JIGYAASA

A Multidisciplinary
Research Initiative of KC College, Mumbai
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Dr. Shalini R Sinha

HSNC UNIVERSITY, MUMBAI
KISHINCHAND CHELLARAM COLLEGE

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Editorial

'Without continual growth and progress, words such as improvement, achievement and success have no meaning- Benjamin Franklin'

Growth and progress have been the bywords of the two innovative research-oriented projects of the college – Jigyaasa- Science Honors Program (SHP) and Certificate Programme for Commerce & Arts (CPCA), over the years.

With the implementation of the New Education Policy 2020 on the anvil, breaking the silos between disciplines becomes important. Students need to imbibe a holistic education that will help them to solve the day-to-day problems of the real world effectively and efficiently.

It gives us great pleasure in bringing out Jigyaasa –Volume 5, issue 2, which is a compendium of selected research data generated and analyzed by the SHP and CPCA students at K.C College.

The chapters include interesting research projects conducted under the Science, Arts and Commerce sections from a multitude of subjects like Chemistry, Microbiology, Statistics, Psychology and Commerce, providing insights into topics such Study of components used in Correction pen, Experience of mental health professionals during Covid 19, Effect of Green Nanotechnology in enhanced antimicrobial activity, Analysis of the new trends in Advertising and their impact on sales and many more.

These articles bear testimony to the efforts taken by the research guides and students, at the same time serving as a stepping-stone for the future batches of students who might be inspired to carry forward certain interesting possibilities of their predecessors and discover yet another life lesson.

Such research experiences open up different avenues of thinking, change attitudes and give deep insights into human issues and provide ways of resolving them. Jigyaasa research compendium will prove to be a guiding light to future generation of students who would

learn from these volumes and contribute their own research knowledge to future volumes.

Editors:

Professor Sagarika Damle – Convener, SHP &

Dr. Shalini R. Sinha – Vice Principal and Convener, CPCA

Foreword

"Research is turning the unknown into reality." -Stephan Magee

With the discussion of implementation of NEP in higher education, conducting research becomes crucial for developing critical thinking among college students. Research always has been the core here at K.C. College affiliated to the HSNC University. It has been offering the two most popular research programmes- Certificate Course in Commerce and Arts (CPCA) and Jigyaasa – Science Honors Programme (SHP) to students for more than 10 years now.

The two programmes inspire, motivate and guide students to initiate and conduct research on several pertinent topics of interest under the effective guidance by their teachers o that students naturally develop curiosity for the unknown and find answers for the burning questions they have in their mind.

As part of the CPCA and SHP programmes, students are helped at every step of the research. From the initial phase of conceptualizing the topic for research, finding the past literature on the topic, synthesizing the current and the past research studies to designing and carrying out the research study. Students, with the help of the teacher supervisors, are guided systematically to discover, analyse and report what they found as per research ethics and research guidelines.

This entire research journey between the students and teachers is extremely enriching for not only developing research skills but even developing the character of the students that go a long way in students' as well as teachers' lives. Jigyaasa Volume V - issue II provides a number of research papers that include students' research work from Arts, Commerce and Science streams investigating several unknown realms in Chemistry, Microbiology, Psychology, Statistics and Commerce.

I wish to acknowledge the hard work of teacher mentors and students who worked extremely hard for creating their research work and congratulate all of them to be able to publish their work. I wish good luck to all the students and teachers for their future endeavours in research.

Dr. Hemlata K. Bagla

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SECTION I - CHEMISTRY

Chapter 1 - Effects of *Zingiber Cassumunar* against Microbes and Indigestion

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ABSTRACT

Zingiber cassumunar Roxb. (Zingiberaceae), is an important medicinal plant known as "Plai (Phlai)" in Thailand, "Bangle" in Indonesia, and "Bulei" in China. Traditionally, this plant has been used to treat inflammation, pain, and respiratory problems. The rhizomes are the primary part of the plant that has been used for medicinal purposes due to their constituents with therapeutic properties, including phenylbutenoids, curcuminoids, and essential oils. Since the 1970s, many studies have been conducted on the phytochemicals and bioactivities of *Z. cassumunar* to establish fundamental scientific evidence that supports its use in traditional medicine. The accumulated biological studies on the extracts, solvent fractions, and constituents of *Z. cassumunar* have described their diverse medicinal properties, including antioxidant, anti- inflammatory, anticancer, neuroprotective/ neurotrophic, cosmeceutical, and antifungal/ antimicrobial bioactivities. In this review, we summarize information on the phytochemicals of *Z. cassumunar* and the bioactivities of its extracts and constituents.

Keywords*: Zingiber cassumunar,* phenylbutenoid, curcuminoid, essential oil, antioxidant, anti-inflammation, antimicrobial, indigestion

INTRODUCTION:

Indigestion also called as dyspepsia is often a sign of an underlying problem, such as gastroesophageal reflux disease, ulcers, or gall bladder disease, rather than a condition of its own. Many people in India as well as all over the world face the problem of indigestion especially due to

change in the life style. People of all ages and of both sexes are affected by indigestion. It's extremely common. Researchers estimate that pain and discomfort from indigestion up to 60 percent of the U.S. population every year. These plants can play significant role in indigestion control. Hence, we have chosen plant named *Zingiber cassumnar* having anti-indigestion and anti-microbial properties.

Z. cassumnar rhizomes have analgesic and anti-inflammatory properties. In addition, an American study found that *Zingiber cassumn*ar oil exhibits antimicrobial activity. Reference. It also contained in the rhizomes of the plant that it has antifungal properties against pathogenic fungi. Reference The plant also contains the essential oils 31–48% sabinene, 4–30% terpineol, and apparently unique curcuminoid antioxidants, namely cassumunarin types A, B, and C.

METHODOLOGY:

Study of antimicrobial activity of *Zingiber cassumunar*:

Essential oils obtained by steam distillation were analyzed by gas chromatography-mass spectrometry (GC-MS). The antimicrobial activity of the essential oils was evaluated against four bacteria: *Bacillus cereus (B. cereus), Staphylococcus aureus (S. aureus), Escherichia coli (E. coli),* and *Pseudomonas aeruginosa (P. aeruginosa);* and *two fungi: Candida albicans (C. albicans)* and *Cyptococcus neoformans (C. neoformans),* using disc-diffusion and broth microdilution methods.

Study of *Zingiber cassumunar* against indigestion:

Ginger can be peeled, then grated, sliced, diced, or shaved to use when cooking. It can be eaten raw, steeped in water to make ginger tea, or added to soup, stir-fry, salad, or other meals. One of the chemicals found in ginger is an ingredient in some antacids. Ginger is also available in powder, capsule, oil, or tea form. The most important thing to remember is to take ginger in moderation. Sticking to around four grams a bit less than an eighth of a cup should be enough to give you some relief without making symptoms worse. You can also split this up and take divided doses throughout the day.

CONCLUSION:

This review presented a comprehensive report of the phytochemicals and bioactivities of *Z. cassumunar*. As traditional uses, the rhizomes of this plant have been widely used in different countries in Southeast Asia for the treatment of inflammation, pain, rheumatic arthritis, asthma, and skin trouble. Since 1970s, many studies on the phytochemicals and bioactivity of *Z. cassumunar* have been conducted in order to establish the scientific fundamental facts and evidence of such traditional medicinal uses. The preliminary results suggest antimicrobial properties of *Zingiber cassumunar*, which may be useful for food preservation, pharmaceutical treatment and natural therapies.

Although it's anti-inflammatory properties may make it effective against acid reflux, there isn't a medical basis for this. At this time, there aren't any studies on whether it is a suitable treatment for acid reflux symptoms.

Research on *Zingiber cassumunar* is primarily limited to its nausea-reducing capabilities. Researchers are still investigating the general safety and any medicinal properties that it may have. A 2011 study found that participants taking ginger supplements had reduced inflammation markers within one month.

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Chapter 2 - Wonders of Spices: Study and its Applications

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ABSTRACT:

Spices are extracted from a plant source such as root, stem, bark, seed or fruit which are used to add flavour, aroma and colour to food. The essential oils extracted from the spices contain many medicinal properties such as anti-diabetic, anti-carcinogenic, as well as anti-oxidative and antimicrobial properties. An experiment was carried out to study the physical and physiochemical properties of the spices (cinnamon) viz. Nature, colour, appearance, weight, moisture content and the solubility of cinnamon. Hexane, an organic solvent, was used to test the solubility of cinnamon. Steam distillation method was used for the extraction of essential oils from cinnamon. An online survey was conducted in which questions on other spices such as turmeric and cloves were also included. Literature review was done on cinnamon, cloves, cardamom, saffron and ginger to study their medicinal and antimicrobial properties.

Keywords: Cinnamon, turmeric, cloves, essential oils, steam distillation, medicinal properties, anti-diabetic

INTRODUCTION:

The Food and Drug Administration (FDA) has defined spices as aromatic vegetable substances, in the whole, broken, or ground form whose significant function in food is seasoning rather than nutrition'.[1] Spices, usually, come from the dried part of the plant such as a bud (clove), bark (cinnamon), root (ginger, turmeric), aromatic seeds (cumin), and flower stigma (saffron), which distinguishes it from herbs, which come from the leaves of the herbaceous plants.[2] Spices contain volatile oils and aromatic scent used for flavouring and aroma. They are also been used as preservatives, therapeutic and flavouring agents for centuries in

Middle East Asian countries. India is known as 'The Land of Spices' which means that it is a reservoir of spices.[3] Indian spices are popular and have occupied a huge position in the domestic as well as international trade market for its flavour and aroma. The warm tropical and subtropical climate in India also provides favourable conditions for the growth of spices. International Standard Association (ISO) has listed 109 spices, out of which India produces around 75 species of spices in its various climatic regions. Many spices contain medicinal properties such as anti-diabetic, anti-carcinogenic, anti-oxidative, anti-microbial, anti-hypertensive and anti-inflammatory effect which makes it a genuine reason to be added in every consumable commodity.[4] Spices are the main ingredient in every Indian dish.

A placebo-controlled clinical trial was conducted which included 208 type 2 diabetes patients from the Endocrine and Metabolism Research Center, Isfahan University of Medical Sciences, Isfahan, Iran. The subjects were divided into four groups, receiving either 3g cardamom, or 3g cinnamon, or 3g ginger, or 1g saffron, with a combination of three glasses of black tea. [5] The people in the control group consumed three glasses of tea without any spice. Dried powder from cardamom (cardamomum) small seed pods, ginger (Zingiberaceae) rhizome of the *Zingiber officinale* plant, cinnamon (*Cinnamomum verum*) sticks from the inner bark of tree, and saffron (*Saffron crocus*) stigmas of the *Crocus sativus* flower, were used.

After 8 weeks of clinical trial, it was recorded that cinnamon, cardamom, ginger, and saffron consumption had significant effects on total cholesterol, LDL (low density lipoproteins), and HDL (high density lipoproteins) levels compared with the control consumption. It was also observed that cinnamon intake significantly decreased the level of fasting blood sugar and hs-CRP (high-sensitivity C-reactive protein) and ginger consumption showed significant decrease in F2-isoprostane (a prostaglandin) concentration and hs-CRP levels as compared to the observations recorded from the control group. Other groups showed no significant difference. However, the spices did not have any significant effects on glycemic control, inflammation, and oxidative stress. The

herbal spices showed beneficial effects on cholesterol, but showed no effects on glycemic control, oxidative stress and inflammation. [5]

The experiment was done on Albino mice of both sexes. The essential oils from cloves were extracted by hydrodistillation method and the components were separated by Gas Chromatography and Mass Spectrometry (GS-MS). Diazepam was used as a reference drug. Strychnine and Picrotoxin were used as anticonvulsants. Thiopental sodium was used as a hypnotic drug. 1% Tween 80 was injected in the control group. The experiment was conducted in three separate parts to observe the anticonvulsants, anxiolytic and hypnotic activities of clove essential oils. [6]

The analysis carried out by Gas Chromatography and Mass Spectrometry showed that Clove Essential oil consists of 11 components. Eugenol (62.29%), Caryophyllene (30.59%), and Humulene (3.07%) are the main components of Clove Essential Oil. There was a significant increase in the onset of convulsion and reduced its duration depending upon the dosage as compared to the control for strychnine and picrotoxin induced convulsions. All doses of clove essential oil showed increase in latency time and ambulation and decrease in grooming when compared with the control group. Clove essential oil was also effective in producing a significant decrease in the time of onset of sleep and also increased duration of sleep which was induced by thiopental sodium as compared to diazepam. [6]

Curcumina longa (Turmeric) is natively grown in India and is the best natural remedy used by Indians. It acts as an anti-inflammatory, anti-neoplastic and anti-geogenic in nature. A dose of 12 mg/ day of curcumin was declared safe for humans. It was seen that curcumin plays a major role in effectiveness against various viral diseases such as Herpes, SARS-COV-2 and hepatitis. Curcumin targets cellular pathways and thus inhibits the growth of viruses. It plays a vital role in inhibiting viral replication by targeting molecular level pathways. Cinnamon, mostly grown abundantly in the Middle East, plays an important role. It belongs to Lauraceae, an aromatic species. Cinnamon has about 21 chemical

compounds which includes Cinnamaldehyde (60.41%) and eugenol (3.19%) which has antibacterial effects. Cinnamon also has antimicrobial, antiviral, antifungal, antioxidant, antihypertensive, antidiabetic, antitumor, gastroprotective, and immunomodulatory effects. Cloves belonging to the family Myrtaceae are also antibacterial. It is also used to increase shelf life of food in food industries. Cloves are well known to prevent nausea and vomiting (antiemetic in nature). They also possess antimicrobial activities and are effective against gram positive and gram-negative bacteria.[7]

The unusual outbreak led to many catastrophic events, people by themselves came out with home remedies. Hence, an online survey was carried out to know about what home remedies people use. The survey included a random population all over the world. The response was mainly from the age group 13-68. The total population for the survey was 531, out of which 7.8% were COVID positive. Most people think that spices play an important role in these tough times. People used sanitizers and masks to boost their immunities. People prefer kadha as a best home remedy where 56% of people were found to take koradha one time a day and 26% to take koradha two times a day. People preferred lemons and oranges more. People were boosting their immunity by Vitamin C rich fruits and tablets. A clinical trial in a hospital of China was carried out, people were given 12 mg/day of vitamin, which was found to be defensive against coronavirus.

According to a survey most people used kadha, in which their main ingredient was cinnamon, clove, ginger, garlic, tulsi and black pepper. It was seen that cinnamon, clove, tulsi and turmeric play a vital role in SARS-COV-2, including some viral infections. [8] Turmeric has some antiviral properties and tulsi helps in increasing helper T cells levels as well as natural killer cells. The intake of Vitamin C was increased by people by taking Vitamin C enriched fruits like Amla and lemon. Black pepper helps in relieving nasal congestion which is the most common symptom of SARS-COV 2. It also boosts immunity and has antiviral properties. 26% of people were tested and 7% were found positive for

Coronavirus. 93.6% people believe spices as a best remedy against COVID 19. [8]

METHODOLOGY:

All the chemicals used for analysis were AR grade chemicals. pH measurement was done on an equiptronics pH meter.

Moisture content, pH and Solubility:

1 g of cinnamon powder was added to 10 cc distilled water and mixed thoroughly. The insoluble matter was separated with the help of filteration. The insoluble residue was the dried and weighed.

10 g cinnamon powder was added to 25cc distilled water and the pH was measured using a pH meter

For the estimation of moisture content, 1 g of the powder was weighed in a tared crucible. The crucible was the heated in a hot air oven set at 700C for 1 hour. The crucible was cooled and weighed after every 15 minutes interval.

Steam Distillation:

Steam distillation is the simplest and easiest method for extraction of volatile components of a compound. Cinnamon has lot of phenolic and essential oil components. The major essential oil in cinnamon is Cinnamaldehyde. [9] It comprises about 90% of essential oil components. Other chemical components like eugenol, coumaric acid and cinnamyl alcohol are also present. Steam distillation of cinnamon powder was done to extract cinnamon essential oil. Cinnamon bark was first ground into powder. Powdered cinnamon was used for further analysis. 50 g of cinnamon powder with 50 cm³ of water and 50 cm³ of solvent was taken in a round bottomed flask. The flask was shaken well and then distilled. Solvent used was organic solvent, n-Hexane. n-Hexane or DCM (Dichloromethane) are best suitable for cinnamon essential oil extraction because it has low boiling point and evaporates faster leaving desired essential oil behind [10].

Survey Analysis

Spices are considered to be the heart of Indian cooking. Spices are known as one of the most remarkable ingredients for its indigenous flavour, nutritional value and medicinal properties. The present study is aimed to identify the most frequently consumed spices at households and to assess the consumer knowledge and perception about organic spices. The survey method using questionnaire was carried out to elicit the required information from female respondents, of different areas in Mumbai. A general survey was done to gather information about the most commonly used spices by people in day-to-day life. We included some experimental activities by FSSAI, which were too basic and helped us to know whether the spices used in day-to-day life are adulterated or not Hypothesis

Null hypothesis: "People use soft and rollable cinnamon."

An online survey was conducted by using google docs. It included three parts- 1. Introduction. 2. Some general questions on spices and 3. Some basic household activities using water to understand basic properties and adulteration of spices used by people.

Observation:

28 Random samples were collected for survey analysis. The target population were primarily women.

RESULTS AND DISCUSSION:

The experimental results recorded were as follows

1. Moisture content of 1 gm cinnamon powder after one hour= 0.198 g.
2. Moisture content in percentage= 0.198/1.00 x 100 = 19.80%.
3. Weight of Insoluble matter of 1 gm cinnamon powder= 0.563g.
4. Percentage of insoluble matter of 1 gm cinnamon powder= 56.30%.
5. pH of soluble matter of 10 gm cinnamon powder by pH meter= 7.33
6. pH of 10 gm cinnamon powder in water (by pH meter) = 5.19.

Results of the Survey:

- 36.70% of people were using soft and rollable cinnamon.
- 64.30% of people were using hard and brittle cinnamon.
- 18 people amongst 28 were using hard and brittle whereas 10 were using soft and rollable.
- Out of a total 28 responses, cloves of 25 people floated whereas only of 3 people sunk.
- 89.30% of people's cloves floated.
- 10.70% of people's cloves sunk.

A Chi-Square calculation was done on the data obtained for use of cinnamon.

A null hypothesis was set "People used soft and rollable cinnamon."

$\chi 2 = \sum(O_i – E_i)^2/E_i$

Level of significance= 0.05 (i.e., 5%)

Degree of freedom = (n-1) = (2-1) = 1

Observed value (Oi) = 10 (Soft and Rollable)

Observed value (Oi) = 18 (Hard and brittle)

Expected value (Ei) = (observation 1 + observation 2)/ 2 = 10+18/2 =14

$\chi 2$ (Hard and brittle) = (18) ^{2}/14 =324/14 = 23.14

$\chi 2$ (Soft and rollable) = (10) ^{2}/14 =100/14 = 7.14

$\chi 2$ (Hard and brittle) + $\chi 2$ (Soft and rollable) = 23.14+ 7.14 =30.28

$\chi 2$ (α=0.05, n=1) = 3.34

$\chi 2$ calculated value is less than $\chi 2$ tabulated

Null hypothesis is rejected and an alternate hypothesis is accepted. [11]

People use hard and brittle cinnamon instead of soft and rollable.

CONCLUSION:

Cinnamon is hard and brittle. It contains 11% of water and 83% of carbohydrates (53% is mainly dietary fibres), 4% of proteins and very little fat (1%). It is highly fibrous and hence, it is insoluble in water. About 1 mg/ L can be dissolved in water. It is 2-3 m in height. It can bear harsh conditions of soil and temperature. It is acidic in nature. It contains many monoterpenes, Sesquiterpenes and phenol terpenes. These compounds contribute to the aroma and flavour of cinnamon. Cinnamon bark consists of 5-75% of essential oil. The major cinnamon essential oil is cinnamaldehyde which constitutes 90% of essential oil. Besides Cinnamaldehyde there are other cinnamon oil chemical components such as cinnamic acid, coumaric acid, cinnamyl alcohol, and eugenol.

Survey method was used to understand the people's opinion about organic spices, most commonly used spices and adulteration of spices. There were 25 female respondents and only 3 male respondents. People were asked whether they prefer ground or whole spices, 57% of people use both types of spices. People use spices for medicinal use as well. Spices have many antimicrobial, antifungal and anti-diabetic properties. Cloves of 25 people were old and adulterated whereas only 3 respondents were fresh. Since cinnamon was our main interest further statistical analysis on it was done. A chi-square calculation was carried out and a null hypothesis was set- 'People use soft and rollable species of cinnamon'. Chi calculated value was greater than Chi tabulated value. Hence, null hypothesis- 'People use soft and rollable cinnamon' was rejected and alternate hypothesis- 'People use hard and brittle cinnamon' was accepted. It was seen most of the people use general spices and very few of them preferred organic spices. Only 16 people knew about organic spices whereas the other 12 had no knowledge about organic spices. Most of the people used spices which were months old. It was also observed that most people use adulterated spices.

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Chapter 3 - Study of Components Present in Correction Pen and Derivative Methods to Replace VOCS

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ABSTRACT:

Whitener also known as correction pen, used to cover mistakes while typing or hand writing on paper consists of chemicals which are harmful to human body when inhaled. The most abundant chemical in the correction fluid is titanium dioxide which acts as the pigment; however, it is harmful in high concentrations. The toxic solvent used are trichloroethane, toluene, xylene, etc. Many people use whitener, some use it for covering mistakes while many use it as drug addiction due to its pleasant smell. Researches have been done on VOCs, it's harmful impact on living beings, but still industries are using VOCs in many products. People prefer buying these products because they are cheap. In order to make it more durable we tried substituting TiO_2 with lithopone i.e., mixture of $BaSO_4$ and $ZnSO_4$ with solvent as ethyl lactate. Lithopone having a refractive index 1.84 can be used as a pigment agent however it showed negative results. Due to the outbreak of pandemic no lab work was allowed and a survey was conducted. The survey showed that most of the people came in experience with the correction fluid at early stage of their life and out of them 83.4% of the people had issues with the liquid sticking to hand and eventually entering the body through mouth. The research further showed that 50% of people are unaware of the contents of the correction fluid. Thus, efforts must be made to prepare a safer nontoxic and degradable correction fluid.

Keywords: correction fluid, solvent, Volatile organic compounds

INTRODUCTION:

Correction fluid is a liquid product designed to cover mistakes made while typing, hand writing, or photocopying markings on paper.

Typically, it is applied to paper using a brush. When it dries, it forms a solid film that effectively covers the error and allows the correct mark to be written over it. Correction fluids are composed of pigments, polymeric binders, and solvents that are mixed together in large batch tanks. First developed during the late 1950s, correction fluid formulations have steadily improved over the years.

The need for correcting mistakes made during writing has been around for as long as writing itself. While erasers worked well for pencil marks, they did little to remove mistakes made with a fountain pen, type- writer, or ball point pen. At some point, it was realized that a mistake could be covered using an ink that was the same colour as the paper. This led to the development of the first correction fluids. These fluids were typically white inks. These products were inferior because they did not match the paper colour very well, took a long time to dry, and were difficult to write over. Correction fluids were greatly improved during the 1950s when polymer technology was utilized. This allowed production of a product which would adhere better to paper, spread easier, and remain flexible when dry. The opacifying agent is a key ingredient in the correction fluid formula.

The most common opacifying agent is titanium dioxide. This is an inorganic material derived from various titanium ores. It is an opaque material, which does not significantly absorb visual light. Since it has a high refractive index, it produces a predominantly white color. In general, the opacifying agent makes up from about 40- 60% of the formula. A polymeric material is used to affix it to the paper. This polymer creates the film that strongly bonds to the paper fibers when it dries, or cures.

A variety of polymeric resins can be used such as acrylic resins, petroleum resins, chlorinated polyolefin resins and even synthetic rubber. To make the optimal film, often a copolymer is used. One type copolymer system is a latex emulsion. This is made by polymerizing methacrylate with a nitrogen containing monomer in the presence of

ethylene vinyl acetate. In a typical correction fluid formula, the polymer resin comprises 5-15% of the formula.

To control the viscosity and dry time of the correction fluid, a solvent is necessary. Two types of solvent are used are aqueous based and organic based. Organ8c based solvents are acetone, toluene, xylene, ethyl acetate, ethyl methyl ketone. Various suspending agents like hydroxyethyl cellulose, can-do than gum or guar gum and dispersing agents like phosphate esters, ethoxylated alcohol and polysorbitals are used to dissolve the solvent. Most of the contents of correction fluid are Volatile Organic compounds (VOC's), which are harmful for our environment and human beings.

Many researches have been done on 'Analysis of VOCs in different compounds" and concluded that most of the materials which we use in day-to-day life are containing VOCs. There are many research done in which correction pen is used for making fabricated paper based devices and yes it has many advantages for using correction pen in fabricated paper based devices but it has some disadvantages also for using correction pen because it has many VOCs compounds in it, it will be dangerous for the employee while carrying with the experiment or while manufacturing.

So, our main aim is firstly, to detect the compounds which are present in the correction pen and to replace those compounds with some less harmful or green solvents and secondly, to do a survey on use of whitener in day-to-day life, so that we can spread awareness about correction pen and VOCs. Through our research we are trying to achieve some derivative methods to replace VOCs in some compounds like whitener pen

MATERIALS AND METHOD:

A small experiment was performed in the lab for making whitener ink using green solvent.

	Compounds present in correction pen	**Green compounds that can be used to replace toxic compounds.**
Opacifying agent	Titanium dioxide	Mixture of $ZnSO_4$ and $BaSO_4$. Calcite (calcium carbonate) Levulinic acid.
Polymeric film former.	Acrylic resins, petroleumresins, chlorinated polyolefin resins.	Alta Print 264 resins (Resins without using phenols and formaldehyde)
Solvents	Toluene,xylene, ethyl acetate, xylene, Methyl, ethyl keton	Ethyllactate Citrussolvent Dimethyl carbonate

Required Materials:

Compound	Volume
$BaSO_4$	3.53g
$ZnSO_4$	1.47g
Ethyl lactate	5ml

Procedure:

<u>Step 1:</u>

- 5.00g mixture of $ZnSO_4$ and $BaSO_4$ was prepared by taking 70% $BaSO_4$ and 30% $ZnSO_4$.
- 3.53g of $BaSO_4$ and 1.46g of $ZnSO_4$ was weighed and transferred to 50ml beaker.
- 5ml of ethyl lactate was added and the mixture was stirred continuously until a white mixture was formed.
- The mixture was kept closed in the beaker for 15 mins.
- Observations were noted.

Step 2:

- 5.00g mixture of ZnSO4 and BaSO4 was prepared by taking 70% BaSO4 and 30% ZnSO4.
- 3.53g of BaSO4 and 1.46g of ZnSO4 was weighed and transferred to 50ml beaker.
- 5ml of distilled water was added and the mixture was stirred continuously until a white mixture was formed.
- The mixture was kept closed in the beaker for 15 mins.
- Observations were noted

Online survey was done on use of whitener pen in day-to-day life. A questionnaire was prepared on whitener to know how many people use whitener and how many are aware of the contents and harmful effect of whitener.

RESULT:

The following survey showed that nearly 66% of people use correction pen out of which 80.3% believe that isn't safe for use.

Do you think using whitener pen is safe?

- Yes
- No
- Maybe

36.4%
43.9%
19.7%
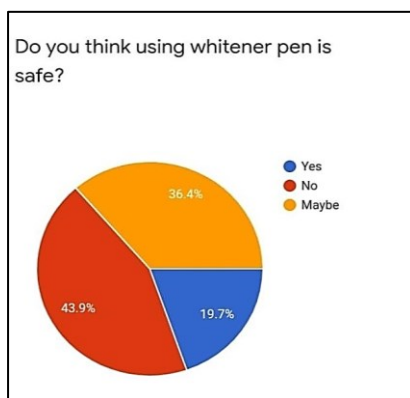
50% of the people are not aware of the contents of the pen. Correction pen when stuck on the hand can be difficult to remove and out of every 100 people 83 face this issue
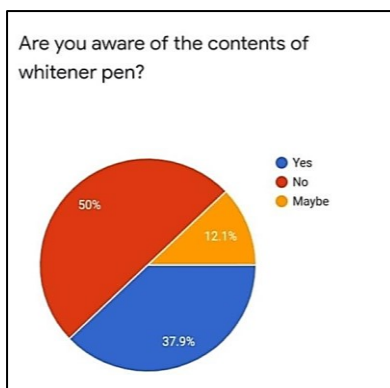
To end all of it 86.4% people are looking for safe and nontoxic alternatives
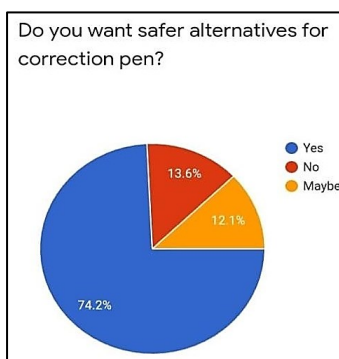
CONCLUSION:

In our experiments, $ZnSO_4$ and $BaSO_4$ did not completely dissolve in ethyl lactate. This prepared mixture dissolved the ink on the paper and the paper turned almost transparent. When we repeated the same experiment using water instead of ethyl lactate, this time ink did not separate but after sometime water evaporated and compound remained behind on the paper.

From both the experiments, $BaSO_4$ and $ZnSO4$ can be used for its whitening property but ethyl lactate is not suitable for erasing ink as it

was dissolving the ink. So, our further research would be to use some other green solvent for making correction fluid.

From our online survey on use of whitener, we came to know that 66.7% people are using whitener in daily life but only 37.9% people are aware of the contents of whitener. While purchasing the product 31.8 % people prefer price of the product as it is cheaply available in local shops. There were approximately 35% who have experienced feeling of dizziness while using whitener, as we now know that whitener contain Volatile organic solvents which have many side effects. 74.2% people are expecting to see safer alternatives for making correction fluid.

The toxic materials present in correction fluids may accumulate in human bodies as 56.1% of people have problems when it gets stuck on the hand and eventually may enter through mouth. As most of the people have their first experience during their early childhood it's important for the whitener to be nontoxic and degradable so that it may not lead to major harmful effects. Thus, we conclude that most of the contents of the whitener are hazardous in higher amount and some changes can be made in order to improve it.

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Chapter 4 - Toothpaste: An Assessment on Toothpaste Formulation

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ABSTRACT:

In order to create a product effective in preventing or treating or solving various dental issues, the formulator needs to mix several different ingredients of different forms and sources. This gives rise to various innovative measures and development of different combinations of ingredients to give the best outcomes. The formulator has to ensure that the consumer can trust and utilise the product for daily hygiene. The primary solution to prevent dental diseases is to maintain dental hygiene by preventing the formation of dental plaque. The removal of plaque is essential for a clean and healthy mouth.

In this paper we have enlisted the main components of the herbal and non-herbal toothpaste available in the Indian market. Therapeutic effects of the constituents have also been explained.

