RETINAL THICKNESS VARIATION IN PATIENTS WITH GESTATIONAL DIABETES MELLITUS

Thesis

Submitted to

All India Institute of Medical Sciences, Jodhpur

In partial fulfillment of the requirement for the degree of

Doctor of Medicine (MD)

Ophthalmology

June, 2022

AIIMS, Jodhpur **Dr. Shadman Parveen**

All India Institute of Medical Sciences, Jodhpur

DECLARATION

I hereby declare that this project titled "**Retinal thickness variation in patients with Gestational Diabetes Mellitus**" is the bonafide record of my original research. It has not been submitted to any other institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

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CERTIFICATE

This is to certify that the thesis titled "**Retinal thickness variation in patients with Gestational Diabetes Mellitus"** is the bonafide work of **Dr. Shadman Parveen** under my guidance and supervision, in the Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur.

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CERTIFICATE

Certified that the project titled "**Retinal thickness variation in patients with Gestational Diabetes Mellitus"** is the record of research done in this department by **Dr. Shadman Parveen.** She has fulfilled all the necessary conditions for the submission of this research work.

Dr. Kavita R. Bhatnagar
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ACKNOWLEDGEMENT

The completion of this research project would not have been possible without the blessings, guidance and support of my family, friends, seniors and colleagues. With immense pleasure, I would like to begin this acknowledgement by expressing my gratitude to my thesis guide, ***Dr. Kavita R. Bhatnagar*** *ma'am, Professor and Head, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur for her immense support, guidance and constructive criticism; extremely important for the grooming of any post-graduate student.*

I am also indebted to express my gratitude to my co-guides, ***Dr. Pratibha Singh*** *ma'am, Professor and Head, Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, Jodhpur, for her guidance and support throughout, and* ***Dr. Seema Meena*** *ma'am, Assistant Professor, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur, for her encouragement and support.*

I am also thankful to ***Dr Suwarna Suman*** *ma'am, Assistant Professor, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur,* ***Dr. Jyoti Shakrawal Varshney*** *ma'am, Assistant Professor, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur,* ***Dr. Manjari Tandon*** *ma'am, Assistant Professor, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur,* ***Dr Kirti Jaisingh*** *ma'am, Assistant Professor, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur,* ***Dr. Nikhil Agarwal*** *sir, Assistant Professor, Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur, for their valuable guidance throughout.*

Words fall short for expressing my gratitude to my seniors for always being supportive, ***Dr. Priyanka Rathore, Dr. Abhishek Sheemar*** *and* ***Dr. Sujeet Prakash*** *for being more of a friend than a senior;* ***Dr. Aparna M Rao, Dr. Shilpa More, Dr. Monika Samota, Dr. Nishant Parashar*** *and* ***Dr. Achala Ramawat****, Senior residents in the Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur for their guidance.*

This acknowledgement would be incomplete without expressing my gratitude to my seniors especially ***Dr.Anushree Naidu ma'am, Dr. Sonalika Gogia ma'am*** *and* ***Dr. Sulabh Sahu*** *sir and ex-Senior resident* ***Dr. Vaishali Rakheja and Dr Arushi Gupta*** *for guiding me throughout,* ***Dr. Kanchan Solanki****, who helped me throughout right from the protocol preparation to execution of this research project who helped me in the selection of topic and*

protocol preparation.

I am thankful to my co-pg, ***Dr. Sakshi Shiromani*** *and my juniors specially,* ***Dr. Falguni Roy****,* ***Dr. Krati Srivastava****,* ***Dr. Shihail Jinna*** *and* ***Dr. Ronak Asodariya*** *for helping me throughout. I am thankful to all the Optometrists especially* ***Mr. Raghuveer Singh Udawat, Ms. Diksha Katiyar****,* ***Mr. Sampat Ram*** *and* ***Mr. Jitendra Chandel,*** *the nursing staff of Ophthalmology OT and the supporting staff in the department.*

I am thankful to my patients for providing consent for the research project.

This research work would not have been possible without the blessings of my parents ***Mr. Sadre Alam*** *and* ***Mrs. Shahnaz Bano,*** *my brothers* ***Sharique Tanveer*** *and* ***Salman Khursheed,*** *and my friends* ***Dr. Shafaq Bhandari, Dr. Aashim Garg, Dr. Garnepally Lakshmi Prasad, Dr. Sanchari Nandi, Dr. Charan Kollanur*** *and* ***Gaurav Suthar*** *for their tireless support and motivation throughout.*

Last but not the least, I would like to thank ***Dr. Rehana V R ma'am*** *for her constant guidance and support throughout, especially in the data compilation and the statistical analysis of this study.*

I apologize to all those whose name is not mentioned in this acknowledgement. All those who have contributed in this project will always have a special place in my heart.

Dr. Shadman Parveen

LIST OF ABBREVIATIONS

GDM	Gestational Diabetes Mellitus
DR	Diabetic Retinopathy
PDR	Proliferative Diabetic Retinopathy
NDR	No Diabetic Retinopathy
PPDR	Pre-Proliferative Diabetic Retinopathy
DPN	Diabetic Polyneuropathy
OCT	Optical Coherence Tomography
RNFL	Retinal Nerve Fibre Layer
GCL	Ganglion Cell Layer
MT	Macular Thickness
IOP	Intra Ocular Pressure
CCT	Central Corneal Thickness
VA	Visual Acuity
BCVA	Best Corrected Visual Acuity
UDVA	Uncorrected Distance Visual Acuity
RE	Right Eye
LE	Left Eye
HD-OCT	High Definition -Optical Coherence Tomography
SD-OCT	Spectral Domain-Optical Coherence Tomography

DCCT	Diabetes Control and Complications Trial
ADA	American Diabetes Association
DIEP	Diabetes In Early Pregnancy
ROC	Receiver Operator Characteristic
SITA	Swedish Interactive Threshold Algorithm
IQR	Inter Quartile Range
ONH	Optic Nerve Head
VEGF	Vascular Endothelial Growth Factor
ETDRS	Early Treatment Diabetic Retinopathy Study
SFCT	Sub-Foveal Choroidal Thickness
NDGG	National Diabetes Data Group
SIM	Superior Inner Macula
GLV	Global Loss Volume
FLV	Focal Loss Volume
GCC	Ganglion Cell Complex
CSF	Central Foveal Subfield
CPT	Central Point Thickness
CSCR	Central Serous Chorio-Retinopathy
CNVM	Choroidal Neo-Vascular Membrane
SD	Standard Deviation
OGTT	Oral Glucose Tolerance Test

GCT	Glucose Challenge Test
IADPSG	International Association of Diabetes And Pregnancy Study Group
TBUT	Tear film Break-Up Time
MGD	Meibomian Gland Dysfunction
OSSS	Ocular Surface Staining Score
IPL	Inner Plexiform Layer
OPD	Out Patient Department
DM	Diabetes Mellitus
HbA1c	Glycated Haemoglobin
AIIMS	All India Institute of Medical Sciences
SPSS	Statistical Package of Social Sciences

SYNOPSIS

Optical Coherence Tomography (OCT) is a diagnostic technique that is non-invasive and provides an in vivo cross-sectional view of the retina. OCT utilizes a concept of low coherence interferometry to create a cross-sectional map of the retina that is accurate to within at least 10-15 microns. [1] OCT was first introduced in 1991 and has also found many uses outside of ophthalmology, where it has been used to image certain non-transparent tissues. Due to the transparency of the eye (i.e. the retina can be viewed through the pupil), OCT has gained wide popularity as an ophthalmic diagnostic tool. From its inception, OCT images were acquired in a time domain fashion. Time domain systems acquire approximately 400 A-scans per second using 6 radial slices oriented 30 degrees apart. Because the slices are 30 degrees apart, care must be taken to avoid missing pathology between the slices.

Spectral domain technology, on the other hand, scans approximately 20,000-40,000 scans per second. [2] This increased scan rate and number diminishes the likelihood of motion artifact, enhances the resolution and decreases the chance of missing lesions. Whereas most time domain OCTs are accurate to 10-15 microns, newer spectral domain machines may approach 3-micron resolution. They image 6 radial slices whereas spectral domain systems continuously image a 6mm area. This diminishes the chance of inadvertently missing pathology.

Diagnostic criteria for GDM (American Diabetes Association 2015 guidelines)-2 step strategy:

50g GCT (glucose challenge test-non fasting) with blood sugar measurement after 1 hour: if blood sugar levels more than or equal to 140mg/dl. [3,4,]

Proceed to 100g Oral Glucose Tolerance Test (OGTT). GDM is diagnosed when 2 or more blood sugar values meet or exceed: fasting: 95 mg/dl;1 hour:180mg/dl;2 hours:155mg/dl; 3 hours:140mg/dl.

At our institution, in the Department of Obstetrics and Gynaecology, the World Health Organisation (1998) and ADA (2013) guidelines are being followed. It is a single step strategy which recommends 75 grams 2 hours oral glucose tolerance test.

fasting: 95 mg/dl;1 hour:180mg/dl;2 hours:155mg/dl.

Pre-gestational Diabetes-

Pre-gestational diabetes is defined as Type I or Type II DM that existed before conception with a random plasma glucose level more than 200 mg/dl plus classic signs and symptoms such as polydipsia, polyuria and unexplained weight loss or those with a fasting glucose level exceeding 125 mg/dl are considered by the ADA (2013) to have overt diabetes. [5]

The aim of this study is to compare Optical Coherence Tomography based Retinal Nerve Fibre Layer thickness at the Disc and Macula and Ganglion Cell Layer thickness in women with GDM vs healthy pregnant females.

INDEX

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

INTRODUCTION

INTRODUCTION

OCT (optical coherence tomography) is a brand-new form of optical imaging modality. OCT provides high-resolution cross-sectional tomographic imaging of the interior microstructure of materials and biologic systems. The optical backscattering in a cross-sectional plane through the tissue is represented by OCT pictures, which are two-dimensional data sets. Imaging can be performed in situ and in real time. [6] It is a non-invasive diagnostic technique, that provides an in vivo cross-sectional view of the retina. OCT utilizes a concept of low coherence interferometry to create a cross-sectional map of the retina that is accurate to within at least 10-15 microns, that is one to two orders magnitude higher than the conventional ultrasound. [7]

OCT has grown in popularity as an ophthalmic diagnostic and screening technique due to the eye's transparency (the retina can be seen via the pupil). OCT pictures have been collected in the time domain since the beginning. Using six radial slices aligned 30 degrees apart, time domain systems gather roughly 400 A-scans per second. Because the slices are 30 degrees apart, it's important to keep an eye out for missed pathologies in the gaps.

On the other hand, spectral domain technology scans at a rate of 20,000-40,000 scans per second. [2] This higher scan rate and quantity reduces motion artefact, improves resolution, and lowers the risk of missing lesions. Newer spectral domain machines may attain 3-micron resolution, although most time domain OCTs are accurate to 10-15 microns. Spectral domain systems continually image a 6mm area, whereas most time domain OCTs capture six radial slices. This reduces the likelihood of missing pathology by accident.

The development of these newer generations of 3D-OCT with improvement in resolution power, has led to easy accessibility of the RNFL and retinal ganglion complex. [7]

The retinal nerve fibre layer (RNFL) is made up of the retinal ganglion cell axons that converge to form the optic nerve. [8,9]

The nerve fibres lose their medullary sheaths as they pass through the lamina cribrosa sclerae and proceed as simple axis-cylinders through the choroid and retina. Over the retinal surface they are arranged as a radiating plexus. The majority of the fibres are centripetal and are direct continuations of the axis-cylinder processes of the ganglionic layer's cells, but a few are centrifugal and ramify in the inner plexiform and inner nuclear layers, where they

terminate in enlarged extremities. Retinal Nerve Fibre Layer is made up of axons of ganglion cells and approximately 50% of retinal ganglion cells are located within the macula, hence macular imaging is a valuable scanning location for assessment of variation in retinal ganglion cell and RNFL thickness. [10,11] As these cells are transparent, the imaging of retinal ganglion cells is difficult. Histologically ganglion cell and inner plexiform layer (GCL+) is the next best possible layer that can be used to quantify retinal ganglion cells. [12,13]

The RNFL can be measured qualitatively during ophthalmoscopy and RNFL-enhanced photography in the clinical context, as well as statistically utilising a variety of imaging technologies designed for diagnosis and follow-up. On OCT the RNFL thickness map provides an overview on the distribution profile of the RNFL over the optic disc (peripapillary area) and the macular area. The RNFL thickness map and the RNFL thickness deviation map make RNFL faults easier to see. In the RNFL thickness deviation map, RNFL readings below the lower 95 percent normal distribution range in each super-pixel are highlighted and color-coded based on the probability of normality. Outside the lower 95th and 99th centiles, RNFL measurements are coded in yellow and red, respectively. [7]

Pregnancy induces many multiorgan changes, like hemodynamic changes, which include increased blood volume, cardiac output and increased water retention due to decreased plasma osmolality. [14,15]

In pregnancy ocular changes include increased pigmentation in the skin around the eyes, dry eye syndrome, decrease in corneal sensitivity, increase in corneal thickness and increased ocular blood flow. [16,17]

The most common medical disorder co-existing with pregnancy is Diabetes. [18] Diabetes developed during pregnancy increases the likelihood of type II diabetes later in life and leads to mother and child morbidity. Pregnancy is a diabetogenic state because the placenta secretes substances like corticotrophin releasing hormone, placental lactogen, and progesterone. [19]

The retina, as one of the body's most metabolically active organs, is especially vulnerable to substrate imbalance or ischemia. Early on in diabetes, retinal pericytes and microvascular endothelial cells are destroyed. Proliferative diabetic retinopathy is a serious consequence of diabetes that puts our vision at danger. [20]

In women with pregestational type I or II diabetes, pregnancy causes PDR to deteriorate. According to previous research, the prevalence of DR is 57–62 percent at the initial examination in type I DM pregnancy and 17–28 percent in type II DM pregnancy. The Diabetes Control and Complications Trial (DCCT) and Research Group, as well as the Diabetes in Early Pregnancy (DIEP) studies discovered that retinopathy progression in pregnancy ranged from 8% to 70%. [21,22,23]

Gestational Diabetes Mellitus (GDM), is diabetes that is diagnosed for the first time during pregnancy, usually in the second or third trimester, and is not pre-existing type 1 or type 2 diabetes. Globally, the burden of GDM ranges between 2% and 14%. The occurrence of GDM among India's urban population has been estimated to be between 16% to 17.8%. [24,25,26]

The American Diabetes Association (ADA) (2013) defines pre-existing diabetes mellitus as Type I or Type II DM with a random plasma glucose level greater than 200 mg/dl and classic signs and symptoms such as polydipsia, polyuria, and unexplained weight loss, or those with a fasting glucose level greater than 125 mg/dl. [5,27]

Screening for Diabetic retinopathy is important, due to the fact that patient may remain asymptomatic till they develop the farfetched sequelae, such as diabetic macular oedema or severe non proliferative and proliferative diabetic retinopathy.

There are few studies depicting variation in the macular thickness and peripapillary retinal nerve fibre layer thickness occurring in patients with gestational diabetes mellitus, so these can be used as screening test for development of diabetic retinopathy in pregnancy before development of microvascular changes. [28]

The present study will assess any variation in Macular and peripapillary Retinal Nerve Fibre layer thickness, Ganglion cell +Inner Plexiform Layer (GCL+) changes in pregnant women with gestational diabetes mellitus and healthy pregnant women.

AIM & OBJECTIVES

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RESEARCH QUESTION:

Is there any significant difference between the OCT based Macular and Peripapillary Retinal Nerve Fibre layer thickness and GCL+ thickness between pregnant females with gestational diabetes mellitus, when compared to healthy pregnant females.

AIM:

Comparison of Macular and Peripapillary Retinal Nerve Fibre layer thickness, Ganglion cell layer + Inner Plexiform layer thickness, between patients with gestational diabetes mellitus and healthy pregnant females.

OBJECTIVES:

1. Analysis of the changes, in Retinal Nerve Fibre layer thickness in Peripapillary and Macular area, in patients with Gestational Diabetes Mellitus at ≥ 24 weeks of gestation.
2. Analysis of the changes, in Ganglion cell + Inner plexiform layer (GCL+) thickness in Gestational Diabetes Mellitus at ≥ 24weeks of gestation.
3. A comparative analysis of these OCT parameters, with those of healthy pregnant women of ≥ 24 weeks of gestation.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Optical coherence tomography (OCT) is a type of optical imaging modality. OCT provides high-resolution cross-sectional tomographic imaging of interior microstructure in materials and biologic systems. The photos are two-dimensional data sets that depict optical backscattering in a cross-sectional plane across the tissue. In situ and real-time imaging are also possible options. It's a non-invasive diagnostic procedure that gives you a cross-sectional image of our retina in real time. [6]

Figure 1: Optical Coherence Tomography (OCT) Machine (Adapted from: https://visionsource-visionhealthinstitute.com/vision-care-products/advanced-diagnostic-testing/optical-coherence-tomography-oct/)

OCT was originally employed in a clinical setting in 1991, and it has since been employed in domains other than ophthalmology to examine a range of non-transparent tissues.

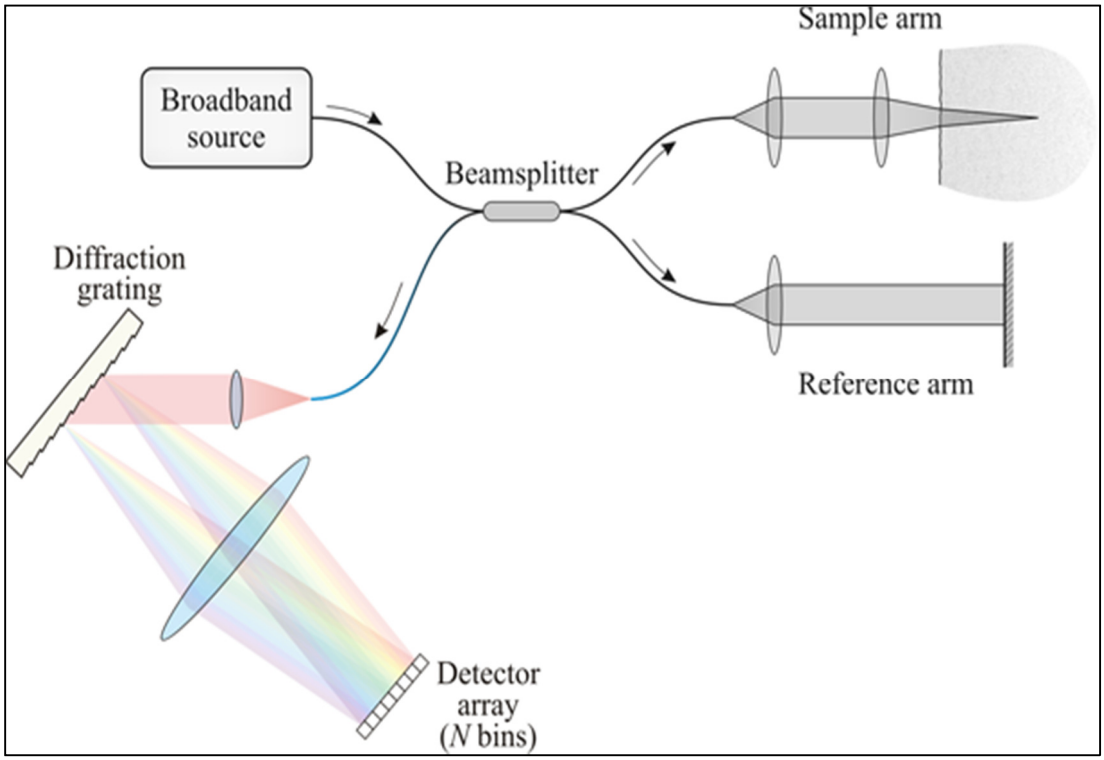

Figure 2: OCT machine principle.

(Adapted from : http://obel.ee.uwa.edu.au/research/fundamentals/introduction-oct/)

As we can view the retina through the pupil, the OCT technique has proved an important diagnostic and screening tool in ophthalmology. In the beginning, OCT images were acquired in a time domain fashion. Using 6 radial slices aligned 30 degrees apart, time domain systems gather roughly 400 A-scans per second. Because the slices are 30 degrees apart, it's important to keep an eye out for missed pathologies between them.

On the other hand, Spectral domain technology scans approximately 20,000-40,000 scans in one second. [2] This enhanced scan rate and frequency reduces motion artefact, improves resolution, and reduces the likelihood of missing lesions. While most time domain OCTs have a resolution of 10-15 microns, newer spectral domain devices may have a resolution of 3-microns. Spectral domain systems continually image a 6mm area, whereas most time domain OCTs image 6 radial slices. This reduces the chances of missing pathology by accident. The development of these newer generations of 3D-OCT with improvement in resolution power, has led to easy accessibility of the RNFL and retinal ganglion complex. [7]

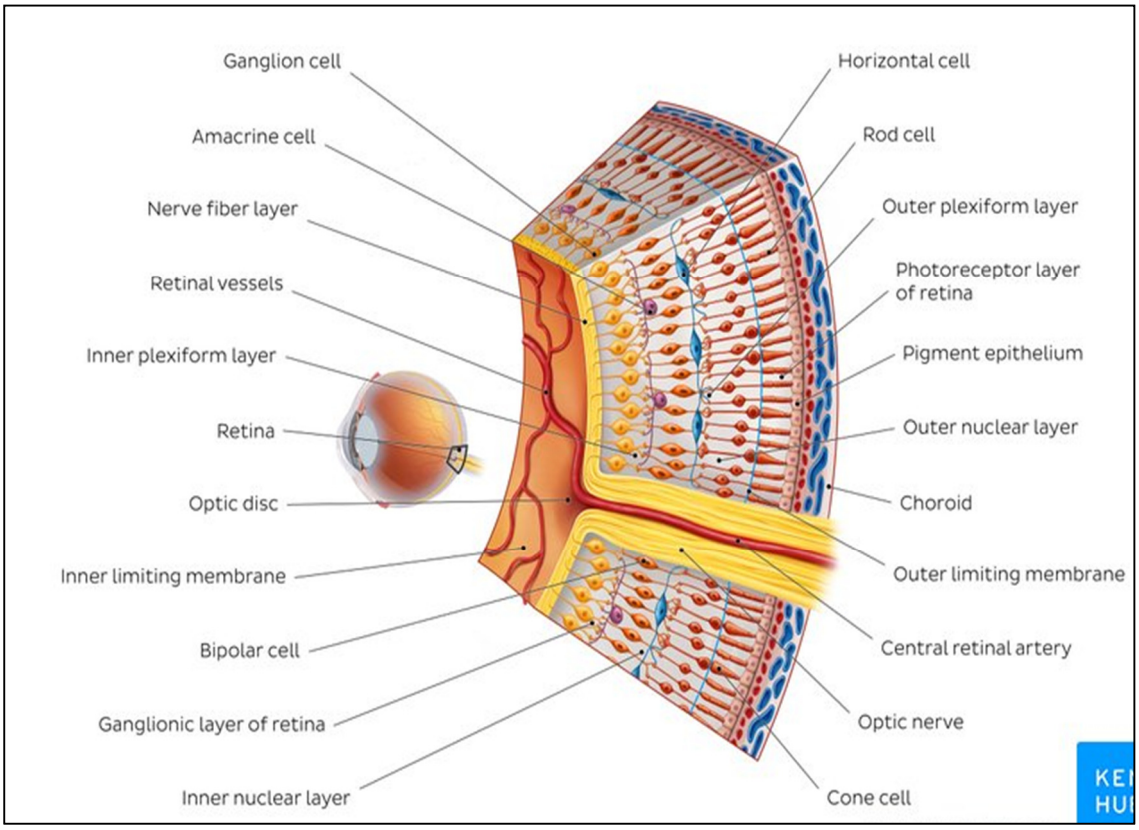

Figure 3: Layers of retina.

(Adapted from : https://www.kenhub.com/en/library/anatomy/photoreceptors)

Figure 3 shows cross-sectional view of the different retinal layers. The retinal nerve fibre layer (RNFL) is basically the axons of the retinal ganglion cell that converge to form the optic nerve which leaves the eye. [8] The nerve fibres shed their medullary sheaths as they travel through the lamina cribrosa of the sclera and are continued as simple axis-cylinders through the choroid and retina.

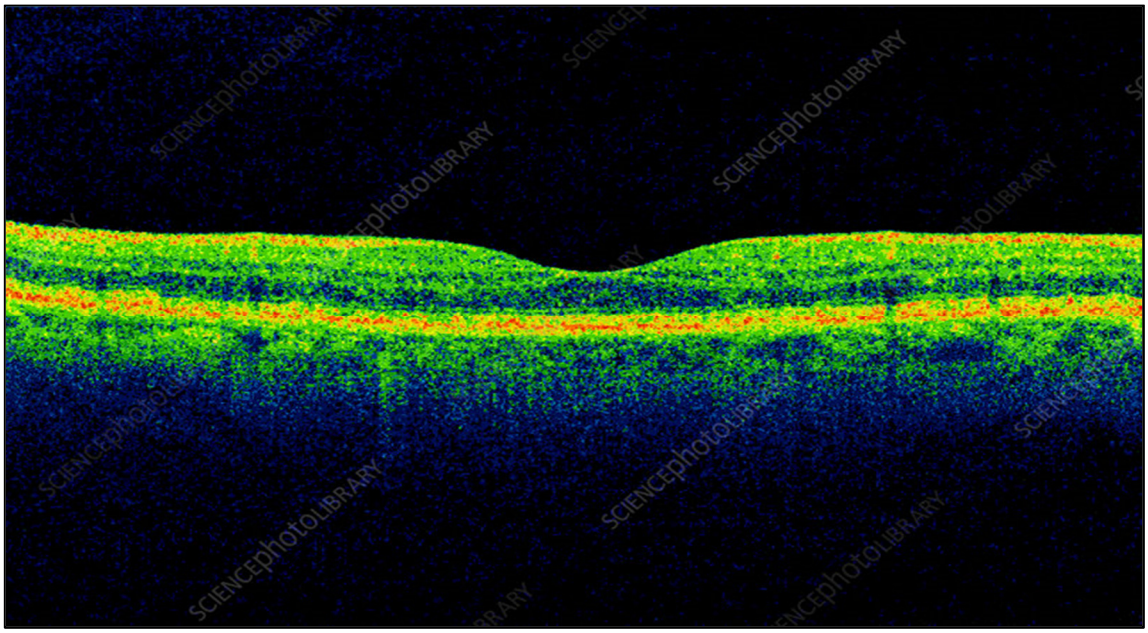

Figure 4: Retinal layers shown on an OCT

(Adapted from : https://www.sciencephoto.com/media/690599/view/normal-retina-oct-scan)

Approximately 50% of retinal ganglion cells are located within the macula, hence macular imaging is a valuable scanning location for assessment of variation in retinal ganglion cell and RNFL thickness. As these cells are transparent, the imaging of retinal ganglion cells is difficult. Histologically ganglion cell and inner plexiform layer (GCL+) is the next best possible layer that can be used to quantify retinal ganglion cells. [12]

Clinically RNFL can be assessed qualitatively during ophthalmoscopy and through RNFL-enhanced photography. Quantitatively RNFL can be assessed using several imaging devices designed for diagnosis and follow up. On OCT the RNFL thickness map provides an overview on the distribution profile of the RNFL over the optic disc (peripapillary area) and the macular area.

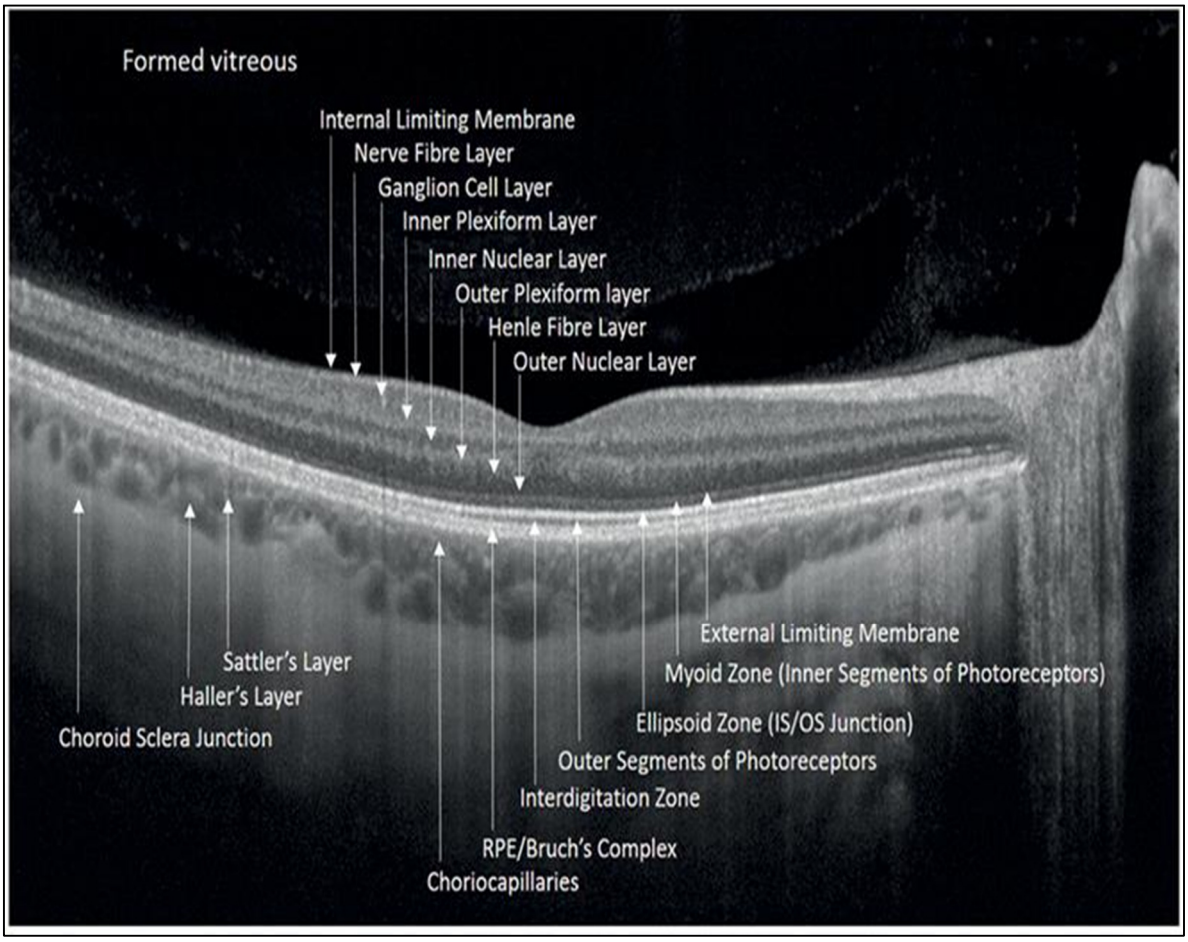

Figure 5: Different layers of retina on OCT.

