Annual Report

2021-2022

Bharati Vidyapeeth (Deemed to be University)

INTERACTIVE RESEARCH SCHOOL FOR HEALTH AFFAIRS

IRSHA
INTERACTIVE RESEARCH SCHOOL FOR HEALTH AFFAIRS

Bharati Vidyapeeth Deemed University
Interactive Research School for Health Affairs (IRSHA)
Annual Report July 2021- June 2022

Overview of Director

It is my privilege to present the Annual report of Interactive Research School for Health Affairs (IRSHA) for the year 2021-2022. All the departments of IRSHA were successful in receiving financial support of Rs.859.36 Lakhs from national funding agencies for carrying out their research work. This year student fellowships of Rs. 37.38 lakhs were received. In the current year 2 students were awarded PhD degree.

NIBEC laboratory, was reaccredited by NABL for testing of SARS-CoV-2 virus neutralization along with dengue and chikungunya neutralization. Accreditation for SARS-CoV-2 neutralization was particularly important because NIBEC played a key role in supporting nation by providing services to SARS-CoV-2 vaccine manufacturers. The BSL3 laboratory was certified by Government of India..

In the year 2021-2022 research work at the institute culminated into 22 publications research articles

Several activities had been organized at the institute and also the staff and students participated in national and international events. A brief summary of these events, activities and achievements by all the staff members has been presented in the current report.

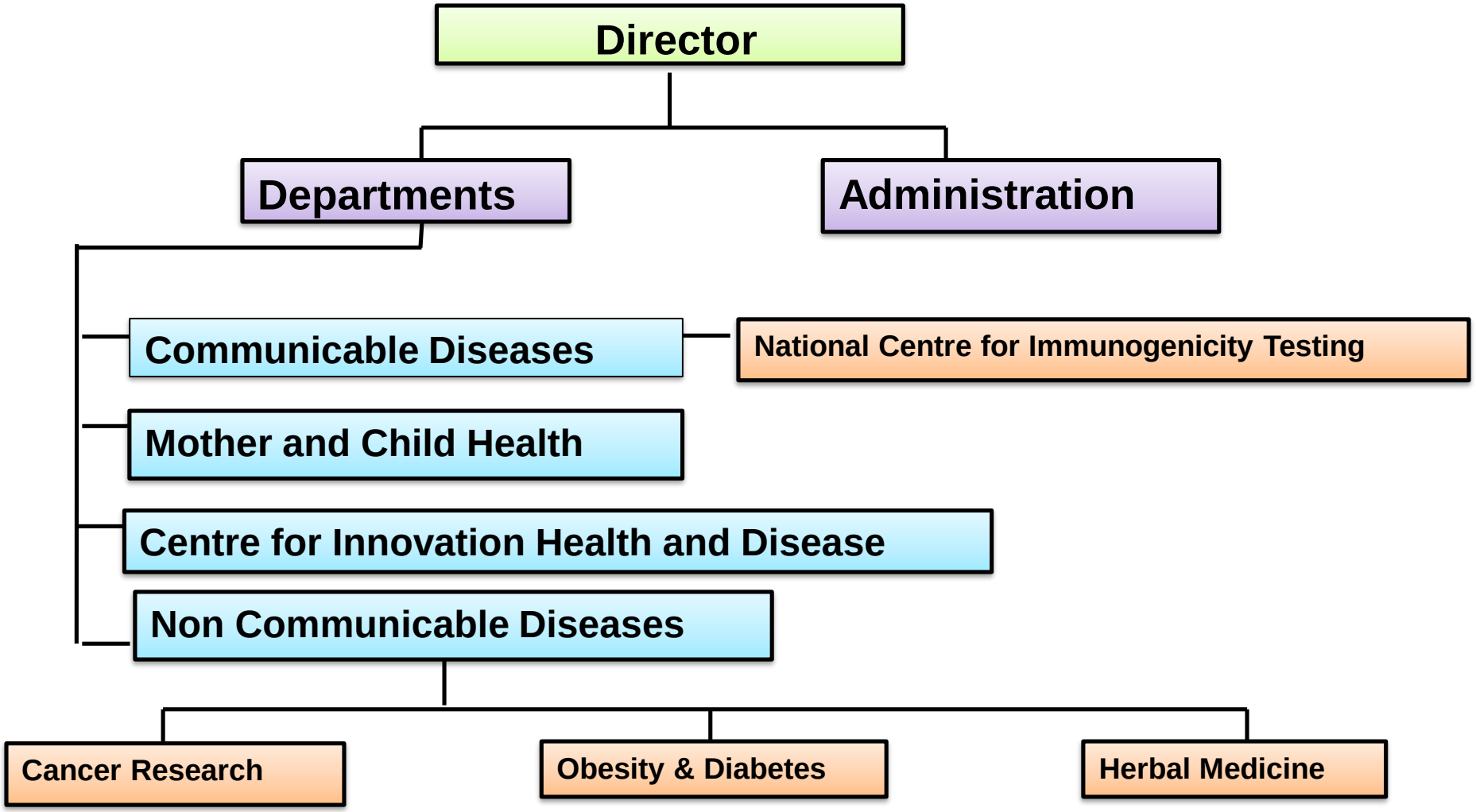
I appreciate the support and hard work of all the scientists, technical and administrative staff for their commendable performance.

Finally I sincerely thank the management for extending all the support for undertaking our research work.

Dr A C Mishra, M Sc, Ph D, LL B, FASc, FNA

Director

Organogram


Director
Departments
Administration
Communicable Diseases
National Centre for Immunogenicity Testing
Mother and Child Health
Centre for Innovation Health and Disease
Non Communicable Diseases
Cancer Research
Obesity & Diabetes
Herbal Medicine

Name of the Programme: Mother and Child Health

1. **Title:** Investigating Mechanisms Leading to Preeclampsia (**Project ID:** MCH/17/1/E); **Funding:** ICMR, Centre for Advanced Research; **Duration:** March 2017 to March 2022; **Sanctioned Amount**: Rs. 7,55,55,247/- **Investigators: PI** - Dr. Sadhana Joshi; **Co PI**- Dr. Girija Wagh, Dr. Sanjay Lalwani, Dr. Sanjay Gupte; Co-Investigators - Dr. Giriraj Chandak; Dr. Savita Mehendale, Dr. Arun Kinare, Dr. Priscilla Joshi, Dr. Leena Srivastav, Dr. Hemant Mandke, Dr. Anvita Kale, Dr. Deepali Sundrani, Dr. Nisha Wadhwani; **Ph.D. Students**: Aditi Godhamgaonkar; Vaishali Kasture (DST Inspire-SRF); Juhi Nema (CSIR-JRF); Anjali Jadhav (ICMR-SRF); Kinjal Dave (CSIR-JRF); **Human Ethical Approval**: IEC/2015/37, dated 03.10.2015

Background: The current study aims to follow pregnant women from early pregnancy until delivery, to examine changes across gestation in nutritional, biochemical, and molecular measures and identify the underlying mechanisms which influence the pathophysiology of preeclampsia (PE). This will be useful in development/validation of biomarkers for early prediction of PE. The study will also follow up the children's growth during infancy and their neurodevelopment at the age of 2 years.

Work done:

Results of the study

- A total number of 1814 pregnant women recruited from two hospitals (Bharati Hospital and Gupte Hospital) of which 1154 women delivered and were included in the study.
- Analysis for this report includes data on 1096 singleton pregnancies of which 112 women had preeclampsia (PE) and 984 were women without preeclampsia (non-PE).
- Maternal blood was collected at each time point; cord blood and placenta were collected at delivery.
- Information on subjects' clinical history, medication, SLI, physical activity, 24 hr dietary recall, FFQ, ultrasonography and color Doppler measures were recorded at each time point.

- Women with PE were older, had a higher SLI score, were professionals and more educated, had higher BMI and systolic and diastolic blood pressure at all the time points, had a higher percentage of nulliparous women, higher percentage of assisted mode of conception and caesarean sections as compared to non-PE women.
- Gestational age at birth was lower in the PE group as compared to the non-PE group.
- Babies born to mothers with PE had a lower birth weight and head circumference as compared to the non-PE group.
- The percent preterm birth and SGA babies in the PE group were higher than the non-PE group.
- TSH levels were higher in women with PE as compared to non-PE women at V1.
- Fetal growth measures such as BPD, HC, AC, and EFW were lower at 18-22 weeks of gestation and FL was lower at 32-35 weeks of gestation in the PE group as compared to the non-PE group
- Mean uterine artery PI was higher at 11-14 weeks and 18-22 weeks of gestation in the PE group as compared to the non-PE group.
- Umbilical artery PI and fetal MCA PI at 32-35 weeks were lower in the PE group as compared to the non-PE group.
- Fetal growth measures such as AC, FL, and EFW at 32-35 weeks were negatively associated while mean uterine artery PI at 11-14 weeks and 18-22 weeks was positively associated with with preeclampsia after adjusting for confounders.
- The placentae of women with PE had a lower thickness at centre, at edge and at cord insertion as compared to the non-PE placentae.
- The percentage of bilobed and irregular shape and percentage of velamentous cord insertion was more in case of PE as compared to the non-PE group.
- Physical activity was lower in women with preeclampsia across pregnancy, but not associated with an increased risk of preeclampsia
- Women with preeclampsia consumed lower millets and green leafy vegetables, whereas higher ghee/butter, milk/milk products and nuts/oilseeds in early pregnancy. However, none of the above were associated with risk for preeclampsia.
- The REVAMP participants gained less weight throughout pregnancy compared to Intergrowth-21st reference.

- Data on maternal erythrocyte fatty acid levels shows that in the PE group at V1, saturated fatty acid levels were higher; at V2, total omega-6 fatty acids and omega-6/omega3 fatty acid ratio were higher; at V3, arachidonic acid was higher as compared to the non-PE group.
- The Δ6 desaturase index was higher in the PE group at V1, V2, and at delivery while Δ5 desaturase index was lower at V2, and at delivery.
- Δ6 desaturase index at 11-14 weeks showed significant predictive power in predicting EOP with the cut-off value of 0.138.
- No significant differences in the maternal and cord levels of folate, vitamin B_{12} and homocysteine between PE and non-PE groups.
- Maternal serum magnesium levels were lower in the PE group at V2.
- Magnesium levels were negatively associated with the risk of PE at V2 after adjusting for confounders.
- Hs-CRP levels were higher at V1, V2 and V3 in the PE group but not associated with risk of preeclampsia.
- Maternal vitamin D levels were lower in the PE group at V2 and at delivery
- No significant differences were observed in the MDA levels between both the groups.
- Angiogenic factors like PlGF in maternal plasma were lower at all the time points while VEGF was lower only at V1 in the PE group.
- Anti-angiogenic factors like sEng in maternal plasma was higher at all the time points while sFlt-1 was lower at V3 in the PE group.
- sEng/PlGF ratio was higher at V1, V2, and V3 while sFlt-1/PlGF ratio was higher at V2, V3, and V4 in the PE group.

Children Follow Up

Follow up of children for anthropometric measurements at various time points is ongoing. The children are followed up as per the vaccination routine/schedule at 6 wks, 10 wks, 14 wks, 6 months, 9 months, 12 months, 15 months, 18 months and 24 months. Table 25 shows the anthropometric measures such as weight at various time points on children till date.

The birth weight was lower in the PE group as compared to the non-PE group. Subsequently it was observed that the weight of the child remained lower at 6 weeks, 10 weeks, 14 weeks, 6 months (trend, but no significance). The child shows catch up in weight from 15 months upto 2 years.

Developmental Scores

The Developmental Screening Test by Bharath Raj is being administered telephonically at >2 years of age by trained Psychologists at both the hospitals. The test is designed for the purpose of measuring mental development of children from birth to 15 years of age. The test consists of 88 items which represent behavioral characteristics of respective age levels. At each age level, items are drawn from behavioral areas like:

- Motor development- These items have many neurological and behavioral implications.
- Adaptive behavior- These items represent sensory-motor adjustment to objects, persons and situations.
- Speech- Language- These items find a place which are inclusive of all visible and audible forms of communication like vocalizations, words etc.
- Personal- Social development- They comprise of child's personal responsiveness to the social culture of which he is a member. e.g. Play cooperativeness etc

There was a lower trend (p=0.076) observed for the Developmental Quotient (DQ) levels in the PE group as compared to the non-PE group.

Data Entry and Data Validation

Data entry for all the questionnaires administered to the subjects enrolled in the study has been completed. Furthermore, double data entry and data validation has been completed for majority of the questionnaires/parameters. The remaining double data entry and validation is ongoing.

2.Title: Early Interventions to Support Trajectories for Healthy Life in India (EINSTEIN). Healthy Life Trajectories Initiative (HeLTI) (**Project ID:** MCH/17/2/E) Multicentric Project; **Funding:** DBT; **Sanctioned Amount:** Total Sanctioned Rs. 743.44 Lakhs; IRSHA Share: Rs.13.50 Lakhs; **Duration:** Dec 2017 to Nov 2022; **Investigator at IRSHA**: Dr. Sadhana Joshi; **Human Ethical Approval**: IEC/2018/34

Background: The study is a community-based, cluster randomized intervention with three arms (pre-conception, pregnancy and control) set in rural Mysore, South India, with individual villages forming the basis for the cluster. The primary outcome at age 5 years in the children

across all HeLTI cohorts is adiposity, measured by fat mass index. Other key outcomes at 5 years include; overweight and obesity, glucose metabolism, blood pressure, and infant/child development.

Work done:

Formative work: Mysore Team commenced the formative work in November 2018 in three villages.

Community engagement: Extensive community engagement to explain the study and assess the community's interest and willingness to not only participate, but also contribute to the study design and delivery

Qualitative work: Undertook focus group discussions (FGDs) with village women, husbands, mothers/mothers-in-law, village leaders and officials, and local community health staff.

Quantitative work:

Intervention development: The core members of the India and Canada teams conceptualised the intervention modules and prepared the outline in February 2019. The intervention will be delivered across four phases. The local team then developed six pre-conceptional modules: General Health; Healthy Eating; Health Lifestyle; Keeping Clean; Positive Thinking; and Preparing for Pregnancy.

Harmonisation and governance : All four HeLTI teams have worked together to harmonise data variables and intervention domains and we have achieved a high degree of harmonisation

3. Title: OPTIMISE: Optimal preconception nutrition to offset inflammation and non-communicable disease risk in pregnant women and their children in China, India and South Africa; (Project ID: MCH/17/2/E) **Funding:** Medical Research Council, United Kingdom; **Duration** : 5 years; Project Sanctioned but not initiated; **Investigators: Principal Investigator** Dr Kalyanaraman Kumaran University of Southampton Human Development and Health; **Co-Investigator** Professor Caroline Fall University of Southampton Human Development and Health Co-Investigator Professor Philip Calder University of Southampton Human Development

and Health Co-Investigator Dr Mark Johnson Imperial College London Surgery and Cancer; Co-Investigator Dr Amanda SferruzziPerri University of Cambridge Physiology Development and Neuroscience; Co-Investigator Professor Shane Norris University of the Witwatersrand Faculty of Health Sciences Co-Investigator Professor Stephen Matthews University of Toronto Physiology; Co-Investigator Dr Stephen Lye University of Toronto Physiology; Co-Investigator Dr Ghattu V Krishnaveni CSI Holdsworth Memorial Hospital Research; Co-Investigator Dr Giriraj Chandak CSIR - Centre for Cellular and Molecular; Co-Investigator Dr catherine birken Hospital for Sick Children (SickKids) Paediatrics and Genetics Co-Investigator Professor Cindy-Lee Dennis University of Toronto Unlisted; Co-Investigator Dr William Fraser University of Sherbrooke Faculty of Medicine and Health Sciences Co-Investigator Professor Hefeng Huang Huang Shanghai Jiao Tong University Medical School; Co-Investigator Professor Luigi Bouchard University of Sherbrooke Faculty of Medicine and Health Sciences; Co-Investigator Dr Fengxiu Ouyang Shanghai Jiao Tong University; Co-Investigator Dr Yanting Wu Shanghai Jiao Tong University Medical School; Co-Investigator Dr SADHANA JOSHI Bharati Vidyapeeth University IRSHA, Pune (School for Health Affairs)

Hypothesis: We propose that inflammation is an important modifiable factor underlying an inter-generational cycle of non-communicable disease (NCD) risk in low- and middle-income countries (LMICs). We hypothesise that recent dietary changes in LMICs (causing the 'double burden of malnutrition') set up a chronic inflammatory state which increases the risk of type 2 diabetes (T2DM) and cardiovascular disease (CVD). Among pregnant women, this inflammatory state leads to pregnancy complications (gestational diabetes, hypertensive disorders and pre-term birth) and placental changes that impair fetal growth. These disrupt fetal neurodevelopment and increase fetal adiposity. Optimising maternal diet and nutritional status before and during pregnancy will reduce inflammation, prevent pregnancy complications and improve newborn body composition. Long term benefits, beyond the scope this project, will be reduced NCD risk in the mother, and improved brain development and reduced cardiometabolic disease in the offspring.

OPTIMISE aims to leverage a unique trio of harmonised randomised controlled trials (RCTs) taking place in China, India and South Africa to:

Determine context-specific nutritional factors influencing inflammatory load among young women and how nutrition interacts with other drivers of inflammation

Elucidate relationships between maternal inflammatory load and common adverse pregnancy outcomes (gestational diabetes, hypertensive disorders, pre-term birth and fetal growth restriction)

Determine if a package of interventions to optimise women's nutrition before and during pregnancy reduces inflammatory load and these adverse pregnancy/birth outcomes

Investigate mechanisms, including altered placental structure, inflammation and nutrient

transport capacity, linking inflammatory load with adverse pregnancy outcomes.

Work Done: The study has been initiated and we are awaiting for samples.

4. Title: Epigenetic regulation of angiogenic factors in assisted reproductive technology (ART) and non-ART derived placentae **(Project ID**: MC/19/4/E); **Funding:** DBT; **Sanctioned Amount**: 59.91 Lakhs; **Duration:** July 2019 to July 2022; **Investigators: PI**- Dr. Deepali P. Sundrani **Co-Investigators:** Dr. Sadhana Joshi; Dr. Sanjay Gupte

Background: In India, the rate of infertility is on the rise thereby increasing the demand for assisted reproductive technology (ART) procedures. ART treatment coincides with several phases of epigenetic programming during gametogenesis and early embryo development. During these stages,*de novo* methylation and chromatin remodeling takes place which influences the placental structure and function by switching on and off various genes. This study aims to examine the placental epigenetic patterns of angiogenic factors in women undergoing ART procedures and also examine their association with maternal one carbon metabolites and fatty acid profile.

Work Done:

The project is completed and the findings are as follows.

- Recruitment and sample collection for 94 non-ART and 65 ART subjects is completed.
- Subjects history and clinical information and neonatal characteristics have been recorded.
- mRNA expression of VEGF, PlGF, FLT-1, KDR genes
- Methylation levels of VEGF and FLT1 genes completed on 28 non-ART and 26 ART samples
- Customized miRNA array developed and miRNA expression analysis initiated

Results and Conclusion

- Maternal age and diastolic blood pressure was higher and gestational age and birth weight of the neonate was lower in ART women as compared to women of the non-ART group.
- Placental mRNA expression levels of FLT-1 and KDR were higher in ART placentae whereas placental mRNA expression of PlGF was lower and VEGF was higher.
- Further, mean methylation at the VEGF promoter was lower in the placenta of ART women as compared to those who conceived naturally. Our data indicates that there is altered angiogenesis in the placentae of women undergoing ART procedure.
- miRNA miRCURY array designed for miRNAs targeting angiogenic factors identified differential miRNAs that were associated with ART procedure.
- Validation of these miRNAs on larger sample size has been initiated.

5. Title: Maternal Vitamin D and its Association with Angiogenesis in Preeclampsia. (**Project ID:** MCH/17/1/P); **Funding:** CSIR-SRF, Duration: April 2017- April 2022, **Sanctioned Amount**: 22.94 lakhs, **Guide:** Dr. Sadhana Joshi**; PhD** Student: Juhi Nema (CSIR JRF/SRF) **Ethical Approval**: IEC/2015/37, dated 03.10.2015

Background: The current study explores the association of maternal vitamin D levels with angiogenic growth factors in preeclampsia.It also focuses on the potential mechanisms through which maternal vitamin D may regulate angiogenesis in preeclampsia.

W**ork done:**

Human study: Vitamin D was estimated on 66 normotensive control women and 31 women with preeclampsia. Maternal serum vitamin D (25(OH)D) levels were estimated at four different time points across gestation that is 11-13 weeks, 18-22 weeks, 26-28 weeks and at delivery. Cord blood serum vitamin D (25(OH)D) were also estimated.

Results and Conclusion:

The present study estimates the vitamin D status in women with and without preeclampsia. This cohort includes a total of 1154 women, of which 1096 women were with singleton pregnancy, among which 108 women developed preeclampsia. This study includes 324 pregnant women (216 Non-PE and 108 PE women). Serum vitamin D levels at V1 were found to be lower in women who subsequently developed preeclampsia as compared to the Non-PE women ($p = 0.068$). At V2, vitamin D levels were found to be significantly lower in women who subsequently developed preeclampsia as compared to the Non-PE women ($p < 0.01$). Serum vitamin D levels at V3 were found to be comparable between the two groups. Serum vitamin D levels at V4 were found to be significantly lower in women with preeclampsia as compared to the women without preeclampsia ($p < 0.01$).

6. Title: Influence of maternal one carbon metabolites on placental epigenetic patterns (**Project ID:** MCH/18/2/P) **Funding**: CSIR; **Sanctioned Amount:** 22.94 lakhs ; **Duration:** August 2018 – August 2023; **Guide**: Dr. Sadhana Joshi; **PhD Student**: Kinjal Dave (CSIR JRF/SRF) **Ethical Approval:** BVDU/MC/51

Background: Alterations in the one carbon metabolism which supplies methyl group for all biological methylation reactions can result in changes in the DNA methylation patterns. The current study therefore aims to examine the placental CpG methylation and mRNA expression levels of angiogenic factors, *PEMT* and *FADS* in women with preeclampsia and compare it with normotensive women. We also aim to examine the association of the CpG methylation patterns with maternal blood pressure and fetal outcome.

Work done: A total of 200 placental tissues (100 normotensive controls, 100 preeclampsia) were collected from central maternal region and stored at -80°C. Genomic DNA was isolated from placental samples using the DNeasy Blood and Tissue kit.

Gene specific methylation analysis of selected candidate genes PlGF, FLT-1, HIF1A, HIF3A and PEMT was completed. Data showed significant hyomethylation at various CpG sites in the PlGF promoter region and FLT-1 gene and significant hypermethylation on two CpG sites in the HIF3A gene and one CpG site in HIF1A. This data indicates altered methylation of these genes in the preeclampsia placentae may influence angiogenesis, placental growth as well as intrauterine fetal development that may predispose the children to higher risk of cardiometabolic disorders in future.

7. Title: Fatty Acids, Oxidative Stress and Neurotrophins in Gestational Diabetes Mellitus (**Project ID:** MCH/18/3/P) **Funding**: ICMR; **Sanctioned Amount:** ; **Duration:** August 2018 – August 2023; **Guide**: Dr. Sadhana Joshi; **PhD Student**: Anjali Jadhav (ICMR SRF) **Ethical Approval:** BVDU/MC/51

Background: The present study reports the levels of fatty acids, oxidative stress markers (Protein carbonyl, Malondialdehyde), antioxidant (Glutathione), neurotrophins (BDNF, NGF) in the placenta in the women with GDM and compares them with non GDM women. We also report the levels of fatty acids longitudinally across pregnancy in the above women and their association with birth outcome. The association of fatty acid levels, oxidative stress markers and neurotrophins with birth outcome measures are also reported. Hypothesis: "Long chain polyunsaturated fatty acids, oxidative stress and growth factors will be altered in women with Gestational Diabetes Mellitus"..

Work done:

This study was conducted at Interactive Research School for Health Affairs (IRSHA) and pregnant women coming to Gupte Hospital and Research Centre, Pune constituted the participants for the current study. This study involves a total of 130 pregnant women (70 non-GDM women) and (60 women with GDM).

Results:

- Altered placental fatty acid levels in women with GDM
- Decreased level of glutathione in the GDM placenta
- Analysis of neurotrophic factors i.e. BDNF and NGF from GDMA dn Non-GDM placentae is on-going

8. Title: Placental Telomere Attrition in Women with Preeclampsia. (**Project ID:** MCH/18/3/P)

Guide: Dr. Sadhana Joshi**;** **PhD** Student: Aditi Godhamgaonkar; **Ethical Approval**: IEC/2015/37, dated 03.10.2015

Background: The current study explores the influence of maternal fatty acid status and oxidative stress profile with placental telomere length in women with preeclampsia.

Work done:

Fatty acid estimation of 324 samples (108 preeclampsia women and 216 non-preeclampsia women. Maternal RBC fatty acids were estimated at four different time points across gestation that is 11-13 weeks, 18-22 weeks, 26-28 weeks and at delivery. Cord fatty acids were also estimated. Maternal plasma MDA levels were estimated at four different time points across gestation that is 11-13 weeks, 18-22 weeks, 26-28 weeks and at delivery.

Results and Conclusion:

Maternal total erythrocyte saturated fatty acids and omega-6/omega-3 fatty acid ratio was higher in the PE group as compared to the non-PE group at 11-14 weeks and 18-22 weeks respectively. Maternal Δ5 desaturase index was lower while Δ6 desaturase index was higher in the PE group at 11-14 and 18-22 weeks. Maternal stearoyl CoA desaturase-18 (SCD-18) index was lower at 11-14 weeks and at delivery. These changes were mainly observed in the early onset PE (EOP) group. Maternal plasma MDA were comparable between the PE and non-PE group at all timepoints across gestation. Maternal plasma MDA were significantly higher levels at 26–28 weeks in EOP women when compared to non-PE women ($p < 0.05$). Elevated plasma MDA levels were positively associated with birth length at 18–22 weeks and 26–28 weeks in the

PEgroup ($p < 0.05$ for both). Maternal plasma MDA levels were positively associated with systolic blood pressure at 18–22 weeks.

9. Title: Role of Maternal Nutrients and its influence on Inflammation and Angiogenesis in women with Gestational Diabetes Mellitus. (**Project ID:** MCH/18/4/P).**Guide:** Dr. Sadhana Joshi**;** **PhD** Student: Shweta D. Madiwale **Ethical Approval**: BVDUMC/IEC/84A, dated 20.04.2023 **Duration**: Feb 2022- Feb 2025

Background: The current study explores the role of Maternal plasma micronutrients – Folate, vitamin B_{12} and homocysteine levels across gestation in Gestational Diabetes Mellitus.

Work done:

Micronutrients (Folate, vitamin B_{12} and homocysteine) were estimated on 100 Non-Gestational Diabetes Mellitus women and 100 women with Gestational Diabetes Mellitus. Maternal plasma micronutrient levels were estimated at four different time points across gestation that is 11-13 weeks, 18-22 weeks, 26-28 weeks and at delivery.

Results and Conclusion:

This study includes 200 pregnant women (100 Non-GDM and 100 GDM women). Plasma vitamin B_{12} levels at V3 and at delivery were significantly higher in women with GDM compared with non-GDM women. Plasma folate levels at V2, V3 and at delivery were higher in women with GDM. Homocysteine levels were significantly lower in women with GDM compared with non-GDM women across gestation from V1 to as delivery.

10.Title: Exploring the Role of Postnatal Omega-3 Fatty Acid Supplementation on Neuropeptide Y Levels and Cognitive Performance in Offspring subjected to Maternal Separation using a Rat Model (**Project ID:** MCH/21/1/I); **Funding:** Bharati Vidyapeeth Deemed to be University. **Duration:** March 2021 to March 2022; **Sanctioned Amount**: Rs. 1,00,000/- **Investigators: PI** - Dr. Anvita Kale; Animal **Ethical Approval**: IEC/2015/37, dated 03.10.2015

Background: Maternal separation is a well reported model of early life stress. Early life stress (ELS) is reported to affect brain development and may lead to psychological, physiological and behavioral changes in later life. Recent human and animal studies have started to reveal links between ELS and neuropeptide Y system in the brain. Further role of omega 3 fatty acids in brain function is well established

Objectives: The present study evaluates the effect of maternal separation on NPY levels and also assess if a postnatal omega 3 fatty acid supplementation can improve these levels using a rat model. **Methods:** The study will be carried out at the Animal House facility of Bharati Vidyapeeth. Female Wistar Albino rats (n=24) will be assigned to control diets from prepregnancy till end of lactation. Maternal separation will begin from postnatal d0 (PND0) till postnatal D21 (PND 21). Postweaning these litters will be assigned to three dietary groups (n=8) in each group i.e 1) control; 2) Maternal Separation and 3) Maternal Separation + Omega-3 Fatty Acids (1.2mg/day). These diets will continue till the end of lactation. At end of lactation 2 pups from each dam in each group will be assessed for cognitive performance and then dissected to collect brain tissue for biochemical estimations.

