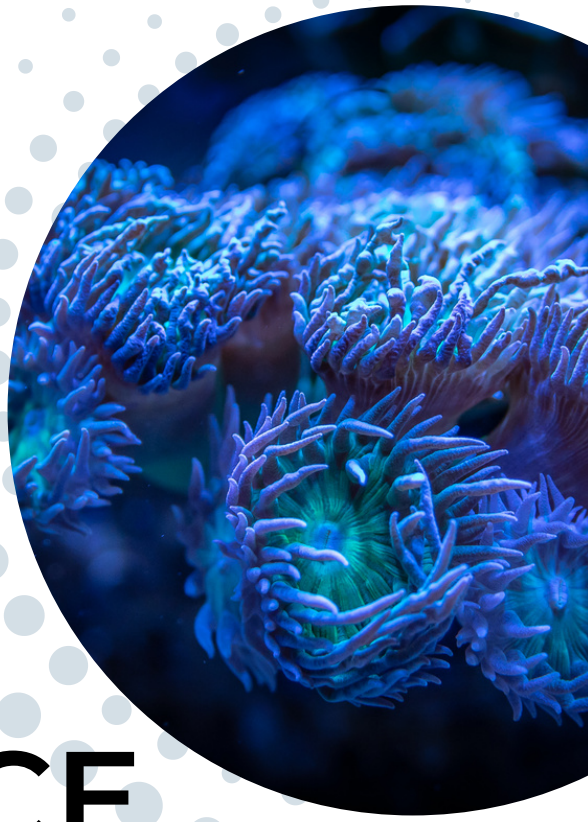

APPLYING LIFE SCIENCE FOR A BETTER TOMORROW

Dr Satinder Kaur Gujral

Dr. Meena Arora

Dr. Gagan Deep Singh

Applying Life Science for a Better Tomorrow

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PREFACE

Life sciences give a solid basis of factual knowledge and new ways to look at the world. From health care to the environment to controversies over regenerative medicine and genetic testing, the life sciences touch every area of our existence. While significant academic improvement has been achieved in the past few decades, there is still a lot that we don't know.

Researchers from numerous disciplines offer their insight into the field of life sciences, making it an interdisciplinary science. Scholars in the life sciences create fresh understanding by integrating the latest study in academic subjects like medicine and biology with new, improved analytical tools from other fields of science and mathematics.

Social science and humanities fields, in contrast to these, are employed to study life sciences from a social point of view. Collaborating between disciplines can lead to innovative and distinctive responses to challenges for which a single technique and one topic discipline alone cannot provide answers.

ACKNOWLEDGEMENT

This edited book on **Applying Life Science for a Better Tomorrow** is an attempt to bring together various researches done in the area of life sciences to a common platform. This Book would have not been possible without the kind contributions of all the Researchers who have contributed their hard work towards this book. We are indebted to all the contributors for trusting us with their hard work. We would like to express my profound gratitude to all our teachers who have been encouraging us to do things differently. We also extend our heartfelt gratitude to Empyreal Publishing House for their wholehearted support throughout the publication process. We are also grateful to my family members who were very patient and supportive during the entire editorial process.

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Table of Contents

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SLEEP QUALITY IN PUBLIC SAFETY POLICE OFFICERS

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ABSTRACT

Introduction: Among the consequences of shift work, there is a direct relationship with poor sleep quality, with the Public Security Police (PSP) agents being a possible target of this problem, as they experience this form of work.

Objectives: Evaluate sleep quality in PSP agents, relating it to shift work.

Materials and Methods: The sample consisted of 1877 Portuguese agents, 165 female and 1712 male. The collection took place in 2020, by answering an online form, which included a sociodemographic questionnaire, the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale to quantify sleep quality.

Results: There was a predominance of poor sleep quality in the groups that work in shifts, with a higher percentage in those that always work in shifts. Good sleep quality prevails more in the group that never takes shifts. There was a higher prevalence of poor sleep quality in the group that reported working mainly in rotating/variable shifts. Taking into account the three periods (day/morning, afternoon and night), there is a higher prevalence of poor sleep quality in the group that refers to working more than one period of the day, with the night shift representing higher percentage of poor sleep quality.

Discussion: The results of this study are consistent with the results of other investigations and are similar to other professionals who work in shifts, highlighting the negative impact shift work has no sleep and, consequently, on these workers health.

Conclusions: For the study sample, shift work proved to be a deteriorating factor in sleep quality, with the rotating shift and the night shift being the ones with the highest prevalence of poor sleep quality.

Keywords: Sleep, Sleep Wake Disorders, Sleepiness, Shift Work, Police.

INTRODUCTION

Sleep is a complexly structured vital process, considered as an unconscious and reversible state defined by well-organized and structured processes. (Antunes et al., 2008; Buysse, 2014).

The alternation between periods of sleep and wakefulness leads to physiological changes such as body temperature, heart rate and hormone production. This cycle is particularly important because it allows the neurological restoration essential for growth, learning, memory maintenance and the proper functioning of the organism (Aló e et al., 2005; Zanuto et al., 2015).

Sleep has three stages: wakefulness, sleep NREM (*Non-Rapid Eye Movements*) which is subdivided into N1 phase, N2 phase and N3 phase, and sleep REM (*Rapid Eye Movements*) (Zanuto et al., 2015). A disorder that affects one of these phases can lead to a decline in sleep quality and, as a consequence, in quality of life, with a higher incidence of metabolic and cardiovascular diseases such as: arterial hypertension, stroke, myocardial infarction, obesity and diabetes mellitus. It can also interfere with the development of simple and daily activities such as driving a vehicle, increasing the risk of road accidents (Akerstedt et al., 2002; Gan et al., 2015; Luyster et al., 2012; Vyas et al., 2012).

To estimate whether sleep quality is affected, we apply the *Pittsburg Sleep Quality Index* (PSQI) which applies scores to evaluated parameters such as sleep duration, sleep latency and the number of awakenings. The overall PSQI value ranges from 0 to 21, in

which higher scores indicate worse sleep quality, and a score greater than 5 is considered poor sleep quality (Del Rio et al., 2017).

The assessment of drowsiness propensity can be made by applying the Sleepiness Scale of *Epworth* (ESE). It consists of a questionnaire that assigns a score taking into account the probability of falling asleep in daily activities, some of them known as "highly sleepy". The score ranges from 0 to 24, with 0 to 6 being considered normal sleep, 7 to 8 being an intermediate value, and 9 to 24 being abnormal sleepiness (Bertolazi et al., 2009; Johns, 1991). In addition to this more subjective method, more complex tests and exams such as the Sleep Latency Test and Polysomnography can be used (Bertolazi et al., 2009).

Human beings are regulated by biological rhythms. The sleep/wake cycle is one of the examples of this synchronization, influenced by endogenous and exogenous factors (Ciampo & Ciampo, 2016). When there is a change in exogenous factors, circadian rhythms are intrinsic and will continue to influence sleep, but their quality is compromised, which may be due to day-to-day changes (shift work), with emphasis on night work and long working hours (Luyster et al., 2012). Drowsiness may be due to limitations in sleep quality, which impairs rapid response to external stimuli, concentration, and the ability to perform activities such as driving (Bertolazi et al., 2009; Canani e Barreto, 2001).

Shift work is a very old practice, dating back to the beginning of social life and has evolved to respond to modern society. For this reason, this form of work organization responds to certain services and now includes night and irregular hours, to ensure full-time availability such as hospitals or security services. This diversity of work schedules is usually divided into two forms. It can be fixed or variable shift. In the fixed shift, the worker has a certain schedule, which can be morning, afternoon or evening, with a constant frequency. In the variable shift, the worker alternates between hours, which can have a slow or fast rotation depending on the organization of the workplace (Simões et al, 2010). Although this way of working has been responding to the needs of society, it conflicts with the natural biological rhythms of the Human Being, interrupting the

circadian rhythm, being considered a subtype of sleep and circadian rhythm disorders (Park & Lee, 2019).

Public Security Police (PSP) agents are responsible for "ensuring democratic legality, guaranteeing internal security and the rights of citizens, under the terms of the Constitution and the Law".(Departamento de Recursos Humanos, 2021). These functions expose this class of professionals to several dangerous and traumatic situations, which condition the development of stress and, in more extreme cases, Burnout Syndrome (Machado, 2011). In addition to these events, they are also exposed to excessive workloads with shift services and night shifts (Fekedulegn et al., 2016; Ma et al., 2019). Taking into account the factors to which this profession is exposed, especially with the change in shift schedules, there is a break in the usual period of rest, which causes changes in the quality of sleep and consequently excessive daytime sleepiness, that is, during the period who should be awake and active (Garbarino et al., 2019).

Some studies carried out on the relationship between shift work and sleep quality in these professionals show that sleep quality is negatively affected due to shift work and especially night shift work. The results of the study of Gerber et al. (2010) n which shift workers have more sleep complaints compared to fixed-time workers. In the article by Bernardo et al. (2018) a percentage of 79.2% of poor sleep quality was obtained and 68.6% belonged to rotating shifts. Fekedulegn et al. (2016) showed an overall prevalence of poor sleep quality of 54%, of which the shift that presented the worst results was the night shift.

The general objective of this study was understand the quality of sleep of Police agents.

MAIN BODY OF THE ARTICLE

Materials And Methods

Observational cross-sectional study with a quantitative approach, in order to obtain a profile of the sample obtained by the non-probabilistic snowball sampling technique.

Of the total number of Police staff in 2021, the population had a total of 20,557 professionals at its service, of which 89.75% are male and 10.25% are female. 1877

questionnaires were collected, of which 165 are female and 1712 are male, aged between 21 and 68 years, with an average of 42.53±9.3 years, fulfilling the inclusion criteria contained in the protocol of data collection.

Study Protocol

The data used for the preparation of this study were collected in Portugal through the dissemination of a link by the population to be studied using Google Forms, between October and December 2020.

The following questionnaires were used and adapted: sociodemographic questionnaire, to collect sociodemographic variables; Pittsburgh Sleep Quality Questionnaire, to score sleep quality; Epworth Sleepiness Scale, to assess the degree of sleepiness. All subjects read and accepted informed consent before accessing the questionnaire.

For sample eligibility, some inclusion criteria were applied: PSP agents had to be active, not have a diagnosis of any sleep disorder and not be under sleep-inducing therapy. In order to guarantee anonymity, each questionnaire received was coded. Body Mass Index (BMI) values were calculated using the formula BMI= Weight (kg) / (Height (m) x Height (m)), PSQI and ESE and then divided by classes. The nominal qualitative variables were studied: sex; marital status; type of shift and time of day and ordinal qualitative variables: educational qualifications; category; seniority of service; time in the current unit and how often you work in shifts. The quantitative variables collected were: age; height; Weight; global PSQI score; ESE.