(Adapted from : https://www.opticianonline.net/cet-archive/153)

The RNFL thickness map and the RNFL thickness deviation map facilitate visualization of RNFL defects. In the RNFL thickness deviation map, RNFL readings below the lower 95 percent normal distribution range in each super-pixel are highlighted and color-coded based on the probability of normality. Outside the lower 95th and 99th centiles, RNFL measurements are coded in yellow and red, respectively. [7]

Pregnancy is an overwhelming experience which induces many multiorgan changes, one of them being changes in retinal thickness which is more pronounced in patients with Gestational Diabetes Mellitus (GDM). [14]

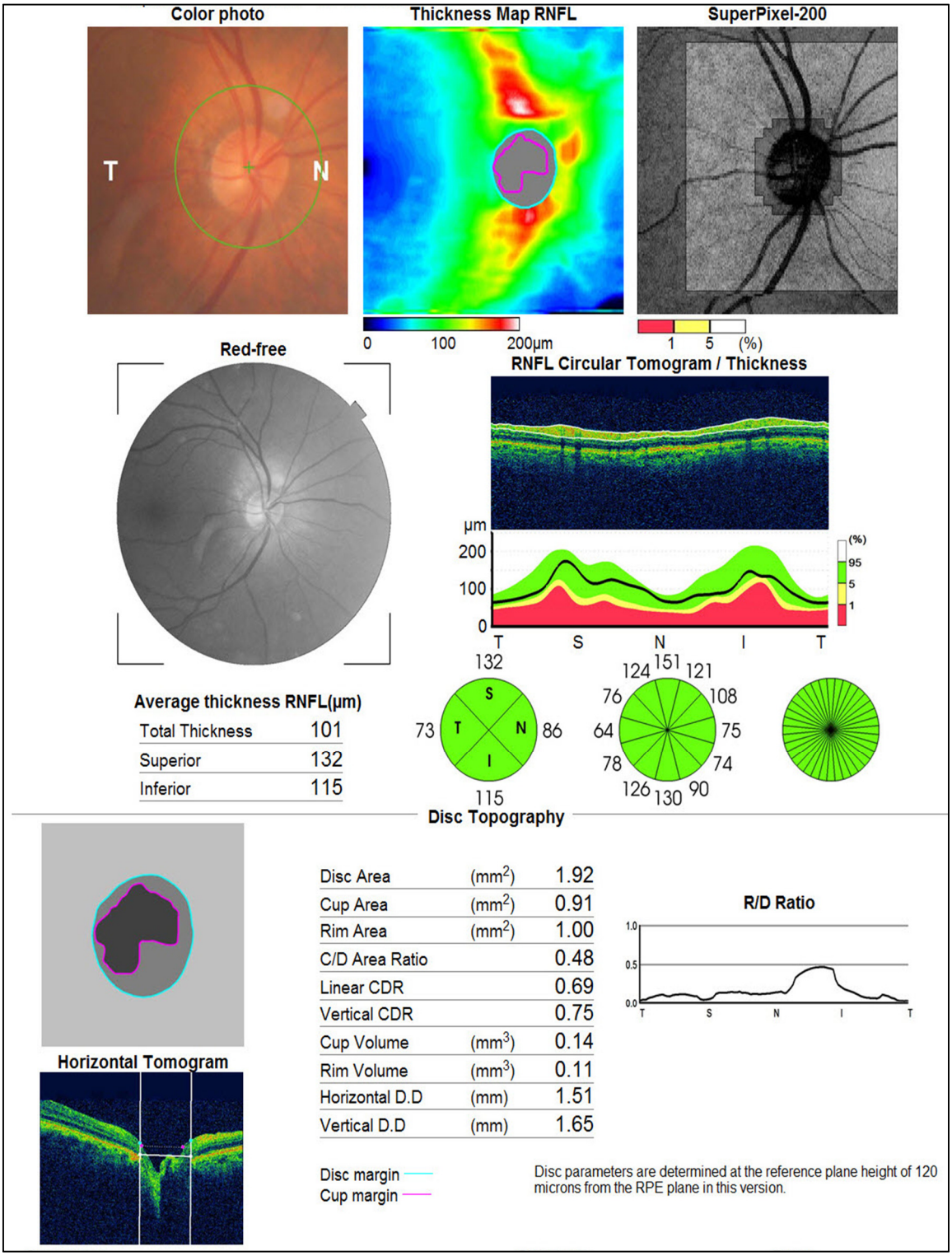

Figure 6: OCT report showing peripapillary RNFL thickness.

(Source: Department Of Opthalmology, AIIMS Jodhpur)

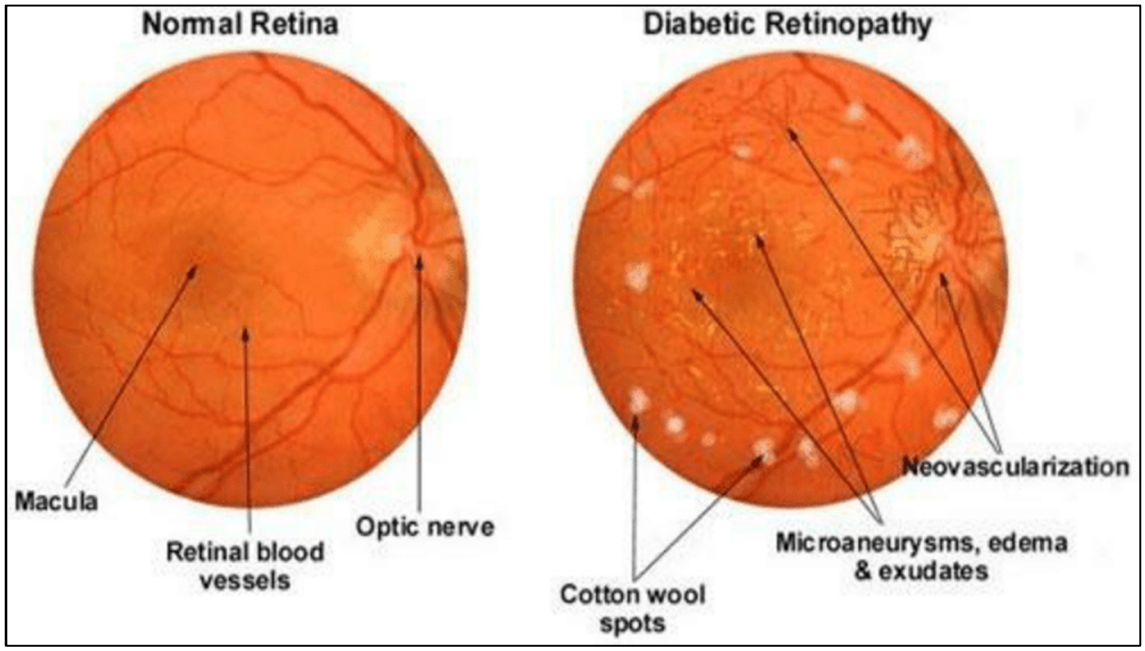

Figure 7: Diabetic Retinopathy changes in the fundus.
(Adapted from: https://www.researchgate.net/figure/Difference-between-Normal-Retina-and-Diabetic-Retinopathy_fig2_282609747)

In pregnancy ocular changes include increased pigmentation in the skin around the eyes, dry eye syndrome, decrease in corneal sensitivity, increase in corneal thickness and increased ocular blood flow. [16,17]

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The present study will assess any variation in Macular and peripapillary Retinal Nerve Fibre layer thickness, Ganglion cell +Inner Plexiform Layer (GCL+) changes in pregnant women with gestational diabetes mellitus and healthy pregnant women.

Thus, screening for diabetic retinopathy becomes crucial in such cases, as the patients with early diabetic retinopathy may be completely asymptomatic, until advanced microvascular changes like, macular edema and/or proliferative diabetic retinopathy (PDR) evolve.

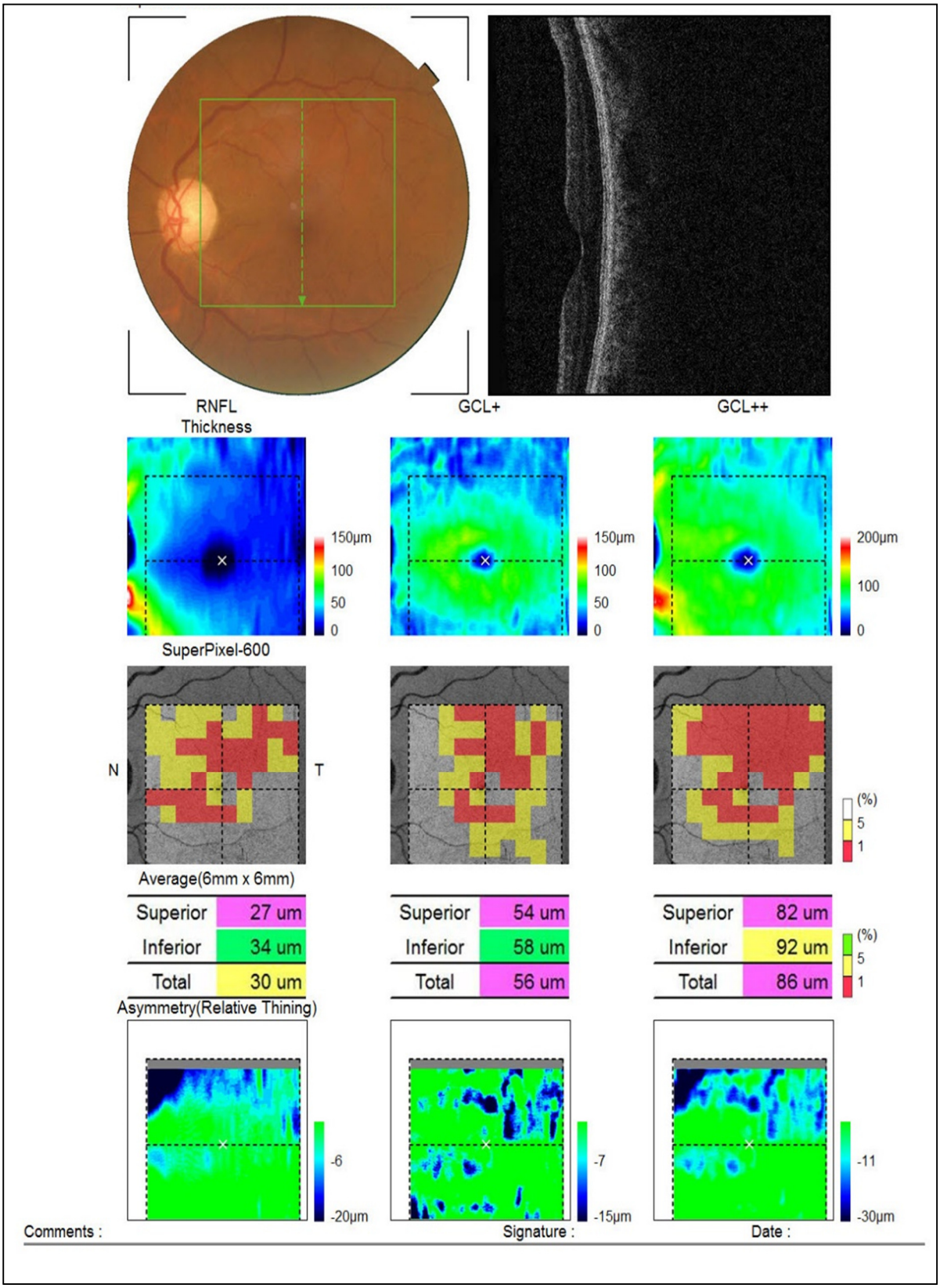


Figure 8: OCT report showing macular, GCL+ and GCL++ thickness.

(Source: Department Of Opthalmology, AIIMS Jodhpur)

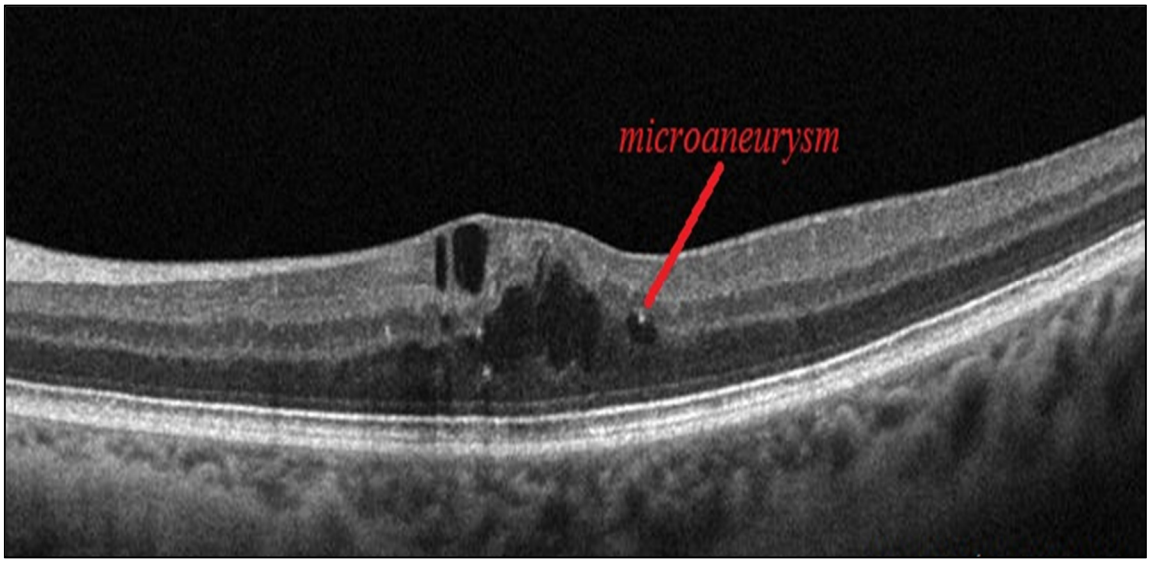


Figure 9: OCT image showing microaneurysm in a patient of diabetic retinopathy.

(Adapted from: https://www.octscans.com/diabetic-retinopathy.html)

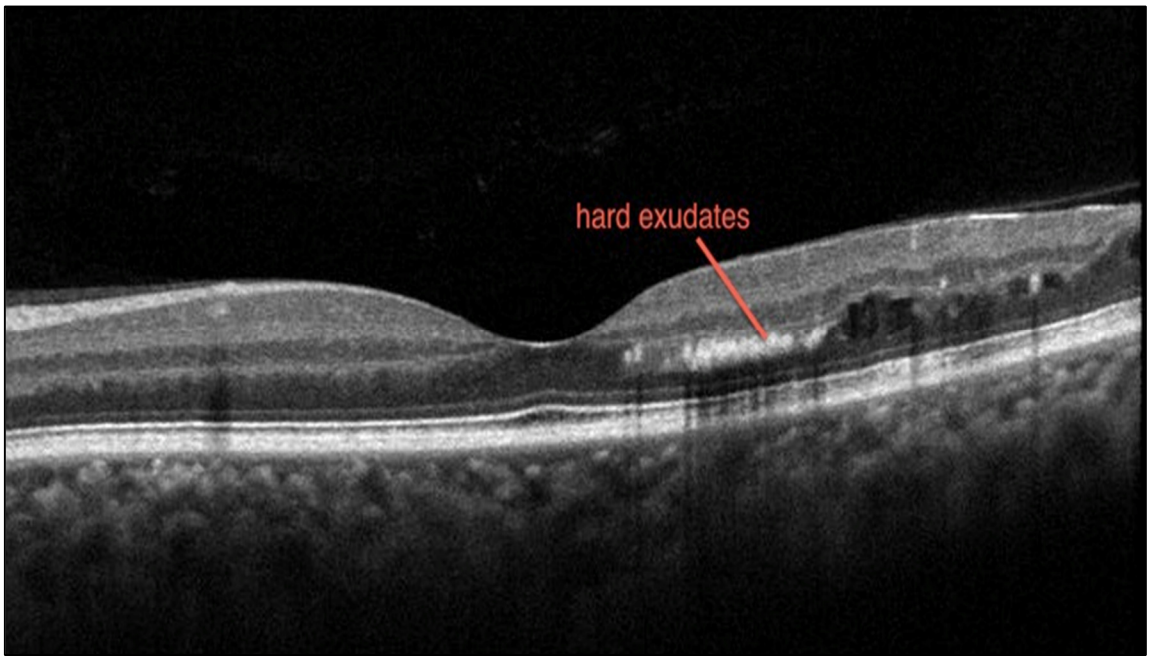


Figure 10: OCT image showing hard exudates in a patient of diabetic retinopathy.

(Adapted from: https://www.octscans.com/diabetic-retinopathy.html)

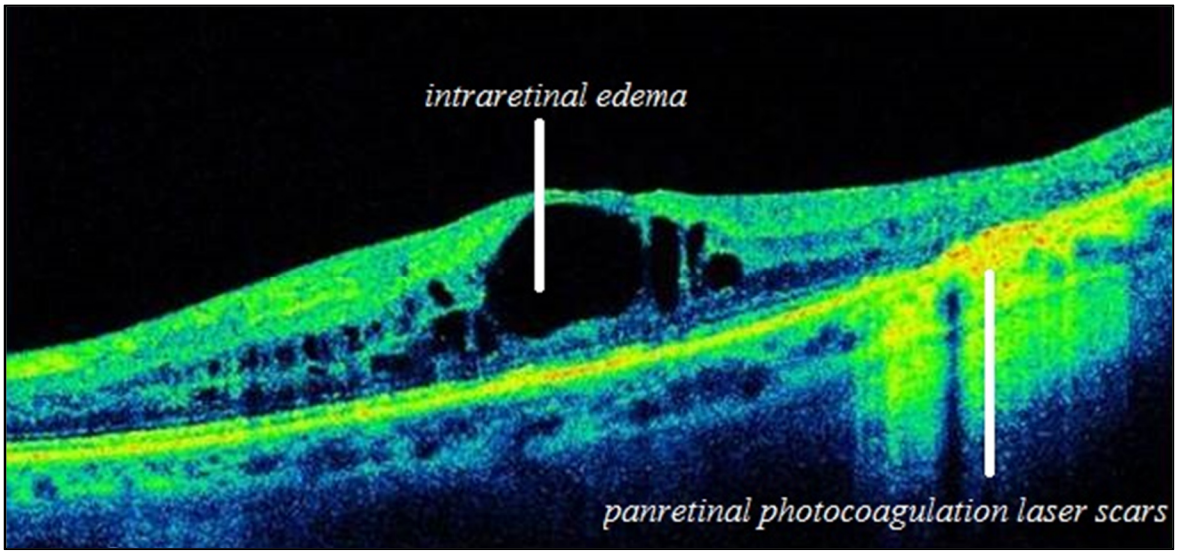


Figure 11: Diabetic macular edema with large intraretinal cysts located in multiple retinal layers. (Adapted from: https://www.octscans.com/diabetic-retinopathy.html)

The various studies conducted are as follows-

1. Sugimoto M et al in 2005 conducted a research employing optical coherence tomography (OCT) to detect early diabetic damage in type 2 diabetes mellitus patients with no diabetic retinopathy (NDR) and to evaluate OCT as a clinical diagnostic tool. A total of 32 patients with NDR (n = 32) were included in the study. OCT was used to assess the thickness of the retina and the retinal nerve fibre layer (RNFL). The retinal thickness (n = 48) and RNFL thickness (n = 34) were measured in two healthy normal populations. Both OCT measurements were taken in four different locations (temporal, superior, nasal and inferior). To evaluate the predictor variables, the receiver operator characteristic (ROC) curve was created. They discovered that in the superior portions, retinal thickness rose (p = 0.03) and RNFL thickness reduced (p = 0.02) when comparing normal and NDR eyes. The superior retinal thickness had a 0.65 area under the ROC curve, while the superior RNFL thickness had a 0.63 area under the ROC curve. Both OCT assessments can detect early retinal degeneration in NDR patients, according to the researchers. [31]

2. T Oshitari et al in the year 2009 used Stratus optical coherence tomography to investigate the early changes in the thicknesses of the macula and retinal nerve fibre layer (RNFL) in diabetic patients. With the help of fundus examination, the macular thickness was measured in 31 normal participants (control; 19 men and 12 women), 45 diabetic patients classified as NDR (25 men and 20 women), and 24 diabetic patients (17 men and 7 women)

with PPDR but without macular oedema. The thickness of the RNFL was measured in 30 control participants (16 men and 14 women), 45 diabetic patients classified as NDR (25 men and 20 women), and 22 diabetic patients classified as PPDR (16 men and 6 women). The mean ages of the control, NDR, and PPDR groups were 60.0±12.8, 61.6±11.2, and 65.6±8.8 years, respectively. The differences in the mean ages were not significant among the three groups. The programs for the fast macular thickness and the fast RNFL thickness measurements were used. Six radial scans of 6 mm length through the fovea are used in the rapid macular thickness protocol. The distance between the vitreoretinal interface and the anterior surface of the retinal pigment epithelium along each A-scan was used to calculate the retinal thickness. Five sectors in the inner rings with a diameter of 3 mm, the centre, superior, nasal, temporal, and inferior sectors, were examined using the retinal map analysis methodology. The average thickness of the central 1 mm diameter ring was used to determine the thickness of the centre sector. The outer sectors with a diameter of 3 to 6 mm were eliminated due to lower measurement reliability than the inside sectors. The fast RNFL thickness protocol consisted of three circular peripapillary scans of 3.4 mm diameter centred on the optic disc. Each scan consisted of 256 measurements along the circumference. The average overall peripapillary thickness and the thickness of the superior and inferior quadrants were analysed. Scans with a signal strength of less than 5, error messages, or poor fixation during the scans were all rejected. Due to scan quality issues, three scans were discarded from the RNFL research. The mean macular thickness in the centre sector of the NDR group was considerably lower than that of the control group. The macular thickness of the centre sector in the PPDR group was substantially thicker than in the NDR group. The coefficient of correlation between the duration of the DM and the macular thickness of the centre sector was significant for both diabetic groups. Thus, the central macula was thicker in eyes with longer duration of DM. In the NDR group, the mean, superior, and inferior RNFL thicknesses were thinner than the corresponding sectors of the control group, but the differences were not significant. In the PPDR group, the mean RNFL and the superior and inferior peripapillary sectors were significantly thinner than the corresponding sectors of the control. The mean RNFL and superior and inferior sectors of the PPDR group were substantially thinner than those of the NDR group. For both the diabetic groups, the coefficient of correlation between the duration of DM and the mean RNFL thickness was low but significant. Thus, the RNFL thickness was thinner in eyes with longer duration of DM. In normal participants, the differences of the macular and RNFL thicknesses between men and women were not significant. In the women with NDR, however, the macular thicknesses of

all areas (centre, superior, nasal, temporal, inferior) were significantly thinner than those of men with NDR. In addition, in women with NDR the nasal and temporal sectors of the macular thickness were significantly thinner than that of the normal women. As a result, the macular thickness of women with NDR is more vulnerable to the effects of diabetes in the early stages than it is in males. In the normal, NDR, and PPDR groups, there were no significant variations in RNFL thickness between men and women. The mean, superior, and inferior RNFL thicknesses of men with PPDR, on the other hand, were substantially thinner than those of normal males. As a result, men's RNFL thickness is more susceptible to the effects of diabetes than women's. The macular and RNFL thicknesses are altered in the early stages of diabetic retinopathy. Men and women have varied macular and RNFL thicknesses. [32]

3. Tarannum Mansoori et al conducted a study to measure RNFL thickness around disc using SD-OCT in normal Indian eyes, for which, he recruited 210 normal subjects. All subjects underwent comprehensive ophthalmic examination, automated perimetry using SITA, Standard 24-2 program with Humphrey visual field analyzer after informed consent. Subjects with best corrected visual acuity of > 20/30, refractive error within ± 3D of sphere and ± 1.5 D of cylinder, intraocular pressure < 21 mm of Hg, clear ocular media, open angles on gonioscopy, healthy optic disc and normal visual field, were designated as having normal eyes. Those with ocular disease or a history of intraocular surgery were excluded from the study. After dilatation, one participant's eye was randomly selected for RNFL scanning using spectral OCT. A circular scan with a 3.4 mm circle diameter was centred around the ONH using an internal fixation target, and the location for optimal scan positioning in relation to the ONH was noted on the SLO image. RNFL parameters evaluated were: average peripapillary RNFL thickness, four quadrants, and eight sectors RNFL thickness. Student's t-test was used to compare RNFL thickness between gender. 110 males (age, 41.27 ± 19.9 years) and 100 females (age, 41.7 ± 16.4 years) were there. The average peripapillary RNFLT was 114.03 ± 9.6 µm (range, 90–139). RNFL thickness was thickest in inferior quadrant, followed by superior quadrant, nasal quadrant, and thinnest in temporal quadrant. Various RNFL metrics collected were examined between males and females but none demonstrated statistical significance. Mean values of superior quadrant and sector, nasal quadrant and sector, superior temporal sector, inferior nasal sector and inferior temporal sector were significantly different across the age groups. They found that age had a statistically significant negative correlation with average RNFL thickness. Except for inferior

quadrant, other quadrants showed statistically significant inverse correlation with age. One eye of each participant underwent RNFL scanning around optic nerve using SD OCT. The average peripapillary RNFL thickness was 114.03 ± 9.59 µm. Gender had no effect on the RNFL thickness parameters. Age had significant negative correlation with average *(p* = 0.005), superior (*p* = 0.04), temporal *(p* = 0.049), and nasal quadrants *(p* = 0.01) RNFL thickness. Inferior quadrant RNFL thickness also had a negative correlation with age, but it was not statistically significant *(p* = 0.15). The results showed significantly higher values of RNFL thickness when compared to White eyes and lower value when compared to RNFL thickness in normal Latino population. The study's limitation was that it was based on cross-sectional data, and it would be ideal to assess RNFL thickness longitudinally across time to determine the effect of ageing on RNFL thickness. Furthermore, the patients' disc sizes were not determined; nonetheless, a recent investigation on Indian eyes found that ONH size had no effect on RNFL thickness. Finally, the work provides a normative database for RNFL thickness in Indian eyes using SD-OCT. When assessing structural changes in glaucoma, age-related and geographical differences in RNFL thicknes should be taken into account. [33]

4. Park HY et al in 2011 conducted a study in 2011 to detect early nerve fibre layer (NFL) changes around the optic disc and macula in diabetic patients using Cirrus HD-optical coherence tomography (OCT). Forty normal patients without any optic nerve or retinal disease, 37 patients with diabetes with no diabetic retinopathy (NDR) and 89 patients with diabetic retinopathy (DR) of differing severity were enrolled. They found that the NFL thickness around the optic disc was measured using Cirrus HD-OCT. The NFL thickness at the macula was also determined by scanning the macula with the optic disc scanning techniques. The NFL thickness around the optic disc differed statistically among all groups and tended to become thinner as the degree of DR progressed. The mean, superior and inferior peripapillary NFL thickness differed among groups. As the severity of DR progressed, the mean, superior, temporal, inferior and nasal macular NFL thickness tended to become thinner. However, only the macular NFL thickness of the superior sector differed significantly among the groups and especially between the control and NDR groups. They concluded that the difference in NFL was first detected in the superior macular region, which differed significantly between the control group and diabetic group without clinical DR. This could be detected simply by modifying the Cirrus HD-OCT scan technique to detect the NFL thickness in the macular area. [34]