Results

Reproductive Performance

The total weight gain of dams during pregnancy was similar between groups 1) (Control: 140.5±10.55g); 2) MS: 146.17 ± 29.728g and 3) MS + O: 146.83 ± 33.820g. The litter size and litter weight was also similar between groups. However, the pup weight was lower in the MS group as compared to both control ($p=0.014$) and MS + O ($p=0.028$) on d21 of lactation.

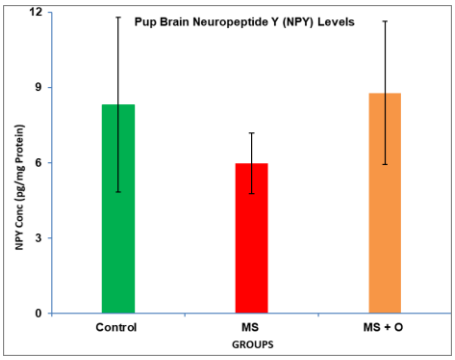
Pup Brain Fatty Acid Levels at End of Lactation

Maternal Separation had no effect on the levels of fatty acids in the pup brain at the end of lactation. Omega 3 fatty acid supplememtation increased the levels of docosahexaenoic acid in the brain of the pups from the MS + O group at the end of lactation. All other fatty acids were similar between groups (Table. 1).

Pup Brain Neuropeptide Y Levels at End of Lactation

The levels of neuropeptide Y in the pup brain from the control were (8.30 ± 3.48pg/mg protein); MS group were (5.97 ± 1.21 pg/mg protein) and in the MS + O group were (8.78 ± 2.85 pg/mg protein) and were similar between groups (Fig.1)

Fig 1: Neuropeptide y Levels in Pup Brain at End of Lactation

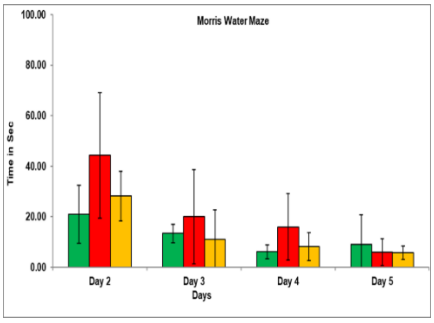


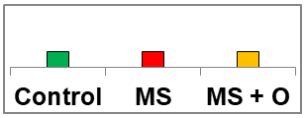
Data is expressed as Mean ± SD; MS: Maternal Separation; MS + O: Maternal separation supplemented with omega 3 fatty acids

Cognitive Performance of the Adult Offspring

Maternal separation and maternal separation supplemented with omega 3 fatty acids did not affect the cognition of the offspring neither on the eight arm radial maze nor the Morris water maze test and was similar to control (Fig. 2 and Fig. 3).

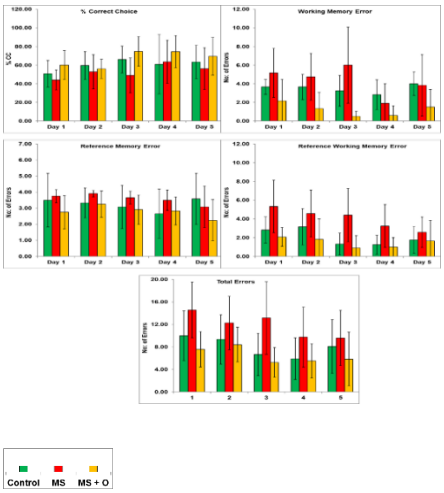
Figure 2: Cognitive Assessment using Morris Water Maze Test





Data is expressed as Mean ± SD; MS: Maternal Separation; MS + O: Maternal separation supplemented with omega 3 fatty acids

Figure 3: Cognitive Assessment using Eight Arm Radial Maze Test



Data is expressed as Mean ± SD; MS: Maternal Separation; MS + O: Maternal separation supplemented with omega 3 fatty acids

Manuscript preparation in progress

Name of the Programme: Cancer Research Lab

1. **Title:** Evaluating the effect of Alpha Linolenic acid, an omega-3 fatty acid on the modulation of epigenetic markers in cervical cancer cells.**Project ID:** (Project ID: CR/18/1/E); **Funding:** DST SERB; **Duration:** Oct 2018-Oct 2021;**Sanctioned Amount:** 33,16,800/-; **Investigators:** NA; **PI:** Dr. Ruchika Kaul-Ghanekar; **Ph.D. Students:** Ms Amrita Ulhe; **Human Ethical Approval:** NA

   Background: Cervical cancer occurs mostly due to high rates of infection with human papillomavirus (HPV). Among high-risk strains, HPV 16 and 18 are those closely associated with cervical carcinoma. It is the second leading cancer in Indian women and fourth leading cause in the world. Even though conventional therapies have greatly reduced the mortality but they have not been able to prevent the disease recurrence. Carcinogenesis involves both genetic and epigenetic changes that alter the expression of genes which are important for the development of cancer. Dietary fatty acids, particularly, omega 3, have been reported to prevent cancer risk by blocking or reversing cancer progression through various molecular targets including epigenetic modulation with the least undesirable effects, which are caused by available synthetic epigenetic drugs. Dietary components have also been shown to regulate cancer growth by regulating epigenetic mechanisms through selective activation or inactivation of gene expression. ALA, an essential omega-3 fatty acid, has been reported to down-regulate proliferation of breast, colon and esophageal cancer cell lines through various mechanisms. We have previously reported the anticancer potential of ALA in cervical cancer in vitro. In the present study, we evaluated whether ALA could regulate the growth of cervical cancer cells by inducing epigenetic alterations in the cells

Work done:

- The effect of ALA on EZH2, EHMT2 and KDM1A mRNA expression was determined in HeLa, SiHa and C33A, cervical cancer cell lines by qPCR. In HeLa, ALA decreased EZH2 mRNA expression by ~2.9, ~4.18 and ~4.23 –folds at 20, 40 and 80µM conc.,

respectively. In SiHa, ALA decreased EZH2 mRNA expression by ~3.71-folds at 80µM dose in conc. of ALA. In C33A, EZH2 mRNA expression, was decreased by ~1.67 and ~2.12 –fold sat 40 and 80µM conc., respectively. In HeLa, ALA decreased EHMT2 mRNA expression by ~2.9, ~4.09 and ~4.27-folds at 20, 40 and 80µM conc., respectively. In SiHa, EHMT2 mRNA expression was decreased by ~4.02-folds at 80µM dose in conc. of ALA. In C33A, ALA decreased EHMT2 mRNA expression by ~1.69, ~1.61 and ~2.49 –folds at 20, 40 and 80µM conc., respectively. In HeLa, ALA downregulated KDM1A mRNA expression by ~1.52,~2.33 and ~3.69-folds, at 20, 40 and 80 µM conc. respectively. In SiHa, ALA downregulated KDM1A mRNA expression by ~4.6-folds at 80 µM conc. In C33A, ALA downregulated KDM1A mRNA expression by ~1.80-folds in C33A, at 80 µM conc.

- The effect of ALA on KAT2B, ESCO2 and HAT1 mRNA expression was determined in HeLa, SiHa and C33A, cervical cancer cell lines by qPCR.

Results and conclusion:

- ALA significantly decreased DNA methyltransferase (DNMT)-1 expression in cervical cancer cells. DNMTs facilitate hypermethylation of CpG islands in the promoter region of tumor suppressor genes leading to their silencing. Inhibition of DNMT-1 can lead to DNA demethylation and can thus restore the expression of tumor suppressor genes and cell cycle regulators. In HeLa, SiHa and C33A at maximum dose of 80 µM, DNMT1activity was decreased by ~1.5,~2.4 and ~6 folds, respectively, compared to the untreated control cells.
- Histone acetyltransferase (HATs) belongs to KAT family, which acetylate specific lysine in histones, and functions in regulating chromatin organization and function. On treatment of HeLa, SiHa and C33A with 80µM conc. of ALA, the KAT2B mRNA expression was increased by ~2.02, 2.6 and 2.03-folds, respectively. ESCO2 mRNA expression was increased by ~1.54 and~1.76 -folds in HeLa and SiHA at 80µM conc. of ALA, respectively. In C33A, at 40 and 80µM conc. of ALA, ESCO2 mRNA expression was found to be upregulated by ~1.67 and ~3.01-folds, respectively. At 40 and 80µM, ALA decreased HAT1 mRNA expression by~2.55 and ~4.79 in HeLa, respectively.

While in SiHa, HAT1 mRNA expression was downregulated by ~2.33 and ~6.58-folds at 40 and 80µM conc. of ALA, respectively. In C33A, HAT1 mRNA expression was downregulated at 80µM conc. of ALA, by 3.08 –folds.

- In conclusion, ALA exhibited significant inhibition of KAT2B, ESCO2, EZH2, EHMT2 and upregulation of HAT1 and KDM1A mRNA expression in cervical cancer cell lines indicating epigenetic modulation in cervical cancer cells.

2. **Title:** Phytochemical standardization and evaluation of anti-cancer and immunomodulatory activity of Unani formulation, *Itrifal ghudadi*. **Project ID:** (Project ID: CR/20/2/E)**; Funding:** AYUSH-EOI; **Duration:** Mar 2020-Mar 2023; **Sanctioned amount:** 43, 57,750/-; **Investigators: PI:** Dr BothiRaj, Poona college of Pharmacy **Co-PI:** Dr. Ruchika Kaul Ghanekar, **Human Ethical Approval:** NA

   Background: In the previous year, the authentic plant material resources were identified and plant material was obtained. The preparation of traditional Unani formulation, *Itrifal Ghudadi* was optimized under the guidance of Hakim.

   Work done:

   The phytochemical composition of IG and its individual ingredients has been studied by LCMS. The effect of IG has been studied on the viability of cervical cancer (HeLa and SiHa), breast cancer (MCF-7 and MDA MB 231) and oral cancer (SCC-9) cell lines. The cancer cell line showing efficient response to IG has been studied for growth kinetics.

   Results and conclusion:

- The LC-MS analysis of IG revealed the presence of 43 bioactives with reported pharmacological activity.
- IG significantly decreased the viability of HeLa, SiHa, MDAMB-231, and SSC-9 cells and was found to be most potent against MDAMB231. At 800 µg/ml, viability of MDAMB 231 was decreased to 43.9 %.

- IG decreased the growth kinetics of MDAMB231 in a dose and time dependent manner. At 300 µg/ml dose, growth of cells was decreased to 69.9, 88.3, 94.9 % for 24, 48 and 72 h respectively, compared to the untreated cells.

3. **Title:** Evaluating the anticancer activity and mechanism of action of Unani formulation *Habbe Musaffi Khoon* (HMK) against cervical cancer. **Project ID:** (Project ID: CR/18/3/E) **Funding :** CCRUM Ministry of Aayush Duration: Sep 2018- Sep 2021, **Sanctioned amount** :57,56,500/- **Investigators** : **PI**: Dr. Ruchika Kaul Ghanekar (Cancer Research Lab, Interactive Research School of Health Affairs (IRSHA), BVDU, Pune, Maharashtra) **Co-PI:** Dr. Gazalla Mulla (Z.V.M, Unani Medical College, Pune, Maharashtra) Dr. Prerna Raina (Cancer Research Lab, IRSHA, BVDU) **PhD Students:** Nidhi Sharma(SRF); **Human Ethics Approval:** NA

   Background: Cervical cancer is the second most common cancer in Indian women. Current treatment modalities (chemotherapy, and/or surgery, and/or radiotherapy) associated with side effects, drug resistance and immunosuppression. Developing effective adjunct herbal therapies for the treatment of the cancer has become an urgent need of the hour. Habbe Musaffi Khoon, is a Unani formulation that is used as a blood purifier and also for treatment of various gynaecological infections (Unani pharmacopeia, PartII,Vol-3).The existing literature reports the anticancer activity of majority of the constituents of Habbe Musaffi Khoon (formulation of 16 ingredients).

   Work done:

   The mechanism of action of Habbe Musaffi Khoon was evaluated on cervical cancer cells (HeLa, SiHa and C33A) in terms of regulating angiogenetic marker (VEGF) , metastasis marker (MMP-2) , Tumor regulatory markers (p53 and MDM2) and HPV oncoproteins E6 and E7

   Results and Conclusion:

- At 80 µg/ml dose, HMK downregulated the mRNA expression of VEGF in HeLa, SiHa and C33A by 1.7, 2.4 , 1.7 folds. At the same dose, mRNA expression of MMP-2 in

HeLa and SiHa was decreased by 1.5 and 1 folds, respectively. The mRNA expression of p53 in HeLa, SiHa and C33A was increased by 1.5, 2.9, 1.4 folds at 80 µg/ml concentration, respectively. HMKaq downregulated MDM2 mRNA expression in HeLa, SiHa and C33A by1.5, 2 and 1.3 folds.

- It can be concluded that HMKaq inhibited angiogenesis and metastasis in HeLa, SiHa and C33A by down regulating the gene expression of VEGF and MMP2 genes . HMKaq inhibited the growth of cervical cancer cells by targetting p53-MDM2 pathway.

4. **Title:** Evaluation of anti-cancer potential of selected phytochemicals against breast cancer stem cells (BCSCs); **Project ID:** (Project ID: CR/18/1/I) **Funding:** NA **Duration:** Oct 2018 – Oct 2023, **Sanctioned Amount:** NA **Investigators:** NA **PI:** Dr. Ruchika Kaul Ghanekar **Ph.D. Students:** Ms Akanksha Mahajan, **Human Ethical Approval:** NA

   Background: Breast cancer still remains the major cause of cancer related deaths in women, despite of numerous advancements in treatment approaches. Even after removal of tumor from primary cancer site, in some patients tumor relapses aggressively at distant sites in the body. Treatment failure in cancer is governed by a smaller subset of tumor seed cells called as Cancer Stem Cells (CSCs) which have capability to generate entire tumor mass. Breast cancer stem cells are the root cause of tumor relapse, migration and drug resistance. Not more than a few synthetic drugs are available to target BCSCs, but they pose a drawback of inducing resistance in the BCSCs. Natural or herbal medicines have proven themselves better with their more effective, targeted action with less or no side effects. The plant *Xanthium strumarium* has gained recognition through various forms of traditional medicine. Also, recently studies have shown various medicinal properties of the plant such as anodyne, antibacterial, antifungal, antimalarial, antirheumatic, antispasmodic, antitussive, cytotoxic, hypoglycaemic, etc. but there is less data on the anticancer studies of this plant. The study proposes to evaluate the anticancer activity of the aqueous seed extract and to evaluate its phytochemical composition. We further propose to screen down the most active phytocompound against breast cancer stem cells and cancer stem cell regulating pathways. The molecular mechanism of action of selected phytocompound would be evaluated.

Work done:

The previous report outlined the completion of the first objective concerning the establishment of the mammosphere model and the examination of GR's effect on MDA-MB-231 cell viability. However, subsequent investigation into the molecular mechanisms of GR yielded inconsistent and non-dose-dependent results. GR displayed limited efficacy on MDA-MB-231 cells and mammospheres, with potential cell cycle arrest observed at lower doses. Notably, GR is a synthetic drug used clinically for chemotherapy side effects, suggesting its presence in XSaq may be due to impurity or contamination, rendering it unsuitable for the proposed study's objectives. Consequently, a new topic and title were proposed following a guide change and discussion with the scientific committee.

Further we started work under the objective 1, which involved identifying potential therapeutic targets of Enterolactone (EL) for targeting Triple Negative Breast Cancer-Cancer Stem Cells (TNBC-CSCs). Therapeutic targets for TNBC and CSCs were sourced from various drug target prediction and curated databases.a total number of 53 gene targets were identified, which correspond with TNBC-CSCs and are responsive to EL. KEGG and GO enrichment analysis highlighted molecular mechanisms and biological processes associated with TNBC-CSCs, supporting EL's potential efficacy.

Results and Conclusion:

Molecular docking further revealed EL's strong interaction with key targets like ESR1, AKT1, EGFR, etc., indicating therapeutic promise. Network pharmacology analysis reinforced EL's ability to target multiple pathways crucial in TNBC-CSCs. These findings lay the groundwork for subsequent in vitro mechanistic studies.

5. **Title:** Evaluating the effect of phytochemical, Matairesinol, on Repolarization of THP-1 derived macrophages. Project ID: (Project ID: CR/17/2/I) (DBT JRF) **Funding:** NA **Duration:** Sep 2017- Sep 2024 **Sanctioned Amount:** NA, **Investigators: PI:** Dr.

Ruchika Kaul-Ghanekar, **Co-PI:** NA, **Co-Investigators:** NA, **Ph.D. Students:** Amol Rajendra Chaudhary, **Human Ethical Approval:** NA

Background: In the tumor microenvironment, tumor-associated macrophages (TAMs) constitute 30–50% of stromal cells and significantly influence cancer prognosis. Their plasticity between M1 (anti-tumoral) and M2 (pro-tumoral) phenotypes makes them potential therapeutic targets. Treatments aim to reduce M2-TAM recruitment, selectively deplete them, or reprogram them towards M1 phenotype. A study evaluated the effect of matairesinol (MAT) on M2 macrophage polarization, which is crucial for potential therapeutic interventions in triple-negative breast cancer (TNBC).

Work done: In M2a macrophages, MAT notably downregulated M2 markers, such as CD206, TGM2, IL-10, and TGF-β, by 4.74 ($p<0.001$), 3.91 ($p<0.001$), 6.88 ($p<0.001$), and 9.49 ($p<0.001$) fold, respectively. Concurrently, there was an upregulation of CD86, CCR7, and TNF-α by 5.18 ($p<0.001$), 17.31 ($p<0.001$), and 3.84 ($p<0.001$) folds, respectively. Interestingly, in M2d macrophages, MAT significantly downregulated M2 markers, CD206, MARCO, IL-10, and TGF-β by 3.31 ($p<0.01$), 8.23 ($p<0.001$), 2.29 ($p<0.001$), and 7.97 ($p<0.001$) fold, respectively. Simultaneously, there was an upregulation of CD86, CD16, and TNF-α, by 3.57 ($p<0.001$), 3.59 ($p<0.001$), and 4 ($p<0.01$) folds, respectively

Results and conclusion: These observations suggested that MAT treatment induced repolarization of M2a and M2d macrophages towards the M1 phenotype.

6. **Title:** Investigating the Therapeutic Potential of Plant Lignan for targeting Lipid Metabolism Reprogramming in Breast Cancer. Project ID: (CR/19/3/I) **Funding:** NA, **Duration:** Nov 2019 – Nov 2024, **Sanctioned Amount:** NA, **Investigators: PI:** Dr. Ruchika Kaul-Ghanekar, **PhD Student:** Ms. Prajakta Devappa Patil, **Human Ethical Approval:** NA.

   Background: Considering the pivotal role of lipids in the progression of cancer, targeting lipid metabolism-related pathways offers new therapeutic opportunities for

cancer. Lipid metabolism reprogramming in breast cancer is vital to target as it plays a pivotal role in cancer progression, influencing tumor growth, invasion, metastasis, and resistance to therapy. Exploring natural compounds, specifically plant lignans, in rewiring lipid metabolism to advance targeted therapies for breast cancer, offers potential breakthroughs in personalized medicine and minimizing treatment-related side effects. Its significance lies in its potential to impact global health by providing novel, accessible breast cancer prevention and treatment approaches. Our computational and laboratory results emphasize the potential of lignans, especially Sesamin, in reshaping lipid metabolism reprogramming. Further detailed exploration of these findings holds promise for advancing our understanding of their role in cancer therapy.

Work Done:

The effect of SE was evaluated on the viability and growth kinetics of MCF-7, and MDA-MB-231 was evaluated by using MTT assay. The effect of SE on lipid droplet accumulation was evaluated by nile red assay and the expression of lipid regulatory markers was evaluated by using qRT-PCR.

Results and Conclusion:

- Sesamin (SE) significantly reduced the viability of MCF-7 breast cancer cells at a 100 μM dose. Viability decreased to 79.9 ± 6.5%, 82.2 ± 8%, and 71.3 ± 6.9% at 24, 48, and 72 hours, respectively. In contrast, SE did not affect the viability of normal breast epithelial cells, MCF-10A, up to the same dose and time frame.
- SE also significantly reduced the growth kinetics of MDA-MB-231 breast cancer cells. At 100 μM, growth was decreased by 1.4, 1.6, and 1.4-fold at 24, 48, and 72 hours, respectively.
- SE treatment caused a noticeable reduction in lipid droplet accumulation in MCF-7 and MDA-MB-231 cells. At 100 μM, lipid droplets were reduced by 1.6 and 1.5-fold in MCF-7 and MDA-MB-231, respectively, at 24 hours.
- SE altered the expression of lipid regulatory markers in MDA-MB-231 cells. At 100 μM, the expression of FASN, ACC-1, and SCD-1 was reduced by approximately 3.3, 2.5, and 2.57-fold, respectively, compared to untreated controls. In terms of cholesterol regulatory

markers, SE reduced HMGCR and SREBP-2 expression by 3.2 and 5.9-fold, respectively, while upregulating LXR-alpha expression by 4.54-fold.

7. **Title:** Evaluating the effect of selected bioactive on cytokine and chemokine regulation in Prostate cancer. Project ID: (CR/19/4/I) **Funding:** NA, **Duration:** Feb2019- Feb 2024, **Sanctioned Amount:** NA, **Investigators: PI:** Dr. Ruchika Kaul-Ghanekar, **PhD Student:** Ms. Rama Rajadnya,
   Human Ethical Approval: NA.

   Background: Prostate cancer (PCa) is the most diagnosed carcinoma in men, mostly non symptomatic un-till reaches advance stage. Statistically, Second most frequently observed cancer and the fifth leading cause of cancer related death in men globally.Inflammatory molecules induced signaling pathways such as PI3K/Akt, EGFR/Ras/MAPK, Jak/Stat are associated with PCa development and progression. Elevated EGFR signaling is directly or indirectly linked with pro-inflammatory cytokines which are related with high risk of Castration resistant PCa (CRPC) and bone metastasis. Proinflammatory cytokines along with specific receptors (such as IL-8/CXCR7) increase the downstream signaling pathways (such as Akt, mTOR) resulting into increased metastasis in PCa. The present study aims to evaluate the effect of Matairesinol on pro-inflammatory cytokines and assosiated signaling pathways in PCa progression.

   Work Done:

   Previously, we reported the regulatory effect of MAT on pro-inflammatory and anti-inflammatory cytokines in PC3(castration resistant Prostate cancer) cell line. In the present study, we evaluated the effect of MAT on mRNA expression of cytokine and chemokine receptors, STAT3/6 and E-Cadherin. We observed reduced mRNA expression of Pro-inflammatory cytokine TGF-β and its receptor TGFBR1 by 6.47 and 1.60 fold at 200 µM concentration of MAT , respectively .At the same dose, mRNA expression of Pro-inflammatory chemokine CXCL16 and its receptor CXCR6 was decreased by 8.43 and 2.93 folds, respectively. The STAT3 and STAT6 are important signaling molecules in the cytokine mediated signaling pathway. mRNA expression of STAT6 and STAT3 was decreased by 2.44 and 2.61 fold respectively at 200 µM.CDH1/ E-Cadherin is an

important epithelial marker which is expressed high in normal epithelial cells and progressively reduces in PCa metastasis.CDH1 levels increased after MAT treatment at 200 µM dose by 12.05 fold.

Results and Conclusion:

MAT decreased expression of pro-inflammatory cytokine, chemokine, its receptor and STAT3/6 which would be helpful in reducing the PCa progression.

8. **Title**: Role of Selected Phytochemicals in Regulation of Aberrant Lipid Metabolism in Prostate Cancer. Project ID: (CR/21/5/I) **Funding:** NA, **Duration:** July 2021- June 2022, **Sanctioned Amount:** NA, **Investigators: PI:** Dr. Ruchika Kaul-Ghanekar, **PhD Student:** Minal G. Mahajan **Human Ethical Approval:** NA

Background:

In prostate cancer, aberrant lipid metabolism is one of major hallmark for development of Castration resistant prostate cancer (CRPC). Thus, targeting dysregulated lipid metabolism could be the effective strategy for prostate cancer treatment. Matairesinol (MR) is a plant lignan which has been reported to prevent tumor growth and induce apoptosis in *in vivo* PCa models. The study performed in our lab have demonstrated the cytotoxic effect of MR in breast cancer cell lines. In the current study, we have observed that MR exerted cytotoxic effect in PC-3 cell line. Studies suggested that MR affected growth kinetics and reduced mitochondrial membrane potential in prostate cancer cell line (PC-3). Further, we have explored the potential of Matairesinol in regulation of denovo fatty acid synthesis in prostate cancer. In current year, studies were performed to understand role of MR in regulation denovo cholesterol synthesis in PC-3 cell line.

Work done:

The effect of MR in regulating expression of de novo cholesterol synthesis genes was determined in PC-3 cells.

Results: We have evaluated the effect of MR in modulating expression of de novo cholesterol synthesis genes (SREBP-2 and HMGCR) in PC-3 cells by qPCR. The cells were treated with different concentrations (20, 40, 80 µg/ml) of MR and incubated at 37℃ for 24 hours. At 80 µg/ml concentration of MR; the expression of SREBP-2 was decreased by 33.17-folds ($p < 0.001$) in PC-3 cells (Fig. 1). Also, expression of HMGCR was downregulated by ~68.91-folds ($p < 0.001$) in PC-3 cells at 80 µg/ml concentration of MR (Fig. 1). This suggests role of MR in modulating aberrant de novo cholesterol synthesis in prostate cancer.

Conclusion: Matairesinol has a potential to regulate aberrant de novo cholesterol synthesis in prostate cancer cells.

Name of the Programme: Obesity- Diabetes

1. **Title:** Effect of Yoga Intervention on Skeletal Muscle linked Glucose Homeostasis in Pre- Diabetic individuals. Project ID: (Obdb/19/1/E) Funding: DST (SATYAM); Duration: March 2019-September 2022; Sanctioned Amount: Rs. Rs.46, 74,200/-; Investigators: PI: Dr. Supriya Bhalerao Co I (1): Dr. Pranita Ashok (till 28th Feb, 2022) Dr. Anuradha Joshi (1st March, 2022 onwards) Co I (2): Mrs. Anita Patil Project Staff: Dr. Ravina Randive (SRF) Till 31st December 2021 Dr. Suresh Khadke (JRF) Till 31st December 2021 Human Ethical Approval: IEC/2019/05 (04.03.2019) IEC/2019/35 (06.07.2019 amended) IEC/2019/05

   Background:

   In the present study, pre-diabetic individuals identified through community screening were randomly allocated to follow either Yoga or Exercise for a period of 4 months. The effect of these interventions was assessed on functional capacity of skeletal muscles as they form the major site for glucose uptake and their strengthening may enhance proper glucose disposal and glycemic status. It was expected that the project will enable us to bridge the gap in existing knowledge about Yoga and its effect on skeletal muscle linked glucose homeostasis.

   Objectives:

   To evaluate the effect of Yoga interventions on muscle mass, strength, endurance and flexibility which are direct or indirect indicators of fat deposition in skeletal muscles.

   Work done:

   In this year, a total of 102 individuals were screened from the community, 24 were recruited, of which 10 completed the study. The overall recruitment status is as follows:

Table 1: Details of enrolment in study

Details	No. of Patients
Screened	229
Recruited	42
Participants completed	19 (Yoga- 10; Exercise- 9)
Participants drop out	17
Participants ongoing	6

Results:

The study is ongoing. The data will be analysed after completion of the committed sample size.

2. **Title:** Prevalence of Single Nucleotide Polymorphisms in lipid metabolizing genes in patients with Type 2 Diabetes Mellitus; Project ID: (Obdb/21/1/I) Duration: March 2021- November 2025 Investigators: PI: Dr. Supriya Bhalerao PhD student: Anu Moses Human Ethical Approval: BVDUMC/IEC/39 Human Ethical Approval (amended):

Background: Insulin resistance (IR), the essential component of metabolic syndrome, has traditionally been defined from a glucocentric viewpoint, with glucotoxicity playing a lead role. However, as overabundant circulating fatty acids are now known to be overt contributors, there is a paradigm shift in the understanding of metabolic syndrome acknowledging the importance of lipotoxicity as a major perpetuator of insulin resistance. Ectopic accumulation of fat in liver, adipose, muscle and pancreatic islets, provokes insulin resistance through various mechanisms. The novel lipocentric view depicts the hyperglycaemia of type 2 diabetes mellitus (T2DM) and the underlying insulin resistance as being secondary to the metabolic trauma caused by ectopic lipid deposition or lipotoxicity. Considering the hypothesis shift to lipocentric pathology, in the present study we wish to study prevalence of SNPs in Lipid metabolizing genes in patients with T2DM.