Keywords: toothpastes, ingredients, non-herbal toothpastes, herbal toothpastes

INTRODUCTION:

Toothpaste is a paste or gel that is used to maintain and improve oral health and aesthetics.[1] Over the years toothpaste formulations have evolved considerably. An effective toothpaste is that which is formulated for maximum bioavailability. The primary cause of dental diseases is plaque, formed from microbial action and resulting in gum diseases and cavities. If not cleaned and removed correctly it can further harden and form tartar. The best way to control dental diseases is by brushing your teeth regularly. Toothpastes are used as primary teeth cleaners. Besides tooth cleansing, toothpastes aids in prevention of gingivitis and tooth decay which leads to more severe dental issues. The manufacturer, while

formulating toothpastes, uses different ingredients for high efficiency and action against various dental concerns, herbal and non - herbal.

In this paper we have enlisted the various ingredients of Herbal and Non-Herbal toothpaste and explained their therapeutic action against dental issues.

Objectives:

- To compare the ingredients in herbal and non-herbal toothpastes.
- To understand the usage and preference of Indian consumers towards 'toothpaste' category products.
- Consumer expectations when it comes to primary benefits of the toothpaste

METHODOLOGY:

The authors used a define search strategy to study for the ascertainment of the toothpaste formulations, both herbal and non-herbal. A total of 10 toothpastes,5 herbal and 5 non herbal toothpaste formulations were studied by the authors. Further, an online survey was distributed to 100 respondents spread across varied demographic profiles in India.

Ingredients of Toothpastes:

Toothpastes are perhaps the most complex healthcare product. Typically, an abrasive or mixture thereof is suspended in an aqueous humectant phase by means of a hydrocolloid. In this matrix, surfactants, active (i.e., therapeutic) ingredients, flavour compounds, sweeteners, colourings, preservatives and other excipients are embedded.

Herbs:

Lavang (extract of *Eugenia aromatica*): *Eugenia aromatica* is an unopened flower bud growing on a tree belonging to the family of myrtaceae. *Eugenia aromatica* (Clove) are used in dentistry, where the essential oil is used as anodyne (pain killer) for dental emergencies. According to Hansel and Sticher (2001), *Eugenia aromatica* (Clove) is

a natural antiviral, antimicrobial, antiseptic and anti-fungal and antinociceptive agent. The oil of clove (eugenol) has been used in a variety of health conditions including indigestion, generalized stress, parasitic infection, cough, toothaches, headaches and blood impurities (Alqareer, et al, 2012).

Pudina (extract of *Mentha arvensis*): *Mentha arvensis* (wild mint) is a perennial herb with square stems, slightly hairy to smooth leaves that are strongly aromatic when crushed. Mint essential oils have applications in food flavouring and preservation, as fragrance, and in medicine. Mint plant preparations, such as essential oil, show very good antimicrobial and cytotoxic activities (Hussain et al., 2010).

Karpur (camphor): Camphor appears as a colourless or white coloured crystalline powder with strong mothball-like odour. Camphor oil is the oil extracted from the wood of the Camphor tree *Cinnamomum camphora*. Camphor oil has anti-inflammatory and analgesic properties. Its antiseptic properties help relieve toothache and freshen breath.

Tulsi (extract of *Ocimum basilicum*): *Ocimum basilicum* (sweet basil) belongs to the family Lamiaceae. The essential oil has antimicrobial, antifungal, and insect- repelling, anticonvulsant, hypnotic, and antioxidant activities. Ahonkai *et al*., in their research, they discovered that incorporation of volatile oil of *O. basilicum* showed antibacterial activities comparable to commercial toothpaste (which contains *O. basilicum* 0.01% among others) against most resistant organisms.

Mishreya (extract of *Foeniculum vulgare*): *Foeniculum vulgare* Mill. is a biennial medicinal and aromatic plant belonging to the family Apiaceae (Umbelliferaceae). Different pharmacological experiments in a number of in vitro and in vivo models have convincingly demonstrated the ability of *F. vulgare* to exhibit antifungal, antibacterial, antioxidant, antithrombotic and hepatoprotective activities. Essential oil extract of *Foeniculum vulgare* has antibacterial activity against Streptococcus mutants.

Twak (extract of *Cinnamomum zeylanicum*): Cinnamon is a common spice used by different cultures around the world for several centuries. It is obtained from the inner bark of trees from the genus Cinnamomum, a tropical evergreen plant that has two main varieties, one of which is *Cinnamomum zeylanicum*. It has antimicrobial, anti-parasitic, antioxidant and free radical scavenging properties.

Amalaki (extract of embilica officinalis): *Emblica officinalis* Gaertn. or *Phyllanthus emblica* Linn. (Euphorbiaceae), commonly known as Indian gooseberry or Amla, has superior value in entirely indigenous traditional system of medicine. Scientific studies have shown that amla possesses antibacterial, antifungal, antiviral, antiulcerogenic, wound healing properties among several others.

Madhu (extract of honey): Honey is the sweet, viscous substance elaborated by the honeybee from the nectar of plants. According to a study conducted by AL-Dany A. Atwa *et al.* (2014 April), Topical application of honey can modify the pH, reduce bacterial counts, and inhibit bacterial growth.

Nimba/Neem (Extract of *Azadirachta indica*): Neem (*Azadirachta indica*) is a member of the Meliaceae family and its role as a health-promoting effect is attributed to its rich source of antioxidants. A study was made to evaluate the antimicrobial properties of organic extracts of neem against bacterial strains causing dental carries and results showed that petroleum ether and chloroform extract showed strong antimicrobial activity against *S.mutans*. Chloroform extract showed strong activity against *Streptococcus salivarius* and third strain *Fusobacterium nucleaum* was highly sensitive to both ethanol and water extract. Earlier findings confirmed that dried chewing sticks of neem showed maximum antibacterial activity against *S.mutans* as compared to *S.salivarius, S.mitis* and *S.sanguis.*

Kumari (extract of aloe vera): Aloe vera is a plant that belongs to Liliaceae family. It contains various minerals and vitamins. It has various properties such as immunomodulatory, antiviral and anti- inflammatory in nature.

Myrrh extract: Myrrh is the resinous exudate obtained by the incision in *Commiphora molmol* trees (Family Burseraceae). It shows antibacterial, anti-inflammatory, antiulcer and astringent effects.

Chamomile extract: Chamomile has been used as an herbal medication since ancient times. It has healing properties with antibacterial and antifungal activities and also is applied topically to relieve pain.

Tea tree oil: Tea Tree Oil (TTO) is the volatile essential oil derived mainly from the Australian native plant Melaleuca alternifolia. It is employed largely for its antimicrobial properties.

Sage oil: *S. officinalis* (Sage, garden sage, or common sage) is a perennial, evergreen subshrub, with woody stems, grayish leaves and blue to purplish flowers. Sage containing dentifrice effectively reduced the number of Streptococcus mutans in dental plaque.

Eucalyptus oil: Eucalyptus oil and its major component, 1,8- cineole, have antimicrobial effects against many bacteria, including Mycobacterium tuberculosis and methicillin-resistant Staphylococcus aureus, viruses, and fungi (including *Candida*). A study carried out found that essential oil of *E. camaldulensis* retards biofilm formation that can contribute to the development of novel anticaries treatments.

Maricha (*Piper nigrum*): Piper nigrum or black pepper, is used for the treatment of abscesses, tooth decay and toothaches.

Pippali (*Piper longum*): Pippali or Long Pepper, is like black pepper, used for the treatment of abscesses, tooth decay and toothaches.

Shunthi (*Zingiber officinale*): *Zingiber officinale* or ginger is used in dentistry for treatment of toothache and gingivitis. Studies by Atai et al. show that ethanol extract of ginger was effective on *Candida albicans* at concentration of 1:5, this shows that ginger extracts can be used to treat oral candidiasis. It also shows antimicrobial effects.

Tomar (*Zanthoxylum armatum*): *Zanthoxylum armatum* fruit extracts have strong antifungal, cytotoxic, phytotoxic, insecticidal effects.

Gairik Powder: In Ayurvedic mineral Gairik comes under Uparasa group. It is a red coloured mineral containing iron and oxygen with a chemical formula of Fe_2O_3.

Acacia arabica (Stem bark extract): *Acacia arabica* containing toothpaste can decrease plaque, gingivitis and BOP% scores. It is suggested that *Acacia arthica*- containing Toothpaste could be a useful approach for gingivitis prevention and that it may be recommended for daily oral hygiene procedures.

Terminalia bellerica fruit extract: *Terminalia bellerica* in combination with *E. officinalis* and *Terminalia chebula* in 1:1:1 ratio (*Triphala*) shows significant reduction in *S. mutans* count and contributes to its strong antioxidant activity.

Emblica officinalis: *Emblica officinalis* is used in combination with *Terminalia bellerica* and *Terminalia chebula* in 1:1:1 ratio in Triphala showing significant reduction in *S. mutans* count, but individually it is the least anti-microbial.

Embelia ribes: *Embelia ribes,* commonly known as black pepper, are antibacterial and antifungal.

Vitex negundo: *Vitex negundo* contains many polyphenolic compounds such as terpenoids, glycosidic iridoids, flavonoids, and alkaloids. It showed antibacterial activity against oral microbes.

Salvadora persica: *Salvadora persica* (meswak) has been scientifically proven to be very useful in the prevention of tooth decay, even when used without any other tooth - cleaning methods. The tannins and resins in meswak have an astringent effect on the mucous membrane and form a layer over the enamel which indeed gives protection to the teeth.

Acacia farnesiana: *Acacia farnesiana*, is used as an astringent and anti-inflammatory agent, in swollen gums and dental caries.

Acacia catechu: *Acacia catechu* is highly precious for its powerful astringent and antioxidant activities. Used externally as a powder itself, it arrests the bleeding in gums. The extracts of Acacia catechu bark have

a very good antibacterial activity against *Streptococcus sangius* and *Streptococcus mutans* than Chlorhexidine.

<u>*Mimusops elengi*</u>: *Mimusops elengi* flower extract is good for teeth, in ayurveda it is known for strengthening teeth.

Chemical Constituents

<u>Carrageenan</u>: A water soluble extractive mixture of sulphated polysaccharides from Red Algae. Chief sources are the Irish moss *Chondrus crispus* (Carrageen), and *Gigartina stellata*. It is used as a binder in toothpastes to hold together the powdered and liquid ingredients.

<u>PVM/MA Copolymer</u>: PVM/MA is the non-proprietary designation for a polyvinylmethyl ether maleic acid copolymer. It has been demonstrated that there is a greater uptake of triclosan to enamel and buccal epithelial cells from the use of a fluoride dentifrice containing triclosan and the PVM/MA copolymer than from a dentifrice containing triclosan alone.

<u>Sodium saccharin</u>: Sodium saccharin appears as odourless white crystals or crystalline powder. It is one of the most common sweeteners used in toothpastes to improve the taste of toothpastes and give them a mild and sweet taste.

<u>Titanium dioxide / CL77891</u>: Titanium dioxide, also known as titanium (IV) oxide or, titania is the naturally occurring oxide of titanium. It is used as a pigment under the names titanium white, Pigment White 6 (PW6), or Cl 77891. Titanium dioxide (TiO_2) is commonly applied to enhance the white colour and brightness of food products. TiO_2 is also used as white pigment in other products such as toothpaste.

<u>Zinc gluconate</u>: Zinc gluconate is a zinc salt of gluconic acid composed of two gluconic acid molecules for each zinc cation (2+). Zinc is formulated into oral health products to control plaque, reduce malodour and inhibit calculus formation. Low concentrations of zinc can both reduce enamel demineralisation and modify remineralisation, during

caries clinical trials, the addition of zinc to fluoride toothpastes has not affected their ability to reduce carries.

Zinc oxide: Crude zinc oxide is a yellow-grey granular solid with no odour. It is insoluble in water. In vitro and in situ studies revealed that zinc oxide can have a significant effect on the inhibition of dentine demineralization, even when the zinc oxide is blended into toothpaste.

CI 74260: phthalocyanine green dye which is used as dye for toothpaste.

CI 74260: phthalocyanine green dye which is used as dye for toothpaste.

p-thymol: Thymol is a phenol obtained from thyme oil or other volatile oils. It is used as a stabilizer in pharmaceutical preparations. It has been used for its antiseptic, antibacterial, and antifungal action.

Xanthan: Xanthomonas campestris is a bacterium which commonly develops on certain species of Brassicaceae where, by using the vegetable substrate, it produces a gummy exudate: xanthan "gum", a high-molecular- mass anionic polysaccharide. It exists as sodium, potassium or calcium salt. Soluble in hot and cold water, xanthan gum forms aqueous solutions of which the viscosity remains practically unchanged by temperature changes, as well as pH changes. Xanthan gum is used as a stabiliser, binder (thickener), and emulsifier.

Cellulose gum: Cellulose gum or carboxymethylcellulose is physiologically inactive, it dissolves in water, it is very compatible with other ingredients, highly stable and relatively low in price. It is used in the form of derivatives such as sodium carboxymethylcellulose, methylcellulose, hydroxyethylcellulose and hydroxypropylcellulose. It is used as a binder, to prevent the separation of powder and liquid ingredients and give an appropriate degree of viscoelasticity and form to the toothpaste. They can prevent the toothpaste from drying out by binding water.

Water: Water is the most common solvent used in toothpaste. It dissolves the ingredients and allows them to be mixed.

<u>Sorbitol</u>: Sorbitol is a sugar alcohol found in fruits and plants with diuretic, laxative and cathartic properties. Sorbitol is used as humectants along with glycerol and a sweetener in toothpastes. As humectants it prevents loss of water, and subsequent hardening of the paste in the tube or when it is exposed to air. As a sweetener sorbitol improves the taste of toothpastes giving a mild and sweet taste. They usually don't cause sudden spikes in blood sugar, but the carbohydrate in them can affect your blood sugar. High amounts of sorbitol have shown evidence of causing bloating and diarrhoea. Sorbitol also has no benefit for tooth health and is used exclusively to improve the taste and texture of toothpastes.

<u>Saccharin</u>: It is derived from coal tar, a chemical-based fructose. Since they are excessively sweet, they are only used in small amounts to make the toothpastes palatable. They are purely used for the purpose to add flavour to the toothpastes. There have been various studies that state that saccharin has been linked to bladder cancer and tumours. It is rare, but sometimes advised by doctors to be avoided during pregnancy as it has shown evidence of crossing through the placenta to the foetus.

<u>Sodium saccharin</u>: Sodium saccharin appears as odourless white crystals or crystalline powder. It is one of the most common sweeteners used in toothpastes to improve the taste of toothpastes and give them a mild and sweet taste.

<u>Sucralose</u>: Popularly known as Splenda, is a chlorocarbon. They have no effect on tooth decay. Sucralose is calorie free but is extremely sweet (approximately 600 times as sweet as sugar).

<u>Abrasive</u>: Abrasives are indispensable in toothpastes. They necessary for grinding the food off the teeth and polishing them. They remove food particles and plaque adhering to the surface of the teeth. As harsh as that might sound, it is the main purpose of the toothpaste. The particles size that is less than 0.02mm or less are considered safe by the FDA. If the size exceeds it may cause damage to the tooth surface causing scratches and damaging the gums. The pH of abrasives should range from weakly acidic to weakly alkaline which are insoluble in water.

Silica//Hydrated Silica: Chemically, silica is an oxide of silicon, viz., silicon dioxide, and is generally colourless to white and insoluble in water. Silica is used as a mild abrasive and very suitable for use in toothpastes containing fluoride because no insoluble salt is formed when it reacts with fluoride. As its refractive index is lower than that of other abrasives, silica can be used to make clear gel toothpastes.

Calcium Carbonate: Calcium carbonate appears as white, odourless powder or colourless crystals. Practically insoluble in water. There are two types - Ground calcium carbonate, results directly from the mining of limestone and Precipitated calcium carbonate, produced industrially by the decomposition of limestone to calcium oxide, followed by subsequent decarbonisation or as a by- product of the Solvay process. Calcium carbonate is a mild abrasive which helps to safely remove plaque when brushing and gently polishes away surface stains. Cleaning effective calcium carbonate material is useful for making dentifrice compositions, and yet at the same time is relatively soft and not excessively abrasive to teeth and tissue surfaces.

Mica: It is a mild abrasive and adds the glittery shine to the toothpaste. They are capable of breaking apart the food particles but at the same gentle enough to not damage the surface. Mica is coated with titanium dioxide which then acts as a 'pearling agent' leaving the paste with a glossy white effect.

Activated charcoal: It is a fine powder with a grainy texture made from wood, coconut shells and other substances that are oxidised under extreme heat. They have shown evidence of eliminating the extrinsic stains on the enamel. But they have no impact on intrinsic stains therefore they aren't necessarily beneficial for having a whitening effect. There is no proof for charcoal having antibacterial, antifungal, antiviral and detoxifying effects but they might alleviate cavities. However, charcoal can be hugely abrasive, causing more damage to the teeth. The particle size for activated charcoal is 0.045-0.180mm and the expected value being not more than 0.02mm. This could cause severe tooth damage in the long run.

Sodium lauryl sulphate: Sodium lauryl sulphate is a mixture of sodium alkyl sulphates, consisting mainly of sodium dodecyl sulphate. It is a white or pale-yellow powder or crystals with a slight characteristic odour. It is used as a foaming agent in toothpastes. Sodium lauryl sulphate has many adverse effects including development of ulcers, hence resulting in the development of toothpaste with alternative surfactants such as sodium lauryl sarcosinate, socamidopopybetaine.

Benzyl alcohol: Benzyl alcohol is an aromatic alcohol that consists of benzene bearing a single hydroxy methyl substituent. It has a role as a solvent, a metabolite, an antioxidant and a fragrance.

Potassium nitrate: Potassium Nitrate appears as a white to dirty grey crystalline solid, water soluble. It is used in de-sensitivity toothpastes. These shield the nerve endings from irritants that block the pain signals through the nerves to reach the brain (active ingredients).

PUBLIC SURVEY: TOOTHPASTE PREFERENCES

A survey was conducted amongst 100 people from various demographics in India. Maximum number of participants complained of sensitivity (47%) and cavities (41%) as their main dental concerns. The survey pointed at majority using a single toothpaste while brushing twice a day. The main determining factor while purchasing toothpastes was found to be brand of toothpaste (65%) while only 28% looked at the ingredients. The survey also showed that majority if the participants preferred Colgate (57%) as a brand followed by Close up, Sensodyne, Pepsodent, Dabur, Himalaya and Patanjali, and a majority (90%) were satisfied with the results from their current toothpaste.

CONCLUSION:

Various different ingredients have to be combined to produce the perfect formula for a toothpaste. The formula should ensure that the toothpaste will be effective against the various dental issues and provide the consumer with satisfactory results after using the product.

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SECTION II - MICROBIOLOGY

Chapter 5 - Choice of People Pre and Post Pandemic

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ABSTRACT

The emergence of novel pathogens, bacterial or viral, have always posed serious challenges to public health around the globe. In this study we focus on figuring out the changes that has happened in the participants hygiene routines pre and post pandemic. Hand hygiene relates to hand washing, the act of cleansing the hands with water or another liquid, with or without the use of soap or other detergents, for the purpose of removing soil, dirt, and/or microorganisms and most importantly to ensure proper hand hygiene. The focus of study includes the brands preferred by the participants in regards with hand washes and sanitizers as well as centring the amount of time spent by each participant on hand washing. The data is collected with the help of google forms and 306 responses were recorded with 60.4% of test population consisting of students of age group 17 – 22 years.

Keywords: COVID-19 Pandemic, Sanitizers, Hand washes, Survey, Hand Hygiene.

INTRODUCTION:

The advent of SARS-CoV-2, a new virus, has created unprecedented challenges to global public health. Currently, COVID-19 methods are solely supportive and preventive in a lot of countries where vaccines are not available or not in enough amounts, with the goal of decreasing transmission.

There are vaccines available to treat COVID-19 infection, but the entire community to be fully vaccinated will take a significant amount of time

and the infection incidence is rapidly growing across the world. Only preventative actions are recommended till the entire vaccination can take place. WHO recommends a healthy lifestyle with a strong immune system to combat and prevent the disease. Hand washing is a strategy for preventing transmission in public or hospital environments. People commonly use hand washes, hand detergents, and hand sanitizers to avoid the dynamic transmission of COVID-19. Antiseptic hand washes or antibacterial detergents are designed to be used with water and then rinsed away with clean water to eliminate any soap or grime. "Hand sanitizers" are meant to be used and left on the skin surface in the absence of water and soap, not to be washed with water to keep them effective.

The Environmental Protection Agency (EPA) of the United States has classified microbial treatments into three groups depending on their overall efficacy:

- A sterilant is a substance that kills or destroys all types of microbiological life. Ethylene oxide, glutaraldehyde, and peroxyacetic acid are examples of chemical sterilant.
- Disinfectants destroy pathogenic fungus and vegetative bacteria on inanimate surfaces, but not always bacterial spores. The most common disinfectants found in homes, swimming pools, and water purifiers are general disinfectants.
- Sanitizer is a chemical that lowers, but does not always remove, microbiological contamination to levels that are deemed acceptable for human health. Sanitizers can be used to kill vegetative cells.

Sterilant may be unnecessary for daily usage but are important in healthcare environments. Disinfection of homes and inanimate objects bought from outside are a necessity for everyday life. When outdoors, usage of sanitizers is a must whenever coming in contact with a person, or an object or before consumption of any edibles.

Alcohol-based hand sanitizers suggested by the WHO for regular hand hygiene, are mostly composed of ethanol, isopropyl alcohols, and hydrogen peroxides in various forms and combinations.

Use of liquid soaps have wider acceptability because solid soap due to its reusable nature, may hold bacteria acquired from previous uses, so it is important to wash the soap itself before and after use. [21]. Hand washing with contaminated soap could colonize the hands with Gram-negative bacteria, which results in an increase in bacterial counts on the skin [22].

Plain soap and water hand washing is preferable when the hands are visibly dirty, soiled or contaminated with blood because alcohol-based hand rubs are ineffective in the presence of organic material. In addition, alcohols are ineffective against non-lipid enveloped viruses e.g., Noro viruses and the spores of bacteria e.g., *Clostridium difficile* and *B. anthracis* and protozoan cysts e.g., *Giardia lamblia* [23].

Literature Review:

The World Health Organization (WHO) defines an alcohol-based hand rub as: "An alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to inactivate microorganisms and/or temporarily suppress their growth. Such preparations may contain one or more types of alcohol, other active ingredients with excipients, and humectants." [1]

Isopropanol, ethanol, n-propanol, or a combination of these are the most common active components in alcohol-based hand antiseptics. Alcohols' antibacterial properties are due to their potential to denature and coagulate proteins. Microbes lose their protective coats and become non-functional as a result of this. The Centre for Disease Control and Prevention recommends sanitizers with 80 percent (percent volume/volume) ethanol or 75 percent isopropyl alcohol; however, sanitizers with 60 to 95 percent alcohol are typically appropriate.[3][6]

The WHO has published the following formulations to guide to the production of large quantities of hand sanitizer from chemicals available

in developing countries, where commercial hand sanitizer may not be available [2].

Because these percentages [refer Table 1 and 2] are in the centre of the permissible range, the required percentages of ethanol and isopropyl alcohol are retained at 80 percent and 75 percent, respectively. In particular, greater than recommended quantities are paradoxically less effective since proteins do not quickly denature in the absence of water. Antiseptic hand rub alcohol concentrations are usually reported as a percentage of volume, rather than as a percentage of weight. A 15-second contact period was able to decrease gram-positive and gram-negative bacteria by more than 105 in research using 85% [weight/weight] ethanol [25].

The most common alcohol component, ethanol, looks to be the most efficient against viruses, whereas propanol is thought to be a superior bactericidal alcohol. Alcohols used together may have a synergistic impact. The amount of alcohol in hand sanitizers affects their effectiveness, with one research showing that a hand rub containing 85 percent ethanol was substantially more effective in reducing bacterial populations than treatments containing 60 percent to 62 percent ethanol. Alcohol based hand sanitizers frequently include hydrating components, such as glycerine, which avoid skin dryness, as well as moisturisers, like aloe vera, which help replenish some of the water lost during usage.

Ingredient	Volume required (1L prep)	Active ingredient % (v/v)
Ethanol 96%	833 mL	80%
Glycerol 98%	14.5 mL	1.45%
Hydrogen Peroxide 3%	41.7 mL	0.13%
Distilled Water	added to 1000 mL	18.43%

Table 1: Formulation

None of the aforementioned alcohols have been found to cause acquired bacterial resistance, thus they are regarded very effective for usage in

medical contexts but some bacteria are gaining tolerance for the alcohol-based sanitizers [26].

Nonmedicated soaps are often detergent- based products. They come in a variety of formats, including bar soaps, tissue, leaflets, and more as well as liquid preparations This cleaning action can be associated majorly to the detergent properties. Such soaps do not contain any active ingredient which has antimicrobial activity apart from preservatives. Because the surfactants in soap loosen dirt and bacteria off skin, and individuals prefer to scrub hands more completely when using soap, germs are removed even more effectively.

To date, research have demonstrated that using antibacterial soaps provides no additional health benefits for consumers (this does not include healthcare professionals) compared to using plain soap. [27]

Ingredient	Volume required (1L prep)	Active ingredient % (v/v)
Isopropyl alcohol 99.8%	751.5 mL	75.15%
Glycerol	14.5 mL	1.45%
Hydrogen peroxide 3%	41.7 mL	0.13%
Distilled water	added to 1000 mL	23.43%

Table 2: Formulation 2

As a consequence, in September 2016, the FDA published a final regulation stating that 19 chemicals in popular "antibacterial" soaps, including triclosan, were no more effective than non-antibacterial soap and water, and so these products could no longer be advertised to the general public. Hand sanitizers, wipes, and antibacterial products used in hospital environments are not affected by this law.

Friction created by lathering and scrubbing hands, helps remove dirt, oil, and germs off the skin. Because microbes may be found on all areas of the hand, including beneath the nails, the entire hand should be washed 11-15 times. Wash your hands for at least 20 seconds (6). Clean flowing

water should be used since hands might get re-infected if placed in a basin of standing water that has been polluted by prior use. When required, however, washing with non-potable water may enhance health in case of extreme conditions like a natural disaster or due to other mishaps which might cause non availability of flowing water. Although water temperature appears to have little effect on microbe eradication, warmer water may cause greater skin irritation and is more ecologically expensive. Turning off the faucet after soaking hands saves water, and there's no evidence that large amounts of germs are transmitted from hands to faucet.

Because few research on the health effects of varying handwashing periods have been conducted, determining the ideal amount of time for handwashing is challenging. Nearly all of those that exist have assessed decreases in total numbers of microorganisms, with just a tiny fraction of those capable of causing sickness, and none have examined health consequences. Reducing the number of germs on your hands alone isn't always connected to greater health. Many factors, including the kind and amount of filth on the hands and the environment of the person washing hands, are likely to influence the ideal duration of time for handwashing.

Surgeons, for example, are more likely to come into touch with disease-causing germs and risk spreading dangerous diseases to susceptible patients, thus they may need to wash their hands more thoroughly than someone who prepares their own lunch at home. Nonetheless, data shows that washing hands for 15 to 30 seconds eliminates more germs than washing for less time.

As a result, several governments and international organisations have established guidelines recommending that people wash their hands for around 20 seconds (with an additional 20-30 seconds for drying). While some guidelines suggest using a paper towel to turn off the faucet after rinsing your hands, this practise results in more water and paper towels being used, and no studies have shown that it benefits health. Dry your hands with a clean towel or let them air dry. Germs are more easily transmitted to and from moist hands, thus hands should be dried after

washing. However, there are few research on hand drying and the results of existing studies disagree, the optimal technique to dry hands remains a mystery. Furthermore, the majority of these research evaluate total microbe concentrations on hands following various hand-drying procedures, not only disease- causing bacteria. The removal of germs from hands has not been related to improved health. Despite this, research show that using a clean towel or air drying your hands is the best option.

Continuous use of the aforementioned hand sanitizers has been linked to an increased risk of antibiotic resistance and other viral illnesses

Aim and Objective:

The study focuses of figuring out the changes that has happened in the participants hygiene routines pre and post pandemic. The focus of study includes the brands preferred by the participants in regards with hand washes and sanitizers as well as centring the amount of time spent by each participant on hand washing.

The objective of the study are as follows:

- To prepare an appropriate questionnaire in regard with the topic.
- To collect data with the help of google forms.
- To share the survey in the target population.
- Analysing the responses recorded.
- To conclude the findings of the survey

MATERIALS AND METHODS:

An online survey was conducted using Google Forms which was disseminated using social media platforms. The demography profile of 306 respondents was recorded and 60.4% of test population comprised of students of age group 17 – 22 years.

RESULTS:

The survey consisted of 306 participants with majority belonging to the 17-22 age group. 40.8% of the participants were males and 59.2% females. The survey showed changes in the hand washing frequency of the participants pre and post pandemic. Majority of the participants had an average hand washing frequency of 0- 5 handwashes per day before the pandemic, which goes up to 2-7 during the pandemic and stays that way after ease of lockdown restrictions as well, indicating the changes in routines and consciousness towards the pandemic.
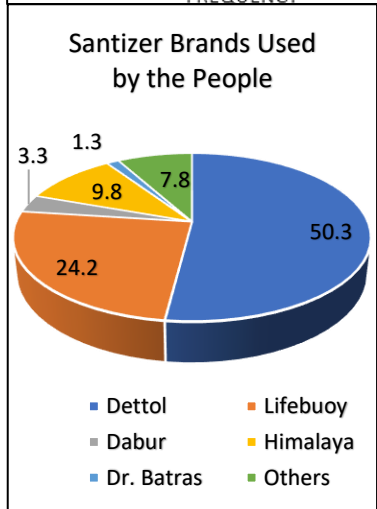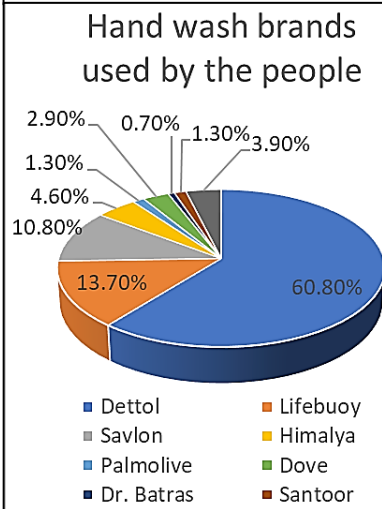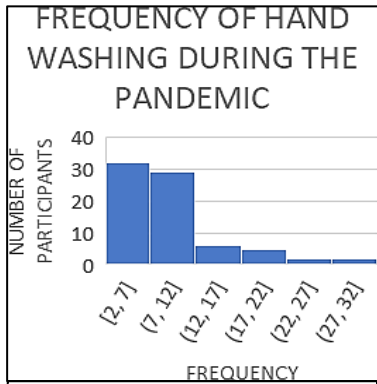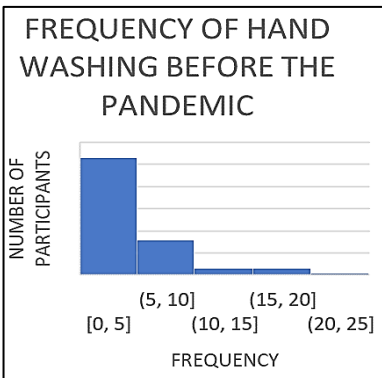
68.3% of the participants preferred using both liquid soaps and sanitizers for cleaning their hands with Dettol being the leading brands amongst the participants for both hand washes (60.8%) and for sanitizers (50.3%). For the relative time period of hand washing 81% of the participants chose to wash their hands for 10-30 seconds, following the appropriate conditions decided by the WHO and CDC.

