Ramakrishna,** Philanthropist, Chunampet
2. **Mr. G.K. Ramamurthy**, Managing Trustee, M/s GKR charities
3. **Dr. Kenneth C.Hobbs**, cofounder of the Whitby Medical Center, Ontario, Canada

F. Dr. K. Anji Reddy Gold Medal Oration Award

(Instituted in 2001 to honour an Indian scientist who has contributed significantly in the frontier areas of Science and Technology in the country)

1. **Dr.N.K.Ganguly**, Director General, ICMR, New Delhi

2. **Dr. Manju Sharma**, Secretary, Department of Bio-Technology, Government of India, New Delhi

3. **Dr. R.A.Mashelkar** B.Chem.Engg., Ph.D., D.Sc, Director General, Council of Scientific and Industrial Research (CSIR), New Delhi

4. **Dr. C. K. Prahalad** - Professor of Corporate Strategy, Michigan Ross School of Business, University of Michigan, U.S.A.

G. MDRF Award for Innovation in Research & Development

(Instituted with the main objective of honouring an Indian Scientist who has made innovative contributions in Research & Development)

1. **Dr. K. Anji Reddy,** Chairman, Dr. Reddy's Laboratories.
2. **Dr. Kiran Mazumdar Shaw**, Chairman & Managing Director, Biocon Limited, Bangalore**.**

H. 'Outstanding Personality Award'

1. **Dr. A.M. Ikram**, Assistant Commandant General, Home Guards and Secretary, Indian Medical Association, Private Practitioner's wing, Vellore.[2008]

I. DMDSC Honour Award

1. **Dr.Vijay Viswanathan**, Managing Director, M.V. Hospital for Diabetes, Royapuram, Chennai and President, Prof.M.Viswanathan Diabetes Research Centre, Royapuram, Chennai.
2. **Dr.C.R.Anand Moses**, Director & Professor, Madras Medical College and Govt. Rajiv Gandhi Hospital, Chennai.
3. **Dr.L.P.Thangavelu**, Managing Director, Ashwin Hospital, Coimbatore.
4. **DR. A. Muruganathan**, Chairman, A.G. Hospital, Tirupur.
5. **Dr.G.Chandra Mohan**, Consultant Diabetologist, Madurai diabetes hospital and research center, Madurai.
6. **Dr. Waleed Khalid Al Zadjali,** Chairman, Al Bashayer Specialized Medical group of Establishments and Chairman, Oman Medical Association, Muscat.
7. **Dr. Jayanta Kumar Panda,** Associate Professor, P.G. Dept of Medicine, S.C.B. Medical College, Cuttack .

J. MDRF Honour Lecture Award

1. **Prof.Chinmoy Shankar Dey,** Professor, IIT New Delhi
2. **Dr.Nikhil Tandon,** Professor, Department of Endocrinology and Metabolism, All India Institute of Medical Sciences (AIIMS), New Delhi.

K. MDRF- UAB Gold Medal Oration Award

(Instituted in 2004, with the main objective of honoring scientists who have contributed significantly to medical science particularly in the field of Community Medicine)

1. **Prof. O. Dale Williams,** Prof. and Associate Director, Division of Preventive Medicine, Univ. of Alabama at Birmingham, USA.
2. **Dr. Cora E. Lewis,** Prof. of Medicine, Division of Preventive Medicine, Univ. of Alabama at Birmingham, USA.

3. **Dr. Myron Gross**, Associate Professor, Laboratory Medicine and Pathology, Univ. of Minnesota, USA
4. **Dr. D. Prabhakaran**, Executive Director, Centre for Chronic Disease Control (CCDC) and Initiative for Cardiovascular Health Research in the Developing Countries (IC Health), New Delhi, India.
5. **Dr. J.S. Thakur**, Cluster Focal Point, National Professional Officer, Non Communicable Diseases and Social Determinants of Health, WHO Country Office for India, New Delhi, India
6. **Dr. V. Shanta**, Chairman, Cancer Institute (WIA), Chennai, India.
7. **Prof.K.Srinath Reddy,** President, PHFI, New Delhi & Former Head, Department of Cardiology, AIIMS, New Delhi.
8. **Prof. Ashok Kumar Das**, Senior Professor of Medicine & Medical Superintendent, Jawaharlal Nehru Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry
9. **Dr.Anura V. Kurpad**, Professor of Physiology & Nutrition at St John's Medical College, and Founding Dean of St. John's Research Institute
10. **Prof. K. VijayRaghavan**, Secretary, Department of Biotechnology (DBT), Government of India, New Delhi.
11. **Dr.Soumya Swaminathan,** Secretary, Department of Health Research, Director General, ICMR, New Delhi.

L. MDRF-UOM Oration Award

1. **Dr. Dwaipayan Bharadwaj,** Scientist, Institute of Genomics and Integrative Biology, New Delhi

M. MDRF-UOM Honor Award

1. **Prof. Narinder K. Mehra,** Head, Dept of Immunology and Immunogenecity, AIIMS, New Delhi

N. Prof.M.Viswanathan Gold Medal Oration

1. **Dr. Samuel Dagogo-Jack,** Professor of Medicine, and Chief, Division of Endocrinology, Diabetes and Metabolism, A. C. Mullins Endowed Professor in Translational Research at the University of Tennessee Health Science Center (UTHSC), Memphis, Tennessee.
2. **Dr. Torben Hansen,** Professor, Department of Genetics of Human Metabolism, The Novo Nordisk Foundation Center for Basic Metabolic Research, University of Copenhagen, Denmark.

O. Dr.Rema Mohan Gold Medal Oration

1. **Dr. Shashank Joshi,** Professor, Department of Endocrinology, Grant Medical College & Sir J. J. Group of Hospitals, Mumbai and Consultant Endocrinologist, Lilavati Hospital, Mumbai and President, Association of Physicians of India and Indian Academy of Diabetes
2. **Dr. Massimo Porta,** Professor and Head, Department of Internal Medicine & Director, Postgraduate School of Internal Medicine, University of Turin, Torino, Italy.