Objectives:

1. To study the prevalence of selected SNPs in the patients with T2DM.
2. To explore the difference in prevalence of the SNPs with respect to sex and Body Mass Index.

Work done:

The selection of SNPs is done using bioinformatics tools e.g. KEGG pathway database, HumanCyc database etc. Further, 7 diabetic and 7 normal individuals have been recruited in the study.

3. **Title:** Evaluation of the effect of CIT on innate and adaptive immune response in healthy individuals. Project ID: (Obdb/20/2/E) **Funding:** Charak Pharma Pvt. Ltd. **Duration:** October 2020 – ongoing **Sanctioned Amount:** Rs.10,50,000/-**Investigators:PI-:**Dr. Supriya Bhalerao **Co-PI:** Dr. Madhavi Mahajan **Ethics Approval:** BVDUCOA/EC/2829/2020-2021 **CTRI registration:**CTRI/2020/12/030139

Background: The COVID-19 pandemic has emphasized the need of maintaining and boosting immunity. Though Ayurveda can offer various immunomodulating drugs and formulations, lack of scientific evidence raises a question about the potential of these medicines. The present study was therefore planned to study the effect of a patent and proprietary polyherbal formulation CIT on innate and adaptive immune responses in healthy individuals.

Objectives:

1. To determine the effect of polyherbal formulation CIT on immune status and quality of life
2. To assess the effect of polyherbal formulation CIT on oxidative stress
3. To evaluate the effect of polyherbal formulation CIT on inflammation

Work done:

Recruitment of healthy individuals of either sex aged 18- 35 years was resumed post lockdown and a decline in the number of active cases of COVID- 19. Twenty two individuals

were screened for eligibility criteria in this duration, of which 12 were recruited in the study. Of these, 10 individuals completed the study. The statistical data analysis was done followed by preparation of final report of the study. The manuscript for the study was prepared and communicated to the journal Perspectives in Clinical Research.

Results:

A total of 28 participants completed the study; 18 from CIT group and 10 from placebo group. A significant ($p = 0.0385$) increase in Peak Expiratory Flow Rate was seen in CIT group on day 60 compared to day 0, suggestive of improved lung capacity. When immunity was evaluated subjectively using Immune Status Questionnaire, the immune status score was found significantly ($p = 0.0001$) increased in CIT group post study, compared to baseline. For WHOQOL- BREF questionnaire, there was an increase only in 1 domain for placebo group while CIT showed improvement in 3 domains out of 4. An increase was seen in CD4 count in CIT group on day 60 while it decreased in placebo group compared to day 0. The CD8 counts in the placebo group on day 60 were significantly ($p = 0.0452$) lesser than the CIT group. MDA from RBCs in CIT group showed a significant ($p = 0.0067$) decrease post treatment while in placebo group, there was an increase in MDA levels on day 60 compared to day 0. There was an increase in median GPx levels from RBCs in both, CIT and Placebo groups on day 60 compared to day 0, that was significant ($p = 0.0129$) only in CIT group. In PBMCs treated with LPS, CIT group demonstrated significant decrease ($p = 0.0009$) in TNF-α (a pro-inflammatory cytokine) post study compared to day 0 while in placebo group the levels remained almost similar. IL-10 (anti-inflammatory cytokine) levels in LPS stimulated PBMCs significantly ($p = 0.0003$) increased in CIT group while in placebo group, they were almost constant on day 60 compared to day 0

Conclusion:

CIT caused improvement in respiratory health, immune status and QOL of healthy individuals. It also reduced oxidative stress in RBCs, showed anti-inflammatory effect on LPS-stimulated PBMCs and was found to be safe. CIT can thus be considered a promising polyherbal formulation with immunomodulatory potential.

Name of the Programme: Herbal Medicine

1. **Title:** Chemometric analysis and development of methodology for quality standardization of *Vidanga*

   Funding: CSIR HRDG

   Duration: 01-01-2022 to 31-12-2022

   Sanctioned Amount: Rs. 5,20,800

   Investigators: NA

   PI Co PI- NA

   Ph.D. Students: Manoj Khavate

   Human Ethical Approval: NA

   Background: Vidanga, also known as *Embelia ribes*, is a high-value (Rs. 8000/ kg) sold medicinal medication with an annual demand of more than 100 Metric tonnes. However, Vidanga collection has recently dropped, and as a result, a crude medicine from another species, *Embelia tsjeriam-cottam* Roxb, has been marketed as Vidanga. *E. tsjeriam-cottam* is also much easier to collect than *E. ribes* because it is a large shrub that produces more fruits and is widespread all over India, whereas *E. ribes* has a limited distribution.Embelin, a prominent secondary metabolite found in both E. ribes and *E. tsjeriam-cottam*, is a common phytochemical. Because of its phytochemical similarities to *E. ribes, Embelia tsjeriam-cottam* has the potential to be reused as Vidanga. As a result, it was critical to develop analytical methods with high sensitivity and accuracy for detecting adulteration.

   Work done: The present investigation was aimed to elucidate the effectiveness of *E. tsjeriam-cottam* and *E. ribes* on attenuation of inflammation in rat models. The untargeted metabolomics study was under taken for analyzing the alteration in metabolites caused due to dosage of *E. tsjeriam-cottam* and *E. ribes.* UV-visible spectroscopy and partial least squares discriminant analysis (PLS-DA) for determining the difference between *E. ribes* and *E. tsjeriam-cottam* was assessed in this study. Before utilising Ethyl acetate to extract phytochemicals, authentic samples were obtained and processed. A UV-visible spectrometer was used to collect spectral data in the 190-1100 nm region. The Vidanga was be classified using a PLS-DA classification model based on their UV visible spectra. The findings show that UV-visible spectroscopy combined with

PLS-DA can be used to discriminate between adulterations and detect *E. tsjeriam-cottam* in a sensitive and accurate manner.

Results: The feasibility of employing UV-visible spectroscopy and PLS-DA method for discrimination between *E. ribes* and *E. tsjeriam-cottam* was confirmed.

Conclusion: This promising result may open the way for a potential application of UV-visible spectroscopy for the authentication of herbal drugs in the near future.

2. **Title:** Development of a novel synbiotic using Dioscorea as a prebiotic against Ulcerative Colitis

   Funding: UGC

   Duration: 01-11-2021 to 13-08-2024

   Sanctioned Amount: Rs. 5, 20, 800

   Investigators: NA

   PICo PI- NA

   Ph.D. Students: Apurva Jadhav

   Human Ethical Approval: NA

   Background: Synbiotics have been found to reduce levels of inflammation, improve digestion, and improve the balance of bacteria in the gut, all of which can help reduce the symptoms of ulcerative colitis. Prebiotics are naturally occurring complex carbohydrates found in plants and the *Dioscorea* spp. Plants of Maharashtra will be an excellent source of prebiotics. The secondary screening will be conducted for anti-inflammatory properties, and consent will be obtained from the Maharashtra State Biodiversity Board. The plant parts will be assessed for their prebiotic potentials and combined with probiotics to create synbiotic formulations. The best and most effective formulations will be evaluated for their anti-inflammatory potential in vivo.

   Work done: The present investigation is aimed to purify and assess the prebiotic potential of *Dioscorea* collected from Maharashtra; hence different species of *Dioscorea* plant have been collected, extraction of prebiotics is done, and further optimization of the dosage for probiotics, prebiotics and synbiotics in an in-vivo *Drosophila melanogaster* model is going on.

   Results: Among different species of *Dioscorea* collected from Maharashtra, we have prioritized selected species based on their prebiotic potential and in vivo studies in the *Drosophila* model.

Conclusion: The *Dioscorea* plant has good prebiotic potential, and now work is underway for its synbiotic potential.

3. **Title:** Anti-inflammatory and immunomodulatory activity of synbiotic formulation against intestinal inflammation

Funding: BVDU
Duration: 2021-2022
Sanctioned Amount: Rs. 1,00,000
Investigators: Dr. Suresh Jagtap
PICo PI- NA
Ph.D. Students: Mayur Aswani
Human Ethical Approval: NA

Background:

The gut immune system is influenced by many factors, including dietary components and commensal bacteria. Nutrients that affect gut immunity and strategies that restore it by affecting the microbial composition are being developed as new therapeutic approaches to treat several inflammatory diseases. Owing to urbanized diet, lifestyle and overuse of antibiotics have led to condition known as dysbiosis ultimately affecting gut immunity and thereby provoking inflammatory response. These food supplements termed as functional foods have been demonstrated to alter, modify and reinstate the pre-existing intestinal flora. They also facilitate smooth functions such as eliminate pathogens, improve immunity, maintain luminal pH, etc. In this project we have evaluated the efficacy of selected synbiotics to modulate the immunity.

Results:

Prioritized synbiotic formulation has shown significant effect on immunomodulation with respect to parameters viz. body weight, organ weight, hematology, liver enzymes such as SGPT, SGOT, total serum protein and directly using both arm of immunity i.e., humoral and cell mediated immunity.

Name: Centre for Innovation in Nutrition Health Disease (CINHD)

1. **Title:** ICAR -AICRP- Linseed Value Addition Centre **Project ID:** INHD/15/1/E **Funding:** ICAR, New Delhi **Duration:** April 2015 onwards **Scientist in-charge:** Dr. Anand A. Zanwar **Amount received:** Total 114.86 Lakh (2015-22), 13.78 Lakh (2021-22)

Background: Broad objective is linseed value addition. Following objectives for 2021-22 were planned and approved during Annual Linseed Group meeting of linseed held at ICAR-IIOR, Hyderabad in virtual mode during 18-19 August 2021.

Objectives:

A. Blending of linseed oil with edible oil
B. Development of linseed derived omega-3 health supplements
C. Nutritional evaluation of released linseed varieties in India
D. Development of value added cake from linseed

Work done:

A. Blending of linseed oil with edible oil

- To carry out thermal stability of blended oil with plant derived standardized extracts:

Following fresh blends of edible oils with linseed oil were prepared

- Base oil: Palm olein (PO), Coconut oil (CO), Rice bran oil (RBO)
- Blended oils: Palm Olein+ linseed oil (PO+LO-80:20), coconut oil + linseed oil (CO+LO-80:20), rice bran oil + linseed oil (RBO+LO-80:20)
- Following antioxidants were studied with blended oils during thermal stability study:
    - Ginger oil
    - Black pepper oil

Thermal treatment:

Three liters of each type of oil/blends (with/without antioxidants) were placed into stainless steel 2500W electric deep fryer and heated to 180 °C for 8 hr continuously. The oil samples were collected initially (before heating) and at the end of 30 min, 1 hr, 2 hr, 4 hr, 6 hr and 8 hr. These

oil samples were analyzed for peroxide value, p-anisidine value, Totox value, free fatty acid content and fatty acid profile to understand thermo-oxidative stability.

Last year we reported effect of various antioxidants such as TBHQ+Tri E, AP+TBHQ, AP+Tri E, Rosemary extract and Green Tea extract on peroxide value, p-anisidine value, Totox value, free fatty acid content and fatty acid profile during thermal treatment for 8 hr. This year under similar experimental conditions, we are reporting effect of Ginger oil and Black pepper oil.

- To carry out thermal stability of blended oil:

In this experiment selected set of treatments (antioxidants) were used and evaluated effect on degradation during thermal cycles in blended oil using parameters such as total polar molecules, conjugated dienes and conjugated trienes, and trans fats.

Results

Studies on blending of linseed oil with other edible oils were started in 2017. So far following conclusions are drawn:

- Blending of linseed oil was found to improve ratio of omega-6 to 3 ratio less than 3:1 in all experimental blends (i.e. coconut oil, palm olein and rice bran oil blends with linseed oil)
- Omega-3 fatty acid was found to be stable for heating for 15-20 minutes upto 180 °C
- Fried products prepared using edible oils blended with linseed oil were found to be acceptable/palatable based on sensory evaluation study during domestic heating.
- Efficiency of different antioxidants during storage stability study was observed as given below: AP>TBHQ>Tri-vitamin E> α-tocopherol. Asorbyl palmitate is preferred over other antioxidants in controlling the peroxidation in blended oils for long term storage stability (12-15 months) of experimental edible blended oil (i.e. palm olein, rice bran oil and coconut oil) with linseed oil in 80:20 proportion.
- In case of thermal stability study, palm olein and rice bran oil are more suitable as compared to coconut oil, further studies are presently ongoing.

B. Development of linseed derived omega-3 health supplements

In 2020-21, oil-in water type linseed oil emulsion, linseed oil + vitamin emulsion and linseed oil + protein emulsion were prepared and studied in regular raw milk for nutritional characteristics and thermal stability of plain milk. This year the same emulsions were prepared in the batch of 1

kg each using colloidal mill and these emulsions were added to flavored milk for developing health supplements/omega-3 beverages.

Results:

Last year we developed emulsified methodology was used to fortify milk with omega-3 fatty acid along with vitamins/protein using emulsification method and evaluated performance of these formulations in plain milk for domestic use. This year, we carried utility of these formulations in flavoured milk. These emulsified formulations were added to flavoured milk and subjected for autoclaving and kept in refrigerator for stability assessment. Studies on incorporation of emulsified formulation in flavoured milk showed improved nutritional characteristics of flavoured milk without gross alterations on stability and acceptability of milk. So, value added emulsified formulations to fortify flavoured milk with omega-3 fatty acid, vitamins and protein has been developed and omega-3 fatty acid in flavoured milk was found to be stable for 4 months. This formulation is ideal for fortification of omega-3 fatty acid in milk beverages at domestic level.

C. Nutritional evaluation of released linseed varieties in India

This year we have analysed 5 released linseed varieties namely Ruchi, (LCK-5021), Indu (LCK1108), Rajan (LCK-1009), Mau Azad Alsi (LMS149-4) and Azad Alsi-1 (LMS9-2K).

The protein content was comparable in all varieties and was highest in Indu i.e. 19.28%. The fat content was ranging between 38.02 to 39.47% in the tested varieties. Total carbohydrate content were ranging between 31.27 to 33.73%. Ash value was highest in Ruchi i.e. 4.09 and lowest in Azad Alsi-1 i.e. 2.72. Dietary fibre content was highest in Azad Alsi-1 i.e. 34.01 and lowest in Indu i.e. 28.28%. Energy value was highest in Mau Azad Alsi i.e. 560.67 Kcal/100gm and lowest in Rajan i.e. 547.54 Kcal/100gm. Calcium ranged between 268 mg/kg (Azad Alsi-1) to 403 mg/kg (Rajan). Iron was ranging between 41.5 mg/kg (Mau Azad Alsi) to 8.7 mg/kg (Rajan). Potassium ranged between 848 mg/kg (Azad Alsi-1) to 1453 mg/kg (Ruchi) and zinc ranged between 2.10 mg/kg (Azad Alsi-1) to 3.78 mg/kg (Ruchi).

There was not much variation in the fatty acid profile in the tested linseed varieties. The saturated fatty acid ranged between 10.62±0.06% (Azad Alsi-1) to 12.78±0.08% (Ruchi). The mono-saturated fatty acid levels ranged between 21.52±0.04% (Rajan) to 25.00±0.11% (Mau Azad Alsi) Linoleic acid levels ranged between 14.55±0.12% (Azad Alsi-1) to 11.22±0.06%

(Ruchi and Indu). α-linolenic acid (omega-3 fatty acid) was ranging between 50.28±0.22% (Mau Azad Alsi) to 53.33±0.09% (Rajan). So far we have tested 11 released varieties.

D. Development of value added cake from linseed

In order to incorporate omega-3 acid i.e. alpha-linolenic acid in the cake, emulsion, multigrain, premix and linseed oil were tried and compared with control group to incorporate in the cake to improve the nutritional value of the cake and add healthy features in the cake. The cakes were prepared using fully automatic cake maker using standard operative procedure provided by manufacture.

There was wide variation in oil content as per the kind of flour/oil used in the preparation of cake. The protein content was slightly higher in all the experimental group as compared to control group. Dietary fibre was significantly higher in multigrain and linseed premix group and carbohydrate levels were slightly in emulsion and linseed oil group and lower in multigrain and linseed premix group as compared to control group. As expected, saturated fatty acid content was significantly reduced in all experimental group. Mono-unsaturated fatty acid content were significantly higher in multigrain and linseed premix group. Poly-unsaturated content were significantly increased in all experimental group. Omega-6 to 3 ratio was lesser than 5:1 in all experimental groups as compared to control group (14.19:1).

There was significant alterations in various texture properties. Hardness was reduced in all experimental group, however it was equivalent within experimental group. Cohesiveness in experimental group was comparable to that of control group. Springiness, chewiness and gumminess was significantly reduced in case of multigrain group as compared to that of control group, remaining experimental groups were comparable to that of control group. Adhesive force was significantly reduced in all experimental group as compared to that of control group. Slight reduction in stiffness was noted in all experimental group as compared to that of control group. Stability study of cake was performed after two week based on the fatty acid. It was observed that cake prepared using linseed oil emulsion, multigrain, linseed premix and linseed oil were fairly stable w.r.t. PUFA content and omega-6 to 3 ratios at the end of 2 weeks.

Conclusion:

There was significant improvement in PUFA content and improved omega-6 to 3 ratio in all experimental group. However saturated fatty acid content was reduced in Multigrain and Premix groups. Both protein and dietary fibre content were also improved in case of Multigrain

and Premix groups only. Further stability study was also confirmed stability upto 2 weeks equivalent to control group.

2. **Title: Extraction of bioactive lignan and development of value added products from flaxseed. Project ID:** INHD/19/2/E **Funding:** SERB and Industry (RWNLF, Pune) **Sanctioned amount:** 51.30 Lakh **PI:** Dr. Anand Zanwar **Co-investigator:** M. L. Panse **Collaborator:** Real World Nutritional Laboratory Foundation, Pune **Duration:** 27th November 2019 to 26th Nov 2022 **Ethics Committee approval**: BVDUMC/3020/2019/001/009

Background: Last year we fractionated flaxseed and selected high lignan containing portion of flaxseed and developed lab scale extraction methodology of extraction of SDG lignan and carried out optimization trials to enrich the lignan content. This year we have successfully up-scaled extraction methodology using solid-liquid extractor and batch wise operation also carried out using this pilot plant model.

Work done:

Lignan extraction, characterisation, and toxicity study:

Extraction process includes fractionation of different part of flaxseed, defatting, simultaneous alkaline hydrolysis and alcoholic extraction, drying of crude product followed by its fractionation to get free flowing powder. The entire lab to pilot scale operation was completed using solid-liquid extractor. Further SDG.lignan content by using LC-MS/MS was approximately 19%. Finally, determination of aflatoxins (was carried out using LC-MS), heavy metals and mineral (using inductively coupled plasma mass spectrometry - ICP-MS), pesticide residual analysis (total 278 pesticides were analyzed using LC-MS/MS and GC-MS/ MS) was carried out. The developed method has shown significant value addition of SDG.lignan content and method is suitable for industrial scale operation. The solvents used are very much commonly used in industries and easily recoverable hence very much economical. This lignan concentrate showed non-toxic effects in in vitro cell line toxicity study to evaluate cytotoxic effect of various lignan fractions isolated from flaxseed using H9C2 (2-1), MiaPaca-2 and HepG2 cell lines and in vivo acute oral toxicity study as OECD guideline 425.

Development of fortified cookies:

Omega-3 fatty acid and protein enriched value added cookies were formulated. Considering the consumer requirement margarine and ghee based cookies were prepared at commercial bakery unit. Supplementation of Omega-3 fatty acid from flaxseed and protein from soy flour improved the nutritional quality of cookies with essential fatty acid which is lacking in bakery products. Various initial parameters such as proximate analysis, fatty acid profile, color analysis, universal texture analysis revealed safe incorporation of omega-3 fatty acid and protein in cookies and sensory evaluation study confirmed consumer acceptability of these cookies. Production/preparation of final batch was carried out in commercial bakery unit to avoid up scaling troubleshooting. Hence developed cookies will be readily available for commercialization after stability study is over. Further up scaling of flaxseed omega-3 premix for cookies is also optimized with help of industrial partner i.e. Real World Nutrition Laboratory Foundation, Pune.

Development of Aata (flour):

The de-hull portion of flaxseed fractionation was selected for development of flour pre-mix and subjected for characterisation, stability (using stability chamber at 40°C and 65Rh). Stability study constitute various parameters such as functional assessment, fatty acid profile and oxidative stability study. In this study, flaxseed omega-3 flour pre-mix was developed with the help of de-hulled portion of flaxseed, BHT, methyl parabane and vitamin premix. Functional assessment and fatty acid profile during stability period were comparable to control group, indicates stability of both 5% and 10% flour and pre-mix for the period of 6 months.

3. **Title:** Evaluating effects of linseed oil blends on omega-6 to omega-3 ratio of various tissues in an animal model. **Project ID:** INHD/21/1/I Funding: Institutional (Intra-mural); Duration: 2021-2022; Sanctioned Amount: 1,00,000/- Co-PI- Dr. Anand A. Zanwar

   Background: Vegetable oils are major contributors of the FAs in the diet. Majority of these oils are rich in ω-6 FA. Modulating ω-6 :ω-3 ratio in the oils is possible by blending ω-3 rich linseed oil. Here, oxidatively and thermally stable palm olein and coconut oil have been used for preparing linseed oil blends. Initial physicochemical characterization and nine months storage stability indicate that these blends can be used as cooking oils. Therefore, understanding the effects of consumption of these oil blends on various tissues

is important. Dietary use of linseed oil blends with palm olein and coconut oil can improve ω-6: ω-3 ratio in various tissues.

Aim:

To study the effect of consumption of linseed oil blends on ω-6: ω-3 ratio in various tissues involved in lipid metabolism

Objectives:

1. To assess the changes in the fatty acid profile of various tissues of rats fed with linseed oil blends.
2. To assess various biochemical parameters
3. To correlate ω-6: ω-3 ratio of the blends with FA of tissues and biochemical parameters studied

Material and methods

Animals

- Species/ common name: Wistar Rat
- Age/ weight/ size- 10 weeks old/ 180-200g
- Gender: Male

Sample Size : 8 animals in each group

Study per : 6 months

Treatment : Palm olein + Linseed oil (80:20 V/V)
Coconut oil + Linseed oil (80:20 V/V)

Study groups:

- Group A- Control group (No treatment)
- Group B- Palm olein (Palm olein (1.0 ml per day) for 3 months.
- Group C- Palm olein +Linseed (Palm olein + Linseed 1.0 ml per day) for 3 months.
- Group D- Coconut oil (Coconut oil 1.0 ml per day) for 3 months.
- Group E- Coconut oil +Linseed (Coconut oil + Linseed 1.0 ml per day) for 3 months.

Wistar rats with above specifications will be acclimatized for one week in BVDU's Medical College, Central Animal House, Pune. All the animals will be fed with regular rat chow diet and water ad libitum and subjected for treatment as mentioned above. At the end of three months, blood and organs of interest will be harvested. Plasma and RBCs will be separated from the

blood. Plasma will be stored at -80 ˚C until further analysis. RBCs will be processed immediately for fatty acid profiling. Organs of interest are heart, liver, adipose tissue, brain and. All the organs will be weighed and divided in to two parts. First part will be formalin fixation of the tissues for histopathology, second part will be flash frozen and stored at -80 ˚C for FA acid profiling. During entire treatment period, animals will be observed for any sign of discomfort like lethargy, low food intake etc.

Parameters to be studied during study period

Body weight of the animals will be measured once a week. Food intake will be measured at the interval of month for 4 conjugative days.

Parameters to be studied at the end of the study

1. Hematogram
2. Plasma lipid profile (TG, TC, HDL, LDL and VLDL)
3. Liver function test
4. RBC, Heart, liver, brain and adipose tissue FA profile
5. Histopathology: Liver, brain, Heart, adipose tissue

Work done:

Institutional Ethics Committee approval was taken, and study was initiated by acclimatizing the animals.

4. **Title:** Developing high oleic safflower genotypes through functional genomics; **Funding:** Institutional **Project ID:** CINHD/21/2/I **PI:** Dr. P. B. Ghorpade **Technical Assistant:** Mr. Yogesh S. Badhe **Duration:** 2021 onwards

Background: High oleic safflower genotype was developed with ICAR-NASF funding during 2015-2018. From 2018 onwards the high oleic lines are being tested in the field over the last 4 years for its agronomic characteristics, oil content and high oleic content. We are now reporting the results of M-7 generation (2021-22).

Work done:

20 high oleic genotypes from M-6 (2020-21) were grown in 2021-22 season for high oleic content. At the end of the season seeds were harvested and analysed for oleic acid content by gas

chromatography. The fatty acid content of different genotypes is presented in table 1. Out of 20 genotypes 15 had oleic acid content in the range of 71-80% which were selected for growing in M-8 generation (2022-23).

Table: The fatty acid content of different genotypes

		Fatty acid %			
Sr No.	**Genotype**	**Palmitic**	**Stearic**	**Oleic**	**Linoleic**
1	NASF-2	6.4	2.19	43.15	48.26
2	NASF-3	6.23	2.63	71.26	19.88
3	NASF-4	6.13	2.15	74.74	16.99
4	NASF-5	6.34	2.26	59.96	31.44
5	NASF-6	6.09	1.69	76.49	15.73
6	NASF-7	5.54	1.77	77.1	15.59
7	NASF-8	5.33	1.89	78.24	14.54
8	NASF-10	6.26	1.95	77.87	13.92
9	NASF-11	5.28	2	80.35	12.07
10	NASF-12	6.19	2.52	77.59	13.7
11	NASF-16	6.38	1.93	74.9	16.79
12	NASF-17	6.89	2.23	33.09	57.79
13	NASF-21	6.97	2.4	32.94	57.69
14	NASF-26	5.71	2.22	72.78	19.29
15	NASF-29-2	6.25	1.84	73.84	18.06
16	NASF-29-4	6.29	1.95	54.32	37.45
17	NASF-29-6	6.07	1.92	75.38	16.63
18	NASF-29-7	6.77	1.55	72.38	19.29
19	NASF-29-8	6.7	2.26	74.75	16.29
20	NASF-29-9	5.58	1.66	76.78	15.98

Conclusion: Promising genotype NASF-12 was selected based on their superior agronomic performance and high oleic content (77.59%).

5. **Title:** Developing Omega-3 Edible Oil Blends and Evaluating Their Effects and Safety in Pre-clinical Studies; **Project ID**: CINHD/16/5/I/P **Funding**: Departmental **Duration**: registered in 2018; **Sanctioned Amount**: NA **Guide**: Dr. Anand A. Zanwar; Co-Guide: Prof. M. V. Hegde **Ph.D. Student**: Mrs. Asavari Joshi

Background: During 2020-2021, storage stability for palm olein (PO) or groundnut oil blend containing 20 % FSO (P20 and G20) was conducted and it was found that, P20 blend was stable atleast upto nine months while G20 displayed deterioration right from the first month of storage which exceed regulatory limit (for peroxide value) in the fifth month of storage. While storage stability study for coconut oil blend (C20) with flaxseed oil was continued.