5. Camila Zanella Benfica et al in their cross-sectional study divided 144 eyes of 72 pregnant women in the third trimester into four groups. Group 1 included 27 non-diabetic pregnant women (control group); Group 2 included 15 pregnant women with GDM; Group 3 included 16 pregnant women with type 2 diabetes mellitus (type 2 DM); and Group 4 included 14 pregnant women with type 1 diabetes mellitus (type 1 DM) (type 1 DM). Subjects with a history of laser photocoagulation, anti-vascular endothelial growth factor (VEGF) treatment, ocular surgery or any ocular pathology except for DR were excluded. The criteria used for GDM diagnosis was International Association of Diabetes in Pregnancy Study Groups (IADPSG). The glycosylated haemoglobin A1c (HbA1c) of all diabetic patients was analysed. DR grading was performed according to the international severity scale. The diagnosis for each individual was based on the grading of the worse eye per subject. The detailed ophthalmic examination was done which included uncorrected visual acuity, best-corrected visual acuity, applanation tonometry, slit-lamp assisted biomicroscopy, indirect ophthalmoscopy and SD-OCT. CT was measured at ten different locations: at the fovea and every 500 µm from the fovea up to 2,500 µm temporally and up to 2,000 µm nasally. The OCT scans were performed in 54 eyes of 27 healthy pregnant women, 30 eyes of 15 pregnant women with GDM, 32 eyes of 16 pregnant women with type 2 DM and 28 eyes of 14 pregnant women with type 1 DM. No significant difference was found with age, ethnicity and gestational age between groups. HbA1c values were significantly higher in patients with type 1 DM (7.4% ± 1.2%) compared with GDM patients (5.7% ± 0.8%) (*p*=0.06). Two patients from group 2 and six patients from group 3 had chronic hypertension diagnosis (*p*=0.001), requiring adjustment in CT analysis. Of the 14 subjects with type 1 DM, 6 (42.9%) were diagnosed with DR. In comparison, only one patient (6.3%) with type 2 DM was diagnosed with moderate nonproliferative retinopathy (*p*=0.031). On OCT, none of the DR individuals showed retinal edoema, and they were all treatment-naive at the time of the exam. When the 10 CT measures of the four groups were compared, the choroid in individuals with type 1 DM was always thinner, even when hypertension was taken into account. Nondiabetic, GDM, and type 2 DM groups showed no significant differences. Macular thickness was significantly higher in pregnant women with GDM from macular points T5 to T1 than in pregnant women with type 1 DM. Macular thickness was considerably higher in pregnant women with type 2 DM compared to pregnant women with type 1 DM in the subfoveal assessment. There were no statistically significant differences in nasal to fovea measurements between the groups. They assessed only the groups with diabetic patients, adjusting also for HbA1c levels, the choroid was thinner in patients with

type 1 DM in comparison with patients with GDM or type 2 DM. CT measurements in T5, T3, T2, T1 and SF macular points were significantly thinner in patients with type 1 DM in comparison with patients with GDM and type 2 DM. The choroid in T4 and N1 macular points, however, was significantly thinner in patients with type 1 DM only in comparison with patients with DMG. They also did an analysis exclusively between the type 1 DM and type 2 DM groups in order to examine CT while controlling for the period of DM diagnosis and the presence of DR. At all macular stages, CT of patients with type 1 DM remained thinner than CT of patients with type 2 DM, although statistical significance was found only in T4, T3, T2, T1 and SF points. During the third trimester, the study found no statistically significant difference in CT between non-diabetic pregnant women, pregnant women with GDM, and pregnant women with type 2 DM. On sub-foveal and temporal to the fovea analysis, pregnant women with type 1 DM had considerably thinner CT readings. [35]

6. Acmaz G et al conducted a prospective cross-sectional study in 2015. Three groups participated in the research. The first group included 36 singleton-pregnant women who were diagnosed with GDM according to the NDDG Criteria after 24 weeks of pregnancy, had no physical condition other than diabetes, and had not received any medication (such as insulin) prior to the study. After 24 weeks of pregnancy, the second group consisted of 24 healthy singleton-pregnant women. The third group consisted of 38 healthy reproductive-age women who were not pregnant. All types of hypertension, renal disease, vascular disease, arteritis, and auto-immune disease, multiple pregnancies, and anyone on medication were excluded from all groups. Women with glaucoma, cystoid macular edema, macular degeneration, optic atrophy, intraocular pressure higher than 21 mmHg, cataract, best corrected visual acuity poorer than 20/30, high spherical (3) or cylindrical (2) diopters refractive errors, or uveitis were also excluded. After a thorough ophthalmologic examination, a Spectralis OCT device was utilised to evaluate the patient without pupillary dilation and in the same dim room lighting. The SD-OCT tests used in the study were all completed by the same expert (MA). Each of the 9 subfields established by the Early Treatment Diabetic Retinopathy Study (ETDRS) group was displayed using the macular map analysis procedure. The central foveal subfield (CSF) thickness was calculated as the average of all locations inside a 1-mm radius inner circle. The central point thickness (CPT), which was defined as an average of 6 radial scans at the foveola, was recorded for each of the individuals. The peripapillary RNFL thickness parameters that were automatically calculated by the SD-OCT and divided into regions: temporal quadrant, temporal superior quadrant, nasal superior quadrant, nasal

quadrant, nasal inferior quadrant, temporal inferior quadrant, and average thickness. Non centered and low-quality scans were excluded from the study. Spectralis optical coherence tomography (OCT) was used for the assessment. Macular, choroid, and retinal nerve fibre layer (RNFL) thicknesses were evaluated in patients with GDM and comparisons were made among pregnant women with GDM, healthy pregnant women, and healthy non-pregnant women for these parameters. Mean age of the healthy non-pregnant group was 31.87±7.76, mean age of healthy pregnant group was 27.72±5.12 and mean age of GDM group was 32.51±4.88. GDM group was significantly older than healthy pregnant group Macular central subfield and foveal center thickness were significantly thinner and choroidal thickness was significantly thicker in the healthy pregnant and GDM groups (p <0.001). However, there was no significant difference between the GDM group and the healthy pregnant group. The nasal part of the RNFL was significantly thinner in the GDM group than the healthy pregnant group. None of the patients had retinopathy at the time of examination. The decreased nasal part of RNFL thickness may be the first retinal change in patients with GDM. The study suggested that OCT should be performed for patients with GDM for detection of early retinal changes associated with GDM. They concluded that decreased nasal part of RNFL thickness may be the first retinal change in patients with GDM and OCT should be performed for the patients with GDM for detection of early retinal changes associated with GDM. [21]

7. LauraSalvi et al conducted a study in 2015 to compare optical coherence tomography (OCT)-derived neuro-retinal parameters in patients with type 2 diabetes and non-diabetic controls and to evaluate their correlation with diabetic retinopathy (DR) and polyneuropathy (DPN). One-hundred consecutive patients with type 2 diabetes were examined by spectral–domain (SD) OCT for evaluating ganglion cell complex (GCC) and retinal nerve fibre layer (RNFL) thickness and two new pattern-based quantitative measures of GCC damage, global and focal loss volume (GLV and FLV). Fifty-six and age-matched non-diabetic subjects served as control. They found that RNFL thickness (101.0 ± 10.6 vs. 106.4 ± 10.3 μm, p = 0.003) was significantly lower and GLV (6.58 ± 4.98 vs. 4.52 ± 3.10 %, p = 0.008) and FLV (1.90 ± 1.97 vs. 0.89 ± 0.84 %, p < 0.0001) were significantly higher in diabetic versus control subjects. The OCT parameters did not differ significantly according to DR grade. Conversely, RNFL thickness was lower and GLV and FLV were higher in patients with versus those without DPN, and the extent of changes increased significantly with quartiles of DPN score. At both bivariate and multivariate analysis, OCT parameters, especially FLV, correlated significantly with DPN measures. They concluded that the GCC is significantly

affected in patients with type 2 diabetes and SD-OCT might represent a useful tool to detect DPN, but not DR in these individuals. [36]

8. Amir Tengku-Fatishah et al conducted a prospective cross-sectional study from December 2016 to June 2018. They included 220 eyes from 78 pregnant women with GDM (78 eyes), 72 healthy pregnant women (72 eyes), and 70 healthy non-pregnant women (70 eyes) in this study. All participants were 20–45 years old. Inclusion criteria for pregnant women with GDM included confirmed diagnosis of GDM based on the following: (i) 75-gram oral glucose tolerance test (OGTT) with the cut-off value for fasting glucose concentration at ≥5.1 mmol/l, (ii) and/or the 2-hour postprandial level at ≥7.8 mmol/l. The lack of pre-existing medical ailment was one of the inclusion criteria for both pregnant and non-pregnant women. Patients with a history of ocular trauma or any intraocular surgery, including refractive surgery, refractive error greater than ± 4.0 D, axial length greater than 22–25mm, and best-corrected visual acuity worse than 6/12 (20/40) were excluded from the study. The study included pregnant women with GDM and healthy pregnant women with a singleton pregnancy and gestational weeks in the third trimester who visited the Obstetrics or Ophthalmology Clinics. The non-pregnant participants were recruited among institution's female personnel who were of reproductive age. data included age, duration of GDM, type of treatment, family history and previous history of GDM were recorded. Macular and RNFL thickness was measured with spectral-domain optical coherence tomography (OCT), Cirrus HD OCT (Carl Zeiss Meditec, USA). Mean macular image was captured based on the macular map protocol, using Early Treatment Diabetic Retinopathy Study circles of 1mm (central fovea), 3mm (inner macula), and 6mm (outer macula). The peripapillary RNFL region was divided into four quadrants: superior, inferior, nasal, and temporal. Analysis was performed on the right eye. Images with signal strength >5 were analyzed. The thickness measurement was only taken once during the third trimester. All individuals had good vision, with an acuity of at least 6/9 (20/30) or better. During the evaluation, none of the individuals had clinical diabetic retinopathy or retinal oedema. In pregnant women with GDM, the mean macular and RNFL thickness appeared to be comparable to that of healthy pregnant women and healthy non-pregnant women. In pregnant women with GDM, age, HbA1c, duration of diabetes, therapy received, history of GDM, and spherical equivalent had no effect on mean macular and retinal thickness. [37]

9. Dondu Melek Ulusoy et al conducted a prospective comparative study which was conducted in the Departments of Obstetrics, Gynecology, and Ophthalmology at Kayseri Education and Research Hospital. All participants received both oral and written information about the study, and each participant provided written informed consent. The study group included 29 healthy pregnant women in their third trimester, the control group included 36 healthy non-pregnant women of reproductive age. Prior history of significant ocular disease, a refractive error of less than -2 diopters (D) or more than +2 D, a best corrected visual acuity (BCVA) worse than 20/20, amblyopia, IOP readings greater than 21 mm Hg, glaucoma, history of uveitis, retinal disease, ocular trauma or tumour, poor image quality, and dense media opacities were all exclusion criteria for this study. A history of systemic disease, such as hypertension or diabetes mellitus, as well as the development of problems in pregnant women, such as gestational diabetes mellitus, preeclampsia, and pregnancy-induced hypertension, were also exclusion factors. A Snellen BCVA, biomicroscopy, IOP assessed by Goldmann applanation tonometry, and dilated fundus examination were all performed on all subjects in both groups. The third-generation Spectralis OCT equipment (software version 5.6.3.0; Spectralis OCT, Heidelberg Engineering, Dossenheim, Germany) was employed for assessment after this thorough ophthalmologic examination. Mean SFCT measurements differed with statistical significance between the pregnant women of the study group and control group (p=0.000). However, the mean foveal and parafoveal macular thickness values did not differ with any statistical significance between the pregnant women of the study group and control group (p>0.05). There was also a statistically significant difference in the mean SFCT values between those taken during pregnancy and those taken 3mo after delivery (p=0.000). There was, however, no significant difference in the mean foveal and parafoveal macular thickness measured during pregnancy and those measured 3mo after delivery (p>0.05). The SFCT value was not significantly associated with AL, IOP, MABP, OPP, BCVA or age in either the study or control group. SFCT was also not significantly associated with gestational age during pregnancy. [38]

10. Morteza Entezari et al conducted a study in 2018 where they used RNFL measurements in pregnant women before and after delivery to assess pregnancy-induced oedema in the retina. The study was conducted between April 2013 and March 2015 at the Department of Obstetrics and Gynaecology at Imam Hossein Medical Center connected with Shahid Beheshti University of Medical Sciences in Tehran, Iran, in collaboration with the Department of Ophthalmology. 32 pregnant women with a gestational age of 28 weeks or

more were compared during pregnancy and the postpartum period in a prospective cohort study. From April 2013 to July 2015, 43 out of 157 pregnant women (16 to 38 years old) with a gestational age of 28 weeks or more and a maximum of 48 hours postpartum who were referred to the Obstetrics and Gynecology Department were found to be in good health. Gestational age was based on the precise data of the last menstrual period and/or ultrasound gestational age measurement in the first trimester. Potential participants were clinically examined and excluded in case of history of any medical or obstetrical problems, taking any medication or prediagnosed with hypertension, diabetes or other systemic disease and lack of informed consent and/or authorisation form to the processing of personal data. Finally, demographic data collection form was completed for each participant The RNFL thickness was measured by Optical Coherence Tomography (OCT). After delivery, all studied women were called at least three times for the second OCT analysis. Above mentioned assessment was repeated, once again during 2 to 8 months in postpartum period. Two months' time period was selected due to complete regression of pregnancy-induced changes. All measurements were carried out by the same professional. RNFL thickness as main outcome was compared during pregnancy and 2-8 months after delivery. The study revealed an increase in RNFL thickness in late pregnancy, with regression to normal range, 2-8 months after delivery. In common medical diseases during pregnancy, such as diabetes and chronic hypertension with decreased RNFL thickness before pregnancy, these two contra-effects should be considered. More prospective studies should be conducted to investigate final effect of increased RNFL thickness in pregnancy of hypertensive and diabetic women in comparison to normal pregnancy. They found that the mean RNFL thickness was significantly more during pregnancy in comparison with the postpartum period, 107±9 µm versus 103±9 µm (p=0.013). They concluded that RNFL thickness in diabetes and chronic hypertension or other chronic diseases might be misdiagnosed in pregnancy due to pregnancy induced increased thickness. [20]

11. Keerti Mundey et al conducted a study on the assessment of Foveal and Parafoveal Retinal Thickness in Healthy Pregnant Rural North Indian Women. 60 healthy pregnant women (60 eyes) and 20 healthy non-pregnant women (20 eyes) who were taken as a control group, were included in the study. Group 1 consisted of 20 healthy eyes from 20 pregnant women in the first trimester; Group 2 consisted of 20 healthy eyes from 20 pregnant women in the second trimester; Group 3 consisted of 20 healthy eyes from 20 pregnant women in the third trimester; and Group 4 (control group) consisted of 20 healthy eyes from 20 non-

pregnant women in the fourth trimester. All of the participants were recruited from a single medical college in a rural area of north India. The study followed the principles of the Declaration of Helsinki for human subjects research. The study protocol was approved by the Institutional Ethics Committee and informed consent from all the participants was taken. All healthy pregnant rural women were recruited from the Department of Gynaecology and Obstetrics and healthy rural non-pregnant patients were selected from women reporting to Department of Ophthalmology for minor anterior segment ailments such as chalazion, mild allergic conjunctivitis, blepharitis and meibomitis. Inclusion criteria: The study group included healthy pregnant women in first, second and third trimester between 18 to 30 years of age while the control group included healthy non-pregnant women in a comparable age group. Common inclusion criteria for all groups included best corrected visual acuity (BCVA) 20/20 (Snellen). Exclusion Criteria: Women with refractive errors higher than - 0.50 or ± 0.50, having systemic diseases such as diabetes mellitus and hypertension, ocular diseases such as glaucoma, uveitis, retinopathy, amblyopia or history of laser therapy and trauma or intraocular surgical intervention. This study included 60 healthy pregnant women (60 eyes) and 20 healthy non-pregnant women (20 eyes) who served as a control group. Group 1 consisted of 20 eyes of 20 healthy women in the first trimester; Group 2 consisted of 20 eyes of 20 healthy women in the second trimester; Group 3 consisted of 20 eyes of 20 healthy women in the third trimester; and Group 4 (control group) consisted of 20 eyes of 20 healthy non-pregnant women. The age group of all participants was in a defined, narrow band of 18-30 years. A statistically significant difference for foveal thickness was found among the Group 1–3 ($p< 0.001$) and Group 3-4 ($p< 0.0001$). A statistically significant difference in the parafoveal region was found only in superior inner macula (SIM) region between Groups 2-3 ($p< 0.03$), 3-4 ($p< 0.01$). They found that pregnancy affects the retinal thickness, especially in the third trimester. Normative data on the changes in the retina in healthy pregnant women will be valuable in differentiating early pathological changes and may have prognostic and diagnostic significance in various conditions such as pregnancy induced hypertension, preeclampsia, gestational diabetes and pre-existing diabetes mellitus with pregnancy. They found that more population-based studies on pregnant women are needed to establish a normative database of retinal thickness with each commercially available OCT machine as data is not interchangeable between different OCT machines. [39]

12. Mehmet Demir et al investigated the thickness of the retinal nerve fibre layer and ganglion cell complex in patients with type 2 diabetes mellitus. 246 eyes of 123 patients were

evaluated prospectively. Inclusion criteria for diabetic patients were type 2 DM. Group 1 (n = 33) included patients who had no DR, Group2 included 30patients who had mild NPDR(n=30patients) and Group 3 (n = 30) included patients who had moderate NPDR. The control Group 4, included 30 healthy patients who had no systemic or ophthalmologic problems. All patients in the control group were evaluated for undiagnosed DM. All participants evaluated by retinal specialists through indirect fundoscopy, slit-lamp stereo biomicroscopy and fundus fluorescein angiography. Mild NPDR was defined as microaneurysms only, moderate NPDR was defined more than just microaneurysms, but less than severe NPDR by international clinical DR disease severity scale. Exclusion criteria were refractive error (spheric Equivalent) >±3.00D, visual acuity below 0.1 logarithm of the minimum angle of resolution, had significant media opacity, a history of glaucoma, uveitis, retinal disease, grade of DR >moderate DR and history of intraocular surgery in the last 6 months. All subjects underwent pupillary dilation (Tropicamide 1%, Alcon Lab, Inc., USA) and an ophthalmologic examination, including slit-lamp biomicroscopy (SL, Tokyo, Japan) with a +78D handheld lens and OCT. Fundus fluorescein angiography (Kowa VX-10i, Kowa Company, Ltd., Tokyo, Japan) was performed in diabetic patients for excluded severe or proliferative retinopathy. The mean glycosylated hemoglobin (HbA1c) was calculated from all available HbA1c measurements in the last 6 months preceding the study visit in the diabetic patients. RNFL and GCC thickness were measured using spectral domain OCT (RTVue-100, Optovue Inc., Fremont, CA, USA). One hundred and twenty-three patients (246 eyes) were analysed. HbA1c level significantly higher in the patients with DM compared to the controls. The ratio of HbA1c was similar in diabetic patients. GCC and RNFL were thinner in patients with DM compared to control but this difference was not statistically significant. They found that the RNFL and GCC thickness were thinner in patients with type 2 diabetes than controls, but this thinning was not statistically significant. [40]

13. Minu Sasikumar et al in 2018 used OCT measures to estimate RNFL thickness in women with gestational diabetes mellitus. Patients attending the Obstetrics and Gynecology OPD at Jubilee Mission Medical College were studied in a prospective observational study. The study involved two groups of women aged 18 to 40 years old who were 32 to 34 weeks pregnant. Group 1: Pregnant women who are in good health. Group 2: GDM-affected pregnant women. Peripapillary RNFL is quantified in superior, inferior, nasal, and temporal domains using CIRRUS HD OCT. 2 stage technique for GDM diagnosis (American Diabetes

Association 2015 guidelines): If blood sugar levels are more than or equivalent to 140mg/dl after a 50g glucose challenge test (non-fasting) with blood sugar measurement after 1 hour, proceed to the 100g Oral Glucose Tolerance Test (OGTT). When two or more blood sugar levels reach or exceed: fasting: 95 mg/dl; 1 hour: 180 mg/dl; 2 hour: 155 mg/dl; 3 hour: 140 mg/dl, GDM was diagnosed. Data was taken from 182 patients, who were divided into two groups based on their pregnancy status: 94 healthy pregnant women and 88 pregnant women with gestational diabetes mellitus. In both healthy pregnant women and GDM patients, all four quadrants of the peripapillary RNFL were thinned, with substantial thinning in all except the temporal and inferior quadrants, which exhibited greatest thickness and the temporal quadrant, which showed minimal thickness. The maximum thickness measured in healthy pregnant women was 131.4159.05m, while in GDM patients it was 118.8518.24m. The superior and temporal RNFL quadrants, as well as fasting GTT values, revealed a strong positive connection with mean RNFL thickness. Peripapillary RNFL thinning in GDM patients observed in their third trimester suggests a neurodegenerative process prior to microvascular alterations in gestational diabetes mellitus, according to the researchers. The degree of retinal thinning in the macula was connected to the patients' glycaemic state. As a result, all GDM patients must have a routine retinal evaluation using OCT to detect early neurodegenerative changes and to keep blood glucose levels in the normal range to prevent diabetic retinopathy. [41]

The aim of this study is to determine, if the OCT parameters being assessed, can prove to be potential screening tools, to recognise early changes of diabetic retinopathy, by comparing Retinal Nerve Fibre layer thickness in macular and peripapillary region and Ganglion cell layer + Inner Plexiform layer thickness between patients with gestational diabetes mellitus and healthy pregnant females.

MATERIALS & METHODS

MATERIALS AND METHODS

STUDY SITE:

Study was conducted in the Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur

TYPE OF STUDY:

Analytical cross-sectional study.

INCLUSION CRITERIA:

1. Pregnant women with gestational age of 24 weeks or more, diagnosed with gestational diabetes mellitus.
2. Healthy pregnant women with gestational age of 24 weeks or more.

EXCLUSION CRITERIA:

1. Women not giving consent for inclusion in the study.
2. Pregnant women with gestational age less than 24 weeks.
3. Women with known diabetes before pregnancy.
4. Any co-existing systemic illness like hypertension, auto-immune diseases, vascular disease or renal diseases.
5. Any pre-existing retinal disease like optic disc coloboma, optic disc pit maculopathy, glaucoma, CSCR, macular hole, CNVM that may affect the OCT parameters being evaluated.

SAMPLE SIZE

With reference to the study conducted by Minu Sasikumar et al: **"RNFL variation in gestational diabetes mellitus: An optical coherence tomography based study"**, 2018, they have reported the Peripapillary RNFL in GDM group as 91.16±13.25 and in control group as 100.75±41.55. Considering this, we estimate a sample size of 162 in each group i.e. 324 patients at 95% confidence interval and 80% power.

This is a comparison of two means from 2 different samples.

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 \ X \ 2{S_p}^2}{d^2}$$

Where, pooled standard deviation, ${S_p}^2 = \frac{\sigma 1^2 + \sigma 2^2}{2}$

difference of mean, $d = \mu_1 - \mu_2$

$Z_{(1-\alpha/2)} = 1.96$ at 5% level of significance.

$Z_{(1-\beta)} = 0.842$ at $\beta = 20\%$ (80% power)

$\sigma_1 = 13.25$

$\sigma_2 = 41.55$

$\mu_1 = 91.16$

$\mu_2 = 100.75$

METHODOLOGY

The study was an analytical cross-sectional study conducted at the Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur in collaboration with the Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, Jodhpur. Data collection was started on January 6, 2020. Patients were recruited till the sample size was met (last patient was recruited on June 21, 2021.)

During this time frame, the pregnant females diagnosed with Gestational Diabetes Mellitus (GDM) in the Department of Obstetrics and Gynaecology, were advised to visit the Department of Ophthalmology.

Diagnostic criteria for GDM (American Diabetes Association 2015 guidelines)- Two step strategy:

50g glucose challenge test-non fasting, with measurement of blood sugar after 1 hour: if levels more than or equal to 140mg/dl

We then proceeded to 100g Oral Glucose Tolerance Test. We diagnosed patients as GDM when 2 or more blood sugar values meet or exceed:

Fasting blood sugar: 95 mg/dl; 1-hour blood sugar:180mg/dl; 2 hours blood sugar:155mg/dl; 3 hours blood sugar:140mg/dl.

At our institution, in the Department of Obstetrics and Gynaecology, the International Association of Diabetes and Pregnancy Study Group (IADPSG) criteria was followed. In the fasting state an OGTT was done, using 75 g of glucose at 24-28 weeks and if any one of the following cut-offs was met GDM was diagnosed i.e.

a. Fasting ≥ 92 mg/dl (≥ 5.2 mmol/l) or

b. Blood glucose ≥ 180 mg/dl (≥ 10 mmol/l) at 1-hour or

c. Blood glucose ≥ 153mg/dl (≥ 8.5 mmol/l) at 2-hour.

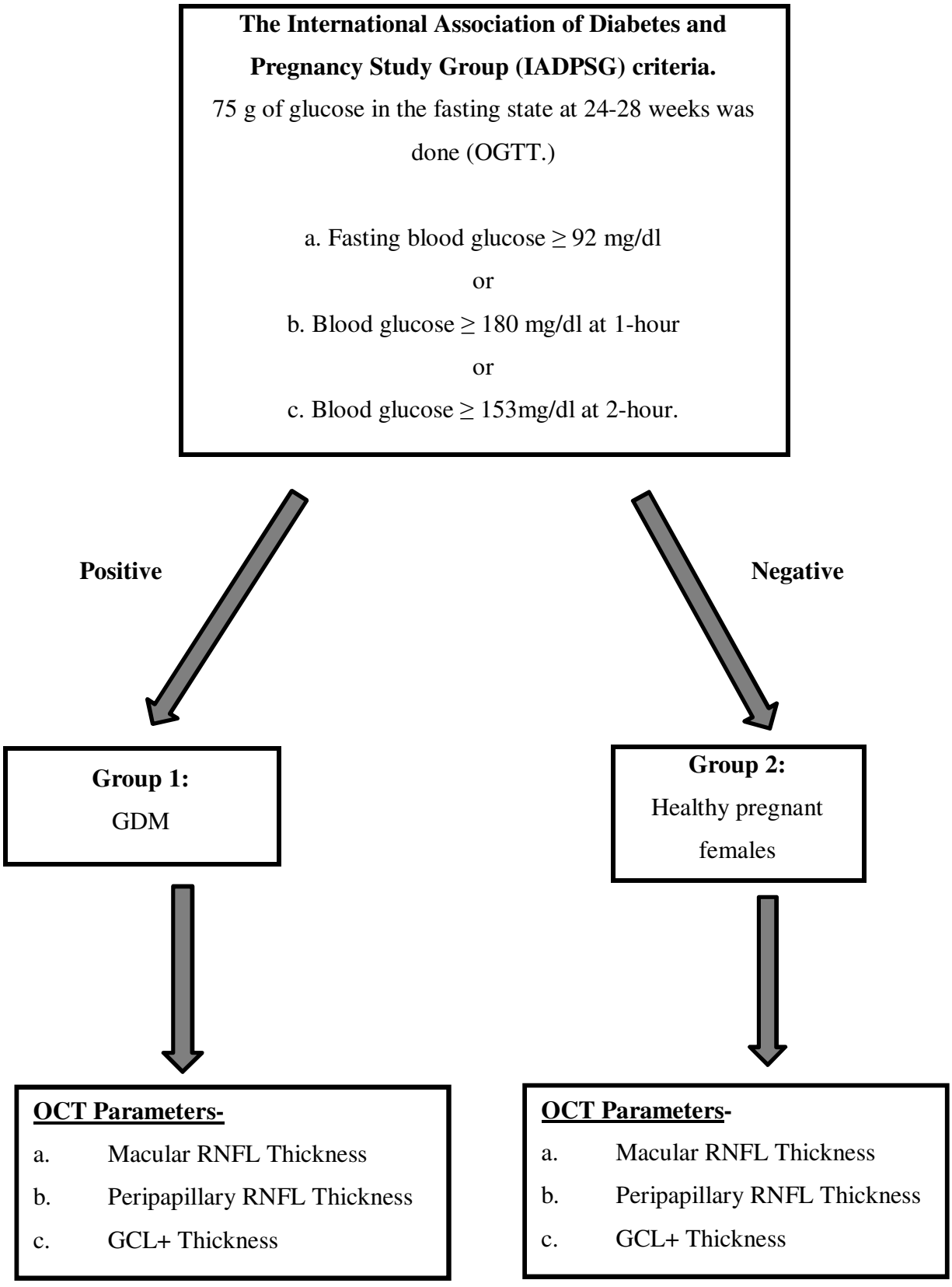
The patients were classified into two groups.

Group 1 included pregnant women, with 24 weeks or more gestational age, with gestational diabetes mellitus.

Group 2 included the healthy pregnant women, with 24 weeks or more gestational age.

These are the pregnant women with gestational age of 24 weeks or more, without any co-existing systemic illness like hypertension, auto-immune diseases, vascular disease, renal diseases or any pre-existing retinal disease like optic disc coloboma, optic disc pit maculopathy, glaucoma, CSCR, macular hole, CNVM.

Patients who met the inclusion criteria were categorized into 162 healthy pregnant women and 162 gestational diabetes mellitus patients according to IADPSG Criteria.


The International Association of Diabetes and Pregnancy Study Group (IADPSG) criteria.
75 g of glucose in the fasting state at 24-28 weeks was done (OGTT.)
a. Fasting blood glucose ≥ 92 mg/dl
or
b. Blood glucose ≥ 180 mg/dl at 1-hour
or
c. Blood glucose ≥ 153mg/dl at 2-hour.
Positive
Negative
Group 1:
GDM
Group 2:
Healthy pregnant females
OCT Parameters-
a. Macular RNFL Thickness
b. Peripapillary RNFL Thickness
c. GCL+ Thickness
OCT Parameters-
a. Macular RNFL Thickness
b. Peripapillary RNFL Thickness
c. GCL+ Thickness

The patients who met the inclusion criteria, were recruited, after obtaining the due clearance from the ethical committee.

The patient was informed about the nature of study and each patient was given a patient information sheet. After obtaining a written informed consent from the patient a detailed history regarding onset of ocular symptoms, if any, duration, progression and any associated complaints was assessed. History regarding any co-existing medical illness or addictions, and history of any previous surgeries ocular or non-ocular, was recorded. After ensuring that the patient satisfied our inclusion criteria, she was assessed for visual acuity of both eyes unaided and with best correction possible using Snellen's Chart.

Intraocular pressure of both eyes was recorded by applanation tonometry (Goldman applanation tonometry/ Perkin's tonometer), central corneal thickness with autorefractometer and Schirmer test using the Whatman filter paper 41 and assessment of corneal sensations was performed in all four quadrants using a wisp of the cotton-tipped applicator.

Figure 12: Measurement of Central Corneal Thickness (CCT) using Autorefractometer. (Source: Department Of Opthalmology, AIIMS Jodhpur)

Figure 13: Measurement of intra-ocular pressure using Goldman applanation tonometry. (Source: Department Of Opthalmology, AIIMS Jodhpur)

Figure 14: Schirmer test using Schirmer strips (Whatman filter paper 41). (Source: Department Of Opthalmology, AIIMS Jodhpur)

The Schirmer test was done with the help of a Schirmer paper strip and placing it in the lower fornix of the eye. It was placed at the junction of the outer one-third and medial two-thirds of the lower eyelid for 5 minutes. After 5 minutes the strip was removed from the eye and the wet portion was measured.