P. DMDEA Gold Medal Oration

1. **Dr. Desmond Schatz,** Professor and Associate Chair, Department of Pediatrics, Division of Endocrinology, University of Florida, Gainesville, Florida, USA.

Q. Dr.Mohan's International Diabetes Update Oration

1. **Dr. Sreekumaran Nair,** Professor, Department of Medicine, Endocrine Research Unit, Mayo Clinic and Foundation, Rochester, Minnesota.

R. Dr. Jerome Markovitz Oration Award

1. **Dr. Sampath Parthasarathy**, Director, Division of Research, Department of Gynecology and Obstetrics, Emory University School of Medicine, Atlanta, USA.

2. **Dr. Myron D.Gross**, Director, Molecular Epidemiology and Biomarker Research Laboratory and Associate Professor, Department of Laboratory Medicine and Pathology, School of Medicine, University of Minnesota, Minneapolis, Minnesota, USA.
3. **Dr. Vivian A. Fonseca**, Prof. of Medicine & Chief of the Section of Endocrinology, Tulane University Medical Centre, New Orleans, USA.
4. **Dr. Nikhil Tandon**, Professor, Department of Endocrinology and Metabolism, All India Institute of Medical Sciences, New Delhi, India.

AWARDS AND HONOURS

PROF. V. MOHAN

Name of Oration /Award	Awarding Organization	Year
World India Diabetes Foundation (WIDF) award	Investigator in Diabetes from World India Diabetes Foundation, USA	2012
RSSDI West Bengal Chapter Annual Oration	West Bengal	2012
RSSDI – UPICON ORATION	RSSDI –UP Chapter, Ghaziabad, UP	2012
First Vice Chancellor Dr. Lalitha Kameswaran Foundation Day Oration	Dr. M.G.R. Medical University, Chennai	2012
Prof. A. S. Thambiah Oration	Indian Society of Teledermatology (INSTED), Chennai	2012
Life Time Achievement 2012	Indian Medical Association Pondicherry State Branch, Puducherry	2013
Fellowship (FACE)	American College of Endocrinology ,USA	2013
JDF ORATION	The Diabetes Challenge - Diabetes Endocrine Summit by Jharkand Diabetes Forum (JDF) in association with Integrated Diabetes & Endocrine Academy (IDEA) & North Eastern Diabetes Society (NEDS), Jamshedpur	2013
Diabetes Club of tiruchirappalli - DCTCON 2013 Endowment Oration	Diabetes Club of Tiruchirappalli, Trichy	2013
Career Achievement Award	Arizona Association of Physicians of Indian Origin, Phoenix, Arizona, USA	2013
PROGRESS Oration 2013	Practical Obstetrics & Gynecology Congress Organized by EV Kalyani Medical Foundation & Society for Medical Learning Resources Transfer, Chennai	2013
Fellowship	American College of Physicians (FACP), USA	2013

Dr. K. Janakiraman's Gold Medal Award	Association of Salem (DAS) during the First Annual Conference of Diabetes Association of Salem	2013
Honorary Fellow	Royal Society of Tropical Medicine Hygiene, UK	2013
Fellow	World Academy of Sciences (TWAS) - for the advancement of science in developing countries, Italy	2013
Diabetes Technology Society Leadership award	Diabetes Technology Society, San Francisco	2013
Eighth S. Ganapathi subramanian Memorial Lecture award	The Institute of Cost Accountants of India, Southern India	2014
KMCH ICE 2014 Oration award	Kovai Medical Center and Hospital, Coimbatore	2014
Jeff Goulder Memorial Lecture Award	Warwick Medical School, Warwick, UK	2014
Lifetime Achievement Award for Excellence in Diabetes Care	South Asian Community by the South Asian Health Foundation, Birmingham, UK	2014
XVII Dr. S. Rangarajan Memorial Oration	Sundaram Medical Foundation, Dr. Rangarajan Memorial Hospital during FORUM 2014,Chennai	2014
World Diabetes Day Oration	Research Society for Study of Diabetes in India (RSSDI) West Bengal Chapter, Kolkatta	2014
2014 SGRF Excellence in Science Award	SciGenom Research Foundation (SGRF) at 2014 NextGen Genomics & Bioinformatics Technologies (NGBT) Conference, Bangalore	2014
India's Most Admired Diabetologist 2014 Award	7th Annual Pharmaceutical Leadership Summit & Pharma leaders Business Leadership Awards 2014, Mumbai	2014

Dr. Jivraj Mehta Award	Association Physicians of India	2015
Prof. B. Kizar Ahamath Endowment Lecture	University of Madras, Chennai	2015
Ranbaxy Research Awards-2013 in Medical Sciences (Clinical Research	Ranbaxy Science Foundation at the Ranbaxy Science Foundation's 21st Annual Symposium and Research Awards Ceremony, Delhi.	2015
6th KMA IDF Oration 2015	Indian Doctors Forum, Kuwait	2015
Prof. M. Viswanathan Memorial Oration	JPEF Annual Convention 2015, Trivandrum	2015
Honorary Doctor of Science (D.Sc.)	Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka	2015
Dr. Muralidhar S Rao Oration	Association of Physicians of India (API), Kalaburagi Chapter, Kalaburagi (Gulbarga), Karnataka	2015
Dr. Sircar-USV Oration	14th Annual Conference of Uttarakhand and Uttar Pradesh Diabetes Association Association (UPDACON 2015), Nainital	2015
Master in the American College of Physicians (MACP)	Philadelphia, PA, USA	2015
8th ISCR Award 2015	Clinical Research in India : Patients First & Research for India by Indian Society of Clinical Research (ISCR), Mumbai	2016
The K. Venkatanarayana TANKER Foundation Awareness Award	Tamilnadu Kidney Research Foundation, Chennai	2016
Dhanvanthri Oration	PSG Institute Sciences and of Medical Research, Coimbatore	2016