Work done:

1. Storage stability for coconut oil (CO) blend containing 20 % FSO (C20) was completed
2. Effect of C20 on inflammation in THP-1 cells was determined
3. Effect of P20 and C20 on HepG2 cells was determined in terms of viability, FA profile, lipid accumulation and lipid peroxidation

Results

1. Storage stability for coconut oil blend (C20)

Table 1. Effect of storage on peroxide value and acid value for CO and C20

Oil/Blend	0 Month	3rd Month	6th Month	9th Month
Peroxide value (PV, milliequivalentO2/ kg oil)				
CO	0.3±0.0	0.46±0.06$^{\mu}$	0.74 ± 0.06 $^{\mu}$	0.9 ±0.0 $^{\mu}$
C20	0.5±0.0$^{\beta}$	0.82±0.06 $^{\mu\,\beta}$	0.98 ± 0.01 $^{\mu\,\beta}$	2.2 ±0.1 $^{\mu\,\beta}$
Acid value (AV, mg KOH/ g oil)				
CO	0.24±0.00	0.37± 0.01 $^{\mu}$	0.46 ± 0.06 $^{\mu}$	0.58 ±0.01 $^{\mu}$
C20	0.48±0.00 $^{\beta}$	0.49 ± 0.01 $^{\beta}$	0.46 ±0.06*	0.55 ± 0.00 $^{\mu\,\beta}$

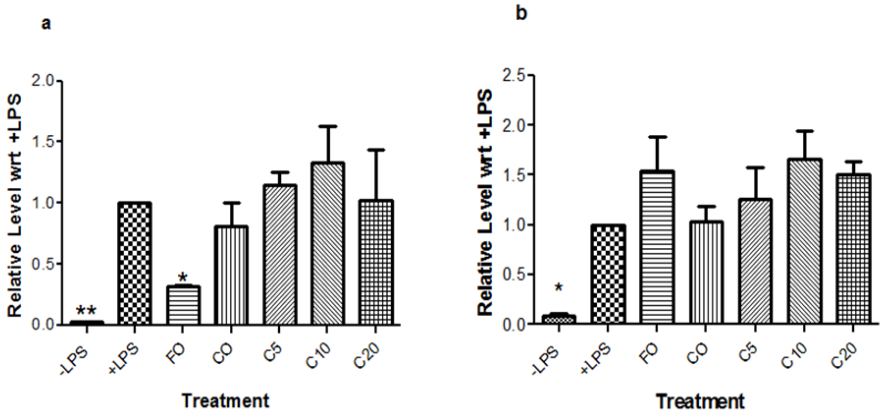
CO and C20 were stored at room temperature upto nine months. Peroxide value and acid value were determined at mentioned time intervals. Data is represented as Mean ± SD (n=3). Two-way ANOVA and Bonferroni posttests were applied to determine statistical significance. µ; $p \leq 0.001$ vs 0 Month, *; $p \leq 0.05$ vs 0 Month, β; $p \leq 0.001$ vs CO respective time points

Effect of blending FSO with CO on long term storage stability was studied for the blend containing highest percentage of FSO (i.e. C20). Table 1 represents effect of storage on PV and AV upto nine months. As the data indicates, there was significant rise in both the parameters right from third month to nine month for CO when compared with 0-month values. Similar trend was seen in case of C20 for PV but for AV, significant change was noticed from 6 month. At the end of nine months, there was 3 fold and 4.4 fold rise in PV for CO and C20 respectively while 2.4 and 1.1 fold rise in AV was observed for CO and C20 respectively.

FA analysis was done for CO and C20 at specified time points. We did not see any significant change in FA composition at these time points compared to initial (0 month) data (data not shown). Thus, Table 1 indicates that CO and C20 were oxidatively stable at room temperature atleast upto nine months without significant alteration in their FA composition.

2. Effect of C20 on inflammation in THP-1 cells

Figure 1 Effect of CO blends on inflammatory markers



THP-1 cells were pretreated with the oils or blends (125 µg/mL) for 48 h followed by co-incubation with LPS (25 ng/mL) for 6 h (TNFα) and 24 h (IL-6). Quantitation of TNFα (a) and IL-6 (b) was done in the cell supernatants by ELISA. Data are presented as fold change wrt +LPS (n=3). One-way

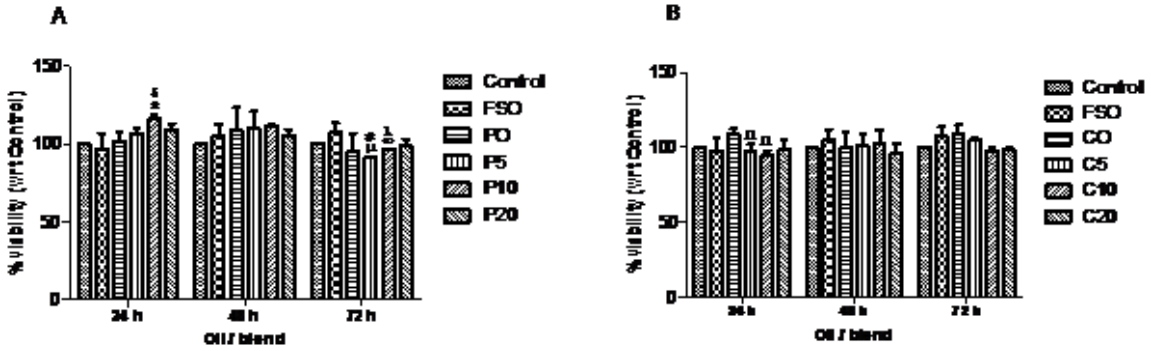
ANOVA and Dunnett's Multiple Comparison Test was applied to determine statistically significant differences among the oils and blends. *, ** ; $p \leq 0.01$ *vs* +LPS

Here, Figure 1a and 1b shows that LPS stimulation of THP-1 cells resulted in increased levels of TNFα and IL-6 in the supernatant (+LPS). The pre-treatment of THP-1 cells with FO prior to LPS addition, resulted in the significant decrease in TNFα level but did not significantly alter IL-6 level. Blends have not affected both the inflammatory markers. This might be because of ω-3 FA levels achieved in the cells are not sufficient to down-regulate LPS induced inflammation. Here, we observed that though the ω-6: ω-3 ratios were favourably altered incase of blends, concentrations of individual FA were probably not high enough to show anti-inflammatory effect.

3. Effect of P20 and C20 on HepG2 cells

3.1 Effect of cell viability

Figure 2 Effect of PO and CO blends on HepG2 viability



Effect of oil blends on HepG2 cell viability: HepG2 cells were treated with individual oils or blends for 24h, 48 h and 72 h. At the end of each incubation period, MTT assay was performed to determine cell viability. Data is presented as Mean ± SD (n=3). Two Way ANOVA and Bonferroni Posttests were applied *; $p \leq 0.05$ vs Control, δ; $p \leq 0.01$ vs FO, μ; $p \leq 0.05$ vs 24 h, ∞; $p \leq 0.01$ vs 24 h; #; $p \leq 0.01$ vs 48 h , λ; $p \leq 0.05$ vs 48 h and *Ω;* $p \leq 0.05$ vs CO

From Figure 2, it can be seen that there was no adverse effect of the blends treatment on HepG2 cell viability.

3.2 Effect of blends on fatty acid profile of HepG2 cells

Table 2: Effect of blends on fatty acid profile of HepG2 cells

Table 2A

Fatty acid	**Control**	**FSO**	**PO**	**P5**	**P10**	**P20**
Palmitic acid	15.63 ± 0.40	18.52 ± 1.68	18.49 ± 1.15	21.77 ± 3.12**	19.52 ± 0.09	22.53 ± 4.27***
Stearic acid	8.51 ± 0.99	9.07 ± 1.31	5.57 ± 2.52	9.65 ± 2.30	8.68 ± 1.07	9.89 ± 1.84
Oleic acid	12.99 ± 2.80	16.54 ± 2.59	16.24 ± 3.10	17.33 ± 3.62	18.55 ± 1.05**	15.95 ± 2.51
Linoleic acid	1.85 ± 0.27	1.95 ± 0.51	2.57 ± 0.08	2.49 ± 1.12	3.12 ± 0.08	2.15 ± 0.52
Alpha Linolenic acid	0.00 ± 0.00	2.06 ± 1.24	0.00 ± 0.00	0.00 ± 0.00	0.39 ± 0.15	0.53 ± 0.11
Arachidonic acid	4.72 ± 0.74	4.49 ± 0.13	3.59 ± 1.25	3.07 ± 1.49	4.00 ± 0.17	2.79 ± 2.69
Docosahexanoic acid	2.23 ± 0.16	1.67 ± 1.02	1.74 ± 0.57	1.51 ± 0.55	1.95 ± 0.12	1.45 ± 1.00
Omega-6: Omega-3	2.94 ± 0.01	1.73 ± 0.20	3.66 ± 0.54	3.55 ± 0.78	3.05 ± 0.01	2.43 ± 0.26

Table 2B

Fatty acid	Control	FSO	CO	C5	C10	C20
Palmitic acid	15.63 ± 0.40	18.52 ± 1.68	23.54 ± 0.79$^{***,\#}$	22.56 ± 1.29***	20.48 ± 0.23*	21.05 ± 0.33**
Stearic acid	8.51 ± 0.99	9.07 ± 1.31	9.52 ± 0.96	9.16 ± 0.65	6.73 ± 2.55	6.76 ± 2.20
Oleic acid	12.99 ± 2.80	16.54 ± 2.59	11.12 ± 1.03$^{\$}$	11.21 ± 0.45$^{\$}$	14.88 ± 4.99	15.32 ± 5.96
Linoleic acid	1.85 ± 0.27	1.95 ± 0.51	3.98 ± 0.49	0.70 ± 0.28	1.60 ± 0.88	1.59 ± 1.27
Alpha Linolenic acid	0.00 ± 0.00	2.06 ± 1.24	0.00 ± 0.00	0.00 ± 0.00	0.38 ± 0.12	0.46 ± 0.21
Arachidonic acid	4.72 ± 0.74	4.49 ± 0.13	0.76 ± 0.04	3.16 ± 0.36	1.99 ± 1.79	1.95 ± 1.44
Docosahexanoic acid	2.23 ± 0.16	1.67 ± 1.02	0.69 ± 0.01	0.71 ± 0.04	0.70 ± 0.06	0.70 ± 0.05
Omega-6: Omega-3	2.94 ± 0.01	1.73 ± 0.20	6.92 ± 0.71$^{\#}$	5.47 ± 0.16	3.46 ± 1.35	3.17 ± 0.84

Effect of blends on FA profile of the cells was studied by gas chromatographic analysis of total lipids extracted from the cells after treatment. The data is presented as % FA of total FA extracted (n=2). Two Way ANOVA and Bonferroni Posttests were applied. *; $p \leq 0.05$ vs Control, **; $p \leq 0.01$ vs Control ***; $p \leq 0.001$ vs Control, #; $p \leq 0.05$ vs FSO, and $; $p \leq 0.01$ vs FSO

Here, we have treated the cells with FA in the same proportion present in the oils/ blends. When the cells were treated with PO and its blends which are rich in PA and OA, there was rise

in the levels of these FA. As the percentage of FSO in the blend raised, levels of the ω-3 FA (ALA and DHA) raised, resulting in the decrease in the ω-6: ω-3 FA ratio. Though these results were statistically non-significant, there was dose dependent trend. CO and its blends are rich in medium chain FA; LAU. There was no significant change in the LAU levels in the treated cells. Trends observed for the ALA incorporation from the blends and ω-6 to ω-3 ratios were similar to PO blends. Thus, from Table 2, it is clear that treatment of HepG2 cells with blends containing FSO as a source ω-3 FA, results in the lowering of omega-6 to omega-3 ratio.

3.3 Lipid accumulation and lipid peroxidation in HepG2 cells

Figure 3A

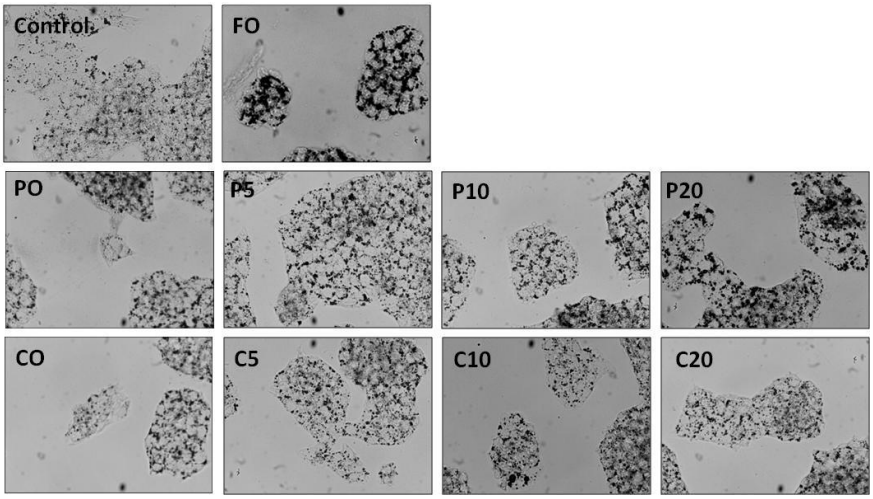


Figure 3B

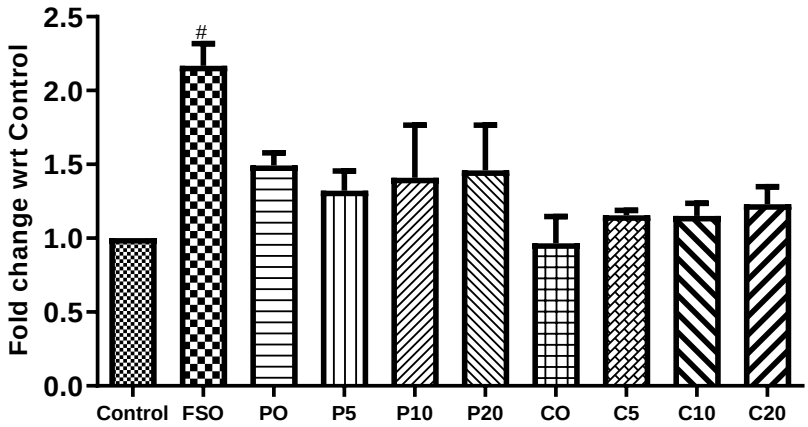
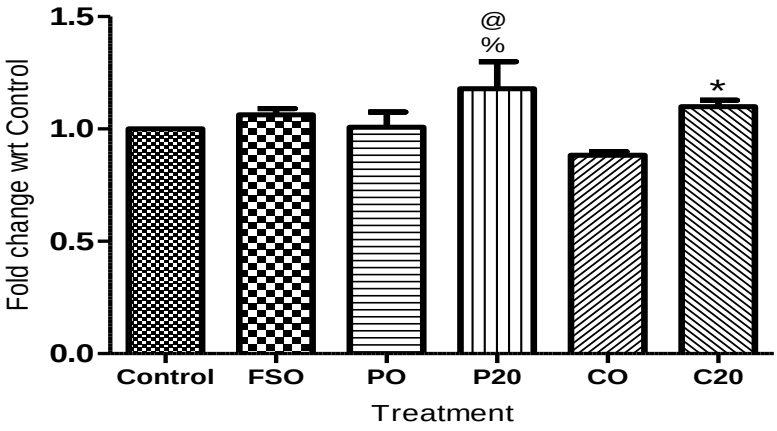


Figure 3C



Effect of blends on lipid accumulation and lipid peroxidation in HepG2 cells. HepG2 cells were treated with individual oils/ blends (250 µg/ml) for 48 h. Lipid accumulation was visualized by staining the cells with Oil Red O stain. Quantitative analysis of the lipid accumulation was done by extracting the Oil Red O stain from the cells and measuring absorbance at 520 nM (n=3). Lipid peroxidation was measured in the cell lysates after the treatment interms of TBAR (n=3). One-way ANOVA and Tukey's Multiple Comparison Test was applied. #; $p \leq 0.001$ vs Control , %; $p \leq 0.05$ vs Control, @; $p \leq 0.05$ vs PO, and *; $p \leq 0.05$ vs CO

As shown in Figure 3A, FO treatment lead to maximum lipid accumulation followed by P20. Lowest lipid accumulation was observed in CO and its blends. Here, FO had the highest PUFA content followed by P20. The quantitative data of lipid accumulation also confirms the same observation (Figure 3B).

Figure 3C represents lipid peroxidation in the cells after individual oil and blends containing highest percentage of oxidatively susceptible flaxseed oil (FSO). No significant rise in FSO treated cells was observed. On the other hand, significant oxidative stress as lipid peroxidation was observed in the cells was seen incase of P20 and C20 treated cells. Thus, Figure 3 indicates that lipid accumulation in HepG2 cells depends on the PUFA and MUFA content (FA profile) of the oil/blend. Additionally, PUFA content especially ω-3 FA content of the cells might influence lipid peroxidation.

Conclusion

Here, for CO and its blend we observed that though there was significant rise in the PV and AV, these values were significantly lower than CODEX. Thus, it is clear that, both CO and C20 are stable at room temperature for at least upto nine months as indicated by their PV and AV. Though C20 modulated FA composition of THP-1 cells favourably, it did not affect studied inflammatory markers. In HepG2 cells, at non-toxic concentrations of blends, non-significant improvement in the LA/ALA ratio was seen. FSO resulted in highest lipid accumulation probably resulting in strengthening of antioxidant defense system with no detected lipid peroxidation.

6. **Title:** Development of premix for fortification of omega-3 fatty acids and protein in cereal based functional food. **Project ID:** INHD/21/3/I **Funding:** Institutional **Duration/registration date:** 29th Dec 2021 **Name of Ph.D. Student:** Gauri Ligade **Guide:** Dr. Anand Zanwar

Work done:

1. Course work completed
2. Detailed literature done on area of research work

Name of the Program: Communicable Diseases

1.Title: Establishment of National Centre for Immunogenicity Testing (NCIT) to evaluate vaccines in clinical trials (**Project ID:** CD/19/1/E); **Funding:** DBT-BIRAC (Under National Biopharma Mission) **Duration:** March 2019 – March 2023 **Sanctioned Amount:** Rs. 16 crores **Investigators: PI** - Dr A C Mishra; **Co-Investigators** – Dr. Vidya Arankalle, Dr. Shubham Shrivastava, Dr. Harshad Patil, Dr. Ruta Kulkarni, Dr. Rashmi Virkar, Dr. Archana Kulkarni-Munje, Dr. Suhas Mhaske, Dr. Sudha Ramkumar. **Ph.D. Students:** None **Human Ethical Approval:** IEC/2019/33

Background:

At the Department of Communicable Diseases (renamed as Translational Virology), cell-based, Plaque Reduction Neutralization Tests (PRNT) were developed for dengue and chikungunya viruses and validated as per ISO 17025-2005 guidelines. The laboratory was accredited for these assays and ELISAs for dengue seromarkers. In view of the requirement of a specialized laboratory for the assessment of these and upcoming vaccines and antivirals, the Department of Biotechnology, Government of India under BIRAC-National Biopharma Mission (Rs 12.5crores) and Bharati Vidyapeeth Deemed to be University provided Rs 3.5crore) provided funding. The duration of the project is for 4 years (2019-23). Notably, a State-of-the-art facility with one BSL-3 and 8 BSL-2 laboratories was established in a record time of one year. The available tests were reaccredited in the new facility by NABL under ISO 17025-2017 standards and GCLP compliance. With the emergence of the SARS-CoV-2 virus and several variants causing a long-lasting pandemic, the focus was shifted to COVID-19 as a national priority. The laboratory performed excellent work with utmost care and speed.

Objectives of the project:

1. Initiation of services of accredited assays in the existing facility & establishment of a new State-of-the-art GCLP facility.
2. Standardization, accreditation, reaccreditation, and providing services for dengue assays.

3. Standardization, accreditation, reaccreditation, and providing services for chikungunya assays.

The most significant development has been the certification of NIBAC's BSL-3 facility by the Department of Biotechnology in May 2022. Ours is the first certified BSL-3 laboratory in the country.

1.1 Services provided to the industries:

During the current year, we provided invaluable services to many vaccine manufacturers as well as for anti-viral testing against SARS-CoV-2 and some of its variants. Services were also extended to startups and academia.

Immunogenicity testing:

Table 1 displays services provided for immunogenicity testing. These projects were managed by Drs Shubham Shrivastava, Ruta Kulkarni, and Rashmi Virkar.

Total tests performed: 10178.

Table 1: Immunogenicity testing services provided by NIBEC during 2021-2022

Sr. No.	**Project Title (Project ID)**	**Client**	**Name of test**
1.	A Phase 1, double blind, randomized, placebo-controlled study to evaluate the safety and immunogenicity of Dengusiil in healthy adults (Dengusiil)	Serum Institute of India, Pvt. Ltd.	Dengue PRNT
2.	A prospective, randomized, adaptive, phase I/II clinical study to evaluate the safety and immunogenicity of	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT

	Novel Corona Virus - 2019-nCov vaccine candidate of M/s Cadila Healthcare Limited by intradermal route in healthy subjects. (CoV-ZC-2013)		
3.	Testing of animal sera samples and human clinical sera samples for SARS-CoV-2 virus neutralization potential using a microneutralization and / or plaque reduction neutralization test (PRNT) assay established and validated at IRSHA as advised by Zydus (CoV-ZC-2005)	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT
4.	To study virus neutralization assay (PRNT) in human sera samples (CoV-ZC-2017)	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT
5.	Virus neutralization assay (SARS-CoV-2 PRNT) for dog serum samples (CoV-ZC-2101)	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT
6.	A prospective, randomized, phase I/II clinical study to evaluate the safety and immunogenicity of 3mg dose of Novel Corona Virus -2019-nCov vaccine candidate of M/s Cadila Healthcare Limited by intradermal route in healthy subjects (CoV-ZC-2112)	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT
7.	A phase III, randomized, multi-centre, double blind, placebo controlled, study to evaluate efficacy, safety and immunogenicity of Novel	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT

	Corona Virus -2019-nCov vaccine candidate of M/s Cadila Healthcare Limited (CoV-ZC-2113)		
8.	A prospective, open-label, single arm, multicenter, phase III clinical study to evaluate the immunogenicity and safety of 3mg (2 dose) regimen of Novel Corona Virus -2019-nCov vaccine candidate of M/s Cadila Healthcare Limited by intradermal route in healthy subjects (CoV-ZC-2114)	Zydus Cadila Healthcare Ltd.	SARS-CoV-2 PRNT
9.	Development of monoclonal antibody against SARS-CoV-2 (CoV-SI-2021)	Serum Institute of India, Pvt. Ltd.	SARS-CoV-2 PRNT
10.	Randomized, Phase I/II, Placebo-controlled, Dose-Ranging, study to evaluate the Safety, Tolerability and Immunogenicity of the candidate HGCO19 (COVID-19 vaccine) in healthy adult (CoV-GN-2104)	Gennova Biopharmaceuticals Ltd	SARS-CoV-2 PRNT
11.	Development of human monoclonal antibodies against SARS-CoV-2 using convalescent patient blood (CoV-BK-2020)	Bioklone Biotech Pvt Ltd	SARS-CoV-2 PRNT
12.	A Phase II/III Adaptive Seamless Design, Randomized, Controlled Trial to Evaluate Safety and Immunogenicity of 2-dose regimen of BBV87 Chikungunya Vaccine in Healthy Subjects Aged 12 to 65 years in Panama, Colombia and Thailand (IVI-CHIK)	International Vaccine Institute, South Korea	CHIKV IgG ELISA, CHIKV PRNT

13.	A Phase II, Single blind, Randomized, Parallel group, Dose ranging, Single Dose Study of Dengue Monoclonal antibody (Dengue mAb) in Adults with Dengue Fever (SII-DEN-Mab)	Serum Institute of India, Pvt. Ltd.	Dengue ELISA, NSET, PCR and PRNT
14.	A Seamless Phase II/III, Observer-blind, Multi-Centre, Randomized Clinical Trial to Evaluate Immunogenicity and Safety of BBV87, an Inactivated Chikungunya Virus Vaccine in Healthy Subjects 12-65 Years of Age (BBIL-CHIK)	Bharat Biotech	CHIKV IgG ELISA, CHIKV PRNT
15.	A Prospective double-blind randomised Phase III Clinical Study to Evaluate the Immunogenicity and Safety of Single Booster dose of Biological E's CORBEVAX vaccine when Administered to COVID-19-Negative Adult Volunteers Previously vaccinated with 2-doses of either Covishield or Covaxin (BioE-CoV)	Biological E Ltd	SARS-CoV-2 PRNT
16.	A randomized, double-blinded, placebo-controlled, parallel-group, multi-centre, adaptive, seamless bridging study followed by a phase II/III study to assess the safety and immunogenicity of Anti-COVID-19 AKS-452 vaccine for SARS-Cov-2 infection in Indian healthy subjects (Akston-CoV)	Akston Biosciences	SARS-CoV-2 PRNT
17.	Establish serial sero-surveillance to monitor the trend of SARS-CoV-2, Dengue and Chikungunya infection transmission in the	BIRAC-NBM	DENV PRNT, CHIKV PRNT, SARS-CoV-2

	general population, India (DRIVEN 2020)		PRNT
18.	Active virosome vaccine for prevention of COVID-19 sponsored by BIRAC (CoV-SG-2110)	Seagull Biosolutions Pvt Ltd	SARS-CoV-2 PRNT
19.	Serum evaluation against SARS-CoV-2 strains (Reliance-CoV-PreC)	Reliance Life Sciences	SARS-CoV-2 PRNT and CBA
20.	Pre-vaccination screening of subjects for CHIKV IgG for Bharat Biotech CHIKV vaccine trial (BVDU-CHIK)	Bharati Vidyapeeth Medical College	CHIKV IgG ELISA
21.	SARS-CoV-2 virus neutralization of equine Anti-COVID antibody fragments (Vinsbio)	Vins Bioproducts	SARS-CoV-2 MNT

Anti-viral testing: The details of the anti-viral services offered this year are provided in Table 2. For antiviral testing Dr. Rashmi Virkar and Dr. Sudha Ramkumar were responsible.

Table 2: Antiviral testing services carried out during 2021-22

Sr. No.	**Title of the Project**	**Client/Customer's Name**
1	Determination of antiviral assessment of Wipro Enterprises Limited Products against SARS-CoV2 Virus	Wipro Enterprises Pvt Ltd
2	Determination of antiviral assessment of Wipro Enterprises Limited Products against SARS-CoV2 Virus	
3	Determination of antiviral assessment of Wipro Maxkleen floor cleaner against SARS-CoV2 Virus	

4	Determination of antiviral assessment of Santoor Handy Gel Handwash against SARS-CoV2 Virus	
5	Invitro assessment of alpha monalaurin against SARS-CoV-2	Clintrek Research Pvt Ltd
6	Evaluation of Recoverz Capsules against SARS-CoV-2 Wild Strain	Zum Helen Diagnostics and Therapeutics Pvt Limited
7	Evaluation of Recoverz Capsules against SARS-CoV-2 Delta variant	
8	Antiviral efficacy of LIVINGUARD Technology against COVID 19	Livingurad Technologies Pvt Limited
9	Antiviral efficacy of LIVINGUARD Hand Sanitizer against COVID 19	
10	Ivermectin for treatment of COVID 19	ICT (Institute of Chemical Technology)
11	Antiviral Activity of Colloidal Silver Hand Sanitizer against SARS-CoV2 Virus	Nanz Med Pharma Pvt Ltd
12	Anti SARS-COV-2 (Covid-19) Activity of Cov-Cur Nano-Curcumin	Oncocur India Pvt Ltd
13	In-Vitro Virucidal activity of Povidone Iodine 2% w/v Gargle (Cofsils Experdine Gargle & Cipladine gargle) against SARS-CoV-2	Cipla Health Limited
14	In-Vitro Virucidal activity of Povidone Iodine 0.5% w/v Naselin Anti-viral Nasal Spray against SARS-CoV-2	Cipla Health Limited
15	Effect of Lactoferrin Mouthwash Solution on SARS Cov-2 virus	La Renon and Frimline Pvt Limited

16	Effect of Lactoferrin Mouthwash Solution on SARS Cov 2 variants	
17	In Vitro study of Covifight against respiratory virus	Meril Life Science Pvt Limited
18	Virucidal activity assessment of products against SARS-CoV-2 Virus	Sundar Dezire Pvt Limited
19	Virucidal activity assessment of products against SARS-CoV-2 Virus	
20	CPE Score based SARS-CoV-2 antiviral studies against ARNA Samples in three modes	Arna Immuno ingredients Pvt Ltd
21	ISO 18184 Test Work ORDER 1	Anabio Technologies Private Limited
22	Antiviral activity of disinfectant liquid	
23	ISO 18184 Test for Nanofiber	
24	ISO18184 and ISO21702	
25	Thermoplastic polyurethane SARS-CoV-2 test ls0 21702	
26	Anti-Viral Testing of NCEs	Sai Life Science Pvt Limited
27	Anti-Viral Testing of NCEs	
28	Anti-Viral Testing of NCEs	
29	Deactivation efficiency of SCoAV-35 on AiRTH Coated filter.	Airth Research Private Limited
30	Antiviral Study of Ber and Pc dyes	ICT MUMBAI

Additionally, the following tests were standardized and validated as part of extended objectives or readiness and were proved significant to the industries.

2.Title: Isolation/characterization of SARS-CoV-2 Omicron variants and standardization/validation of cell-based neutralization assays **(Project ID: CD/21/2/E)** Funding: DBT-BIRAC (as part of NIBEC Project CD/19/3/E) **Duration:** July 2021 – June 2022 **Sanctioned Amount:** NA **PI:** Dr. Rashmi Virkar, **Co-PI/ Co-Investigators**: Dr. Vidya A. Arankalle, Dr. A.C. Mishra **Ph.D. Students:** NA **Human Ethical Approval:** IEC/2020/25

Fifty-two Nasopharyngeal swab samples (NPS) collected during different times within the third wave were used for virus isolation in VERO cells. We could isolate SARS-COV-2 from 13 samples. The variant type was determined by full genome/spike region sequencing. These included: BA.1 (n=5), BA.2 (n=6), and BA.5 (n=2) variants.