CONCLUSION:

The COVID – 19 Pandemic has created a dramatic Global disruption, with millions of confirmed cases and deaths globally. People were advised to follow efficient hygiene routines and practice social distancing to avoid the spread of the disease as much as possible. An online survey was conducted to understand the measures people adopted for COVID – 19 and what changes were made in their hygiene routine and brand choices for hand washes and sanitizers. The survey was mainly targeted to students, working professionals, and homemakers of different Ages, Gender and Region. The study obtained a total of 306 responses which were collected between January 2021 to June 2021.

The data collected showed an increase in the average number of handwashes performed in a day by the participant. The count went up from 5.5 handwashes per person to 9.5 handwashes per day, which again came down to 8.7 when the lockdown restrictions had been eased.

The majority of the survey population (46.4%) washed their hands for an interval of 10-20 seconds, followed by 20-30 seconds (34.6%), 14.4% washing their hands for 0-10 seconds, and lastly 4.6% people washing it for 30-40 seconds. 68.3% of the participants preferred using soaps and sanitizers both for cleaning their hands, whereas 28.8% and 2.9% of participants used only soaps and sanitizers respectively. In the choice of brands for both soaps and sanitizers, the majority of the population (60.8% and 50.3% respectively) favoured DETTOL for cleaning purposes, followed by LIFEBUOY in both categories 83.3% of participants used alcohol-based sanitizers while only 23.3% changed their regular brands during the pandemic.

LIMITATIONS:

- The major limitation of the survey method is that we couldn't reach people devoid of social media.
- Language barrier.
- There might have been a possibility
- that the test population had faced certain difficulties in understanding the conceptual questions

FUTURE PROSPECTS;

A study of the regular flora of the participant's hands can be done. For this, the preferred study population would be a batch of students, which are mostly in the same environment throughout the day, to ensure uniform conditions as much as possible. Further diversification can be based on gender and age, and a study can be carried out to see if different products differ based on gender. Also how long does it take for the normal flora to re-establish after cleaning the hands, and if the re-establishing time and the type of flora vary with different brands.

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Chapter 6 - Study on Usage of Masks, Gloves and Application of Green Nanotechnology for Enhanced Antimicrobial Activity

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ABSTRACT:

The current study is designed to collate information on pattern of usage of protective equipment in the COVID-19 pandemics. The study highlights protective measures adopted for COVID-19 by the test population and evaluates the challenges faced with respect to usage of face masks, gloves. An online survey was conducted using Google Forms which was disseminated using social media platforms and the data obtained was analysed using Jamovi [version 1.6.1]. The demography profile of 339 respondents was recorded and 62% of test population comprised of students of age group 18 – 23 years. The survey highlighted the type of protective equipment used by people frequently and it was found that 48% of the respondents used only masks and 42% used both masks and gloves. Homemade masks were used by (33.92%) and plastic gloves by (53.4%) of the population. 81% of the population reused masks after washing and 72% discarded the gloves after single use. Scale analysis was used to evaluate the experience of mask usage based on the factors like comfort, breathability and expense. In the survey, certain questions were directed exclusively to healthcare professionals and their response suggested that a mask can be used for 6 – 10 hours and gloves for 4 – 6 hours without irritation. Awareness about antimicrobial coating, which is a process of applying antimicrobial agents such as biocides or silver nanoparticles on protective equipment was analysed in the current study. 55% (186/339) of the respondents were aware of antimicrobial coatings on masks and gloves and 52% wanted to use them. Thus, the survey propelled the idea of testing the efficacy of antimicrobial coatings in our study further. In this study, we have used Aloe vera to synthesize

nanoparticles. Susceptibility of test cultures *S. aureus* and *E. coli* towards AgNP's was checked and studied.

Keywords: Covid-19, Masks and Gloves, Scale analysis, Silver Nanoparticles

INTRODUCTION:

The COVID-19 pandemics has created a dramatic Global disruption, with over millions of confirmed cases and deaths globally. Due to the sudden pandemic people were advised to wear protective equipment such as face masks, gloves and PPE kits and practice rigorous sanitization measures for personal safety as well as to safeguard others. A survey was conducted to understand the protective measures adopted for COVID-19 and the difficulties/challenges faced by the people in the process of using the protective equipment. The survey was mainly targeted to Students, Working professionals and Homemakers of different Age, Gender and Region. The study obtained 339 total responses which was conducted from 6th September 2020 to 4th November 2020.

Awareness about antimicrobial coatings, which is a process of applying antimicrobial agents such as biocides or silver nanoparticles on protective equipment was analysed in the current study. Thus, the survey propelled the idea of testing the efficacy of antimicrobial coatings in our study further. The synthesis of nanoparticles is evolving into an important branch of nanotechnology. Studies are ongoing to find new methods and materials to make them, due to their huge applications in the field of physics, chemistry and biology. Many techniques are involved for synthesizing of nanoparticles, such as chemical reduction of silver ions in aqueous solution with or without stabilizing agents. This method of synthesis requires short period of time and capping agents. Most of these methods are extremely expensive and also involve the use of toxic, hazardous chemicals, which may pose potential environmental and biological risks. (Narayanaswamy et al, 2015) [1]

The environmental non-toxic protocol for synthesis of nanoparticles is leading in the biological approaches which are free from toxic by-products. Thus, there is an increasing demand for "Green Nanotechnology". Many biological approaches for both extracellular and intracellular nanoparticles synthesis have been reported till date using microorganisms including bacteria, (Mukherjee S. et al, 2019) [2] fungi (Guilger-Casagrande et al, 2019) [3] and plants. (Ponarulselvam, S. et al, 2012) [4] Plants are one of the best materials used to synthesize nanoparticles, as they are free from toxic chemicals and provides natural capping agents. It eliminates the elaborate processes of maintaining microbial cultures. Among the various synthesis methods, plant-mediated synthesis of nanoparticles is abundantly preferred as it is cost-effective, environment friendly, and safe for human therapeutic use (Kumar V et al, 2009) [5]. Many reports are available on the biosynthesis of silver nanoparticles using several plant extracts.

In this study we have used Aloe vera to synthesize nanoparticles, Aloe vera being a succulent shrub has medicinal properties due to its richness in biomolecules. Gel of aloe vera contains pectin, cellulose, hemicelluloses, flavonoids, polyphenols, anthraquinones, ascorbic acid, citric acid, acetic acid and acetylated galactoglucomannan called Acemannan. Due to richness of biomolecules in Aloe vera it finds nutritional, medicinal and cosmetic value. Attempts made by the researchers had been successful in the synthesis of nanoparticles using microbes and extracts of plant products obtained from Aloe vera. (Logaranjan, K et al, 2016) [6]

The formed nanoparticles thus, were planned to be impregnated on protective equipment and then further testing for its antimicrobial activities against microbial strains *Escherichia coli* and *Staphylococcus aureus* could be performed and results shall be studied accordingly.

METHODOLOGY:

Survey: Formulation and Distribution - An online survey was conducted using Google Forms which was disseminated using social

media platforms and the data obtained was analysed using Jamovi [Version 1.6.1]. The demography profile of 339 respondents was recorded and 62% of test population comprised of students of age group 18-23 years. The survey highlighted the type of protective equipment used by people. Scale analysis was used to evaluate the experience of mask usage based on the factors like comfort, breathability and expense. In the survey, certain questions were directed exclusively to healthcare professionals. Awareness of anti-microbial coated masks and gloves was inquired and opinions on whether people are ready to use such protective equipment was recorded. Some profession specific questions were also asked and the responses were studied accordingly.

Preparation of Fresh Aloe Vera Extract

Aloe vera leaves were purchased from a local gardener in Telangana, India and were washed thoroughly with distilled water before use. The external layers were peeled and the slimy gel was collected into a 250 ml beaker (rinsed with alcohol). The solid slimy gel was blended in a mixture until it turned into a liquid/semi solid solution. Further this solution was filtered using a muslin cloth (washed with alcohol) into a 250 ml conical flask (rinsed with alcohol). The extract obtained was regarded as 100 % pure Aloe vera extract (Logaranjan, K et al, 2016) [6].

Formation of Nanoparticles

Metallic salt solutions viz.; Cooper sulphate, Zinc nitrate and Silver nitrate were taken for testing, in the concentrations of 0.1 M respectively making a total volume of 100 ml. From these solutions 10 ml was pipetted in separate 100 ml beakers (rinsed with alcohol) and the metallic salt solutions were labelled accordingly. To each of the beakers 10 ml of freshly prepared Aloe vera extract was added. The resulting solution was then kept under dark conditions and change in coloration was observed periodically, which was an indication of respective nanoparticles formation. The generation of nanoparticles was confirmed and characterized by UV-Vis spectroscopy. Upon characterization by UV-Vis spectrophotometer, the suitable metallic salt among other salt solutions was found to be Silver nitrate, which was responsible for finest

nanoparticle production i.e. nanoparticles with a Plasmon peak of 432 nm were observed. Hence other metallic salt solutions were not taken into consideration. Another reason explaining the inefficiency of the copper and zinc nanoparticles was that, after performing the disc diffusion technique, zones of inhibition obtained were negligible or it insufficient antibacterial activity was seen. (M. Pooja Umaiyal et al, 2019) [7] (Madiha B et al, 2018) [8] (Parthasarathy G, 2017) [9]

Then for curating the accurate dilutions, another test was performed in which, the silver nitrate solution was distributed into different dilutions keeping the Aloe vera extract amount constant. The dilutions made varied by a parameter of 5 ml in each of the subsequent dilutions and it can be represented with the help of the following dilution table:

Amount of Aloe vera extract (mL)	Amount of Metallic Salt solution (mL)	Dilutions
10 ml	10ml	1:1
10ml	15ml	1:1.5
10ml	20ml	1:2
10ml	25ml	1:2.5
10ml	30ml	1:3

Table 1: Dilution table for preparation of silver nanoparticles

NOTE: The dilutions were made in sterile test tubes in order to maintain aseptic conditions. They were kept under dark conditions and the protocol followed for the nanoparticle generation is same as above.

The different nanoparticles formed were again characterized by UV-Vis spectroscopy. For determining the finest of them. The two dilutions which showed the highest Plasmon peaks were taken into consideration and the test for antibacterial activity was performed by the Disc Diffusion technique. The control used was 0.1 M Silver nitrate solution.

Checking the Antibacterial Activity

The Antibacterial activity was performed by Disc Diffusion technique (Somayeh Razmavar et al, 2014) [10] it involves the use of whatmann filter paper disc (size 42). All the discs were autoclaved and then dried using Hot air Oven. The medium used was Nutrient Agar and activity was checked against 18 – 24 hr old pure test cultures of E. coli and S. aureus obtained from K. C College, Microbiology Department. The culture densities were maintained at (0.5 Mc Farlands) for both E. coli and S. aureus). The nanoparticle dilutions selected previously were made into the concentrations of 25%, 50%, 75% and 100% and a control solution was also prepared with undiluted solution of 0.1 M Silver nitrate.

Technique

The plates were divided into four equal halves and they were marked for each of the concentrations of nanoparticle dilutions i.e., 25%, 50%, 75% and 100%.

Plates were swabbed uniformly with the test cultures and the sterile dried discs were then dipped into different concentrations for few minutes and were placed at different predetermined spots on the Agar plate containing the bacterial test cultures swabbed on it.

- The plates were then incubated at 37o C for 24 hr.
- The diameters of the zone sizes observed were measured accurately
- and efficiency of the concentrations was determined by comparing them with control zone sizes.

RESULTS AND OBSERVATIONS:

The Survey results were very helpful in understanding the view point of people in regards to antimicrobial coatings and their use in coating of protective equipment.

The results obtained from our Survey study are as follows:

The demographic analysis showed that maximum responses from the age group of 18 – 23.

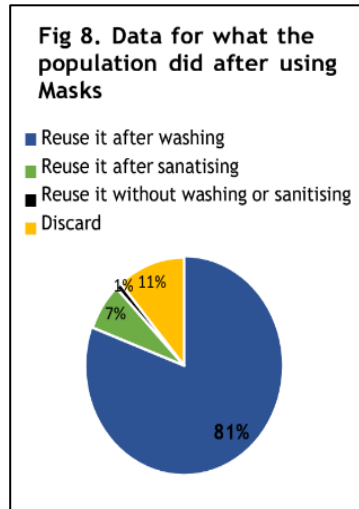Fig 1. Data depicting age distribution

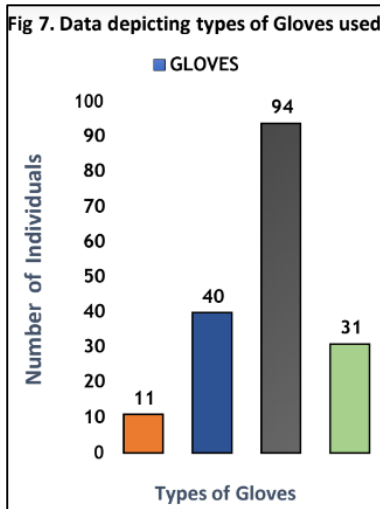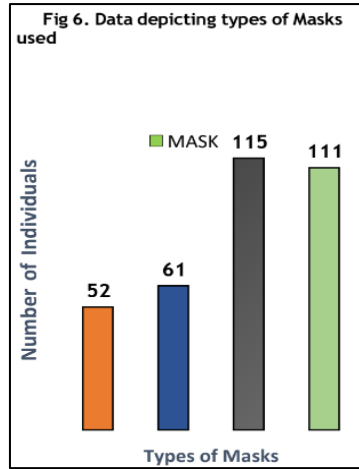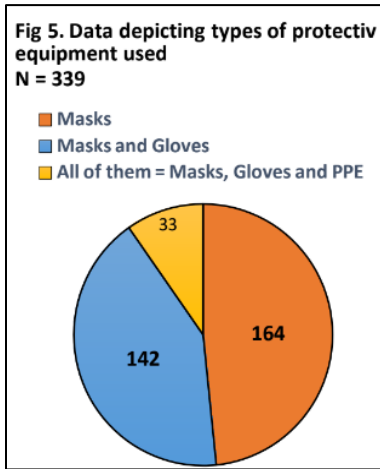Data depicting regional density
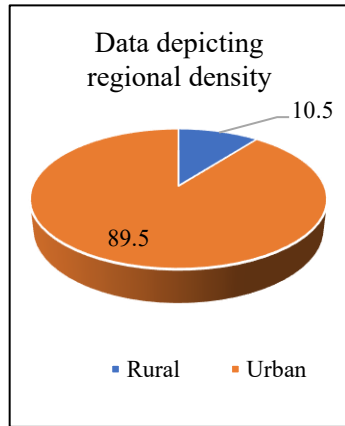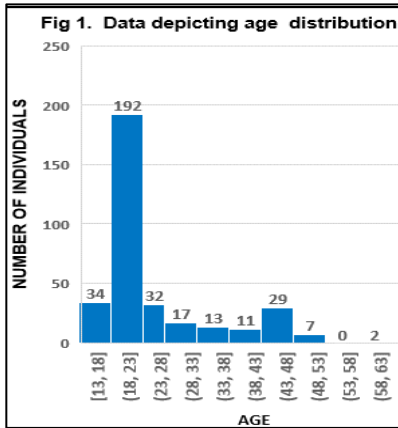
A very high percentage of people (90%) responding to the survey were from urban region whereas only (10%) population responded from the rural region

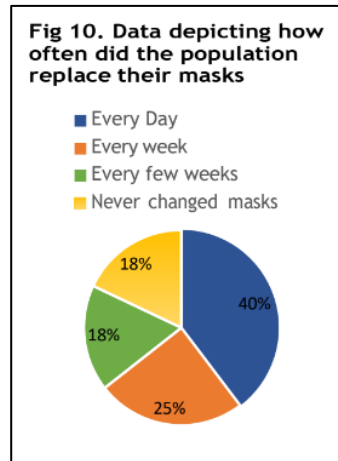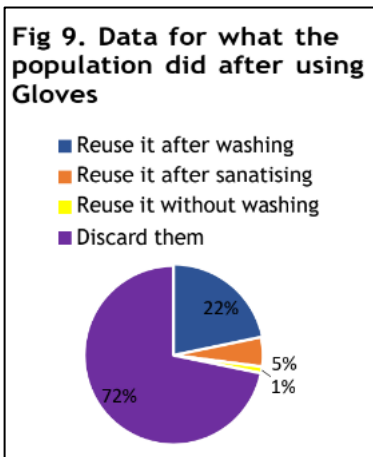The profession distribution showed 62% Students, 35% Working professionals and 3% Homemakers

Profession Distribution

Gender Density
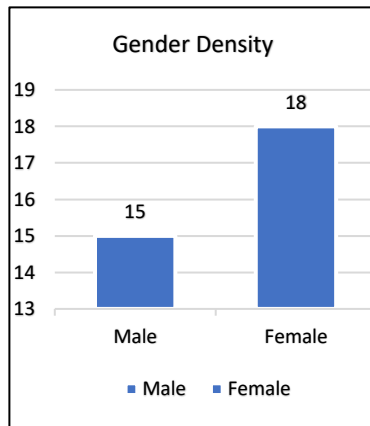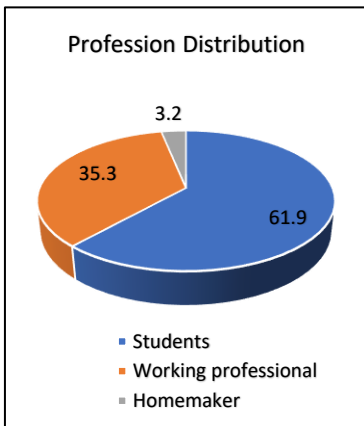
The gender analysis showed 180 Female respondents whereas 159 Male respondents, nearly giving a 1:1 ratio

Fig 5. Data depicting types of protectiv equipment used
N = 339

- Masks
- Masks and Gloves
- All of them = Masks, Gloves and PPE

Fig 6. Data depicting types of Masks used

Fig 7. Data depicting types of Gloves used

Fig 8. Data for what the population did after using Masks

- Reuse it after washing
- Reuse it after sanatising
- Reuse it without washing or sanitising
- Discard

The counts show that most abundantly used protective equipment were Masks (48.3%), Masks and Gloves together (41.8%) and a very low population has used all of them (9.7%).

When asked about the preference of protective equipment following was discovered:

- (33.9%) of the test population was using Homemade or cotton cloth masks.
- (32.7%) used different combination of masks throughout the pandemic whereas.
- (53.4%) of the test population preferred to use Disposable plastic gloves and a mere (22.7%) used Latex gloves
- (81%) of the test population reused their masks after washing and (11%) of them discarded it after use.
- (72%) of the test population discarded their gloves after use whereas (22%) of them reused them after washing

Fig 9. Data for what the population did after using Gloves

- Reuse it after washing
- Reuse it after sanatising
- Reuse it without washing
- Discard them

22%
5%
1%
72%

Fig 10. Data depicting how often did the population replace their masks

- Every Day
- Every week
- Every few weeks
- Never changed masks

18%
18%
40%
25%

Mask replacement was found to be a concern as only (40%) replaced their masks regularly everyday posing a threat of mask contamination amongst others due to prolonged usage

We also performed a chi square statistical test in order to validate the difference among opinions of the test population. The result was as follows:
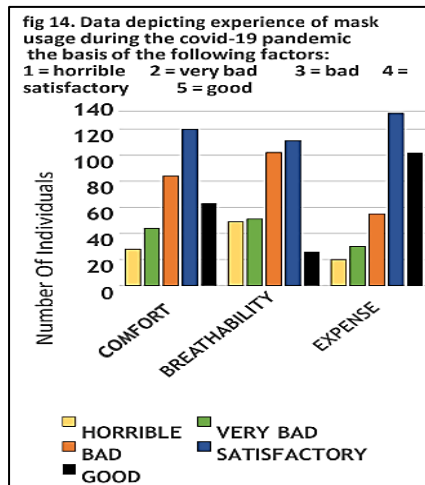
If Null Hypothesis H0 = There is no significant difference

And Alternative Hypothesis H1 = There is a significant difference

Since $p = <0.05$

Therefore, Null hypothesis is rejected and alternative hypothesis may be retained.

This implies that statistically there is a significant difference in mask replacement frequency by the test population

fig 14. Data depicting experience of mask usage during the covid-19 pandemic the basis of the following factors: 1 = horrible   2 = very bad   3 = bad   4 = satisfactory   5 = good

Statistical tests were performed to know whether there is statistically any significant difference in the responses generated across different professions and based on the Chi square test results following can be determined on basis of the following factors:

Comfort:

Contingency Tables

Contingency Tables

How would you like to rate your experience of Mask usage during the current Pandemic crisis on the basis of the following factors: 1 = Horrible 2 = Very Bad 3 = Bad 4 = Satisfactory 5 = Good [Comfort]	Profession			Tota
	Home Maker	Students	Working Professionals	
1	2	11	15	28
2	2	33	9	44
3	0	53	31	84
4	4	80	36	120
5	3	33	27	63
Total	11	210	118	339

x^2 Tests

	Value	df	p
x^2	17.1	8	0.029
N	339		

If Null hypothesis H0 = There is no significant difference.; And Alternative Hypothesis H1 = There is a significant difference; Since p = < 0.05. Therefore, Alternate hypothesis is retained and Null hypothesis may be rejected. This implies that statistically there is a significant difference in mask usage on the basis of comfort levels among the test population across professions.

Breathability:

Contingency Tables

Contingency Tables

How would you like to rate your experience of Mask usage during the current Pandemic crisis on the basis of the following factors: 1 = Horrible 2 = Very Bad 3 = Bad 4 = Satisfactory 5 = Good [Breathing Problems]	Profession			Total
	Home Maker	Students	Working Professionals	
1	4	29	16	49
2	2	33	16	51
3	1	61	40	102
4	3	75	33	111
5	1	12	13	26
Total	11	210	118	339

x^2 Tests

	Value	df	p
x^2	10.6	8	0.223
N	339		

Fig 16. Data depicting preference of test population w.r.t use of antimicrobial coated



If Null Hypothesis H0 = There is no significant difference; And Alternative Hypothesis H1 = There is a significant difference; Since p = > 0.05. Therefore, Null hypothesis is retained and alternative hypothesis may be rejected. This implies that statistically there is no significant difference in breathing problems faced among people from different professions.

Expense:

If Null Hypothesis H0 = There is no significant difference

And Alternative Hypothesis H1 = There is a significant difference; Since p = > 0.05

Fig 15. Data depicting awareness of antimicrobial coated protective equipment
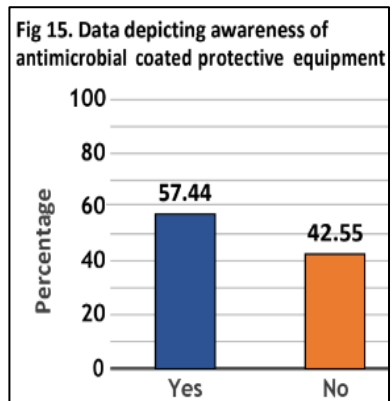
Contingency Tables

Contingency Tables

				Profession			
How would you like to rate your experience of Mask usage during the current Pandemic crisis on the basis of the following factors: 1 = Horrible 2 = Very Bad 3 = Bad 4 = Satisfactory 5 = Good [Expense]				Home Maker	Students	Working Professionals	Tota
1	χ^2 Tests			1	8	11	20
2				0	17	13	30
3		Value	df	p	33	20	55
3				2	33	20	55
4	χ^2	9.96	8	0.268	82	47	132
5	N	339			70	27	102
Total				11	210	118	339

Therefore, Null hypothesis is retained This implies that statistically there, is no significant difference and it can be said that people from different professions are comfortable with respect to expense of Masks. More than 50% of the test population was aware of Anti-microbial coatings and when asked about, whether they would like to use such antimicrobial coated protective equipment approximately same percentage of people responded with a "YES". Healthcare professionals suggested that a mask can be used efficiently for 6-10 hours and gloves

Fig 19. Data depicting preference of healthcare professionals' w.r.t use of antimicrobial coated protective equipment
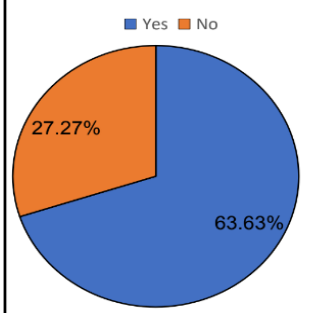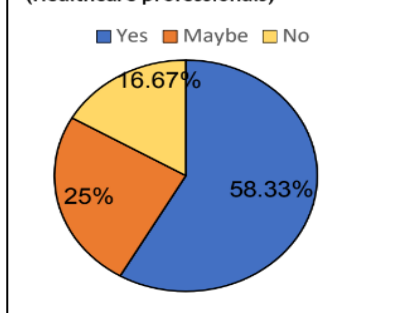

Fig 18. Data for usage of antimicrobial coatings in protective equipment (Healthcare professionals)

for 4-6 hours. Healthcare professionals were separately asked about the antimicrobial coatings and would they be helpful (58.83%) of them

responded with a "YES" whereas (63.63%) agreed to its usage on protective equipment. Further study was conducted in laboratory for formation of nanoparticles and to test the efficiency of formed nanoparticles on test cultures *S. aureus* and *E. coli.* The characterization of silver nanoparticles was performed using UV-Vis spectroscopy which yielded following observations:

Fig 20 . Data for Characterization of **Silver nanoparticles** by using UV- Vis spectroscopy
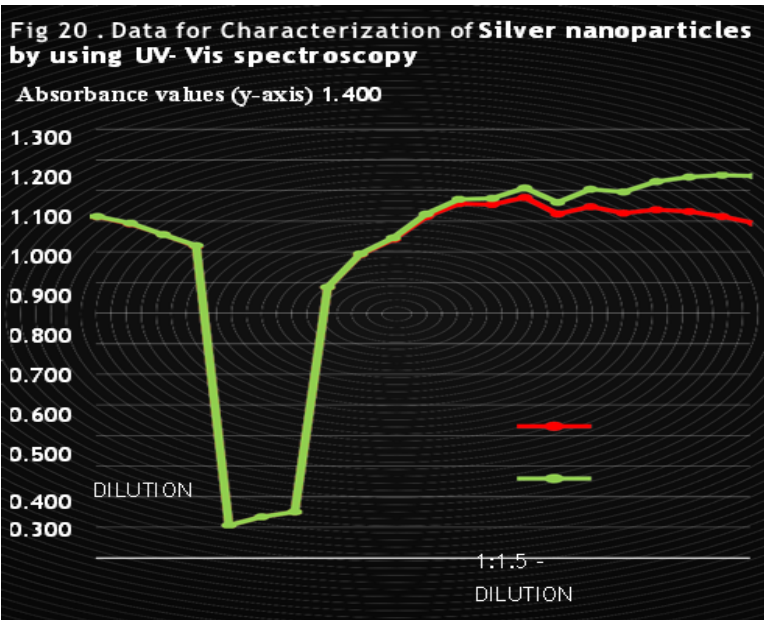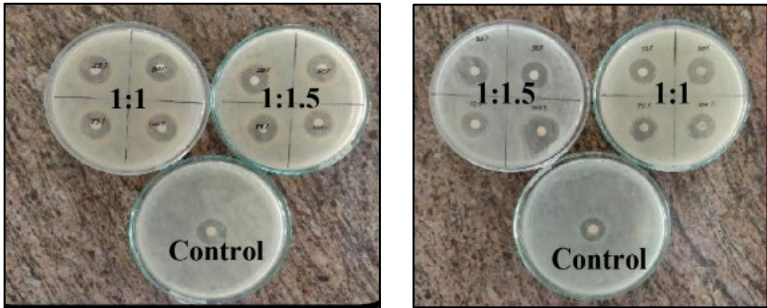
Susceptibility testing of test cultures *S. aureus* and *E. coli* towards silver nanoparticles was checked, which is shown below in Fig 21 and Fig 22

Table 2 depicts the zone sizes obtained for the 1:1 Dilution which were found to be less effective or comparatively similar to the zone sizes observed in the table 3 i.e., for the Dilution 1:1.5

Organism	Control	25%	50%	75%	100%
S. aureus	17 mm	17 mm	17 mm	17 mm	17 mm
E. coli	16 mm	16 mm	16 mm	16 mm	16 mm

There was no such effective concentration found against *S. aureus* compared to the Control as all the concentrations developed the same zones of inhibition except for 75% concentration which showed the least inhibition i.e. 16mm.

Similarly in case of *E. coli* there was no such effective concentration found as well, all of the concentrations developed nearly the same zones of inhibition i.e., 16mm for 25% and 75%, whereas 17mm for 50% and 100% concentrations accordingly

Organism	Control	25%	50%	75%	100%
S. aureus	17mm	17mm	18mm	17mm	17mm
E. coli	16mm	19mm	16mm	17mm	20mm

The 50% concentration of 1:1.5 dilution was one of the most effective concentrations of the silver nanoparticles formed against S. aureus as it gave an 18mm zone of inhibition followed by 25%, 75% and 100% concentrations having the zone sizes 17mm, 17mm and 17mm respectively.

In case of E. coli, the 100% concentration of 1:1.5 dilution was one of the most effective concentrations of the silver nanoparticles formed as it gave a 20mm zone of inhibition followed by 25%, 75% and 50% concentrations having the zone sizes 19mm, 17mm and 16mm respectively. The zone of inhibitions for both S. aureus and E. coli at 1:1 dilution was found to be 17mm and at 1:1.5 dilution it was found to be 18mm and 19mm for S. aureus and E. coli respectively.

DISCUSSION:

The current outbreak of the novel- coronavirus (COVID-19), epi-cantered in Hubei province of the People's Republic of China, has spread to many other countries. In this paper, we investigated the types of mask and gloves used by test population and gathered data on their opinion on using masks and gloves on the basis of Comfort, Breathability and Expense. We have provided a simple statistical analysis on the awareness of Anti-microbial masks and gloves among general public in COVID-19 pandemic. We made Green synthesised Silver Nanoparticles to use as antimicrobial coatings for masks and gloves. The majority of population used Homemade or Cotton cloth masks which they preferred to reuse after washing with soap and water.

"The filtration effectiveness of cloth masks is generally lower than that of medical masks and respirators; however, cloth masks may provide some protection if well designed and used correctly. Multilayer cloth masks, designed to fit around the face and made of water-resistant fabric with a high number of threads and finer weave, may provide reasonable protection." (Chughtai AA et al, 2020)

Cotton cloth masks have lower effectiveness and by reusing them after washing can reduce their effectiveness more due to tearing of microfibers.

Majority of population used Plastic gloves which they discarded after single use. About 18% of the test population had never changed their masks whereas 17% changed masks every moth indicating lack of awareness on reduced effectiveness of masks on prolonged use. 42% of the population was not aware of Antimicrobial coated masks and gloves indicating lack of awareness on such masks and gloves.