Dr. RANJIT UNNIKRISHNAN

Name of Oration /Award	Awarding Organisation	Year
BEST DOCTOR AWARD	Tamilnadu Dr. MGR Medical University for his exemplary services in the field of Diabetology	2012
Fellow, Royal College of Physicians and Surgeons (FRCP), Glasgow	Royal College of Physicians and Surgeons (FRCP), Glasgow	2014
Fellow, Royal College of Physicians of Edinburgh (FRCP)	Royal College of Physicians of Edinburgh (FRCP), Edinburgh	2014
Fellow, American College of Physicians (FACP)	American College of Physicians (FACP), USA	2014
Fellow, Royal College of Physicians (FRCP)	Royal College of Physicians (FRCP), London	2015
Dr. Coelho Memorial Lectureship in Experimental Medicine	Association of Physicians of India at APICON	2015

Dr.R.M. ANJANA

Name of Oration /Award	Awarding Organisation	Year
Boehringer-Knoll Junior Lectureship in Diabetes Award	Association of Physicians of India (API)	2012
Young Outstanding Women Achievers Award	Tamil Nadu Dr. M.G.R. Medical University, Chennai	2012
Young Innovator Award	Indo-UK Diabetes Summit organized by Indo-British Health Initiative (IBHI) and the British Deputy High Commission, Chennai	2013

Fellow, American College of Physicians (FACP)	American College of Physicians (FACP), USA	2014
Fellow, Royal College of Physicians of Edinburgh (FRCP)	Royal College of Physicians of Edinburgh (FRCP), Edinburgh	2014
Tamil Nadu Young Scientist Award	Science City, Govt. of Tamil Nadu	2014
Fellow, Royal College of Physicians (FRCP)	Royal College of Physicians (FRCP), London	2015
E-Merck Award **for the best paper presentation**	APICON 2015, Gurgaon, Haryana	2015
Novartis Young Investigator	Award by the Research Society for the Study of Diabetes in India	2015

Dr. M. BALASUBRAMANYAM

Name of Oration /Award	Awarding Organisation	Year
Fellow	Andhra Pradesh Akademi of Sciences	2014
Endeavour Executive Fellowship	Education Department of Australia	2014-15

Dr. RADHA VENKATESAN

Name of Oration /Award	Awarding Organisation	Year
Faculty of INSPIRE program	DST for science students	2015-2014

Dr. S. POONGOTHAI

Name of Oration /Award	Awarding Organisation	Year
Awarded the best poster presentation	"Challenges in long term study" -**LEADER** held at Chennai	2014
National Co-ordinator" Impact of Retention activites"	Novo Nordisk	2015
2nd prize for the least protocol deviations	the Annual CRC summit for DEVOTE, India	2015

Dr. K. GOKULAKRISHNAN

Name of Oration /Award	Awarding Organisation	Year
Best Oral Presentation Award	Research Society for the Study of Diabetes in India (RSSDI)	2014
Best Poster Presentation Award	Research Society for the Study of Diabetes in India (RSSDI)	2014
EASD's Young Scientist Training Program	Hannover Medical School, Institute of Clinical Biochemistry, Hannover/Germany	2013
Travel Grant award	EASD's Young Scientist Training Programe	2013
Visiting Fellow (Training)	NorthWest Lipid Research Laboratory, University of Washington, Seattle, USA	2013

Seed Grant Award	NIH/NHLBI, USA	2013
D43-Postdoctoral Fellowship Award	Emory University, Atlanta, USA	2012-2014
Young Scientist Award	Science and Engineering Research Board SERB, Department of Science and Technology (DST)	2012

Dr. RANJANI HARISH

Name of Oration /Award	Awarding Organisation	Year
Invite speaker	Invite speaker in the symposium on primary prevention of diabetes. Presented Lifestyle in the prevention of diabetes from India	**2015**
Best Poster Presentation Award	Research Society for the Study of Diabetes in India (RSSDI)	2014
Best Poster Presentation Award	Research Society for the Study of Diabetes in India (RSSDI)	2013

Dr. PRIYA MIRANDA

Name of Oration /Award	Awarding Organisation	Year
Best Poster	Diabetes India 2013	2013
2nd Place: Oral presentation	International Conference on Technological Advances in Super Foods for Health Care	2013

Dr. SHINY ABHIJIT

Name of Oration /Award	Awarding Organisation	Year
Visiting Scientist	University of Florida, USA	2015
Young Investigator Award	International Conference on Free Radical Research, Lonavala	2014
Best Oration Award	Research Society for the study of Diabetes in India, Chennai	2012

Dr. KANTHIMATHI

Name of Oration /Award	Awarding Organisation	Year
Poster Presentation – 1st prize	Conference of RSSDI, Noida, India	2013

Dr. BODHINI

Name of Oration /Award	Awarding Organisation	Year
Women Scientist fellowship and research grant	Department of Science and Technology (DST), Govt of India under the Women Scientists Scheme (WOS-A)	2012

AWARDS RECEIVED BY PHD STUDENTS

Name of Oration /Award	Awarding Organization	Year
Young Scientist Award Received by C. Sathishkumar, Research Scholar, Department of Cell & Molecular Biology for best original research paper presentation.	Indian Science Congress Association (ISCA), Govt. of India	2015

FELLOWSHIPS RECEIVED BY PhD STUDENTS

Research Fellow	Awarding Agency	Department	Year
Sathishkumar C	CSIR (SRF)	Cell and Molecular Biology	2013-2015
Liju Samuel	CSIR (SRF)	Cell and Molecular Biology	2013-2016