For the development of PRNT for BA.1 Omicron variant, CD/22/0005 virus was propagated in Vero cells and used to develop plaque assay and PRNT. The optimized assay was validated employing ICH (Q2) guidelines.

3Title: Evaluation of neutralizing antibody response against wild-type SARS-CoV-2 and Delta, Kappa, Omicron BA.1 variants among Covishield and Covaxin recipients (Project ID: CD/21/1/I) **Funding:** DBT-BIRAC (as part of NIBEC Project CD/19/3/E and CD/21/1/E) **Sanctioned Amount:** NA **Duration:** July 2021– June 2022 **PI:** Dr. Vidya A. Arankalle, **Co-PI/ Co-Investigators**: Dr. Rashmi Virkar, D. A C Mishra **Ph.D. Students:** NA **Human Ethical Approval:** BVDUMC/IEC/71, BVDUMC/IEC/185A

Background: COVISHIELD and COVAXIN are the two vaccines used in India. Several variants emerged during the pandemic, some being immune escape mutants. To understand the neutralization potential of the vaccine-induced antibodies, it is essential to perform neutralization tests against the emerging variants.

Work done: The standardized and validated PRNT50 assays for the detection and quantitation of neutralizing antibodies against the wild type (D614G), delta, kappa variants, and BA.1, the

subvariant of Omicron were used to compare the response against Covishield and Covaxin. Samples collected 1-month post-complete immunization with two vaccine doses were tested.

Among Covishield recipients (n=33), a significant reduction in neutralizing antibody titers was noted against Delta (p=0.0020), Kappa (p=0.0002), and BA.1 (p<0.0001) variants when compared to the wild type. (Figure 6A). A similar trend was noted among Covaxin recipients (p=0.0034, <0.0001 (n=33) and 0.0020 (n=22) respectively (6B). When the variant-wise response was compared among the recipients of the two vaccines, Nab titers among Covishield recipients were higher against the wild-type virus, and kappa and Omicron variants.

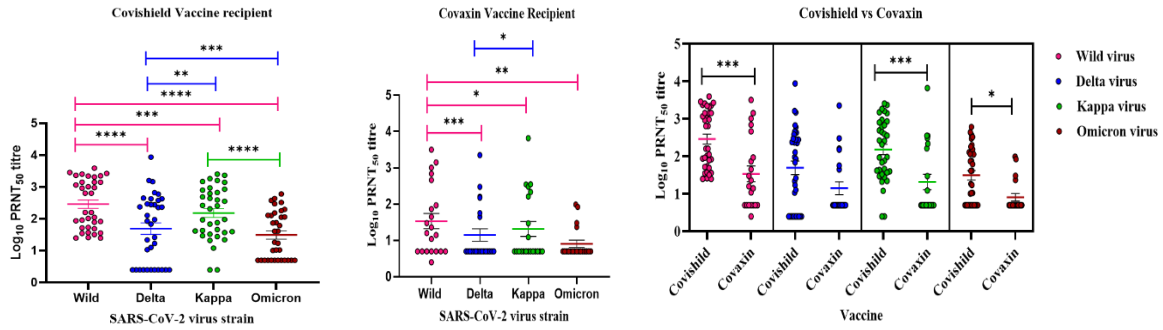


Figure 1:

4Title: Validation of CMI assays for dengue & chikungunya (**Project ID:** CD/21/3/I) **Funding:** DBT-BIRAC (as part of NIBEC Project CD/19/3/E) **Sanctioned Amount:** NA **Duration:** July 2021– June 2022 **PI:** Dr Archana Kulkarni-Munje, **Co-PI/ Co-Investigators:** Dr. Vidya A. Arankalle, Dr. A C Mishra **Ph.D. Students:** NA **Human Ethical Approval:** BVDUMC/IEC/71, BVDUMC/IEC/185A

Background: Given the importance of cell-based assays in vaccine immunogenicity, developing such assays for dengue and chikungunya was considered important.

Dengue:

Assay for enumeration of virus-specific T cells (CD4/CD8 T cells), memory T cells, cytotoxic T cells, and Th1 cytokine (IFN-γ, IL-2 & TNF-α) secreting cells were developed using overlapping

NS3 and NS5 peptides consensus in all dengue 1-4 serotypes. This flow cytometry-based assay was validated according to H62 guidelines designed specifically for flow cytometry assays by CLSI (Clinical and Laboratory Standards Institute, Malvern, PA, US). Additionally, dengue-specific (NS3 & NS5) Th1/Th2/Th17 cytokine secretion (pg/ml) in PBMC culture supernatants was standardized using a commercially available cytometric bead array kit (CBA) kit. IFN-γ ELISPOT to evaluate dengue virus-specific T cell functionality was validated.

Chikungunya:

For the assessment of CMI, E1, E2 and nsp1 peptides were used for the stimulation of PBMCs. The assay included enumeration of virus-specific T cells (CD4/CD8 T cells), memory T cells, cytotoxic T cells and Th1 cytokine (IFN-γ, IL-2 & TNF-α) secreting cells. Validation of the assay according to the H62 guidelines for flow cytometry is in process. To evaluate Chikungunya virus-specific T cell functionality, IFN-γ ELISPOT was standardized.

For all the CMI assays, GCLP guidelines were followed for training & competency of technical staff, test-specific SOP release, and validation process.

5.Title: Capacity enhancement of National Immunogenicity and Biologics Evaluation Center for assessing the immunogenicity of SARS-CoV-2 vaccines (**Project ID:** CD/21/3/E). **Funding:** DBT-BIRAC (Under National Biopharma Mission) **Duration:** February 2021 – January 2022

Sanctioned Amount: Rs. 13.41 crore **Investigators - PI:** Dr. A C Mishra, **Co-Investigators** – Dr. Vidya Arankalle, Dr. Shubham Shrivastava, Dr. Harshad Patil, Dr. Ruta Kulkarni, Dr. Rashmi Virkar, Dr. Archana Kulkarni-Munje, Dr. Suhas Mhaske, Dr. Sudha Ramkumar **Ph.D. Students:** NA **Human Ethical Approval:** IEC/2020/25

Background:

Unprecedented collaborative efforts have been made globally to reduce the duration of the development of effective vaccines for COVID-19. Several vaccines employing different platforms have been developed and evaluated in clinical trials. More and more industries are coming forward for the development of such vaccines. Considering the need for large-scale

testing during clinical trials, the NIBEC was supported by BIRAC-DBT by providing additional funds for enhancing the capabilities of testing samples in clinical trials with expected accuracy and in a short time.

Objectives:

1. Facility Augmentation and Upgradation of technology for existing key tests
2. Pseudo virus technology transfer and standardization of surrogate neutralization assay
3. Development of tests for CMI responses to natural COVID-19 infections and the vaccines
4. Manpower training, ILC activities and develop and share standardized reagents and protocols for testing.

Work done:

1.1. All the instruments requested under the project were received and the procedures were standardized for the automated machines.

6.Title: Production of Lentivirus-based pseudovirus and development of pseudo-virus-based neutralization assay. (**Project ID:** CD/21/3/E). PI: Dr Rajashree Patil. Co-investigators: Dr V A Arankalle, Dr A C Mishra. **Duration: March 2021- Feb 2022**

Background: Lentivirus-based pseudoviruses are generated by removing the envelope protein gene and pathogenic genes of HIV-1 retrovirus. This results in lacking autonomous replication capacity and being able to infect host cells for just one cycle. Pseudoviruses provide high safety, robust operability, and suitability for efficient rapid throughput detection. The safety profile of pseudoviruses allows studying the neutralization assay without needing specialized BSL-3 or BSL-4 labs.

Work performed in the lab using the lentiviral system:

The Lentiviral vector system was established to develop SARS-CoV-2 pseudovirus and reporter stable cell lines.

- For this work, 2nd and 3rd generation lentivirus production systems were developed. These systems provide more safety because the components necessary for virus production are split across multiple plasmids (3 plasmids for the 2nd-generation system and 4 plasmids for the 3rd-generation system).
- Further, we have generated genome-integrating as well as non-genome-integrating lentivirus systems.

7.Title: Production of Lentivirus-based pseudovirus and development of pseudo-virus-based neutralization assay (**Project ID:** CD/21/4/I) **Funding:** DBT-BIRAC (as part of NIBEC Project CD/21/3/E) **Duration:** February 2021 – January 2022 **Sanctioned Amount**: Rs. 13.41 crore **Investigators - PI:** Dr. Rajashree Patil, **Co-Investigators** – Dr. Vidya Arankalle, Dr. A C Mishra **Ph.D. Students:** NA **Human Ethical Approval:** IEC/2020/25

Background: Lentivirus-based pseudovirus is generated by removing the envelope protein gene and pathogenic genes of HIV-1 retrovirus. This results in lacking autonomous replication capacity and being able to infect host cells for just one cycle. Pseudovirus provides high safety, robust operability, and suitability for efficient rapid throughput detection. The safety profile of pseudovirus allows for studying the neutralization assay without needing specialized BSL-3 or BSL-4 labs.

Work done:

The Lentiviral vector system was established to develop SARS-CoV-2 pseudovirus and reporter stable cell lines. For this work, 2nd and 3rd-generation lentivirus production systems were developed. These systems provide more safety because the components necessary for virus production are split across multiple plasmids (3 plasmids for the 2nd-generation system and 4 plasmids for the 3rd-generation system). Further, we have generated genome-integrating as well as non-genome-integrating lentivirus systems.

Second-generation pseudovirus production - An initial attempt at pseudovirus production was made using a second-generation lentiviral system. GFP reporter-based SARS-CoV-2 spike

pseudo-typed virus particles were successfully generated and transduced into permissive HEK-ACE2 cells (Figure 2A). Quantitation of GFP-positive cells was performed using CTL-Fluorospot (Figure 2B). This pseudovirus showed neutralization results with SARS-CoV-2 specific monoclonal antibody, however, with clinical samples variable neutralization activity was observed. Hence, the GFP reporter-based SARS-CoV-2 spike pseudo-typed virus was not used for further neutralization assay development.

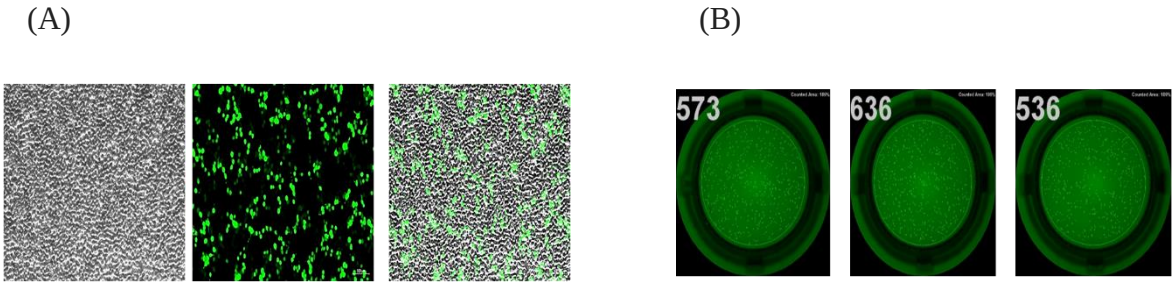
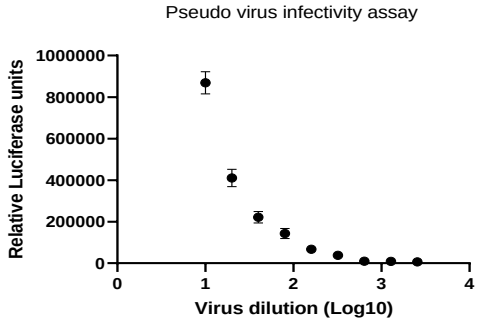


Figure 2: *A) Microscopic image indicating green fluorescence due to transduction of GFP-based SARS-CoV-2 spike pseudo-typed virus particles in HEK ACE2 cells (10X magnification). B) Quantification of GFP-based SARS-CoV-2 spike pseudo-typed virus-infected cells using CTL-Fluorospot instrument (Cellular Technology Ltd).*

Development of neutralization assay using third-generation luciferase-based pseudovirus: Next, we implemented the third-generation lentiviral system to produce Luciferase reporter-based SARS-CoV-2 spike pseudo-typed virus particles. Virus infectivity assays were performed on HEK ACE2 cells to determine the virus titer. 1.8 x 10^7 RLU/mL pseudo virus titer was obtained (Figure 3A). Next, to check the functionality of pseudovirus SARS-CoV-2 Spike (D614G-IMG06) specific monoclonal antibody was used. Neutralization assay with SARS-CoV-2 specific monoclonal antibody showed 0.16 µg/mL NT_{50} (Mab known NT_{50}= 0.11 µg/mL) (Figure 3B). Further, input virus optimization was carried out using a neutralization assay with the available SARS-CoV-2 antibody positive reference material. Three virus dilutions were tested 1:100, 1:500, 1:1000 (Figure 3C). Using 1:500 virus dilution, 15 clinical samples showed a significant correlation with $PRNT_{50}$ (r=0.8155, p=<0.0001) (Figure 3D). Other conditions such

as the stability of diluted virus and the use of attached or freshly trypsinized cells for neutralization test were also tested. To increase the contact between the virus and cells, freshly trypsinized cells were added to the mixture of virus and serum instead of attached cells and neutralization titer was compared. Both the methods showed comparable NT_{50} (Figure 3E). To study the stability of diluted virus, a neutralization assay was performed with freshly diluted virus and stored diluted virus (Figure 3F). It was observed that only one freeze-thaw cycle is acceptable for neutralization assay with stored diluted virus.

A)



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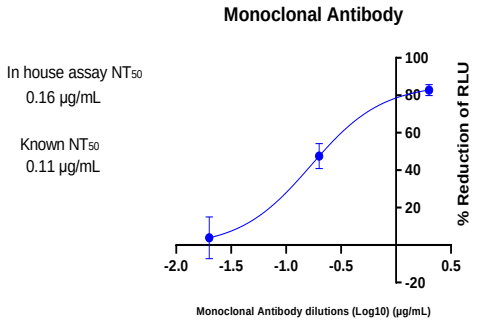

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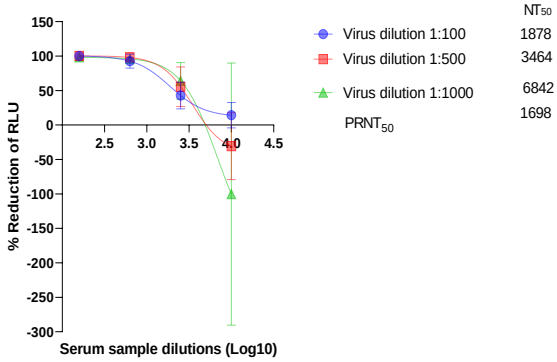

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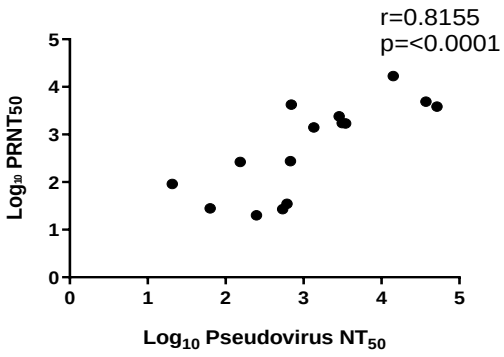
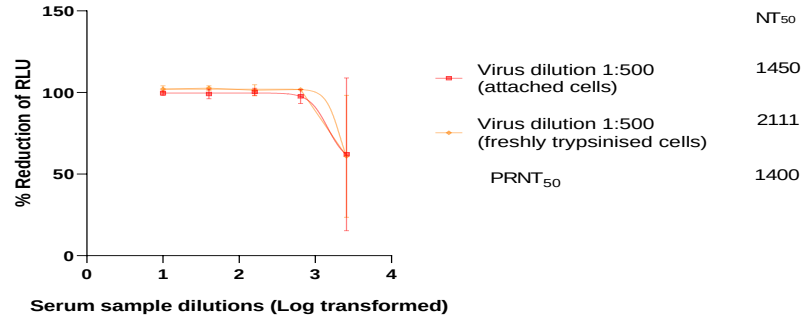


E)



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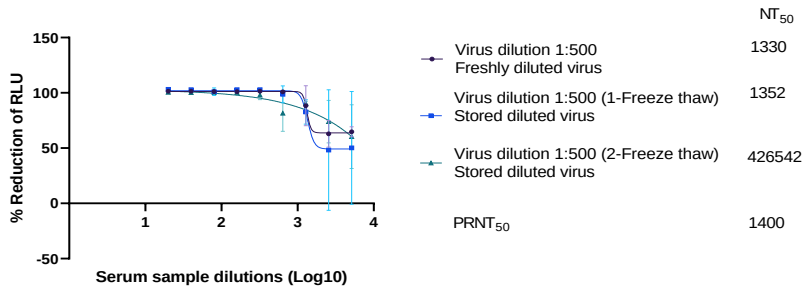


Figure 3: *A) Luciferase-based reporter pseudo virus titration. HEK ACE2 cells (2 x 10^4) were seeded in 96 well plates. Pseudo virus was diluted 10-fold and subsequently two-fold serial dilutions were performed (eight replicates were performed). Titer was expressed as relative luciferase units per ml (RLU/ml) and B) Functional assay for confirmation of pseudovirus. Neutralization assay was performed with SARS-CoV-2 (IMG06) specific monoclonal antibody using 1:500 diluted virus. C) Input virus optimization was carried out employing neutralization assay with internal SARS-CoV-2 antibody positive reference material. Three virus dilutions were tested 1:100 (blue line), 1:500 (red line), 1:1000 (green line). D) Titers obtained by pseudovirus neutralization were individually compared with neutralizing antibody titers by $PRNT_{50}$. Spearman's correlation test was used to assess the correlation between pseudovirus neutralization and $PRNT_{50}$ E) attached and freshly trypsinized cells F) using stored diluted virus. The pseudovirus NT_{50} values were calculated with non-linear regression [log (inhibitor) vs. response (four parameters)].*

Conclusion: We have optimized the conditions for second-generation, Integrase free-second generation, and third-generation lentiviral-based pseudovirus production. Under this activity following parameters were standardized:

1. Optimum vector ratio of lentiviral transfer **(T)** (pLV-eGFP/ pHAGE-CMV-Luc2-IRES-ZsGreen-W), envelope **(E)** vector (T: P: E) determined for SARS-CoV-2 Spike pseudo-typed virus generation.
2. Optimization performed for media composition, vector transfection conditions, pseudovirus harvest time, virus concentration method, and storage conditions for virus stability.
3. Optimization of lentivirus transduction steps using VSV-G pseudo-typed virus.
4. Optimization of infectivity and neutralization assay conditions.
5. Quantitative output method selection for high throughput pseudovirus neutralization assay-Flurospot- Cellular Technology Limited (CTL) was the most efficient, accurate, and cost-effective for GFP reporter pseudovirus-based neutralization. For the Luciferase reporter pseudovirus, the microplate reader was a more convenient method.
6. Pseudovirus-based neutralization assays were standardized with standard monoclonal antibody.

8.Title: T cell immune response to Spike & Nucleocapsid proteins of SARS CoV-2 (**Project ID:** CD/21/5/I) **Funding:** DBT-BIRAC (as part of NIBEC Project CD/21/3/E) **Duration:** February 2021 – January 2022 **Sanctioned Amount**: Rs. 13.41 crore **Investigators - PI:** Dr. Archana Kulkarni-Munje, **Co-Investigators** – Dr. Vidya Arankalle, Dr. A C Mishra **Ph.D. Students:** NA **Human Ethical Approval:** IEC/2020/25

Background:

Previously, it has been shown that antibody levels wane with time in SARS-CoV-1 infection, while cellular immunity can last 6 to 11 years. Similarly, a recent study of antibody levels revealed that 40% of asymptomatic and 13% of symptomatic patients infected by SARS-CoV-2 became negative for immunoglobulin G eight weeks post-recovery. A recent study in recovered COVID-19 patients revealed that even in the absence of antibodies to SARS-CoV-2, a robust T-cell immune response was measured, indicating the importance of T-cell immunity in response to

COVID-19. All current SARS-CoV-2 vaccines include the Spike protein and a robust T-cell immunity against Nucleocapsid-derived peptides can be detected in convalescent COVID-19 patients. Besides this, inactivated virus vaccines such as Covaxin are used in India. Therefore, identifying T-cell epitope-derived peptides within these two viral proteins will provide effective tools for measuring T-cell responses in COVID-19 patients with different degrees of disease severity and evaluating the immunogenicity of vaccine candidates in clinical trials. The T cell responses can be analysed by two assays namely, flow cytometry-based intracellular cytokine assay and ELISPOT technique-based for the quantification of T cells secreting IFN-γ.

Assay-1

Evaluation of cell-mediated immune response (CMI) to Spike & Nucleocapsid proteins of SARS CoV-2- by Intracellular cytokine secretion (ICS) assay using flow cytometry approach (CoV-CMI -ICS)

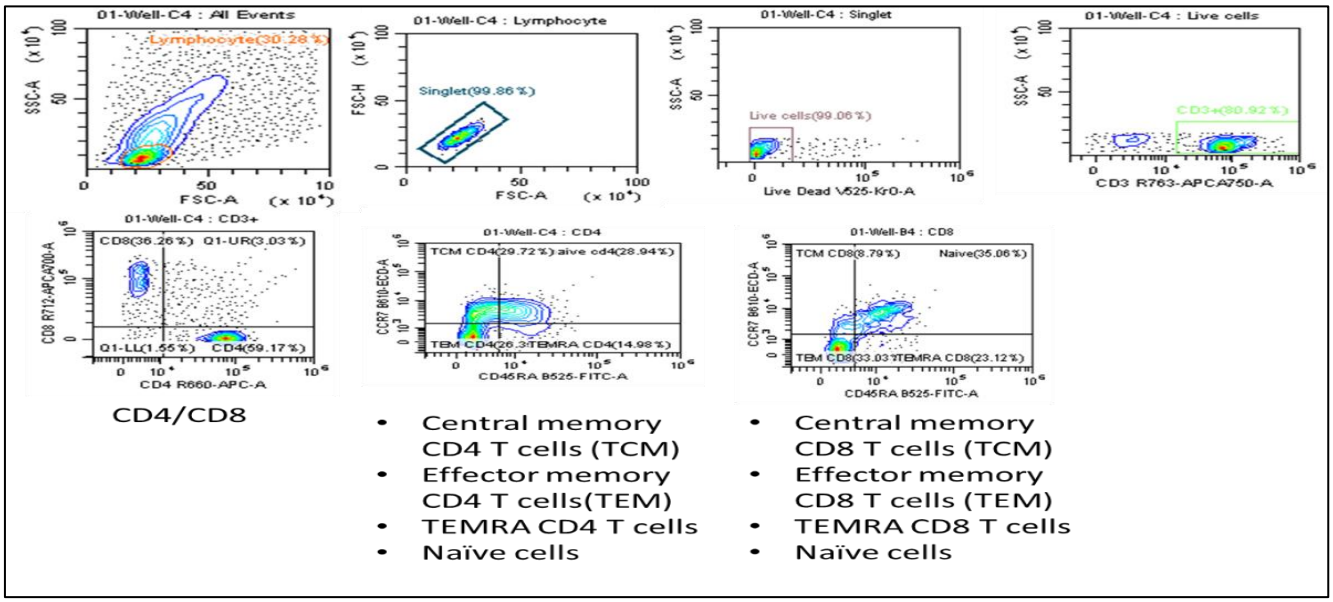
Methodology

The PBMCs of vaccine recipient are exposed to Spike & Nucleocapsid peptide pool for about 48 hrs in a humidified CO_2 incubator in a sterile condition in the presence of golgi inhibitors along with CD107a antibody and then the cells are harvested and subjected to immunostaining by live dead stain and fluorochrome-labeled antibodies against surface markers (CD3, CD4, CD8, CD137, CCR7, CD45RA) and intracellular proteins (IFN-γ, IL-2, TNF-α, GranzymeB). After immunostaining the cells are acquired on a flow cytometer (CytoFLEX LX) and the desired cellular population is identified and enumerated as follows:

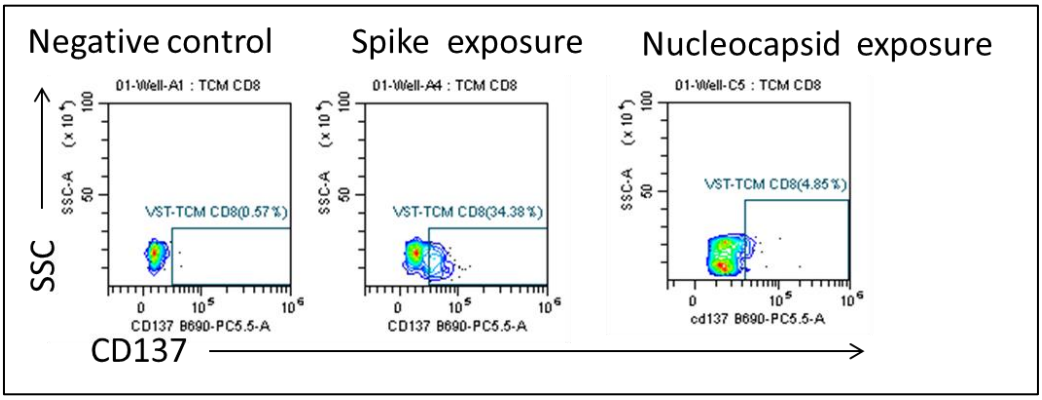
- Antigen specific CD4 and CD8 T cells based on CD137 expression.
- Antigen specific memory CD4 and CD8 T cells based on absence of CD45RA expression.
- Antigen specific central memory and effector memory CD4 and CD8 T cells (CCR7 expression).
- Antigen specific TEMRA (effector memory T cells re-expresses CD45RA) based on CD45RA & CCR7 expression.
- Monofunctional, bifunctional, and polyfunctional antigen-specific T cells (based on either separate or combinational expression of IFN-γ, TNF-α & IL-2)

- Antigen-specific cytotoxic T cell response (Coexpression of CD107a, Granzyme B, and IFN-γ)

(A)



(B)



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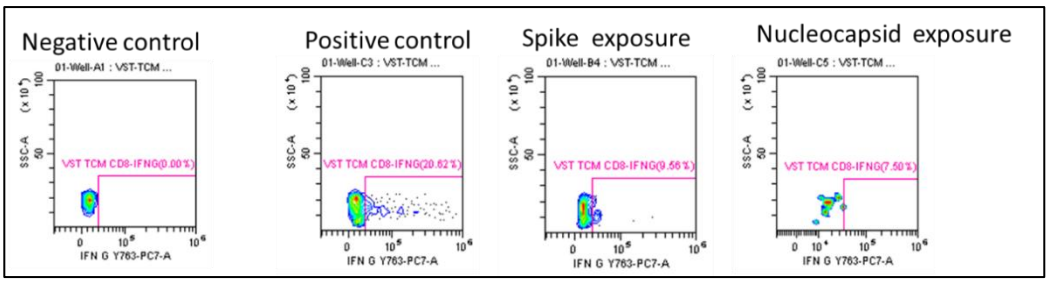


Figure 4: *A Flow cytometry gating strategy to identify memory T cell subsets. (A) Gating strategy used to identify memory T cells. During acquisition, the lymphocytes were live-gated using the side and forward scatter dot plot display. Singlets were segregated based on the area and height of the Forward scatter. The live lymphocyte population was further discriminated against based on the live dead stain. CD3 positive population of live cell population was used to identify CD4 and CD8 T cells. Based on the expression of CCR7 and CD45RA, the expression of CD4 and CD8 T cells were categorized as Central memory, Effector memory, and TEMRA population. (B) Gating strategy used to identify antigen-specific T cells. CD137 expression was used to identify antigen-specific memory T cell subsets. The functionality of these subsets was assessed in terms of cytokine production (e.g. IFN-γ) was analyzed. Three controls were used in the assay namely, FMC (Flurochrome minus cytokine antibodies and CD137 antibody), negative control, and positive control. While giving final readouts for percentages of antigen-specific cell or cytokine-producing cells, the negative control values are subtracted from the readouts obtained in spike or Nucleocapsid peptide pool exposed cells.*

Assay 2: Evaluation of cell-mediated immune response (CMI) to Spike & Nucleocapsid proteins of SARS CoV-2 by ELISPOT assay to assess Interferon-γ production by T cells after the antigenic stimulus. (SARS Cov-2- Spike & Nucleocapsid peptides) (CoV-CMI-ELISPOT)

Methodology

ELISpot assays employ the sandwich enzyme-linked immunosorbent assay (ELISA) technique. Either a monoclonal or polyclonal antibody specific to the chosen analyte is pre-coated onto a PVDF (polyvinylidene difluoride)-backed microplate. We used the commercially available kit for ELISPOT assay which comprised precoated plates. Peptide-based antigenic stimulated cells are pipetted into the wells and the microplate is placed into a humidified 37°C CO2 incubator for a specified time. During this incubation period, the immobilized antibody, near the secreting cells, binds to the secreted analyte. After washing away any cells and unbound substances, a biotinylated antibody specific to the chosen analyte is added to the wells. Following a wash to remove any unbound biotinylated antibody, alkaline phosphatase-conjugated to streptavidin is

added. The unbound enzyme is subsequently removed by washing and a substrate solution (BCIP/NBT) is added. A blue-black colored precipitate forms and appears as spots at the sites of cytokine localization, with each spot representing an individual analyte-secreting cell. The spots can be counted with an automated ELISpot reader system, CTL S6 macroanalyser. Most studies have demonstrated strong T cellular immunity against Spike and Nucleocapsid hence, peptide pool array covering whole spike and Nucleocapsid are used for PBMC stimulation.