In Australia, a telephone survey by Taylor et al found that younger people (aged 16-34 years) were less willing to wear a facemask. (Taylor M et al, 2009) [12] The study evaluated willingness to comply with mask-wearing and was analysed by asking respondents that, how willing they would be to wear a facemask. Responses were assessed on a five-

point Likert scale, with options ranging from 'Not at all' to 'Extremely willing'. Tang et al evaluated factors influencing the use of facemasks

prevent the transmission of SARS in Hong Kong via telephone surveys, and found that participants aged 50–59 years were most likely to wear facemasks (68%), while those aged between 19-29 years were least likely to wear facemasks (52.8%). (Tang CS et al, 2004) [13]. In this study, compliance with mask-wearing was measured by asking participants to specify how frequently they wore facemasks to prevent SARS transmission. These two studies suggest that younger people were less likely to comply with mask-wearing. In our current study, 62% responses were from age group of (20-23) years using a face mask. The slightly higher usage amongst youngsters could be due to multiple reasons in the current study like fear generated due to non-availability of vaccine in the age group of 18 to 30, at the time of survey, along with sense of responsibility towards the family and society.

In several studies, it was observed that women were more likely to wear facemasks than men. During the SARS outbreak in Hong Kong, it was reported that Women were more likely to wear facemasks to prevent SARS (OR 1.810, 95% CI 1.445–2.268). (Tang CS et al, 2004) [13] This was similarly observed during the H1N1 outbreak where women were more likely to wear facemasks regularly in public areas (OR 1.94, $p < 0.001$) and when going out while experiencing influenza-like symptoms (OR 2.44, $p < 0.001$). (Tang CS et al, 2004)

[13] In a study of two metro stations in Mexico City, it was observed that more females wore facemasks during the H1N1 outbreak (Condon BJ et al 2010) [16]. However, according to our study females expressed marginally more displeasure towards comfort levels while wearing a mask as compared to males, but the difference was statistically proved to be insignificant ($P = 0.411$).

The previous studied suggested a possible association between the location of residence and mask-wearing compliance. Taylor et al found that people living in rural areas were more likely to wear facemasks (Taylor M et al, 2009) [12]. The study conducted in Taiwan found that

people living in north eastern Taiwan were more likely to practice all preventive measures compared to those living in central Taiwan (adjusted OR 6.01). (Lau JT et al. 2010) [15] The current study was majority of the responses from urban area and the usage of protective equipment was found in high numbers confirming the analytics obtained in previous studies. However, more studies need to be carried out with the rural population to confirm the frequency of usage of protective kits amongst them.

In Taiwan, it was reported that N95 masks that originally cost 85 cents each were sold for USD 20 each during the SARS outbreak in 2003. (McNeil D et al 2004) [17] However, the report did not elaborate on the impact of cost on an individual's decision to wear masks, which may be significant, particularly during outbreaks when the demand for masks may outstrip the supply. Our test population was using different types of masks like Surgical (15.3%), N-95(18%), Homemade (33.9%) and combinations of masks (32.7%). We interrogated to evaluate the experience of using mask on the basis of expense and found that 38.3% females and 39.6% males expressed satisfaction regarding the cost of the masks. The study emphasised that along with comfort, cost could also be a driving factor in wearing a mask and changing/disposing it as per instructions of medical experts. If the cost is more affordable, then people are more likely to wear it.

Our main objective was to develop antimicrobial silver nanoparticles for masks and gloves, which could be accessible and easy to use for medical staff and the population.

Silver nanoparticles are nanoparticles of silver of between 1 nm and 100 nm in size. Introduction of silver into bacterial cells induces a high degree of structural and morphological changes, which can lead to cell death. As the silver nanoparticles come in contact with the bacteria, they adhere to the cell wall and cell membrane. Once bound, some of the silver passes through to the inside, and interacts with phosphate-containing compounds like DNA and RNA, while another portion adheres to the sulphur-containing proteins on the membrane (Klasen HJ,

2000) [18] The silver-sulphur interactions at the membrane cause the cell wall to undergo structural changes, like the formation of pits and pores. Through these pores, cellular components are released into the extracellular fluid, simply due to the osmotic difference. Within the cell, the integration of silver creates a low molecular weight region where the DNA then condenses. Having DNA in a condensed state inhibits the cell's replication proteins contact with the DNA. Thus the introduction of silver nanoparticles inhibits replication and is sufficient to cause the death of the cell (Feng QL et al, 2000) [19]

We made green synthesised silver nanoparticles with the help of aloe vera (Aloe vera). And tested its efficacy against S. aureus and E. coli. AGNP of different dilutions were made. Silver nitrate solution was distributed into different dilutions keeping the Aloe vera extract amount the same. Nanoparticles were formed after 24 hours. Further these different nanoparticles were characterized by UV-Vis spectroscopy. Two dilutions which showed the highest Plasmon peak were taken into consideration and the test for antibacterial activity was performed by the Disc Diffusion technique. Efficacy of green synthesised AGNPs were checked on cultures of *S. aureus* and *E. coli*.

CONCLUSION:

Majority of population used Homemade or Cotton cloth masks, which they reused after washing. Majority of population preferred to use Disposable Plastic Gloves. 81% of the Test population were reusing their masks without washing indicative of poor practice as they may have lacked knowledge on good sanitation practices and require proper guidance. 18% of the population had never changed their masks and 17% changed their masks only once a month. Majority of population had Satisfactory experience towards Comfort, Breathability and Expense. Working Professionals had Bad experience towards Breathability but the difference was found to be insignificant. More than 50% of population was aware of Antimicrobial coated masks and gloves and majority of them wanted to use such masks and gloves. Healthcare professionals suggested that Masks can be worn for 6-10 hours and gloves can be used

for 4-6 hours without reducing their effectiveness. Wearing masks properly, maintaining social distancing and good personal hygiene are needed to be followed to contain the virus. Green synthesised silver nanoparticles (AGNP) were created and their antimicrobial activity was checked with test cultures S. aureus and E. coli. We plan to coat these antimicrobial AGNPs onto different masks and gloves and check their efficacy.

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Chapter 7 - Survey Regarding Awareness of Probiotic and Prebiotic

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ABSTRACT:

Probiotics are live microorganisms that exhibit properties beneficial to health when consumed. They are also commonly found as gut microflora which help digest food and also improve its absorption. This microflora also plays a role in maintaining intestinal immunity as it prevents colonization of other harmful pathogens. Prebiotics are food source for this microflora. They are certain dietary fibres and carbohydrates that the usual gastric juices are unable to digest but they are easily digestible by the probiotic organisms.

After knowing the importance of Probiotics many commercial products were marketed. Naturally also consumption of products like curd and certain dairy products was emphasized as it has lactic acid bacteria. The pivotal role of dietary fibres which is derived from many traditionally consumed foods, fruits and spices were enlightened. We all also know that even Ayurveda states the significance of a good intestinal health, as majorly diseases arise due to disbalance or any sort of infection in the intestine. Immunity was a key element in this Covid situation. Individuals with co-morbidity were at more risk. Maintaining good intestinal health was important to gain immune strength. Gut microbiota alterations were one of the factors which increased the chances of acquiring an infection. Consuming Probiotics leads to a good intestinal health ultimately resulting in immune power.

The aim of the study was also to estimate the awareness of the application of Probiotics. The study statistically proved that the sample of individuals examined were quite aware of consumption of Probiotics. Even the consumption of Prebiotics was observed amongst the sample

individuals. The survey also consisted questions regarding the benefits and applications of Probiotics and Prebiotics respectively. The awareness regarding immunity and the way a good intestine helps us in experiencing a healthy life.

Keywords: Probiotics, prebiotics, intestine, immunity, awareness.

INTRODUCTION:

The immune response is initiated by innate immunity following exposure to foreign substances or tissue injury. Innate immunity exerts protective roles in host homeostasis in part by priming adaptive immune responses against persisting insults and inducing inflammation.

Sensing of the intestinal microbiota by the host mucosal immune system plays significant roles in maintaining intestinal homeostasis and inducing systemic protective responses. Thus, manipulation of the intestinal microbiota is a potential alternative approach for maintaining health and preventing and/or treating diseases.

Probiotics were defined as 'live microorganisms which, when consumed in adequate amounts as part of food, confer a health benefit on the host'. Lactobacillus, Bifidobacterium, and Saccharomyces are three extensively studied and commonly used probiotics in humans and animals.

Prebiotics are broadly defined as a food ingredient that is composed of oligosaccharides that are not digestible by the host and that has a beneficial effect on host health through selective stimulation of the growth and/or activity of specific members of the gut microbiota.

The vast majority of the bacteria in the colon are strict anaerobes that derive energy from fermentation. The gut microbiota can ferment Fiber due to their expression of several enzymes and transport proteins.

Diet alone has the strongest and most direct effects on gut microbial colonization. Because bacteria have different preferences for different energy sources.

Thus, diet is closely related to the species present in the gut microbiota. Dietary fibres can act as effective prebiotics by inducing major shifts in gut microbial composition and directly affecting the mucosal immune system, resulting in an improvement in enteric inflammatory disorders and the systemic immune response.

METHODOLOGY:

Survey was conducted by preparing a questionnaire using Google forms and the forms were circulated in the sample population through social media platforms. The data collected was analysed using Jamovi software (version 6.1) The responses recorded were 168 and the age group of the respondents was between 18 to 27 years. The survey focused on aspects related to awareness of Probiotics and also stated the importance of maintaining a proper intestinal health. The was categorised graphically mainly on basis of gender. Many benefits Probiotics and prebiotics were also asked.

RESULTS

The data analysis performed based on the data recorded through Survey are as follows:

The age statistics of the responses is: maximum 54.8% responses were from respondents of age 22 years.

Age
168 responses
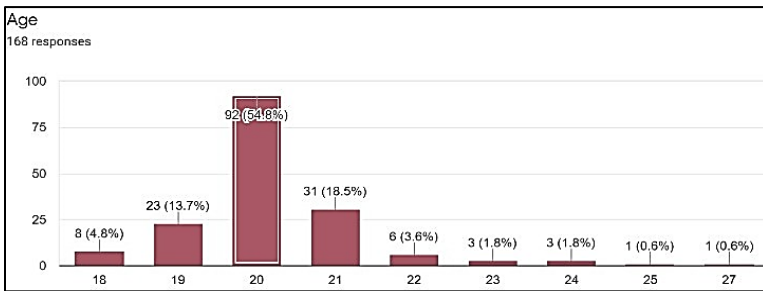
The gender statistics of the responses is: maximum female responses of about 61.3% were recorded and about 38.7% males responded.
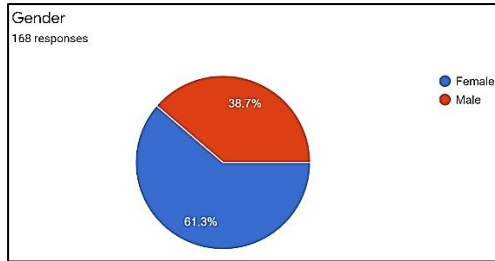
The data showed that 58.3% people were aware of probiotics, 11.3% had never heard about it and 30.4% were knowing about probiotics but not clearly. Almost 50% of the respondents consumed probiotics.
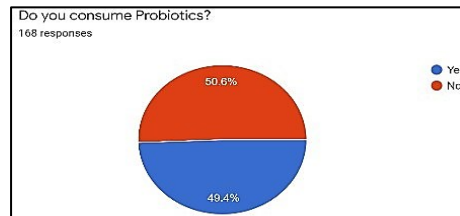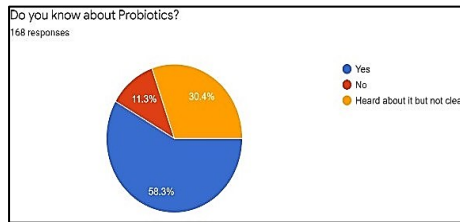

25.3% of the respondents take probiotics daily, 45.6% once in a week, 17.1% several times in a month and 12% only after a course of antibiotic. Benefits of probiotics as improving digestive health and supporting immune system stated was 91.7% and 77.4% respectively from the total responses.
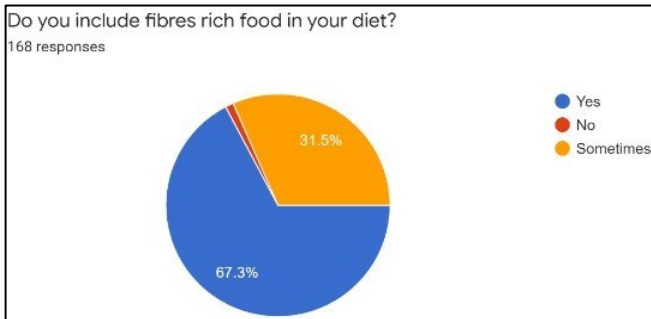
Typical probiotic foods were recorded as Yoghurt by 91.1% and curd by 79.2%.
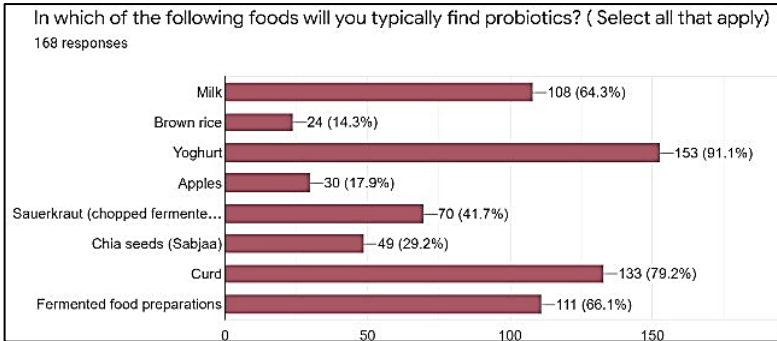
Almost 80.4% respondents were knowing about Yakult. 50.6% occasionally consumed curd in their diet where 42.9% included regularly.
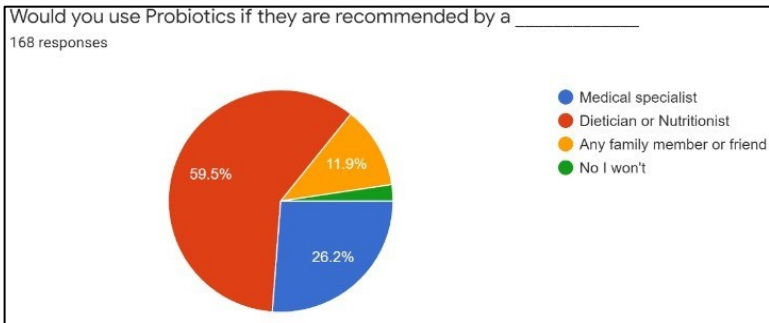
Utilization of probiotics on recommendation of a dietician or nutritionist was stated by 59.5% and a medical specialist by 26.2%. 66.7% said that

Bananas are a source of prebiotics. 67.3% respondents include fibres in their diet. On statistically analysing the entire data by carrying out Chi-square test for independence by differentiating the responses on basis of gender, the result is:

A. Do you know about Probiotics? On the basis of gender.

Chi square test for Independence: If Null Hypothesis (Ho) states that there is no significant association among gender and the levels of knowledge about Probiotics. And if Alternate Hypothesis(H1) states that there is significant association among gender and the levels of knowledge of Probiotics.

Contingency Tables

Contingency Tables

A	Heard about it but not clear	Yes	No	Total
Female	31	65	7	103
Male	20	33	12	65
Total	51	98	19	168

χ^2 Tests

	Value	df	p
χ^2	5.8409	2	0.054
N	168		

Since p > 0.05; As a result, Null Hypothesis (Ho) is rejected which indicates that there is significant association among gender and the levels of knowledge about Probiotics.

B. Do you know about Probiotics? On the basis of age.

Chi square test for Independence: If Null Hypothesis (Ho) states that there is no significant association among levels of age and the knowledge

Contingency Tables

Contingency Tables

B	18	19	20	21	22	23	24	25	27	Total
Heard about it but not clear	4	11	25	6	3	0	1	0	1	51
Yes	3	7	58	21	3	3	2	1	0	98
No	1	5	9	4	0	0	0	0	0	19
Total	8	23	92	31	6	3	3	1	1	168

χ^2 Tests			
	Value	df	p
χ^2	18.886	16	0.275
N	168		

about Probiotics. And if Alternate Hypothesis(H1) states that there is significant association among levels of age and the knowledge of Probiotics. Since p > 0.05.

As a result, Null Hypothesis (Ho) is rejected which indicates that there is significant association among levels of age and the levels of knowledge about Probiotics.

C. Do you consume Probiotics?

Chi square test for Independence: If Null Hypothesis (Ho) states that there is no significant association among gender and the levels of consumption of Probiotics. And if Alternate Hypothesis(H1) states that there is significant association among gender and the levels of consumption of Probiotics.

Since p > 0.05; As a result, Null Hypothesis (Ho) is rejected which indicates that there is significant association among gender and the levels of consumption of Probiotics.

Contingency Tables

Contingency Tables			
	A		
B	Female	Male	Total
No	49	36	85
Yes	54	29	83
Total	103	65	168

χ^2 Tests			
	Value	df	p
χ^2	0.97289	1	0.324
N	168		

consuming Yoghurt or curd in diet. And if Alternate Hypothesis(H1) states that there is significant association among gender and the levels of consuming Yoghurt or curd in diet.

Since p > 0.05; As a result, Null Hypothesis (Ho) is rejected which indicates that there is significant association among gender and the levels of consuming Yoghurt or curd in diet.

F.   Would you consume Probiotics if referred by?

Chi square test for Independence: If Null Hypothesis (Ho) states that there is no significant association among gender and the levels of getting reference regarding consuming Probiotics. And if Alternate Hypothesis(H1) states that there is significant association among gender and the levels of getting reference regarding consuming Probiotics.

Contingency Tables

Contingency Tables

B	A Female	Male	Total
Dietician or Nutritionist	66	34	100
Medical specialist	22	22	44
No I won't	3	1	4
Any family member or friend	12	8	20
Total	103	65	168

X² Tests

	Value	df	p
X^2	3.6305	3	0.304
N	168		

Since p > 0.05; As a result, Null Hypothesis (Ho) is rejected which indicates that there is significant association among gender and the levels of getting reference regarding consuming Probiotics.

DISCUSSION:

In this study regarding the awareness about Probiotics various findings were obtained. The age group examined was 18 to 27 years. When the data was analysed on the basis of gender, it was observed that there is a significant difference about the knowledge of probiotics and prebiotics among the genders. It was found that females were more aware about their diet related practices, as compared to males. Consumption of

probiotics was more often among females. The surveyed population was much aware about the benefits of probiotics, and also about the commercial as well as natural products that are known to have probiotic activity. Females also consumed curd more likely in their diet as a supplement to enhance digestion.

Knowledge about prebiotics was also seen among the sample population. Females were more aware about the benefits of prebiotics, too. Foods that provide prebiotic activity and improve gut health were known.

CONCLUSION:

The study results that there is much awareness regarding immune health and Probiotics. The pandemic situation has resulted in a positive manner; for people to get aware of hygiene, healthy eating habits, maintaining good intestinal health and many more. Irrespective of gender, it could be concluded from the study that importance of consuming Probiotics is seen among individuals of the examined age group. Many of the traditional food habits are now into practice to get immune against infections. People are also now aware that how a healthy lifestyle allows us to stay fit and far from diseases. Balancing body fluids, maintaining optimum body temperature, to follow proper diet habits are some of the facts at the pandemic taught us. Prevalence of traditional practices with scientific reasoning is the new trend now.

Probiotics modulate the innate and adaptive immune responses, facilitating the immune system's development and maturation. Several beneficial effects of probiotics on the host intestinal mucosal defences system have been identified.

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Chapter 8 - Study on the Usage, Awareness and Efficiency of Bio- Cleaners

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ABSTRACT:

It is well known that water is a useful tool for reducing potential contamination present on fruits and vegetables, but it can also transfer pathogenic microorganisms. The contamination of fruits and vegetables has been reported to occur anywhere from farm to fork. So, one of the methods of disinfection of fruits and vegetables at home, i.e. biocleaner, was studied to analyse its awareness and efficiency. Biocleaners are solutions designed to remove harmful germs and pesticides, leaving no aftertaste, smell, or residue. The efficiency of biocleaner was checked using 3 test organisms, i.e., E. coli, S. typhi and S. aureus, as they were the most common organisms present on fruits and vegetables. The resultant biocleaner was effective only until a particular concentration up to 12.5%. The further approach was to compare the inhibitory effects of UV radiation and Dalton bio-cleaner on the test organisms.

An online survey was conducted to know about the usage and awareness regarding one of the eco-friendly disinfecting solutions biocleaner and to understand the measures people have adopted for disinfecting fruits and vegetables and the means they have adopted for disinfecting fruits and vegetables from the start of the pandemic.

Keywords: Biocleaner, UV radiation, Disinfection

INTRODUCTION:

Although it is well known that the quality of the air we breathe, the fruits and vegetables we eat and the water we drink can affect our health but it is far more difficult to understand about the cleaning, disinfecting and chemical products that we use or spray to clean and disinfect them.

The world is facing an unusual threat from the COVID-19 pandemic caused by the SARS-CoV-2 virus. Many countries are following the advice from the World Health Organization (WHO) regarding the introduction of physical distancing measures as one of the ways in which transmission of the disease can be reduced.

The application of these measures has resulted in the closure of many businesses, schools, and institutes of education, and restrictions on travel and social gatherings. For some people, working from home, teleworking, and on-line or internet discussions and meetings are now normal practices. Food industry personnel, however, do not have the opportunity to work from home and are required to continue to work in their usual workplaces. Maintaining the movement of food along the food chain is an essential function to which all stakeholders along the food chain need to contribute. [WHO/2019- nCoV/Food Safety/2020.1]

Importance of Fruits and Vegetables and their Sanitization

Sanitization of fruits and vegetables was important even before the COVID-19 pandemic. As fruits and vegetables play an essential role in a healthy diet by serving as a source of phytonutrients such as carotenoids, cyclic compounds, indoles, polyphenols, and various other secondary metabolites and micronutrients such as vitamins and minerals help perform multiple biological activities in day-to-day life.[Beecher,1999; Slavin et .al, 2012; Brechtet et.al,2004; Minocha et.al,2018;Santarelli et.al,2018.].

Health advisors and dieticians insist on the consumption of a majority of these fruits and vegetables in raw form in order to keep the complete phytochemicals and nutrients profiles that are otherwise lost during cooking or other processes. [Brookie et.al, 2018; Callejón et.al, 2015; FDA (Food and Drug Administration), 2001a; Forsythe et.al, 2010; Yeni et.al, 2016; Gorny et.al, 2005.] During the last few decades, consumption of fruits and vegetables showed a significant increase, and this trend is expected to continue through the next decades. According to the FAO (2020), fruit consumption increased by c.a. 25% while vegetable consumption increased by c.a. 22%, with some discrepancies observed

between different regions of the world. [FAO (Food and Agriculture Organization), 2020].

However, the increased consumption of fresh fruits and vegetables has led to an increasedrisk of contracting food-borne illnesses associated with pathogens and toxic chemicals. The contamination of fruits and vegetable has been reported to occur anywhere from farm to fork. The point of contact between the pathogen and commodity is believed to lie between the pre-harvest phases through contaminated seeds, irrigation water, soil, and pests; to postharvest processes including machine contact surfaces, cross-contamination from cutting boards, transportation, or improper handling [FDA, 2001a; Forsythe, 2010; Gorny, 2005; Yeni et.al,2016; Zhao, Zhao et.al, 1998.]

Transmission of Pathogens by Fruits and Vegetables

Different microbial groups of the microbiome of fresh produce [Fruits and vegetables] can have diverse effects on human health. Fruits and vegetables can be contaminated with spoilage or pathogenic bacteria at any stage from production to consumption [Santarelli et.al, 2012; Slavin et.al, 2018.]. Although their microflora is dominated by spoilage bacteria, yeasts, and molds, fruits and vegetables can harbor pathogenic bacteria such as *Salmonella*, *Escherichia coli*, *Bacilluscereu* s, *Campylobacter* spp., *Yersinia enterocolitica*, *Listeria monocytogenes*, and *Clostridium botulinum*, as well as some viruses and parasites [Santarelli et.al,2012].

For instance, In Royal Hospital, Oman, May 2008, B. cereus caused a nosocomial outbreak with gastroenteritis and affected 58 individuals. B. cereus and its toxin were found in different foods, including vegetables [Brookie et.al, 2018]. Shiga toxin producing E. coli O104:H4 in Germany caused a more serious outbreak, May–July 2011 where 2987 cases of gastroenteritis, 855 cases of hemolytic- uremic syndrome, and 53 deaths were reported. [Tanmayee Bhilwadikar et.al] Contrary to the hundreds of pathogenic microorganisms known, human pathogens account for much less than 1% and only few viruses are associated with food-borne outbreaks. To date, more than a hundred of enteric viruses

have been recognized pathogenic causing food borne illness and most of them are Hepatitis A and Noroviruses. Indeed, the history of viruses as food contaminants and food-borne illness causing agents is recent and juvenile compared to bacterial food-borne illnesses known from decades ago. [Gorny et.al, 2005.]

As numerous viruses are susceptible to contaminate crops during growth, harvesting, handling, marketing and minimal processing, these steps share one common factor, which is human. Different studies showed viruses might persist on different crops for periods of 2 to 14 days under different conditions such as refrigeration, household and freezing. The persistence of the viruses depends on the inanimate surface or the medium, and greatly on their two major structures. First are enveloped viruses possessing an external layer made of proteins and lipids. This layer is easily destructured by soaps or alcohols inactivating the viruses). In contrast, the second category of viruses are non-enveloped ones and have an external protein shell which is resistant to environmental stressors and many disinfectants.

Unfortunately, in food-borne diseases caused by viruses only Avian Influenza, SARS, and Nipah diseases are caused by enveloped ones, while other non-enveloped ones are major contributors to many infections for example, astroviruses, Aichi virus, caliciviruses, HAV, and HEV which are small and more difficult to control. In matter of persistence, the different studies show that rotavirus (non-enveloped) were found on strawberry irrigated with contaminated water, and these non-enveloped viruses are more persistent, therefore, surviving and spreading from fresh produce production to their storage even though their concentration declines because of their inability to multiply. Interesting research investigated the persistence of poliovirus on different fruits and vegetables. In this study, the decimal reduction times (D-value = days after which the initial virus number declines by 90%) was 14.2 days for white cabbage,

11.6 days for lettuce and 8.4 days for frozen strawberries, while no decline was observed for green onion and fresh raspberries. Other

examples reported the persistence of hepatitis A virus in spinach during refrigerated storage, and norovirus and adenovirus were found to be persistent in soft berries. These results show well that viruses could persist under the retail and household storage conditions for several days and represent a real risk for the consumers if fresh crops are contaminated prior to their consumption.

Besides the minimally processed fruits and vegetables are typically sold to the consumer in a ready-to-use or ready-to-eat form, and are well appreciated by the consumers.   Unfortunately, during their processing and packaging, produce might be subjected to some viruses' contamination. For example, enteric viruses were detected on the packaging material of minimally processed leafy greens, and many viruses survive well on hands and are spread by workers. Another case was reported by Bidawid, Farber, and Sattar, who demonstrated that approximately 10% of the HAV virus particles are transferred from faecally contaminated fingers to foods and surfaces, thus increasing the potential for contamination. [Bidawid, 2000b; Mokhtari et.al ,2009; Zahra S et.al]

Regarding COVID-19 as it is a respiratory illness and the primary transmission route is through person-to-person contact and through direct contact with respiratory droplets generated when an infected person coughs or sneezes. There is no evidence to date of viruses that cause respiratory illnesses being transmitted via food or food packaging. Corona viruses cannot multiply in food; they need an animal or human host to multiply. The most recent advice from the WHO is that current evidence indicates that COVID-19 virus is transmitted during close contact through respiratory droplets (formed on coughing or sneezing) and by fomites. [3] The virus can spread directly from person- to-person when a COVID-19 case coughs or sneezes, producing droplets that reach the nose, mouth, or eyes of another person. Alternatively, as the respiratory droplets are too heavy to be airborne, they land on objects and surfaces surrounding the infected person. It is possible that someone may become infected by touching a contaminated surface, object, or the hand of an infected person and then touching their own mouth, nose,

or eyes. [WHO/2019-nCoV/Food Safety/2020.1] Little is known on SARS-CoV-2, but preliminary studies showed that this virus might survive 24 hrs. on cardboard and 72 hrs. on plastic, materials used in fruits and vegetables packaging. Based on preliminary data, there is no evidence of food or food packaging being associated with transmission of SARS-CoV-2. Some agencies indicated that in case some commodities and handlers are contaminated among the multiple people involved from the farm to the table, a cross-contamination may occur, and the risk of the contamination of food, food contact materials, and packaging from infected but asymptomatic workers should not be discarded even though considered "Very Low = meaning very rare but cannot be excluded. [Gorny et.al,2005] The escalating demand for food production has led to increased use of pesticides in the agricultural fields, resulting in the occurrence of these hazardous chemical residues in soil, water, air, as well as on the surface of crops and vegetables. [Noureddine Benkeblia]

Some pesticides comprise highly recalcitrant chemicals that are aimed to eliminate a wide variety of pests, bacteria, fungi, and weeds. However, excessive and prolonged use of these pesticides often leads to their accumulation on fruit and vegetable surfaces, which become potentially toxic to the human body [Mokhtar et.al, 2009; Fenik et.al, 2011]. The maximum residue level (MRL) is the index set to represent the permitted level of pesticide residues, and it shows that a product containing residues below the MRL value is safe to consume. Vegetable samples collected from the Andaman Islands, India, and revealed 15.3% of total samples contained pesticide residues above MRL [Sharma et.al, 2010]. Post-harvest washing, which was once considered a decontamination method, is now viewed as a high-risk cross-contamination point.

All these facts suggest that the pathogen can be transmitted by the contaminated food package and water [Swarnam et.al, 2013] along with harmful chemicals like pesticides and insecticides. Therefore, risk-management approaches should be adopted to inspect the potential infected food, especially the cold chain food.

This has increased attention towards the microbiological safety of fruits and vegetables and, in particular, on intervention to kill or remove human pathogens from fresh produce. Efforts to minimize the microbial contamination of fresh fruits and vegetables are essential and timely. Effectively washing fruits and veggies before eating them is very important. Water alone is not effective for germ removal and cleaning vegetables & fruits. It often leaves behind pesticides and is not able to disinfect the vegetables and fruits from food-borne illnesses causing germs. This can affect the health and safety of a person. Bio Cleaner is an edible and safe ingredient-based Solution with excellent cleansing power to mostly remove many surface hazards like pesticides, fungicides, bacteria's, pathogens, sand, oil, wax, dirt, etc. Present on the surface of vegetables and fruits which are nearly impossible to wash with water alone. [Gormley et.al, 2020]

MATERIAL AND METHODS:

Dilution Table:

	stock (ml)	Dilution(ml)	Culture(ml)	
1	1	-	0.1	undiluted
2	1	1	0.1	1:2
3	1	1	0.1	1:4
4	1	1	0.1	1:8
5	1	1	0.1	1:16
6	1	1	0.1	1:32
7	1	1	0.1	1:64
Positive control	-	1	0.1	
Negative control	1	1	-	

To determine the minimum inhibitory concentration of dalton bio-cleaner.