The patient then underwent a thorough slit-lamp examination to evaluate the anterior segment and we also measured Tear film Break-Up Time and Ocular Surface Staining Score (OSSS).

Figure 15: Slit-lamp examination to evaluate the anterior segment of the patient. (Source: Department Of Opthalmology, AIIMS Jodhpur)

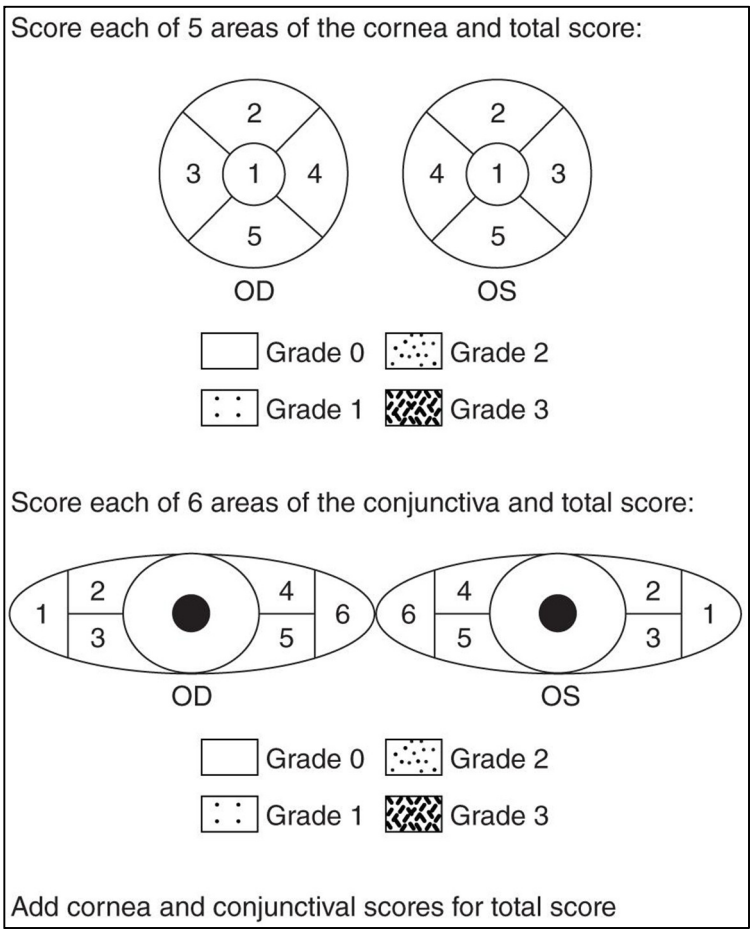


Figure 16: Ocular Surface Staining Score done using National Eye Institute/ Industry (NEI) Grading Scale. (Adapted from https://www.aao.org/image/neiindustry-grading-system)

The Ocular Surface Staining Score was done after staining both the eyes of the patient with 1 mg of Fluorescein sodium strip. The patient's eyes were then examined under cobalt blue filter of a slit lamp biomicroscope. The National Eye Institute/ Industry (NEI) Grading Scale was used to calculate OSSS. The NEI grading scale consists of a grid that divides corneal area into five sections and conjunctival area into six sections, each of which is given a score between zero and three depending on the amount corneal and conjunctival fluorescein staining. The total Ocular Surface Staining Score is achieved by adding corneal and conjunctival scores. Grade 0 is specified when no staining is present, and the maximum score is 15.[42]

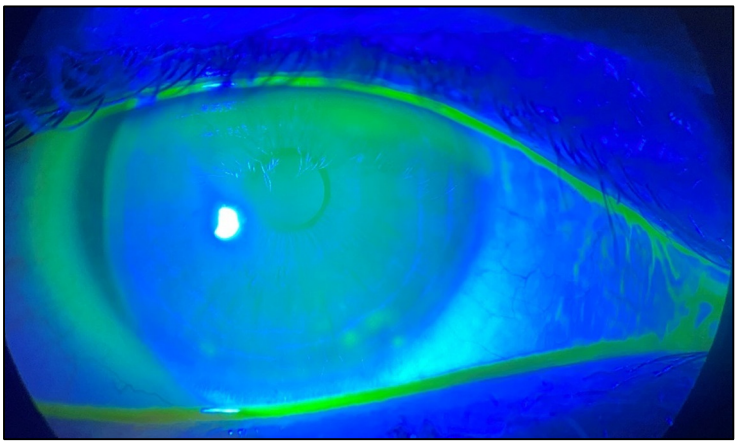


Figure 17: Ocular Surface Staining Score measurement using NEI grading scale. (Source: Department Of Opthalmology, AIIMS Jodhpur)

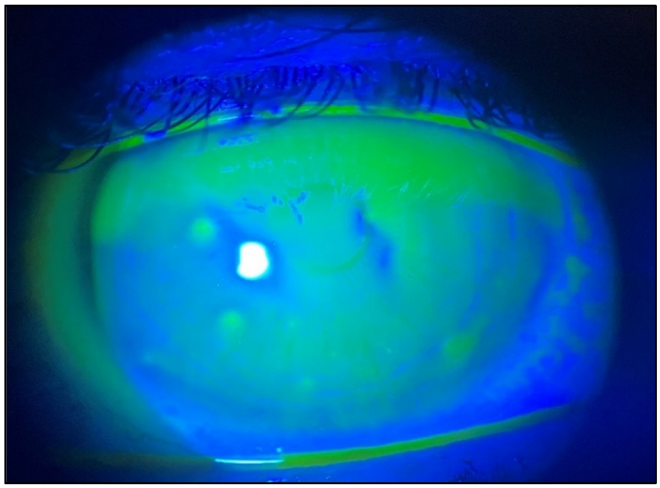


Figure 18: Tear film Break-Up Time measurement under cobalt blue filter of a slit-lamp biomicroscope. (Source: Department Of Opthalmology, AIIMS Jodhpur)

Likewise, the Tear film Break-Up Time (TBUT) was also measured by staining the eyes with sodium fluorescein impregnated strips (1%) and observed using a slit-lamp biomicroscope under cobalt blue filter and the time was noted after instructing the patient to blink. The time taken for the first appearance of a 'dark' dry spot was recorded as the 'tear-film break-up time'. A tear film break-up time of less than 10 seconds was suggestive of a dry eye.[43]

Posterior segment examination by slit lamp bio-microscopy with +90 D lens and fundus evaluation was also done by indirect ophthalmoscope using +20 D lens, after obtaining an adequate pharmacological mydriasis.

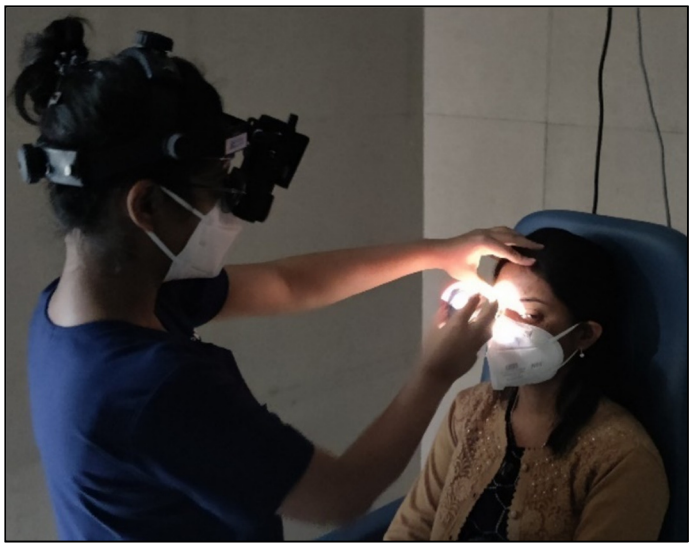


Figure 19: Fundus evaluation by indirect ophthalmoscope using +20 D lens. (Source: Department Of Opthalmology, AIIMS Jodhpur)

Optical Coherence Tomography was done in both groups using Spectral Domain 3D OCT after pupillary dilation and following parameters were evaluated-

1. Macular RNFL Thickness of the scanned retina.
2. Peripapillary RNFL thickness in all four quadrants.
3. GCL+ thickness in superior and inferior half of the scanned retina.

Figure 20: Optical Coherence Tomography was done using Spectral Domain 3D OCT machine. (Source: Department Of Opthalmology, AIIMS Jodhpur)

The findings were then recorded and the data was entered and analysed using Statistical Software Package for Social Sciences (SPSS) version 23.

STATISTICAL ANALYSIS

- Data was entered, cleaned and analysed using (Statistical Software Package for Social Sciences) SPSS version 23.
- All nominal variables like gender were described using frequency and percentages and analysed using Chi Square test or Fischer's Exact test.
- All Ordinal variables were described using median and IQR (Inter Quartile Range) and analysed using Mann Whitney U test.
- All continuous variables were described using mean and Standard Deviation and analysed using Independent Sample t test.
- The analysed data was organised in frequency distribution tables.
- Graphs like bar charts and pie-charts were plotted where ever necessary.
- A *p* value of less than 0.05 was considered statistically significant.

ETHICAL CONSIDERATION

- The following study was conducted after approval from the Institutional Ethics Committee.
- Informed consent was taken from the women being enrolled for the study by providing them a proper printed consent form along with patient information sheet, after properly explaining the purpose and the nature of the study.

RESULTS

RESULTS

The study was conducted at Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur in collaboration with the Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, Jodhpur, Rajasthan.

Data collection was started on 6th January 2020. Patients were recruited till the sample size was met (last patient was recruited on June 21, 2021). 324 patients attending OPD of the Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, Jodhpur were recruited for this study. Patients who met the inclusion criteria were categorized into 162 healthy pregnant female group and 162 gestational diabetes mellitus patients according to IADPSG Criteria.

The patients diagnosed with Gestational Diabetes Mellitus in the outpatient department of Obstetrics and Gynaecology were advised to visit the Department of Ophthalmology. The patients who met the inclusion criteria, were recruited.

The data from 648 eyes (of 324 patients) was coded, cleaned and entered into a Microsoft Excel spreadsheet before being analyzed with SPSS vs 23.

GDM women's median monthly income, female occupation, and educational level were not statistically different from healthy pregnant women, according to the statistics. However, there were substantial differences in parity, family history of diabetes, and previous history of GDM between the two groups. (Table 1)

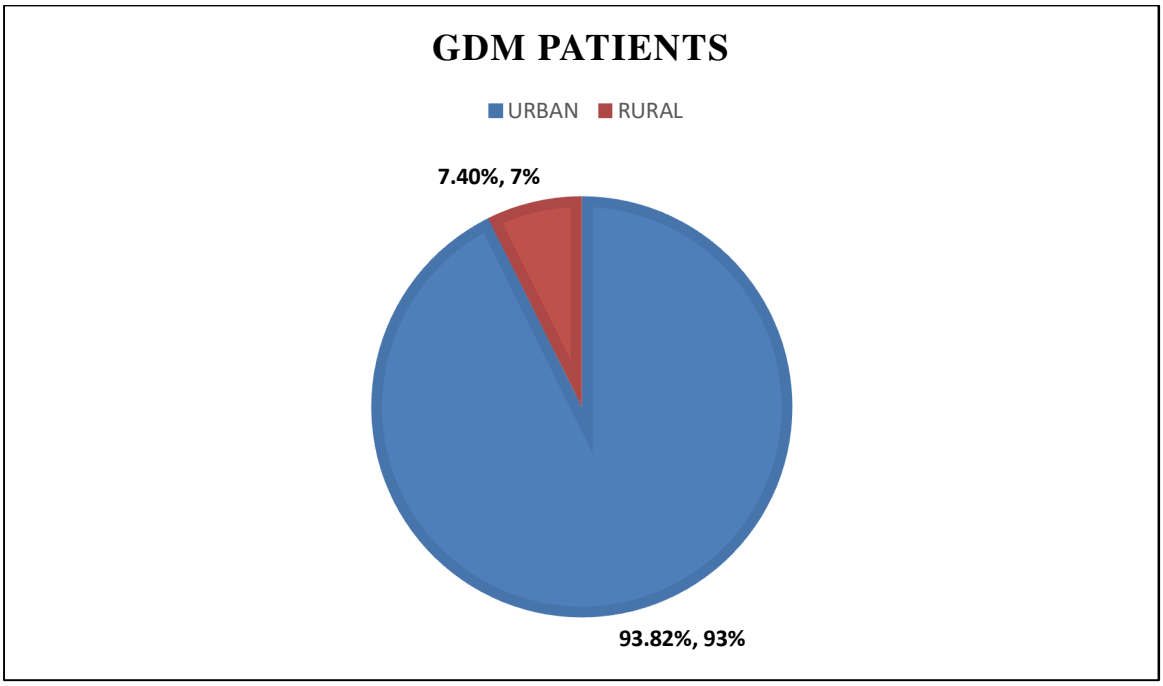
Table 1: Socio-demographic details of the study population

Variables	Categories	GDM (n=162)	Healthy pregnant women (n=162)	*p*- value
Occupation	**Housewife**	148 (91.35%)	144 (88.88%)	0.456
	Professional	14 (8.64%)	18 (11.11%)	
Income*	**Median monthly income (IQR)**	30500 (23000-37000)	31500 (20000-46500)	0.464#
Residence	**Urban**	150 (93.82%)	148 (91.35%)	0.682
	Rural	12 (7.40%)	14 (8.64%)	
Previous history of GDM	**Yes**	40 (24.69%)	20 (12.34%)	**0.0042**
	No	122 (75.30%)	142 (87.65%)	
Family history of Diabetes	**Yes**	121 (74.69%)	22 (13.58%)	**<0.0001**
	No	41 (25.30%)	140 (86.41%)	
Education level	**Illiterate**	60 (37.03%)	62 (38.27%)	0.724
	School's education	62 (38.27%)	66 (40.74%)	
	Above school's education	40 (24.69%)	34 (20.98%)	
Parity	**Primiparous**	88 (54.32%)	94 (58.02%)	0.795
	Multiparous	72 (44.44%)	66 (40.74%)	
	Grand multiparous	2 (1.23%)	2 (1.23%)	

*Calculated only for participants with occupation, GDM group (n=14) and healthy pregnant group (n=18) # *p* value by Mann Whitney U test, *p* value for other variables calculated by Chi square test.

Table 1 shows the sociodemographic details of the study population in healthy pregnant women and pregnant women with GDM. The data showed that in the GDM group 14 women were with the occupation (professionals) while in the healthy pregnant group only 18 were professionals. The median monthly income was Rs. 30,500 in GDM group and Rs. 31,500 in healthy pregnant women group (which was calculated only for the participants with occupation). The difference between the two groups was not statistically significant.

Figure 21: Geographic distribution of GDM patients



The data indicated that 93.82% women in GDM group resided in the urban areas and 7.40% resided in the rural areas. (Figure 21)

Figure 22: Geographic distribution of Healthy pregnant females.

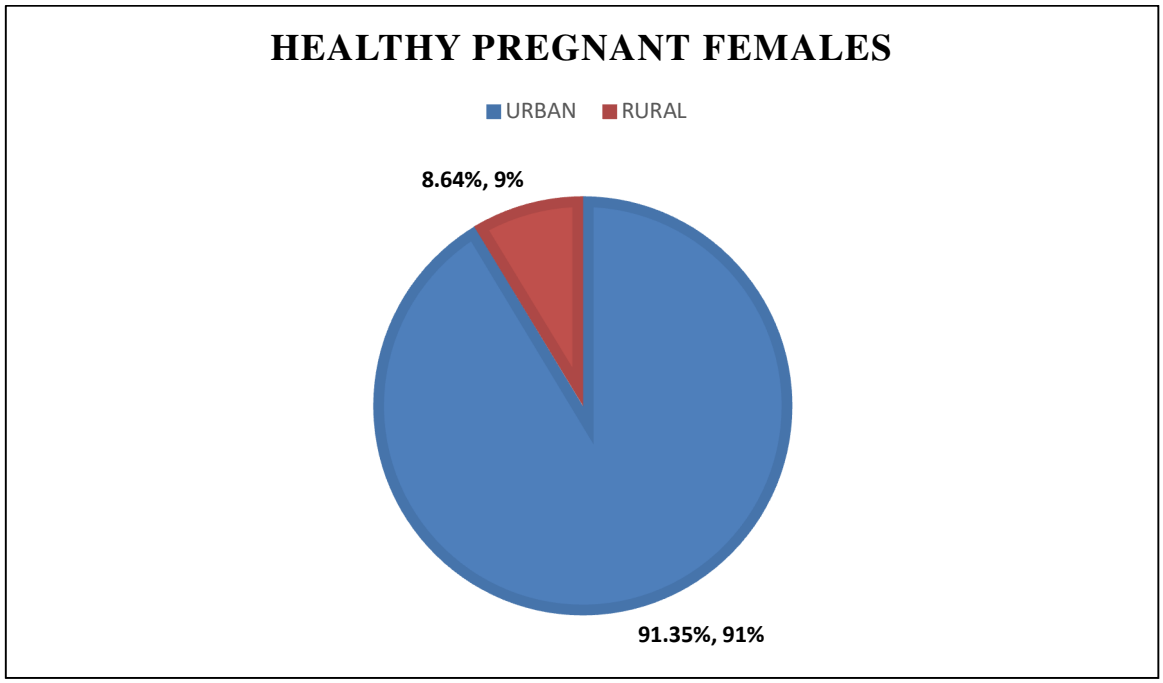


Figure 22 depicts that 91.35% women in the healthy pregnant group resided in the urban areas whereas 8.64% belonged to rural area.

Figure 23: Previous history of GDM in the study population.

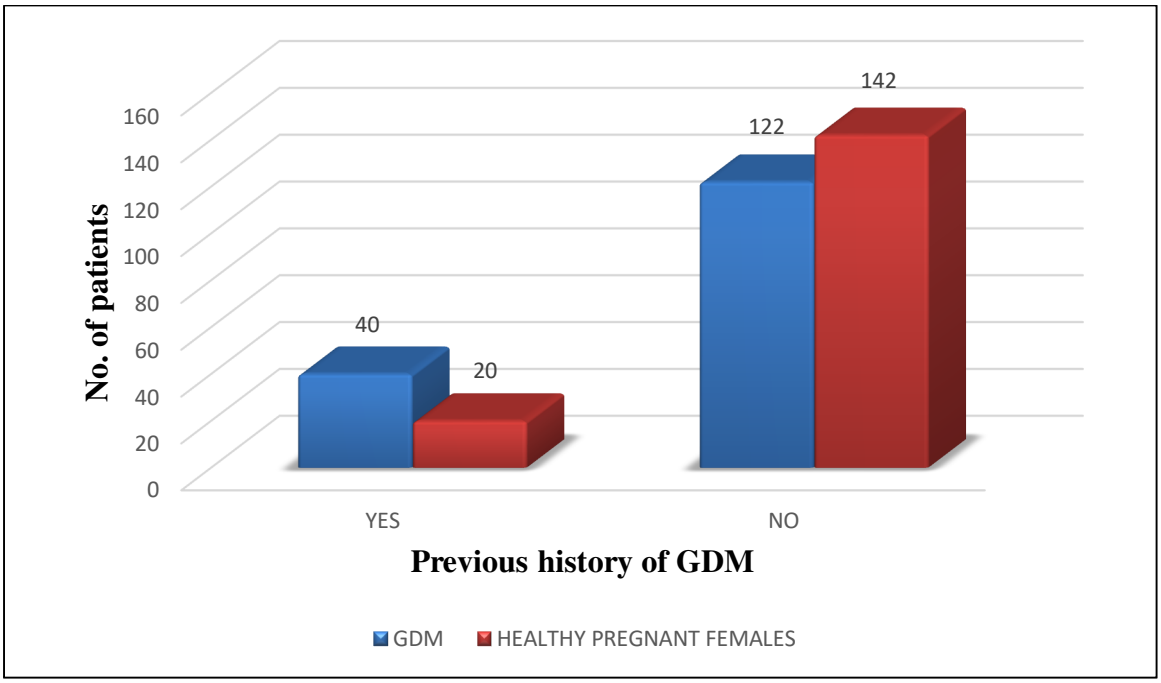
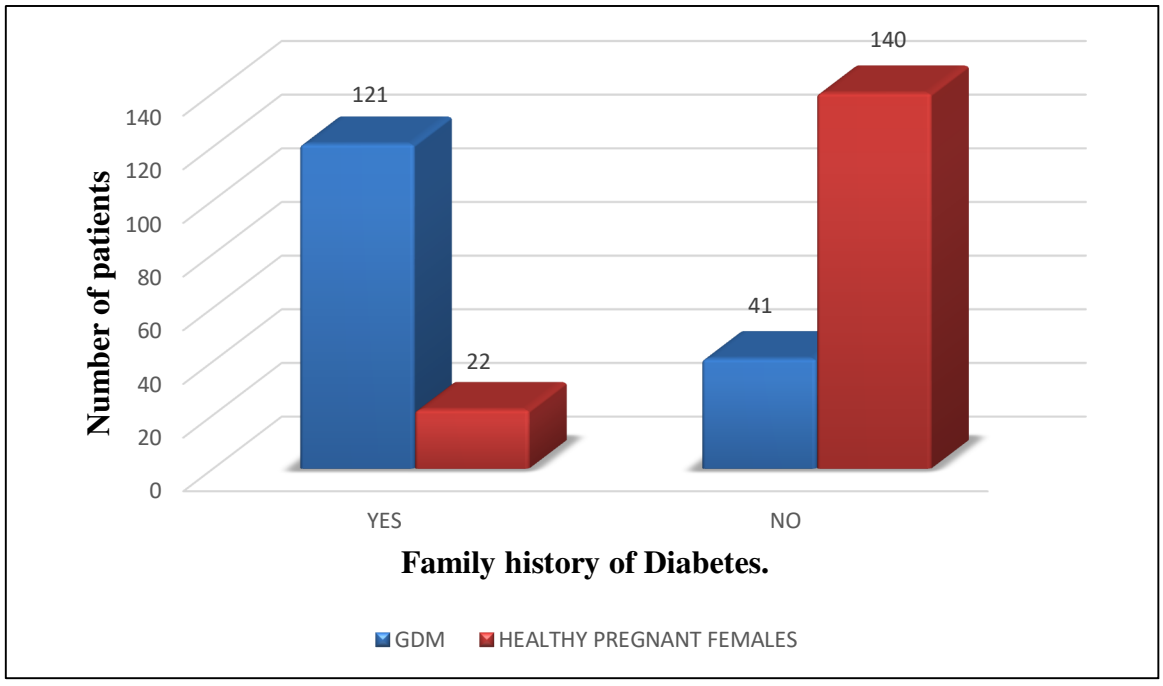


Figure 23 shows that previous history of GDM was present in 40 women in GDM group while only in 20 women in healthy pregnant group. The data was statistically significant. (p =0.0042).

Figure 24: Family history of Diabetes in the study population.



121 (74.69%) GDM women and 22 (13.58%) healthy pregnant women had history of Diabetes in their family. While 41(25.30%) women in GDM group and 140 (86.41%) in healthy pregnant group had no family history of Diabetes (Figure 24)

Figure 25: Education level of the study population

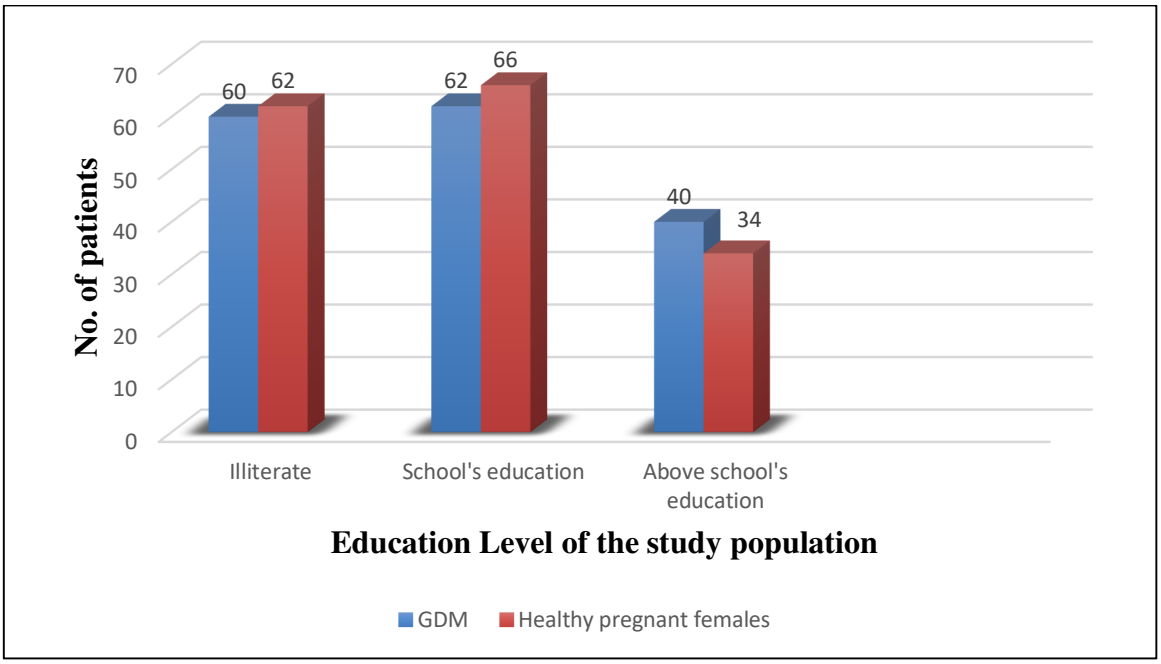


Figure 25 shows that majority of the patients were 'illiterate' or fall in 'school's education' category in both the groups. 40 (24.69%) women in the GDM group and 34 (20.98%) in the healthy pregnant group were in 'above school's education' category.

Table 2: Age distribution of the study population

Age (years)	**GDM (n=162)**		**Healthy pregnant women (n=162)**		***p*- value**
	N	%	N	%	
19-25	67	41.36	74	45.68	0.853*
26-30	38	23.46	37	22.84	
31-35	33	20.37	31	19.14	
36-40	24	14.81	20	12.35	
Mean±SD	28.72±5.29		28±5.27		0.219#

*Chi square test # independent t test

The mean age in GDM group was 28.72±5.29 years and in healthy pregnant group was 28±5.27 years. Age ranged from 19-39 years in both the groups. Median age of GDM group was 28 years (24.75-34.00) while it was 26 years (24.00 - 32.00) in healthy pregnant group. Maximum patients in both the groups belonged to the age group of 19-30 years.

In our study, age was not a comparable factor as the *p*-value was not significant between healthy pregnant and GDM patients. Thereby age does not influence retinal thickness at the level of RNFL in both groups. (Table 2).

Figure 26: Age distribution of the study population

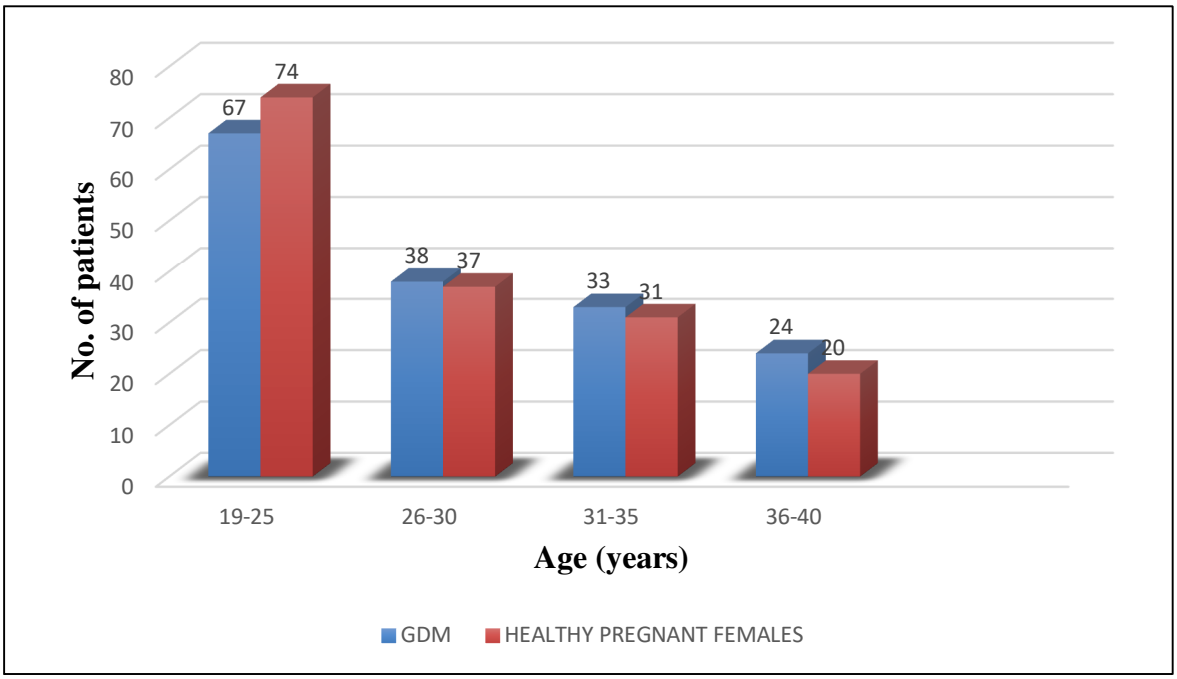


Figure 26 shows that maximum patients in our study population were in the age group of 19-25 years in both the groups.

Table 3: HbA1c levels of the study population.