Both the assays were validated according to H62 guidelines designed specifically for flow cytometry assays by CLSI. Besides, these were used in research on the immunogenicity of COVID-19 vaccines.

9.Title: To study neutralizing antibody levels in COVISHIELD vaccinee and COVID-19 patients using MSD ACE2 neutralization assay (**Project ID:** CD/21/6/I) **Funding:** DBT-BIRAC (as part of NIBEC Project CD/21/3/E) **Duration:** February 2021 – January 2022 **Sanctioned Amount**: Rs. 13.41 crore **Investigators - PI:** Dr. Vidya Arankalle, **Co-Investigators** – Dr.Rajashree Patil, Dr. A C Mishra **Ph.D. Students:** NA **Human Ethical Approval:** IEC/2020/25

Background:

Assessing the neutralization potential of vaccine recipients and COVID-19 patients against emerging viral variants is essential. Developing variant-based PRNTs for all the emerging SARS-CoV-2 variants is a difficult task. With the availability of an MSD platform that can simultaneously detect and quantitate antibodies against multiple SARS-CoV-2 variants, we explored the use of the V-PLEX SARS-CoV-2 Panel 15 (ACE2) Kit available at the time of conducting this study. This is a multiplex assay for measuring the antibodies that block the binding of ACE2 to Spike antigens from variants of SARS-CoV-2 including the wild type-Wuhan, Alpha, Beta, and Delta variants and other variants present in the kit.

Results:

We first assessed the performance of the MSD assay. None of the thirty-eight IgG-anti-SARS-CoV-2 negative pre-vaccination plasma samples scored reactive against all the 10 variants when a cutoff value of ≥1.5fold was used in the MSD assay. Next, we compared the MSD assay with a live virus neutralization assay ($PRNT_{50}$) that uses the Wuhan-Hu-1 strain (B.1, D614G-Wild-type). For this, seven serum and forty plasma samples (n=47) from the first wave of COVID-19 patients were used. ACE2 competition by the MSD assay and antibody titers from PRNT50 assay showed excellent correlation when all the variants used in the MSD assay were considered (r=0.76-0.83, p <0.0001, Fig 1a). Despite differences in the biological properties of the variants, the cross-reactivity of antibodies against multiple variants might explain why the PRNT exhibited a high correlation with other variants besides Wuhan. In India, the first COVID-19 wave was dominated by the Wuhan-Hu-1 strain (B.1), while the second wave was initially caused by the B.1.617.1/ Kappa lineage variant and, later by the B.1.617.2/ Delta lineage variant. We first compared anti-variant-antibody seropositivity among the three patient groups (figure 1b). Percent seropositivity against different variants was comparable among Wuhan (63-89%) and Delta (68-79%) variant-infected patients. However, most of the Kappa-infected patients (56-72%) were antibody-negative. Though the number of patients was small, when the samples were collected within one week of the onset of symptoms, antibody response in Kappa patients seemed to be delayed. To understand variant-specific quantitative differences in all patient groups, ACE2-competition was compared. In accordance with the highest antibody negativity in the Kappa patients, the median ACE2 competition was lowest in this patient group across all the variants (figure 1c).

Figure 1d provides variant pairs with significant differences in the patient groups [Wuhan-Delta (n=8), Wuhan-Kappa (n=0), Delta-Kappa (n=27)]. Given the lack of antibodies among majority of Kappa patients, we considered only antibody-positive samples (figure 1e). This analysis revealed that whenever antibodies were present at the time of blood collection, both Kappa and Delta patients exhibited high and comparable neutralizing antibody levels against different variants. We would like to point out here that the Kappa variant has E484Q mutation. The 484 position in the RBD region is crucial for the interaction of neutralizing antibodies, mutation at this position resulted in a reduction in neutralizing antibody titer. In addition, E484Q mutation

hinders electrostatic bonds at E484 and K31 in the Spike RBD region affecting interaction with ACE2. Delta variants carry L452R, T478K (RBD region) mutations that affect binding at ACE2 by enhancing the stabilization of the ACE2-RBD complex. These mutations have been shown to alter viral interaction with ACE2 and might have affected antibody response in these patient groups. In the absence of follow-up samples, a subsequent comparison was not possible.

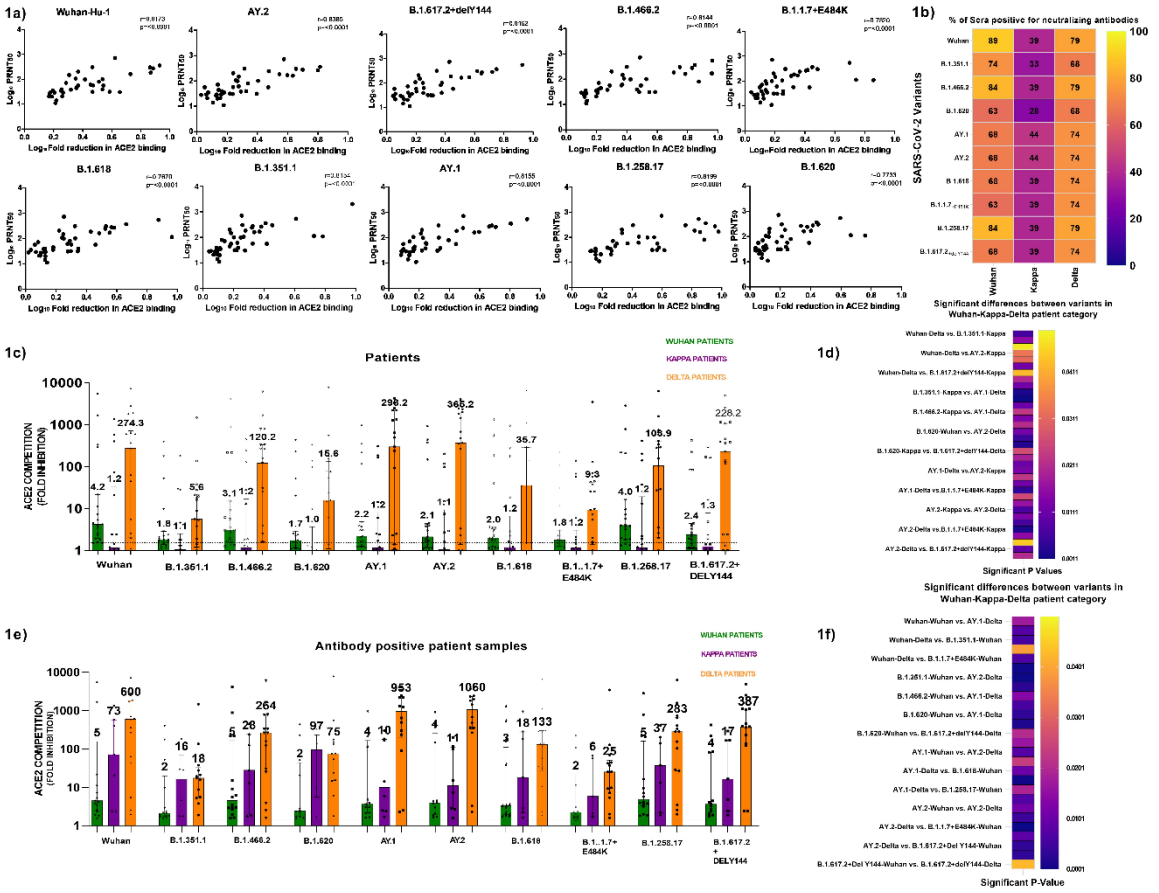


Figure 5: *(A) For assessing the performance of MSD in relation to PRNT50 employing the Wuhan-Hu-1 strain, 47 samples from COVID-19 patients infected during the first wave were tested by both methods. ACE2 competition by all the ten variants present in the MSD-15 panel was individually compared with neutralizing antibody titers by PRNT50. The correlation between ACE2 competition and PRNT50 for every variant was analyzed by Spearman's correlation. Spearman's rho= r value varied from 0.76 to 0.83 while the p-value was <0.0001 for all the variants. (B) MSD ACE2 assay was performed on plasma samples of COVID-19 patients naturally infected with Wuhan virus (n=19), B.1.617.1/ Kappa lineage variant (n=18),*

and B.1.617.2 strain/ Delta lineage variant (n=19). Individual variant-wise percent positivity in the patient groups is depicted. (C) For the comparisons of anti-variant antibody levels in the three patient groups, ACE2 competition values were compared across the ten variants in all three patient groups. One-way ANOVA corrected for multiple comparisons by Tukey's test was performed. This analysis included all the patients irrespective of antibody positivity. (D) The heat map depicts variant pairs showing significant differences (one-way ANOVA) in the patient groups. The significant p values are indicated using color code. (E) For this analysis, samples positive for anti-variant antibodies were considered for assessing the cross-reactivity of the generated antibodies. For the comparisons of anti-variant antibody levels in the three patient groups, ACE2 competition values were compared across the ten variants in all three patient groups. One-way ANOVA corrected for multiple comparisons by Tukey's test was used. (F) The heat map for antibody-positive patients depicts variant pairs with significant differences (one-way ANOVA) in the patient groups. Significant p values are marked using color code ACE competition values are presented as Median±IQR. The dotted line indicates the cutoff value (≥1.5) for ACE2 competition (fold inhibition). P values <0.05 were considered significant.

Neutralization potential against the major VOCs is reduced in COVISHIELD vaccine recipients -

Low anti-variant neutralizing antibody response in the pre-negatives: At 1-month post-vaccination (Figure 6A), antibody positivity for the Wuhan strain was 88.4% in MSD which was comparable (p=1) to 95% (114/120) in PRNT50 when the same vaccinees were tested earlier. Surprisingly, almost 40% of the vaccinees lacked antibodies against AY.2, B.1.1.7+E484K, B.1.351.1, B.1.620 (p=0.002-0.006). Even when optimum antibody response is expected, a large proportion of the pre-negative vaccinees were at risk of infection from these variants. For the other variants, positivity was comparable with Wuhan.

At 6 months, antibody positivity decreased for all the variants (Figure 6B). When compared with the Wuhan strain (68.8%), a lower proportion of antibody positives (15.6- 37.5%, p= 0.02-<0.001) were detected for eight variants; the difference with B.1.258.17 (43.8%) was not significant (p=0.07). Thus, by 6 months post-immunization, most of the pre-negatives lacked anti-variant neutralizing antibodies and could be susceptible to infections with a variety of

variants. At 6 months, a significant decline in Nab levels was recorded for an additional four variants. Except for Wuhan (Median±IQR, 1.6; 1.4-2.1), median ACE2-competition against all the other variants was below the cutoff value of 1.5 (Figure 6E). Taken together, Nab response to the variants known to have immune evasion-associated mutations was inferior even at 1 month and declined sharply for all the variants by 6 months.

Higher and more durable anti-variant Nab response in the pre-positives: At 1-month post-immunization, all the 32 vaccinees with hybrid immunity were Nab positive for all the variants examined (Figure 6B). As the vaccine was administered post-1st wave, the highest ACE2 competition was observed against the Wuhan strain (Figure 6D). High fold reduction in ACE-2 binding (5.6-20.9fold, p=0.039-<0.0001) was recorded for B.1.351.1, B.1.620, B.1.618, and B.1.1.7+E484K variants with characteristic mutations in the S protein (Figure 6D). Notably, except B.1.618 these variants are classified by the WHO as VOCs. At the 6-month follow-up, a small proportion (3.5-10.7%, Figure 6B) of the pre-positive vaccinees circulating lower Nab levels at 1 month, turned out antibody negative against the same four variants. Nab levels continued to be lower for these variants while comparable levels were recorded against the remaining variants (Figure 6F). Overall, irrespective of the prior antibody positivity, Nab levels were consistently lower for the VOCs included in the MSD panel.

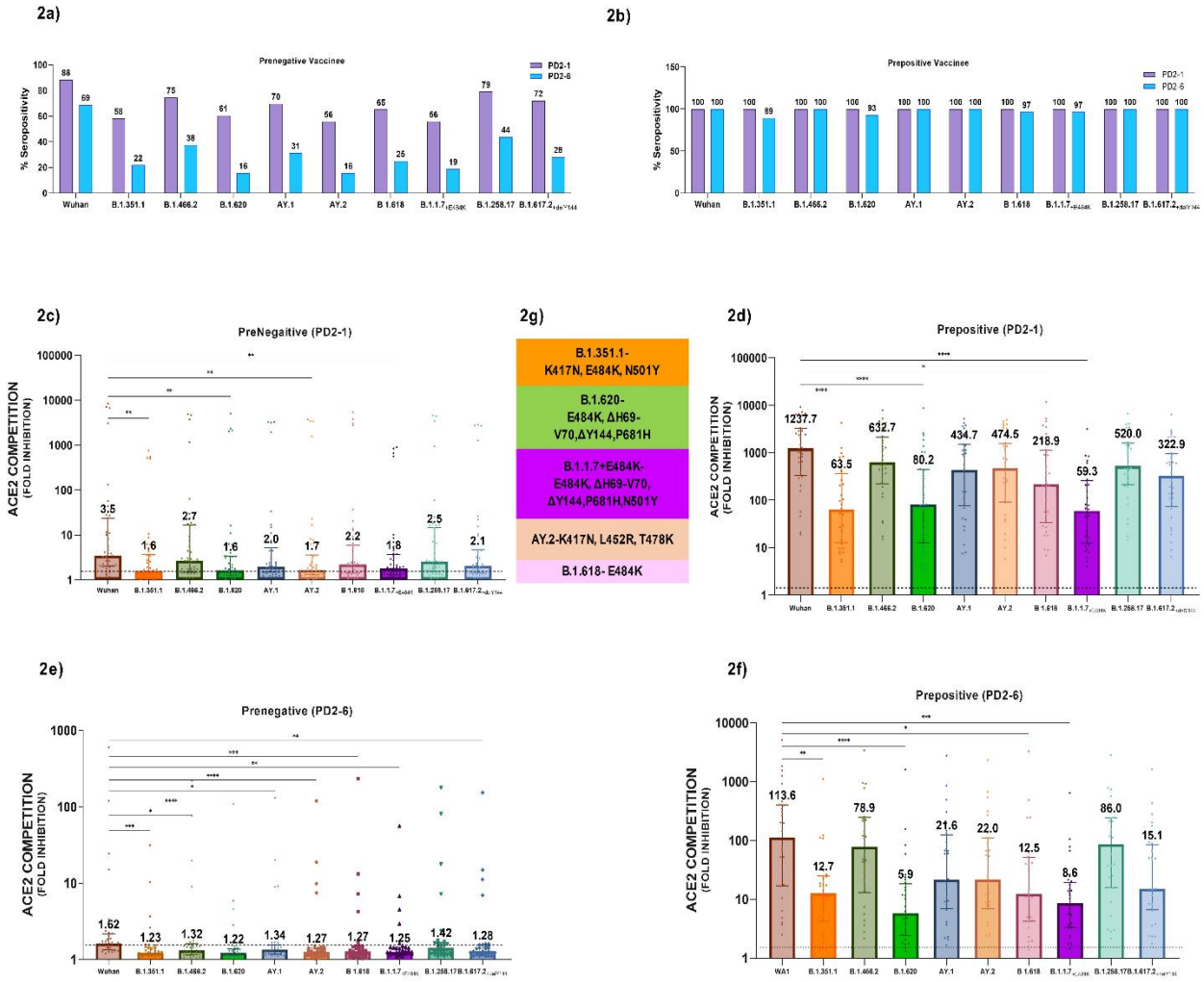


Figure 6: *Plasma samples from COVISHIELD vaccine recipients either negative (prenegative) or positive (prepositive) for IgG-anti-SARS-CoV-2 antibodies were tested for anti-variant antibodies in the MSD-15 assay at 1 (PD2-1) and 6 months (PD2-6) after complete vaccination with two doses. The cutoff value for the assay was > 1.5. (A, B) provide variant-specific percent antibody positivity among prenegatives and prepositives respectively at both the time points. The value above each bar represents % seropositivity. ACE2 competition (fold inhibition) values were compared between all the variants at PD2-1 and PD2-6 among prenegatives (C, E) and prepositives (D, F). Inter-variant comparisons were made for the vaccinee groups at both the timepoints using the Kruskal–Wallis test (post-hoc test– Dunn's test). The dotted line indicates the cutoff value (≥1.5). The value above each bar represents the median ACE2 competition*

*value; variation measures the interquartile range (25%–75%), n = 43 PD2-1 prenegative vaccinee, n = 32 PD2-6 prenegative vaccinee, n = 32 PD2-1 prepositive vaccinee, n = 28 PD2-6 prepositive vaccinee. Stars expressing p values are: ****p < 0.0001, ***p < 0.001, **p < 0.01, and *p < 0.05. (G) denotes mutations identified in the respective variants with confirmed immune evasion by experimental studies.*

10Title: Development of potent adjuvanted respiratory syncytial virus vaccine for mucosal delivery (**Project ID:** CD/19/4/E) **Funding:** Wellcome-DBT India Alliance **Duration:** January 2019 - December 2023 **Sanctioned Amount:** 1.69 crore **Investigators - PI:** Dr. Harshad Padmanabh Patil, **Co-Investigator:** Dr. Vidya Arankalle **Ph.D. Student:** Mr. Ahmedali Mandviwala **Animal Ethical Approval:** BVDUMC/1881/2018/002/010 (renewed number BVDUMC/570/2021/001/008)

Background: The study plans to evaluate the immunogenicity of the RSV-virus-like-particles (RSV-VLP) vaccine with chimeric adjuvants recognized by two PRR ligands following sublingual or pulmonary delivery in mice. During the previous year, the RSV virus A2 strain obtained from American Type Culture Collection (ATCC) was propagated, three structural proteins of RSV viz M, G, and F were expressed using baculovirus expression systems and RSV-VLPs were developed.

Objectives:

1. Production of candidate RSV vaccines, consisting of VLPs plus different combinations of adjuvants
2. Determination of the immunological and protective properties of these vaccine candidates in mice
3. Evaluation of the effects of these vaccine candidates on human PBMC or PBMC-derived cells

Work done:

Work on objective 2 was executed in the year.

Humoral immune responses after immunization - In vivo studies were conducted to determine the immunogenicity of the VLPs. The immune response elicited by BPL-RSV and FI-RSV were the comparators. Of significance, the mice immunized with RSV-VLPs (5 or 10 µg) generated significantly higher VLP-specific IgG titers than the mice that received BPL- or formalin-inactivated RSV (Figure 7A). Similarly, IgG responses against RSV fusion (RSV-F, Figure 7B) and matrix (RSV-M, Figure 7D) proteins were higher in the VLP-immunized mice. Surprisingly, the response against glycoprotein, RSV-G, was not enhanced for the VLP (p value 0.07 to 0.88) (Figure 7C). B cell ELISpot using splenocytes from immunized mice was conducted to determine the numbers of antigen-specific ASCs. The VLPs induced a comparable number of ASCs as the inactivated RSV antigens (Figure 7E). Determination of neutralizing antibody titers highlighted that the mice immunized with either 5 or 10 µg VLPs generated significantly higher levels of neutralizing antibodies than those with either inactivated RSV antigens (Figure 7F).

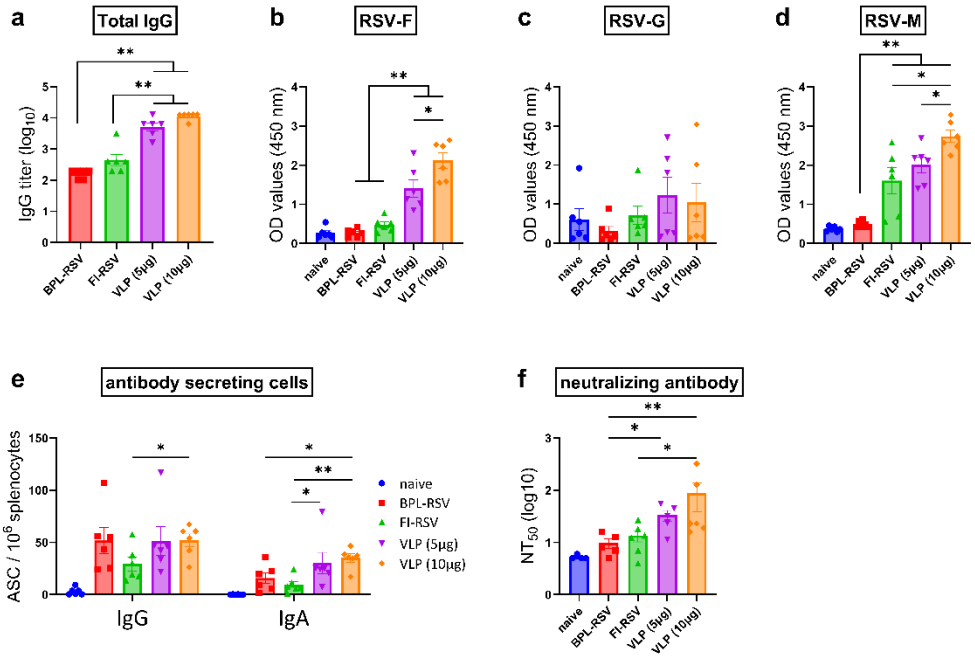


Figure 7. Figure 1. *Humoral response after immunization with RSV-VLPs. Mice (n=6 per group) were immunized twice on days 1 and 21 with 5µg BPL-RSV, FI-RSV or 5 or 10 µg RSV-VLP. Control mice remained unimmunized. Blood was collected 21 days after the first dose and 7 days after the second dose (day 28) upon sacrifice. Antibody responses after immunization were determined by measuring (a) the total IgG titre against RSV and ELISA reactivity of the collected sera against (b) RSV-F, (c) RSV-G, and (d) RSV-M proteins. (e) ASCs producing RSV-specific IgG or IgA from splenocytes were measured by ELISpot. HEp-2 cells were used to determine (f) neutralizing antibody levels in sera. Statistical analysis was accomplished by using the non-parametric Kruskal-Wallis test : *, $p < 0.05$; **, $p < 0.01$. Bar represents mean ± SEM.*

In vivo studies were conducted to determine the immunogenicity of the VLPs. The immune response elicited by BPL-RSV and FI-RSV were the comparators. Of significance, the mice immunized with RSV-VLPs (5 or 10 µg) generated significantly higher VLP-specific IgG titers than the mice that received BPL- or formalin-inactivated RSV (Fig. 1a). Similarly, IgG responses against RSV fusion (RSV-F, Fig. 1b) and matrix (RSV-M, Fig. 1d) proteins were higher in the VLP-immunized mice. Surprisingly, the responses against glycoprotein, RSV-G, were not enhanced for the VLP (p value 0.07 to 0.88) (Fig. 1c). B cell ELISpot using splenocytes from immunized mice was conducted to determine the numbers of antigen-specific ASCs. The VLPs induced similar numbers of ASCs as the inactivated RSV antigens (Fig. 1e). Determination of neutralizing antibody titers highlighted that the mice immunized with either 5 or 10 µg VLPs generated significantly higher levels of neutralizing antibodies than in mice immunized with either of the inactivated RSV antigens (Fig. 1f).

IFN-γ and IL-4 response after immunization:

To characterize the immune response generated after immunization, we quantified Th1 cytokine (IFN-γ) and Th2 cytokine (IL-4) generated from in-vitro stimulated or non-stimulated splenocytes. Immunization with VLPs induced the highest numbers of IFN-γ SFCs upon stimulation compared to inactivated RSV virus or mock immunizations. The number of IL-4 SFCs was similar in all immunized groups after stimulation. Similar observations were noticed for secreted IFN-γ and IL-4 in supernatants of the restimulated and non-stimulated splenocytes

(p values 0.11 to 0.90) (Fig 2d-e). No difference in the IFN-γ and IL-4 levels was observed in sera of naïve and immunized mice.

Protection from live RSV after challenge in immunized mice:

To investigate the possibility of enhanced respiratory disease (ERD), we examined lung pathology in the immunized mice, upon RSV challenge (Fig. 3a-e). The lungs of mice infected with the live virus had mild congested vascular tissue in the lung parenchyma, mild alveolar pathological changes with alveolitis with mononuclear inflammatory cellular infiltration in the alveolar parenchyma (Fig. 3b). Minimal pathology was seen in mice that received BPL-RSV (Fig. 3c). However, mice immunized with FI-RSV showed signs of enhanced inflammation such as alveolitis and infiltrates in both the peribronchial and perivascular areas (Fig. 3d). In contrast, the lungs of the mice that received RSV-VLP (Fig. 3e) showed no signs of lung pathology and were very similar to the lungs of naïve mice (Fig. 3a). Overall, mice immunized with FI-RSV showed ERD while immunization of mice with VLPs prevented lung inflammation after RSV challenge (Fig. 3f). No weight loss was observed in the RSV challenged mice.

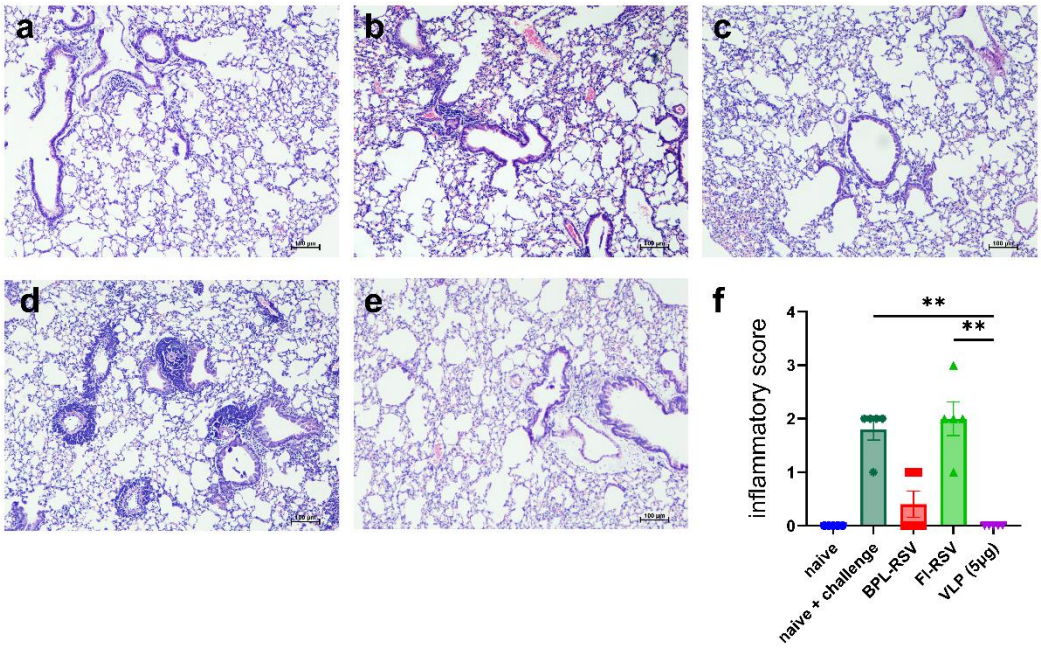


Figure 8*. Lung pathology in mice challenged with live RSV after immunization. Mice (n=5 per group) were immunized twice and subsequently challenged with live RSV 7 days after the second dose. The lungs were harvested 4 days post-challenge, fixed, sectioned, and stained with H&E to evaluate RSV-mediated enhanced respiratory disease. Representative images of lungs from (a) naive, (b) non-immunized and challenged, (c) BPL-RSV-, (d) FI-RSV- and (e) RSV-VLP-immunized and challenged mice. (f) The lung pathology score was calculated after analysing the lung sections from each mouse. Statistical analysis was accomplished by using the non-parametric Kruskal-Wallis test: *, $p < 0.05$; **, $p < 0.01$. Bar represents mean ± SEM.*

Conclusion: Mice immunized with VLPs developed high levels of serum IgG and neutralizing antibodies compared with mice immunized with inactivated virus. The VLP vaccine also induced higher levels of IFN-γ and IL-4-producing cells. VLP immunization abolished lung pathology in the mice after the RSV challenge. Overall, our results indicate that RSV-VLPs consisting of prefusogenic F, glycoprotein, and matrix proteins are a potential vaccine candidate against RSV.