- Prepare 1:2-fold dilution of Dalton bio-cleaner (1:64)
- 24hour old culture suspensions of E. coli, S. aureus, S. typhi (0.5- Macfarland's Density) was the test oranisms used for the study.
- Incubate at 37°C for 24 hours. Tube number 8 and 9 are positive (nutrient broth + culture) and negative (nutrient broth + bio-cleaner) controls respectively.
- After incubation, a series of dilution tubes are observed for microbial growth usually indicated by turbidity and/or a pellet of microorganisms in the bottom of the tube.
- The last tube in the dilution series that does not demonstrate growth corresponds with the minimum inhibitory concentration of the antimicrobial agent.

To study the inhibitory effect of ultraviolet rays and dalton bio-cleaner:

For bio-cleaner-

- Take spinach leaves, surface, sterilize it using absolute alcohol.
- Swab it with 0.1 ml of test organism (24 hour old culture suspension of E. coli, S. aureus, S. typhi).
- Now dip these leaves in the beaker containing bio-cleaner for given time intervals 2 minutes, 5 minutes, 10 minutes and 15 minutes.
- Take a swab from the leaves, surface spread it on the nutrient agar plate.
- For positive control, take a swab from unwashed leaf and surface spread on the nutrient agar plate.
- Keep these respective plates for incubation for 24 hours at 37°C and observe the growth patterns.

For UV:

- Take spinach leaves, surface sterilize it using absolute alcohol. Swab it with 0.1 ml of test organism
- Now Expose the culture to UV for the time interval of 2 minutes, 5 minutes, 10 minutes and 15 minutes.
- Take a swab from the leaves and spread on the nutrient agar plate.
- Keep these respective plates for incubation for 24 hours at 37°C and observe the growth patterns.
- Also compare the results with the bio-cleaner plate

RESULTS:

MIC of Dalton Bio-cleaner:

Dilution	Observation		
	S. typhi	*S. aureus*	*E. coli*
Undiluted	-	-	-
1:2	-	-	-
1:4	-	-	-
1:8	-	-	-
1:16	+	+	+
1:32	+	+	+
1:64	+	+	+
Positive	+	+	+
Negative	-	-	-

Observation table for MIC of Dalton bio-cleaner against test organisms. (+ indicates growth, - indicated no growth)

MIC for S. aureus, S. typhi and E. coli was observed as 1:8, which is 12.5%.

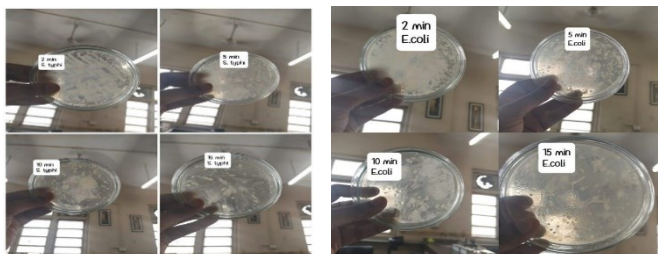The picture below depicts the MIC for *E. coli, S. aureus* and *S. typhi.* The turbidity indicates growth
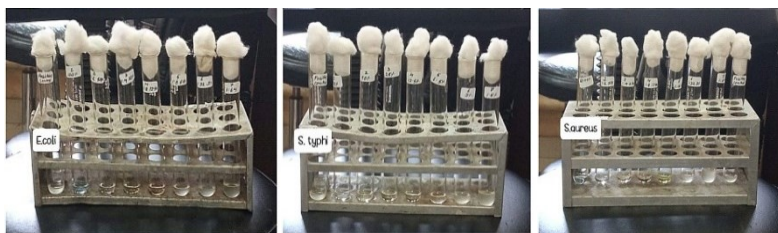
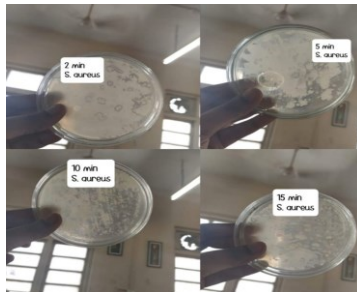**Inhibitory effects of Dalton bio-cleaner and UV rays**

For bio-cleaner:

Test organism	Time of exposure (in minutes)			
	2	5	10	15
E. coli	+++	++	++	+
S. typhi	+++	++	++	+
S. aureus	+++	++	++	+

Effects of Bio-cleaner on test organisms for different time intervals (+++ matt growth, ++ heavy growth, + for growth, - for no growth)
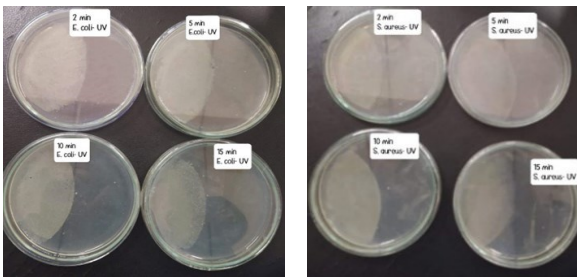
The above pictures show the growth pattern and inhibitory effect of Dalton bio-cleaner towards *E. coli, S. typhi,* and *S. aureus*

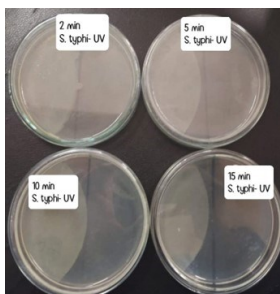<u>For UV:</u>

Test organism	Time of exposure (in minutes)			
	2	5	10	15
E. coli	-	-	-	-
S. typhi	-	-	-	-
S. aureus	-	-	-	-

Effects of UV rays on test organisms for different time intervals (+++ matt growth, ++ heavy growth, + for growth, - for no growth)

The above picture depicts the effect of UV on *E. coli, S. typhi, S. aureus*in the given time frame. The half side of the plate lid was directly exposed to UV and remaining part was covered with the lid

DISCUSSION:

Our study aims to analyze the efficiency of biocleaners and the awareness of biocleaner among the respondents. Washing with disinfecting solution like biocleaner is important for hygiene of fruits and vegetables, it particularly removes soil and debris. Most of the sanitizing solutions induce higher microbial reduction after washing when compared to water washing alone. To check whether the bio-cleaner is effective enough to kill microorganisms, two different experiments were carried out using easily available biocleaner Dalton and three test organisms, E. coli, S.aureus and S.typhi. The need for knowing the exact concentration at which the disinfecting agent works to remove the maximum amount of pathogenic organisms is important. Minimum Inhibitory Concentration is defined as the lowest concentration of an antimicrobial agent that can inhibit a visible growth of microbes. MIC was determined by using tube dilution method. When diluted at a concentration of 6.25% or less, microorganisms could flourish, i.e. the bio-cleaner was no more effective in inhibiting microbial flora. Therefore, the bio cleaner was only effective enough to inhibit   the cultures of E.coli, S. aureus and S.typhi until 1:8 dilution. It also means

that excessive dilution of bio- cleaner will not inhibit growth of organisms. The further approach was to compare the inhibitory effects of UV radiation and Dalton bio-cleaner on the test organisms. Ultraviolet germicidal irradiation is a disinfection method that uses UV light to kill microorganisms. For this experiment, a sample of spinach leaves was taken and sterilized using alcohol, test organisms were swabbed on it. These leaves were taken further to analyze which method is more efficient biocleaner or UV radiation to inhibit test organisms. For, UV irradiation method swabs were taken from these leaves and inoculated on different Nutrient Agar media and were kept for different time intervals under UV radiation and for biocleaner these leaves were first dipped in the biocleaner for different time intervals and then swabs were taken from it and inoculated on different time interval labeled Nutrient Agar plates and growth was seen after incubation of 24 hrs at 37°C. It was observed that UV radiation was far more efficient than biocleaner in inhibiting the test organism in a shorter time.

Further, an online survey was conducted to analyze the usage and awareness of biocleaner among people. The online survey was conducted using Google Forms, which was disseminated using social media platforms. The survey was targeted for all categories, including peoples of different age, gender and region. The study obtained a total of 410 responses which were collected from 28 Feb 2021 until 16 March 2021.

About 82.2 % (337 participates) of the participant were between the age group of 15 -24 years, 10% (41 participates) of the participant were between the age group of 25 - 34 years, while 4.6 %(19 participates) of the people were between the age group of 45- 54 years and a little over 2.9 % (12 participates) of the people were between the age group of 35 - 44 years and only 0.3% (1 participate)were between the age group of 65- 74 years.

The data collected showed that majority of people were not using biocleaner i.e. among 410 participant of the survey 327 were not using biocleaner whereas 83 participant were using biocleaner to disinfect their

fruits and vegetables among which the majority (78.3%) started using it once the pandemic started.

Among the 196 male participants 42 males use bio cleaner for washing their vegetables and fruits while 154 males don't use it.Among 214 female participants 41 females use bio cleaner for washing their vegetables and fruits while 173 females don't use it.

Most of the people (31. 3%) came to know about the bio cleaner through friends or relatives followed by 26.5% through advertisement on social media, 19.3% through advertisement on TV, while 12% newspaper article advertisement and rest of the 10.8% participant Googled about it.

In the choice of brands for biocleaner, most of the population, i.e. 64.6% favoured Dalton. Among the participants who were using biocleane 54.2% said that they will continue using it even after the pandemic ends and the rest of them were not sure (27.7%) or will stop (18.1%) using biocleaner, once the pandemic gets over.

Among 83 participants of the survey, who were using bio cleaner were aware of the properties/facts about the biocleaner. Whereas among 327 participants who were not using biocleaner, only 130 people did not have any idea about the properties of biocleaner, rests all were aware about the properties.

Comparatively, people who were not using biocleaner preferred washing fruits and vegetables with plain water only (65.4%). Among these, participants who were not using biocleaner 44.6% adopted over one method to cleanse their fruits and vegetables; the rest of the 55.4% were using the same old method. These participants were not using biocleaner because they didn't feel it was required (36.7%), they were using other alternative methods (30.6%) and the rest of them were not aware about it (27.8%). These participants were interested in using biocleaner in future if they came to know about its benefits. The similarities among the participants who were using the biocleaner, and those who were not using most of them, were aware of few or over properties/facts about the biocleaner.

CONCLUSION:

The minimal inhibitory concentration for all the test organisms was found to be 12.5% of bio-cleaner and tolerance was found to be 25%. The resultant biocleaner was effective only until a particular concentration up to 12.5%. It could kill organisms at a high concentration. It was also found that ultraviolet radiation was highly effective to kill the microorganisms for a shorter time period of exposure, i.e. 2 min, whereas biocleaners comparatively took longer time to inhibit organisms. This implies that we need to expose the vegetables and fruits against biocleaners, for a minimum of above 15min, to effectively kill the microbes. An online survey was conducted to analyze the usage and awareness of biocleaner among people. It was observed that only 130 people out of 410 were not aware of its properties.

FUTURE STUDIES:

To understand and study further the efficiency Of Bio-Cleaners the following studies need to be carried out which are as follows

- To study the efficiency of bio-cleaner against spore forming organisms, viruses.
- To study the sensitivity of microorganisms to biocleaners by disc diffusion method.
- To perform Time kill curve study against Bio-cleaners using organisms.
- Comparative study of bio cleaner against other methods of disinfection of fruits and vegetables.
- Finding other sustainable products for disinfecting fruits and vegetables and their efficiency.
- To find the mechanism of individual ingredient present in a biocleaner against the pathogenic organisms known to be transmitted against fruits and vegetables.

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SECTION III - STATISTICS

Chapter 9 - Predictive Modelling and Analysis of Pima Indian Diabetes Database using Python

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ABSTRACT:

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Considering how chronic this disease is, the number of diabetic patients has been increasing day by day which is becoming a huge concern for society. Understanding how critical this disease is this is the inspiration for the selection of the topic for the research paper.

This study aims to select the best machine learning classification algorithm which accurately predicts whether or not the patients in the dataset have diabetics or not.

The dataset which is being dealt with is secondary data. This secondary dataset is being collected from the website which is an online community of data scientists and machine learning practitioners (Kaggle). Several machine learning classification algorithms were fitted like Logistic Regression, K-Nearest Neighbours, Support Vector Machine, Naïve Bayes Classifier, Decision Tree and Random Forest. Python is the software used for the analysis. This study is based on 768 observations under 9 variables. In this study it has been found out that the average Blood Pressure for a diabetic patient is in between 68.25 to 73.39 mmHg. The average blood pressure of non-diabetic patient is between 66.6 and 69.76 mmHg. The population average glucose level for diabetic patient is estimated to be in between 138 to 145 mg/dL. The population average glucose level for non-diabetic patients is estimated to be in between 108 to 112 mg/dL. The best fitted machine learning algorithms which

accurately predicts whether the person is diabetic or not are Logistic Regression and Random Forest.

This paper includes the inferential, univariate, and multivariate statistical analysis and develops the predictive models for the classification of the PIMA Indian Diabetes Database.

Keywords: Inferential, Univariate, Multivariate, Predictive Modelling

INTRODUCTION:

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycemia, or raised blood sugar, is a common effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels.

WHO estimates the total death due to diabetes will rise to 50% in the next decade? According to WHO and ADA, there are four types of diabetes: Type-I, Type-II diabetes, Gestational Diabetes (GDM) and rare specific diabetes. Type-I diabetes is responsible for 5% to 10% of total diabetes, it occurred due to lack of insulin production. Destruction of the pancreas organ is the source of insulin production loss in human body which leads to insulin- dependent diabetes. Type-II diabetes, however, is more common (90% of the diabetic population) is caused by "insulin resistance" and metabolic disorders, the result is an increase in sugar levels in the blood.

Between 2000 and 2016, there was a 5% increase in premature mortality from diabetes. In high-income countries, the premature mortality rate due to diabetes decreased from 2000 to 2010 but then increased in 2010-2016. In lower-middle-income countries, the premature mortality rate due to diabetes increased across both periods.

In 2014, 8.5% of adults aged 18 years and older had diabetes. In 2019, diabetes was the direct cause of 1.5 million deaths. To present a more accurate picture of the deaths causes by diabetes, however, deaths due to

higher-than-optimal blood glucose through cardiovascular disease, chronic kidney disease and tuberculosis should be added. In 2012 (year of the latest available data), there were another 2.2 million deaths due to high blood glucose.

As of 2015, 30.3 million people in the United States, or 9.4 per cent of the population, had diabetes. More than 1 in 4 of them didn't know they had the disease. Diabetes affects 1 in 4 people over the age of 65. About 90-95 per cent of cases in adults are type 2 diabetes.

By contrast, the probability of dying from any one of the four main non-communicable diseases (cardiovascular diseases, cancer, chronic respiratory diseases or diabetes) between the ages of 30 and 70 decreased by 18% globally between 2000 and 2016

OBJECTIVES:

The objective of this study aims to select the best machine learning classification algorithm which accurately predicts whether or not the patients in the dataset have diabetics or not.

METHODOLOGY:

The methodology of this study goes through following stages:

- About the Data
- Explanatory Data Analysis
- Inferential Statistics
- Data pre-processing
    - Missing Values
    - Outliers
    - Standardization
- Train-Test Split
- Working Procedure

About the Data:

The dataset which is being dealt with is secondary data. This secondary dataset is being collected from the website which is an online community

of data scientists and machine learning practitioners (Kaggle - https://www.kaggle.com/). This dataset is originally from the National Institute of Diabetes and Digestive and Kidney Diseases. This dataset has been uploaded by UCI Machine learning and was updated 5 years ago (as of July 2021). The given dataset has 768 observations under 9 variables naming

- Pregnancies - Number of times pregnant
- Glucose - Plasma glucose concentration - 2 hours in an oral glucose tolerance test (mg/dL)
- Blood Pressure - Diastolic blood pressure (mmHg)
- Skin Thickness - Triceps skin fold thickness (mm)
- Insulin - 2-Hour serum insulin (mu U/ml)
- BMI - Body mass index
- Diabetes Pedigree Function - Diabetes pedigree function
- Age - Age (years)
- Outcome - Class variable (Target variable- 0 and 1)

Where 0 stands for non-Diabetic patient and 1 stand for Diabetic Patient.

In this dataset there are 8 dependent variables (Pregnancies, Glucose, Blood Pressure, Skin Thickness, Insulin, BMI, Diabetes Pedigree Function, Age) and 1 independent variable (Outcome). The classification algorithm will be binary classification algorithm (i.e., whether person is diabetic patient or not)

EDA (Explanatory Data Analysis)

Explanatory Data Analysis is approach about how data analysis should be carried out. It gives proper insights about the data and it helps to understand the dataset very well. This research carries out both univariate and multivariate data analysis.
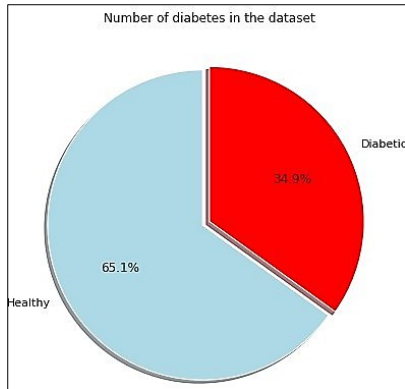
Interpretation – In the given dataset 65.1 % of the population are healthy (non-diabetic) whereas the remaining 34.9 % are diabetic.
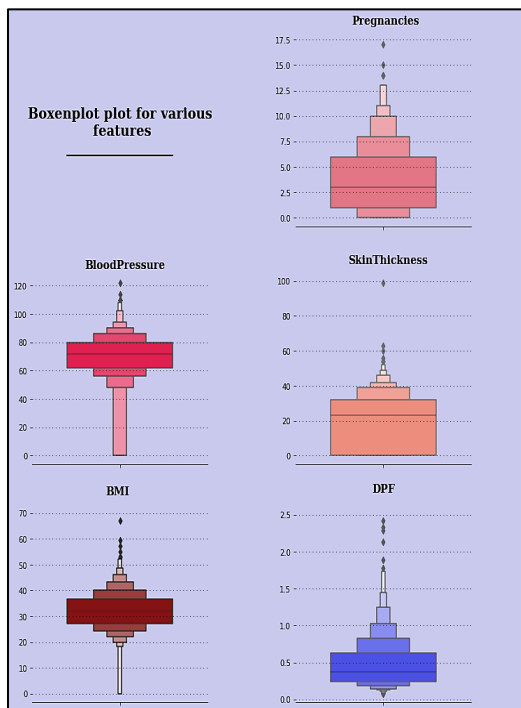
Interpretation – In the boxplots alongside, it is found that there are outliers in the variables which will be treated eventually before fitting the machine learning classification model.


Correlation Between Features
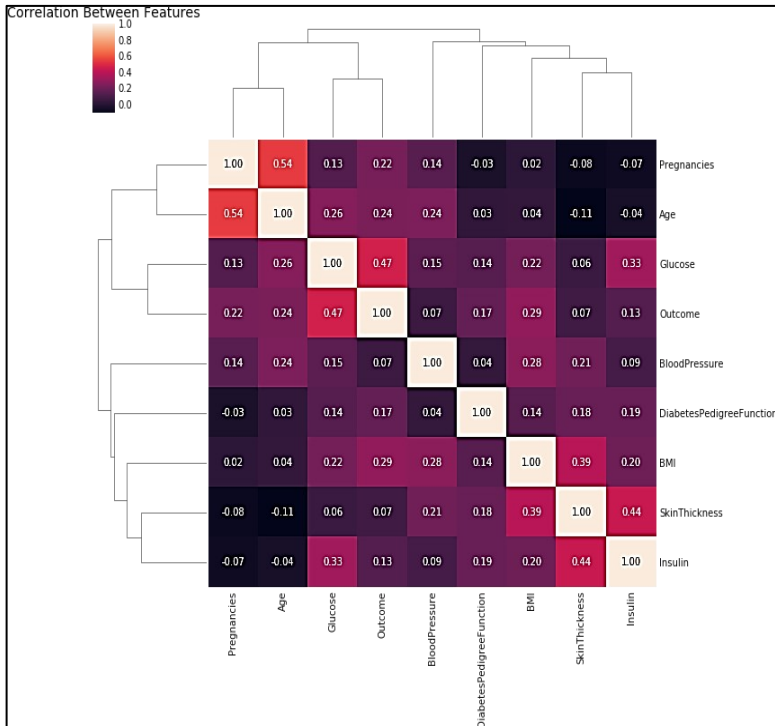
Interpretation – The above heatmap shows the correlation between the variables. It is found that there is no strong correlation between the dependent variables and independent variables as well there is no strong correlation among the dependent variables.
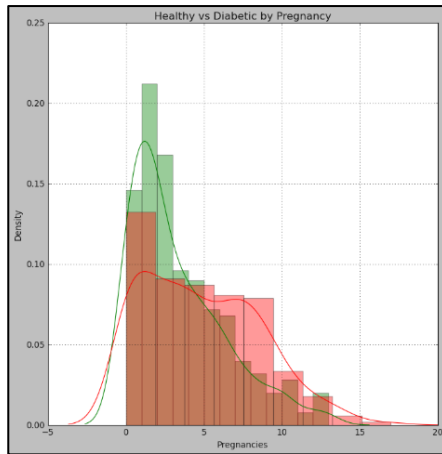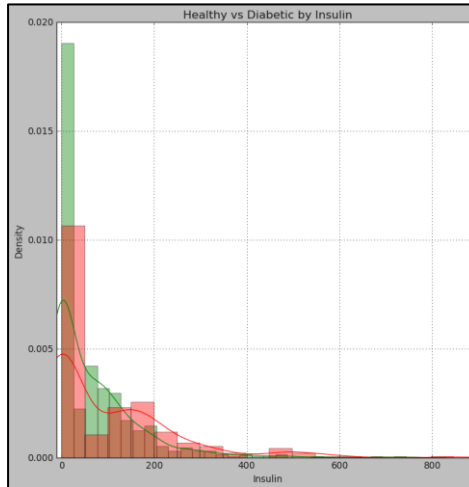
Interpretation - From above graph, we can say that the Pregnancy isn't likely cause for diabetes as the distribution between the Healthy and Diabetic is almost same.
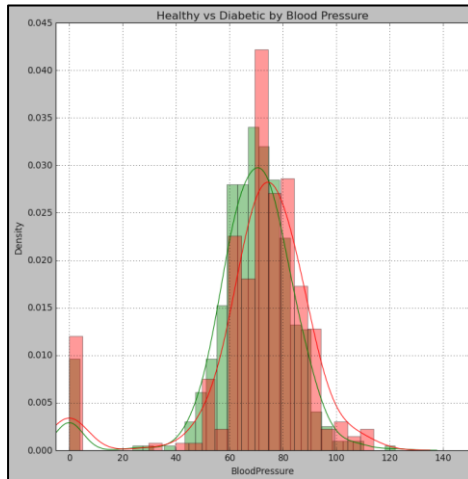
Interpretation – From above graph, it can be concluded that diabetic and healthy people are evenly distributed with low and normal BP but, there are less healthy people who have high BP.
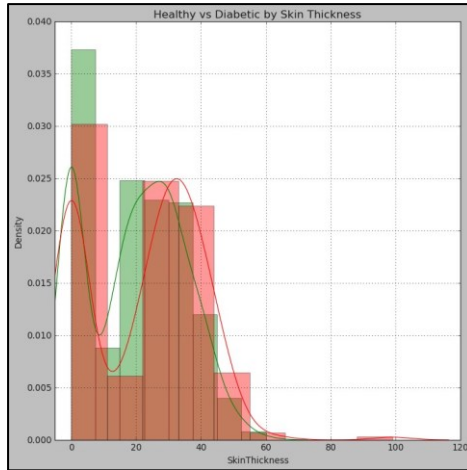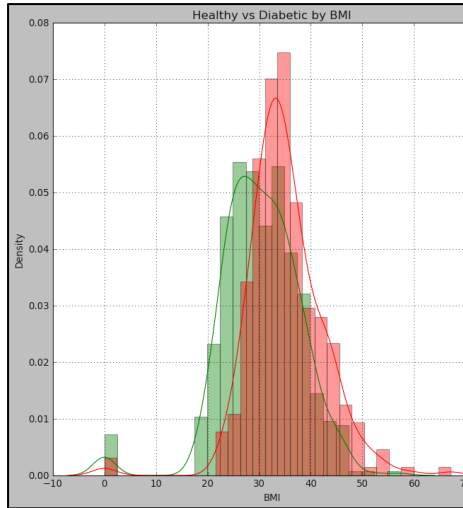
Interpretation – From the above graph, the distribution between healthy and diabetic people are around same for skin thickness
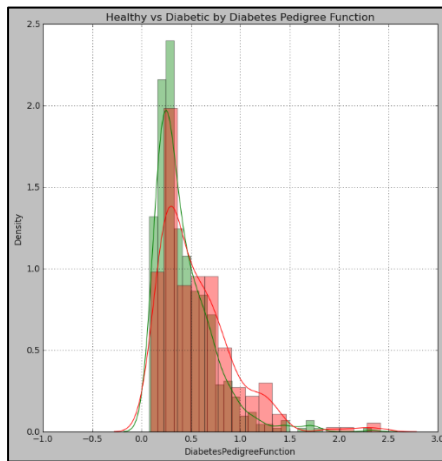

Interpretation – From above graph, it can be concluded that as the level of insulin increases there are high chances of being a diabetic patient. There are more healthy people around insulin levels 0- 100
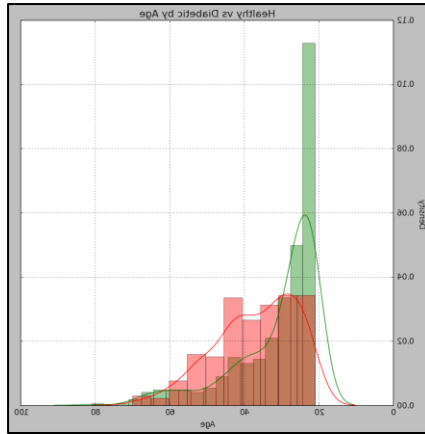
Interpretation – From above graph it can be concluded that, as the BMI increases the person likely being healthy decreases and being diabetic patient increases

Interpretation – From above graph, as the function increase the diabetic people increases, showing that the diabetes could be hereditary for that individual

Interpretation – From above graph, it can be said that there are more healthy people around 20-25 age but as the age gradually increases so does the people being diabetic, this shows that age and diabetes go hand in hand.
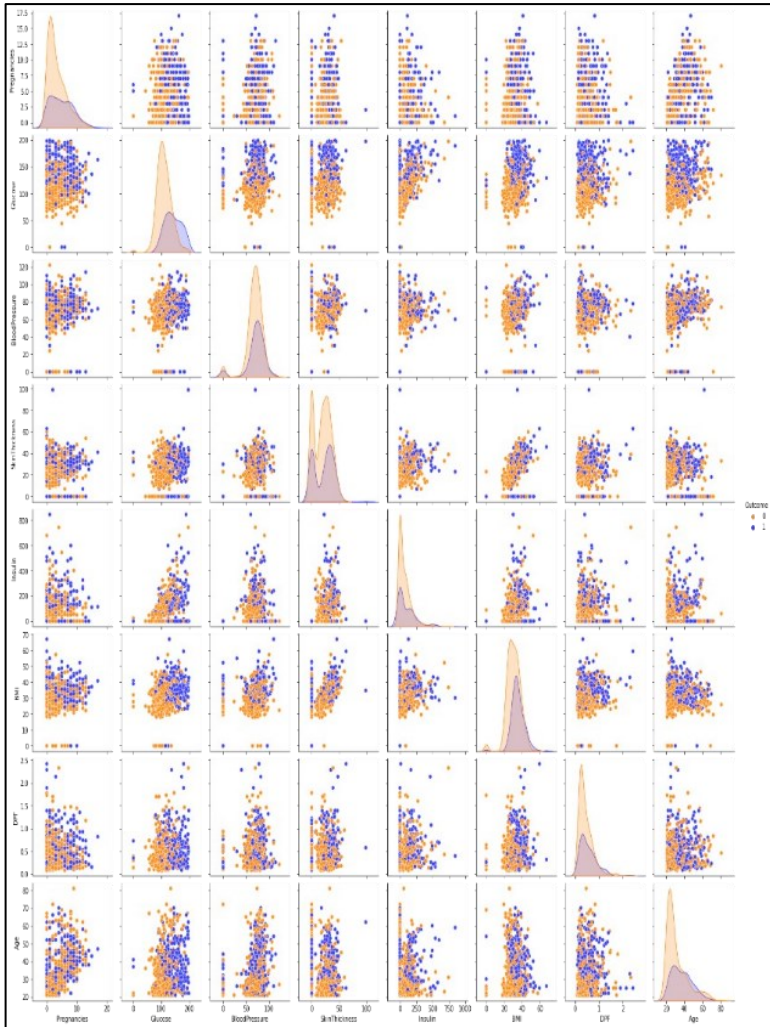
The above Pair plot tells the following:

- As Insulin and Glucose increase, there are higher chances of Diabetes.
- As BMI and Glucose increase, there are higher chances of Diabetes.

- Age alone isn't really an indicator of Diabetes.
- Middle-aged people with high Glucose levels and high Blood Pressure levels have higher chances of Diabetes.

Conclusions from Explanatory Data Analysis are as follows: -
- There are no missing (NaN) values in the data.
- The number of outliers in all the variables is very less.
- According to the heatmap, there is no apparent linear correlation between feature variables according to the heatmap.
- The distribution curve of insulin and DPF is right-skewed in nature
- The distribution curve of Glucose with respect to Outcome shows that there is a smaller number of people with high Glucose level but they have higher chances of diabetes.
- The Blood Pressure lies between 40 and 100, and there are fewer people with diabetes in this range

Inferential Statistics:

- Performing Statistical inference using data analysis to infer properties of distribution of probability.
- Inferential statistical analysis infers properties of our current population.
- Finding the average Blood Pressure of diabetic patient.
- Population: Diabetic Patients
- Parameter of interest: Average Blood Pressure

```
unbiased_point_estimate = dataset[dataset.Outcome == 1]['BloodPressure'].mean()
std = dataset[dataset.Outcome == 1]['BloodPressure'].std()
(unbiased_point_estimate,std)
```

```
(70.82462686567165, 21.49181165060413)
```

```
Margin_of_error = 1.96 * std/np.sqrt(dataset[dataset.Outcome == 1]['BloodPressure'].count
())
Margin_of_error
```

```
2.57312983381338
```

```
sm.stats.DescrStatsW(dataset[dataset.Outcome == 1]['BloodPressure']).zconfint_mean()
```

```
(68.25154431372279, 73.3977094176205)
```

```
lcb = unbiased_point_estimate - Margin_of_error
ucb = unbiased_point_estimate + Margin_of_error
(lcb,ucb)
```

```
(68.25149703185826, 73.39775669948503)
```

```
unbiased_point_estimate = dataset[dataset.Outcome == 0]['BloodPressure'].mean()
std = dataset[dataset.Outcome == 0]['BloodPressure'].std()
(unbiased_point_estimate,std)
```

```
(68.184, 18.063075413305828)
```

```
Margin_of_error = 1.96 * std/np.sqrt(dataset[dataset.Outcome == 0]['BloodPressure'].cou
Margin_of_error
```

```
1.5832983686687918
```

```
lcb = unbiased_point_estimate - Margin_of_error
ucb = unbiased_point_estimate + Margin_of_error
(lcb,ucb)
```

```
(66.6007016313312, 69.76729836866879)
```

```
sm.stats.DescrStatsW(dataset[dataset.Outcome == 0]['BloodPressure']).zconfint_mean()
```

```
(66.60073072481028, 69.76726927518972)
```

- With 95% confidence interval, the average Blood Pressure for a diabetic patient is in between 68.25 to 73.39 mmHg.
- Finding the average Blood Pressure of non-diabetic patient.