SEMINARS AND CONFERENCES ATTENDED BY FACULTY OF MDRF

PROF. DR. V. MOHAN

S. no	Particulars	Year
1.	Novo Nordisk Gulf & Oman Diabetes Association**, Muscat**	2012
2.	9th IDF-WPR Congress & 4th AASD Scientific Meeting at **Kyoto, Japan**	2012
3.	Arizona Association of Physicians of Indian Origin (AAPI) and Arizona Sikh Medical Association (ASMA) Meeting, **Phoenix, Arizona, USA**	2013
4.	Vanderbilt University School of Medicine meeting at **Nashville, TN, USA**	2013
5.	Association of Kerala Medical Graduates Conference, **Houston, Texas, USA**	2013
6.	Saint Peter's University Hospital – CME Program, **New Brunswick, NJ, USA**	2013
7.	Novo Nordisk Gulf & Oman Diabetes Association**, Muscat**	2013
8.	13th Annual Diabetes Technology Meeting, **San Francisco, USA**	2013
9.	Genentech**, San Francisco, USA**	2013
10.	World Diabetes Congress 2013, **Melbourne**	2013
11.	WISDEM & Warwick Medical School Annual Clinical Symposium, **2014** University of Warwick, **UK**	2014
12.	4th Biannual Meeting of Diabetes in Asia Study Group **2014** at **Muscat, Sultanate of Oman**	2014
13.	Consensus panel on Cardiorenal disease prevention and intervention among South Asians at **San Francisco**	2014
14.	American Diabetes Association, **San Francisco, California**	2014

15.	IDF Education Summit**, Singapore**	2014
16.	50th Annual Meeting of the EASD, Vienna, **Austria**	2014
17.	15th Annual Conference of South Asian Health Foundation (SAHF) - Excellence in Diabetes Care across the life course in South Asians, **Birmingham, UK**	2014
18.	CME Program at Servier Gulf, **Muscat**	2014
19.	Academic Model Providing Access To Healthcare (AMPATH), **Eldoret, Kenya**	2015
20.	Sanofi Meeting, **Nairobi, Kenya**	2015
21.	Merck Serono Meeting, **Oman, Muscat**	2015
22.	Merck meeting, **Oman, Bahrain**	2015
23.	**6th KMA IDF Oration 2015** by Indian Doctors Forum, **Kuwait**	2015
24.	**Special Faculty Seminar** at the Faculty of Medicine, Kuwait University, **Kuwait**	2015
25.	Lecture at Dasman Diabetes Research Institute, **Kuwait**	2015
26.	Merck meeting, **Kuwait**	2015
27.	World Health Organization (WHO) Strategic Technical Meeting on Diabetes Management, **Geneva, Switzerland**	2015
28.	Harvard School of Public Health (HSPH) meeting, **Boston, MA, USA**	2015
29.	Joslin Diabetes Center meeting, **Boston, MA, USA**	2015
30.	American Diabetes Association, Boston, **USA**	2015
31.	IDF 2015 World Diabetes Congress at **Vancouver, Canada**	2015

Dr. RANJIT UNNIKRISHNAN

S. no	Particulars	Year
1.	3rd World Congress of Diabetes in Asia Study Group, DASG at **Mumbai**	2012
2.	40th Annual Meeting of the Research Society for the Study of Diabetes at India (RSSDI)	2012
3.	"Inter-Medical Colleges Diabetes Quiz" at National Diabetes Summit at **Amritsar**	2013
4.	Invited lecture at the 5th World Congress of Diabetes India held at **Kochi**	2013
5.	Annual Convention of JPEF held at **Trivandrum**	2013
6.	41st Annual Conference of Research Society for study of Diabetes India (RSSDI) at **Noida**	2013
7.	IDF World Diabetes Congress at **Melbourne, Australia**	2013
8.	13th International Symposium on Diabetes held at **Mumbai**	2014
9.	69th Annual Meeting of the Association of Physicians of India (APICON) at **Ludhiana**	2014
10.	IMD-held at **Colombo**	2014
11.	Dr. Mohan's International Diabetes Update	2014
12.	KRSSDI Decennial Conclave at **Mangalore**	2014
13.	42nd Annual Conference of the Research Society for the Study of Diabetes in India (RSSDI) at **Bangalore**	2014
14.	Participated as Faculty in the Contact Class of the Postgraduate Diabetes diploma organized by the Cardiff University at **Delhi**	2015

15.	70th Annual Meeting of the Association of Physicians of India (APICON) APICON 2015 held in **Gurgaon**	2015
16.	Diabetes and Endocrine Summit held at **Coimbatore**	2015
17.	Changing Diabetes in Children organized by ISPAD at **Bangalore**	2015
18.	6th World Congress of DiabetesIndia at **Chennai**	2015
19.	3rd Hemoglobin Update at **Chennai**	2015
20.	Second Dr Mohan's International Diabetes Update held at **Chennai**	2015
21.	43rd Annual Conference of the Research Society for the Study of Diabetes in India (RSSDI) at **Lucknow**	2015
22.	71st Annual Meeting of the Association of Physicians of India (APICON) held at **Hyderabad**	2016

Dr. R.M. ANJANA

S. no	Particulars	Year
1.	ADA-PAMS 'Clinical Update in Diabetes' – 2015	2015
2.	8th International DIP Symposium, **Berlin, Germany**	2015
3.	14th Annual Meeting of the International Society of Behavioral Nutrition and Physical Activity, **Edinburgh, Scotland,** 2015	2015
4.	Dr.Mohan's Internaitonal Diabetes Update 2015	2015
5.	ADA-PAMS 'Clinical Update in Diabetes' – 2015	2015
6.	Technological Advances, Innovation in Health Industry Care organized by Madras Management Association	2015
7.	IPEN meeting at ISBNPA in **Edinburgh**	2015
8.	5th Annual Scientific Meeting of AP & TS RSSDI DIABETES UPDATE 2015	2015