Statistical analysis

The software used for the statistical treatment of the data was the IBM SPSS Statistics® software from IBM Corp, version 20.

Quantitative data were described with measures of central tendency and dispersion. Qualitative data were described through absolute and/or relative prevalence (N and/or %).

The normality of the distribution of variables was evaluated by the Kolmogorov-Smirnov test, and the non-parametric statistical test of independent samples Chi-square was later used to analyze the relationships between the variables necessary to achieve

the intended objectives. Statistical tests were considered statistically significant for a p-value <0.05.

Ethical issues

The investigation was submitted to an ethics committee that gave a positive opinion to its accomplishment.

The research team declares that it has no conflict of interest and declares to respect all the principles expressed in the Declaration of Helsinki.

RESULTS

The sample made up a total of 1890 individuals, of which 13 were excluded for not responding or responding incoherently to essential questions for the investigation, in the end the sample obtained was 1877 individuals. Of these, there was a predominance of males (91.2%) and the age group between 41 and 50 years (37.8%), with a mean age of 42.53±9.3 years.

Regarding marital status, the majority were married or in a de facto union (74.3%). As for educational qualifications, the main one mentioned was secondary education, with 65.6% of the individuals studied. The body mass index (BMI) presented an average of 26.27±3.1 kg/m^2, with the majority being overweight (53.3%).

At a professional level, there was a prevalence of the post of main agent (48.5%), with a seniority of more than 5 years (86.4%) and more than 5 years in the current unit (58.4%).

In terms of shift work, the majority reported always working in shifts (61.7%), with the rotating/variable shift being the most referenced (72.6%) and in both periods of the day (46.2%).

The ESS presented an average of 8.3± 5.1. After dividing by classes, it appears that 43.7% have normal sleep, 13.4% have intermediate sleepiness and 42.9% have abnormal sleepiness.

The PSQI presented an average of 7.6 and 3.1 of standard deviation. After division by classes, it appears that 26.4% have good sleep quality, 73.6% have poor sleep quality.

Sociodemographic characteristics and sleep quality

Through the statistical analysis, it is verified that the quality of sleep is influenced by age and educational qualifications, not having presented a significant value in the correlation between the variables "Gender", "BMI" and "marital status" with sleep quality (Table 1).

Table 1 - Distribution of sociodemographic variables by sleep quality

Sleep quality						
		good sleep quality		poor sleep quality		
		N	% of the total	N	% of the total	*p-value*
Sex	Feminine	47	2,5%	118	6,3%	0,288
	Male	448	23,9%	1264	67,3%	
Age	21 to 30 years	59	3,1%	191	10,2%	0,023
	31 to 40 years	109	5,8%	369	19,7%	
	41 to 50 years	187	10%	523	27,9%	
	51 to 60 years	139	7,4%	298	15,9%	
	61 to 70 years	1	0,1%	1	0,1%	
BMI	under normal weight	0	0,0%	2	0,1%	0,356
	Normal	174	9,3%	491	26,2%	
	Overweight	265	14,1%	735	39,2%	
	Grade I obesity	54	2,9%	132	7%	
	Grade II obesity	2	0,1%	20	1,1%	
	Grade III obesity	0	0,0%	2	0,1%	
Marital status	Single	81	4,3%	248	13,2%	0,750
	Married/de facto union	377	20,1%	1018	54,2%	
		34	1,8%	106	5,6%	

	Divorced / Separated Widower	3	0,2%	10	0,5%	
Literary qualifications	up to 6th grade	1	0,1%	5	0,3%	0,0001
	up to 9th grade	29	1,5%	100	5,3%	
	Secondary	310	16,5%	921	49,1%	
	professional	33	1,8%	118	6,3%	
	technical course	6	0,3%	10	0,5%	
	baccalaureate	55	2,9%	150	8%	
	Graduation	56	3%	67	3,6%	
	Master's degree	5	0,3%	11	0,6%	
	Other					

Legend: N=number of subjects; %=percentage; BMI= Body Mass Index.

Occupational characteristics and sleep quality

Taking into account the relationship between the job position/graduation and the quality of sleep, a statistically significant relationship was observed with a p-value of 0.0001 between these two variables (Table 2), the same was not true for seniority. service and sleep quality (Table 3) in which there is no statistically significant relationship.

Table 2 – Distribution of the "category" variable by sleep quality.

Sleep quality						
		good sleep quality		poor sleep quality		
		N	% of the total	N	% of the total	*p-value*
Category	Chief	1	0,1%	1	0,1%	0,0001
	Superintendent	6	0,3%	3	0,2%	
	Superintendent	8	0,4%	11	0,6%	
	quartermaster	7	0,4%	6	0,3%	
	superintendent	42	2,2%	39	2,1%	
	commissioner	22	1,2%	24	1,3%	

	Deputy	71	3,8%	201	10,7%	
	Commissioner	21	1,1%	24	1,3%	
	Chief Coordinator	4	0,2%	8	0,4%	
	Main Boss	220	11,7%	691	36,8%	
	Coordinating Agent	93	5%	374	19,9%	
	Main Agent					
	Agent					

Legend: N=number of subjects; %=percentage. The percentage shown refers to the total.

Table 3 - Relationship of "Long-time of service" with the quality of sleep.

Sleep quality						
		Good sleep quality		Poor sleep quality		
		N	% of the total	N	% of the total	*p-value*
Seniority of service	Less than 1 year	20	1,1 %	46	2,5%	
	From 1 to 3 years old	15	0,8%	68	3,6%	
	From 4 to 5 years	22	1,2%	84	4,5%	0,137
	More than 5 years	438	23,3%	1184	63,1%	

Legend: N=number of subjects; %=percentage. The percentage shown refers to the total.

When we analyze Table 4, we observe the existence of a statistical significance between the quality of sleep and the time of the individuals in the unit where they currently are, with a p-value of 0.036.

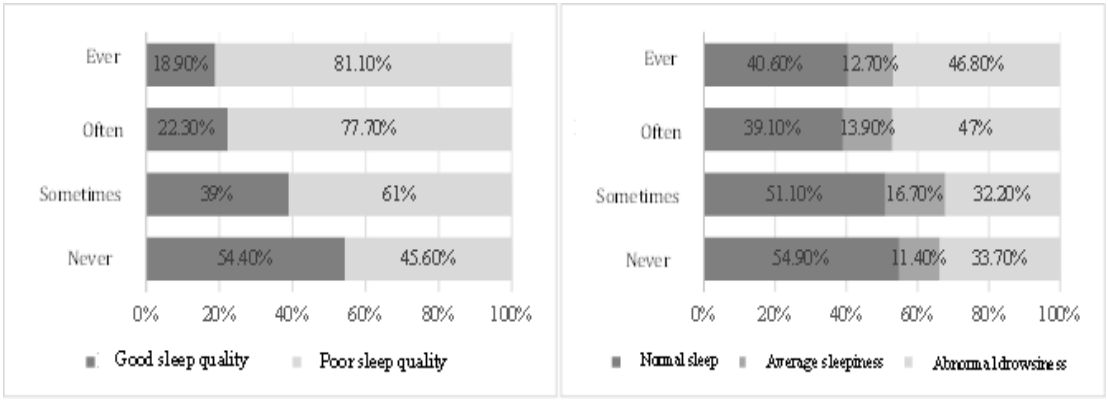
Table 4 - Relation of "Time in the current unit" with the quality of sleep.

Sleep quality						
		Good sleep quality		Poor sleep quality		
		N	% of the total	N	% of the total	*p-value*
Time in current unit	Less than 1 year From 1 to 3 years old From 4 to 5 years More than 5 years	63 108 34 290	3,4% 5,8% 1,8% 15,5%	203 238 135 806	10,8% 12,7% 7,2% 42,9%	0,036

Legend: N=number of subjects; %=percentage. The percentage shown refers to the total.

Shift work and sleep quality

It can be seen that in the groups that work in shifts, there is a predominance of poor sleep quality and daytime sleepiness (Figure 1). It is also clear from the analysis of these graphs that good sleep quality and normal sleep prevail in the group that never performs shifts.



A - Sleep quality B - Daytime sleepiness

Figure 1 – Relationship between sleep quality and daytime sleepiness with shift (p=0,0001).

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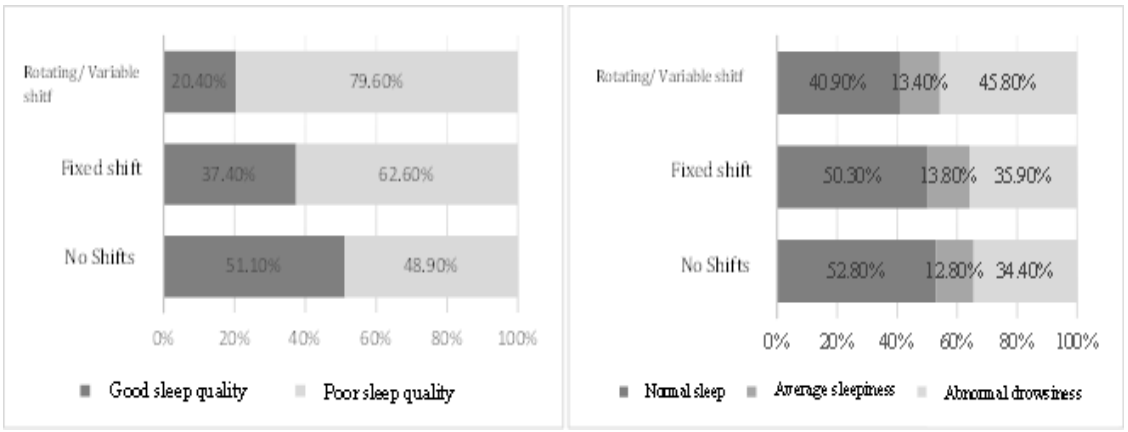
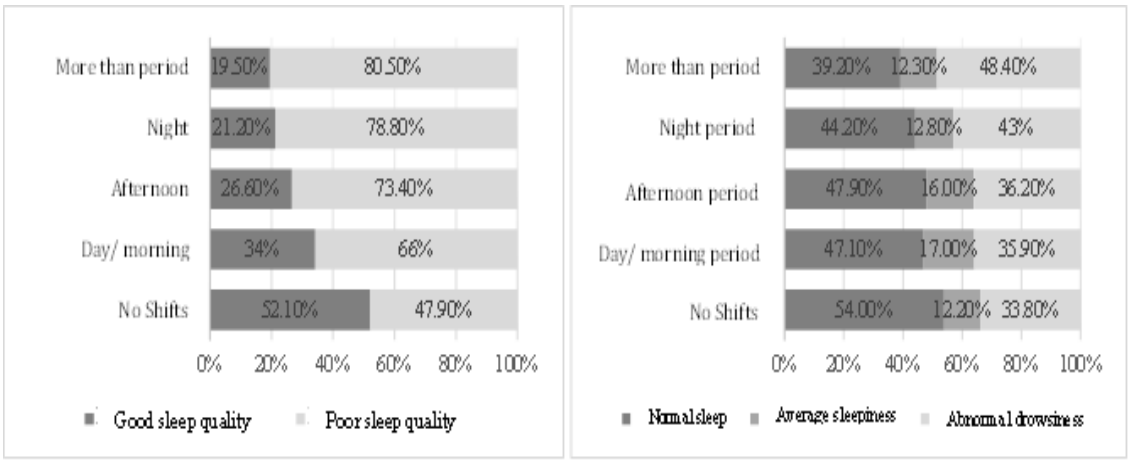
When verifying the sleep behavior with the type of shift, it appears that there is a higher prevalence of poor sleep quality and daytime sleepiness in the group that refers to working mainly in rotating/variable shifts (Figure 2).