- Population: Diabetic Patients
- Parameter of interest: Average Blood Pressure

With 95 % confidence interval, the average blood pressure of non-diabetic patient is between 66.6 and 69.76 mmHg

Parameter of Interest: Average Glucose level

```
unbiased_point_estimate = dataset[dataset.Outcome == 1]['Glucose'].mean()
unbiased_point_estimate
```

```
141.25746268656715
```

```
std = dataset[dataset.Outcome == 1]['Glucose'].std()
std
```

```
31.939622058007195
```

```
std_error = std/np.sqrt(dataset[dataset.Outcome == 1]['Glucose'].count())
std_error
```

```
1.9510229398885643
```

```
lcb = unbiased_point_estimate - 1.96 *std_error
ucb = unbiased_point_estimate + 1.96 *std_error
(lcb , ucb)
```

```
(137.43345772438556, 145.08146764874874)
```

```
sm.stats.DescrStatsW(dataset[dataset.Outcome == 1]['Glucose']).zconfint_mean()
```

```
(137.43352799137412, 145.08139738176018)
```

With 95% confidence interval, the population average glucose level for diabetic patient is estimated to be in between 138 to 145 mg/dL.

- Finding average glucose level for non-diabetic patient
- Population: Non-Diabetic Patient
- Parameter of Interest: Average Glucose level

```
unbiased_point_estimate = dataset[dataset.Outcome == 0]['Glucose'].mean()
std = dataset[dataset.Outcome == 0]['Glucose'].std()
print((unbiased_point_estimate,std))

std_error = std/np.sqrt(dataset[dataset.Outcome == 0]['Glucose'].count())
print(std_error)

lcb = unbiased_point_estimate - 1.96 *std_error
ucb = unbiased_point_estimate + 1.96 *std_error
(lcb , ucb)
```

```
(109.98, 26.14119975535359)
1.16906999332743

(107.68862281307824, 112.27137718692177)
```

There is a clear distinction of glucose level between the diabetic and non-diabetic patient. With 95% confidence the population average glucose level for non-diabetic patients is estimated to be in between 108 to 112 mg/dL. (Rounded off to nearest decimal).

Data Pre-processing

```
df.isnull().sum()

Pregnancies      0
Glucose          0
BloodPressure    0
SkinThickness    0
Insulin          0
BMI              0
DPF              0
Age              0
Outcome          0
dtype: int64
```

The given dataset has no missing values. There is no need for the imputation in the dataset.
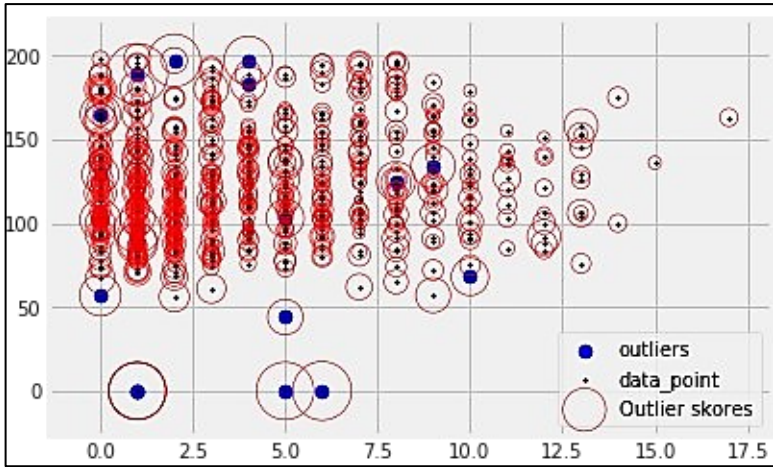
The above plot is been created with help of the LocalOutlierFactor() function in python. The names of the variables were gathered during a single- column list. With the assistance of the Local Outlier Factor (LOF) algorithm which is a highly unsupervised anomaly detection method that computes the local density deviation of a given datum with regard to its neighbors. It considers as outliers the samples that have a substantially lower density than their neighbors [4].

Then outlier values with threshold were applied to a listing and later normalized the values to avoid bias. To drop the outliers the function that has been used is drop (outlier index) where outlier index is the variable where outlier values with threshold were applied to a list.

Dataset may contain attributes with a mix of scales for various quantities. It is said that the more effective the data would be if the attributes have the same scale. To avoid this problem, the data has been standardized. In python, StandardScaler() removes the mean and scales variable to the unit variance and this is been operated independently by features. It can be influenced by outliers so before standardizing it has been made sure that data has outliers has been removed.
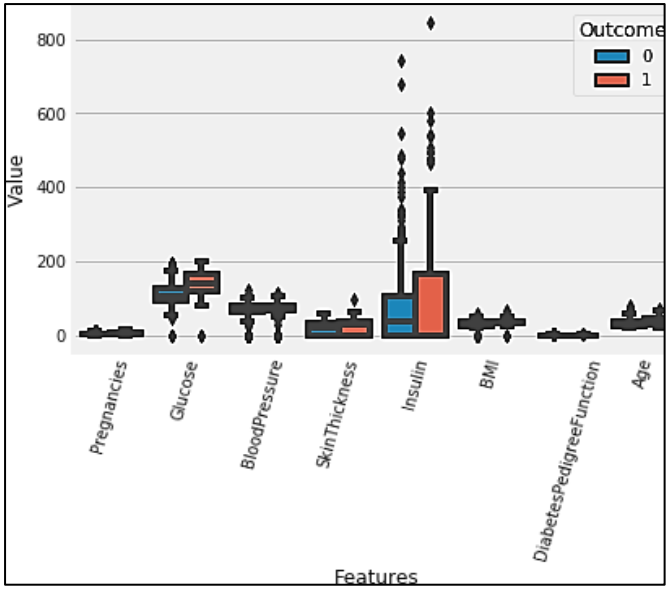
Before Standardization
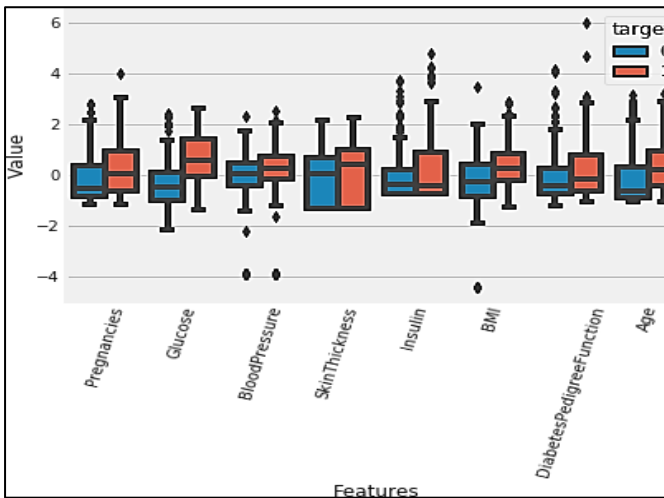
After Standardization

Train Test Split:

Using the train-test split technique to evaluate the performance for the classification models

The procedure involves taking a dataset and dividing it into two subsets. The first subset is used to fit the model and is referred to as the training dataset. The second subset is not used to train the model; instead, the input element of the dataset is provided to the model, then predictions are made and compared to the expected values. This second dataset is referred to as the test dataset.

- Train Dataset: Used to fit the machine learning model.
- Test Dataset: Used to evaluate the fit machine learning model.

The objective is to estimate the performance of the machine learning model on new data: data not used to train the model.

This is how we expect to use the model in practice. Namely, to fit it on available data with known inputs and outputs, then make predictions on new examples in the future where we do not have the expected output or target values

The given dataset has divided 70 percent of the dataset as Train Dataset by using Simple Random Sampling technique and the remaining 30 percent of the dataset as Test Dataset by using Simple Random Sampling Technique.

Working Procedure:

To check the adequacy of classifiers performance measures need to be taken into account. True positives (TP) refer to the positive cases that were correctly labelled by the classifier, while true negatives (TN) are the negative cases that were correctly labeled the classifier. False positives (FP) are the negative cases that were incorrectly labelled, while false negatives (FN) are the positive cases that were incorrectly labelled. Some evaluation measures of classifiers are as follows:

(1) Accuracy: Overall, how often is the classifier correct?
Accuracy = (TN)/(TP+TN+FP+FN).
(2) Specificity When it's actually no, how often does it predict no?
Specificity = (TN)/(TN+FP).
(3) Sensitivity: When it's actually yes, how often does it predict yes?
Sensitivity = (TP)/(TP+FN).
(4) F1-Score: This is a weighted average of the true positive rate (recall) and precision.
F1-score = 2TP/(2TP+FP+FN)
(5) Precision: When it predicts yes, how often is it correct?
Precision = TP/(TP+FP)

RESULTS:

After doing all the data pre-processing and Train- Test split. It's time to train and test the machine learning algorithms and check its accuracy.

Logistic Regression

Assumptions:

- Observations should come from independent sample
- The dependent variable should be binary
- Logistic Regression requires little or no multicollinearity
- Large sample size
- Logistic regression assumes linearity of independent variables and log odds
- No outliers

During the data pre-processing it has been made sure that dataset has no multicollinearity and outliers

Checking the significance of the model

H0: All the variables in the model are statistically insignificant i.e.

$\beta 1 = \beta 2 = \beta 3 = \beta 4 = \beta 5 = \beta 6 = \beta 7 = \beta 8 = 0$

H1: At least one of the independent variables is statistically significant i.e. H1: at least one $\beta i \neq 0$ (i=1,2,3,4,5,6,7,8)

Dep. Variable:		y	No. Observations:	522
Model:		Logit	Df Residuals:	514
Method:		MLE	Df Model:	7
Date:	Sat, 31 Jul 2021		Pseudo R-squ.:	0.1812
Time:		16:29:23	Log-Likelihood:	-275.33
converged:		True	LL-Null:	-336.26
Covariance Type:		nonrobust	LLR p-value:	3.126e-23

	coef	std err	z	P>|z|	[0.025	0.975]
x1	0.2740	0.129	2.123	0.034	0.021	0.527
x2	1.1089	0.142	7.830	0.000	0.831	1.387
x3	-0.1814	0.122	-1.486	0.137	-0.421	0.058
x4	-0.0669	0.129	-0.519	0.603	-0.319	0.186
x5	-0.0163	0.127	-0.129	0.897	-0.264	0.232
x6	0.5541	0.128	4.319	0.000	0.303	0.806
x7	0.3646	0.115	3.178	0.001	0.140	0.589
x8	0.1100	0.135	0.815	0.415	-0.155	0.375

Since p-value 3.126e-23 < 0.05, we reject our null hypothesis (H0) and conclude that the model Logistic Regression is significantly fitting the data better than a null model with no predictors.

The model has been fitted and it gives the confusion matrix as shown below.
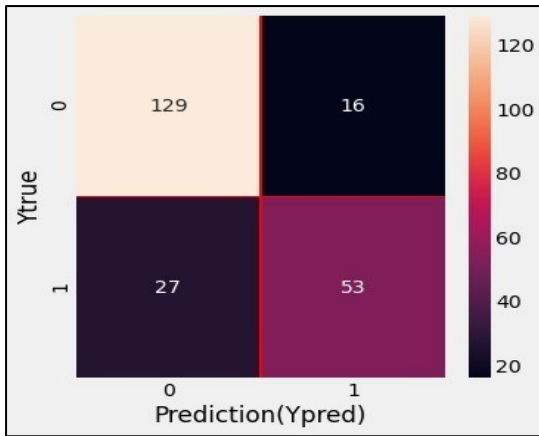
The results obtained from the confusion matrix are as follows:

1. Accuracy = 80.89 %
2. Specificity = 76.81 %
3. Sensitivity = 82.69 %
4. F1-score = 85.71 %
5. Precision = 88.97 %

The fitted logistic regression model is given by f(x)= - 0.8720556(constant) + 2.74(x1) + 1.1089(x2) - 0.1814(x3) - 0.0669(x4) - 0.0163(x5) + 0.5541(x6) + 0.3645(x7) +0.11(x8)

Where, x1= Pregnancies, x2= Glucose, x3= BloodPressure, x4= SkinThickness, x5= Insulin x6= BMI, x7= Diabetes Pedigree Function, x8= Age

Interpretation – The Logistic Regression model accurately predicts whether the person is diabetic or not with an accuracy of 80.89 %

K-Nearest Neighbour – Assumptions

- KNN assumes that the data is in a feature space. More exactly, the data points are in a metric space. The data can be scalars or possibly even multidimensional vectors. Since the points are in feature space, they have a notion of distance – This need not

necessarily be Euclidean distance although it is the one commonly used.

- Each of the training data consists of a set of vectors and class labels associated with each vector. In the simplest case, it will be either + or – (for positive or negative classes). But KNN, can work equally well with an arbitrary number of classes.
- We are also given a single number "k". This number decides how many neighbours (where neighbours are defined based on the distance metric) influence the classification. This is usually an odd number if the number of classes is 2. If k=1, then the algorithm is simply called the nearest neighbour algorithm.

Fitting the model with parameter tuning (finding the best parameters for the model).

```
def KNN_best_parameters(x_train,x_test,y_train,y_test):

    k_range = list(range(1,51)) #Finding the optimal k value
    weight_options = ['uniform','distance'] #Finding the most suitable weight
    #manhattan_distance = 1
    #euclidean_distance = 2
    distance_options = [1,2] #Finding the most suitable distance type
    print()
    param_grid = dict(n_neighbors=k_range,weights=weight_options,p=distance_options) #We have collected the parameters
    knn =KNeighborsClassifier() #The place where the parameters will be tested has been created.


    grid = GridSearchCV(knn,param_grid,cv=10,scoring='accuracy') #Method for searching parameters
    grid.fit(x_train, y_train) #best parm. obtained

    print('Best training score: {} with parametres: {}'.format(grid.best_score_,grid.best_params_))
    print()

    knn = KNeighborsClassifier(**grid.best_params_) #For trial operation on the test set
    knn.fit(x_train, y_train)

    y_predict_test = knn.predict(x_test)
    y_predict_train = knn.predict(x_train)

    cm_test = confusion_matrix(y_test,y_predict_test)
    cm_train = confusion_matrix(y_train,y_predict_train)

    acc_test = accuracy_score(y_test,y_predict_test)
    acc_train = accuracy_score(y_train,y_predict_train)

    print('Test Score: {}, Train Score: {}'.format(acc_test,acc_train))
    print()
    print('CM Test:',cm_test)
    print('CM Train:',cm_train)

    return grid
```
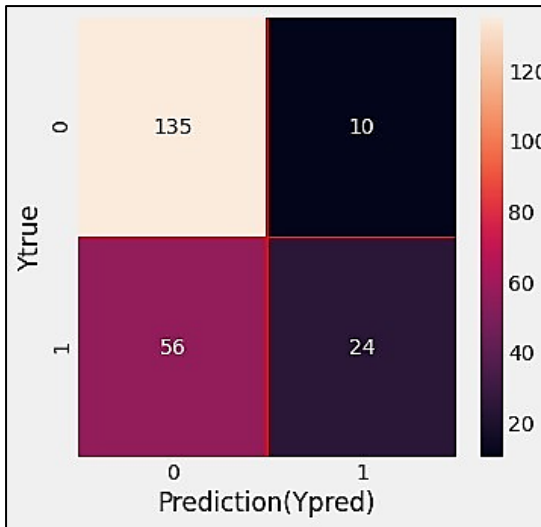
The metric used in the KNN classification algorithm is "Euclidean". After tuning the model, the "n-neighbour" which is best for the model is 36. The confusion matrix after tuning the parameters is as shown below

The results obtained from the confusion matrix are as follows:

- Accuracy = 70.67 %
- Specificity = 70.59 %
- Sensitivity = 70.68 %
- F1-score = 80.36 %
- Precision = 93.10 %

Interpretation – The K-Nearest Neighbours model accurately predicts whether the person is diabetic or not with an accuracy of 70.67%

Support Vector Machine:

Assumption: It assumes data is independent and identically distributed

The kernel used in the Support Vector Machine is "rbf (Radial Basis Function)." Dual coefficients of the support vector in the decision function multiplied by their targets.

Note: - Since the dual coefficient are too big this is not complete dual coefficients of the SVM model. The intercept ndarray of shape (n_classes * (n_classes - 1) / 2,) which shows the Constants in decision.

```
SVM.dual_coef_

array([[-1.        , -1.        , -1.        , -1.        , -1.        ,
        -0.4284918 , -1.        , -1.        , -0.91211714, -1.        ,
        -1.        , -1.        , -1.        , -1.        , -1.        ,
        -1.        , -0.73625718, -0.71231496, -1.        , -1.        ,
        -1.        , -1.        , -1.        , -1.        , -1.        ,
        -1.        , -1.        , -1.        , -1.        , -0.30646335,
        -1.        , -1.        , -1.        , -0.75325904, -1.        ,
        -1.        , -0.9563289 , -1.        , -1.        , -0.80262624,
        -0.22877682, -0.88566711, -1.        , -1.        , -1.        ,
        -1.        , -0.99568252, -0.72071047, -1.        , -1.        ,
        -1.        , -0.87266143, -1.        , -1.        , -0.53175122,
        -1.        , -1.        , -0.90018597, -0.18677073, -0.17182056,
        -1.        , -1.        , -1.        , -1.        , -0.80674651,
```

```
SVM.intercept_

array([-0.14492545])

SVM.support_

array([  0,   1,   4,   9,  13,  18,  23,  24,  26,  28,  31,  36,  38,
        47,  52,  54,  55,  57,  60,  61,  64,  65,  69,  70,  72,  75,
        79,  81,  83,  84,  86,  87,  89, 102, 104, 106, 119, 120, 122,
       125, 127, 134, 142, 144, 151, 152, 153, 155, 157, 164, 166, 168,
       170, 171, 174, 176, 181, 189, 193, 194, 212, 214, 221, 222, 224,
       229, 231, 238, 242, 244, 246, 252, 262, 264, 265, 267, 270, 272,
       280, 282, 291, 294, 296, 301, 306, 308, 309, 310, 312, 316, 317,
       318, 322, 326, 330, 335, 339, 340, 343, 345, 347, 351, 353, 359,
       363, 368, 371, 372, 374, 380, 384, 390, 392, 398, 399, 405, 406,
       408, 409, 412, 416, 417, 419, 422, 424, 427, 428, 429, 437, 442,
       446, 449, 451, 454, 455, 458, 459, 461, 462, 463, 465, 466, 470,
       471, 476, 482, 488, 489, 491, 494, 495, 497, 500, 503, 505, 508,
       509, 511, 514, 519, 521,   3,   5,   6,   8,  10,  11,  12,  16,
        21,  25,  29,  37,  41,  42,  43,  45,  49,  50,  53,  62,  63,
        67,  76,  85,  91,  93,  95,  96, 105, 112, 117, 118, 124, 126,
       129, 130, 131, 132, 136, 138, 143, 145, 149, 158, 159, 160, 169,
       172, 175, 178, 187, 188, 191, 192, 195, 197, 200, 201, 204, 205,
       209, 213, 216, 220, 223, 226, 232, 234, 236, 237, 240, 243, 247,
       250, 253, 255, 256, 257, 259, 268, 271, 274, 283, 284, 287, 290,
       292, 295, 297, 299, 300, 305, 314, 315, 319, 320, 321, 327, 328,
       329, 333, 334, 341, 342, 344, 349, 352, 354, 355, 357, 358, 361,
       362, 367, 373, 377, 381, 382, 385, 387, 388, 391, 394, 395, 396,
       400, 413, 425, 430, 439, 441, 444, 448, 450, 456, 457, 468, 469,
       472, 475, 477, 479, 480, 481, 483, 486, 490, 492, 496, 498, 501,
       502, 507])
```

After tuning the parameter, the results of the confusion matrix are shown below:
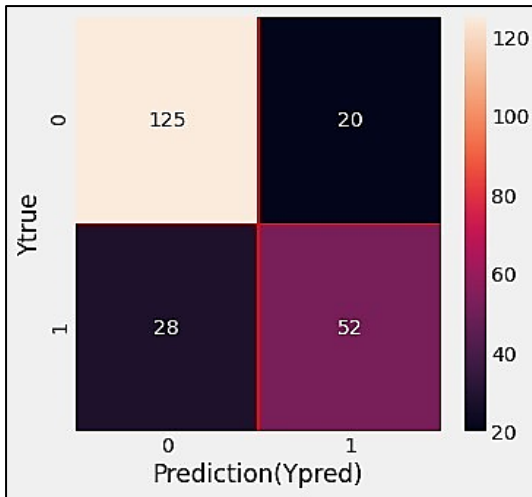
The results obtained from the confusion matrix are as follows:

- Accuracy = 78.67 %
- Specificity = 72.22 %
- Sensitivity = 81.7 %
- F1-score = 83.89 %
- Precision = 86.21 %

Interpretation – The Support Vector Machine model accurately predicts whether the person is diabetic or not with an accuracy of 78.67 %
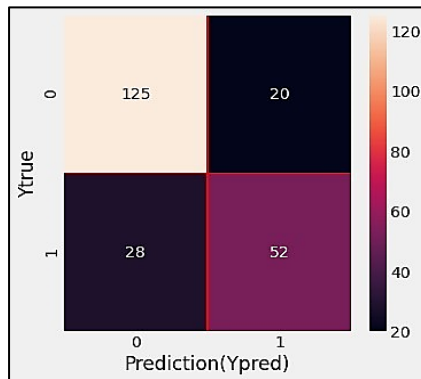
Naïve Bayes Classifier

Assumption: Presence of conditional independence. The parameter Naïve Bayes Classifier have is priors. It calculates Prior probabilities of the classes. The priors are found according to the data.

```
NB.class_prior_

array([0.65517241, 0.34482759])

NB.epsilon_

1e-09

NB.sigma_

array([[0.83982754, 0.66217357, 0.82657412, 0.88559213, 0.68291884,
        1.04432948, 0.80022583, 0.97947108],
       [1.19702336, 0.92034094, 1.31827463, 1.20459438, 1.52060003,
        0.68153905, 1.29530618, 0.88259469]])

NB.theta_

array([[-0.13955096, -0.36186883, -0.04515459, -0.04816145, -0.12188342,
        -0.20618166, -0.1236651 , -0.16848329],
       [ 0.26514682,  0.68755078,  0.08579372,  0.09150675,  0.2315785 ,
         0.39174516,  0.23496369,  0.32011825]])
```

The class prior (0.65517241,0.34482759) indicates the class priors of each class ie. 0.65517241 indicates the class prior probability of non-diabetic person whereas 0.34482759 indicates the class prior probability of diabetic patient.

Epsilon denotes the absolute additive value of variances. Sigma denotes the variance of each feature per class. Theta denotes mean of each feature per class.

After tuning the parameter, the results of the confusion matrix are shown below:

The results obtained from the confusion matrix are as follows:

- Accuracy = 74.67 %
- Specificity = 63.86 %
- Sensitivity = 80.99 % 4. F1-score = 80.14 %
- Precision = 79.31 %

Interpretation: The Naïve Bayes Classifier model accurately predicts whether the person is diabetic or not with an accuracy of 74.67 %

Decision Tree:

Assumptions: Initially, whole training data is considered as root.. Records are distributed recursively on the basis of the attribute value.

No parameters were tuned for this model. The results of the confusion matrix are given below:

The results obtained from the confusion matrix are as follows:

- Accuracy = 68 %
- Specificity = 54.55 %
- Sensitivity = 76.64 %
- F1-score = 74.47 %
- Precision = 72.41 %

Interpretation: The Decision Tree model accurately predicts whether the person is diabetic or not with an accuracy of 68 %

Random Forest

Assumption of no formal distributions. Being a non- parametric model, it can handle skewed and multi- modal data.

The criterion used in the Random Forest is "Gini Index"

The parameters of the model have been tuned to find the optimum n estimator value. This gives the number of trees to build before taking the maximum voting or averages of predictions. Higher number of trees gives better performance but makes code slower.

```
#Find Optimum K value
scores = []
for each in range(80,100):
    RFfind = RandomForestClassifier(n_estimators = each)
    RFfind.fit(x_train,y_train)
    scores.append(RFfind.score(x_test,y_test))

plt.figure(1, figsize=(10, 5))
plt.plot(range(80,100),scores,color="black",linewidth=2)
plt.title("Optimum N Estimator Value")
plt.xlabel("N Estimators")
plt.ylabel("Score(Accuracy)")
plt.grid(True)
plt.show()
```

After tuning the parameters, the results of the confusion matrix are given below:

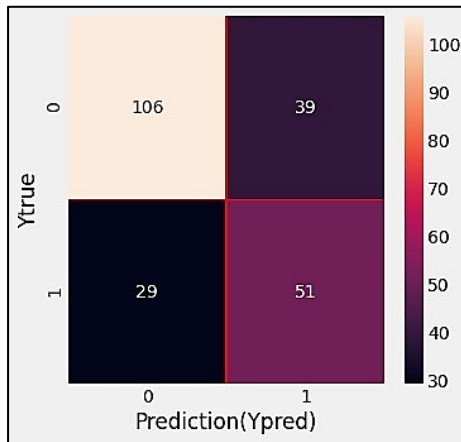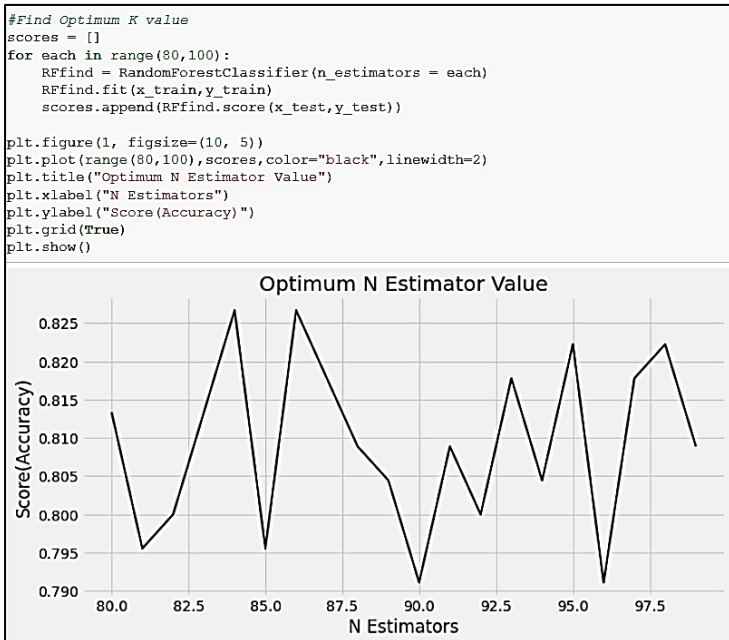The results obtained from the confusion matrix are as follows:

- Accuracy = 81.78 %
- Specificity = 74.07 %
- Sensitivity = 86.11 %
- F1-score = 85.81 %
- Precision = 85.52 %

Interpretation: The Random Forest model accurately predicts whether the person is diabetic or not with an accuracy of 81.78 %

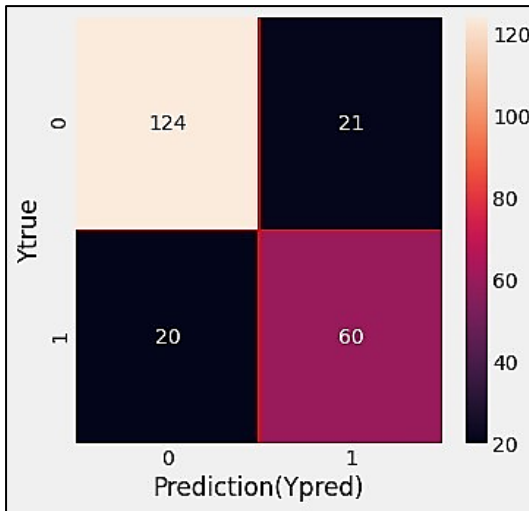Note: All the machine learning classification algorithms fitted have been cross validates with K- folds cross validation.

CONCLUSION:

In this research paper the classifiers, Logistic Regression, K-Nearest Neighbours, Support Vector Machine, Naïve Bayes, Decision Tree, Random Forest were used for classification of the imputed PIMA Indian Diabetes database. In all the classifiers, the parameters have been tuned, which insists that these models are not baseline models. Further the data is divided into training and testing datasets using the 70-30 ratio. The

performance of the classification model depends upon the quality of the dataset and also the amount of data pre- processing is done behind it which helps to increase the accuracy of the data. After running all the classifiers, the results are given below: -

	Accuracy (in%)	Specificity (in %)	Sensitivity (in %)	F1-score (in %)	Precision (in %)
Logistic Regression	80.89	76.81	82.69	85.71	88.97
K-Nearest Neighbors	70.67	70.59	70.68	80.36	93.1
Support Vector Machine	78.67	72.22	81.70	83.89	86.21
Naïve Bayes Classifier	74.67	63.86	80.99	80.14	79.31
Decision Tree	68	54.55	76.64	74.47	72.41
Random Forest	81.78	74.07	86.11	85.81	85.52

After referring to the above table, the highest accuracy is of Random Forest as compared to all the other models. The other classification model which is close to random forest is logistic regression the difference of accuracies between the models is very less, also the Precision and Specificity is high for logistic regression as compared to Random Forest. So, random forest can't be just declared the best classification algorithm just on the basis of accuracy. Let's try to compare both the models on basis of AUC/ROC curve.

ROC curves from the investigated models
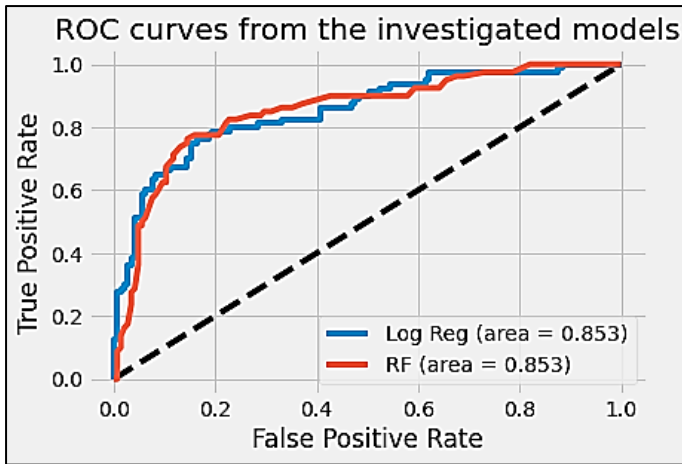
The area under curve for both the models is still the same (0.853). It can be concluded that as of now both the models are best for the prediction whether the person will be diabetic or not. Therefore, Random Forest and Logistic Regression are the best machine learning classification models which can predict whether person is diabetic or non-diabetic as compared to other classification models.