9.	Annual Conference of the Association of Physicians of India **(APICON), Gurgaon**	2015
10.	Annual meeting of International Society of Behavioral Nutrition and Physical Activity (ISBNPA), **San Diego**	2014
11.	International Non Communicable Diseases Research Meet-Manipal Chapter, **Manipal**	2014
12.	NextGen Genomics and Bioinformatics Technologies (NGBT) Conference at **Bangalore**	2014
13.	42nd Annual Conclave of Research Society for the Study of Diabetes in India (RSSDI-2014) at **Bangalore, India**	2014
14.	7th International Conference on Advanced Technologies & Treatments for Diabetes in Vienna, **Austria**	2014
15.	Dr. Mohan's International Diabetes Update 2014, **Chennai.**	2014
16.	Karnataka Research Society for the Diabetes in India at **Mangalore**	2014
17.	Tenth Anniversary Celebrations Centre for Nutrition-Counseling, Research and Extension Activities, Women's Christian College	2014
18.	APICON 2014, 69th Annual Conference of the Association of Physicians of India	2014
19.	IDF World Diabetes Congress, **Melbourne, Australia**.	2013
20.	Indo-UK Diabetes Summit-2013, at Chennai, India, organized by Indo-British Health Initiative (IBHI) and the British Deputy High Commission, **Chennai**	2013
21.	41st Annual Conference on Research Society for the Study of Diabetes in India (RSSDI-2013), **Greater Noida, Delhi**.	2013
22.	DEAR UPDATE 2013, at **Hyderabad, India**	2013
23.	Insulin Incretin Conclave, at **Chennai**	2013
24.	World Congress of Diabetes India 2013, at **Kochi, India**	2013
25.	3rd World Congress of Diabetes in Asia Study Group – DASG 2012,	2012

	Mumbai.	
26.	40th Annual Meeting of the Research Society for the Study of Diabetes in India (RSSDI), **Chennai.**	2012
27.	National Conference on Diabetes and its Implications organized by Department of Biochemistry, Ethiraj College, January 31, **Chennai**	2012

Dr. M. BALASUBRAMANYAM

S.no.	Particulars	Year
1.	2nd Dr.Mohans' International Diabetes Update, **Chennai.**	2015
2.	Medical Sciences Session of the 102nd Indian Science Congress, University of Mumbai, **Mumbai.**	2015
3.	Joint IUBMB-RCB Advanced School – Diabetes and Metabolic Syndrome: Networks, Cross-talks and Interventions, Heritage Village Resort, Manesar, **Gurgaon.**	2014
4.	Indo-Danish Delegation on Research Collaboration, Innovations Fonden, Copenhagen, **Denmark.**	2014
5.	New Biology Session, 101st Indian Science Congress, **University of Jammu**	2014
6.	Challenges & Opportunities in S&T in Developing Countries, JNCASR, **Bangalore.**	2013
7.	Inaugural Fellowship Course on Regenerative Medicine, Dept of Regenerative Medicine and Translational Science, Calcutta School of Tropical Medicine, **Kolkatta**.	2013
8.	Conference on Healthy Aging in Asia – Strategies to Meet Health & Lifestyle Challenges, Grant Copthorne Waterfront, **Singapore**.	2013
9.	INDO-US BILATERAL WORKSHOP ON *"Pancreatic Islets: From Isolation to Transplantation"*. Asian Institute of Gastroenterology, **Hyderabad.**	2012
10.	1st Annual Probiotic Association of India (PAi) Conference & International Symposium on Probiotics for Human Health- New innovations & Emerging Trends, **New Delhi.**	2012

Dr. RADHA VENKATESAN

S. No	Particulars	Year
1	4th Biennial Meeting of the Indian Society for Pediatric and Adolescent Endocrinology (ISPAE), **Gurgaon**	2015
2	NextGen Genomics, Biology, Bioinformatics and Technologies (NGBT) Conference, **Hyderabad**	2015
3	16s sequencing Training program (Microbdiab Project), THSTI, **Haryana**	2015
4	ADA-PAMS Clinical Update In Diabetes 2015 Conference, **Bengaluru**	2015
5	Faculty of Inspire programme for science students- DST Gov, India, Vel Tech, **Chennai**	2015
6	Faculty of Inspire programme for science students- DST Gov, India, Rajalakshmi Engg college, **Chennai**	2015
7	Dr. Mohan's International Diabetes Update 2015, **Chennai**	2015
8	National symposium "Genomics and Human Health", University of Madras, **Chennai**	2015
9	NextGen Genomics, Biology, Bioinformatics and Technologies (NGBT) Conference, Bangalore, **India**	2014
10	64th Annual Meeting of the American Society of Human Genetics , San Diego Convention Center (SDCC) in San Diego, **California**	2014
11	Indo – Danish International conference on gut microbiota, Copenhagen, **Denmark**	2014
12	Training and Colloboration on NGS and functional genomics, Genetech, **USA**	2014
13	Dr. Mohan's International Diabetes Update 2014, The Leela Palace, M.R.C. Nagar, **Chennai**	2014
14	Faculty of Inspire programme for science students- DST Gov, India, Vel Tech, **Chennai**	2014
15	Faculty of Inspire programme for science students- DST Gov, India, Rajalakshmi Engg college, **Chennai**	2014
16	SN Genetics symposium themed "Genetic counselingand gene testing", sankara Nethralaya, **Chennai**	2013
17	American Diabetes Association's 73rd Scientific Sessions 2013, **Chicago**	2013
18	Indian Medical Association & The Association of Physicians of India, **Pune**	2013
19	Next-generation sequencing and bioinformatics for genomics & health	2012