A - Sleep quality B - Daytime sleepiness

Figure 2 - Relationship between sleep quality and daytime sleepiness with the type of shift (p=0,0001).

Taking into account the three periods studied (day/morning, afternoon and night), it is observed that there is a higher prevalence of poor sleep quality and daytime sleepiness in the group that refers to working in more than one period of the day, being the shift night, which represents a higher percentage of poor sleep quality and abnormal sleepiness, as can be seen in figure 3.



A - Sleep quality B - Daytime sleepiness

Figure 3 - Relationship between sleep quality and daytime sleepiness with the period in which the shift runs (p=0,0001).

DISCUSSION

Sleep quality can be impaired by factors such as shift work. This linkage may be related to exposure to sunlight or lack thereof and other biological rhythms that disrupt the circadian rhythm (Fekedulegn et al., 2016). Behavioral risk factors have also been associated with poor sleep quality, but in the present study there was no significant relationship between BMI and sleep quality.

Aspects that could affect sleep quality assessed by the global PSQI score were studied in PSP agents at national level. As expected, a higher percentage of males than females was obtained. In a longitudinal study of officers enrolled in the program "*Buffalo Cardio-Metabolic Occupational Police Stress*", it was observed that the majority of the sample was male (72%), were married and were overweight or obese (81%), which is in line with the results found in the sample studied. In the aforementioned investigation, it was also observed that 49.6% worked predominantly in the day shift, 28% in the afternoon shift and 22% in the night shift, and that the prevalence of poor sleep quality was 53.9%, with 43 .9% in the day shift, 59.8% in the afternoon shift and 69.1% in the night shift, showing a significant relationship between the period in which the shift takes place and poor sleep quality (Fekedulegn et al., 2016).

The results achieved in PSP individuals corroborate these data, noting that the prevalence of poor sleep quality was 73.6%, with a predominance in groups that perform shift work (always, frequently or sometimes), assuming a percentage still highest, 81.10%, in individuals who always work shifts. It was also noticed that in the group that refers to rotating/variable shift work there is a higher prevalence of poor quality of 79.60%, while in the fixed shift it was relatively lower with a percentage of 62.60%, which was also related to the results of the study by Gerber et al, 2010, carried out on 460 elements of a police force in Switzerland, which concluded that shift work always contributes to a decrease in sleep quality.

Taking into account the period in which the shift normally takes place, a prevalence of poor sleep quality was observed, of 80.50% in the group that reported working mainly in more than one shift period. Analyzing the quality of sleep by shift, we observed that the highest percentage of poor sleep quality was obtained by those who work the night

shift with 78.80%, followed by those in the afternoon (73.40%) and finally of those who work during the day/morning period (66%).

In the study "*Influence of Work Characteristics on the Association Between Police Stress and Sleep Quality*" from Ma et al., 2019, 356 police officers participated and an average PSQI score of 6.5 ± 3.4 was obtained. Although it was a lower value than that found in PSP agents (7.6 ± 3.1), it still represents poor sleep quality with PSQI>5. The same was found in the investigation carried out by He et al, 2019, in 177 individuals from the prison police, where it was noticed that the quality of sleep is worse in this class of police security professionals with an overall PSQI score of 7.47 ± 3.80 compared to normal adults and is affected by sex, age, job classification and other factors.

In the battalion of the Military Police of Teresina, Piauí in Brazil, a study was carried out with some results identical to those found. Although in this study the smaller sample was smaller (n=32), the mean age was 44.34±5.63 years, most participants were married (71.87%), the mean weight was 81.87± 14.03 kg, height 1.69±0.06 m and BMI 28.43±3.82 kg/m2, with most participants being overweight (46.87%) and class I obesity (31 .25%). Of the participants, 71.87% reported poor sleep quality, 18.75% were classified as having a sleep disorder and only 9.37% with good sleep quality. The mean of the global PSQI score, as in the previously mentioned studies, presented values of poor sleep quality (8,06 ± 3,60) (Santos Chaves & Shimizu, 2018). All these results obtained by this investigation in Brazil are in agreement with the results found in the studied sample.

The study "Physical activity and sleep quality in military police" showed high percentages of poor sleep quality and a lower percentage of abnormal daytime sleepiness. In this study, 438 participants were analyzed and the PSQI, ESE questionnaires and a form with sociodemographic and occupational information were used. The percentage of poor sleep quality was 79.2%, of which 89.6% are male, 95.1% are private, 68.6% work rotating shifts and 61.7% had normal daytime sleepiness (Bernardo et al., 2018). It is thus possible to verify that from the relationship of the

results found in the bibliographic review and the results found in the PSP agents, they are in agreement, corroborating the reported data.

The data obtained for the profession studied are similar to those of other professionals who also work in shifts, such as nurses and industrial workers (Valdeni Manoel Bernardo et al., 2015). According to the results of the study by Zencirci and Arslan, 2011, 79.1% of nurses had poor sleep quality with an average overall PSQI score of 7.32 ± 3.42). In the article by Simões et al, the results showed that, also in industrial workers, the quality of sleep was unsatisfactory, in this case in 50% of the participants, having obtained an average global PSQI score of 5.7 (Simões et al., 2010).

Poor sleep quality has been associated with negative physical, mental and emotional impacts, which can harm the social, family, academic, professional and economic environment. In the short term it mainly affects day-to-day performance, causing fatigue and excessive daytime sleepiness, impairing concentration, reaction time, memory and mood. In the long term, it has been linked to the development of diseases such as obesity, type II diabetes mellitus, cardiovascular disease, high blood pressure, depression, anxiety, asthma and arthritis (Raposo, 2016).

The use of the PSQI questionnaire and the sample size contribute as an extremely strong point to the results of this investigation in the assessment of sleep quality, however it would be interesting to understand the urban/rural context of the individuals studied in order to understand whether this sociodemographic variable has an impact in the quality of sleep, which is a limitation of the study.

This study contributes to the knowledge about the prevalence of poor sleep quality in the class of professionals of the public security police in Portugal and aims to encourage the implementation of more interventions in the field of sleep hygiene, with the aim of improving not only the quality of sleep of these professionals, but also in the long term, their quality of life.

Effectively, despite verifying that there are many factors that contribute to the poor quality of sleep, both in this work and in all the bibliography used, it appears that some are decisive and that must be mitigated, in order to restore a holistic quality of life. people.

CONCLUSION

Shift work proved to be a deteriorating factor in sleep quality, with the rotating shift and the night period being the ones with the highest prevalence of poor sleep quality..

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OBESITY IN CHILDHOOD AND ADOLESCENCE

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ABSTRACT

Introduction: Nowadays, obesity is considered a global pandemic since in 2014 it reached 1,9 billion people. This problem has been more present in younger populations, being mainly influenced by their eating habits and sedentary lifestyle. The objective of this study is to determine the prevalence of overweight and obesity in children and adolescents, relating it to their risk factors.

Materials and Methods: A total of 327 students aged between 9 and 19 years old (133 were male and 194 were female) participated in this study. They completed a questionnaire and the lipid profile was evaluated.

Results: Most of the students had a normal body mass index. 59 students were overweight (mostly female), 16 were obese and 7 had a lower weight than expected. In the group of overweight and obese students, 43,1% and 50%, respectively, had reduced HDL values and a higher level of triglycerides was observed in 60,3% of overweight students and 56,2% of obese students.

Conclusion: There is a relevant prevalence of overweight and obese individuals in this population. It is confirmed that the role of some risk factors such as physical inactivity and eating habits is really important in the development of this problem.

Keywords: Obesity (D009765); Childhood (D002648); Adolescents (D000293); Sendentarism (D057185); Eating Habits (D005247)

INTRODUCTION

Obesity is included in a crucial group of factors that lead to the development of several cardiovascular pathologies, which is one of the main causes of mortality worldwide. This public health problem has been progressively affecting children and adolescents and its prevalence has been increasing at an alarming rate (1). Obesity and overweight are mainly caused by the existing disproportion between food intake and energy spending and this difference may have genetic, metabolic, environmental, behavioral, social, cultural origins, among others (2,3). Excess of weight is one of the problems that start in childhood and continue to develop and worsen in adulthood, which can later result in diseases such as diabetes mellitus and other cardiovascular pathologies (4,5).

Increased body mass index (BMI) (6, 7-9), poor eating habits (10,11), abnormalities in the lipid profile and lack of regular physical exercise (9) are risk factors and major predictors of the development of arterial hypertension and other cardiovascular diseases. Regarding dietary habits, excessive consumption of red and processed meats is associated with high fat intake, leading to the development of overweight or obesity (12,13).

Globally, about 80% of adolescents do not exercise regularly enough (14,15). This problem affects several countries, regions and is present regardless of the sex (15). Some studies confirm that physical activity decreases as children and adolescents grow and, thus, the sedentary lifestyle associated with obesity is also increasing more and more among young adults (16,17). Currently, the probability of a sedentary young person becoming and inactive adult is increasing and since this inactivity is associated with several cardiovascular pathologies, it is essential to find strategies and programs to counter this trend (15). Nowadays, the sedentary habits of young people include using cellphones and game consoles, watching television, using the computer and studying or reading while sitting. These practices may be associated with reduced sleep time, an unfavorable body adiposity index and lower physical capacity and resistance (15,17).