Variable	**Values**	**GDM (n=162)**	**Healthy pregnant women (n=162)**
HbA1c levels (%)	<4.5	0 (00%)	5 (3.08%)
	4.5-4.9	3 (1.85%)	48 (29.62%)
	5.0-5.4	2 (1.23%)	75 (46.29%)
	5.5-5.9	5 (3.08%)	22 (13.58%)
	6.0-6.4	21 (12.96%)	10 (6.17%)
	6.5-6.9	58 (35.80%)	2 (1.23%)
	≥7	73 (45.06%)	0 (00%)

Table 3 showed HbA1c levels in the study population in healthy pregnant women and pregnant women with GDM patients. The data indicated that 1.85% of GDM patients and 29.62% of healthy pregnant group had HbA1c level in the range of 4.5 to 4.9, 1.23% in GDM group and 46.29% in healthy pregnant group had HbA1c level in the range of 5.0 to 5.4. Furthermore, 3.08% of GDM patients and 13.58% of healthy pregnant females had HbA1c level in the range of 5.5 to 5.9. While majority of the GDM patients had HbA1c levels of more than 7 (45.06%), 12.96% of GDM and 6.17% of healthy pregnant group had HbA1c level in the range of 6.0 to 6.4 and 35.80% of GDM and 1.23% of healthy pregnant women had HbA1c level in the range of 6.5 to 6.9.

Figure 27: HbA1c levels in study population.

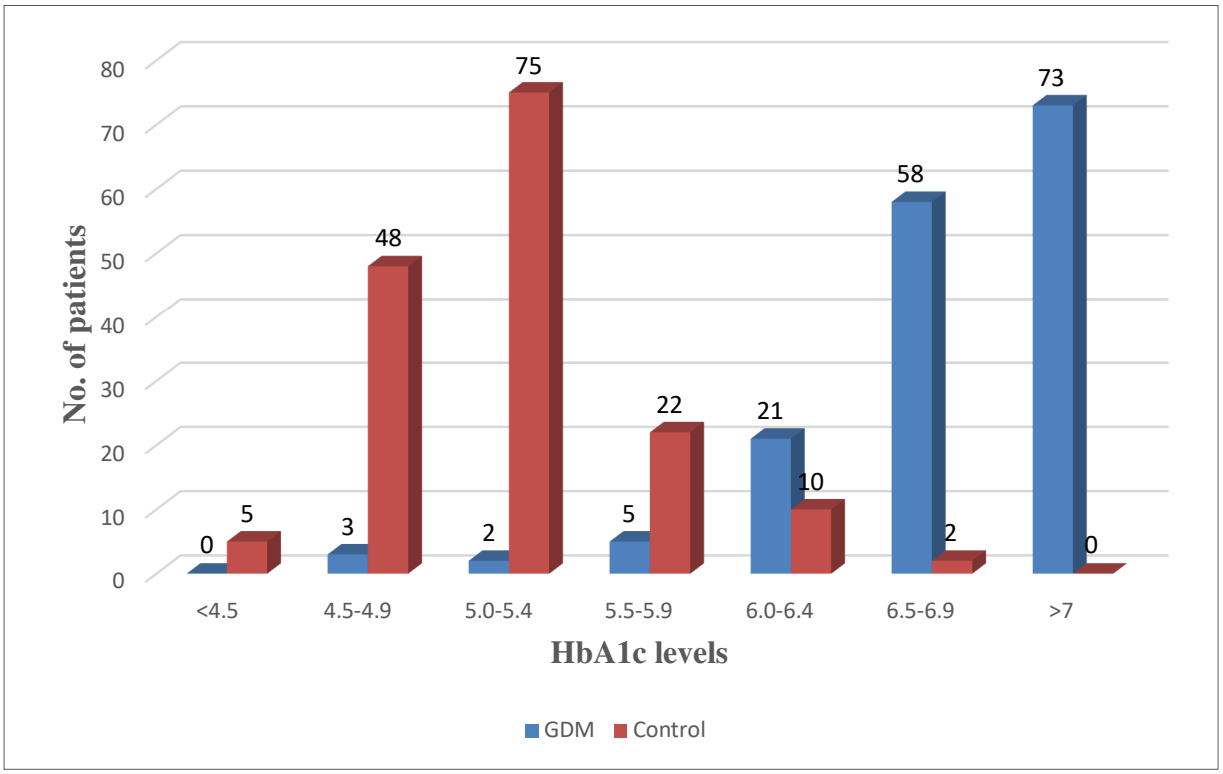


Figure 27 shows that none of the GDM patients had HbA1c levels of less than 4.5. On the other hand, none of the patients in the healthy pregnant group had HbA1c level of ≥7.

Table 4: Uncorrected Distance Visual Acuity (RE) in the study population

UDVA RE	**GDM (n=162)**		**Healthy pregnant women (n=162)**		***p*- value***
	N	%	N	%	
0.00	76	46.91	79	48.77	0.955
0.20	38	23.46	33	20.37	
0.60	22	13.58	21	12.96	
0.80	17	10.49	18	11.11	
1.0	9	5.56	11	6.79	
Total	162	100.00	162	100.00	

**p* value calculated by Chi square test.

Unaided Distance Visual Acuity (UDVA) of right eye on logMAR chart was 0.00 (6/6) in 46.91 % in GDM patients and 48.77% in healthy pregnant group. 23.46% patients in GDM

group and 20.37% in healthy pregnant group had UDVA of 0.20. The BCVA of both the groups was 0.00 (6/6) on logMAR scale.

Likewise 13.58% patients in GDM group and 12.96% patients in healthy pregnant group have UDVA of 0.60. 10.49% patients in GDM group and 11.11% in healthy pregnant group have UDVA of 0.80. While logMAR 1.0 UDVA was seen in 5.56% in GDM group and in 6.79% in healthy pregnant group. The data obtained was statistically insignificant ($p = 0.955$) (Table 4).

Table 5: Uncorrected Distance Visual Acuity (LE) in the study population

UDVA LE	**GDM (n=162)**		**Healthy pregnant women (n=162)**		***p*- value***
	N	%	N	%	
0.00	78	48.15	79	48.77	0.990
0.20	32	19.75	33	20.37	
0.60	20	12.35	21	12.96	
0.80	20	12.35	18	11.11	
1.1	4	2.47	5	3.09	
1.3	8	4.94	6	3.70	
Total	162	100.00	162	100.00	

*p value calculated by Chi square test.

Similarly, maximum number of patients had a distance visual acuity of 0.00 on the logMAR scale in left eye as well.(Table 5)

Figure 28: Uncorrected Distance Visual Acuity RE in the study population

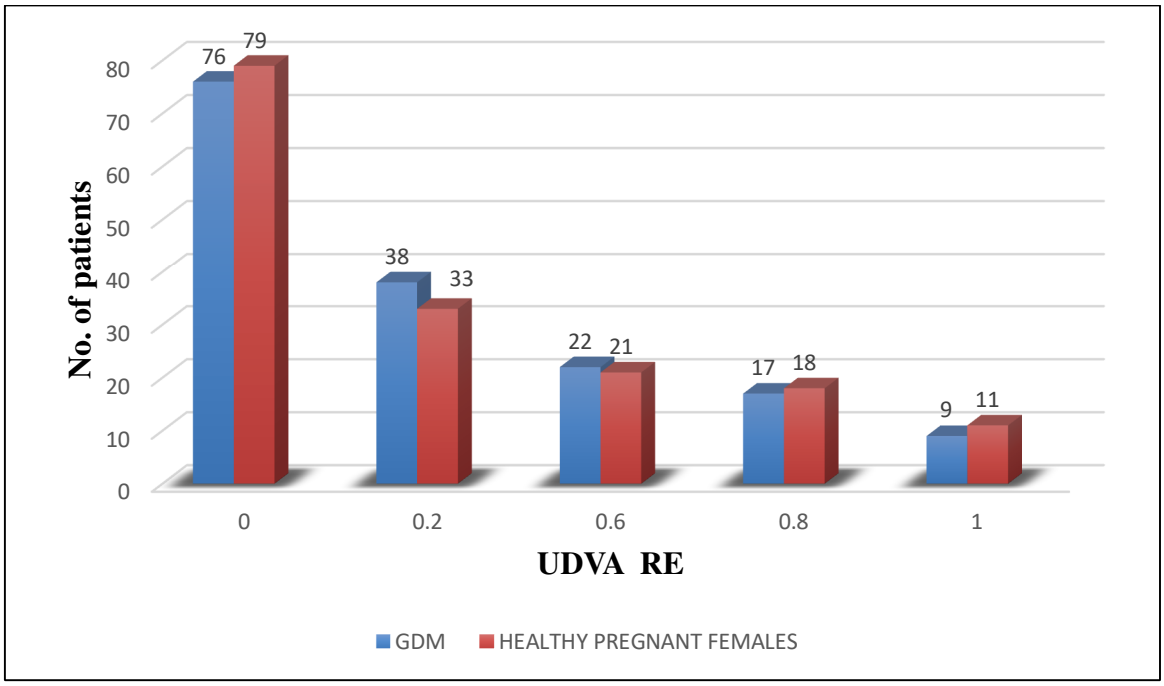
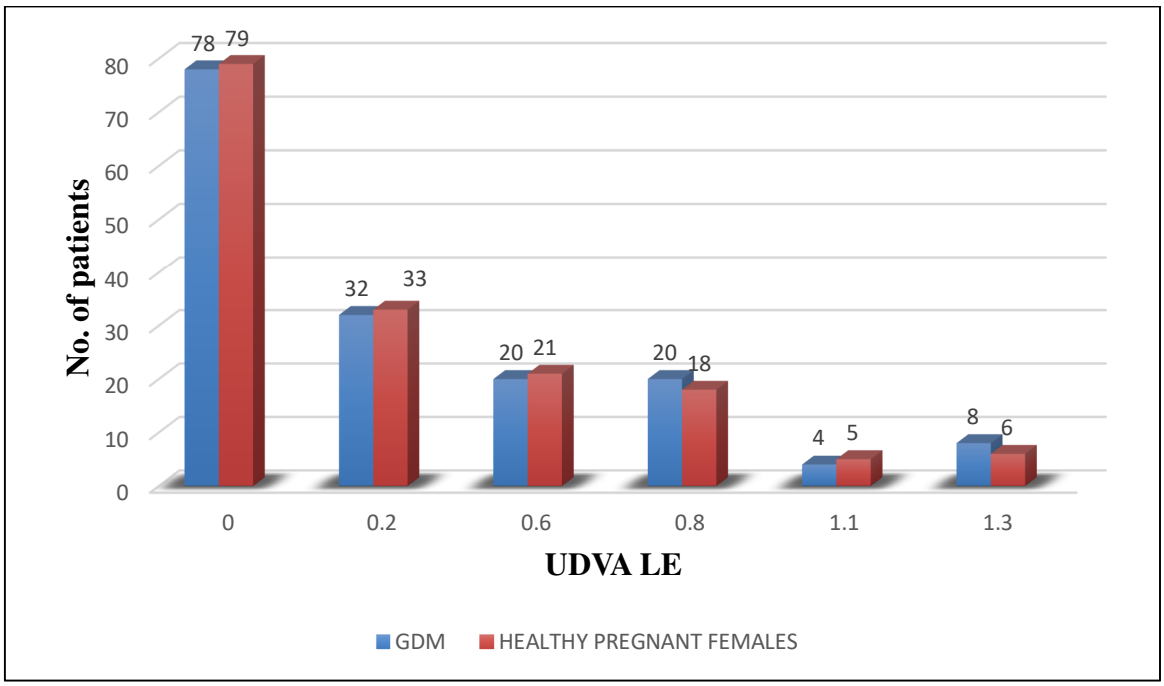


Figure 28 shows that most patients in both the groups have a good uncorrected distance visual acuity i.e. on logMAR chart it was 0.00 (6/6) and few females have logMAR 1.0 UDVA which was seen in 5.56% in GDM group and in 6.79% in healthy pregnant group.

Figure 29: Uncorrected Distance Visual Acuity LE in the study population



Similarly, Figure 29 shows that most patients in both the groups have a good uncorrected distance visual acuity i.e. on logMAR chart it was 0.00 (6/6).

Table 6: Distant Visual Acuity with Pin-hole (RE) in the study population

DVA with PH RE	**GDM (n=162)**		**Healthy pregnant women (n=162)**		***p*-value***
	N	%	N	%	
0.00	149	91.98	141	87.03	0.348
0.20	11	6.79	18	11.11	
0.80	2	1.23	3	1.85	
Total	162	100.00	162	100.00	

**p* value calculated by Chi square test.

DVA with pin hole in right eye on logMAR chart was 0.00 (6/6) in 91.98 % in GDM patients and 87.03% in healthy pregnant group. 6.79% patients in GDM group and 11.11% in healthy pregnant group had UDVA of 0.20. 1.23% patients in GDM group and 1.85% patients in healthy pregnant group have UDVA of 0.80.(Table 6)

Table 7: Distant Visual Acuity with Pin-hole (LE) in the study population

DVA with PH LE	**GDM (n=162)**		**Healthy pregnant women (n=162)**		***p*-value***
	N	%	N	%	
0.00	148	91.36	141	87.03	0.394
0.20	11	6.79	18	11.11	
0.80	3	1.85	3	1.85	
Total	162	100.00	162	100.00	

**p* value calculated by Chi square test.

The similar findings were noted in the left eye as well in terms of 'DVA with pin hole' in the study population. Maximum number of patients had a distance visual acuity with pin hole of 0.00 on the logMAR scale in both the groups (Table 7)

Figure 30: Distant Visual Acuity RE with Pin-hole in the study population

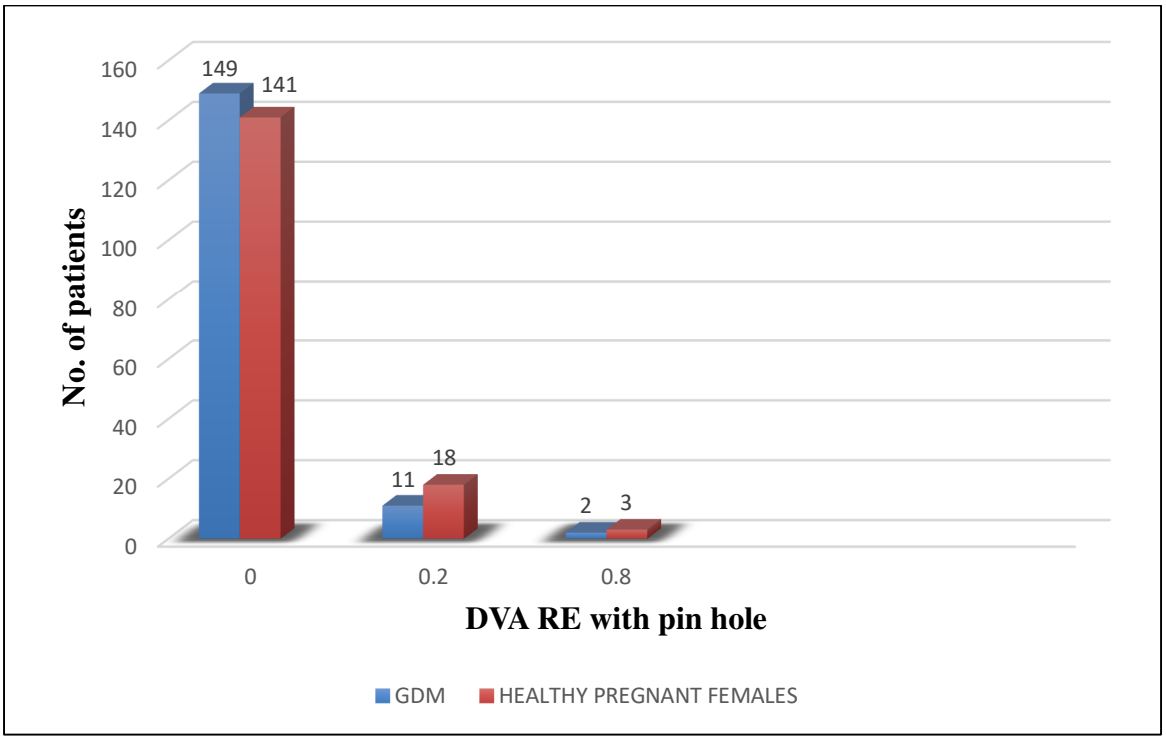
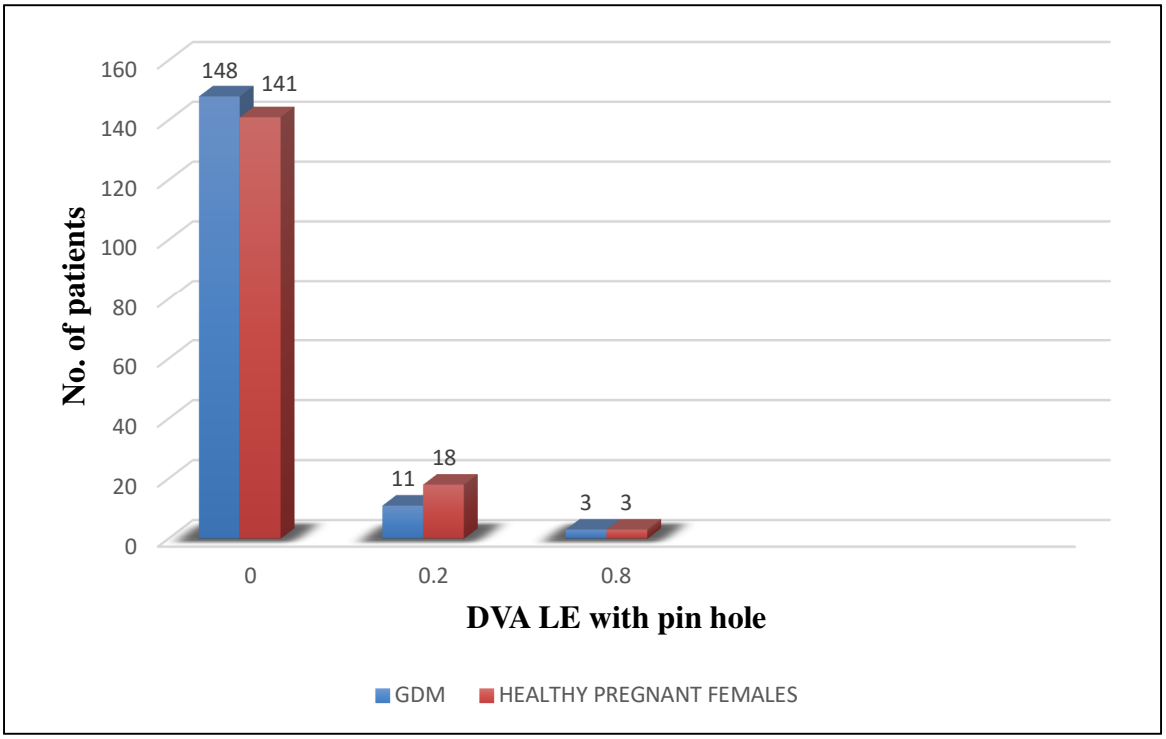


Figure 30 shows that in right eye of most of the patient, they had a distance visual acuity with pin hole of 0.00 on the logMAR scale in both the groups.

Figure 31: Distant Visual Acuity LE with Pin-hole in the study population



From Figure 31 we can see that majority females had distance visual acuity with pin hole as 6/6 (i.e., on logMAR chart it was 0.00).

Table 8: Intra Ocular Pressure, Central Corneal Thickness, Schirmer test and Tear Film Break Up Time of the study population.

Variables		GDM (n=162) (Mean±SD)	Healthy pregnant women (n=162) (Mean±SD)	*p*-value*
IOP (mm of Hg)	RE	14.12±2.02	13.99±1.89	0.534
	LE	14.96±2.03	14.67±2.20	0.210
	Combined$^{\$}$	14.54±2.06	14.32±2.08	0.186
CCT (µ m)	RE	537.40±13.23	534.82±28.78	0.301
	LE	535.82±12.28	537.25±13.26	0.316
	Combined$^{\$}$	536.61±12.77	536.04±22.40	0.689
Schirmer test (mm)	RE	24.13±2.84	24.11±2.87	0.953
	LE	23.66±2.54	23.72±2.58	0.845
	Combined$^{\$}$	23.90±2.71	23.92±2.73	0.931
TBUT (sec)	RE	12.38±1.09	12.40±1.08	0.919
	LE	12.98±1.78	12.86±1.71	0.545
	Combined$^{\$}$	12.68±1.50	12.63±1.45	0.651

**p* value calculated by Independent t-test. $^{\$}$Combined mean for RE and LE for each group.

Both groups were comparable in terms of IOP, CCT, Schirmer test and TBUT.

The intra-ocular pressure was comparable in both the groups. The mean IOP in the right eye was 14.12±2.02 in GDM group and 13.99±1.89 in the healthy pregnant women group (p = 0.534). IOP was 14.96±2.03 in left eye in GDM group and 14.67±2.20 in healthy pregnant group (p = 0.210) (Table 8)

The central corneal thickness (CCT) was also comparable in both groups, 537.40±13.23 in right eye in GDM group and 534.82±28.78 in healthy pregnant women group (p = 0.301) and 535.82±12.28 in left eye in GDM group and 537.25±13.26 in left eye in healthy pregnant women group (p = 0.316). (Table 8)

Schirmer test (type -1) done in both the groups, showed no significant difference between the two groups. In GDM patients, value of Schirmer test in the right eye was 24.13±2.84 mm and in the healthy pregnant group its value was 24.11±2.87 mm (p = 0.953). Similarly in the left eye of GDM patients it was 23.66±2.54 mm and in the healthy pregnant group it was 23.72±2.58 mm (p = 0.845). (Table 8)

Tear film break-up time (TBUT) was also comparable in both the groups. In GDM patients it was 12.38±1.09 seconds in right eye and 12.40±1.08 seconds in the right eye of healthy pregnant women (p = 0.919). Whereas in the left eye TBUT was 12.98±1.78 seconds in GDM group and 12.86±1.71 seconds in healthy pregnant group (p = 0.545). (Table 8)

On dilated fundus examination of the patients, we found normal physiological findings in all the patients. The media was clear, with C:D ratio ranged from 0.2 to 0.5 with a healthy neuroretinal rim. The retinal vasculature was normal in all patients and background was within normal physiological limits. The foveal reflex was normal in all patients.

Table 9: Peripapillary RNFL thickness in the study population.

Peripapillary RNFL thickness (μ m)		**GDM (n=162) (Mean±SD)**	**Healthy pregnant women (n=162) (Mean±SD)**	***p* value***
Right eye	I	132.28±10.43	136.36±20.48	0.025
	S	127.97±14.25	131.96±15.90	**0.018**
	N	62.29±12.71	72.29±6.77	**<0.0001**
	T	61.27±11.87	69.33±10.12	**<0.0001**
	Total	96.09±7.18	102.60±9.01	**<0.0001**
Left eye	I	140.33±8.79	141.51±10.84	0.283
	S	127.86±21.35	135.78±13.85	**<0.0001**
	N	82.60±7.92	86.16±7.73	**<0.0001**
	T	70.36±6.90	79.72±6.45	**<0.0001**
	Total	105.42±6.70	110.79±5.15	**<0.0001**
Combined[$]		100.75±8.36	106.77±8.44	**<0.0001**

**p* value calculated by Independent t-test. [$]Combined mean for RE and LE for each group.

Peripapillary RNFL thickness was decreased significantly in the GDM group. OCT was used to assess the peripapillary RNFL thickness in 648 eyes. The thickness of peripapillary RNFL was measured in four quadrants: superior, inferior, nasal, and temporal quadrants. All 4 quadrants of peripapillary RNFL analyzed showed thinning with significant thinning in superior ($p < 0.0001$), nasal ($p < 0.0001$) and temporal ($p < 0.0001$) quadrants except inferior quadrant ($p = 0.283$) in GDM group when compared with healthy pregnant group.(Table 9)

Figure 32: Mean Peripapillary RNFL thickness in the study population

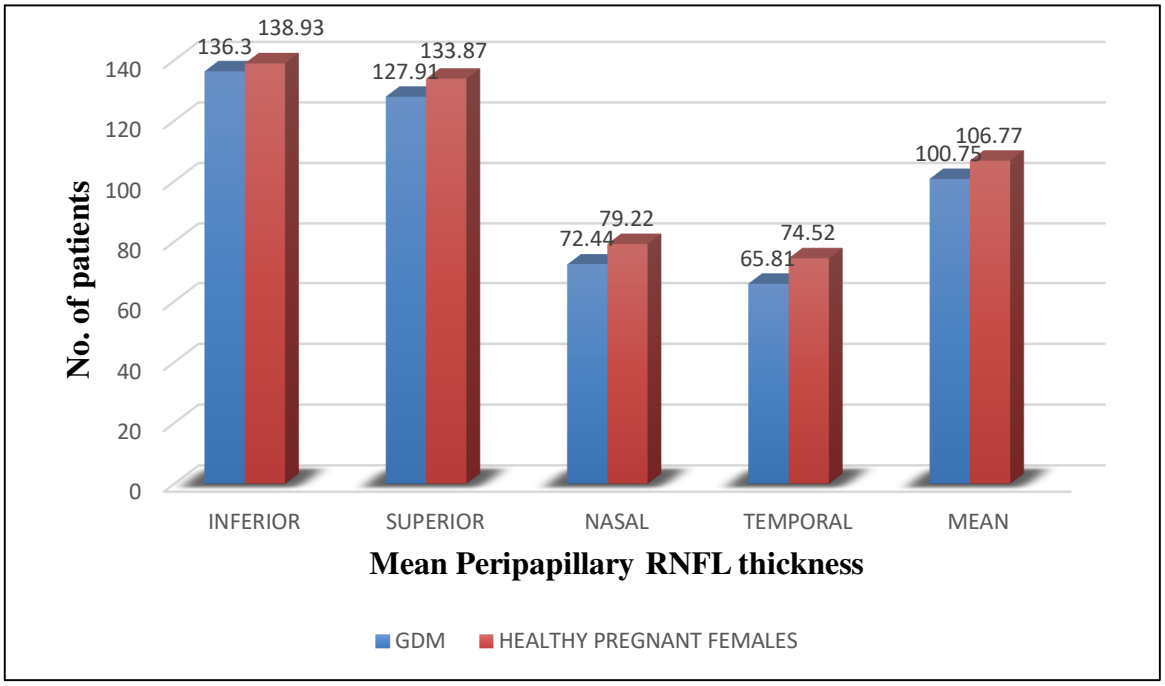


Figure 32 shows that inferior quadrant showed maximum thickness of 140.33±8.79 in the GDM group and 141.51±10.84 in the healthy pregnant group ($p = 0.283$) and temporal quadrant showed minimum thickness of 70.36±6.90 in the GDM group and 79.72±6.45 in the healthy pregnant group ($p < 0.0001$). It was found to be statistically significant between the two groups.

Table 10: Macular RNFL thickness in the study population

Macular RNFL thickness (μ m)		**GDM (n=162) (Mean±SD)**	**Healthy pregnant women (n=162) (Mean±SD)**	***p* value***
Right eye	I	33.77±4.24	35.27±5.42	**0.006**
	S	31.48±4.06	34.52±3.46	**<0.0001**
	Total	32.80±3.49	35.17±3.37	**<0.0001**
Left eye	I	34.87±4.40	36.52±3.66	**<0.0001**
	S	33.51±3.65	35.95±3.84	**<0.0001**
	Total	34.44±3.73	36.45±3.20	**<0.0001**
Combined[$]		33.62±3.70	35.81±3.34	**<0.0001**

**p* value calculated by Independent t-test. [$]Combined mean for RE and LE for each group.

Macular RNFL thickness was significantly decreased in the GDM group.

We compared RNFL thickness around macular area in both the groups. It was assessed in two quadrants- inferior and superior. We found that there was significant difference between the GDM group and the healthy pregnant group. The macular RNFL thickness in the inferior quadrant (in the right eye) was found as 33.77±4.24 in the GDM group and it was 35.27±5.42 in the healthy pregnant female group ($p = 0.006$). The superior part of the macular RNFL was significantly thinner in GDM group with 31.48±4.06 when compared to healthy pregnant females with superior macular thickness of 34.52±3.46 ($p < 0.0001$). Similarly, it was found to be significantly decreased in the GDM group in left eye as well. (Table 10).

Figure 33: Mean Macular RNFL thickness in the study population

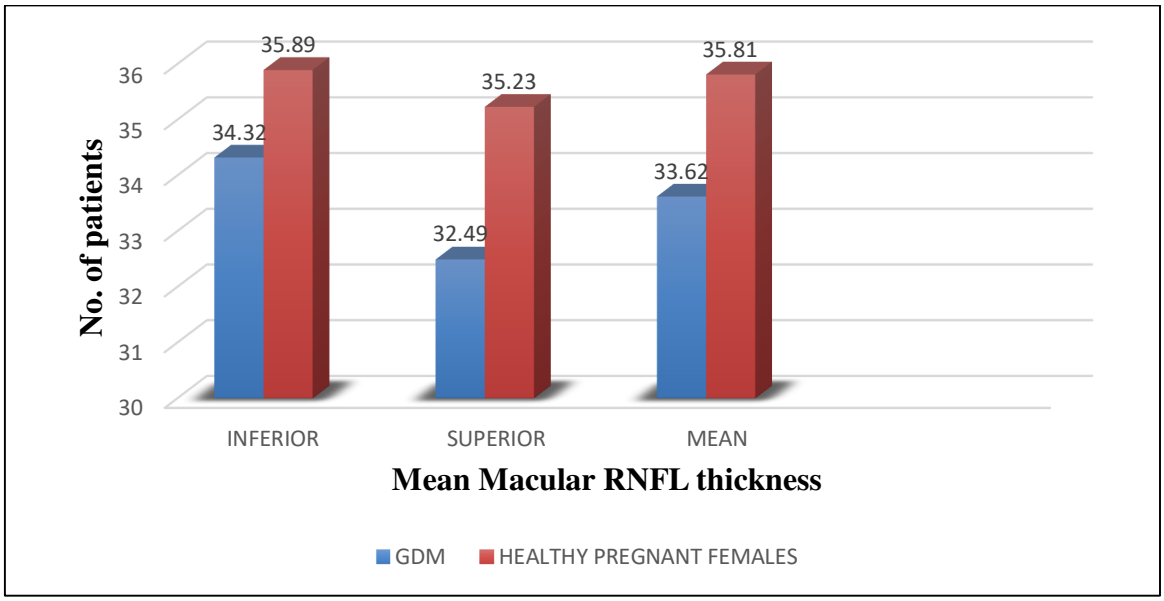


Figure 33. represents that there was significant difference between the GDM group and the healthy pregnant group in terms of macular RNFL thickness.