Ms. SUDHA VASUDEVAN

S. no	Particulars	Year
1	Kaju India meeting by Cashew export promotion council of India, **Kochi**	2015
2	Healthy diet for toddlers - today's scenario, PSBB school, **Chennai**	2015
3	Nutrition research in India, Justice Basheer Ahmed Saiyed College for Women, **Chennai**	2015
4	Healthy lifestyle and NCDs, Sundaram Fasiners, **Chennai**	2015
5	Fit your food for fitness, MOP Vaishnav College, **Chennai**	2015
6	Diet and diabetes - Indian context ,Manipal Medical College, **Manipal**	2014
7	Healthy diet for toddlers -Today's Scenerio, PSBB school, **Chennai**	2014, 2013
8	Role of diet in chronic diseases ,SANOFI India Ltd, **Chennai**	2012
9	Indian diet and metabolic health ,Eithiraj College of Women , **Chennai**	2012

Dr. R. GUHA PRADEEPA

S. no	Particulars	Year
1.	International Diabetes Federation World Congress at Vancouver, **Canada**.	2015
2	Faculty at the Dr.Mohan's international Diabetes Update at **Chennai** , Talk on " Physical activity and diet patterns in India"	2015
3	Faculty at the 13th MDRF-UAB-FIU International Seminar on 'Prevention & Control of Non communicable Diseases ' at **Chennai**	2015
4	External Expert at the 'Meeting of external experts for WHO manual titled 'Development of manualised training modules for health professionals (Doctors, Counselors, Community Health Workers) in addressing behavioural / psychological risk factors for Non communicablediseases (with particular emphasis on tobacco and	2014

	alcohol use)' in Primary Care" at **New Delhi**	
5	Faculty at the 12th MDRF-UAB-FIU International Seminar on 'Prevention & Control of Non communicable Diseases ' at **Chennai**	2014
6	Expert at the "Development of manualised training modules for health professionals in addressing behavioural / psychologicalrisk factors for Non-communicable Diseases in Primary Care" at Dept of Epidemiology, NIMHANS, **Bangalore**	2014
7	International Diabetes Federation World Congress at Melbourne, **Australia**	2013
8	Faculty at the 11th MDRF-UAB-FIU International Seminar on 'Prevention & Control of Non communicable Diseases' at **Chennai.**	2013
9	The Indo-UK Diabetes Summit organized by Indo-British Health Initiative (IBHI) and the British Deputy High Commission, at **Chennai**	2013
10	WHO Regional Meeting on Non communicable Diseases including Mental and Neurological Disorders at Yangon, **Myanmar.**	2012
11	Faculty at the 10th MDRF-UAB-FIU International Seminar on 'Prevention & Control of Non communicable Diseases' at **Chennai.**	2012
12	WHO Regional Meeting on Noncommunicable Diseases including Mental and Neurological Disorders at Yangon, **Myanmar**	2012
13	INDO-US SYMPOSIUM ON THE PANCREAS - Focusing on the Exocrine and Endocrine aspects at **Chennai.**	2012

Dr. S. POONGOTHAI

S. no	Particulars	Year
1.	Delivered talk on Retention –Long term study – **Chennai.**	2014
2	Clinical Research Stakeholders, Reviewing of Clinical Research Protocol and Informed Consent for the Ethics committee members of the Sri Sathya Sai Institute of Higher Learning at **Puttaparti**	2014

3	Impact of Retention activites" on Oct 14th 2015 **Bangalore,** India and received an award for the National Co-ordinator Last patient last visit	2015
4	"Integrating Mental Health and Diabetes – an Indian experience ,NIMHANS, **Bangalore**	2015

Dr. K.GOKULAKRISHNAN

S. no	Particulars	Year
1.	51st EASD Annual Meeting, Stockholm, **Sweden.**	2015
2.	International Conference on Recent Discoveries of Diabetic Biomarkers and Challenges Ahead, **Chennai.**	2015
3.	42nd Annual Conclave of RSSDI, **Bangalore.**	2014
4.	7th International conference on Advanced Technologies and Treatment for diabetes [ATTD].	2014
5.	Ninth and Final Semi-Annual Global Health Centers of Excellence Steering Committee meeting -The National Heart, Lung, and Blood Institute [NHLBI], and the UnitedHealth Chronic Disease Initiative, Bethesda, **Maryland**, **USA**.	2014
6.	42nd Annual Conclave of RSSDI, **Bangalore.**	2014
7.	World Diabetes Congress organized by International Diabetes Federation [IDF], Melbourne, **Australia.**	2013
8.	**5th** World Congress of Diabetes India. Cochin, **Kerala**.	2013
9.	RSSDI, at **Noida.**	2013

Dr. RANJANI HARISH

S.no.	Particulars	Year
1.	10th-13th UAB-MDRF-FIU International Seminar	2012-15
2.	Dr Mohan's International Diabetes Update	2015,14
3.	Technical Advisory Panel for the Program-' PSI India and UP Govt. Comprehensive healthcare screening and treatment program for women'-	2015

	Uttar Pradesh Govt. Initiative	
4.	Consortium for Affordable Medical Technologies (CAMTech) at Massachusetts General Hospital's Centre for Global Health Diabetes Hackathon	2015
5.	Protocol training on "Maps auditing tool"	2015
6.	mDiab project protocol training	2015
7.	Orange Phase II Intervention training program for teachers and students	2014

Dr. SHINY ABHIJIT

S. no	Particulars	Year
1.	Dr. Mohan's International Diabetes update, **Chennai**	2015
2.	International update on Gestational Diabetes, **Chennai**	2015
3.	ADA-PAMS clinical meeting in Diabetes update, **Bangalore.**	2015
4.	14th annual meeting of Society for free radical research, 2014, **Lonawala** – Young Investigator Award.	2014
5.	Neutrophil lymphocyte ratio (NLR): A mesure of systemic inflammation patients with type 2 diabetes. Research Society for Studies in Diabetes - India 2013, **Noida.**	2013
6.	Indo UK Diabetes summit 2013, Indo British Health Initiative (IBHI), **Chennai (Jan 18- 19, 2013).**	2013
7.	"Genomics of Diabetes", SciGenomLabs, Genomics Seminars organised at MDRF.	2012