Some lifestyle modifications that prevent the development of cardiovascular diseases are weight reduction if the individual is overweight or obese, practicing physical activity regularly, adopting a healthy and balanced diet and the intervention of the

individual's own family (10). The development and evolution of these factors are progressively more present in the younger population, making its early detection and treatment more and more relevant (9).

Main body of paper

All participants or their guardians signed the informed consent and they filled in a questionnaire with questions about the practice of physical exercise and eating habits. The lipid profile was evaluated and information on age, weight and height was collected. Subjects were classified according to percentile tables for sex and age. According to the Directorate-General for Health, an individual is considered to be obese if the BMI is greater than or equal to P95; who is overweight, if the BMI is between P95 (inclusive) and P85 and who has an adequate weight, if the BMI is below P85 (18) as shown in Table 1.

Table 1. BMI classification according to percentiles, according to the Directorate-General for Health.

Classification	BMI
Obese	>= P95
Overweight	Between P95 e P85
Normal	<P85

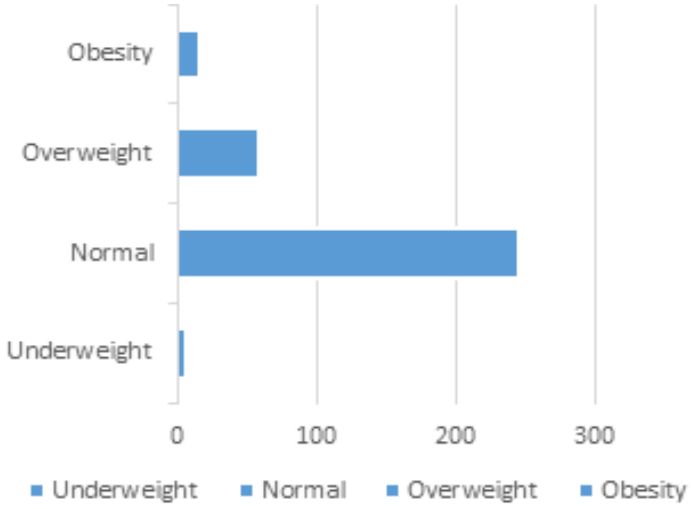
Legend: P - Percentile

First, the variables obtained through the questionnaire, the anthropometric data of each individual and the assessment of the lipid profile, were coded using the IBM SPSS program (Statistical Package for the Social Sciences) version 22. After data collection and after coding the variables, a quantitative and qualitative descriptive analysis was carried out in order to test the hypotheses between the variables under study, through some strategies such as non-parametric tests, the calculation of averages, minimum and maximum values and absolute data. Finally, the confidence interval of 95% was established and $p \leq 0.05$ was used as a criterion for statistical significance. In order to test the distribution of the sample, the Kolmogorov-Smirnov test was used. Cross-reference tables and the Chi-Square test were used to carry out and study the crossing of different variables. When carrying out this research on human beings, it was essential that the

entire research team respected, guaranteed and complied with all the principles mentioned in the Declaration of Helsinki. All student data was encoded using number codes, ensuring full confidentiality and identity protection for all participating individuals.

The individuals who participated in this study were aged between 9 and 19 years and the age group from 15 to 16 years was the most frequent. In the analysis of the distribution of individuals by sex, it was noticed that 40.7% (n=133) of the participants were male and 59.3% were female (n=194).

The average weight of this population is 54.69 kilograms (kg), with a minimum of 23 kg and a maximum of 107 kg. About height, the average was 1.60 meters (m), with a minimum of 1.30 m and a maximum of 1.89 m. Regarding the body mass index, it was found that 74.9% of the students (n=245) had a normal BMI, 18% of the students (n=59) were overweight, mostly female, 4.9% were obese (n=16) and the percentage of obese is the same in both sexes (2.4%) and 2.1% of students (n=7) had a lower weight than expected (Graph 1).



Graph 1. Graph of the Distribution of Individuals by Body Mass Index.

High levels of total cholesterol were present in 3.4% of overweight students and the remaining percentage was found in students with normal or underweight BMI. In the group of overweight and obese students, 43.1% and 50%, respectively, had reduced HDL values. Individuals who had high LDL values had a BMI within the normal range.

It was also observed that increased triglycerides were present in 60.3% of overweight students and in 56.2% of obese students.

In the analysis of the overweight group, 62.7% (n=37) almost always eat meat in their meals compared to only 1.7% (n=1) who almost never eat meat. Only students who eat meat sometimes or almost always suffer from obesity. All students who adopt a vegetarian diet had a normal BMI. However, after using the Chi-Square test, it was found that there is no statistically significant relationship between meat intake and BMI (p=0.883).

The relationship between physical exercise and BMI is not statistically significant (p=0.937), but it was observed that students who practiced more hours of physical activity per week outside the school context had a lower percentage of overweight and obesity.

In a study carried out in Portugal with a sample of children and adolescents, a percentage of overweight individuals (28.3%) was higher than the percentage found in this study (18%), like the percentage of obese young people. (9). In contrast, Fan et al observed a percentage of 6% of overweight individuals and 1.9% of obese individuals (6). Zhang et al found that the highest percentage of obese students was observed in males, which differs from the results found in the studied sample, in which it is observed that there is the same percentage of obese students in both sexes (19). On the other hand, Muhihi et al (20), when studying the body mass index, noticed that it was more prevalent in females, as observed by Mohan et al (21), corroborating the data observed in the group of overweight students in the present study.

Since the region where this study was carried out is an underdeveloped region in terms of initiatives such as programs that encourage the practice of physical exercise and/or the realization of public and free screenings, it is clear that this is a less informed and interested population in this type of activities, reducing the chances of stabilizing the sedentary lifestyle and the rapid diagnosis of various pathologies. The limited amount of spaces dedicated to the practice of physical exercise and sports associations can influence the rate of sedentary lifestyle in this population and, consequently, the

prevalence of overweight or obese young people. The presence of fast-food restaurants can influence the type of food that students eat outside.

Ensenyat et al, confirmed that there are no differences between the sexes, regarding physical inactivity (36), however, in this study it was found that females present higher percentages on the practice of physical exercise only in the school context.

In the study by Chaput et al, it is recommended that children between 4 and 17 years of age practice physical activity for at least 60 minutes a day (15). Several evidences were found that the benefits in terms of cardiovascular health increase, as the time and intensity of physical exercise also increase (15). These benefits resulting from the regular practice of physical exercise affect factors such as adiposity, lipid profile, blood pressure, physical level, cognition, quality of life and cardiovascular events (15,17).

Adolescence is a critical period in the development of each individual and is marked by decisive changes at a psychological and biological level. This phase of instability and increased responsibilities allows individuals to start making their own decisions regarding their habits and lifestyle, including physical exercise and eating habits. For this reason, acquiring more independence, in a transition phase, can lead to the adoption of habits that do not favor cardiovascular health and well-being, such as the excessive consumption of processed foods and practicing less physical exercise.

The relationship between obesity and insulin resistance is known, it is known that insulin resistance triggers hepatic steatosis and inflammation, characterized by an increase of lipids in the liver and a greater synthesis of triglycerides. Adipose tissue is a key component in the development of dyslipidemia, characterized by this increase in triglycerides and a consequent decrease in HDL concentration. Thus, obese or overweight young people have a higher risk of developing cardiovascular pathologies earlier than individuals with a BMI within the normal range (32,44).

Ensenyat et al, found that most of the children's physical inactivity time was spent with their parents (outside the school context and during weekends) (17). For this reason, it is essential to suggest that the family should include certain changes in lifestyle, since the family environment can be the main modeler of the child's behaviors. By contradicting these routines and investing in the regular practice of physical exercise, young people

are strengthening the cardiorespiratory system, stimulating the proper functioning of bones and muscles and improving cardiometabolic health (17). In addition to these benefits, physical activity reduces depressive symptoms, improves cognitive function and mental health, and is associated with improved school performance (14).

CONCLUSION

There is a high prevalence of overweight and obesity in this population. It is confirmed that the role of some risk factors such as physical inactivity and eating habits (specifically meat intake) is very relevant in the development of overweight in young individuals. Some changes in the lifestyle of children and adolescents can prevent the development of overweight and obesity, protecting their cardiovascular health.

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FACE MASK DETECTION USING SEMATIC SEGMENTATION

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ABSTRACT

Due to COVID-19, there are currently no effective face mask detection applications that can meet the significant demand for ensuring safety in transit systems, densely populated places, residential neighbourhoods, large-scale manufacturing, and other businesses. In this new era where we are experiencing a pandemic and people all around are advised to wear masks, some people are not used to it and are avoiding to wear masks. The task here is to predict people wearing masks or not wearing them, given an image or a video. Here, we are proposing a system deals with the technique of an object detection and classification problem with two different classes (Mask and Without Mask). In our approach we try to build a model which takes image or video as inputand find whether the person in it has a mask. This approach helps us to find the person who isn't wearing mask and helps us to avoid the cause of COVID-19. If the person has no mask on his face then he will be shown in red bounding box. Thus finding the person with and without masks becomes easier and it can be done without man power by using face mask detection, can be used in many densely populated areas.

Keywords: Covid-19, Face mask, Corona Virus, Image processing, Video Processing

1. INTRODUCTION

In the present scenario due to COVID-19, wearing mask is one of the mandatory precautions we have to follow to keep ourselves away from the pandemic situation.

Even though wearing masks became mandatory few people are not wearing masks in public places and this may lead the people to get affected by COVID-19 virus. There is a need of AI device that detect the face mask on the person face and thus it helps us in maintaining a good and COVID-19 free environment. There is no efficient face mask detection applications which are now in high demand for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety.

Some individuals are avoiding wearing masks in this new age when we are having a pandemic and it is encouraged for everyone to do so. Given a photograph or a video, one must guess whether or not people are wearing masks. It is an issue with item detection and categorization that involves two classes (Mask and Without Mask).we try to build a model which takes image or video as input and find whether the person in it has a mask.

Face mask detection system can be used in many ways as follows. It can be used in hospitals monitor if their staff is wearing masks during their shift ornot. This model can be applied to the camera in densely populated areas, residential districts, large-scale industries to scan the people face to ensure whether they have a mask on their face. In our approach we try to build a model which takes image or video as input and find whether the person in it has a mask. If the person has no mask on his face then he will be shown in red bounding box .Thus finding the person with and without masks becomes easier and it can be done without man power by using face mask detection. The main objective of our proposed system is to build a model which implements artificial intelligence to detect the mask on a person face in densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety and to avoid the spread of COVID-19 which we are facing now a days.