Table 11: GCL+ Thickness in the study population.

GCL+ Thickness (μ m)		**GDM (n=162) (Mean±SD)**	**Healthy pregnant women (n=162) (Mean±SD)**	***p* value***
Right eye	I	67.36±4.75	70.12±5.36	**<0.0001**
	S	67.58±4.46	70.83±5.16	**<0.0001**
	Total	67.68±4.09	70.72±4.14	**<0.0001**
Left eye	I	68.13±5.33	70.16±6.02	**0.001**
	S	69.25±5.97	72.46±6.68	**<0.0001**
	Total	68.93±5.42	71.54±5.12	**<0.0001**
Combined[$]		68.30±4.83	71.13±4.67	**<0.0001**

**p* value calculated by Independent t-test. [$]Combined mean for RE and LE for each group.

GCL+ thickness was found to be significantly lower in the GDM group. It showed the same trend as macular RNFL thickness. The right eye mean (total) macular RNFL thickness in the GDM group was found to be 67.68±4.09 and in healthy pregnant group was 70.72±4.14 ($p <$ 0.0001) which was statistically significant. Similarly, in left eye as well it followed the same

trend. (Table 11)

Figure 34: Mean GCL+ Thickness in the study population

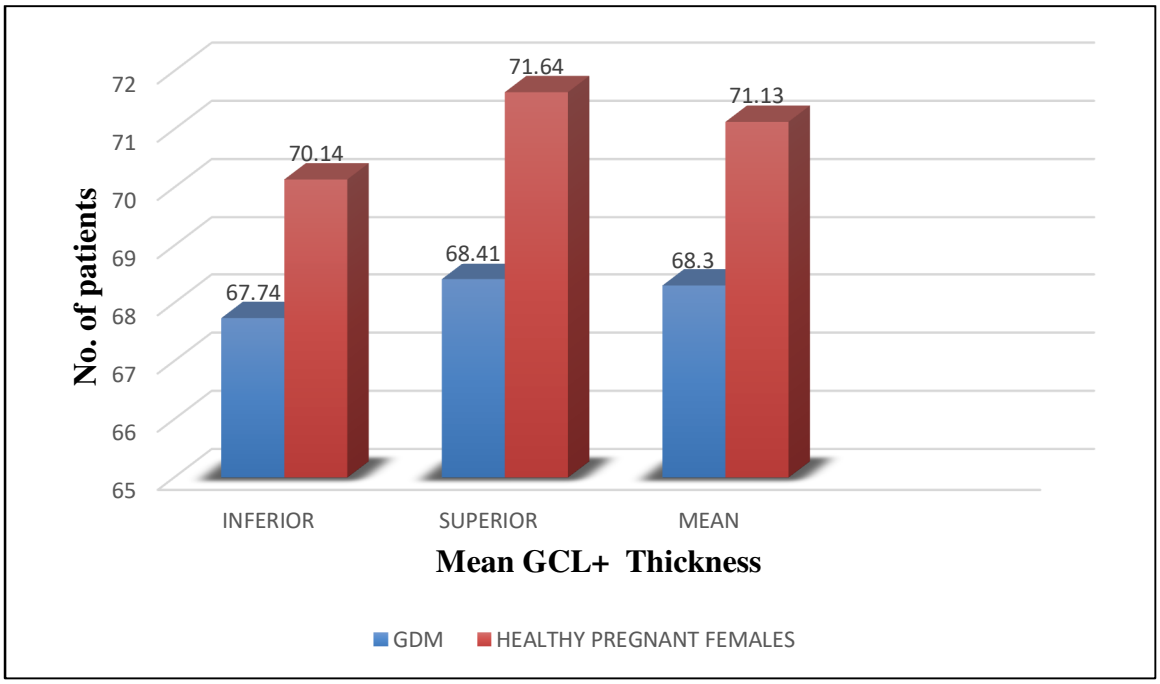


Figure 34 shows that GCL+ thickness (GCL + IPL) is less in GDM group as compared to healthy pregnant females group.

Table 12: GCL++ Thickness in the study population.

GCL++ Thickness (µ m)		**GDM (n=162) (Mean±SD)**	**Healthy pregnant women (n=162) (Mean±SD)**	***p* value***
Right eye	I	103.01±8.41	105.36±7.14	**0.007**
	S	101.96±8.22	103.92±7.20	**0.023**
	Total	102.61±6.93	104.85±5.70	**0.002**
Left eye	I	101.85±6.24	106.96±8.07	**<0.0001**
	S	101.79±6.97	106.79±7.84	**<0.0001**
	Total	102.06±5.76	107.07±6.40	**<0.0001**
Combined[$]		102.33±6.36	105.95±6.16	**<0.0001**

**p* value calculated by Independent t-test. [$]Combined mean for RE and LE for each group.

Furthermore, **GCL ++ thickness** was found to be significantly lower in GDM group. The mean GCL++ thickness of both the eyes followed the same trend as macular and GCL+

thickness, with statistically significant thinning in inferior and superior quadrants in GDM group when compared to healthy pregnant group. In right eye it was found to be 102.61±6.93 in GDM group and 104.85±5.70 in healthy pregnant group ($p = 0.002$).(Table 12)

Figure 35: Mean GCL++ Thickness in the study population

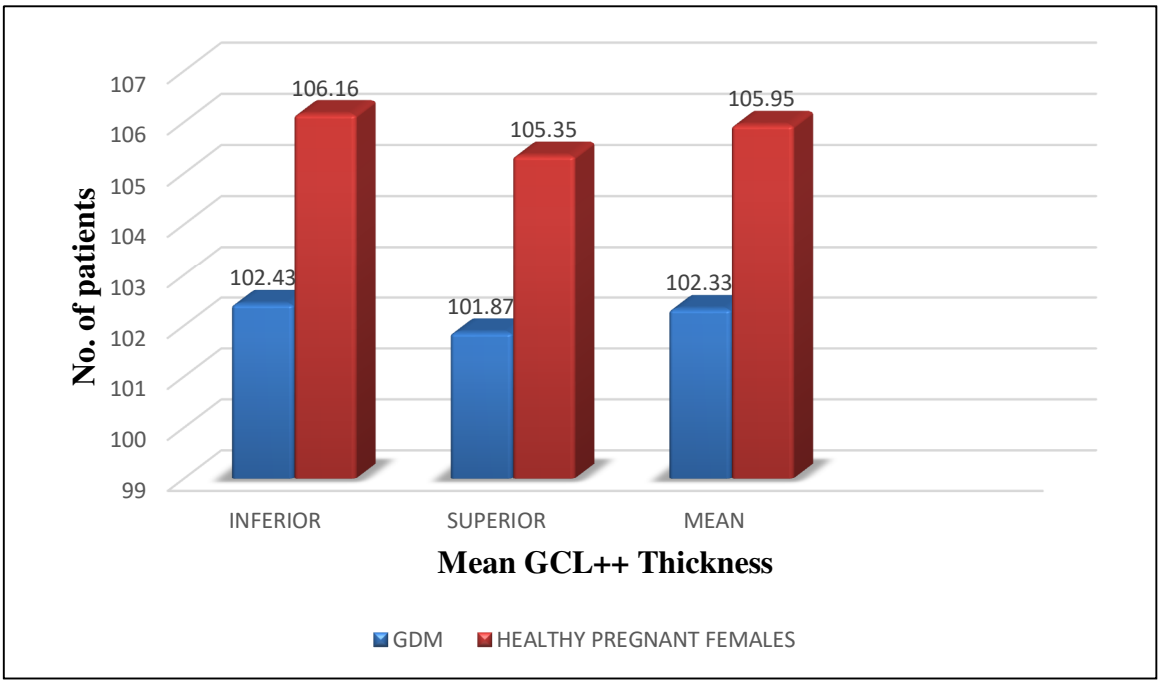


Figure 35 demonstrates that GCL++ thickness is more in healthy pregnant female group as compared to GDM patients.

DISCUSSION

DISCUSSION

Optical coherence tomography (OCT) is a three-dimensional imaging technology that uses light to acquire images from a scattering area.[6] OCT uses a technique known as low coherence interferometry to produce a cross-sectional map of the retina that is accurate to within 10-15 microns, which is one to two orders of magnitude better than conventional ultrasonography.[7] Diabetes developing during pregnancy, increases the incidence of Type II diabetes and contributes to mother and child morbidity. Gestational Diabetes Mellitus (GDM) is a type of diabetes that is diagnosed in the second or third trimester of pregnancy and is not type 1 or type 2. [25] Because patients with diabetic retinopathy are asymptomatic until they develop macular oedema or proliferative diabetic retinopathy, screening is critical.

The RNFL can be measured qualitatively during ophthalmoscopy and RNFL-enhanced photography in the clinical context, as well as statistically utilising a variety of imaging technologies designed for diagnosis and follow-up. The RNFL thickness map on OCT provides a view of the RNFL distribution profile over the optic disc (peripapillary area) and macular area. The RNFL thickness map and the RNFL thickness deviation map make RNFL faults easier to see. In the RNFL thickness deviation map, RNFL readings below the lower 95 percent normal distribution range in each super-pixel are highlighted and color-coded based on the probability of normality. Outside the lower 95th and 99th centiles, RNFL measurements are coded in yellow and red, respectively.[7]

There are studies which have evaluated the retinal nerve fibre layer thickness in peripapillary region mostly and few compared macular thickness in normal pregnancy and in gestational diabetes mellitus patients. In our study we included retinal nerve fibre layer thickness in macular and peripapillary region and Ganglion cell layer + Inner Plexiform layer thickness between patients with gestational diabetes mellitus and healthy pregnant females.

This study was a cross-sectional analytical study conducted on 324 patients (648 eyes) out of which 162 patients belonged to GDM group and 162 belonged to healthy pregnant group. The study was conducted at Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur in collaboration with the Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, Jodhpur. All patients in the study were assessed at 24 weeks or more gestational age.

Patients ranged in age from 19 to 40 years old, and statistical analysis revealed no significant age difference between the two groups. Pradhan et al[44] found a positive link between age and foveal thickness, but a negative correlation between age and other macula quadrants, i.e., his study showed that with advancing age, foveal thickness increases while the superior and inferior macula thins. Alamouti et al[45] found that both the total retinal thickness and the nerve fibre layer thickness significantly decrease with age. Foveal thickness decreased with age, according to Eriksson et al,[46] although research done by Chan A et al[47] and Kanai K et al[48] refuted this. Because the p value in our age comparison research was not significant, it had no effect on the RNFL variances in either group. There is no significant relationship between age and quadrant thinning in our study. There was no significant relationship between age and retinal thinning in the macula, peripapillary RNFL, GCL+ or GCL++ thickness in our study. Average age was 28 years in GDM group and 26 years in the healthy pregnant group, with majority of the subjects in the age group of 19-30 years. 68.52 % of healthy pregnant and 64.82% of GDM patients belonged to this category. Youngest female was 19 years old and oldest was 39 years old.

We have evaluated RNFL thickness in macular and peripapillary region with the help of OCT by dividing the paerpapillary region into four quadrants and macular, Ganglion cell layer + Inner Plexiform layer (GCL+) and GCL++ thickness in superior and inferior quadrants. This data was compared between healthy pregnant women and GDM patients, who had thinning in all four quadrants and significant thinning in all three quadrants (superior, nasal, and temporal). The average RNFL thickness also decreased significantly. This information was compared to data provided by Mansoori et al[33] and Minusasikumar et al[41] in healthy pregnant females. (Table 13)

Table 13: Comparison of RNFL thickness in healthy pregnant females between our study and Mansoori et al and Minu Sasikumar et al.

RNFL thickness	Present Study	Mansoori et al	Minu Sasikumar et al
Healthy pregnant group	106.77±8.44	113.9±10.7	100.75±41.55

When we compared the results of our study to those of Mansoori et al[33] in healthy pregnant females the mean values of peripapillary RNFL obtained in our study were lower, whereas values obtained in study done by Minusasikumar et al[41] in normal subjects were higher in our study. Pregnant women with GDM had even lower values.

Another case-control research by Demir M et al[40] used spectral domain optical coherence tomography to measure inferior and superior values of RNFL and GCC thickness in 123 individuals. The results of persons with type 2 diabetes were compared to those of healthy people. They discovered that people with type 2 diabetes had lower RNFL and GCC values than people without diabetes, although the difference was not statistically significant. As a result of this investigation, it was discovered that patients with type 2 diabetes have a nonsignificant loss of RNFL and GCC. But in our study, we compared these parameters between GDM and Healthy pregnant females group. We found that GCL+ thickness was found to be significantly lower in GDM group. It followed the same trend as macular RNFL thickness, with statistically significant ($p < 0.0001$) thinning in GDM group (68.30±4.83) when compared to healthy pregnant group (71.13±4.67).

Study done by T. Oshitari et al[32] has shown central macula was thicker in eyes with longer duration of DM. Our study showed that there was significant difference between the GDM group and the healthy pregnant group regarding the macular area in two quadrants- inferior and superior. The macular RNFL thickness in the inferior quadrant was found as 33.62±3.70 in the GDM group and it was 35.81±3.34 in the healthy pregnant female group. The superior part of the RNFL in right eye (31.48±4.06) as well as in the left eye (33.51±3.65) was significantly thinner in GDM group ($p < 0.0001$) when compared to healthy pregnant females with superior macular thickness of 34.52±3.46 in the right eye and 35.95±3.84 in the left eye.

Morteza Entezari et al[20] found that RNFL thickness increased during late pregnancy, then returned to normal 2-8 months after birth.

When pregnant women with GDM were compared to healthy pregnant groups in a cross-sectional study done by Amir et al,[37] there was no significant difference in mean macular and RNFL thickness. ($p > 0.05$).

Acmaz et al[21] studied three groups in a prospective cross-sectional study: There were 36 pregnant women with GDM in Group 1, 24 healthy pregnant women in Group 2, and 38 healthy non-pregnant women of reproductive age in Group 3. The examination was

performed using spectral domain optical coherence tomography (OCT). The thicknesses of the macular, choroid, and retinal nerve fibre layer (RNFL) in patients with GDM were measured, and comparisons were conducted between pregnant women with GDM, healthy pregnant women, and healthy non-pregnant women. They discovered that in the GDM group, the nasal region of the RNFL was substantially thinner than in the healthy pregnant group.

In our study we measured peripapillary RNFL thickness in four quadrants –Superior, inferior, nasal and temporal quadrants. All 4 quadrants of peripapillary RNFL analyzed showed thinning with significant thinning in superior ($p < 0.0001$), nasal ($p < 0.0001$) and temporal ($p < 0.0001$) quadrants except inferior quadrant ($p = 0.283$) in left eye of GDM group when compared with healthy pregnant group. Inferior quadrant showing maximum thickness (RE= 132.28±10.43 and LE=140.33±8.79) in GDM group when compared to healthy pregnant group (RE= 136.36±20.48 and LE=141.51±10.84) and temporal quadrant showing minimum thickness.

In women with pregestational type I or II diabetes, pregnancy causes PDR to deteriorate. According to previous research, the prevalence of DR is 57–62 percent at the initial examination in type I DM pregnancy and 17–28 percent in type II DM pregnancy. The Diabetes Control and Complications Trial (DCCT) and Research Group, as well as the Diabetes in Early Pregnancy (DIEP) investigations, discovered that retinopathy progression in pregnancy ranged from 8% to 70%.[21]

The literature is not clear on when the screening of pregnant women with GDM should begin. Because insulin resistance rises throughout the second trimester and glucose levels rise in women who do not make enough insulin to acquire this resistance, screening for GDM is commonly done between 24-28 weeks of pregnancy.[51]

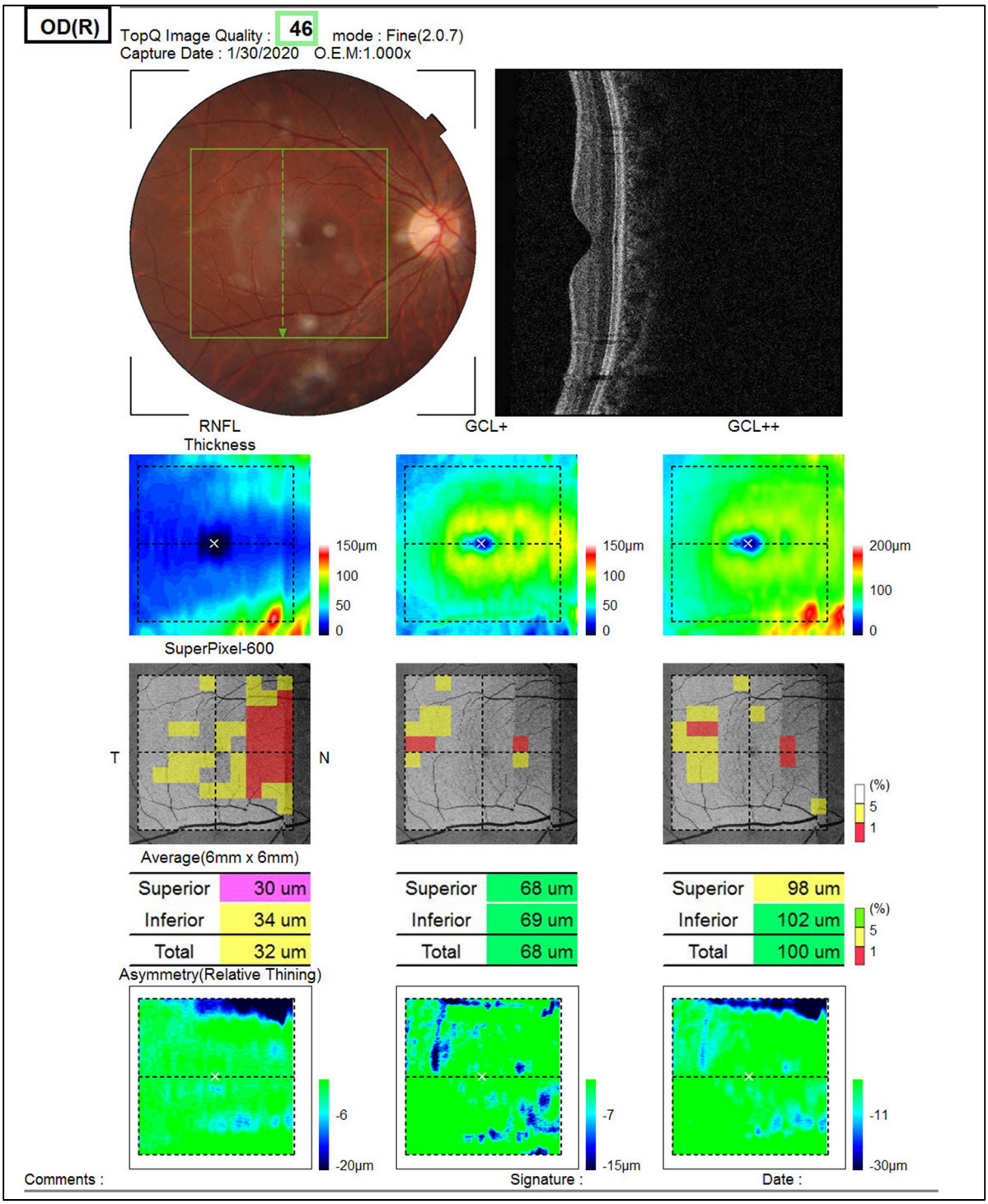


Figure 36: OCT report of our patient showing Macular RNFL, GCL+ and GCL++ thickness. (Source: Department Of Opthalmology, AIIMS Jodhpur)

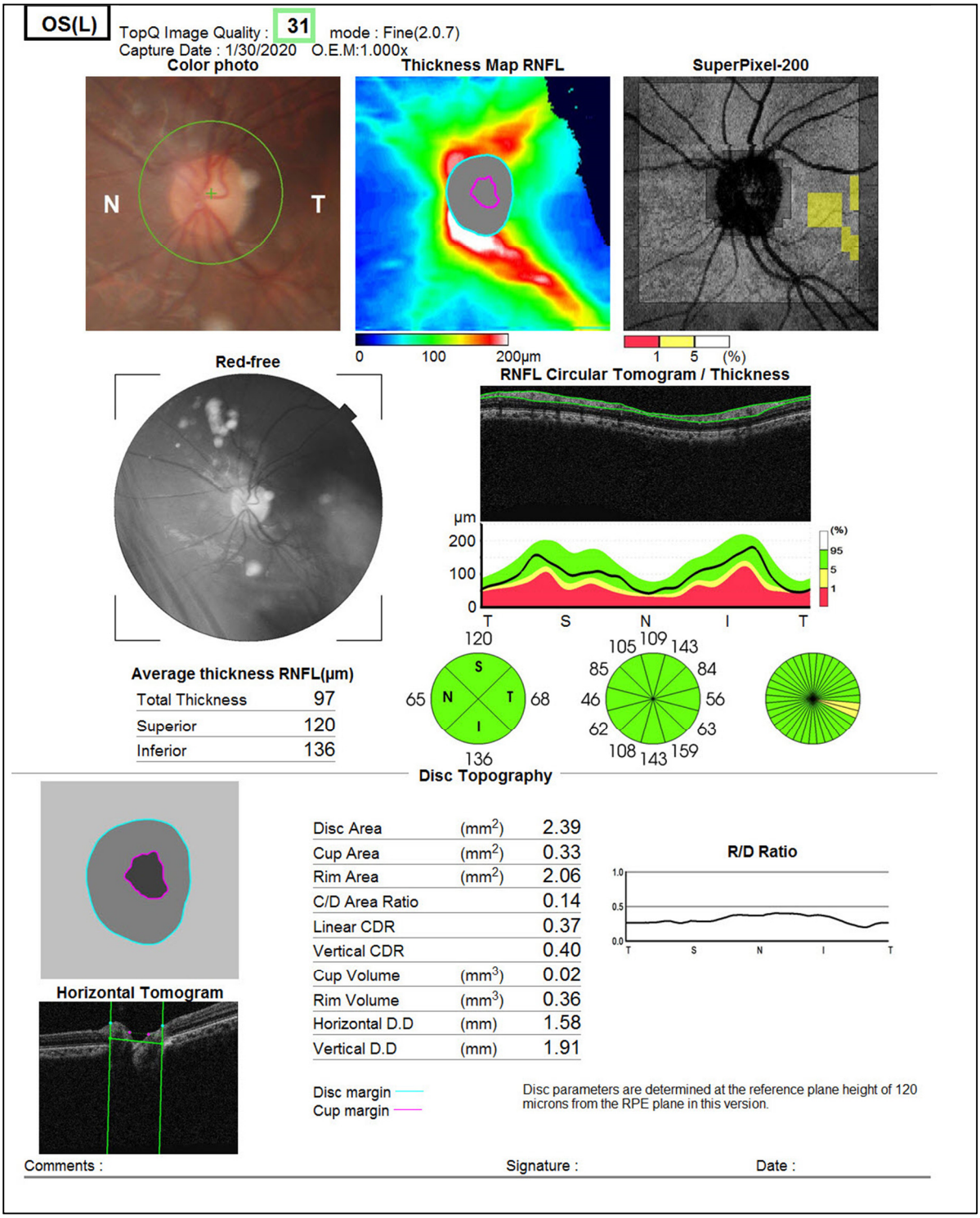


Figure 37: OCT report of our patient showing peripapillary RNFL thickness. (Source: Department Of Opthalmology, AIIMS Jodhpur)

CONCLUSION & LIMITATIONS

CONCLUSION

1. A total of 324 patients were enrolled in this study. They were categorized into 162 healthy pregnant group and 162 pregnant women with gestational diabetes mellitus.

2. In the GDM group 14 women were with the occupation (professionals) while in the healthy pregnant group only 18 were professionals.

3. The median monthly income was Rs. 30,500 in GDM group and Rs. 31,500 in healthy pregnant women group (which was calculated only for the participants with occupation).

4. 93.82% women in GDM group resided in the urban areas and 7.40% resided in the rural areas. 91.35% women in the healthy pregnant group resided in the urban areas whereas 8.64% belonged to rural area.

5. Previous history of GDM was present in 40 women in GDM group while only in 20 women in healthy pregnant group.

6. 121 (74.69%) GDM women and 22 (13.58%) healthy pregnant women had history of Diabetes in their family. While 41(25.30%) women in GDM group and 140 (86.41%) in healthy pregnant group had no family history of Diabetes.

7. Majority of the patients were 'illiterate' (37.03% in GDM group and 38.27% in healthy pregnant group) or fall in 'school's education' category (38.27% in GDM group and 40.74% in healthy pregnant group) in both the groups. 40 (24.69%) women in the GDM group and 34 (20.98%) in the healthy pregnant group were in 'above school's education' category.

8. The mean age in GDM group was 28.72±5.29 years and in healthy pregnant group was 28±5.27 years. Age ranged from 19-39 years in both the groups. Median age of GDM group was 28 years (24.75-34.00) while it was 26 years (24.00 - 32.00) in healthy pregnant group. Maximum patients in both the groups belonged to the age group of 19-30 years.

9. None of the GDM patients had HbA1c levels of less than 4.5. On the other hand, none of the patients in the healthy pregnant group had HbA1c level of $\geq$7.

10. **Mean Peripapillary RNFL** thickness was found to be 100.75±8.36 in the GDM group and 106.77±8.44 in the healthy pregnant group ($p < 0.0001$).

11. **Macular RNFL thickness (mean**) was significantly decreased in GDM group. There was a significant difference between the GDM group and the healthy pregnant group. The macular RNFL thickness was 33.62±3.70 in the GDM group and it was 35.81±3.34 in the healthy pregnant female group.

12. **GCL+ thickness mean** was found to be significantly lower in GDM group. It showed the same trend as macular RNFL thickness, with statistically significant (p value of < 0.0001) 68.30±4.83 in GDM group when compared to healthy pregnant group (71.13±4.67).

13. Furthermore, **Mean GCL ++ thickness** was found to be significantly lower in GDM group. GCL++ followed the same trend as macular and GCL+ thickness, with statistically significant (p value of < 0.0001) with 102.33±6.36 in GDM group when compared to control group (105.95±6.16).

14. Unaided Distance Visual Acuity (UDVA) of right eye on logMAR chart was 0.00 (6/6) in 46.91 % in GDM patients and 48.77% in healthy pregnant group. 23.46% patients in GDM group and 20.37% in healthy pregnant group had UDVA of 0.20. The BCVA of both the groups was 0.00 (6/6) on logMAR scale. Likewise 13.58% patients in GDM group and 12.96% patients in healthy pregnant group have UDVA of 0.60. 10.49% patients in GDM group and 11.11% in healthy pregnant group have UDVA of 0.80. While logMAR 1.0 UDVA was seen in 5.56% in GDM group and in 6.79% in healthy pregnant group. Similarly, maximum number of patients had a distance visual acuity of 0.00 on the logMAR scale in left eye as well.

15. DVA with pin hole in right eye on logMAR chart was 0.00 (6/6) in 91.98 % in GDM patients and 87.03% in healthy pregnant group. 6.79% patients in GDM group and 11.11% in healthy pregnant group had UDVA of 0.20. 1.23% patients in GDM group and 1.85% patients in healthy pregnant group have UDVA of 0.80. The similar findings were noted in the left eye as well in terms of 'DVA with pin hole' in the study population. Maximum number of patients had a distance visual acuity with pin hole of 0.00 on the logMAR scale in both the groups.

16. The intra-ocular pressure was comparable in both the groups. The mean IOP in the right eye was 14.12±2.02 in GDM group and 13.99±1.89 in the healthy pregnant women group (p = 0.534). IOP was 14.96±2.03 in left eye in GDM group and 14.67±2.20 in healthy pregnant group (p = 0.210).

17. The central corneal thickness (CCT) was also comparable in both groups, 537.40±13.23 in right eye in GDM group and 534.82±28.78 in healthy pregnant women group (p = 0.301) and 535.82±12.28 in left eye in GDM group and 537.25±13.26 in left eye in healthy pregnant women group (p = 0.316).

18. Schirmer test (type -1) done in both the groups, showed no significant difference between the two groups. In GDM patients, value of Schirmer test in the right eye was 24.13±2.84 mm and in the healthy pregnant group its value was 24.11±2.87 mm (p = 0.953). Similarly in the left eye of GDM patients it was 23.66±2.54 mm and in the healthy pregnant group it was 23.72±2.58 mm (p = 0.845).

19. Tear film break-up time (TBUT) was also comparable in both the groups. In GDM patients it was 12.38±1.09 seconds in right eye and 12.40±1.08 seconds in the right eye of healthy pregnant women (p = 0.919). Whereas in the left eye TBUT was 12.98±1.78 seconds in GDM group and 12.86±1.71 seconds in healthy pregnant group (p = 0.545).

LIMITATIONS

1. Our study was a cross-sectional study so we were not able to study the long term effects of diabetes in pregnant females.
2. Factors like gestational age were not equally distributed between the groups this may lead to bias.
3. The next limitation is that this study was conducted at only 1 center and on a small subset of Asian patients. Thus, caution should be exercised before generalizing these results to other races or ethnicities.
4. Comparison of blood glucose levels with retinal thinning has not been done in our study. Some studies has showed positive correlation with levels of fasting and 1 hr GTT levels.

BIBLIOGRAPHY

BIBLIOGRAPHY

[1] Huang D, Swanson EA, Lin CP, Schuman JS, Stinson WG, Chang W, et al. Optical coherence tomography. Science. 1991;254(5035):1178-81.

[2] Wojtkowski M, Srinivasan V, Fujimoto JG, Ko T, Schuman JS, Kowalczyk A, et al. Three dimensional retinal imaging with high speed ultrahigh-resolution optical coherence tomography. Ophthalmology 2005;112:1734-46.

[3] Metzger B, Gabbe S, Persson B, Lowe L, Dyer A, Oats J et al. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. Diabetes Care. 2010;33(7):e98-e98.