11Title: Platelet-derived exosomes and their role in endothelial dysfunction in dengue infection (**Project ID:** CD/19/5/E) **Funding:** DBT-BioCARe **Duration:** March 2019 – March 2022 **Sanctioned Amount**: Rs. 46.4 Lakh **Investigators: PI** - Dr Shubham Shrivastava, **Co-investigators** – Dr Deepak G Bhosle (Bharati Vidyapeeth Medical College). **Ph.D. Students:** Ms. Sayali Vedpathak **Human Ethical Approval:** IEC/2019/15; IEC/2020/46 (renewed IEC/2021/59)

Background: This study aimed to evaluate the role of platelet-derived exosomes in endothelial dysfunction during dengue infection.

Work done:

11 blood samples from dengue patients were collected in each year of 2019 and 2020. Later, in the year 2021, another 61 blood samples from dengue patients were received. In total, during the study period of 2019 - 2021, we collected 20 blood samples from healthy donors and 83 dengue patients' samples with different clinical presentations. The disease diagnosis was confirmed by

NS1 antigen detection and/or anti-dengue IgM antibody using commercial ELISA kits. All healthy donor samples were negative for dengue NS1 and anti-DENV IgM antibodies. Dengue patients positive for at least one of the seromarkers were included in this study.

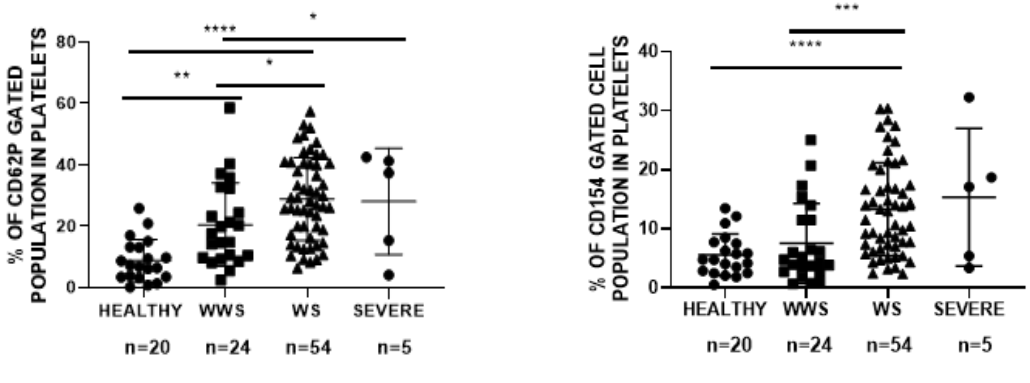
Results:

Expression of platelet activation marker, CD62P, and adhesion molecule, CD154 in dengue patients

Blood samples collected in acid-citrate dextrose (ACD) tubes were processed for platelet-rich plasma fraction and isolation of platelets. The platelet purity and activation status were confirmed by flow cytometry. CD45 negative cell population was selected from the total cell population and then plotted against CD41/CD61 markers.

Platelets were stained with CD62P to check the activation status of platelets and whether it varies with disease severity. Figure 1 clearly shows the increased expression of CD62P on the platelet surface as the dengue disease progresses from mild to severe outcome as depicted in (Figure 1A).

A B



Apart from CD62P, other adhesion molecules are present on the platelet surface and help the platelet to adhere to the endothelium during infection. We selected cell adhesion molecules CD154, and CD151 and checked their expression on platelets during dengue infection.

We did not observe any significant change in the expression of CD151 in dengue patients compared to healthy donors. We observed significantly higher expression of CD154 on the platelet surface in dengue patients with warning signs ($p<0.0001$) and severe dengue patients ($p=<0.05$) in comparison to healthy adults (Figure 1B). Importantly, the rise in CD154 expression was more pronounced in dengue patients with severe disease ($p<0.05$) and with warning signs ($p<0.001$) than those without warning signs and milder symptoms. Our results suggest that increased expression of CD154 on the platelet surface was associated with disease severity in dengue infection.

Characterization of platelets-derived exosomes in dengue patients:

We examined the expression of exosome-specific markers CD9, and CD63 on platelets isolated from healthy donors and dengue patients of each category (n=5) by western blot. As shown in Figure 2B, we detected the increased expression of CD9 and CD63 on platelets isolated from dengue patients than markers expressed on platelets isolated from healthy donors. The presence of CD41 in the lysates of platelets confirms that the exosomal markers are present on the platelets. Then, we examined the expression of CD9, CD63, and CD81 on exosomes derived from platelets isolated from healthy controls and dengue patients (n=12) by western blot. As shown in Figure 2C, we observed an increased expression of CD9, CD63, and CD81 markers on the platelet-derived exosomes isolated from dengue patients than those from healthy donors.

Figure 9. *(A) % of platelets expressing CD62p and (B) % of platelets expressing CD154.*

Apart from CD62P, other adhesion molecules are present on the platelet surface and help the platelet to adhere to the endothelium during infection. We selected cell adhesion molecules CD154, and CD151 and checked their expression on platelets during dengue infection. We did not observe any significant change in the expression of CD151 in dengue patients when compared to healthy donors. We observed significantly higher expression of CD154 on the platelet surface in dengue patients with warning signs ($p<0.0001$) and severe dengue patients ($p=<0.05$) in comparison to healthy adults (Figure 9B). Importantly, the rise in CD154 expression was more pronounced in dengue patients with severe disease ($p<0.05$) and with warning signs ($p<0.001$) than those without warning signs and milder symptoms. Our results

suggest that increased expression of CD154 on the platelet surface was associated with disease severity in dengue infection.

Characterization of platelets-derived exosomes in dengue patients - We examined the expression of exosome-specific markers CD9, CD63 on platelets isolated from healthy donors and dengue patients of each category (n=5) by western blot. As shown in Figure 10B, we detected the increased expression of CD9 and CD63 on platelets isolated from dengue patients than markers expressed on platelets isolated from healthy donors. The presence of CD41 in the lysates of platelets confirms that the exosomal markers are present on the platelets. Then, we examined the expression of CD9, CD63, and CD81 on exosomes derived from platelets isolated from healthy controls and dengue patients (n=12) by western blot. As shown in Figure 10C, we observed an increased expression of CD9, CD63, and CD81 markers on the platelet-derived exosomes isolated from dengue patients than those from healthy donors.

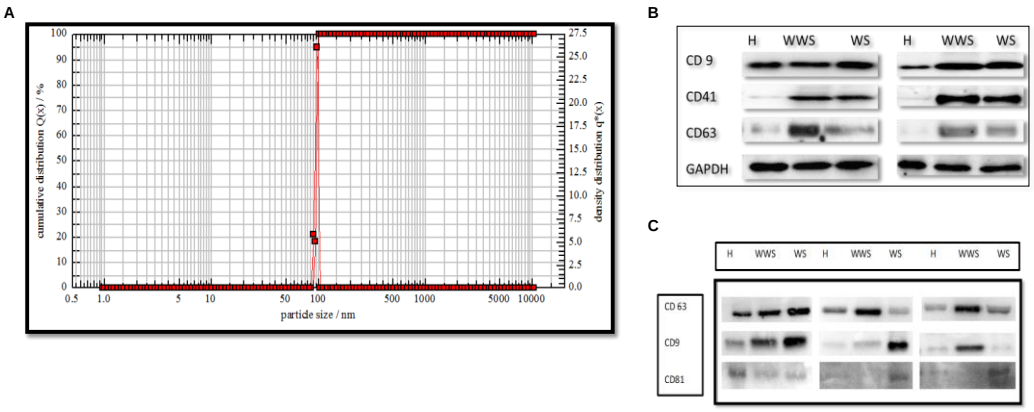


Figure 10. *Characterization of platelet-derived exosomes isolated from dengue patients. (A) Particle size determination of platelet-derived exosomes by DLS, Expression of exosome markers (CD9, and CD63) in (B) platelets and (C) platelet-derived exosomes of healthy donors (H), dengue patients without warning signs (WWS) and with warning signs (WS) respectively.*

Uptake of labeled exosomes in endothelial cells

The platelet-derived exosomes isolated from healthy donors and dengue patients were labeled with PKH67 green, fluorescent dye. We first optimized the exosome uptake experiment in Vero cells and then the same experiment was performed in Human Umbilical Cord Vein Endothelial cells (HUVEC). As shown in Figure 3, HUVEC cells uptake the labeled exosomes irrespective of their origin. Nuclei were stained with DAPI. The effect of exosomes on endothelial permeability needs to be studied further.

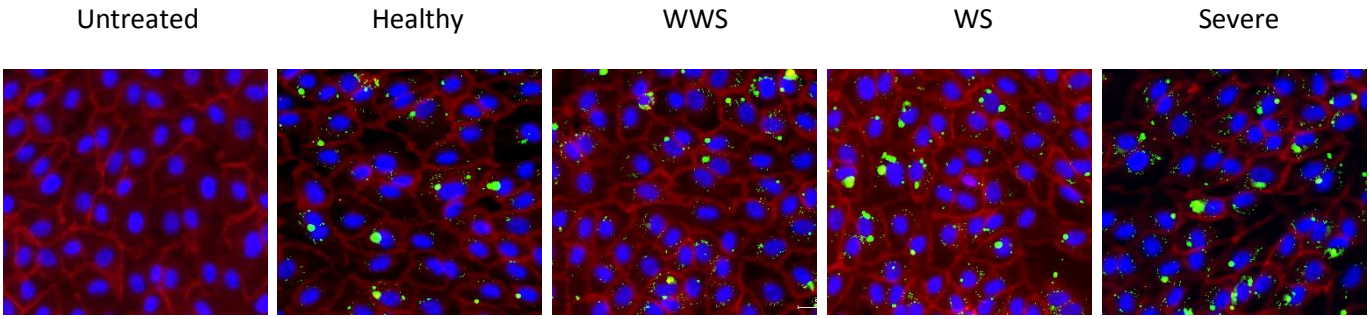


Figure 11. *Internalization of platelet-derived exosomes by endothelial cells*

Conclusion:

1. Increased expression of CD62p and CD154 on platelets in dengue patients suggests activation of platelet and platelet-mediated inflammation in dengue infection.
2. Characterization of Platelet-derived exosomes express CD63 and CD9 on their surface in dengue patients.

Other Information

Budget

Extramural Grants (newly sanctioned and ongoing) Total Projects:

S.No	Name of the Scheme/Project/ Endowments/ Chairs	Name of the Funding agency	Year of Award	Funds provided (INR in lakhs)	Duration of the project	Funds Reced in April 2021-March 2022
1	Capacity enhancement of National Immunogenicity and Biologics Evaluation Center for assessing the immunogenicity of SARS-CoV-2 vaccines	DBT-BIRAC	2021	134.15	Feb 2021-Feb 2023	506.04
2	Establishment of National Centre for Immunogenicity Testing, NCIT to evaluate vaccines in clinical trials	DBT-BIRAC	2019	160.00	2019-2023	97.20
3	Development of potent adjuvanted respiratory	Wellcome-DBT Indian	2019	168.93	2019-2023	20.17

	syncytial virus vaccine for mucosal delivery	Alliance				
4	Platelet derived exosomes and their role in endothelial dysfunction in dengue infection	DBT-BioCARe	2019	46.39	2019-2021	15.18
5	Evaluation of circulatory biomarkers for disease severity in hepatitis E	ICMR	2020	81.95	2020-2022	31.43
6	Seroprevalence of anti-hepatitis A antibodies in four cities from different parts of India	GSK	2019	20.00	2019-2021	10
7	Investigating Mechanisms Leading to Preeclampsia	Indian Council of Medical Research, Centre for Advanced Research	2017	757.95	2017-2022	105.85

8	Exploring the role of maternal fatty acids, placental fatty acid metabolism, and inflammation in determining infant health in gestational diabetes mellitus	Department of Biotechnology	2022	95.52	2022-2025	35.03
9	Evaluating the effect of alpha linolenic acid (ALA), an omega 3 fatty acid, on modulation of epigenetic markers in cervical cancer cell lines	DST-SERB	2018	33.16	2018-2021	4.00
10	Evaluating anticancer activity and mechanism of action of Unani formulation Habbe Musaffi Khoon against curvical cancer	EMR-AYUSH-CCRUM	2018	42.98	2018-2021	8.05

11	Phytochemical standardization and evaluation of anti-cancer and immunomodulatory activity of Unani formulation, Itrifal Gudadi.	EMR-AYUSH	2020	43.57	2020-2023	0
12	Effect of Yoga intervention on skeletal muscle linked glucose homeostasis in pre-diabetic individuals	Department of Science & Technology (DST)	2018	46.74	2018-2021	0
13	AICRP-Linseed Value Addition Centre	ICAR	2015	13.79	2015-onwards	13.78
14	Epigenetic regulation of angiogenic factors in assisted reproductive technology (ART) and non-ART derived placentae	Department of Biotechnology	2019	59.91	2019-2022	0

15	Epigenetic regulation of placental peroxisome proliferator activated receptor (PPAR) in women delivering low birth weight babies	Department of Biotechnology	2019	35.51	2019-2022	12.63

Student Fellowships

Student Fellowships

S.No	Funding Agency	Tilte of the project	Total grant sanctioned (In Lakhs)	Amount Received (INR) In Lakhs
1	Amol Chaudhary DBT - SRF	Evaluating the effect of Matarisenol on macrophage polarization	23.64	2.76
2	Akanksha Mahajan DBT - JRF	Evaluation of anticancer potential of selected phytochemicals against breast cancer stem cells	23.70	5.41

3	Rama Rajadnya DST Inspire JRF	Evaluating the effect of selected bioactive on cytokine and chemokine regulation in prostate cancer	23.62	4.81
4	Prajkta Patil DST Inspire JRF	Evaluating the effect of lignans inregulation of lipid and cholesterol metabolism in breast cancer	23.62	4.81
5	CSIR HRDG Manoj Khawate	Chemometric analysis and development of methodology for quality standardization of 'Vidanga'	4.92	3.60
6	ICMR Ms. Mrunal Gosavi	Development of adjuvanted chikungunya vaccine for systemic delivery.	16.22	10.08
7	UGC-NET Miss. Sayali Vedpathak	Platelet derived exosomes and their role in endothelial dysfunction in dengue infection	9.46	5.91

Publications (Total No: 22)

1. Nikita P. Joshi, Aditi R. Mane, Akriti S. Sahay, Deepali P. Sundrani, Sadhana R. Joshi, Chittaranjan S.Yajnik. Role of placental glucose transporters (GLUTs) in determining fetal growth. Reproductive Sciences. Aug 2021. Pubmed
2. Juhi Nema, Karuna Randhir, Nisha Wadhwani, Deepali Sundrani, Sadhana Joshi. Maternal Vitamin D Deficiency Reduces Docosahexaenoic Acid, Placental Growth Factor and Peroxisome Proliferator Activated Receptor Gamma levels in the Pup Brain in a Rat Model of Preeclampsia. Prostaglandins, Leukotrienes and Essential Fatty Acids. 2021 Dec;175:102364. doi: 10.1016/j.plefa.2021.102364. Epub 2021 Nov 4.Pubmed
3. Sanjay Sawant, Rajesh Patil, Manoj Khawate, Vishal Zambre, Vaibhav Shilimkar, Suresh Jagtap. J2021. Computational assessment of select antiviral phytochemicals as potential SARS-Cov-2 main protease inhibitors: molecular dynamics guided ensemble docking and extended molecular dynamics. In Silico Pharmacology. 9(44): 1-17. 2021 Jul pubmed
4. Tiraki D, Singh K, Shrivastava S, Mishra AC, Arankalle V. Complete genome characterization and evolutionary analysis of dengue viruses isolated during 2016-2017 in Pune, India. Infect Genet Evol. 2021 Sept 1;93:104909. doi: 10.1016/j.meegid.2021.104909. Epub ahead of print. PMID: 34082088. Scopus, pubmed
5. Shama Aphale, Kavita Shinde, Savita Pandita, Minal Mahajan, Prerna Raina, J N Mishra and Ruchika Kaul-Ghanekar. Panchvalkala, a traditional Ayurvedic formulation, exhibits antineoplastic and immunomodulatory activity in cervical cancer cells and C57BL/6 mouse papilloma model.2021 Nov J Ethnopharmacology pubmed scopus
6. Mrunal Ketkar, Amrita Ulhe, Minal Mahajan, Karamchand Patil and Ruchika Kaul-Ghanekar, PhD. Underweight Indian women at a risk for developing breast cancer: a retrospective study. Aug 2021. Asian Pacific Journal of Cancer Care. nil
7. Vaishali Kasture 1, Deepali Sundrani 1, Karuna Randhir 1, Girija Wagh 2, Sadhana Joshi 3 Placental apoptotic markers are associated with placental morphometry Placenta . 2021 Nov;115:1-11. doi: 10.1016/j.placenta.2021.08.051. Epub 2021 Aug 19. Scopus, pubmed, WOS

8. Kartikey Jagtap , Anuradha Mulik , Ninad Nangare , Sharad Pawar , Shridhar Chougule , Suresh Jagtap. Ambiguity in authenticity of selected ‘Vidanga’ market samples with respect to their biochemical and chromatographic evaluation. December 2021. International Journal of Green Pharmacy 15(4):1-9.
9. Shubham Shrivastava 1, Shweta Chelluboina 1, Prashant Jedge 2, Purwa Doke 3, Sonali Palkar 4, Akhilesh Chandra Mishra 1, Vidya A Arankalle 1 Elevated Levels of Neutrophil Activated Proteins, Alpha-Defensins (DEFA1), Calprotectin (S100A8/A9) and Myeloperoxidase (MPO) Are Associated With Disease Severity in COVID-19 Patients. Front Cell Infect Microbiol.. 2021 Oct 21;11:751232. doi: 10.3389/fcimb.2021.751232. eCollection 2021.Pubmed, Scopus,
10. Dipika Agrahar Murugkar a, Anand A. Zanwar b, Arpit Shrivastava a Effect of nano-encapsulation of flaxseed oil on the stability, characterization and incorporation on the quality of eggless cake Applied Food Research. Volume 1, Issue 2, December 2021, 100025. Scopus,
11. Asavari Joshi, Mahabaleshwar V. Hegde, Anand A. Zanwar. Flaxseed oil and palm olein blend to improve omega-6: omega-3 ratio. J Food Sci Technol. 2022 Feb;59(2):498-509. doi: 10.1007/s13197-021-05033-4.IF: 1.946. scopus
12. Malshe N, Patnaik SK, Lalwani S, Suryawanshi P, Kulkarni R, Mhaske S, Mishra AC, Arankalle V. Perinatal transmission of SARS-CoV-2 and transfer of maternal IgG/neutralizing anti-SARS-CoV-2 antibodies from mothers with asymptomatic infection during pregnancy. Infection. 2021 Jul 7:1–7. doi: 10.1007/s15010-021-01650-5. Epub ahead of print. PMID: 34232457; PMCID: PMC8262126. Scopus, wos, pubmed
13. Vedvati Bhapkar and Supriya Bhalerao, Dissemination of COVID-19 research: Time to walk the talk. Journal of Ayurveda and integrative medicine, Jan-March 2022 doi: 10.1016/j.jaim.2021.05.013. scopus, pubmed, wos
14. Sarika Mane # 1, Kunal K Dixit # 2, Nidhi Lathwal 3, Dhiraj Dhotre 4, Priyadarshani Kadus 3, Yogesh S Shouche 4, Supriya Bhalerao 1 Rectal administration of buttermilk processed with medicinal plants alters gut microbiome in obese individuals J Diabetes Metab Disord.. 2021 Aug 20;20(2):1415-1427. doi: 10.1007/s40200-021-00879-z. eCollection 2021 Dec.

15. Juilee S Deshpande 1, Deepali P Sundrani 1, Akriti S Sahay 1, Sanjay A Gupte 2, Sadhana R Joshi 3 Unravelling the potential of angiogenic factors for the early prediction of preeclampsia Hypertens Res. 2021 Jul;44(7):756-769. doi: 10.1038/s41440-021-00647-9. Epub 2021 Apr 1.
16. Kartikey Jagtap1, Anuradha Mulik1, E.A. Singh2 and Suresh Jagtap1* Comparative Study to Evaluate Ethanol and Ethyl Acetate Extracts of Different 'Vidanga' Species for Antioxidant Efficacy and Phyto-Constituents Screening Biomedical & Pharmacology Journal, March 2022. Vol. 15(1), p. 165-177
17. Poonam Ashish Gupte 1, Madhavi Prabhakar Mahajan 2, Minakshi Subhash Revadkar Kole 3, Ajitkumar Harichand Mandlecha 4, Pratima Arun Tatke 5, Vikram Andrew Naharwar 6, Supriya Sudhakar Bhalerao 1 Efficacy and acceptability of pomegranate effervescent granules in patients suffering from acid peptic disorders Indian J Pharmacol. 2022 Jan-Feb;54(1):7-12. doi: 10.4103/ijp.ijp_914_20.
18. Amit A. Jagtap, Yogesh S. Badhe, Pramod D. Farde, Mahabaleshwar V. Hegde & Anand A. Zanwar Long-term Storage Stability Assessment of Omega-3-Fatty Acid Emulsified Formulation Containing Micronutrients Journal of Pharmaceutical Innovation Published: 24 September 2021 Volume 17, pages 1126–1135, (2022).
19. Purwa Doke [1], Jayshree Sachin Gothankar [2], Prakash Prabhakarrao Doke [2], Milind Madhukar Kulkarni [3], Kiran Kishanrao Khalate [3], Shubham Shrivastava [4], Jayesh Rangrao Patil [2], Vidya Avinash Arankalle [5] Time dependent decline of neutralizing antibody titers in COVID-19 patients from Pune, India and evidence of reinfection Microbes Infect. 2022 Jun;24(4):104979.
20. Shubham Shrivastava [#1], Suhas T Mhaske [#1], Meera S Modak [2], Rashmi G Virkar [1], Shamburaje S Pisal [1], Akhilesh Chandra Mishra [1], Vidya A Arankalle [3] Emergence of two distinct variants of SARS-CoV-2 and an explosive second wave of COVID-19: the experience of a tertiary care hospital in Pune, India Arch Virol. 2022 Feb;167(2):393-403. doi: 10.1007/s00705-021-05320-7. Epub 2022 Jan 9.
21. Varsha Shetty,[a] Alok Jakhade,[b] Kavita Shinde,[a] Rajeev Chikate[b] and Ruchika Kaul-Ghanekar*[a] Correction: Folate mediated targeted delivery of cinnamaldehyde loaded and FITC functionalized magnetic nanoparticles in breast cancer: *in vitro*, *in vivo* and pharmacokinetic studies. New Journal of Chemistry. 2021

22. Shruti Koparkar [1], Leena Srivastava [2], Karuna Randhir [1], Kamini Dangat [1], Hemlata Pisal [1], Vrushali Kadam [1], Nandini Malshe [2], Nisha Wadhwani [1], Sanjay Lalwani [2], K Srinivasan [3 4], K Kumaran [5], Caroline Fall [6], Sadhana Joshi [1] Cognitive function and behavioral problems in children born to mothers with preeclampsia: an Indian study Child Neuropsychol.. 2022 Apr;28(3):337-54. doi: 10.1080/09297049.2021.1978418. Epub 2021 Sep 30.

Book chapters (Total No:): None

Patents:

Patent Title	Name of Innovators	Patent Application No.	Filling date	Current status

Awards and Honors (Faculty: 2; Students: 2)

Faculty			
Academic Year	**Name of The Faculty Member**	**Honor**	**Details of Award / Honor**
2021-2022	Dr. Sarika Mane	Best oral presentation	8th International Congress of the Society for Ethnopharmacology, 27th - 29th August 2021
2021-2022	Asavari Joshi	Best oral presentation	Paper presentation at 4th International Conference on Food and Nutrition May 20 and 21, 2022. Bangalore, India

Students			
Academic Year	**Name of The Faculty Member**	**Honor**	**Details of Award / Honor**
2021-2022	Juhi Nema, **Deepali Sundrani, Sadhana Joshi**	keystone symposia	Free registration to at tend Vitamin D Workshop
2021-2022	Anjali Jadhav, **Sadhana Joshi,**	The Chellaram Diabetes Institute (CDI), Pune	2nd prize for the "Oral Presentation"

Papers Presented at International Conferences/Seminars/Workshops: (Total No: 2)

1. Jagtap Amit, Garud Dipali, Hegde Mahabaleshwar, Zanwar Anand. Extraction and fractionation of bioactive lignan using solid-liquid extraction and evaluation of its toxicity at NIPiCON-IPS- 2022 - 6th Nirma Institute of Pharmacy International Conference Jointly Organized with Indian Pharmacological Society, February 17-19, 2022
2. Asavari A Joshi, Mahabaleshwar V Hegde, and Anand A Zanwar. Understanding Effects of Flaxseed oil Blends in Liver Cells. 4th International Conference on Food and Nutrition May 20 and 21, 2022. Bangalore, India

Invited Talks by Faculty (**Total no:11**)

Sr. No	Academic Year	Date	Name of the faculty	Topic
1	2021	2nd September 2021	Dr. Poonam Gupte	Integrated approach in diagnosis and management of PCOS (online lecture series arranged by National Integrated Medical Association)
2	2021	4th September 2021	Dr. Supriya Bhalerao	Research from clinic to practice - Mirage or reality (online lecture series arranged by National Integrated Medical Association)
3.	2022	1st February 2022	Dr. Supriya Bhalerao	Say No to Obesity and Yes to Health- (online lecture arranged by Women Empowerment Cell of Poona College of Pharmacy, Bharati Vidyapeeth on occasion of National Girl Child Day)
4	2021-22	6th July 2021	Dr. Anand Zanwar	Linseed Value Addition
5	2021-22	13th July 2021	Dr. Anand Zanwar	POC-Omega-3 fatty acid
6	2021-22	10th Feb. 2022	Dr. Anand Zanwar	Innovation in Omega-3 Health Products by Linseed Value Addition
7	2021-22	10th Feb. 2022	Dr. M. V. Hegde	Evolution of Real-World Nutrition Laboratory Foundation, A BVDU's initiative for the Omega-3 revolution
8	2021-2022	Sept 2, 2021.	Dr. Sadhana Joshi	"Influence of maternal one carbon metabolites on placental programming and long term

				health" at the International Federation of Placenta Associations (IFPA) conference, Amsterdam (virtual)
9	2021-2022	August 27, 2021	Dr. Sadhana Joshi	"Effect of maternal vitamin supplementation on brain neurotrophins and cognitive performance in the offspring " at IBRO-APRC Associate School on Biophysical to Molecular Techniques: An interface in Neurobiology Research, IGNTU, Amarkantak (MP)
10	2021-2022	Jul 23, 2021	Dr. Sadhana Joshi	"Importance of LC-PUFA in pregnancy and early life" PRERNA platform, VRHP, KEMHRC, Pune
11	2021-2022	21st July 2021	Dr. Sadhana Joshi	Lessons to learn: Insights to become a successful researcher". Symbiosis Institute of Health Sciences (SIHS), a constituent of Symbiosis International (Deemed University), Lavale, Pune, Maharashtra

Ph.D. Degree Awarded: Total :2

Sr. No	Name of the Student	Name of the Guide	Topic	Month and Year of Award
1	Varsha Shetty	Dr. Ruchika Kaul-Ghanekar	Evaluating the potential of cinnamaldehyde loaded iron oxide nanoparticles for targeted delivery in Breast Cancer	Apr-22

2	Vaishali Kasture	Dr. Sadhana Joshi	Association of one carbon metabolites with respective to their methylation potential in women with preeclampsia and normotensive women	Apr-22

Collaborations:

International Collaborations: Nil

Sr. No	Name of the Collaborator	Period of Collaboration	Objectives	Status
	Prof. Caroline Fall Professor of International Paediatric Epidemiology **University of Southampton, UK**	2017 onwards	Advisory	Ongoing
	Kalyanaraman Kumaran Unit Head and Senior Scientist at the Epidemiology Research Unit **Houghton Mifflin Harcourt,US**	2017 onwards	Project	Ongoing
	K.S. JOSEPH PROFESSOR	2022 onwards	Project	Ongoing

	Faculty of Medicine **University of British Columbia, Canada**			
	Simon Fraser **University, Canada** Pablo Nepomnaschy Professor, MSFHR Scholar	2022 onwards	Project	Ongoing
	Sandra Davidge Cardiovascular Research Centre (CVRC), Faculty of Medicine & Dentistry **University of Alberta, Canada**	2022 onwards	Project	Ongoing
	Nalini Singhal Professor - Medicine **University of Calgary, Canada**	2022 onwards	Project	Ongoing
	Jan Sanderson Research Chair **Red River College , Canada**	2022 onwards	Project	Ongoing