2. LITERATURE SURVEY

Gayatri Deore , Ramakrishna Bodhula , Dr. Vishwas Udpikar , Prof. Vidya More Said in the paper Titled Study of Masked Face Detection Approach in Video Analytics By traditional video surveillance methods, a security person will have a duty of staring at hundreds of screens. It is a challenging job for a person to monitor everything

effectivelyeven between only two screens. In the paper Facial Mask Detection using Semantic Segmentation, the authors Toshanlal Meenpal,Ashutosh Balakrishnan ,Amit Verma said Face detection has emerged as a very interesting problem in image processing and computer vision. It has a range of applications from facial motion capture to face recognition which atthe start needs the face to be detected with a very good accuracy. Face detection is more relevant today because it not only used on images but also in video applications like real time surveillance and face detection in videos. In the paper titled A Deep Learning Based Assistive System to Classify COVID-19 Face Mask for Human Safety , written by Md. Rafiuzzaman Bhuiyan , Sharun Akter Khushbu , Md. Sanzidul Islam said about Global pandemic COVID-19 circumstances emerged in an epidemic of dangerous disease inall over the world. The situation now has been under attack and also growing badly in all over the countries proclaimed by the WHO . According to this epidemic beyond 114 countries being affected by this flu-like indications in the body regarding 6.4 days(2-14days).

3 .METHODOLOGY

3.1 System Architecture

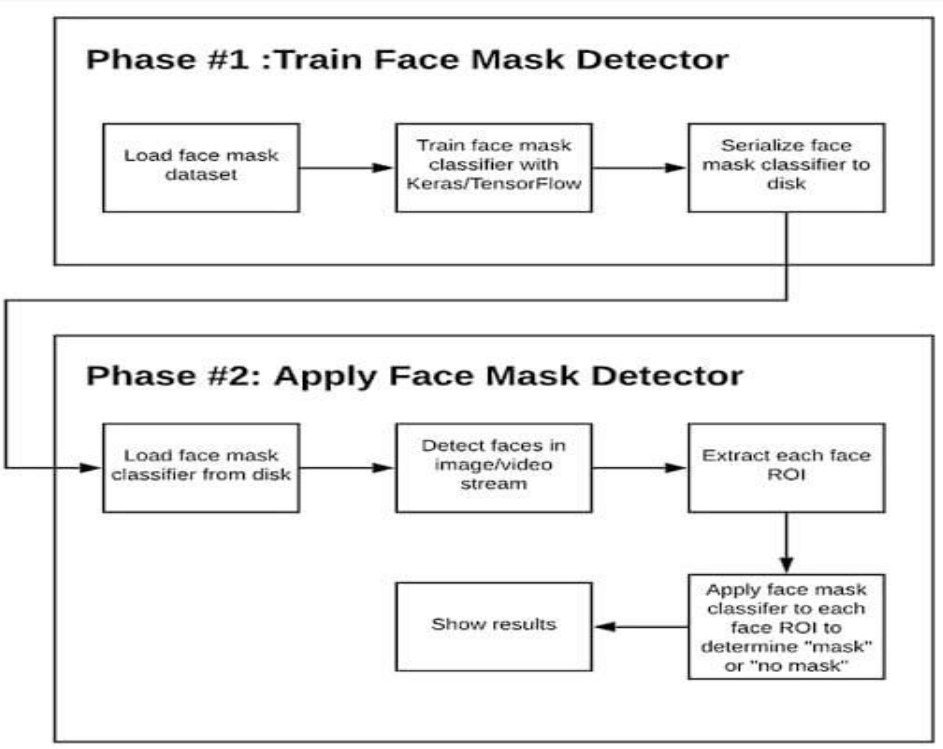

Fig: Flow chart of system

3.2 METHODOLOGY AND TECHNIQUES

This dataset consists of 3835 images belonging to twoclasses:

1) with mask: 1916 images

2) Without mask: 1919 images

The images used were real images of faces wearing masks. The images were collectedfromthe following sources:

1) Kaggle datasets

2) Real-World Mask Face Dataset

There are two modules for face mask detection

1) Training face mask detector.

2) Apply the model on input stream and detect face mask

Our proposed system has two modules - Train mask detector and Detect mask videoThe below are the steps followed in our proposed system

1. Data Preprocessing2.Training models

3. Deploy the model in live webcam

3.3 DATA PREPROCESSING

Tasks to be done in data preprocessing

- Convert all the images present in Dataset (with_mask , without_mask) into arrays (nparrays) , so that with these arrays we can create a deep learning model.
- Create two empty lists - To append the image arrays and to append the catergory to whichthe corresponding image belongs to.
- Split the data into training and testing data (testing - 20% , training - 80%)

3.4 Training Models

For training we re going to follow the Convolutional Neural Network - MobilenetsTasks to be done in training

- Initialize the initial learning rate ,epochs

- Two types of models are generated by using Mobilenet-CNN (output of one model is theinput for other model) .
- Construct the training image generator for data augmentation
- Create the base model by using Mobilenet v2 - CNN , the pretrained models and theirweights from the caffee framework .
- Construct the head of the model that will be placed on the top of the base model - tasks likePooling ,flattening the layers are done here).
- Place the head model on the top of the base model - This will become the actual model wewill train.
- Freeze all the layers in base model so that they will not be updated in the first trainingprocess .
- Make predictions on the test set - for each image in the testing set we need to find the indexof the label with corresponding largest predicted probability .
- Serialize the model to the disk - saved as mask_detector.model in h5 format.
- Plot the training loss and accuracy.

3.5 Deploy model in live webcam

- The prepared model will be saved as mask_detector.model and this model is to be appliedon live webcam for testing
- The trained model has to be tested in the camera for the further use
- We have developed a model for mask detection .
- Now by using the face detector (FaceNet & LBPH) , mask detector (MaskNet)
- Grab the frame from the video stream and resize them to some width (400 pixels i used).
- Detect the faces in the frame and determine if they are wearing mask or not.
- Determine the class label from the label list we have created and we'll use to draw thebounding box and text.

3.2.1 Framework

Keras/Tensorflow : Load the RMFD(Real-world Mask Face Dataset) which contains around 4000 images with both with_mask and without_mask.Train the dataset and classify it by using keras/ Tensorflow , caffee framework and classifying techniques.Serialize and store the trained model in a disk or a folder which we will use further in detection of faces with_masks and without_masks.

3.2.2 Algorithms

LBPH(Linear Binary Pattern Histograms)

LBPH is used to detect faces from the input stream and to find the region of interest which we use further to detect the mask. This algorithm divides the input stream into frames and detects the faces from it and then finds the region of interest (nose and mouth) in our case.

CNN(Convolutional Neural Network)

After detecting the faces and extracting of region of interest(ROI) apply the trained model on this faces with ROI. Now the applying of trained model on the input stream and detection of face mask is done using "Multi-Task Cascaded Convolutional Neural Network".

Multi-task Cascaded Convolutional Networks (MTCNN)

It is a framework developed as a solution for both face detection and face alignment. The process consists of three stages of convolutional networks that are able to recognize faces andlandmark location such as eyes, nose, and mouth.

The three tasks of MTCNN are

1) Face classification
2) Bounding box regression
3) Bounding box regression

MOBILENETV

Convolutional neural networks, such as MobileNet, are specialised for use in embedded and mobile vision applications. They are built using depth-wise separable convolutions,

which are lightweight deep neural networks that can have minimal latency for embedded and mobile devices.

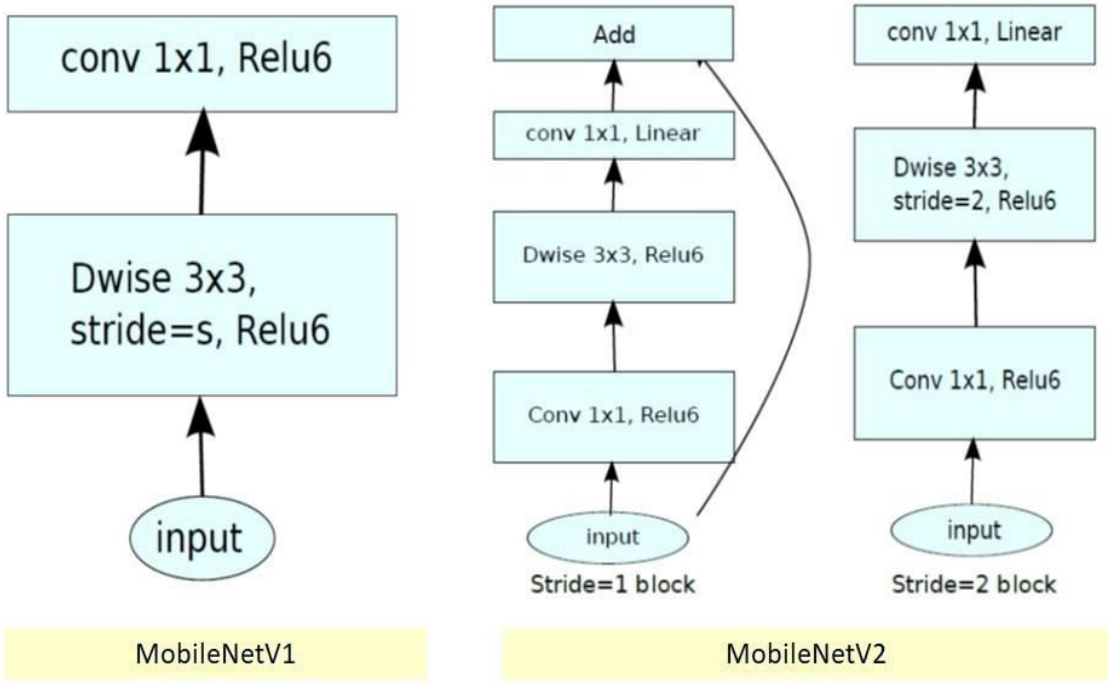

Fig: MobileNetV1 and MobileNetV2

Data Augmentation and Preprocessing - Our dataset is taken as input and fine-tuning is done with MobileNetV2 DNN architecture upon it to create our mask-detector-model.model. A training history evaluation.png containing accuracy/loss curves is also produced for better visualization of Model Evaluation through a plot.