Dr. S. KANTHI MATHI

S. No	Particulars	Year
1	Dr. Mohan's International Update on Gestational Diabetes mellitus	2015
2	Dr. Mohan's International Diabetes Update 2015	2015
3	National symposium "Genomics and Human Health"	2015
4	International Symposium on "Genomics in health and Disease" & 40th Annual Conference of Indian Society of Human Genetics, **Mumbai**	2015

5	International workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, **Chennai**	2015
6	Workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, **Chennai**	2014
7	Indo UK diabetes summit , **Chennai**	2013
8	41st Annual Conference of Research Society for the Study of Diabetes in India – RSSDI 2013 (Poster Presentation)	2013
9	American Diabetes Association's 73rd Scientific Sessions 2013, **Chicago, Illinois** (Poster Presentation)	2013
10	Genetics & Epidemiology- Study Designs and Statistical Method", National institute of Biomedical Genomics, Kalyani, **West Bengal**	2013
11	Next-generation sequencing and bioinformatics for genomics & health	2012

Dr. D. BODHINI

S. No	Particulars	Year
1	Dr. Mohan's International Update on Gestational Diabetes mellitus, **Chennai**	2015
2	Dr. Mohan's International Diabetes Update 2015, **Chennai**	2015
3	National symposium "Genomics and Human Health", **Chennai**	2015
4	International Symposium on "Genomics in health and Disease" & 40th Annual Conference of Indian Society of Human Genetics, **Mumbai**	2015
5	International workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, **Chennai**	2015
6	Workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, **Chennai**	2014
7	Science Communication Workshop by The Wellcome Trust/ DBT India Alliance at **IIT Chennai**	2014
8	Group Monitoring Workshop under Women Scientist Scheme of DST, **Bhubaneswar, India.**	2014
9	Indo UK diabetes summit , **Chennai**	2013
10	Genetics & Epidemiology- Study Designs and Statistical Method", National institute of Biomedical Genomics, Kalyani, **West Bengal**	2013
11	Next-generation sequencing and bioinformatics for genomics & health	2012

Dr. S. SHOBANA

S. no	Particulars	Year
1	Training program on fruits and vegetable preservation, Food and Nutrition Board, Rajaji Bhavan, Chennai	2015
2	Diet as seminal strategy for the prevention and management of diabetes	2015
3	Participated in the multi-stakeholder consultation to develop MyThali, a new pictorial representation of the NIN dietary guidelines for India, to tackle India's nutrition challenges.	2015
4	Training program on bakery products, Tamil Nadu Agricultural University, Coimbatore	2014
5	National consultation on promotion of small millets, organized by DHAN Foundation, Madurai and Tamil Nadu Agricultural University, Coimbatore.	2014
6	The role of diet in the prevention and management of chronic diseases' - National conference Organised by College of Food and Dairy Technology, Chennai	2014
7	Development, Nutritional and Sensory Evaluation of value added products from Finger millet (RAGI)	2014
8	Dairy intake and risk of newly diagnosed type 2 diabetes mellitus among Chennai urban adult men and women	2014
9	Preparation of vermicilli and pasta, Indian Institute of crop processing technology, Tanjore	2013

Dr. M. CHIDAMBARAM

S. No	Particulars	Year
1	Workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, Chennai	2014
2	Dr. MOHAN'S INTERNATIONAL DIABETES UPDATE	2014
3	Indo UK diabetes summit	2013
4	Next-generation sequencing and bioinformatics for genomics & health	2012

Dr. K. BALAMURUGAN

S. No	Particulars	Year
1	Dr. Mohan's International Update on Gestational Diabetes mellitus, Chennai	2015
2	Dr. Mohan's International Diabetes Update 2015, Chennai	2015
3	International workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, Chennai	2015
4	Attended workshop on "Next generation sequencing, Bioinformatics and data analysis", Chennai	2014
5	Workshop on Advanced techniques in genomics, Madras Diabetes Research Foundation, Chennai	2014
6	Indo UK diabetes summit	2013

Dr. RUCHI VAIDYA

S. No	Particulars	Year
1	Beneficial gut microbiota improves glycemic and lipemic response in type 2 diabetes – a resistant starch supplementation trial study- International Scientific Association of prebiotics and probiotics Conference, George town University, Washington DC	2015
2	Bangalore Boston Nutrition Collaboration Course - Advanced research course on research methods and statistical analysis	
3	Healthy Diet - Indian Context - Presentation at SHAR, Sri Hari Kota on World's Diabetes Day	2014
4	Carbohydrates and their link to the diabetes epidemic in India, International Symposium on carbohydrates, CFTRI, Mysore	2013
5	Estimation of fat content using analytical method becomes critical	2012

Ms SUBASHINI

S. No	Particulars	Year
1	Fundamentals of Clinical Data Management (CDM) to held at the Biostatistics Resource & Training Centre, Dept. of Biostatistics, Christian Medical College, Bagayam, Vellore	2013
2	Short course in Biostatistics – Bootstraping (Resampling), Jackknife & Monte Carlo Methods in Research to held at the Biostatistics Resource & Training Centre, Dept. of Biostatistics, Christian Medical College, Bagayam, Vellore	2012

Dr. U. VENKATESAN

S. No	Particulars	Year
1	Workshop on Quantitative Method in Nutrition 2014'- Analytical approaches to Incorporating Dietary Biomarkers and Reducing Measurement Error- Short course on data analysis using STATA-12 and R at St John's Research Institute, Bangalore	2014