[4] Jarrett RJ. Reflections on gestational diabetes mellitus. Lancet. 1981;2(8257):1220-1.

[5] American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2010 Jan;33 Suppl 1:S62-9.

[6] Fujimoto JG, Pitris C, Boppart SA, Brezinski ME. Optical coherence tomography: an emerging technology for biomedical imaging and optical biopsy. Neoplasia. 2000;2(1-2):9–25.

[7] To E, Lam D, Leung C. Retinal Nerve Fiber Layer Imaging with Spectral-domain Optical Coherence Tomography (OCT)—A Review of the Cirrus HD-OCT. US Ophthalmic Review. 2011;04(01):12.

[8] Blumenthal EZ. Quantifying Retinal Nerve Fiber Layer Thickness Histologically: A Novel Approach to Sectioning of the Retina. Invest. Ophthalmol. Vis. Sci. 2004;45(5):1404-1409.

[9] Quigley HA, Addicks EM. Quantitative studies of retinal nerve fiber layer defects. Arch Ophthalmol. 1982;100:807–814.

[10] Mikelberg FS, Drance SM, Schulzer M, Yidegiligne HM, Weis MM. The normal human optic nerve: axon count and axon diameter distribution. Ophthalmology. 1989;96:1325–1328.

[11] Varma R, Skaf M, Barron E. Retinal nerve fiber layer thickness in normal human eyes. Ophthalmology. 1996;103:2114 – 2119.

[12] Knighton RW, Gregori G. The Shape of the Ganglion Cell plus Inner Plexiform Layers of the Normal Human Macula. Investig Opthalmology Vis Sci. 2012 Oct 30;53(11):7412.

[13] Curcio CA, Allen KA. Topography of ganglion cells in the human retina. J Comp Neurol. 1990;300:5–25.

[14] Soma-Pillay P, Nelson-Piercy C, Tolppanen H, Mebazaa A. Physiological changes in pregnancy. Cardiovasc J Afr. 2016 May 18;27(2):89–94.

[15] Locktich G. Clinical biochemistry of pregnancy. Crit Rev Clin Lab Sci. 1997;34(1):67-139.

[16] Kubicka-Trzaska A, Karska-Basta I, Kobylarz j, Romanowska-Dixon B, Pregnancy and the eye. KlinikaOczna.2007;110(10-12):401-04.

[17] Chawla S, Chaudhary T, Aggarwal S, Maiti GD, Jaiswal K, Yadav J. Ophthalmic considerations in pregnancy. Med J Armed Forces India. 2013;69(3):278-284.

[18] Chen HC, Newsom RSB, Patel V, Cassar J, Mather H, Kohner EM. Retinal Blood Flow Changes During Pregnancy in Women With Diabetes. Invest Ophthalmol. 1994;35(8):10.

[19] Getahun D, Nath C, Ananth CV, Chavez MR, Smulian JC. Gestational diabetes in the United States: temporal trends 1989 through 2004. Am J Obstet Gynecol. 2008;198:525.e1-525.e5.

[20] Arab M, Entezari M, Ghamary H, Ramezani A, Ashori A, Mowlazadeh A, et al. Peripapillary retinal nerve fiber layer thickness in preeclampsia and eclampsia. International Ophthalmology. Springer Nature. 2017 Sep 23;38(6):2289–94.

[21] Acmaz G, Atas M, Gulhan A, Acmaz B, Atas F, Aksoy H, et al. Assessment of Macular Peripapillary Nerve Fiber Layer and Choroidal Thickness Changes in Pregnant Women with Gestational Diabetes Mellitus, Healthy Pregnant Women, and Healthy Non-Pregnant Women. Med Sci Monit. 2015;21:1759–64.

[22] Cankaya C, Bozkurt M, Ulutas O: Total macular volume and foveal retinal thickness alterations in healthy pregnant women. Semin Ophthalmol. 2013;28:103–11.

[23] Wei Y, Yang H, Zhu W, Yang H, Li H, Yan J, et al. International Association of Diabetes and Pregnancy Study Group criteria is suitable for gestational diabetes mellitus diagnosis: further evidence from China. Chin Med J (Engl). 2014;127:3553–56.

[24] Vestgaard M, Ringholm L, Laugesen CS, Rasmussen KL, Damm P, Mathiesen ER. Pregnancy-induced sight threatening diabetic retinopathy in women with type 1 diabetes. Diabet Med. 2010;27:431–35.

[25] Siddiqui S, Waghdhare S, Panda M, Sinha S, Singh P, Dubey S, et al. Regional prevalence of gestational diabetes mellitus in North India. J Diabetol. 2019;10(1):25.

[26] Mithal A, Bansal B, Kalra S. Gestational diabetes in India: Science and society. Indian J Endocrinol Metab. 2015;19:701-4.

[27] Kühl C. Etiology and pathogenesis of gestational diabetes. Diabetes Care. 1998 Aug;21 Suppl 2:B19-26.

[28] Kampmann U. Gestational diabetes: A clinical update. World J Diabetes. 2015;6(8):1065.

[29] Yogev Y, Metzger BE, Hod M. Establishing diagnosis of gestational diabetes mellitus: Impact of the hyperglycemia and adverse pregnancy outcome study. Semin Fetal Neonatal Med. 2009;14:94–100.

[30] Feig DS, Zinman B, Wang X, Hux JE. Risk of development of diabetes mellitus after diagnosis of gestational diabetes. CMAJ. 2008;179:229–234.

[31] Sugimoto M, Sasoh M, Ido M, Wakitani Y, Takahashi C, Uji Y. Detection of early diabetic change with optical coherence tomography in type 2 diabetes mellitus patients without retinopathy. Ophthalmologica. 2005; 219:379–85.

[32] Oshitari T, Hanawa K, Adachi-Usami E. Changes of macular and RNFL thicknesses measured by Stratus OCT in patients with early stage diabetes. Eye. 2009;23:884–89.

[33] Mansoori T, Viswanath K, Balakrishna N. Quantification of retinal nerve fiber layer thickness using spectral domain optical coherence tomography in normal Indian population. Indian Journal of Ophthalmology. 2012;60(6):555.

[34] Park HYL, Kim IT, Park CK. Early diabetic changes in the nerve fibre layer at the macula detected by spectral domain optical coherence tomography. British Journal of Ophthalmology. 2011;95(9):1223-28.

[35] Zanella Benfica C, Zanella T, Farias L, Oppermann M, Canani L, Lavinsky D. Macular choroidal thickness in pregnant women with type 1, type 2 and gestational diabetes mellitus measured by spectral-domain optical coherence tomography. Clinical Ophthalmology. 2018;Volume 12:1259-1265.

[36] Salvi L, Plateroti P, Balducci S, Bollanti L, Conti FG, Vitale M, et al. Abnormalities of retinal ganglion cell complex at optical coherence tomography in patients with type 2 diabetes: a sign of diabetic polyneuropathy, not retinopathy. Journal of Diabetes and its Complications. 2015; 30(3):469-76.

[37] Tengku-Fatishah A, Nik-Ahmad-Zuky NL, Shatriah I. Macular and Retinal Nerve Fibre Layer Thickness in Pregnant Women with Gestational Diabetes Mellitus. Clin Ophthalmol. 2020 May 5;14:1215-1221.

[38] Ulusoy DM, Duru N, Ataş M, et al. Measurement of choroidal thickness and macular thickness during and after pregnancy. International Journal of Ophthalmology. 2015 ;8(2):321-325.

[39] Mundey K, Priya. Foveal and Parafoveal Retinal Thickness in Healthy Pregnant Rural North Indian Women. J Clin Biomed Sci. 2015;5(1):30-36.

[40] Demir M, Oba E, Sensoz H, Ozdal E. Retinal nerve fiber layer and ganglion cell complex thickness in patients with type 2 diabetes mellitus. Indian Journal of Ophthalmology. 2014;62(6):719.

[41] Sasikumar M, Kakknatt C, Mathai M. RNFL variation in gestational diabetes mellitus: An optical coherence tomography based study. Indian Journal of Clinical and Experimental Ophthalmology. April-June 2018;4(2):168-74.

[42] Lemp MP. Report of the National Eye Institute: Industry workshop on clinical trials. CLAO J. 1995;21:221-232.

[43] Sihota R, Tandon R. Parsons' Diseases of the Eye. 23rd Edition. India: Elsevier; 2019.

[44] Pradhan Z, Abraham L, Braganza A. Determinants of macular thickness in normal Indian eyes. Journal of Clinical Ophthalmology and Research. 2013;1(1):11.

[45] Alamouti B. Retinal thickness decreases with age: an OCT study. British Journal of Ophthalmology. 2003;87(7):899-901.

[46] Eriksson U, Alm A. Macular thickness decreases with age in normal eyes: a study on the macular thickness map protocol in the Stratus OCT. British Journal of Ophthalmology. 2008;93(11):1448-1452.

[47] Chan A. Normal Macular Thickness Measurements in Healthy Eyes Using Stratus Optical Coherence Tomography. Archives of Ophthalmology. 2006;124(2):193.

[48] Kanai K. Retinal Thickness and Changes with Age. Japanese Journal of Ophthalmology. 2002;46(5):595-596.

[49] Entezari M, Arab M, Barmachi A, Ghamary H, Ghavami B, Saraeian S. Comparison of Retinal Nerve Fiber Layer Thickness in Pregnancy and Postpartum Period. Journal Of Clinical And Diagnostic Research. 2018;12(1):QC05-QC07.

[50] Gokce G. Assessment of Macular Peripapillary Nerve Fiber Layer and Choroidal Thickness Changes in Pregnant Women with Gestational Diabetes Mellitus, Healthy Pregnant Women, and Healthy Non-Pregnant Women. Medical Science Monitor. 2015;21:1759-1764.

[51] Rani PR, Begum J. Screening and Diagnosis of Gestational Diabetes Mellitus, Where Do We Stand. Journal Of Clinical And Diagnostic Research. 2016;10(4):QE01-QE4.

ANNEXURES

ANNEXURE I (a)

अखिल भारतीय आयुर्विज्ञान संस्थान, जोधपुर
All India Institute of Medical Sciences, Jodhpur
संस्थागत नैतिकता समिति
Institutional Ethics Committee

No. AIIMS/IEC/2020/ 2065 **Date: 01/01/2020**

ETHICAL CLEARANCE CERTIFICATE

Certificate Reference Number: **AIIMS/IEC/2019-20/955**

Project title: **"Retinal thickness variation in patients with Gestational Diabetes Mellitus"**

Nature of Project:	**Research Project**
Submitted as:	**M.D. Dissertation**
Student Name:	**Dr.Shadman Parveen**
Guide:	**Dr.Kavita R. Bhatnagar**
Co-Guide:	**Dr.Pratibha Singh & Dr.Seema Meena**

This is to inform that members of Institutional Ethics Committee (Annexure attached) met on **23-12-2019** and after through consideration accorded its approval on above project. Further, should any other methodology be used, would require separate authorization.

The investigator may therefore commence the research from the date of this certificate, using the reference number indicated above.

Please note that the AIIMS IEC must be informed immediately of:

- Any material change in the conditions or undertakings mentioned in the document.
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Investigator must report to the AIIMS IEC in the prescribed format, where applicable, bi-annually, and at the end of the project, in respect of ethical compliance.

AIIMS IEC retains the right to withdraw or amend this if:

- Any unethical principle or practices are revealed or suspected
- Relevant information has been withheld or misrepresented

AIIMS IEC shall have an access to any information or data at any time during the course or after completion of the project.

On behalf of Ethics Committee, I wish you success in your research.

Dr. Praveen Sharma
Member secretary
Institutional Ethics Committee
AIIMS,Jodhpur

Enclose:
1. Annexure I

Page 1 of 2

Basni Phase-2, Jodhpur, Rajasthan-342005, **Website:** www.aiimsjodhpur.edu.in, **Phone:** 0291-2740741 Extn. 3109
Email: ethicscommittee@aiimsjodhpur.edu.in

ANNEXURE I (b)

Annexure I

Institutional Ethics Committee
All India Institution of Medical Sciences, Jodhpur

Meeting of Institutional Ethics committee held on **23-12-2019 at 10:00** AM at Committee Room, Admin Block AIIMS Jodhpur.

Following members were participated in the meeting:-

S/No.	Name of Member	Qualification	Role/Designation in Ethics Committee
1.	Dr. F.S.K Barar	MBBS, MD (Pharmacology)	**Chairman**
2.	Justice N.N Mathur	LLB	Legal Expert
3.	Dr. Varsha Sharma	M.A (Sociology)	Social Scientist
4.	Mr. B.S.Yadav	B.Sc., M.Sc. (Physics), B.Ed.	Lay Person
5.	Dr. K.R.Haldiya	MD (General Medicine)	Clinician
6.	Dr. Arvind Mathur	MBBS, MS (General Medicine)	Clinician
7.	Dr. Surajit Ghatak	MBBS, MS (Anatomy)	Basic Medical Scientist
8.	Dr. Vijaya Lakshmi Nag	MBBS, MD (Microbiology)	Basic Medical Scientist
9.	Dr. Sneha Ambwani	MBBS, MD (Pharmacology)	Basic Medical Scientist
10.	Dr. Kuldeep Singh	MBBS, MD (Paediatric), DM (General Medicine)	Clinician
11.	Dr. Abhinav Dixit	MBBS, MD (Physiology), DNB (Physiology)	Basic Medical Scientist
12.	Dr. Pradeep Kumar Bhatia	MBBS, MD (Anaesthesiology)	Clinician
13.	Dr. Tanuj Kanchan	MBBS, MD (Forensic Medicine)	Basic Medical Scientist
14.	Dr. Pankaj Bhardwaj	MBBS, MD (CM&FM)	Clinician
15.	Dr. Praveen Sharma	M.Sc., Ph.D. (Biochemistry)	Member Secretary

Dr. Praveen Sharma
Member secretary
Institutional Ethics Committee
AIIMS,Jodhpur

Page 2 of 2

ANNEXURE II

DATA COLLECTION SHEET

DATE	
NAME	
AIIMS ID/ REGISTRATION NUMBER	
AGE	
PERIOD OF GESTATION	
RELIGION	
ADDRESS:	
CONTACT NUMBER:	
ALTERNATE CONTACT NUMBER:	
PRIMARY COMPLAINTS WITH DURATION	
'ORY OF PAST ILLNESS	
HISTORY OF SYSTEMIC ILLNESS WITH DURATION	

PERSONAL HISTORY	
FAMILY HISTORY	

OCULAR EXAMINATION-

	RIGHT EYE	**LEFT EYE**
CE VISUAL ACUITY (UNAIDED)		
DISTANCE VISUAL ACUITY WITH PIN-HOLE		
AL ACUITY BEST CORRECTED		
NEAR VISION UNAIDED		
VISION WITH BEST CORRECTION		
IOP(mm of Hg)		
CCT(µ m)		
CORNEAL SENSATION		
SCHIRMER'S TEST(mm)		
TEAR FILM BREAK-UP TIME(TBUT) (sec)		
OCULAR SURFACE STAINING SCORE (Grading)		
MEIBOMIAN GLAND DYSFUNCTION (MGD) (Grading)		

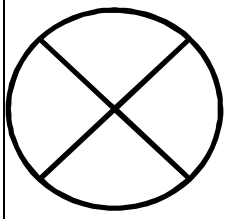
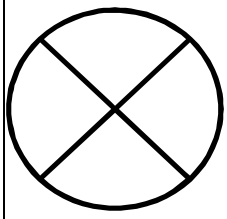
ANTERIOR SEGMENT EVALUATION:

RIGHT EYE	LEFT EYE

FUNDUS EXAMINATION-

RIGHT EYE	LEFT EYE

OCT FINDINGS-

	RIGHT EYE	LEFT EYE
PERIPAPILLARY RNFL THICKNESS (µ m)		
MACULAR RNFL THICKNESS (µ m)	SUPERIOR INFERIOR	SUPERIOR INFERIOR
GCL+ (µ m)	SUPERIOR INFERIOR	SUPERIOR INFERIOR

ANNEXURE III

All India Institute of Medical Sciences Jodhpur, Rajasthan

Informed Consent Form

Title of Thesis/Dissertation: Retinal thickness variation in patients with Gestational Diabetes Mellitus.

Name of PG Student: Dr. Shadman Parveen Tel. No 09455519536/ 6394612054

Patient/Volunteer Identification No._____

I,_____D/o_____R/o

_____give my full, free, voluntary consent to be a part of the study "Retinal thickness variation in patients with Gestational Diabetes Mellitus.", the procedure and nature of which has been explained to me in my own language to my full satisfaction. I confirm that I have had the opportunity to ask questions. I understand that my participation is voluntary and am aware of my right to opt out of the study at any time without giving any reason.

I understand that the information collected about me and any of my medical records may be looked at by responsible individual from Department of Ophthalmology, ALL INDIA INSTITUTE OF MEDICAL SCIENCES (AIIMS) or from regulatory authorities. I give permission for these individuals to have access to my records.

Date : _____ _____

Place :_____ Signature/Left thumb impression

This to certify that the above consent has been obtained in my presence. Date : ___

Place :_____ Signature of PG Student_____

1. Witness 1

_____

Signature

Name:_____

Address : _____

Phone No._____

2. Witness 2

_____

Signature

Name:_____

Address : _____

Phone No._____

ANNEXURE IV

अखिल भारतीय चिकित्सा विज्ञान संस्थान

जोधपुर, राजस्थान

सूचित सहमति प्रपत्र

थीसिस / निबंध का शीर्षक : जेस्टेशनल डायबिटीज मेलिटस के रोगियों में रेटिना की मोटाई में भिन्नता।

पीजी छात्रा का नाम: डॉ. शादमां परवीन । दूरभाष संख्या : 09455519536/ 6394612054

रोगी / स्वयंसेवी की पहचान._____मैं, _____

पुत्री_____अध्ययन का एक हिस्सा बनने के लिए मेरी पूर्ण, स्वतंत्र, स्वैच्छिक सहमति व्यक्त करती हूँ। थीसिस / निबंध का शीर्षक "**जेस्टेशनल डायबिटीज मेलिटस के रोगियों में रेटिना की मोटाई में भिन्नता।**"

जिस प्रक्रिया और प्रकृति को मुझे अपनी पूरी संतुष्टि के लिए अपनी भाषा में समझाया गया है मैं पुष्टि करती हूं कि मुझे प्रश्न पूछने का अवसर मिला है। मैं समझती हूं कि मेरी भागीदारी स्वैच्छिक है और मुझे किसी भी कारण दिए बिना किसी भी समय अध्ययन से बाहर निकलने के मेरे अधिकार की जानकारी है। मैं समझती हूं कि मेरे और मेरे मेडिकल रिकॉर्ड के बारे में एकत्रित की गई जानकारी को नेत्र विज्ञान विभाग, अखिल भारतीय चिकित्सा विज्ञान संस्थान से जिम्मेदार व्यक्ति द्वारा देखा जा सकता है। मैं इन व्यक्तियों को अपने अभिलेखों तक पहुंच के लिए अनुमति देती हूं।

हस्ताक्षर / बाएं अंगूठे का छाप
यह प्रमाणित करने के लिए कि मेरी उपस्थिति में उपरोक्त सहमति प्राप्त की गई है।
तारीख : _____ **स्थान**: _____ **पीजी छात्रा के हस्ताक्षर**_____

1. **गवाह** 1
हस्ताक्षर :
नाम: _____
पता :_____

2. **गवाह** 2
हस्ताक्षर:
नाम: _____
पता : _____

ANNEXURE V

PATIENT INFORMATION SHEET

Title of Thesis/Dissertation: Retinal thickness variation in patients with Gestational Diabetes Mellitus.

You are invited to take part in this research study. Before you decide whether or not to take part it is important for you to understand why the research is being done and what will it involve. Please take your time to read the information and then decide. Queries if any will be addressed. This study aims to compare Optical Coherence Tomography based Retinal Nerve Fibre Layer thickness at the Disc and Macula, Ganglion Cell +Inner Plexiform (GCL+) Layer thickness in women with Gestational Diabetes Mellitus vs healthy pregnant women.

1) Why have I been chosen to take part in the study?

   You have been chosen to take part in the study because you are a known case of Gestational Diabetes Mellitus (GDM). You will be evaluated for different parameters as specified in the title of the study apart from a basic ophthalmological examination. In case you do not belong to the study group, you have been chosen for the research because you are a healthy pregnant female and you belong to the control group.

2) What is the purpose of the study?

   The purpose of the study is to assess the retinal thickness around the optic disc and central seeing area of your eye. This is to find out if there exists any significant difference in the retinal thickness between pregnant females with gestational diabetes mellitus, when compared to healthy pregnant females, in order to understand, if retinal thickness can be used as an effective screening tool, for detecting early changes of diabetes in the eye. This data will aid in devising an early preventive and treatment strategy for decreasing visual impairment in similar patients.

3) Do I have to take part in the study?

   You will be given a Patient Information Sheet and you will be explained about the procedure and nature of the study in your own language. It is up-to you to decide whether or not to take part in the study. In case you decide to take part, you are expected to sign the consent form after thoroughly reading the patient information sheet. If you are not comfortable with the

procedures, you can withdraw your participation from the study, at any time, without giving any reasons.

4) What will happen to me if I take part in the research?

This study is an Analytical cross-sectional study and is a one-time screening. You will be subjected to a history taking and examination. The examination will involve measuring your IOP, CCT, corneal sensations, Schirmer's Test, Tear film break-up time, ocular surface staining score and meibomian gland dysfunction grading, if any. You will then be examined on a slit lamp to evaluate your anterior segment. After this the pupil of your both the eyes will be dilated with 1% Tropicamide eye drop 3 times at the interval of 15 minutes to achieve adequate dilation of pupil. This will be followed by posterior segment evaluation and Ocular Coherence Tomography Imaging where the thickness of your nerve fiber layer of retina around the disc and macula will be evaluated. In addition to this, the ganglion cell layer and inner plexiform layer thickness will also be evaluated. The dilating drops will tend to blurring of vision for next 3-4 hours, hence you should be accompanied by an attendant.

5) What do I have to do?

After giving a written consent, you will have to cooperate for basic investigations being performed like, IOP, CCT, corneal sensations, Schirmer's Test, tear film break-up time, ocular surface staining score and meibomian gland dysfunction grading, if any, and both anterior and posterior segment examination and imaging on OCT machine. This is an analytical cross-sectional study and no follow up from your side will be required.

6) What are the possible benefits of taking part in the study?

Your anterior and posterior segment parameters will be evaluated and you will be screened for any ocular abnormalities. As it is an established fact that gestational diabetes mellitus increases the risk of developing type 2 diabetes mellitus and diabetic retinopathy later in life, hence taking part in this study will improve your odds of being diagnosed with diabetic retinopathy at an early stage, before the microvascular complications like macular oedema and proliferative retinopathy evolve. Moreover, if any significant retinal changes are noted after evaluation, you will be subjected to preventive strategies and you will be a candidate for early treatment, if required.

7) What are the possible side effects of taking part in the study?

Tropicamide 1% which will be instilled for dilating the pupil leads to blurring of near vision and may also cause sensitivity to light. However, this is a temporary effect which lasts only for 3-4 hours from instillation of the drug. There are no additional side effects of taking part in the study.

8) Will my data be kept confidential?

Your medical records and demographic data will be disclosed only to the researcher, treating physician and concerned authorities.

ANNEXURE VI

रोगी सूचना पत्रक

थीसिस / निबंध का शीर्षक-

जेस्टेशनल डायबिटीज मेलिटस के रोगियों में रेटिना की मोटाई में भिन्नता।

आपको इस शोध अध्ययन में भाग लेने के लिए आमंत्रित किया जाता है।भाग लेना है या नहीं ,यह तय करने से पहले यह आपके लिए समझना महत्वपूर्ण है कि शोध क्यों किया जा रहा है और इसमें क्या शामिल होगा। कृपया जानकारी पढ़ने और फिर तय करने के लिए अपना समय लें। आपके हर प्रश्न को संबोधित किया जाएगा। इस अध्ययन का उद्देश्य ऑप्टिकल कोहरेन्स टोमोग्राफी आधारित रेटिना तंत्रिका फाइबर परत और गन्ग्लिओनिक सेल + परत भिन्नता गर्भकालीन मधुमेह मेलिटस में परिवर्तन का आकलन करना है ।

1) **अध्ययन में भाग लेने के लिए मुझे क्यों चुना गया है**?

आपको अध्ययन में भाग लेने के लिए चुना गया है क्योंकि आप जेस्टेशनल डायबिटीज़ मेलिटस के एक रोगी हैं। आपको एक बुनियादी नेत्र विज्ञान परीक्षा के अलावा अध्ययन के शीर्षक में निर्दिष्ट विभिन्न मापदंडों के लिए मूल्यांकन किया जाएगा। यदि आप अध्ययन समूह से संबंधित नहीं हैं, तो आपको अध्ययन के लिए चुना गया है क्योंकि आप एक स्वस्थ गर्भवती महिला हैं और आप तुलना समूह से संबंधित हैं।

2) **अध्ययन का उद्देश्य क्या है**?

अध्ययन का उद्देश्य ऑप्टिक डिस्क और आपकी आंख के केंद्रीय देखने के क्षेत्र के आसपास रेटिना की मोटाई का आकलन करना है। यह पता लगाना है कि स्वस्थ गर्भवती महिलाओं की तुलना में गर्भकालीन मधुमेह मेलिटस के साथ गर्भवती महिलाओं के बीच रेटिना की मोटाई में कोई महत्वपूर्ण अंतर मौजूद है या नहीं, समझने के लिए, यदि रेटिना की मोटाई का उपयोग एक प्रभावी स्क्रीनिंग उपकरण के रूप में किया जा सकता है, आंखों में मधुमेह के शुरुआती परिवर्तनों का पता लगाने के

लिए। यह डेटा समान रोगियों में दृश्य हानि को कम करने के लिए एक प्रारंभिक निवारक और उपचार रणनीति तैयार करने में सहायता करेगा।

3) **क्या मुझे अध्ययन में हिस्सा लेना जरूरी है**?

आपको एक रोगी सूचना पत्र दिया जाएगा और आपको अपनी भाषा में अध्ययन की प्रक्रिया और प्रकृति के बारे में समझाया जाएगा। अध्ययन में भाग लेना है या नहीं, यह आपको तय करना है। यदि आप भाग लेने का निर्णय लेते हैं, तो आपसे अपेक्षा की जाती है कि आप रोगी सूचना पत्र को अच्छी तरह से पढ़ने के बाद सहमति पत्र पर हस्ताक्षर करेंगे। यदि आप प्रक्रियाओं के साथ सहज नहीं हैं, तो आप कोई कारण बताए बिना, किसी भी समय, अध्ययन से अपनी भागीदारी वापस ले सकते हैं ।

4) **यदि मैं अध्ययन में भाग लेती हूं तो मेरे साथ क्या होगा**?

यह अध्ययन एक विश्लेषणात्मक क्रॉस-अनुभागीय अध्ययन है और एक बार की स्क्रीनिंग है। आप एक इतिहास लेने और परीक्षा के अधीन होंगे। परीक्षा में आपके आईओपी, सीसीटी और शिमर टेस्ट, आंसू फिल्म ब्रेक-अप समय, ऑक्यूलर सतह स्टैनिंग स्कोर और मैंबोमिअन ग्रंथि शिथिलता ग्रेडिंग, यदि कोई हो, शामिल होंगे। फिर आपको अपने पूर्वकाल खंड का मूल्यांकन करने के लिए एक स्लिट लैंप पर जांच की जाएगी। इसके बाद आपकी दोनों आँखों की पुतली के पर्याप्त फैलाव को प्राप्त करने के लिए 15 मिनट के अंतराल पर 1% ट्रॉपिकैमाइड आई ड्रॉप 3 बार डाला जाएगा । इसके पश्चात पीछे के सेगमेंट का मूल्यांकन और ऑकुलर कोऑरेंस टोमोग्राफी इमेजिंग किया जाएगा जहां डिस्क और मैक्युला के आसपास रेटिना की आपकी तंत्रिका फाइबर परत की मोटाई का मूल्यांकन किया जाएगा। इसके अलावा, नाड़ीग्रन्थि सेल परत और आंतरिक परत की मोटाई का भी मूल्यांकन किया जाएगा। पुतली फैलने वाली बूंदें अगले 3-4 घंटों के लिए दृष्टि के धुंधला कर सकती है, इसलिए आपको एक परिचर के साथ होना चाहिए।

5) **मुझे क्या करना होगा**?

आपको एक लिखित सहमति पत्र देने के बाद, आईओपी, सीसीटी, शिमर के टेस्ट, आंसू फिल्म ब्रेक-

अप समय, ऑक्यूलर सतह स्टैनिंग स्कोर और मैंबोमिअन ग्रंथि शिथिलता ग्रेडिंग, यदि कोई हो, पोस्टीरियर सेगमेंट इमेजिंग और ऑकुलर कोऑरेंस टोमोग्राफी मशीन पर इमेजिंग जैसी बुनियादी जांच के लिए सहयोग करना होगा। यह एक विश्लेषणात्मक क्रॉस-अनुभागीय अध्ययन है और आपके पक्ष से किसी भी अनुवर्ती की आवश्यकता नहीं होगी।

6) **अध्ययन में भाग लेने के संभावित लाभ क्या हैं**?

आपके पूर्वकाल और पीछे के खंड मापदंडों का मूल्यांकन किया जाएगा और आपको उन सभी मापदंडों में असामान्यताओं के लिए स्क्रीन किया जाएगा। जैसा कि यह एक स्थापित तथ्य है कि गर्भावधि मधुमेह मेलेटस जीवन में बाद में टाइप 2 मधुमेह मेलेटस और डायबिटिक रेटिनोपैथी के विकास के जोखिम को बढ़ाता है, इसलिए इस अध्ययन में भाग लेने से मैक्युलर एडिमा और प्रोलिफ़ेरेटिव रेटिनोपैथी जैसी माइक्रोवास्कुलर जटिलताएं होने से पहले प्रारंभिक अवस्था में डायबिटिक रेटिनोपैथी का निदान होने की संभावना बढ़ जाएगी। इसके अलावा, यदि अध्ययन के बाद कोई महत्वपूर्ण रेटिना परिवर्तन पाया जाता है, तो आपको निवारक रणनीतियों के अधीन किया जाएगा, यदि आप आवश्यक हो तो उपचार के लिए एक प्रारंभिक उम्मीदवार होंगे।

7) **अध्ययन में भाग लेने के संभावित दुष्प्रभाव क्या हैं**?