Some important processes which we performed here:

a. Data augmentation

b. Loading the MobilNetV2 classifier (we will fine-tune this model with pre-trained ImageNetweights)

c. Building a new fully-connected (FC) head

d. Preprocessing

e. Loading image data

4 IMPLEMENTATION

In order to run our project there are few requirements to be downloaded and installed inrespective platforms .This project is run on Python 3.7.6 - IDLE , Command Prompt , Pycharm and in VisualStudio.

Below is the list of libraries and packages with the versions to be installed :

- tensorflow>=2.5.0*
- keras==2.4.3
- imutils==0.5.4
- numpy==1.19.5
- opencv-python==4.5.1.*
- matplotlib==3.4.1
- argparse==1.4.0
- scipy==1.6.2
- scikit-learn==0.24.1
- pillow==8.2.0
- streamlit==0.79.0

All the above mentioned libraries are in a text document named “requirements” which makesus to install them in a quick way.

Steps To Be Followed to Run the Project

- Open command prompt , set the project path and open it “cd Project path”
- Now we have to install the required libraries and packages
- Pip install package name or library name is the command used to install packages andlibraries
- All the required libraries are stored in requirements text document, so, we need to installthat requirements file - “pip install -r requirements.txt “.
- After installing the required libraries we have to train the model by executing the

training code - "python train_mask_detector.py".

- This training takes 14-15 min to make a model and to save the model.
- Run the detect_mask_video.py file for executing the project and to see the final results.
- This project detects whether a person is wearing mask or not by using few AI algorithms
- This detects a person with mask, without mask and also a person wearing a maskpartially.

5 RESULTS

Result of the proposed system is a live webcam which detects the face of the person and then detects if there is a mask present or not

There are three cases to be detected

- Face without a mask
- Face with a mask
- Face with a partial mask (mask covering only mouth)

Fig: Execution of detect mask video.py file

- This training takes 14-15 min to make a model and to save the model.
- Run the detect_mask_video.py file for executing the project and to see the finalresults.

- This project detects whether a person is wearing mask or not by using few AI algorithms
- This detects a person with mask , without mask and also a person wearing a maskpartially.

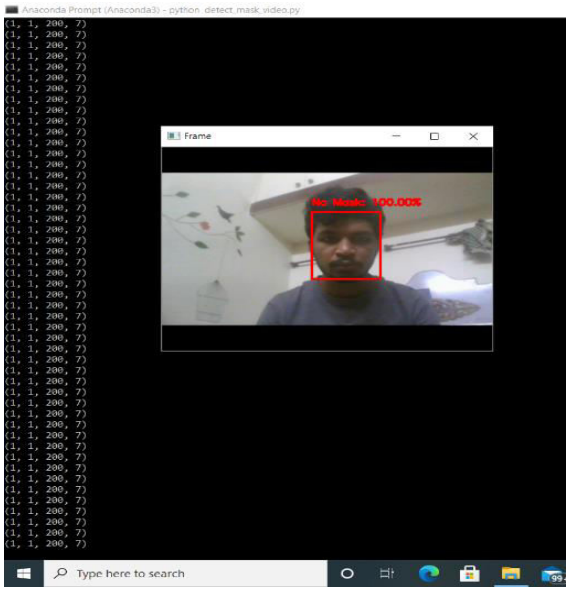

Fig: Face detected without a mask

This is the output when a person without mask is spotted in the live webcam - with a red bounding boxand the accuracy of No-mask -100.00%

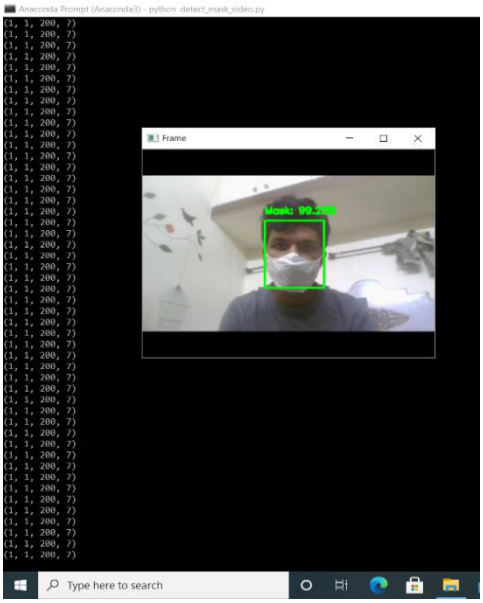

Fig : Face detected with a mask

This is the output when a person with mask is spotted in the live webcam - with a green bounding boxand the accuracy of mask prescence – 99.25%

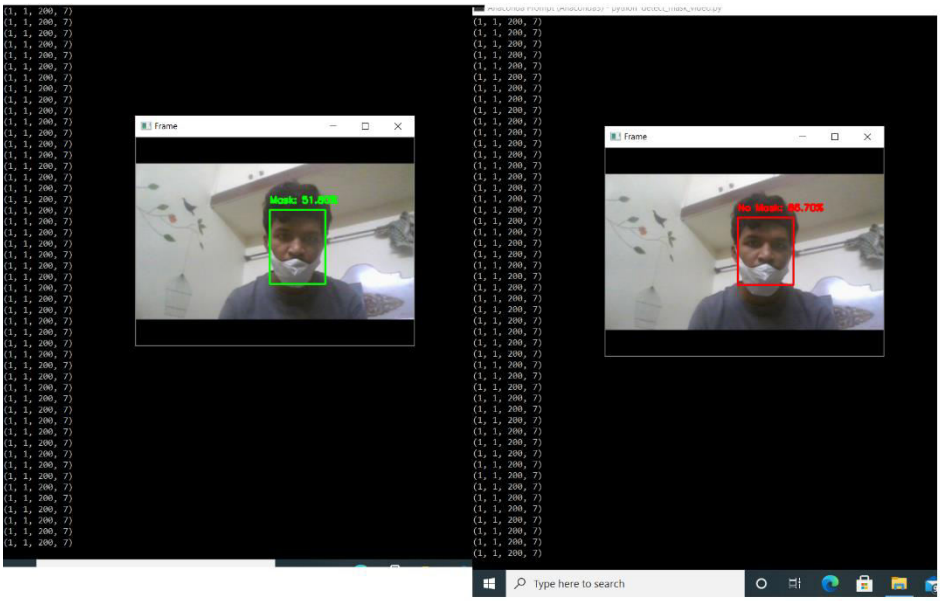

Fig: Face detected with a partial mask

This is the output when a person with a partial mask is spotted in the live webcam - with a red bounding box and No-mask- 86.70% (No-mask accuracy will be high or Mask prescence accuracy will be less than 70%.

6. CONCLUSION

Our proposed model and system similar to face mask detection are in need now a days to face the pandemic COVID-19 and to avoid the use of man power which leads us to ensure safety from COVID-19 virus. Our proposed model can be further developed by inducing face recognition to recognize the person face, to intimate the person to wear mask. It can be used in densely populated areas such as railway stations markets and large scale public places. Due to the COVID-19 outbreak, face mask detection systems can be employed in real-time applications that demand face mask detection for security reasons.

The accuracy to which detection system works depends on the training and the methods usedto detect the face mask. Hence, it can be further developed with different types of training models and methods

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AN ASSESSMENT OF MILLET-BASED PRODUCTION SYSTEM AND ITS AGROECOLOGY IN ODISHA: ISSUES, CHALLENGES AND POLICY RECOMMENDATIONS

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ABSTRACT

Millets are considered as climate-resilient and nutri-cereals for food, income and nutrition security in rainfed regions across the globe. Food and Agriculture Organization (FAO) of the United Nations (UN) declares 2023 as International Year of Millets to create awareness on the health benefits of millets as well as enhance its production under tough condition of wider variability of climate change. However, millets are cultivated across 131 countries, being traditional food for more than 60 crore people in Asia and Africa. India is the largest producers of millets, and it is 80% of Asia's millet production and 20% of the global production. Millets are mainly rich in iron, calcium, and magnesium and nutritious than wheat and rice due to the presence of high protein, fiber, vitamins, and minerals. This paper critically analyse various key components of millet-based production system and its agroecology- conservation, cultivation, consumption and commercialization of millets along with policy recommendations based on the contextual interventions and its impact. The paper reveals about the various useful information from various programme and action research projects implemented across the country including millet missions through using various statistical tools. Moreover, agricultural impact assessment methods are used for collecting and validating data from the primary and secondary sources, community-based organizations, and agriculture departments. It also focuses on various tangible and intangible impact of interventions to safeguard millet-based production, consumption, processing and marketing for enhancing food, income and nutrition security. The study identifies various grassroots policy recommendations to

strengthen interventions like Millet Mission through community-based organizations in the context of climate change and livelihood interventions. The study finds that the production of millets can be enhanced through enabling tribal communities to adopt sustainable agriculture practices, avail timely technical and inputs support from government and civil society organizations of the locality. However, all the recommendations are applicable for the promotion of millets across the world through contextual modifications based on the agroclimatic conditions.

Keywords: agroecology, millet mission, community-based organization, climate change

INTRODUCTION

Rainfed agriculture covers about 82 percent of the world's total agricultural land. Moreover, rain-fed areas continue to produce about 70% of the world's staple food and will do so in the future. The value of rainfed agriculture can be seen in the fact that rainfed areas grow 55 percent of rice, 91 percent coarse grains, 90 percent pulses, 85 percent oilseeds, and 65 percent cotton (Sharma K. D., 2011). In rainfed areas, coarse grains like millets are mainly grown in India. The millets like finger millet (*Eleusine coracana)*, foxtail millet (*Setaria italica)*, barnyard millet (*Echinochloa frumantacea),* little millet (*Panicum sumatrense)*, pearl millet (*Pennisetum glaucum*) and proso millet *(Panicum miliaceum L.*) are found in most of the southern and central states in India especially wherever annual rainfall is below 350 mm, perhaps where no other cereal crop can grow under such moisture stress. These crops are hardy and quite resilient to varied agro-climatic adversities. Farmers at Koraput district are cultivating mainly four types of millets such as *Mandia* (Finger millet), *Suan* (Little millet), *Kangu* (Foxtail millet) and *Ganthia* (Pearl millet*)*. The area of cultivation of millets among the growers is decreasing due to competition of other cash crops. Moreover, growers faced various constraints related to production and post-harvest, processing of millets etc. The decline in millets in India can be attributed to many factors; agronomic, economic, and social. The Green Revolution of the 1970s witnessed government promotion of rice and wheat push millets into ever more marginal areas. Post Green Revolution hastens the loss of genetic diversity and traditional knowledge about the production, processing, and use of millets. Production is inefficient as a result of the lack of suitable higher-yielding

varieties, poor quality seeds, and unimproved cultivation practices. In addition, there is a lack of attractive recipes for adding value, a lack of awareness of the nutritional value of millets, poorly organized integration with markets, and generally unfavorable environmental policy (Padulosi et al., 2015).