Ms.K.S.CHELLA

S. No	Particulars	Year
1	Indo UK diabetes summit	2013
2	Mini-course on Nutrition Epidemiology – Foundations and Applied Methods jointly organized by Madras Diabetes Research Foundation, Harvard School of Public Health & NIH Fogarty at Chennai	2012
3	INDO-US SYMPOSIUM ON THE PANCREAS - Focusing on the Exocrine and Endocrine aspects at Chennai	2012
4	Workshop on "Statistical Analysis Using R" at Department of Statistics, Manipal University, Manipal	2012

INVESTIGATORS' MEETINGS ATTENDED BY PHYSICIANS

S.No	Name of the staff	Meeting attended	Venue and the year
1.	Dr.Parthasarathy and Dr.Selvakumar	TIPS 3 – Investigator's meeting and Trial Update	Malaysia, Jan 2014
2.	Dr.Muthu Ramu	BC1-CT4 –Study on Foot Ulcer-Investigator's meeting	Hyderabad, Sept 2014
3.	Dr.S.Kasthuri	LEADER Investigators Meeting India and UAE	Chennai, Oct 2014
4.	Dr.Jagdish	ELLIPSE Investigator's meeting	Istanbul, Turkey, Dec 2014
5.	Dr.B.Parthasarathy	Devote Investigator's meeting	Gurgaon, April 2015
6.	Dr.S.Kasthuri	Discussion on Diabetic Foot Ulcer Study- Stempeutics	Bangalore, July 2015
7.	Dr.Kathuri, Dr.Parthasarathy, Dr.Jagdish	4th Investigator's meeting-INDEPENDENT study	Chennai, Sept 2015
8.	Dr. Ramuu	Devote mid-trial investigator meeting	Atlanta, Oct 2015
9.	Dr. Jagdish	GRC– 17536-205 INVESTIGATORS' MEETING	Mumbai, Nov 2015
10.	Dr. Kasthuri and Dr.Uthra	SUSTAIN 7 - (NN9535-4216) SEMAGLUTIDE Ph3b trial Investigator Meeting	London, Nov 2015

INVESTIGATORS' MEETINGS ATTENDED BY CLINICAL TRIALS STAFF

S.No	Name of the staff	Meeting attended	Venue and the year
1.	Dr.Poongothai	National Study Co-ordinator's meeting	Rome, Jan 2014
2.	Mr.Nandakumar	Ellipse – Study Co-ordinator's meeting	Rome, Jan 2014
3.	Dr.Poongothai and Ms.Phebegeniya	INDEPENDENT STUDY-2nd Investigator's meeting	Delhi, Feb 2014
4.	Dr.S.Poongothai	BC1-CT4 –Study on Foot Ulcer-Investigator's meeting	Hyderabad, Sept 2014
5.	Dr.S.Poongothai, Ms.Phebegeniya, Ms.karkuzhali and Mr.Nandakumar	INDEPENDENT STUDY – 3rd Investigator's meeting	Chennai, Sept 2014
6.	Dr.S.Poongothai, Ms.karkuzahli, Mr.Nandakumar	LEADER Investigators Meeting India and UAE	Chennai, Oct 2014
7.	Dr.S.Poongothai	Delivered talk on Clinical Research Stakeholders, Reviewing of Clinical Research Protocol and Informed Consent for the Ethics committee	Puttaparthi, Oct 2014
8.	Mr.Nandakumar	ELLIPSE Investigator's meeting	Istanbul, Turkey, Dec 2014
9.	Dr.Ranjani and K.Karkuzhali	I4L-MC-ABER Investigator Study Training	Gurgaon, Feb,2015
10.	Mr.Mohammed Salman Faris	Devote Investigator's meeting	Gurgaon, April ,2015

11.	Dr.S.Poongothai and Ms.karkuzahli	Training the DIACON site for the INDEPENDENT study	Bangalore, April 2015
12.	Dr.S.Poongothai	Ethics Committee Meeting – at Sathya Sai University	Puttaparthi, Sept 2015
13.	Poongothai ,Indu Raja,Karkuzahli, Phebegeniya and Nandakumar	4th Investigator's meeting-INDEPENDENT study	Chennai, Sept 2015
14.	Dr.S.Poongothai, Ms.karkuzahli and Ms.Kavitha	Annual CRC summit for DEVOTE, India	Jaipur, Aug,2015
15.	Ms.karkuzahli	DEVOTE MID-TRIAL INVESTIGATOR MEETING	Atlanta, Oct 2015
16.	Mr.Nandakumar	Meeting on Accreditation for Clinical Research: Awareness and Expectation	Bangalore, Oct 2015
17.	Dr.S.Poongothai	Symposium on Mental health and Chronic diseases	NIMHANS, Bangalore, Nov 2015
18.	Mr.Viswanathan	GRC– 17536-205 INVESTIGATORS' MEETING	Mumbai, Nov 2015
19.	Dr.Kasthuri and Dr.Uthra	SUSTAIN 7 - (NN9535-4216) SEMAGLUTIDE Ph3b trial Investigator Meeting	London, Nov,2015

Acknowledgement

The Board of Management of MDRF would like to place on record of their appreciation of the efforts put in by Dr.K.Gokulakrishnan in compiling the material and Mr.Prathap In designing the cover page of this Report

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MADRAS DIABETES RESEARCH FOUNDATION

Regd. office : 4, Conran Smith Road, Gopalapuram, Chennai-600 086, India.
Ph : 91-44-4396 8888 Fax : 91-44-28350935
E-mail : drmohans@vsnl.net
Kallam Anji Reddy Centre : Plot No. 20, Golden Jubilee Bio tech Park for Women Society, Sipcot - IT Park, Siruseri - 603103. Ph : 91-44-27470608