ट्रोपिकमाइड 1% जो पुतली के पर्याप्त फैलाव को प्राप्त करने के लिए डाला जाएगा, निकट दृष्टि को धुंधला कर सकता है और प्रकाश के प्रति संवेदनशीलता भी पैदा कर सकता है। हालांकि यह एक अस्थायी प्रभाव है जो दवा के टपकाने से केवल 3-4 घंटे तक रहता है ,अध्ययन में भाग लेने के कोई भी अतिरिक्त दुष्प्रभाव नहीं हैं।

8) **क्या मेरा डेटा गोपनीय रखा जाएगा**?

आपके मेडिकल रिकॉर्ड और जनसांख्यिकीय डेटा का केवल शोधकर्ता, चिकित्सक और संबंधित अधिकारियों के सामने खुलासा किया जाएगा।

Visual acuity scales

Foot	Metre	Decimal	LogMAR
20/200	6/60	0.10	1.00
20/160	6/48	0.125	0.90
20/125	6/38	0.16	0.80
20/100	6/30	0.20	0.70
20/80	6/24	0.25	0.60
20/63	6/19	0.32	0.50
20/50	6/15	0.40	0.40
20/40	6/12	0.50	0.30
20/32	6/9.5	0.63	0.20
20/25	6/7.5	0.80	0.10
20/20	6/6	1.00	0.00
20/16	6/4.8	1.25	−0.10
20/12.5	6/3.8	1.60	−0.20
20/10	6/3	2.00	−0.30

S.no	Consent	Name	AIIMS ID	Address	Education level	Occupation	Income (Median monthly income in rupees)
1	YES	URMILA PATEL	AIIMS/JDH/2021/03/011927	Maderna Colony, 342007, Jodhpur.	Above school's education	Housewife	NIL
2	YES	RIYA	AIIMS/JDH/2021/02/004639	259, Roop Nagar 1 Pal Road, Jodhpur	School's education	Housewife	NIL
3	YES	POOJA LADAR	AIIMS/JDH/2021/01/010960	GOLIYA JETMAL, Barmer.	Above school's education.	Professional	15000
4	YES	SUMAN SUTHAR	AIIMS/JDH/2021/01/013266	Mandor , Jodhpur, 42 BN Itbp Paladi Khichiyan	School's education	Housewife	NIL
5	YES	SHREYA SHARMA	AIIMS/JDH/2021/05/003049	Kudi Housing Board, Jodhpur	Above school's education.	Professional	17000
6	YES	EKTA SHARMA	AIIMS/JDH/2016/05/008144	211, Near Reliance Tower , Nezia Khera , Sirsa	Illiterate	Housewife	NIL
7	YES	PUSHPA PANDEY	AIIMS/JDH/2020/10/005853	173, VRINDAVAN BAGACHI, Barmer, BALOTRA	Illiterate	Housewife	NIL
8	YES	TARA DEVI	AIIMS/JDH/2020/07/008635	259, Roop Nagar 1 Pal Road, JODHPUR	Illiterate	Housewife	NIL
9	YES	SUMAN.	AIIMS/JDH/2021/04/009074	330, Sukh Sager, Barmer, BALOTRA	Above school's education.	Housewife	NIL
10	YES	MANJU	AIIMS/JDH/2021/01/018688	851, Sec19 Chb, Jodhpur.	School's education	Housewife	NIL
11	YES	KIRAN CHOUDHARY	AIIMS/JDH/2021/04/005580	C Hh, Madhunan, Basni, Jodhpur.	School's education	Housewife	NIL
12	YES	JYOTI KANWAR	AIIMS/JDH/2020/05/002100	Shanthipura, Hathi Ram Ka Odha, JODHPUR	Illiterate	Housewife	NIL
13	YES	SUSHMITA GEHLOT	AIIMS/JDH/2021/01/012339	97, Dedipanada, Jodhpur, Rajasthan	Illiterate	Housewife	NIL
14	YES	VINITA BALA	AIIMS/JDH/2014/05/000400	ARIHANT COLONY, BILARA, Jodhpur.	Above school's education.	Professional	20000
15	YES	MOOL KANWAR	AIIMS/JDH/2020/10/004030	Opposite Battle Axe House, Nehru Colony, Defence Lab,	Illiterate	Housewife	NIL
16	YES	RITIKA DHARIWAL	AIIMS/JDH/2020/12/010110	7-K-97, Kudi Bhagtasni Housing Board, Sector 2, Jodhpur	Illiterate	Housewife	NIL
17	YES	MANJU	AIIMS/JDH/2021/03/011597	66 Phase-2, Roop Rajat Township, Jodhpur.	Illiterate	Housewife	NIL
18	YES	RITU JAKHAR	AIIMS/JDH/2014/05/004341	9610, RAJBAG MEGHWAL BASTI SOORSAGAR, JO	Illiterate	Housewife	NIL
19	YES	SANGITA GEHLOT	AIIMS/JDH/2020/10/000629	P/11, Behind Police Station, Jodhpur.	Above school's education.	Housewife	NIL
20	YES	SNEHLATA	AIIMS/JDH/2020/01/017478	Pamdit Ji Ki Dhani, , Jodhpur.	School's education	Housewife	NIL
21	YES	MADHU SONI	AIIMS/JDH/2018/01/027735	Quarter No P11, Begin Police Station, Mandore, Jodhpur.	School's education	Housewife	NIL
22	YES	RITU.	AIIMS/JDH/2020/10/003063	P/11, Behind Police Station Mandore, Jodhpur.	Above school's education.	Housewife	NIL
23	YES	PRIYANKA CHOUDHARY	AIIMS/JDH/2020/10/008499	38/107 Ram Dev Nagar Nandri, , Jodhpur.	School's education	Housewife	NIL
24	YES	SHOBHA KUMARI	AIIMS/JDH/2021/03/008939	43-44 , Ashapurna Valley Ext, Sangaria, Jodhpur, Jhalama	School's education	Housewife	NIL
25	YES	PAYAL JAIN	AIIMS/JDH/2021/03/002776	Opposite Battle Axe House, Nehru Colony, Defence Lab,	School's education	Housewife	NIL
26	YES	KINA DEVI	AIIMS/JDH/2020/09/011108	53-54, Mangal Vihar, Jodhpur, Paota C Road	School's education	Professional	25000
27	YES	SITA	AIIMS/JDH/2021/04/008303	Ambav Ji Ka Bas, Gaanv Beda, Teh, Bali, Pali	School's education	Housewife	NIL
28	YES	KAVITA DEVI	AIIMS/JDH/2021/04/003994	RAM NAGAR, H O BARMER.	School's education	Housewife	NIL
29	YES	DIKSHA	AIIMS/JDH/2020/10/001952	259, Roop Nagar 1 Pal Road, JODHPUR	Illiterate	Housewife	NIL
30	YES	RINKU RAJPUROHIT	AIIMS/JDH/2021/04/007099	02 J 33, 1st Puliya , Jodhpur, Chopasani Housing Board	Illiterate	Housewife	NIL
31	YES	JOLLY MULANI	AIIMS/JDH/2020/10/004457	66 Phase-2, Roop Rajat Township, Jodhpur.	Illiterate	Housewife	NIL
32	YES	BHAWANA	AIIMS/JDH/2021/04/007383	1234, BANGARO KI DHANI, BAYTU, BAYTU	Illiterate	Housewife	NIL
33	YES	JYOTI SHARMA	AIIMS/JDH/2021/01/018212	Bangaro Ki Dhani, Barmer, Baytu Chimanji.	Above school's education.	Housewife	NIL
34	YES	TRIKSHITA	AIIMS/JDH/2021/01/020617	12, CHHIPO KA BAS, Jodhpur, DHAWA.	School's education	Housewife	NIL
35	YES	SAJNI	AIIMS/JDH/2021/03/005082	Bhaloni Sauo Ki Dhani, Batadu, Barmer.	School's education	Housewife	NIL
36	YES	NIRMALA BODHIJA	AIIMS/JDH/2021/04/002295	PANCHAL KHURD DEDADON KI HDANIYO TEH O	Above school's education.	Professional	20000
37	YES	SEEMA	AIIMS/JDH/2021/04/002938	OSIAN, Jodhpur	School's education	Housewife	NIL
38	YES	NISHA	AIIMS/JDH/2021/02/010714	TAPRA , Barmer	Illiterate	Housewife	NIL
39	YES	RADHIKA BIYANI	AIIMS/JDH/2020/09/001427	Roop Nagar, Jodhpur.	Illiterate	Housewife	NIL
40	YES	BHAGYASGREE PUROHIT	AIIMS/JDH/2021/04/003997	787, Bapu Nagar Vistar, Pali.	Illiterate	Housewife	NIL
41	YES	JYOTSANA MANGLIYA	AIIMS/JDH/2021/03/012987	KHAWASPURA , JODHPUR	Illiterate	Housewife	NIL
42	YES	VIMLA	AIIMS/JDH/2021/03/000817	TADAU KA BASS, TADAWAS, Nagaur.	Illiterate	Housewife	NIL
43	YES	DISHA PALIWAL	AIIMS/JDH/2020/12/004378	11, Jato Ka Bass, Nagaur	Above school's education.	Housewife	NIL
44	YES	SANDHYA KANWAR	AIIMS/JDH/2020/10/002071	985, Khtiko Ka Bas, Baori, Jodhpur	School's education	Housewife	NIL
45	YES	ANJU	AIIMS/JDH/2021/04/001713	Pal Balaji, Pal Road Jodhpur, Pal, Jodhpur, Thoriyon Ki I	Above school's education.	Professional	50000
46	YES	MANJU KANWAR	AIIMS/JDH/2020/11/001183	383 Sarno Ki Dhaniyaa, Jagdamba Nagar, Jodhpur, Panch	School's education	Housewife	NIL
47	YES	SANGEETA VISHNOI	AIIMS/JDH/2020/06/002257	BINAWAS, Jodhpur, BILARA	Above school's education.	Housewife	NIL
48	YES	SURAJA CHAUHAN	AIIMS/JDH/2018/06/007576	B-96 , Shastri Nagar, Jodhpur	School's education	Housewife	NIL
49	YES	PREETI SHARMA	AIIMS/JDH/2021/04/000018	101, Dewaso Ka Bas, Chopra, Pali, Potaliya	Illiterate	Housewife	NIL
50	YES	MADHWI KUMARI	AIIMS/JDH/2020/08/001211	SADA ARAIN SANDHRA, Hoshiarpur, SANDHRA	School's education	Housewife	NIL
51	YES	SUMAN HARISHKUMAR SUTH	AIIMS/JDH/2021/03/002934	Vpo - Khangta, Teh- Pipar City, Khangta, District- Jodhpu	School's education	Housewife	NIL
52	YES	REENU KUMARI KUMAWAT	AIIMS/JDH/2020/12/002766	Randha, Modha, Jaisalmer, Modha	School's education	Housewife	NIL
53	YES	HANSA SHARMA	AIIMS/JDH/2021/01/022448	Jodhpur, Bhundel Nagaur	Above school's education.	Professional	40000
54	YES	NEHA KANWAR SISODIYA	AIIMS/JDH/2020/10/004560	Barmer, Rjasthan.	Illiterate	Housewife	NIL
55	YES	SHILPI	AIIMS/JDH/2021/03/016589	MAHADEV NAGAR, SANGARIYA, JODHPUR	Illiterate	Housewife	NIL
56	YES	RASHMI JANGID	AIIMS/JDH/2020/12/001058	160, Mahaveer Nagar, Sangriya, Jodhpur.	Illiterate	Housewife	NIL
57	YES	TEENA SONI	AIIMS/JDH/2020/01/026098	Ashok Colony , Ramsagar Chauraha, Jodhpur	Illiterate	Housewife	NIL
58	YES	SONIYA	AIIMS/JDH/2020/11/004799	Saando Ki Pole, Rakhi House, K.k. Chowk, Jodhpur.	Illiterate	Housewife	NIL
59	YES	SANGEETA KUMAWAT	AIIMS/JDH/2020/08/000606	B-36 chandandeep Paota Jodhpur , Dharam Narayan ji ka	School's education	Housewife	NIL
60	YES	MISBAH	AIIMS/JDH/2020/09/003529	B-36 Chandan Deep, Dharamnarayan Ji Ka Hatha Paota, I	Above school's education.	Professional	45000
61	YES	NIRMA DEVI	AIIMS/JDH/2020/02/004566	BHATO KI DHANI , NAGANA , PACHAPADRA, Barm	School's education	Housewife	NIL
62	YES	SHEELA	AIIMS/JDH/2020/09/008236	Barmer, Jak Gidan	School's education	Housewife	NIL
63	YES	PRIYANKA KHARE	AIIMS/JDH/2020/10/005370	282, Udai Nagar, Phalodi, Baorikalan	Illiterate	Housewife	NIL
64	YES	SONU KUMARI	AIIMS/JDH/2020/08/009096	TADAU KA BASS, TADAWAS, Nagaur.	Illiterate	Housewife	NIL
65	YES	POOJA RATHI	AIIMS/JDH/2020/10/009136	66 Phase-2, Roop Rajat Township, Jodhpur.	Illiterate	Housewife	NIL
66	YES	MOHINI SHARMA	AIIMS/JDH/2020/12/005405	247 B, Bagat Ki Koti, Jodhpur.	Above school's education.	Professional	28000
67	YES	KANCHAN KANWAR	AIIMS/JDH/2020/10/006330	1st C Road, Shastri Nagar Post Office, Jodhpur, Sardarpu	School's education	Housewife	NIL
68	YES	SAROJ	AIIMS/JDH/2019/06/007890	Badi Dhani, Badi Dhani, Thoi, Sikar.	School's education	Housewife	NIL
69	YES	NEELAM SHEKHAWAT	AIIMS/JDH/2020/10/004862	Dhorimanna, Barmer,	Above school's education.	Housewife	NIL
70	YES	SHAHNAZ	AIIMS/JDH/2016/07/003508	VISHNOI BAS, Nagar	School's education	Housewife	NIL
71	YES	SHEETAL	AIIMS/JDH/2021/03/006564	A/1, Bank Colony, Paota P.O, Jodhpur, Raika	School's education	Housewife	NIL
72	YES	BHAWANA	AIIMS/JDH/2020/08/005327	Surana Nagar, Arsinghpura, Ajmer	School's education	Housewife	NIL
73	YES	MINAKSHI	AIIMS/JDH/2021/03/006539	20, Tibo KiDhani, Khijan, Jodhpur, Jodhpur.	School's education	Housewife	NIL
74	YES	RANJANA	AIIMS/JDH/2021/01/015419	22, NEHRU PARK RAILWAY COLONY, JODHPUR	Above school's education.	Housewife	NIL
75	YES	POOJA DHAYAL	AIIMS/JDH/2020/08/003760	PALI, JODHPUR	School's education	Housewife	NIL
76	YES	SUSHMITA GEHLOT.	AIIMS/JDH/2021/03/011324	789, PHALODI, JODHPUR	School's education	Housewife	NIL
77	YES	SHOBHA.	AIIMS/JDH/2020/08/008983	Nagaur.	Illiterate	Housewife	NIL
78	YES	SAKSHI	AIIMS/JDH/2020/05/000371	C.h.b, Jodhpur.	Above school's education.	Professional	42000
79	YES	POOJA	AIIMS/JDH/2021/03/011439	Arihant Strore, Lodha Sadan, C Road Road , Paota, Imert	School's education	Housewife	NIL
80	YES	SHEETAL	AIIMS/JDH/2021/03/006564	JODHPUR	School's education	Housewife	NIL
81	YES	BABLU KANWAR	AIIMS/JDH/2021/02/000753	Prempura, Hanuman Garh, Pilibanga	Illiterate	Housewife	NIL
82	YES	RANJANA	AIIMS/JDH/2021/01/015419	SUTHARO Ka Bas, Modaradi, Jaisalmer, Nananiyai	School's education	Housewife	NIL
83	YES	KHUSHBU AGARWAL	AIIMS/JDH/2020/03/002006	247B, Bagat Ki Koti, 342001, Jodhpur.	Illiterate	Housewife	NIL
84	YES	PRAVINA	AIIMS/JDH/2019/03/013460	BHOPALI BHERDI, Jodhpur, NANAN PIPAR CITY	School's education	Housewife	NIL
85	YES	HEENA JAIN	AIIMS/JDH/2020/11/006702	66 Phase-2, Roop Rajat Township, Jodhpur.	Above school's education.	Housewife	NIL
86	YES	MANISHA	AIIMS/JDH/2020/07/009423	282, Udai Nagar, Phalodi, Baorikalan	School's education	Housewife	NIL
87	YES	SONAM VAISHNAV	AIIMS/JDH/2020/12/009696	22, NEHRU PARK RAILAWAY COLONY, JODHPUR	Above school's education.	Housewife	NIL
88	YES	DIMPLE	AIIMS/JDH/2021/01/012659	B-96 , Shastri Nagar, Jodhpur	Illiterate	Housewife	NIL
89	YES	JAHNAVI DABI	AIIMS/JDH/2020/12/001428	KHAWASPURA , JODHPUR	School's education	Housewife	NIL
90	YES	DIL KUSH	AIIMS/JDH/2021/03/004804	133, Sukh Shanti Nagar Nagori Bera, Jodhpur.	Above school's education.	Professional	48000
91	YES	PAPITA	AIIMS/JDH/2021/02/010383	PANCHAL KHURD DEDADON KI HDANIYO TEH O	School's education	Housewife	NIL
92	YES	MRS POOJA KANWAR	AIIMS/JDH/2021/01/017093	44, Karni Nagar , Jodhpur.	Illiterate	Housewife	NIL
93	YES	MAMTA	AIIMS/JDH/2019/12/008275	52, Ramdev Nagar Nandri , Jodhpur.	Illiterate	Housewife	NIL
94	YES	PREKSHA ABANI	AIIMS/JDH/2021/01/018546	Bavari Dravja, Jodhpur, Pipar City	School's education	Housewife	NIL
95	YES	KOMAL JOSHI	AIIMS/JDH/2020/09/009609	1234, GALI NO-12, POKERAN, Jaisalmer, CHHATAN	School's education	Housewife	NIL
96	YES	DHAPU DEVI	AIIMS/JDH/2020/12/005451	NEAR GAYATRI MANDIR, BABA RAMDEV MANDI	Illiterate	Housewife	NIL
97	YES	CHALU KANWAR	AIIMS/JDH/2021/03/006702	W N 27, BASANT VIHAR, Jhunjhunu, CHIRANA	Above school's education.	Professional	20000
98	YES	PRIYANKA	AIIMS/JDH/2021/03/006590	4/8, Sector 4, Beawar, Ajmer.	School's education	Housewife	NIL
99	YES	SONI.	AIIMS/JDH/2021/03/006928	Jodhpur	School's education	Housewife	NIL
100	YES	MUSKAN PATEL	AIIMS/JDH/2020/12/008099	CHATRSINGH KI DHANI, BHOMSAGAR, CHABA, Jo	Illiterate	Housewife	NIL
101	YES	RAKSHA MUNDRA	AIIMS/JDH/2020/07/004656	Village-meda Jageer, Post-Hadetar, Hadetar, Jalor, Tahsil-	Illiterate	Housewife	NIL
102	YES	ANJULA JAIN	AIIMS/JDH/2020/12/000797	Maliyon Ka Bas, ASOP, Jodhpur.	Illiterate	Housewife	NIL
103	YES	DEEPIKA	AIIMS/JDH/2020/07/007618	198/18 E. Chopasani Houseingboard, CHB JODHPUR, Jo	Above school's education.	Housewife	NIL
104	YES	NEELAM.	AIIMS/JDH/2021/01/015474	64, MATE KA TALA , BARMER	School's education	Housewife	NIL
105	YES	SITA	AIIMS/JDH/2020/11/000188	718, Rajendra Nagar Vistar, Industrial Area Post Office, F	School's education	Housewife	NIL
106	YES	ASHA	AIIMS/JDH/2020/11/007545	18/1, 4th RAC, Jaipur, Chainpura	Illiterate	Housewife	NIL
107	YES	ANNU	AIIMS/JDH/2021/03/002162	861, Shanti Nagar, Near Durgapura, 302018, Jaipur.	Above school's education.	Professional	25000
108	YES	MAMTA	AIIMS/JDH/2021/03/002083	Shanti Nagar, Jaipur	School's education	Housewife	NIL
109	YES	UMA LODHI	AIIMS/JDH/2020/01/021491	SANSI COLONY, BHADWASIYA ROAD GALI NO 30	School's education	Housewife	NIL
110	YES	LAXMI KANWAR	AIIMS/JDH/2019/09/014190	20, Tibo KiDhani, Khijan, Jodhpur, Tibna	Illiterate	Housewife	NIL
111	YES	MANJU BISHNOI	AIIMS/JDH/2018/06/003154	Kudi Bhgtasni, Jodhpur.	Illiterate	Housewife	NIL
112	YES	RAJ KANWAR SHEKHAWAT	AIIMS/JDH/2020/08/008863	DABADI OSIYAN DABRI , JODHPUR	Above school's education.	Housewife	NIL
113	YES	BHAGVATI GOR	AIIMS/JDH/2021/03/001473	NAI SARAK, JODHPUR	Illiterate	Housewife	NIL
114	YES	GYANWATI	AIIMS/JDH/2020/09/007628	7-K-97, Kudi Bhagtasni Housing Board, Sector-2, Jodhpur	Illiterate	Housewife	NIL
115	YES	SAWANTRI	AIIMS/JDH/2021/01/016278	11, DALI BAI MANDIR, JODHPUR	Illiterate	Housewife	NIL
116	YES	SHAHEEN PARVEEN	AIIMS/JDH/2019/03/009605	NO. 1, RAM NAGAR, H O BARMER.	Illiterate	Housewife	NIL
117	YES	SUNITA	AIIMS/JDH/2021/02/013692	82, Thadiya, Jodhpur.	Illiterate	Housewife	NIL
118	YES	STUTI JAIN	AIIMS/JDH/2021/01/013368	Mastan Baba Colony, Pali.	Above school's education.	Housewife	NIL
119	YES	POOJA BISHNOI	AIIMS/JDH/2020/12/002605	Suwana Jodhpur	School's education	Housewife	NIL
120	YES	SHALU VERMA	AIIMS/JDH/2020/11/001456	3, Parthavi Raj Singh Nagar, Sanwreej, Jodhpur, Phalodi	Illiterate	Housewife	NIL
121	YES	SARITA JAIN	AIIMS/JDH/2020/08/006276	Jodhpur	School's education	Housewife	NIL
122	YES	MANISHA	AIIMS/JDH/2021/02/004417	4-G 21, Kudi Bhagtasni Housing Board, BHAGAT KI KO	Above school's education.	Professional	46000
123	YES	ANDU	AIIMS/JDH/2020/09/007361	39, Golf Course Scheme, Air Force Area, Jodhpur	School's education	Housewife	NIL
124	YES	VAISHALI	AIIMS/JDH/2020/11/005018	JODHPUR	School's education	Housewife	NIL
125	YES	YASHI SRIVASTAVA	AIIMS/JDH/2020/11/001403	Mahesh Colony, Mahamandir Post Office, Jodhpur.	Illiterate	Housewife	NIL
126	YES	KAMLA	AIIMS/JDH/2021/02/006082	Kesha Ram Absar, Chhapar, Churu.	Illiterate	Housewife	NIL
127	YES	LEELA OSTWAL	AIIMS/JDH/2020/08/002523	4/8, Sector 4, Beawar, Ajmer.	School's education	Housewife	NIL
128	YES	NEHA SAINI	AIIMS/JDH/2020/09/001049	12/380 , CHOPASANI HOUSING BOARD , NANDANV	Above school's education.	Professional	60000
129	YES	CHANDANI KHAN	AIIMS/JDH/2018/09/013389	W N 27, BASANT VIHAR, Jhunjhunu, CHIRANA	School's education	Housewife	NIL
130	YES	KOYAL	AIIMS/JDH/2019/01/018900	147, SANSIYO KI DHANI, BANAR, Jodhpur, GUJRAW	Illiterate	Housewife	NIL
131	YES	MADEENA BANO	AIIMS/JDH/2020/09/008204	Jaisalmer, POKARAN	School's education	Housewife	NIL
132	YES	GARVITA GUPTA	AIIMS/JDH/2015/12/114910	80 A, Silawata Para, Jaisalmer	Illiterate	Housewife	NIL
133	YES	KUSUM GOYAL	AIIMS/JDH/2020/10/009044	Jaloda , Jodhpur	School's education	Housewife	NIL
134	YES	CHOTI DEVI0	AIIMS/JDH/2021/12/006005	20, Kamla Nehru Nagar Jodhpur.	Above school's education.	Housewife	NIL
135	YES	CHANDA NAHAR	AIIMS/JDH/2021/01/021481	70, Kalo Ka Bas, Thirod, Nagaur.	School's education	Housewife	NIL
136	YES	PIRTI	AIIMS/JDH/2021/02/006478	KUDI HOUSING BOARD, JODHPUR	School's education	Housewife	NIL
137	YES	MADHURI HEDA	AIIMS/JDH/2020/06/006452	MANSAGAR,VERA BORIYA, Pali, RADAVAS	Illiterate	Housewife	NIL
138	YES	PRAKASH KANWAR	AIIMS/JDH/2020/09/003609	282, Udai Nagar, Phalodi, Baorikalan	School's education	Housewife	NIL
139	YES	SURABHI KANWAR	AIIMS/JDH/2021/01/019751	B-36 Chandan Deep, Dharamnarayan Ji Ka Hatha Paota, I	Above school's education.	Housewife	NIL
140	YES	SHREYA MEHTA	AIIMS/JDH/2021/01/015742	160, Mahaveer Nagar, Sangriya, Jodhpur.	School's education	Housewife	NIL
141	YES	KARISHMA	AIIMS/JDH/2020/08/001080	H-1, Pratap Nagar, Jodhpur.	School's education	Housewife	NIL
142	YES	JYOTI SINGH	AIIMS/JDH/2020/07/000521	RAJPUTANA NIWAS PABUJI MANDIR KE PAS , Jod	Above school's education.	Professional	50000
143	YES	MEENA VAISHNAV	AIIMS/JDH/2020/11/002897	SECTOR 7 EXT. GALI NO 7 NEW POWER HOUSE R	School's education	Housewife	NIL
144	YES	MUNNI	AIIMS/JDH/2021/02/004416	E86, Pratap Nagar , Jodhpur.	Illiterate	Housewife	NIL
145	YES	INDRA	AIIMS/JDH/2021/01/018499	Mansi Vihar, Gudhagorji, Jodhpur, Todi	Illiterate	Housewife	NIL
146	YES	SURTA	AIIMS/JDH/2021/02/003934	16/394, Chopasani Housing Board, Jodhpur	Illiterate	Housewife	NIL
147	YES	NUPUR BHATI	AIIMS/JDH/2014/12/003583	69, GAYATRINAGAR, PALROAD, JODHPUR	Illiterate	Housewife	NIL
148	YES	KRATIKA SONI	AIIMS/JDH/2020/02/006701	SUTHARON KA BASS SARWADI, PANCHPADRA BA	Illiterate	Housewife	NIL
149	YES	RANU SHARMA	AIIMS/JDH/2018/11/007790	25, Kurada, Nagar	Illiterate	Housewife	NIL
150	YES	ARTI JAJU	AIIMS/JDH/2020/10/007852	Gokul Ba Ki Dhani, Jodhpur	School's education	Housewife	NIL
151	YES	SANGEETA PATEL	AIIMS/JDH/2020/09/011027	8A/67, K B H B, Jodhpur	Above school's education.	Professional	35000
152	YES	RAKHI PANWAR	AIIMS/JDH/2020/10/003854	216, BHARMANION KA BAS , PHALODI, Jodhpur, MO	Illiterate	Housewife	NIL
153	YES	DIVYA	AIIMS/JDH/2020/10/004296	90, RAJPUTO KA VAS MIYON KA BERA, BARMER	School's education	Housewife	NIL
154	YES	LEELA.	AIIMS/JDH/2021/01/022347	113, Krishna Nagar Near Police Line Road, Pali.	School's education	Housewife	NIL
155	YES	ANU KANWAR	AIIMS/JDH/2021/01/014765	K-106, Shiv Basti Masuriya, Shastri Nagar, Jodhpur.	School's education	Housewife	NIL
156	YES	ANURADHA	AIIMS/JDH/2017/10/005250	Gadh Ke Pass ,Bagri Nagar, Pali, Sojat	Illiterate	Housewife	NIL
157	YES	SONAM GULECHA	AIIMS/JDH/2020/06/006705	Jodhpur, Karnal Machu Kha Ki Haweli Gulab Sagar	Above school's education.	Professional	17500
158	YES	SHIVANI RATHORE	AIIMS/JDH/2021/01/022256	Jodhpur, Kakani	School's education	Housewife	NIL
159	YES	SARIKA	AIIMS/JDH/2020/10/003113	NO. 1, RAM NAGAR, H O, BARMER	Illiterate	Housewife	NIL
160	YES	BHUMIKA	AIIMS/JDH/2020/08/009292	Kudi Bhagtasni Housing Board, Sector 2, Jodhpur.	Illiterate	Housewife	NIL
161	YES	MAHIMA SHARMA	AIIMS/JDH/2019/05/016459	72, Ramdev Nagar, Jodhpur	Illiterate	Housewife	NIL
162	YES	PARSI	AIIMS/JDH/2020/12/002931	406, Ridhi Vinayak Apartment, Ratan Nagar, Jodhpur.	Above school's education.	Housewife	NIL