In the above context, the paper critically analyzes the current status of on-farm conservation through varietal diversity, cultivation and major constraints faced in agroecology and its production system.

METHODOLOGY

According to Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA), being an agro-biodiversity hotspot, Koraput has highest number of millet cultivation i.e. four out of six types of small millets namely finger millet, little millet, pearl millet and foxtail millet with maximum number of varietal diversity. Further agricultural impact assessment methods through observations, personal interview and focus group discussions (FGDs) were conducted among millet growers, agriculture officials and community based organizations (CBOs) members in order to triangulate and validate collected information from different primary and secondary sources. There were 100 purposive sample survey from Luhaba village of Subai Gram Panchayat of Semiliguda and Bandliguda village of Jujhari Gram Panchayat of Borigumma were considered. Farmers having experience of at least one type of millet cultivation were considered for personal interview. Moreover, various action research data and its analysis report of government and non-government organizations (NGOs) were critically analysed further to understand the status of millet agroecology as well as suggest for policy level recommendations.

RESULTS AND DISCUSSION

I. Status of millet cultivation

Ethnobotanic surveys indicate that hundreds of such species are still to be found in each country, representing an enormous wealth of agro-biodiversity with potential to contribute to improved incomes, food security and nutrition, combating hidden hunger caused by micronutrient (vitamin and mineral) deficiencies. Moreover, millets are best suited to rainfed/ dry land conditions. Less water consumption, low external inputs

because of fewer incidences of pest & diseases are the additional benefits with millet production. The byproducts/ residues may also be used as fodder/ feed for livestock (Sankaran, 1994). Millets have a comparative advantage in marginal lands where they have been selected to withstand stress conditions and contribute to sustainable production with low inputs at low cost of production (DHAN Foundation & WASSAN, 2012; Padulosi et al., 2015). They also contribute to the diversity-richness as well as to the stability of agro-ecosystems. There are hardly any alternatives to these species for their strategic role in fragile ecosystems, such as found in arid and semi-arid lands, in mountains, steppes and tropical forests. Farmers cultivating land in crop rotation method do harvest more production (Jodha & Singh, 2009).

Out of the total 100 sample households, 72 of them cultivated millet-based crop combinations. It was found that 68 % out of 70 finger millet growers cultivated it without any intercrop or mixed crop. Finger millet was cultivated with little millet as mixed crop by 8 growers. Other crops as mixed with finger millet were blackgram, horsegram, redgram, soybean and foxtail millet. This mix cropping system reduces the probability of crop losses and hence also make availability of food security. The overall productivity of finger millet in both villages is 2.85 qtl/acre. Overall, it was found that higher the landholding category, higher is the productivity. It is as high as 3.15 qtl/acre among medium landholding households followed by 3.10qtl/acre, 2.95 qtl/acre, 2.20 qtl/acre and 2.1 qtl/acre among semi-medium, small, marginal and landless households respectively. It is very low and can be increased up to 15qtl/acre with the adoption of improved package of practices.

II. Issues and challenges

After Green Revolution, there has been a systematic decline in the production of millets. Under traditional practice, seeds of some of these crops are mixed in variable proportions and broadcasted. It also uses a heavy seed rate as a safeguard against poor seed quality and uncertain soil moisture. Such seed rate under favourable soil moisture results in a very dense crop, which is normally not thinned out and leads to crowded plant population and poor yield. Traditional practice of cultivation also does not apply manure or fertilizers or any other intensive management practices (Chang, 1977). The

crop offers poor to modest yield depending on weather. Due to change in climate conditions, there is lots of probability of crop failure and also not even moderate yield. Cropping pattern studies therefore assume special importance in taking cognizance of soil-climate factors and the crops that could be grown within that environment (Venkataramaran & Prahaladchar, 1978; Singh & Sidhu 2004). For increasing the productivity of millets, it is necessary for the use of quality seed produced in participation with growers, planting in rows instead of broadcast sowing, use of scientifically recommended seed rate, encouraging application of farm yard manure and/or fertilizers, thinning to regulate plant population etc. (Ninan & Chandrashekar, 1993).

The study has identified several important constraints which reduce the production. The production constraints revolve around the last ten-years' experience of millet cultivation. The details of the production constraints are given below in the Fig 1.

Figure 1: It depicts production related constraints among millet growers of finger millet, little millet and foxtail millet

The major production constraints are weeding problem around 67% and 61% in case of both finger millets and little millet respectively. Weeding consumes more labour-intensive works as well as it coincides with cash crops and paddy related agricultural operations. However, about 73%, 56% and 53% of lack of availability of quality seeds contributes as production constraints in case of foxtail millet, finger millet and little

millet respectively. Land displacement leads to the lack of land availability among majority of farmers to diversify crops cultivation to improve socio-economic status of families. Appropriate farming implements for summer ploughing and weeding operations can be supported for reducing drudgery of the farmers at Koraput district.

III. Agronomic practices

There are less technological interventions regarding millets cultivation starting varietal diversity to post-harvesting. Moreover, public distribution system which provides rice and wheat at subsidised rate to low-income households lowered the interest level of small and marginal farmers to go for cultivation of millets (Ninan & Chandrashekar, 1993; Mandal et al, 2016). Tree plantation and cash crop cultivation is the major problem for millets cultivation. According to the study findings, there is land encroachment for the cultivation of eucalyptus as well as other cash crops in the rainfed regions to meet the demands of the paper and pulp industry (Nadkarni, 1986). This declining diversity has serious concerns in terms of overuse of natural resources, ecological problems and growing income risk. As diversity in the production pattern declines, variability in the gross value of production also increases (Mruthyunjaya & Kumar, 1989)". It is necessary to diversify varieties as well as improved package of practices to adopt climate change and harvest more yield from millet cultivation. It is observed that most of the growers in the sample used own farm-saved seeds (86 per cent). The government department as a source of seed is meant for the released varieties such as *Champabati, Chilika and Bhairabi* whereas non-government organizations are meant for GPU-28, GPU-48, GPU-66 and GPU-67 varieties. The yield comparison of various finger millet varieties was conducted at field of Jagu Bhoi of Lunguri village by DHAN Foundation can be considered in the table-1. Indigenous varieties like *Dasarabodi, Kala Kerenga, Bodel, Dinda, Chilli, Sunamani* etc. give yield almost equal yield to some of released varieties. It is necessary to adopt improved package of practices to adopt climate change and harvest more yield. Organization has introduced various released varieties through on-farm trials.

Table 1: Comparison of various predominant varieties in similar agroclimatic conditions

SL. No.	Name of the varieties		Yield/ plot in kg (Plot size 3 mX3.5 m)						
		Types of varieties	R1	R2	R3	Total = (R1+R2 +R/3)	Mean yield	Yield /ha	Deviation from grand mean (2875.23)
1	Mati	Local	2.55	2.9	3.45	8.9	2.97	2828.57	-46.664
2	Bati	Local	2.4	2.9	2.2	7.5	2.5	2142.85	-732.384
3	Kala Kerenga	Local	2.4	3.5	3.1	9	3	2857.14	-18.094
4	Sunamani	Local	1.2	2.7	3.05	6.95	2.32	2209.52	-665.714
5	Chilika	Released	2.75	2.5	5.3	10.55	3.52	3352.38	477.146
6	GPU-28	Released	3.25	3.6	2.8	9.65	3.22	3066.66	191.426
7	GPU-67	Released	2.55	3.2	4	9.75	3.25	3095.23	219.996
8	GPU-66	Released	2.6	3.5	4.05	10.15	3.38	3219.04	343.806
9	GPU-48	Released	3.05	4.05	5.45	12.55	4.18	3980.95	1105.716
10	Bhairabi	Released	2	2	2	6	2	2000	-875.234

*R1, R2 and R3 are the rows of randomized complete block design

Source: Randomized complete block designed trials

It can be seen from the above table that released varieties like *Chilika, GPU-28, GPU-67, GPU-66 & GPU-48* etc. gave substantially better yield. These varieties have been introduced through proper PVS approach with the involvement of farmers. The low yield of Bhairabi is due to water logging as well as grain stuttering during the rainfall in maturity stage. Moreover, it is a short duration variety. But it has better performance and farmers do have adopted in a large proportion as it was introduced earlier by agriculture department. It has been found that there is potential of finger millet to increase yield at local context up to 15.92qtl/acre by adopting improved varieties in case of finger millet cultivation. Providing quality seeds can be an effective strategy for intervention in the tribal villages.

IV. Technological Interventions

There are institutional constraints in improving productivity of dry farming and in promoting lightly irrigated cultivation as against intensive irrigation. In the meantime, there is lack of interventions from government for the promotion millets cultivation with the interventions of inputs support, machanisation support etc. There is a change in preference patterns for consumption of millets and people are moving away from them (Sanskritisation). This is mainly due to inclusion of only rice and wheat into the public

distribution system (DHAN Foundation& WASSAN, 2012). According to the study, "The new technology also needs to be supplemented by measures for conservation of soil moisture and supply of proper equipment to farmers, which can enable them to quickly take advantage of the brief spell of rain during which they have to plough, sow and fertilize. Timeliness of operations is of crucial significance to farmers in drought-prone areas. Mechanization is also needed in the first instance for soil and moisture conservation measures. These institutional constraints seem to be more serious in the case of improving the productivity of rainfed crops and semi-arid regions than in irrigated agriculture (Nadkarni, 1986)". Women play major role in the promotion of millets in the tribal areas. They select land, method of cultivation, package of practices needs to be followed for the crop cultivation etc. They are involved starting from seed selection, procurement, land preparation, transplantation, weeding, harvesting etc. agricultural operations. The technological interventions need to be based on their comfortability and handy to use it.

Adaptation of better context specific quality seeds plays major role in production enhancement in the context of climate Change. The existing finger millet varieties may be broadly classified under two heads, viz. i) released varieties and ii) local varieties. There were only four released varieties among the sample households. These are *GPU-28, GPU-48*, GPU-66 and GPU-67. Similarly, there are nine local varieties namely *Dasarabodi mandia*, *Bada mandia, Sana mandia, Chilli mandia, Badu mandia, Modai maskuli, Bodel mandia, Jana mandia* and *mati.* DHAN Foundation, a national based NGO implements Odisha Millet Mission in the block and encouraged system of millet intensification (SMI) methods of cultivation, timely weeding, and other intercultural operations in a large scale to enhance production of millets. By adaptation of various improved package of practices, the yield of the especially finger millet has increased up to 10.8 qtl./acre among the tribal farmers. However, Harsa Trust, a local NGO worked as facilitating agency under OMM implements various activities for promotion of millets at Borigumma block. The percentage of HHs cultivating modern varieties among millet growers is given below in the Fig. 2.