The performance, accuracy can be increased with Ensemble methods, and which model is better between Logistic Regression and Random Forest can be taken as future.

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Chapter 10 - Study on Students' Perspective about Online Learning during Covid-19

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ABSTRACT:

The study was carried out with the purpose of evaluation of different aspects of online learning/education during the course of the COVID-19 pandemic and its effect on the studies and health of the students. It is a survey-based study conducted by taking an online survey of school and college going students.

Keywords: Online learning, COVID-19, school and college students, perception of physical and mental stress

INTRODUCTION:

The World Health Organization (WHO) declared COVID-19 as a pandemic on 11th March 2020. To control the widespread of corona virus among people, the Indian government implemented lockdown in the country. As an initial step, educational institutions like schools, colleges and universities were closed (Raj and Fatima, 2020). The smooth conventional education system was suddenly changed to virtual classes (Adnan and Anwar, 2020).

Globally online classes became an integral part of the educational system. This rapid transformation is linked to various challenges like successful teaching and learning through technology, insufficient access and availability of internet (Adnan and Anwar, 2020). The physical movement and social movement constraints due to quarantine changed the routine lifestyle of students (Son et al., 2020). Adaptation towards virtual classes became a challenge for many students in terms of facing network accessibility, attendance issue and participating in online sessions (Nambiar, 2020).

In India, the current lockdown situation turned many students' lives upside down. Researchers found that Indian students had high level of anxiety during coronavirus outbreak (Rehman et al., 2020). Virtual learning induced stress, affects the cognitive memory process in adulthood that stimulates the strong feeling of anxiety with the association of learning difficulties, teamwork, course assignments, family expectations etc. (Lazarevic and Bentz, 2020).

India is in early stage hence student and teachers are finding difficult to adapt to newly established online classes. The student's perception and satisfaction towards online classes must be investigated. Because if they could not understand the concept being taught in online classes then the quality of education become low and teacher's effort will be wasted (Nambiar, 2020). In addition, the student's perception on home quarantine might affect their mental health. An appropriate way should be addressed to ease student's anxiety (Tang et al., 2020). The student's perspective of experiencing online stress must be evaluated (Lazarevic and Bentz, 2020). Hence, the purpose of this study is to assess the physical and mental stress experienced by school and college students during online classes.

Aim of the study

The aim of this study is to conduct an online survey to understand the effect of online learning among students.

Objective of the study

- To evaluate the likes and dislikes about online teaching and learning among students
- To high light the physical and mental stress faced by students during online classes
- To analyze whether the concept of online curriculum taught was understood by students
- To find open suggestions from students to improve online learning

LITERATURE REVIEW

The education system has been experiencing a devastating situation from the beginning of the lockdown. Most of the exams stay postponed, cancelled and evaluated students by previous assessments. The process of conducting online classes and online examinations in developing countries like India are very complicated (Balachandran et al., 2020).

Widodo et al., 2020 showed that student's readiness to online classes is still lacking. Most students expect to stop online learning and start traditional class room learning. Students experience obstacles with internet connection.

Each student responds to academic stress differently. It makes students to feel tension, pressure and negative emotions including angry, anxiety. The lack of physical school environment, teachers and parents pressure often makes student to lose their interest towards education. Academic stress is aggravated by stressors like length of the time taken during online lectures, anxiety in facing exams, lack of time management to complete a task, prolonged stay in front of electronic gadgets (Pajarianto, 2020).

Most of the students suffer from shortage of technical resources, high internet costs, low internet speed, family financial crisis and mental stress are the main obstacles for the students to afford online education. If the students suffer the most, it will impact the entire learning and teaching environment (Sifat, 2020).

METHODOLOGY:

A set of different open and closed ended questions were framed for school and college students. The questionnaire was circulated using Google forms. In case of school students, the form was circulated to the parents and for those students whose parents agreed to fill the form were considered for the study. This study included a population of 51 school and 330 college ongoing students who sent their response. The study was conducted in Mumbai, the capital city of the Indian state of Maharashtra.

RESULTS AND DISCUSSION:

School Students:

	Gender			Education		
	Female	**Male**	**Other**	**1st-5th**	**6th - 8th**	**9th -10th**
No. of Respondents	22	29	0	13	21	17
N=51(%)	43	57	0	23	41	33

Table 1: No of Respondents
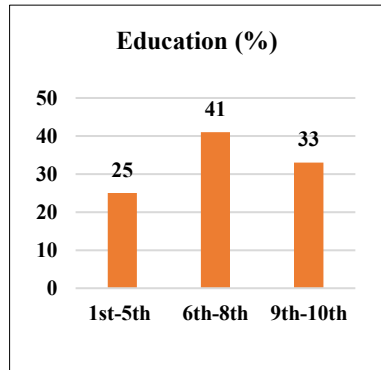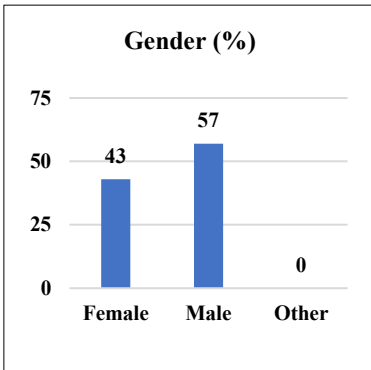
Figure 1 Distribution of Gender

Figure 2 Distribution of Education

As per the results obtained male school students were found to be more than female. The result shows that 6th -8th grade school students were actively responded than primary and high school students.

Device for Online Education (%)
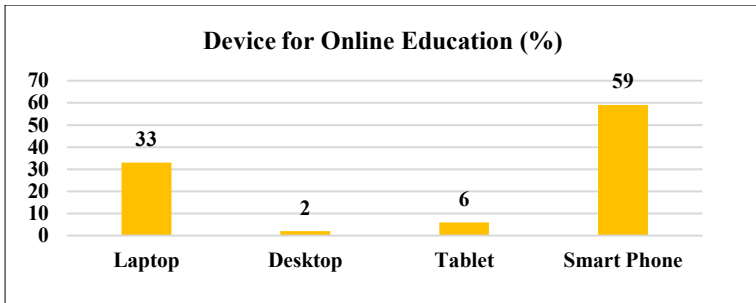
Figure 3 Distribution of Respondents on Device Used

The usage of smart phone was highly preferred by school students comparing to laptop, tablet and desktop.
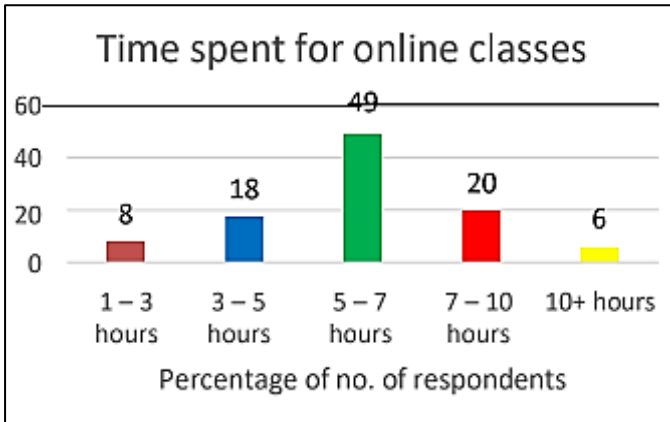
It is evidenced that most of the school kids are attending 5 – 7 hours of online classes. Moderate percentage of students are attending 7-10 hours followed by 3 – 5 hours of online classes. Few students are spending 10+ hours in online classes. They might be spending in private tuitions.
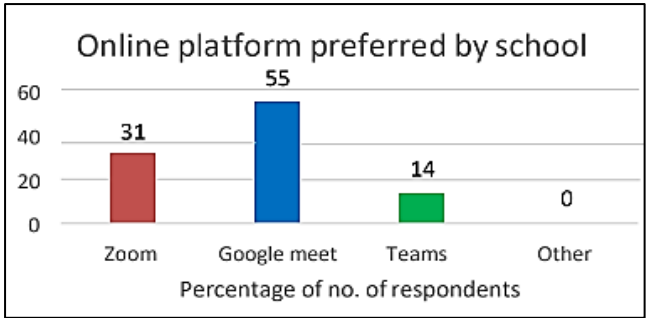
The school managements prefer Google meet as their teaching platform than zoom and teams
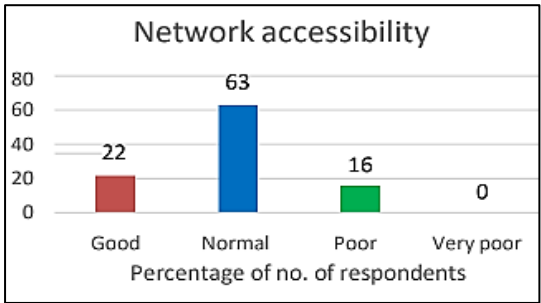
School students' responses on network accessibility is found to be normal and good. Few students were reported the connectivity strength as poor
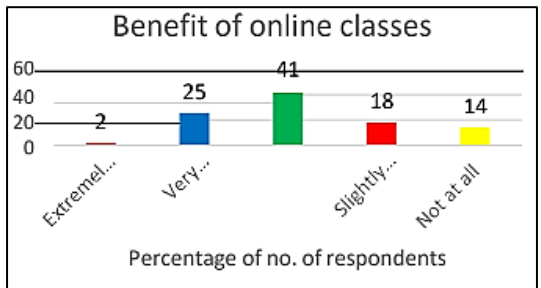
The online classes are found to be moderately beneficial to majority of the school students. Few students were exhausted and reported not at all benefitted

Understanding the subjects

- Yes: 20
- No: 31

No. of respondents
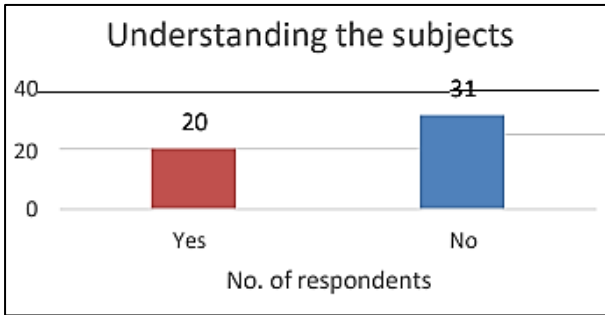
Most of the school students were not able to understand the subjects being taught in online. Few students reported that they can understand
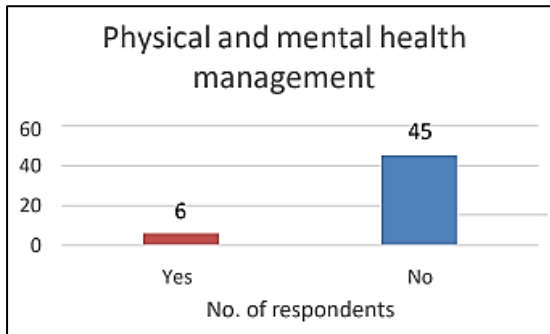
Physical and mental health management

- Yes: 6
- No: 45

No. of respondents

As per the results, majority of the students could not manage the physical and mental health during online classes
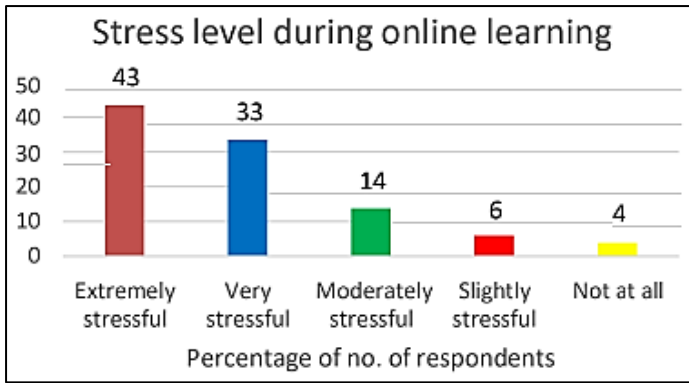
Majority of the students felt extremely stressful during online classes. Very few students were responded as not at all.

College Students:

As per the results obtained male college students were found to be more than female
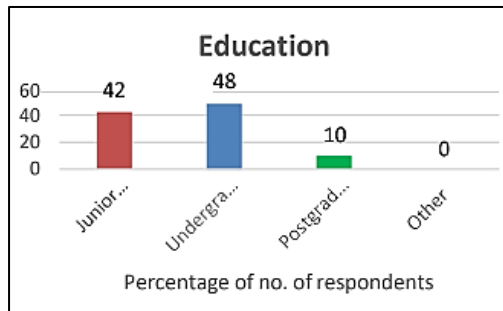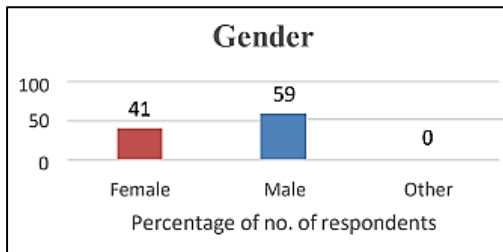
The result shows that undergraduate students were actively responded followed by junior college students, postgraduates than other groups
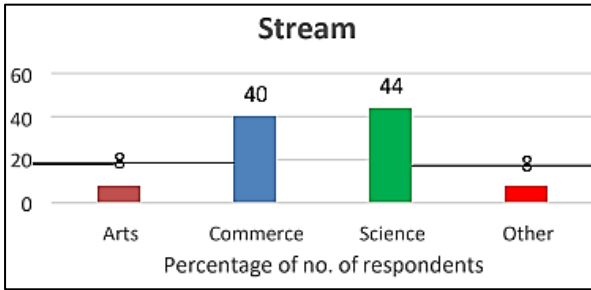
The above results suggest that most of the respondents were from science stream followed by commerce, arts and other subjects
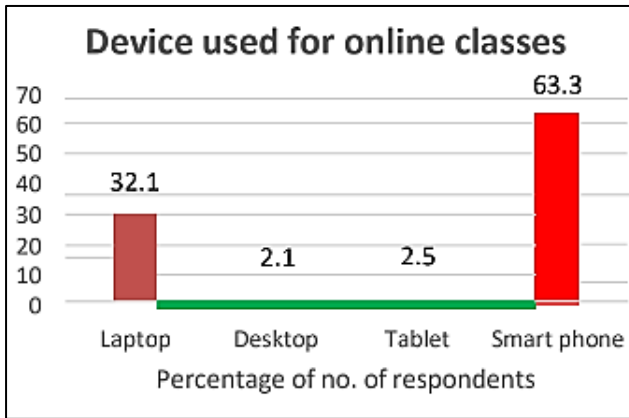
The usage of smart phone was highly preferred by college students and laptop was moderately preferred comparing to tablet and desktop

It is evidenced that most of the college students were attending 1 – 3 hours and 3-5 hours of online classes. Moderate percentage of students are attending 5-7 hours followed by 7 – 10 hours of online classes.

Time spent on online learning
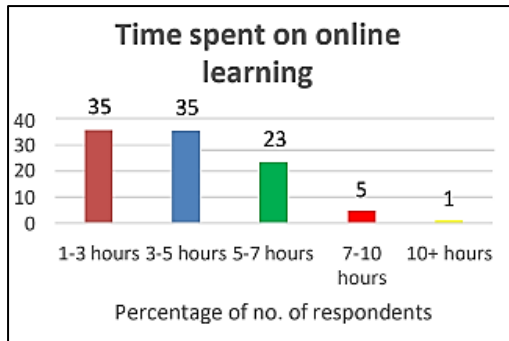
Limited students were spending 10+ hours in online classes. They might be spending in private tuitions

Online platform preferred by institution
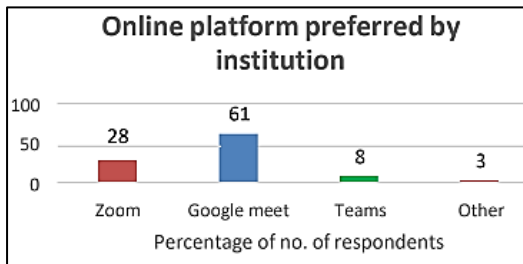
The college management preferred Google meet followed by zoom as their teaching platform than teams and other programs. College students' responses on network accessibility is found to be normal and good. Few students were reported the connectivity strength as poor and very poor.

Benefit of online learning
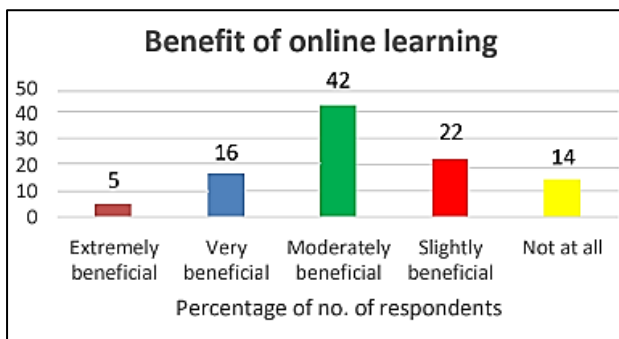
The online classes are found to be moderately beneficial to majority of the students. Few students felt it was extremely beneficial. Limited students were exhausted and reported not at all benefitted. Overall, the results showed that most of the students felt beneficial.

Understanding the subjects

Percentage of no. of respondents

- Yes: 72
- No: 28
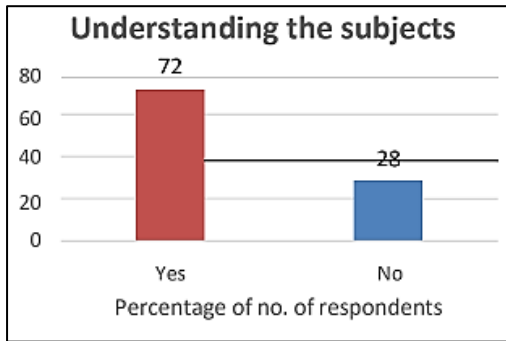
Most of the college students were able to understand the subjects being taught in online. Few students reported that they haven't understood the subjects taught in online
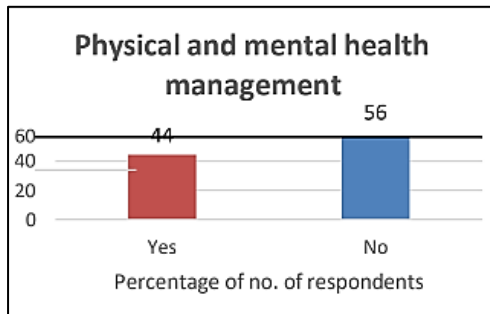
Physical and mental health management

Percentage of no. of respondents

- Yes: 44
- No: 56

As per the results, majority of the students could not manage the physical and mental health during online classes. But some of the students were reported that they could manage their stress.

Stress level during online learning

Percentage of no. of respondents
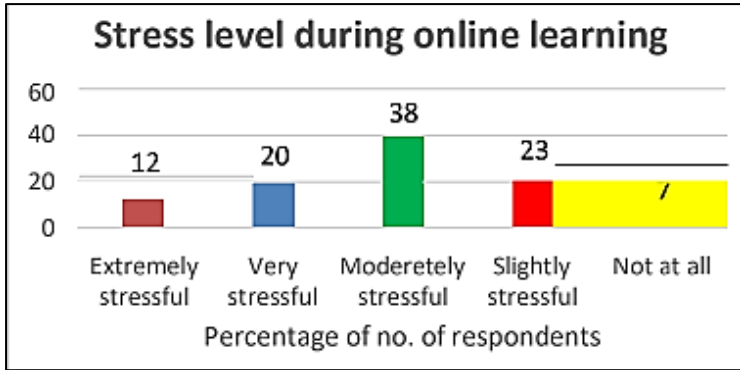
Majority of the students felt moderate to extreme stress during online classes. Some students reported the stress to be slight and very few students were responded to be not at all

DATA ANALYSIS:

Different parameters are compared against different demographic factors using R studio and MS Excel based on the data collected from college students.

To analyze the benefit of online learning against Gender.

H0: There is no significance of difference between the average perception score of the benefit of online learning when compared between the gender. (Male, Female, Other)

H1: There is significance of difference between the average perception score of the benefit of online learning when compared between the gender

	W	p-value
Gender	102025	0.000

Interpretation: Since p-value for Wilcoxon rank sum test is less than 0.05, indicates that there is significance of difference between the average perception of benefit when compared between male and female.

To analyze the benefit of online learning against Grades and Streams:

H0: There is no significance of difference between the average perception score of the benefit of online learning when compared between different Grades (11th – 12th grade, UG, PG, Other) and Streams (Arts, Commerce, Science, Other)

H1: There is significance of difference between the average perception score of the benefit of online learning when compared between different grades and streams

	Kruskal-Wallis chi-squared	**df**	**p-value**
Grade	2.6341	2	0.2679
Stream	10.415	3	0.01535

Interpretation: Since p-value of Grade i.e., 0.2679 greater than 0.05, therefore we do not reject H0 and conclude that the benefit due to online class do not differ between different grades and Since p-value of Stream i.e. 0.01535 is less than 0.05, therefore we reject H0 and conclude that there is a significant difference between different streams in benefit of online learning. Since it is significant, we proceed with Dunn's Test.

	Arts	**Commerce**	**Science**
Commerce	0.0387	-	-
Science	0.0081	1.0000	-
Other	1.0000	1.0000	1.000

Interpretation: Since the p-value of Dunn's test for arts against commerce and arts against science is less than 0.05 indicates significance of difference between the average perception on benefit of online learning

when compared between these streams. Rest all comparison remains non-significant.

To check whether the students could manage their physical and mental health during online learning:

H0: There is no significance of difference between the proportion of respondents those who could manage their physical and mental health and those who could not.

H1: There is significance of difference between the proportion of respondents those who could manage their physical and mental health and those who could not.

Chi-square	Df	p-value
4.3758	1	0.03645

Interpretation: Since p-value i.e., 0.03645 is less than 0.05, therefore the proportion of respondents who could not manage their physical health is greater than the respondents who could manage their physical and mental health. Therefore, we conclude that the respondents could not manage their physical and mental health.

To check the proportion of stress levels in students during online learning

H0: The response distribution for the level of stress is same

H1: The response distribution for the level of stress is not same

Stress level	Oi	Ei	$(Oi – Ei)2$	$\chi 2 = (Oi – Ei)2/ Ei$
Extremely stressful	40	66	676	05:49
Very stressful	65	66	1	00:21
Moderately stressful	127	66	3721	56.37879
Slightly stressful	75	66	81	1.227273
Not at all	23	66	1849	28.01515
Total	330	330		

Chi square = $\chi 2$= (Observed – Expected)2/Expected = (Oi –Ei)2/Ei

<u>Interpretation</u>: Since the highest contribution for $\chi 2$ is in the Moderately stressful category i.e., 10.24242, we conclude that the respondents are finding online learning to be significantly moderately stressful and therefore the response distribution on the level of stress is not same

CONCLUSION:

The study was conducted among school and college students, to know their perspective and stress towards online classes. School students showed negative perspective due to lack of physical activity and communication between teachers, friends. It can be managed by limiting the class hours in online. Also parents support is necessary for the successful progression of school student's education. Whereas, college students prefer online education even though they face severe stress and multiple difficulties like lack of physical activity, continuous classes for many hours without break, which drives them to loose concentration and ability to understand the subjects being taught. However, online classes will not replace physical class environment. These problems can be adjusted by giving short breaks between classes and teaching methodology can be changed like Teachers must have physical white/black board so that it is easier for the students to understand what is being taught. Students must be encouraged to do simple physical activities at home so that they do not become lethargic. For school students, monthly meetings of the teachers with parents and students should be conducted about the study portion that has been uploaded and to analyze the strengths and weakness of each student. Motivational speakers should be invited by schools and colleges to train the teaching faculty to help them to motivate the students

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SECTION IV - PSYCHOLOGY

Chapter 11 - Dust your own Mirror: Exploring Covid-19 Experiences of Mental Health Professionals in Mumbai

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Abstract

Psychological wellbeing of mental health professionals in India is often overlooked and has intensified since COVID-19 pandemic has hit us. In this study, we aimed to understand burnout and coping strategies practiced by Mental Health Professionals (MHPs) in Mumbai during the COVID-19 pandemic. We followed a qualitative approach and used a case study method. 10 MHPs were interviewed online to understand their experience.

Braun and Clarke's thematic analysis was done after data collection. After analysis, five themes were extracted which were difficulties faced by MHPs in transitioning online, client concerns, burnout, positive experiences of MHPs in transitioning online and coping strategies. The results indicated that most participants that were interviewed experienced burnout primarily due to mental fatigue and increased workload and working hours. All the participants shared that they had strong coping mechanisms in place which included physical activities like walking and dancing, practicing mind-body connection like mediation and maintaining nutritional diets, taking time out for self-reflection and social connectedness and media consumption. This study is important because it studied the impact of COVID-19 on MHPs from a qualitative point of view and a broad range of coping strategies practiced by them.

Keywords: Mental Health Professional (MHP), burnout, COVID-19, coping strategies, boundary setting

INTRODUCTION

Has it ever crossed your mind if a therapist needs therapy? The profession of a mentalhealth professional involves empathising, giving positive regard and actively listening to theirclient. The client pours out their feelings, fears and insecurities to which the therapist can have an emotional reaction (Bhatt, 2019). They help the client in adjusting to different situations in life and achieve a balanced mental health. This can turn into a very demanding job of guiding emotionally drained people on a daily basis and coping with Vicarious trauma.

Mental Health Professional (MHP)

Mental health professional is a healthcare practitioner who provides services to improve an individual's mental health or to treat mental health disorders. Mental Health Professional is an umbrella term, as there are many experts who are specialized in different areas of mental health and they fall under this term. There are various types of mental health professionals namely, psychologists, psychotherapists, psychiatrists, counsellors, clinical social workers and others (Grohol, 2016). In this study by MHP we mean psychologist, psychotherapist and counsellors.

A psychologist is a person who specializes in the study of mind and behaviour or in the treatment of mental, emotional and behavioural disorders, a specialist in psychology ("psychologist." Merriam-Webster.com, Dictionary, Merriam Webster, 2021). They have received specific training in diagnosis, psychological assessments and a variety of psychotherapies and research (Grohol, 2016). A psychotherapist is a professional who helpsan individual to heal their emotional, mental, behavioural or relational problems that can cause discomfort or unhappiness to them (Subida, 2013). They help resolve these problems using different therapies. A counsellor is a professional who has received training to hold individual or group counselling sessions. They provide advice, support and a safe space totalk about the problems a person is struggling with (Leonard, 2020).

Negative Impacts of being a MHP

There are many roles that a MHP has to play while performing their duties which in turn sometimes make them prone to burnout (APA, n.d). MHPs address their client's emotional discomfort and traumas on a regular basis, with limited control over their own emotional outcomes and high level of involvement can lead to burnout, distress (Contributor, 2020).

Secondly, their interactions between their personal stressors and professional work brings them emotional stress. It becomes difficult for them to put their own emotions aside and attend to the needs of the clients (Contributor, 2020). This pandemic can be proved as anexample of it. Almost everyone was working from home during the lockdown and some are still working from home. Here, it did become difficult for many professionals to balance their personal stresses and their professional demands.

Burnout (BO)

Burnout is a psychological syndrome of emotional, physical and mental exhaustion caused by excessive and prolonged stress (Smith, 2021). MHPs are experiencing immense work pressure while providing relief to people by sacrificing their quality of life and interpersonal relationships which leads them to experience burnout, compassion fatigue and stress. Some of the symptoms for burnout could be experiencing compassion fatigue, depersonalization and reduction of personal accomplishment (Good Therapy, 2020). In India,there was a shortage of MHPs who were themselves overwhelmed, overlooked and felt burnout during the pandemic. In 2019, 7.5% of India's population was suffering from mental health disorders with less than 4000 mental health professionals available (Birla, 2019) but after the pandemic, in 2020 it rose to 20% according to the recent survey by the Indian Psychiatry Association (Goecker, 2020).

Compassion Fatigue (CF) is defined as "a state of exhaustion and dysfunction – biologically, psychologically and socially as a result of

prolonged exposure to stress" (Figley,1995). CF is similar to Secondary Traumatic Stress Disorder (STSD) and is analogous to PostTraumatic Stress Disorder (PTSD). STSD is secondary exposure to someone else's extremelytraumatic stressful events whereas PTSD occurs owing to the direct threat of an individual (M. L. Marsac, 2020). Researchers which may differ in the terms they use to describe the aspect but at the end their focal point is the relief of clients. Some therapists are able to deal with stressors without having a negative impact while others cannot. Compassion fatigue is inessence the "cost of caring for others" in distress (Figley, 1995).

COVID-19 Pandemic

The World Health Organization (WHO) on 11 March 2020 declared Novel Coronavirus disease (COVID-19) outbreak as a pandemic (WHO, 2020). Like other countries, India too implemented a nationwide lockdown to curb the transmission of the virus(Rehman, 2020). The rapid rise in the cases has caused physical as well as psychological distress on the MHPs worldwide. Other characteristics like increased working hours, high emotional load, infection stigma, lack of adequate support in the work and family environment and interaction between personal issues and professional practices have led them to experience burnout and low on compassion satisfaction (Franza et al., 2020).

Review Of Literature

Research study shows that organizational factors such as excessive workload, long working hours and lack of control results in BO. Interpersonal factors like therapists' personal beliefs and maladaptive coping mechanisms can also increase the risk of burnout(Simpson et al 2018). MHPs have the tendency to minimize their own vulnerability to BO, striving to reachhigher standards whilst denying personal needs and emotions, hesitant to set boundaries, reach out for support, self-blaming for showing signs of stress and fear of letting down others whilst continuing to expose themselves to excessive work pressures (Ledingham, 2015in Simpson et al., 2018).

A study conducted in Italy from March 2020 to April 2020 showed the levels of BO and STSD among 21 therapists and 5 psychologists. On the short Compassion Fatigue Scale (sCFs), 29.65% psychologists experienced BO in the Psychiatric Rehab department and 35.45% in the Multidisciplinary Rehab department. Under the Professional Quality of Life (ProQOL)-Compassion Satisfaction and Fatigue Subscales, the level of STS was 20% amongpsychologists while the level of BO and STS were 31.09%, 28.57% respectively among therapists (Franza et al., 2020). Another study conducted among Malaysian healthcare workers from April 2020 to May 2020 included 11 psychologists and counsellors found that 27.32% experienced personal related burnout, 18.2% experienced work-related burnout and 9.1% client related burnout (Roslan et al., 2021). In an Indian survey of 159 mental health experts conducted in June 2020 by a Bengaluru-based NGO, 'Suicide Prevention India Foundation (SPIF)' found that more than 62% of therapists admitted experiencing caregiver fatigue. Another SPIF survey also found that nearly 65% therapist saw a rise in self-harm and suicide among client since March, 2020and individuals who had made a recovery had relapsed (Menon, 2020).