	Jacquetta Trasler Professor **McGill University, Canada**	2022 onwards	Project	Ongoing
	Stephanie Atkinson Professor, Pediatrics McMaster University, Canada	2022 onwards	Project	Ongoing
	Stephen Mathews Zulfiqar Bhutta Cindy-Lee Dennis **University of Toronto, Canada**	2022 onwards	Project	Ongoing

National Collaborations: (Total : 14)

Sr. No	Name of the Collaborator	Period	Objectives	Status
1	Dr. Girish Tillu, CCIH, University of Pune	2016 till date	Scientific and technical inputs for developing project proposals, Network pharmacology of Ayurvedic formulations	Ongoing

2	Dr. Yogesh Shouche, NCMR-NCCS, Pune	2016 till date	Microbiome analysis	Ongoing
4	Dr. Vaishali Deshmukh, Pune	2016 till date	Expert opinion for all ongoing projects from endocrinology perspective Diabetes/obesity awareness Activities	Ongoing
5	Dr. D. C. Mathangi, Professor of Integrative Medicine, Shriramchandra Institute of Higher Education and Research, Porur, Chennai	Feb 2020 till date	Scientific and technical inputs for developing project proposals	Ongoing
6	Dr. Gaurang Baxi, Professor, Dr. D. Y. Patil College of Physiotherapy, Dr. D. Y. Patil Vidyapeeth, Pune	Feb 2021 till date	Conduct of collaborative projects	Ongoing
7	Dr. A L Kakrani, DY Patil Medical College & Hospital	Mar 2021-Feb 2024	Collaboration on ongoing Dengue research	Ongoing
8	Bharati Hospital And research center	March 2017-Aug 2022	Collaboration on Centre for Advanced Research	Ongoing
9	Gupte Hospital and research center Pune	March 2017-Aug 2022	Collaboration on Centre for Advanced Research	Ongoing
10	K.E.M Hospital, Pune	March 2018-Feb 2022	Collaboration on DBT project	Ongoing
11	St. John's National Academy	Nov	Collaboration on Optimise project	Ongoing

	of Health Sciences , Bangalore	2021-Nov 2025		
12	All India Institute of Medical Sciences (AIIMS) , Delhi	March 2017-Aug 2022	Collaboration on Centre for Advanced Research	Ongoing
13	Council of Scientific and Industrial Research Centre For Cellular And Molecular Biology (CSIR–CCMB)CSIR–CCMB, Hyderabad	March 2017-Aug 2022	Collaboration on Centre for Advanced Research	Ongoing
14	CSI Holdsworth Memorial Hospital, Mysore	Nov 2021-Nov 2025	Collaboration on Centre for Advanced Research, Optimise project, HelTi	Ongoing

MOUs and Linkages: (Total No: 30)

Sr. No	**Name of the Partner**	**Objectives**	**Status**
1	Gennova Biopharmaceuticals	Immunogenicity testing by SARS CoV-2 PRNT for COVID vaccine clinical trial	Ongoing
2	Bharat Biotech	Immunogenicity testing by SARS CoV-2 PRNT for COVID vaccine clinical trial	Ongoing

3	Reliance Life Sciences	Immunogenicity testing using various tests for for COVID vaccine clinical trial	Ongoing
4	Biological E	Immunogenicity testing by SARS CoV-2 PRNT for COVID vaccine clinical trial	Ongoing
5	Akston Biosciences Corporation	Immunogenicity testing by SARS CoV-2 PRNT for COVID vaccine clinical trial	Ongoing
6	Christian Medical College, Vellore and Serum Institute of India, Pvt Ltd	Immunogenicity testing by SARS CoV-2 PRNT for COVID vaccine clinical trial	Ongoing
7	INCLEN (NBM)	SARS CoV2 PRNT, DENV PRNT, CHIKV PRNT testing	Ongoing
8	Society for Health Allied Research and Education (SHARE), India	SARS CoV2 PRNT, DENV PRNT, CHIKV PRNT testing	Ongoing
9	Bharati Vidyapeeth medical College	CHIKV IgG ELISA testing	Ongoing
10	Vins Bioproducts, Telangana	SARS CoV2 MNT and SARS CoV2 PRNT testing	Ongoing
11	Reliance Life Sciences Pvt Ltd	SARS CoV2 PRNT testing	Ongoing
12	Seagull Biosolutions Pvt Ltd	SARS CoV2 PRNT testing	Ongoing

13	Wipro Enterprises Pvt Ltd	SARS CoV2 Antiviral testing	Ongoing
14	ICT(Institute of Chemical Technology)	SARS CoV2 Antiviral testing	Ongoing
15	La Renon and Frimline Pvt Limited	SARS CoV2 Antiviral testing	Ongoing
16	Meril Life Science Pvt Limited	SARS CoV2 Antiviral testing	Ongoing
17	Sundar Dezire Pvt Limited	SARS CoV2 Antiviral testing	Ongoing
18	Arna Immunoingredients Pvt Ltd	SARS CoV2 Antiviral testing	Ongoing
19	Anabio Technologies Private Limited	SARS CoV2 Antiviral testing	Ongoing
20	Sai Life Science Pvt Limited	SARS CoV2 Antiviral testing	Ongoing
21	Torrent Pharmaceuticals	SARS CoV2 Antiviral testing	Ongoing
22	Airth Research Private Limited	SARS CoV2 Antiviral testing	Ongoing
23	ICT MUMBAI	SARS CoV2 Antiviral testing	Ongoing
24	Pop Vax Ltd	SARS CoV2 Antiviral testing	Ongoing
25	Chikkannna Government Arts College (CGAC), A.E.S. College of Arts and Science (AESCAS), Chitkara College of	Research collaboration for development of antiviral drugs	Ongoing

	pharmacy (CCP)		
26	BVDU-COEP	Research collaboration for development of antiviral products	Ongoing
27	TMC-ACTREC (Tata Memorial Centre Advanced Centre for Treatment, Research and Education in Cancer)	Research collaboration for development of antiviral drugs/products	Ongoing
28	Shivaji University, Kolhapur	Research collaboration for the development of antiviral drugs/products	Ongoing
29	DY Patil Medical College & Hospital	Collaboration on ongoing Dengue research	Ongoing
30	Hirabai Cowasji Jehangir Medical Research Institute (HCJMRI)	Undertaking of research and developmental projects in the domain of public health in India	Ongoing

Conference/workshops/Seminar attended

Type of the Event	**Sr. No**	**Name of the Faculty**	**Date**	**Name of the Event**	**Organized By**	**Level (International / National / State / Institute)**
Online workshop	**1**	Dr. Supriya Bhalerao	22-29th October, 2021	WHO terminology workshop		International

Online webinar	2	Dr. Poonam Gupte	7–8th January, 2022	Data analysis of survey study design	Indian Spinal Injuries Centre, Biostatistics Department	National
Conference	3	Dr. Supriya Bhalerao	24th April 2022	SYNAPSE 2022: 3rd International conference on Mind Body Medicine in Diabetes and endocrinology.	Society for prevention, healthcare, education and research SPHERE	International
Conference	4	Shital Giramkar	24th April 2022	SYNAPSE 2022: 3rd International conference on MIND BODY MEDICINE in Diabetes and endocrinology.	Society for prevention, healthcare, education and research SPHERE	International
Conference	5	Shital Giramkar	22nd 24th April 2022	8th International Congress of the Society for Ethnopharmacology, 27th -29th August 2021	SFE India, Pune and Poona College of Pharmacy, Bharati Vidyapeeth Pune	International
Conference	6	Dr. Sarika Mane	22nd 24th April 2022	8th International Congress of the Society for Ethnopharmacology, 27th-29th August 2021	SFE India, Pune and Poona College of Pharmacy, Bharati Vidyapeeth Pune	International
Workshop	1	Dr. Anand Zanwar	September 07, 2021	Fundamentals of Shelf-Life Techniques in New Product Development	National Agriculture and Food Analysis and Research Institute, Pune	National

Workshop		Dr. Anand Zanwar Dr. Prakash Ghorpade	18-19 August 2021	Annual Linseed Group meeting of linseed	ICAR New Delhi and ICAR-IIOR, Hyderabad	National
Workshop		Dr. Anand Zanwar	24th August 2021	SCOPUS: Helping Universities and Researchers Improve Their Performance With Up-to-Date Data and Analytics	IRSHA and IQAC cell of BVDU, Pune	Institute
Workshop		Dr. Anand Zanwar	17th Jan. to 22nd Jan. 2022	Six Days Online Faculty Development Programme on "Development of MOOCs"	IQAC cell of BVDU, Pune and Centre for Distance and Online Education (CDOE)	Institute
Workshop		Dr. Anand Zanwar	2nd Feb 2022	BVDU Data Backup Policy and Implementation	BVDU's BVIEER, Pune and IQAC cell of BVDU, Pune	Institute

Invited Lectures

Sr. No	Name of the Guest	Topic	Date
1	Dr. D.C. Mathangi Professor & HOD, Mind Body Medicine & Lifestyle sciences, Shri Ramchandra Institute of Higher Education & Research, Chennai	Perceived stress scale and its evaluation.	2nd Feb 2022
2	Ms. Himangi Lubree, Biometry expert, Vadu Rural Health Program (VRHP), KEM Hospital Research Center, Pune	Anthropometry measurements- Demonstration and hands on training	17th Feb 2022
3	Angeline Jeyakumar, Assistant Professor, Interdisciplinary School of Health Sciences Savitribai Phule Pune University (Formerly University of Pune)	Food Frequency Questionnaire and its evaluation	17th Feb 2022

Extension activities:

Any other activities

Type of the Event	Theme	Date	Level (International / National / State / Institute)	Role
An online pre-conference workshop in 8th International Congress of the Society of Ethnopharmacology, India	Scientific Communication.	26th August, 2021	International	Hosted the workshop by Obesity-Diabetes Lab, BVDU-IRSHA

Live broadcasting on Aakashwani	Prediabetes awareness on occasion of World Diabetes Day	14th November 2021	National/state	Given an interview on prediabetes
Diabetes check up camp week in community 1. PDEA Ayurveda Rugnalaya & Sterling Multispeciality Hospital 2. Orion Health Centre, Kothrud 3. Dept. Of Medicine, Bharati Hospital	Prediabetes awareness on occasion of World Diabetes Day	1. 15-17th November 2021 2. 16th November 2021 3. 24th November 2021	Institute	Organized by Obesity-Diabetes Lab, BVDU-IRSHA

Any other information or relevant photographs about the program which may be included in the report

- **Dr. Anand Zanwar published following two technical bulletins:**
  - Beena Nair, **Anand Zanwar**, Nandan Mehta, Devendra Payasi, Suma Mogali, A.L. Rathnakumar, T. Boopathi and M. Sujatha. 2021. Value Added Products of Linseed. All India Coordinated Research Project on Linseed, ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad, Telangana, India. Technical Bulletin.
  - Manimurugan, C, Lakshmi Prayaga, **Anand Zanwar** and M. Sujatha. 2021. Diversified uses of linseed. ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad-500 030, Telangana. Technical Bulletin
- **Partial dissertation work in CINHD lab**

- Ms. Kritika Verma - student of M. Sc. Biotechnology from BVDU's RGITBT under guidance of Prof. M. V. Hegde
- Ms. Harshada Mandolikar - student of M. Sc. Biotechnology from Fergusson College, Pune under guidance of Prof. M. V. Hegde
- Mr. Akshay Parcha - student of M. Sc. Biotechnology from Fergusson College, Pune under guidance of Prof. M. V. Hegde
- Ms. Bhakti Satav - student of M. Sc. Biotechnology from BVDU's RGITBT under guidance of Dr. Anand Zanwar
- Ms. Sneha Kanade - student of M. Sc. Biotechnology from BVDU's RGITBT under guidance of Dr. Anand Zanwar

Any other information or relevant photographs about the program which may be included in the report

Celebration of National Ayurveda Day: An online talk by Vd. Hrishikesh Mhetre was arranged on the occasion of Dhanwantari Jayanti to celebrate the National Ayurveda Day. The topic of the talk was "**The pathophysiology of Obesity and Diabetes in Ayurveda w.s.r. to clinical experiences"** scheduled on 1st November, 2021.

Events Organized at IRSHA:

1. The fire drill & Safety program was conducted by "Om Fire Services" on 10th June 2022.
2. One day Webinar on "Multiplexing Elispot for Immune monitoring" organized by LABINDIA INSTRUMENTS in association with IRSHA, on 6th October 2021.

Staff Information

Staff Category	**Number**
Scientific staff	**19**
Technical Staff	**17**
Ph.D. students	**31**
Administrative	**12**
Project Staff	**85**
Total	

A) Name of the Teaching/ Scientific Staff:

Sr. No.	**Name of the Staff**	**Designation**	**Sign**
1	Dr. Akhileshchandra Mishra	Director	
2	Dr. Vidya Arankalle	Senior Scientist	
3	Dr. Sadhana Ramchandra Joshi	Professor	
4	Dr. Ruchika Kaul-Ghanekar	Associate Professor	
5	Dr. Suresh Dnyandeo Jagtap	Associate Professor	
6	Dr. Supriya Bhalerao	Associate Professor	

7	Dr. Shubham Shrivastav	Associate Professor	
8	Dr. Harshad Padmanabh Patil	Associate Professor	
9	Dr. Anvita Kale	Assistant Professor	
10	Dr. Ruta Kulkarni	Assistant Professor	
11	Dr. Deepali Sundrani	Assistant Professor	
12	Dr. Rashmi Govind Virkar	Assistant Professor	
13	Dr. Archana Prasad Munje	Assistant Professor	
14	Dr. Sudha Ramkumar	Assistant Professor	

B) Name of the Technical Staff:

Sr. No.	**Name of the Staff**	**Designation**	**Sign**
1	Dr. Prerna Raina	Senior Research Assistant	
2	Dr. Poonam Ashish Gupte	Senior Research Assistant	
3	Dr. Kamini Dhanesh Dangat	Research Assistant	
4	Dr. Abhijit Avinash Ghadge	Research Assistant	
5	Mrs. Hemlata Mahadeo Pisal	Research Assistant	
6	Dr. Anuradha Rajendra Mulik	Research Assistant	
7	Dr. Sarika S. Mane	Research Assistant	
8	Mr. Kartikey Tanaji Jagtap	Research Assistant	
9	Mrs. Karuna N. Randhir	Technical Assistant	

10	Ms. Vrushali Kadam	Technical Assistant	
11	Ms. Shruti Vidyadhar Koparkar	Technical Assistant	
12	Ms. Kavita Kadam	Technical Assistant	
13	Ms. Shital Ashok Giramkar	Technical Assistant	
14	Ms. Surabhi Subhod Dalvi	Technical Assistant	

C) Name of the Administrative Staff:

Sr. No.	**Name of the Staff**	**Designation**	**Sign**
1	Mr. Vijaychand Pandurang Gavade	Sub Accountant	
2	Mr. Ananda Dinkar Jadhav	Junior Clerk	
3	Mr. Nitin Shankar Mote	Junior Clerk	
4	Mrs. Anjali Rajendra Gajare	Junior Clerk	
5	Mr. Dilip Kaka More	Trainee Clerk	
6	Mr. Shivaji Dhondiram More	Electrician	
7	Mr. Ankush Rambhau Chandere	Driver	
8	Mr. Jagannath Tukaram Yadav	Peon	
9	Mr. Tushar Ashok Shinde	Peon	
10	Mr. Ravindra Balasaheb Mulik	Animal House Attendant	
11	Ms. Supriya Anandrao Patil	Laboratory Assistant	

D) Bharati Hospital Staff:

Sr. No.	Name of the Staff	Designation	Sign
1	Mrs. Dipali Patole	Clerk	

E) Name of the Project Staff & Fellowship Staff:

Sr. No.	Name of the Staff	Designation	Sign
1	Dr. Amrita Ankush Khaire	RA-ICMR	
2	Mr. Amol Rajendra Choudhari	JRF-DBT	
3	Ms. Anjali Jadhav	SRF-ICMR	
4	Ms. Akanksha Mahajan	JRF	
5	Miss. Mrunal Gosavi	SRF- ICMR	
6	Ms. Rama Rajadnya	JRF	
7	Ms. Amrita Ulhe	JRF-DST SERB Fellow	
8	Ms. Juhi Nema	JRF-CSIR-UGC Fellow	
9	Dr. Ashwini Kamble	Women Scientist	
10	Ms. Nidhi Sharma	JRF EMR	
11	Ms. Samradni Pingale	JRF-EMR AYUSH UNANI Fellow	
12	Ms. Aishwarya Rajan Kharkhanis	JRF-DBT Bio-care	
13	Ms. Archana Sharma	JRF-DBT Bio-care	
14	Mr. AhmedAli Mandviwala	JRF-DBT Bio-care	
15	Ms. Himanshi Yadav	Project Technician(III)	

16	Ms. Aditi Mane	Project Associate II DBT	
17	Dr. Ravina Randive	SRF-Yoga Project	
18	Dr. Suresh Khadke	JRF-Yoga Project	
19	Ms. Shraddha Kansara	Clinical Trial Co-ordinator	
20	Dr. Nisha Kemse	Women Scientist	
21	Mr. Tushar Sarjerao Dalavi	Project Technician	
22	Mr. Rushabh Waghmode	RA-ICMR	
23	Mr. Manoj M. Khavate	CSIR-JRF	
24	Ms. Prajakta D. Patil	DST-Inspire-JRF	
25	Ms. Sayali Vedpathak	UGC-JRF	
26	Ms. Apurva Jadhav	UGC-SRF	
27	Ms. Priya Gahlot	Project Assistant	
28	Ms. Brishty Roy	Project Assistant	
29	Ms. Shraddha Hatangadi	RA-HEV Project	

F) Advance Research Project Staff:

Sr. No.	Name of the Staff	Designation	Sign
1	Dr. Nisha Wadhwani	Scientist-B	
2	Dr. Shridevi Gundu	Scientist-B	
3	Ms. Sakshi Selukar	Nutritionist	
4	Ms. Prachi Joshi	Social Worker	

5	Ms. Madhura Sarda	Psychologist	
6	Ms. Shweta Madiwale	Research Assistant	
7	Ms. Anupam Poddar	Social Worker	
8	Ms. Aditi Godhamgaonkar	Lab Assistant	
9	Ms. Nikita Joshi	Lab Assistant	
10	Ms. Divya Shukla	Lab Assistant	
11	Ms. Radhika Kawate	Lab Assistant	
12	Ms. Preeti Sharma	Lab Assistant	
13	Ms. Anandi Shivaram	Lab Assistant	
14	Ms. Sunaina Chhetri	Lab Assistant	
15	Ms. Kajal Shelke	Data Entry Operator	
16	Ms. Divya Gaikwad	Data Entry Operator	
17	Mr. Ganesh Ashok Kumbhar	Data Entry Operator	
18	Mr. Mahesh Balu Funde	Data Entry Operator	
19	Mr. Aniket Shelar	Field Attendant	
20	Ms. Sharvari Patil	Consultant	

G) NCIA Project Staff:

Sr. No.	**Name of the Staff**	**Designation**	**Sign**
1	Dr. Archana Prasad Munje	Assistant Professor	
2	Dr. Sudha Ramkumar	Assistant Professor	

3	Dr. Suhas Tukaram Mhaske	Assistant Professor	
4	Mrs. Rajashree Patil	Scientist B	
5	Ms. Priyanka Padghan	Scientist B	
6	Ms. Anamika Solaskar	Technical Assistant	
7	Mr. Shambhu Raje Pisal	Technical Assistant	
8	Mr. Rahul Harishchandra Kadu	Maintenance Engineer	
9	Ms. Shital Ramkrishna Nikhar	Qualitive Assurance Executive	
10	Ms. Swati Dnyaneshwar Bargal	Qualitive Assurance Executive	
11	Mr. Tushar Lala Bhosale	Technical Officer	
12	Mr. Rahul Lalaso Patil	Health Educator	
13	Ms. Prajakta Sanjay Rane	Research Assistant	
14	Mr. Urmi Majumdar	Research Assistant	
15	Ms. Shweta Chelluboina	Research Assistant	
16	Ms. Amita Kasana	Research Assistant	
17	Ms. Sapna Gawhale	Research Assistant	
18	Ms. Aabha Thite	Project Assistant	
19	Ms. Muskan Thakur	Junior Research Assistant	
20	Ms. Priya Wadhwaniya	Junior Research Assistant	
21	Mr. Shubham Kadlag	Junior Research Assistant	

22	Ms. Kajal Phadtare	Junior Research Assistant	
23	Ms. Sawani Karandikar	Junior Research Assistant	
24	Ms. Rajkanya Toge	Junior Research Assistant	
25	Ms. Jayshri Bhagat	Junior Research Assistant	
26	Ms. Dhruvi Jain	Junior Research Assistant	
27	Ms. Tejashree Shendage	Junior Research Assistant	
28	Ms. Anuradha Patil	Junior Research Assistant	
29	Ms. Abhilasha Kadu	Junior Research Assistant	
30	Mr. Omkar Kalje	Junior Research Assistant	
31	Mr. Sourabh Pandharmise	Junior Research Assistant	
32	Ms. Meghana Walke	Lab Assistant	
33	Mrs. Prajakta Rishikesh Jaswante	Office Assistant	
34	Mr. Amol Kondibhau Ohol	Multitasking Staff	
35	Mr. Mahesh Vitthal Humbe	Multitasking Staff	
36	Ms. Santoshi Sameer Shinde	Office Assistant	

H) Name of the Centre for Innovation in Nutrition Health Disease (CINHD) Staff:

Sr. No.	Name of the Staff	Designation	Sign
A) Name of the Teaching Staff			
1	Dr. M. V. Hegade	Director CINHD	
2	Dr. P.B. Ghorpade	Emeritus Scientist	
3	Dr. Anand Zanwar	Scientist	
4	Ms. Asavari Joshi	Scientist	
5	Mr. M. L. Panse	Director of Research Lab.	
B) Name of the Non-Teaching Staff			
1	Mr. Yogesh Badhe	Project Assistant	
2	Ms. Sunita Bhise	Project Assistant	
3	Mr. Pramod Farde	Technical Assistant	

I) CINHD Staff:

Sr. No.	Name of the Staff	Designation	Sign
1	Mr. Nainesh Maharnwar	Clerk	

J) Name of the PhD Student:

Sr. No.	Name of the Staff	Designation	Sign
1	Ms. Apoorva Parimoo	Ph.D. Student	
2	Ms. Anjali Jadhav	Ph.D. Student	

3	Ms. Minal Mahajan	Ph.D. Student	
4	Ms. Varsha Ganesh Shetty	Ph.D. Student	
5	Mr. Akib Nisar	Ph.D. Student	
6	Mr. Mayur Aaswani	Ph.D. Student	
7	Mrs. Nidhi Sharma	Ph.D. Student	

S.No	**Year of enrollment**	**Name of the Student**	**Student enrollment number (PRN)**	**Date of enrollment**	**Gender**	**Program admitted to**	**Year and Month of Completion**
1	2015-16	Ms. Minal Mahajan	1502015	01/09/2015	Female	Ph.D.	Ongoing
2	2015-16	Ms. Shital Giramkar	1502012	01/09/2015	Female	Ph.D.	Ongoing
3	2015-16	Ms. Varsha Shetty	1502021	01/09/2015	Female	Ph.D.	Apr-22
4	2015-16	Ms. Vaishali Kasture	1502024	09/09/2015	Female	Ph.D.	Mar-22
5	2016-17	Mr. Amol Chaudhary	1716020162	26/05/2017	Male	Ph.D.	Ongoing
6	2017-18	Mrs. Asavari A. Joshi	1716020163	02/09/2017	Female	Ph.D.	Ongoing
7	2017-18	Ms. Anjali Jadhav	1716020167	02/09/2017	Female	Ph.D.	Ongoing
8	2017-18	Ms. Kinjal Dave	1716020172	02/09/2017	Female	Ph.D.	Ongoing
9	2017-18	Ms. Amrita Ulhe	1716020159	02/09/2017	Female	Ph.D.	Ongoing
10	2017-18	Ms. Apoorva Parimoo	1716020161	02/09/2017	Female	Ph.D.	Ongoing
11	2017-18	Ms. Nidhi Sharma	1716020171	02/09/2017	Female	Ph.D.	Ongoing
12	2017-18	Mr. Kartikey Jagtap	1716020157	02/09/2017	Male	Ph.D.	Ongoing
13	2017-18	Ms. Juhi Nema	1716020166	02/09/2017	Female	Ph.D.	Ongoing
14	2017-18	Ms. Mrunal Gosavi	1716020164	02/09/2017	Female	Ph.D.	ongoing
15	2017-18	Mr. Manoj khavate	1716020158	13/02/2018	Male	Ph.D.	Ongoing
16	2018-19	Ms. Akansha Mahajan	1916020004	16/10/2018	Female	Ph.D.	Ongoing
17	2018-19	Ms. Rama Rajadnya	1916020002	16/10/2018	Female	Ph.D.	Ongoing
18	2018-19	Mr. Mayur Aswani	1916020003	16/10/2018	Male	Ph.D.	Ongoing
19	2018-19	Ms. Prajakta Biradar	1916020005	17/01/2019	Female	Ph.D.	Ongoing

20	2019-20	Ms. Aditi Godhamgaonkar	1916020163	29/11/2019	Female	Ph.D.	Ongoing
21	2019-20	Ms. Anu C	1916020161	29/11/2019	Female	Ph.D.	Ongoing
22	2019-20	Mr. Suraj Bhongale	1916020165	29/11/2019	Male	Ph.D.	Ongoing
23	2019-20	Ms. Sayali Vedpathak	1916020167	29/11/2019	Female	Ph.D.	Ongoing
24	2019-20	Ms. Shweta Chelluboina	1916020166	29/11/2019	Female	Ph.D.	Ongoing
25	2020-21	Mr. Shrikant Thopte	2116020164	17/03/2021	Male	Ph.D.	Ongoing
26	2020-21	Mr. Prashant Dange	2116020165	17/03/2021	Male	Ph.D.	Ongoing
27	2020-21	Ms. Madiwale Shweta	2116020167	17/03/2021	Female	Ph.D.	Ongoing
28	2020-21	Ms. Gauri Ligade	2116020168	17/03/2021	Female	Ph.D.	Ongoing
29	2020-21	Mahesh Ekbote	2116020172	17/03/2021	Male	Ph.D.	Ongoing
30	2020-21	Mr. Mandiwala Ahmedali	2116020159	16/03/2021	Male	Ph.D.	Ongoing
31	2021-22	Ms. Apurva Jadhav	2116020173	30/11/2021	Female	Ph.D.	Ongoing

Institutional Committees

SCIENTIFIC REVIEW COMMITTEE

Name and Designation	Role
Dr. Akhilesh Chandra Mishra Director IRSHA.	Chairperson
Dr. Sadhana Joshi Professor & Head, Department of Nutritional Medicine, IRSHA.	Member
Dr. Vidya Arankelle Senior Scientist, Head, Department of Infectious Diseases, IRSHA.	Member
Prof. Mahabaleshwar Hegde Scientific Advisor, Centre for Innovation in Nutrition Health Disease, IRSHA.	Member
Dr. Supriya Bhalerao Associate Professor, Department Obesity, IRSHA.	Member Secretary

INSTITUTIONAL BIOSAFETY COMMITTEE (IBSC)

Approved by DBT, India

Name and Designation	Role
Dr. Akhilesh Chandra Mishra Director IRSHA.	Chairman
Dr. Debashis Mitra, Scientist G, NCCS, Pune.	DBT nominee
Dr. Harshad Patil Associate Professor, Department of Communicable Disease, IRSHA.	Member Secretary
Dr. Kunal Lahiri, Head of the Department, Department of Microbiology, Bharati Vidyapeeth Medical College and Hospital, Pune.	Outside Expert
Dr. Supriya Bhalerao Associate Professor, IRSHA, Bharati Vidyapeeth University, Pune.	Biosafety Officer
Dr. Vidya Arankelle Senior Scientist, IRSHA, Bharati Vidyapeeth University, Pune.	Internal Experts
Dr. Ruchika Kaul-Ghanekar Associate Professor, IRSHA, Bharati Vidyapeeth University, Pune.	

PURCHASE REVIEW COMMITTEE

Name and Designation	Role
Dr. Akhilesh Chandra Mishra Director IRSHA.	Chairperson
Dr. Sadhana Joshi Professor & Head, Department of Nutritional Medicine, IRSHA.	Member
Mr. Vijaychand Gavade Sub-Accountant, IRSHA.	Member
Dr. Harshad Patil Associate Professor, Department of Communicable Disease, IRSHA.	Member Secretary