Mental health platforms like Inner Hour and Your DOST have also witnessed an increase in demand for sessions by 4 times and 120% respectively. This has increased the pressure of the limited number of psychotherapists available in our country (Menon, 2020).

As shown in Figure 1, a concept map was formed before starting data collection to understand our two central domains- BO and Coping strategies.

Figure 1

Concept Map
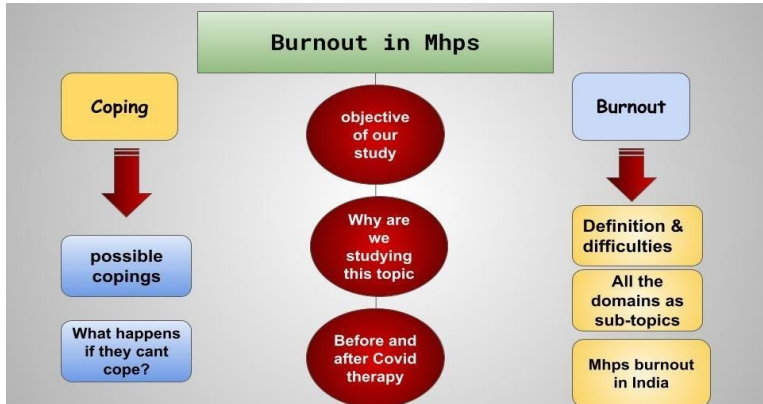
Rationale

We opted for this topic because the impact of COVID-19 on MHPs is a new avenue to study. Secondly, there are more quantitative studies on burnout among MHPs, so we chose qualitative method to learn about their experience. Therefore, this study aims to identify and understand burnout and compassion fatigue among MHP in India during COVID-19. Another reason for opting for this topic was when one of the teammates witnessed a therapist mention their own experience of burnout during the pandemic and her coping strategies.

METHODOLOGY

The COVID-19 pandemic has been a crucial period for MHPs in providing psychological aid to people who are unable to cope up with the current scenario (APA, 2014 in Joshi & Sharma, 2020). It is becoming overwhelming for MHPs to keep up with their workdemands as they provide tele-counselling and online therapy (Agrawal & Yadavar, 2020

in Joshi & Sharma, 2020). Therefore, our study focuses on knowing the experiences of MHPsin this on-going pandemic situation.

Aim

To understand the experience of mental health professionals practicing in Mumbaiduring the COVID-19 pandemic.

Objectives

- To identify burnout among mental health professionals during COVID-19 pandemic.

- To understand various coping strategies used by MHPs for their mental wellbeingduring COVID-19 pandemic.

Research Design

The approach used in data collection is Qualitative research. Qualitative data collectsand analyses non-numerical data like text, audio or video to gather precise understanding of concepts, experiences, opinions and problems faced regarding any domain (Bhandari P, 2020). This method of research not only questions 'what' people think and perceive about a particular topic but also questions 'why' they think so.

Case study method has been used in this research. Case studies help identify the key issues of events being studied. Data was collected through online interviews. Interviews are carried out on one-on-one basis with the respondent to gather in-depth knowledge about their insights and experiences (Lumen, n.d.). Structured questions were asked during the interview. These types of questions are a set of predetermined questions asked in the same order (Cheung, 2014).

Tools

The tool used to gather participants' demographic details was via Google Forms which were sent out through Emails, Instagram Direct Messages (DM) and WhatsApp Messenger. We followed a 3-reminder protocol (text message, email and phone call) and if we still didn't get any response, we dropped out that person and reached out to our next contact. Before conducting the interview, informed consent was obtained from all participants. Interviews were conducted through Zoom Meetings.

Participants were informedabout the research and the identities of the students and the mentor.

Samples

Purposive sampling has been used in this study. Purposive sampling is used when theresearcher relies on their own judgement while picking up participants for the study especially when the researcher thinks that the participants fit the profile they want to study. (Dudovskiy, 2018).

1. Mental health professionals practicing in Mumbai.

2. Should have a minimum experience of two years.

3. Conducted sessions during lockdown.

4. Must have at least a M.A./ M.Sc. in psychology.

5. Must be proficient in English.

Ethical Considerations

An informed consent was taken from the participants prior to their interview. Participation in this study was completely voluntary and the participants had complete rights towithdraw from the study at any point. Confidentiality and anonymity of the participants was maintained throughout the study. The interviews were recorded for research purpose, only after taking consent from the participants and the recording was shared with them. Theserecordings were then transcript for data analysis. The interviewers underwent training before conducting interviews. They were also equipped with resources in case of triggers during the interviews.

Pilot Study

2 pilot studies were conducted prior to the interviews. There were no negative feedbacks from these 2 pilot studies, the participants shared that the questions were framed intelligently and they were ready to engage over multiple sessions. Through these pilots, we learnt to cater time management and various research skills. Hence, we decided to have only 2 pilot studies.

Table 1

Pilot Study Overview

	Name	Age	Gender	Specialization	Experience (Years)
Pilot 1	Seema	27	Female	Counselling young adults and teens	3.5
Pilot 2	Prachi	50	Female	Clinical Psychology	20

*names have been changed due to confidentiality purposes.

Data Collection

The study was conducted in Mumbai from May 2021 to June 2021. 10 interviews were conducted. Out of these 10 participants, 9 were female participants and 1 male participant. All the interviews were conducted with 2 interviewees being present. One team member asked questions, while the other made observation notes. We terminated our study at 10 participants since this is qualitative research and it was our minimum requirement.

Secondly, we were not receiving any new experiences from any participants. Table 2 outlines the participants' name, age, gender, their specialization and years of experience.

Table 2

Participant Overview

	Name	Age	Gender	Specialization	Experience (years)
1.	Sanya	45	Female	Psychotherapy, Counselling Therapy	4
2.	Hetvi	26	Female	Clinical Psychology, Remedial Counselling	4
3.	Mitali	31	Female	Counselling Psychology	5
4.	Neha	36	Female	Narrative therapist, Parenting and Family Therapy	6

5.	Syona	27	Female	Clinical Psychology	6
6.	Priya	27	Female	Counselling Psychology	6
7.	Shilpa	41	Female	Clinical Psychology	10
8.	Veronica	36	Female	Narrative Practitioner, Autism Interventionist	12
9.	Fatima	35	Female	Counselling psychology, Art Based Therapy	12
10.	Meet	44	Male	Clinical psychology, Psychodiagnostics	20

Names have been changed due to confidentiality purposes.

Braun and Clarke's thematic analysis was done after data collection. The American Psychological Association (APA) defines thematic analysis as "a qualitative research strategyfor identifying, analysing, and reporting identifiable patterns or themes within data" (APA, n.d.). Codes were generated using the interview transcripts and then collated into potential themes. These themes were then reviewed and named (Caulfield, 2020).

Reflexivity

One of the major reasons for working on this topic was when we came across a therapist burnout experience which intrigued us to choose this topic. During the beginning ofthe research, we wondered if we'd do justice to this topic but with constant motivation by oursupervisor and teammates we started with our research. After the pilot interviews, we gainedconfidence when we received positive feedback. We also noticed that when the participants non-verbal cues like body language and tone matched ours, we felt more confident and comfortable conducting interviews. We specifically choose to study MHP's practicing in Mumbai because of cultural similarity which placed us in the same scope. With every interview, we learnt to empathize better, listen more effectively, learning that self-care is an essential practice, the importance of introspection and acknowledging our own feelings and opinions.

RESULTS AND DISCUSSION

The present study is aimed at gathering an in-depth experience of the

MHPs practicing in Mumbai during the Covid-19 pandemic, to evaluate the scope of burnout and toknow various coping strategies followed by them.

Ten interviews were conducted and transcript. After analysing the therapists' experiences, themes were extracted using Braun & Clarke's thematic analysis. The followingtable, table 3 maps out the overview of the themes we discovered.

Table 3

Themes

Themes	Sub-themes
Difficulties in transitioning online	Difficulties experienced by MHPs Issues from clients Setting boundaries Overcoming difficulties
Client concerns	Anxiety and stress Trauma and grief
Burnout	Mental fatigue Increase in workload
Positive experience in transitioning online	Increased awareness among people Comfortable working from home
Self-care	Self-reflection Social connectedness Regathering post sessions Advices to other MHPs

While we explain each theme in detail, we have used the following nomenclature in terms of participants' responses. If six or more participants have had common experiences, we have used 'most'. We have used 'some' if three to five participants have shared something. We have used 'few' if one or two participants have mentioned something.

Theme 1: Difficulties in transitioning online

One of the focal points of our study was to find out the difficulties MHPs and their clientsfaced while transitioning to online therapy.

a)   Difficulties experienced by MHP

Most of our participants shared that they had difficulty in reading non-verbal cues oftheir clients. Non-verbal cues are an important element in a therapeutic setting and helps in taking the mental state examination of the clients. It became difficult to detect these small changes in facial expressions, eye moments, posture and conducting various hands-on activities in an online setting.

Fatima: We used to take a lot of effort to confirm how they are, how they are sitting,how they are walking, those cues weren't there right? So, using more verbal optionslike "what's happening in your body?" had become a task for me.

Transiting to an online setting was difficult for some participants as they took time tounderstand various online platforms and faced technological difficulties. They expressed thatdue to frequent connectivity issues the rapport and flow of the sessions got disturbed. It was also difficult to build an emotional connection as clients were uncomfortable in opening up initially.

Hetvi: Network glitch, you know, it does happen so the rapport and the flow getsdisrupted so I guess that is one flaw and I think it's inevitable.

b)   Issues from clients

There were difficulties that few participants faced due to their client's end while transitioning online like cancelling sessions due to space constraints where their clients wereunable to find a safe and quiet place for the session. Unpunctual clients who would not turn up during time decided and time constraints were the most common issues faced.

Priya: I'm having a session tomorrow and the client does not turn up tomorrow and after 3-4hours that client is messaging you that, "oh, I am sorry I couldn't turn up, I totally forgot about it."

Shilpa: The other problem was adjusting time. For example, if I say 2 o'clock, the session is at 2. Now if at 2' o'clock if they suddenly get a guest coming at their place so I can't say "please don't call your guest"

and then have to cancel.

c)   Setting boundaries

Few of the participants faced difficulties in setting boundaries while taking online sessions such as loss of privacy, undeniable requests for taking sessions after working hours,adamant clients wanting in-person sessions and contacting during leisure hours of the day.

Mitali: One of my clients actually managed to google it and find out where I stay, my home address. She said that this is your address, you live only 20 mins from my house, I cancome to your house with a covid negative report but I want to have a physical session. So having to reiterate the boundary also was something. The most difficult part is drawing boundaries. So those boundaries for clients suddenly being available on WhatsApp they randomly call you whenever they want because "Hello I have your number", so those were the new issues and new challenges that I had to work through. While taking the interview, most participants shared their concern regarding paymentissues, where sometimes their clients ghosted them after sessions, asked for additional discounts, delayed payments, made unnecessary excuses for avoiding payments and demanded free trial sessions.

Fatima: We struggled with the payment because people were not paying so we hadto send them reminders, it was like very frustrating.

Hetvi: The part where you give a session and then give a client to pay that definitelydidn't work because I was like ghosted then.

Some participants also had to refuse clients due to increased workload because there was anincrease in the number of people seeking therapy. So, setting boundaries was important for their personal reasons and ensuring their own mental wellbeing.

Hetvi: On an average, I see at least four clients a day. I do not exceed a number of six.I haven't taken more than 6 because by then I'm mentally drained.

Sanya: I don't want more than two or three sessions, because it's not okay

to be tiredand have a session because you'll never be able to give your hundred percent.

d)   Overcoming difficulties

To overcome these difficulties, participants came up with different measures like learning technological skills for example google calendars for scheduling appointments, learning to operate online platforms like zoom and google meet, giving free sessions to provide clarity to their clients, having a fixed routine for each session and showing strong paperwork to practice evidence-based therapy. Hetvi: We started doing 15-20 minutes of the session where they could just call, theywouldn't be charged and they would get to ask whatever they want. That is what I could do from my side.

Theme 2: Client concerns

This pandemic has been difficult for many people as shared by our participants. Mostof their clients came up with concerns like anxiety and stress. Other concerns were uncertainty regarding the pandemic, losing jobs, loneliness, depression, feeling demotivated, self-doubts, suicidal thoughts, dealing with overwhelming emotions and relationship issues. Participants also shared concerns among the kids that they have become more irritable, overeating, hypersomnia and increase in fatigue levels. They noticed an increase in the magnitude of stress and anxiety with different combinations.

Fatima: There are some clients who have had a lot of combinations of anxiety andstress, largely any counselling, it's a spectrum of anxiety and depression.

Sanya: But it's that extra tempering on the already concocted stress that has existed,that has elevated the volume of the impact of stress on people, suddenly the magnitude has increased because of the environment, lack of social connect and inability to vent out.

Some of the participants identified trauma and grief among their clients as people around them got diagnosed, losing their loved ones to

pandemic and coping with this suddenloss became difficult which further shot up during the second wave of Covid-19.

Hetvi: Extreme, severe trauma for those who are losing the loved ones or who have family members who are getting diagnosed with covid. So, they are dealing with a lotof trauma and stress. That is mainly what is concerning people. What really concerns me is that after the pandemic is over, we are going to be dealing with symptoms ofPTSD.

Theme 3: Burnout

The central point of our study was to study the experiences of burnout in MHPs during the pandemic and thus a lot of our questions were geared up to identify burnout in our participants. Hetvi- The frequency of burnout has definitely gone higher, that is one concern.

We found out that most of our participants experienced mental fatigue due to vicarious trauma, past client experiences, overwhelming emotions because of uncertainty,frequent irritation due to schedule shifts, dealing with personal grief, work dissatisfactionwhere they felt that they were not doing enough and a sense of missing out in life.

Hetvi: There is so much fatigue because the sessions are trauma informed. So I thinkthe burnout also depends upon the type of treatment that I am in. There is trauma which affects first respondents, even though I am not the victim or I'm not a survivorof the trauma but because I am sitting with someone who has experienced it and I constantly look at a part of the journey, we also sort of also show the stressful response, so it becomes extremely fatigue and tired.

Kiran: My burnout peak has reached eight out of 10. Most of the participants experienced burnout due to increase in their workload and working hours. They started working more than 8 hours a day as more people were reachingout, frequent rescheduling and cancellation from the clients' end and continuous online sessions resulting in increased screen time and longer working hours.

Shilpa: It has increased now, because now I see that my appointments

are fuller than what it was previously, I'm seeing quite a load during the pandemic, post the pandemic i.e now there are a lot of cases coming up.

Mitali: I went through crisis where I was trying to distract myself with more sessions, more work, do random courses on Coursera to understand what that was about but then I realized that I can't have more clients. I did a lot of that and got burned out thenrealised it's not happening.

Theme 4: Positive Experiences

We wanted to know a holistic experience of MHPs transitioning online. While they had negative experiences, they also had some positive experiences transitioning online. Most of the participants were very happy to share that more people were reaching out and themain reason being the increased awareness on addressing one's mental health, breaking stigmas and resistance towards seeing therapy.

Syona: A lot of people reached out to me because they needed an immediate thing andthere was a lot of resistance. So that helped break the resistance because they applied it. They saw that therapy really works.

Hetvi: Mental health has finally received just acceptance in the society and it wasnecessary.

Some of the participants also got comfortable working from home as they saved a lotof time not commuting, it has expanded work, taking breaks between sessions became convenient, balancing personal and professional life became easy

Priya: I realized that working from home is kind of working for me and it was alsonecessary to accept the reality so then I started enjoying it.

Theme 5: Self-care Methods

Inspite of all these difficulties, we wanted to understand self-care methods of our participants which is an essential practice in this field. Self-care is linked to increased well-being, reduced stress and negative affect, increased positive affect, thriving, better clinical performance, compassion satisfaction, and overall quality of life (Posluns & Gall,

2019). Participants practiced self-care by engaging in physical activities like walking. Participants also practiced self-care in a way to keep their mind and body connected to avoid exhaustiondue to continuous work. Activities such as meditation, reading, maintaining a healthy diet, sleep patterns and taking breaks like power naps.

Hetvi: There have been habits like walks every day, meditation. So, I do this for 30-40 minutes of meditation that really, really helps me. I do have the routine of taking power naps. I do take 20-30 minutes power naps in afternoons especially. Those 20 minutes power naps are so rejuvenating that I can take 2-3 sessions. They do help, the rest is very important.

Priya: One more thing that is there is healthy eating so nutritious eating you are alsomight have heard that you are what you eat

Participants engaged in self-reflection methods like evaluating themselves, taking time off work and maintaining thought logs. They practiced these methods at the end of theday which proved helpful for them. A few MHPs noticed that they needed therapy themselves.

Shilpa- I make spare time for myself and spend it with myself, so there are timeswhen my phone is switched off and I am disconnected with everybody.

Neha: I'm also taking my own therapy, which allows me to cope. Being a therapist doesn't mean you're immune to your own personal challenges. The moment I noticethat, I know it's time for me to take on a session for myself and clean my mirror.

Apart from these self-care methods, participants reconnected socially by spending time withtheir family and friends. They also took out time for content consumption like watching Instagram reels, playing online games, binge watching sitcoms and movies.

Syona: I have had patterns where I binge watched and I have gotten to work a couplehours later. I think that also got my mood going.

Neha: I've been going away once a month or once in two months for the weekend or aholiday, as I could.

We also asked participants if they had any advice for other MHPs to which they responded to focus on skills and not money, practicing empathy in daily life, being kind to themselves especially during these hard times, letting go of personal opinions during sessions, knowing the benefits of self-love and self-care and seeking therapy if needed.

Neha: I can give is for everyone to keep dusting their own mirror. So, be kind toyourself is the best advice I can give.

Syona: The fundamental rule of a therapist is to approach a client believing that theydon't know anything. And that's the truth that I don't know, I am not the master of your life. You are the master. So, I don't know. I'm on this journey with you together.But when I project my own personality then it beats the purpose, so I think the fundamental thing that I would tell other mental health professionals is to let go of their opinions, let go of who they are for that 50-minute session.

Most of our participants experienced increased burnout since the pandemic started primarily due to mental fatigue and increased workload. In a study by McCormack et. al (2018), younger psychologists reported higher levels of burnout than their older peers. A similar trend was observed in our research. Younger participants reported feeling more burnout than older participants. Regardless of their experience, all the participants had strongcoping mechanisms in place. Data collection was done during the second wave and thus higher levels of burnout were reported by the participants. It also made people aware of mental health concerns and helped them to fight the stigma of seeking help during the need.

Our participants observed a few trends. To begin with, a rise in Post-Traumatic StressDisorder (PTSD) can be observed after the pandemic. To their knowledge the second wave was more intense than the first wave which increased anxiety, helplessness and grief among their clients. Dealing with children on an online platform caused difficulty to the participants where participants reported that kids were very uncomfortable and clumsy with the online setting. Our participants used social media platforms to increase mental health awareness after which

they saw more people were willing to address their issues.

Limitations

To commence with, this study is a qualitative approach, the results cannot be statistically represented. We cannot generalize the results to a larger population since the sample size was limited to Mumbai. Further, our male-female participants ratio was not equal. We interviewed 9 female and one male MHP. We didn't record experiences of other MHPs like psychiatrists, clinical social workers, psychiatric social workers and psychiatric nurses. All the interviews were conducted in English and thus it doesn't record experiences ofMHPs speaking other languages.

Future research

Future studies can be conducted by including a more diverse sample. It can also lookat other first respondents like psychiatrists, social workers, nurses among others. A quantitative approach can be used for future studies. To conclude, interviews can be conducted in other vernacular languages to gather experiences from different diversities.

CONCLUSION

The current study aimed at identifying burnout and to understand various coping strategies among MHPs practicing in Mumbai during the COVID-19 pandemic. This study has identified burnout experiences through a qualitative lens, studying each experience closely.

There were certain trends that we observed as an interviewee that most of our participants reported that they had difficulty in setting boundaries with their clients. Although they had strong coping strategies, some managed to alter them in order to deal with increasedworkload and deal with mental fatigue and vicarious trauma.

An important implication of our study derives from our findings is the importance of traditional therapy in reading non-verbal cues of the client. In an online setting, taking a note of these cues became very difficult for MHPs. Second implication stems from the participantssharing extreme ways in which boundaries were violated, there was loss of privacy,

untimely phone calls and adamant clients as it was easier to reach their MHP due to transition to an online setting. Our research can be beneficial for other MHPs, students and other health care workers as all the participants shared their self-care routine and advice, they had to give which can be helpful for our future practice.

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SECTION V - COMMERCE

Chapter 12 - A Research Study to Analyze the New Trends in Advertising and their Impact on the Sale of the Consumer Durables in India with Special Reference to South Mumbai

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ABSTRACT

The research paper presents insights about the latest changes taking place in the field of advertising. The paper discusses the technological adaptation in the advertising industry, it presents details about the new innovative trends in the field of advertising. The research paper also incorporates the comparative study about the changes taking place in the advertising industry in the global arena, wherein illustrations are incorporated so as to present the current scenario of the advertising industry.

INTRODUCTION

Advertising is a form of communication process, a business practice and social force that disseminates commercial or sometimes non-commercial messages to a target audience. It is dated back to the Christian era. One of the first known methods of advertising was outdoor signs, which would be painted on the wall of a building and were usually very eye-catching. Archaeologists have found signs in the ruins of ancient Rome and Pompeii. In the eighteenth century, modern advertising began where Great Britain boasted of the most modern form of advertising. Signs and billboards were a few of them.

Advertising as we know today began during the last quarter of the nineteenth century. Advertising agencies were relatively unknown then and those that existed had ill-defined responsibilities. The mix of products for which they were placing advertisements was quite different

from those on the market at the turn of the century. Quaker Oats itself had not been invented. Thus, the history of advertising in America falls into two eras separated at about this turning point.

Importance

Advertising is important for the customer

Just imagine the television, a newspaper or a radio channel without an advertisement! No one can any day imagine this. Advertising plays a very important role in a customer's life. Customers are the people who buy the product, only after they are made aware of the products available in the market. If the product is not advertised, no customer will come to know what products are available and will not buy the product even if it was for their benefit. One more thing is that advertising helps people find the best products for themselves, their children and their family. When they come to know about the range of products, they are able to compare them before they buy them so that they get what they desire after spending their valuable money. Thus, advertising is important for the customers

Advertising is important for sellers and companies producing the product

Yes, advertising plays a very important role for the producers and the sellers of products, because -

- Advertising helps in increasing sales.

- Advertising helps producers or companies to know their competitors and plan accordingly to meet up the level of competition.

- If any company wants to introduce or launch a new product in the market, advertising will make a ground for the product. Advertising helps in making people aware of the new product so that the consumers come and try it.

- Advertising helps in creating goodwill for the company and gains customer loyalty after reaching a mature age.

- The demand for a product keeps on coming with the help of advertising and demand and supply become a never-ending process.

Advertising is important for society

Advertising helps in educating people. There are also some social issues which advertising deals with like child labour, liquor consumption, girl child killing, smoking, family planning education, etc. Thus, advertising plays a very important role in society.

Objectives of the study

1) To study the present and future trends taking place in the advertising industry.
2) To study the effect of the new trends in advertising on the consumers.
3) To study the effect of new trends in advertising on the sale of products.
4) To study the different reasons and preferences of consumers towards the latest trends in advertising.

Scope of the study

The study will be focusing on the recent trends which are taking place in the world of advertising. Therefore, the scope of the subject is restricted to the above topic. For the purpose of this study sample size will be taken from consumers in South Mumbai.

The study will be limited to students studying in degree colleges in South Mumbai. The study will also include the following factors.

1) Customer behaviour of students in South Mumbai.
2) Preferences and reasons towards counterfeit products.
3) Effects of counterfeit products on the sale of original products.

Research methodology of the study

A proper research methodology should be adopted in order to achieve the set objectives. The wide scope of information needed to be collected was gathered by the questionnaire method.

- Data collection: The data will be collected by using the following sources.
  - o Primary data: As the study is focused only in South Mumbai, primary data will be collected from the consumers within this area.
  - o Secondary data: Secondary data will be collected through newspapers, business magazines, internet sites and relevant books.
- Research instrument: The data collection will be done using structured questionnaires.
- Sampling details: In all, a questionnaire will be administered with consumers in South Mumbai.

PRESENT TRENDS

Present situation of advertising is far different from its history. It is very common and has become an integral part of the selling business. Today, special advertising agencies have come up for this very purpose. These agencies are redefining themselves as communication companies that assist the clients to improve their overall communication effectiveness by offering strategic and practical advice on many forms of communication. This is because advertisements may work in the sense that communication effects are stored in the memory.

Today advertising has come up with all new trends which are certainly out of the box and makes their customers engage more with the product and have loyalty towards the product.

Companies are using different methods to promote their products in their own unique way which has led to new trendsetting at every interval. To start off with the trends, let us look at the most common tools.

Television

It has become an integral part of advertising in this 21st century as every household has its own TV. Flashing advertisements on TV means reaching thousands of potential customers in one go.

E.g., During a World Cup Match hundreds of crores of people are reached if the advertisement flashes in between overs. Also if it is a popular TV show, people are reached quite easily. It targets more public in one go.

Radio

Although it might seem to be an outdated technique, it is very effective in the sense of reaching even the poorest person residing in villages. It also has equal, if not more reach to people as compared to the TV.

E.g., Our very own Prime Minister Shri Narendra Modi uses this medium to communicate his messages to masses via radio (Mann Ki Baat), although TV and media is available.

Advertorials

A book specially published for the purpose of advertising is known as advertorial. Companies wanting to recruit people for jobs or low scale companies give their ads in advertorials.

E.g., Recently a new trend of rickshaws in Mumbai had these 'advertorials' kept in them for the purpose of passengers to read and also earn rickshaw-walas more income.

Newspaper & Books

The cheapest, most affordable and mass connective measure can be none other than the newspaper, attracting the potent customer. Also, publication houses of books have their advertisements on the books since the printing press was invented, and newspapers have also served as a great source of advertisement. Moreover, they require no medium like phones, Internet etc which enhances their connectivity to the public.

E.g., Every morning, a person is loaded with advertisements when he opens the newspaper to read the daily news.

Films & Media

Recently there has been an uproar about promoting products through films. There comes a special trailer or poster of a particular scene of the film where a hero, heroine or even both pose or talk about the product. It gives the product an exclusivity of being used in the film. Also, there are media promos wherein the product is taken to a channel and things are discussed over it.

E.g., Considering films, the actors go out of their way for publicity and promotion of their films. Unique looks of character in films are also carried off in personal life as Amir Khan did for Dhoom 3. Also, actors appear on Reality shows like Comedy Nights with Kapil, DID, etc. for promotion.

Internet

The drastic development of computers and the advent of the Internet in the late 90s of the 20th centuries opened the floodgates for developing new techniques in advertising. There is no denial to the fact that in 2015 and the years to come, Internet has and will provide great help to advertisement companies to reach too public

E.g., Online shopping companies like Amazon, Flipkart, eBay, etc have come up and occupied a major position not just for advertisement or online selling but also for launch of new products.

NEW TRENDS

Digital Advertising

Digital advertising is the new form of advertising. Digital advertising is an umbrella term for the targeted, measurable and interactive marketing of products or services using digital technologies to reach consumers. The key objective is to promote a brand, to advertise a product and to increase the sales. The tools of advertising are as follows:

A. Social Media Advertising

Companies have noticed that social media is becoming very popular, so they have started advertising on social media. Advertising on social media will be very beneficial for companies because it will reach thousands of people as many people browse social media on a daily basis.

E.g., A Company can create a page of product and post on facebook so as to inform people that new product has come

B. Email Marketing

Email Marketing is directly marketing a commercial message to a group of people using email. Here the message is only sent to potential or current customers. It usually involves using email to send ads, create brand awareness or to build loyalty.

E.g., Buzzfeed which uses short and punchy line to advertise a product and to attracts customers to buy that product

C. Mobile Advertising

Advertising through cell phones is one of the smart and customer friendly approaches to reach customers. Companies know that now almost everyone has a mobile phone in their hands so they have started on mobile as well. It includes advertising in the form of Short Message Service, Mobile Games or Multimedia Managing Service.

E.g., In 2012, 'Nike' partnered with messaging app 'We Chat' to try and connect with youth audience at shanghai festival of sports

D. Tele-Advertising

Tele-advertising is the act of advertising goods or services to potential customers over the telephone. It is a form of direct marketing. The Marketer uses telecom and call centers to attract prospects and to sell to existing customers.

E.g., A company that organizes continuing education conferences for dentist could use tele-marketing to contact a large number of dental

practices to raise awareness about an upcoming conference, and encourage dentist to attend

E. Green Marketing

Green Marketing is the marketing of products that are presumed to be environmentally safe. This concept of green marketing came into existence due to growing concern over environmental degradation. Green marketing involves developing products and packages that are environment friendly or less harmful to the environment. Green Marketing includes many areas ranging from conservation of environment to control of pollution.

E.g., Wipro infotech was India's first company to launch environment friendly computer peripheral

F. Social Marketing

Social Marketing seeks to influence social behaviours not to benefit the marketers, but to benefit the target audience and the general society. Social marketing concept focuses only on the welfare of the people. Social marketing does not have commercial angle

E.g., This technique has been used extensively in international health programs such has polio vaccination

G. Viral Advertising

Viral Advertising refers to an advertising strategy that focuses on spreading information and opinions about a product or service from person to person. It encourages individuals to pass on the message about the upcoming products to others. Through this advertising, information spreads like a virus to thousands of people.

E.g., in Hotmail every email by every Hotmail subscriber used to conclude with the tagline "Get your private, free email at http://www.hotmail.com"

Future Scope

Times are changing and so the demand of the companies to market their product in an altogether different way to catch the customers' attraction every time they show their products and create brand loyalty so that even in the long run, the company does not lose their customers to the rival companies.

Sometimes it is association with particular social work like 'P and G' does for 'education in India' or sometimes it's like 'Colgate and Pepsodent' which compares their products to each other and show its advantage to the consumers or like 'Cadbury' which has associated itself to gift for all occasion 'Kuch Meetha Ho Jaye'.

Such tag lines are a must for companies to identify themselves with. Moreover, times are moving towards marketing and packaging over quality. Consumer's trends too are moving towards more luxurious products than just needful commodities. They want commodities which make them feel better along with improving their standard of living. So, here advertising companies have to focus more on giving the product a luxurious feel and a premium sense

India is being seen as the next business hub after China in the coming years. "Made in India" tag itself will sell more products of any company just because of trust of the world on India's quality and manufacturing sector

One more trend which could rule the advertising world is cloud advertisement. Today, cloud storage has been growing and all the companies are taking advantage of it. Providing an advertising medium to other companies to advertise could easily set a storm in the market.

Now-a-days even Railways, Airways and Public transport are utilized for advertisement via speakers, TV in them and even magazines

Conclusion

Future is here, we just cannot predict what is coming next. Maybe a whole new way which is untouched, unseen, undertaken, underutilized;

you just never know. ''All it takes is an 'Uncommon Thinking' from an 'Uncommon Man' of an 'Uncommon Breed' who has 'Uncommon Ways' of looking at very Common Things'.

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