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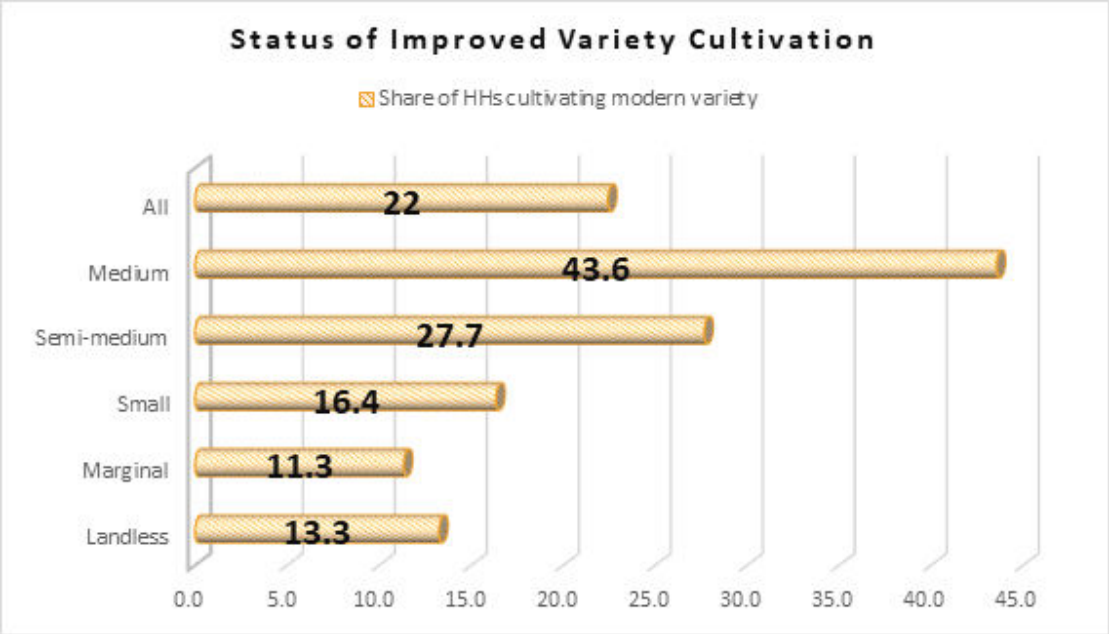

Figure 2: It depicts the distribution of improved varieties among finger millet growers

Around 22 per cent of finger millet growers were using released varieties. The remaining growers were cultivating local varieties. The category of varieties grown by 5 per cent of the growers could not be identified. Among the released varieties, *Bhairabi* was found to be the dominant ones (10 per cent growers) followed by GPU-66 (7 per cent) and GPU-67 (5 per cent). It was observed through the survey that there is lack of little millet varietal diversity at the household farm level in both the Gram Panchayats. Only two households were found with two varieties of little millet each, though there were a total of three known varieties cultivated among the sample households. There is no released variety of little millet cultivated among the sample households. The three known local varieties were called *Bada suan, Ganjei suan* and *Sana/Mami suan*. *Bada suan* was found to be the dominant one.

V. Drudgery in post-harvest operations of millets

Nutritious millets are neglected in all respects of technology in developing new varieties of seeds, improved package of practices, harvesting, threshing, post-harvest as well as processing etc. It involves lots of drudgery and time consuming for threshing and processing into fine grain. All these tedious post-harvest operations are performed by the women. There is no efficient technology for processing these grains at village level, despite India producing about 2 million tons of these grains. This has discouraged the

use of these millets in household consumption, particularly when there is access to alternative grains like rice, wheat or sorghum (Bhag et al., 2010). There are several research has been conducted by different government and non-government research institutions for understanding constraints faced by millets growers in the nation level. This is another reason contributing to the decreasing popularity of these grains even among people who had been its traditional consumers (Ohiokipihai et al., 1998).

At Luhaba and Bandliguda, farmers face major problem in threshing of millets, and they use a long stick to thresh millets on the road. However, around 26% and 38% families faced problem in processing of finger millet and little millet due to unavailability of millet processing unit in the villages respectively. However, they have to depend upon other nearby villages for processing millets.

VI. Consumption of millets

Millets are highly nutritious and contain high amounts of fiber, vitamins and minerals as compared to other crops. By any nutritional parameter, millets are miles ahead of rice and wheat in terms of their mineral content. Finger millet has thirty times more Calcium than rice while every other millet has at least twice the amount of Calcium compared to rice (ICAR-IIMR, 2016). In view of nation's food security and the declining ground water scenario, Dr. M.S. Swaminathan's report on 'National Commission on Growers' suggested for bringing in the millets under the purview of the PDS in India. Once the millets are made available for consumption to the public, it was envisaged that it may trigger the production of the same. The study "Nutritional status of the Bonda high Landers of Odisha" explains about the different dietary habits of tribal people at Koraput district as Bonda is itself one of the tribal communities. According to the study, tribal communities frequently consume millets recipes in the form of rice, gruel, snacks, etc. irrespective of seasonality; they consume finger millet Landa, Mandru, Anda etc., and Upma, Khir and rice from little millet. They make local beverages from millets. The per capita consumption of cereals and millets food during harvesting is more (420gram) than lean season (326 grams) as there is more laborious work (Modak & Das, 2009).

Cent percentage of the households consume finger millet in the study areas in the form of ragi gruel (*Mandia Jau*), and other traditional recipes like *Landa, Pendum, Mandru,*

mecha, anda, etc. However, its consumption is declined among the youth and school going students. It is due to lack of knowledge on the health and nutrition benefits of the millets as well as unavailability of various attractive recipes. Tribal communities do believe that consumption of millets heals headache, body pain, and various intestine problems and strengthen their immunity system. In sun, they can work for long time after consuming one glass of millet porridge. During the festivals, they usually prepare various traditional recipes with leaves of Sal, turmeric and some other plants of the forest. These recipes are served to *Nishanimunda* or any other village deities during *Push or Chita Paraba*. Millets has higher priorities in preparation of these recipes along with the local pulses. As per the survey, 11 % and 14% of household have consumed *Suan and Kangu* respectively since last one year.

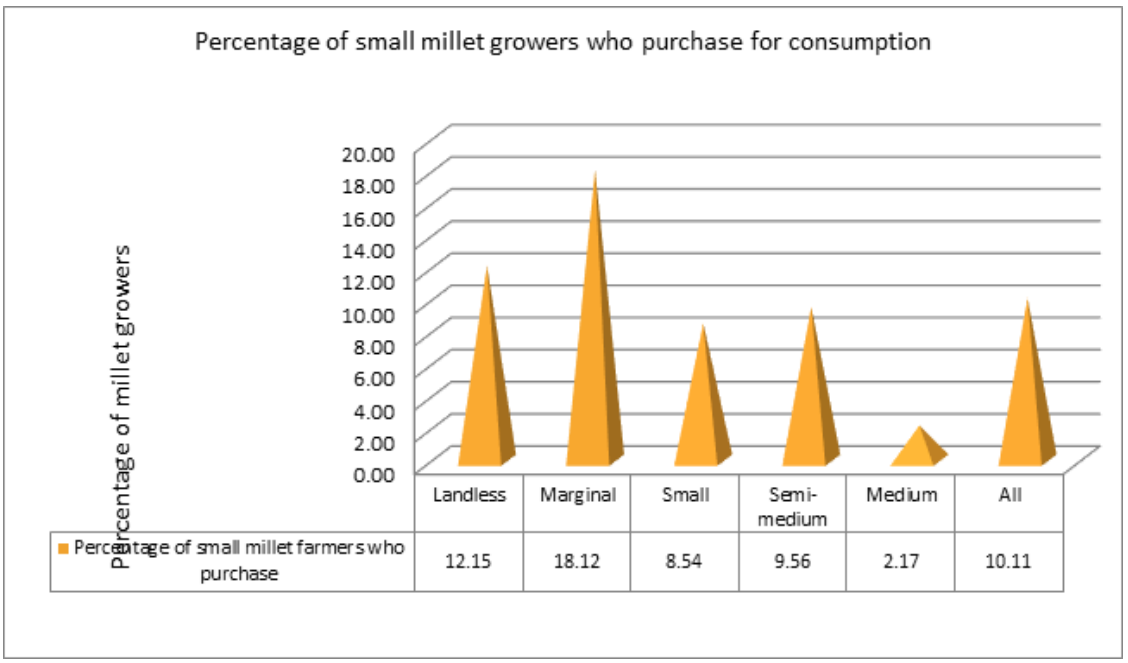

Figure 3: It depicts percentage of small millet growers who also purchase it for own consumption.

VII.Marketing of millets

Bringing back of nutritious millets to the local food system needs lots of efforts from its production system to marketing i.e., across millet producing clusters to non-producing clusters of millets. However, marketing plays an important role for door step availability of inputs of millets for cultivation, processing, value addition and its consumption. The

price of millets has been increased more three times of the MSP during 2010-11. For example, MSP of ragi has been increased from Rs.965/- in 2010-11 to Rs.3377/- per quintal in 2021-22. This increase in MSP motivates farmers to go for cultivation, still it is not sufficient for the farmers as they are deprived to sell in the MSP across due the complex procedures in the procurement system. In Kharif Marketing Season (KMS) 2018-19, Odisha Millet Mission, Govt. of Odisha initiated ragi procurement through the Tribal Development Co-operative Corporation of Odisha Ltd. (TDCCOL) at Rs.2897 per quintals. But, farmers in the interior areas don't have access to the ragi procurement centre *(Mandi)*, and go for distress selling at door step to the middleman. Moreover, farmers show hesitation to sell at fair average quality (FAQ) parameters as it involves lots of drudgery like drying in sun, removing foreign particles etc. Moreover, there is payment related issues like late payment due to technical and operational issues by the procurement agency. However, this system of ragi procurement also helped producers to bargain price of ragi in local market. Community institutions like Self-help groups, Farmers Producers Organizations (FPOs) etc. are being engaged for marketing of millets.

VIII. Policy recommendations

Now, COVID-19 pandemic has given an opportunity for all migrants of the tribal villages to be engaged in agriculture related activities. Millet growers need to have better access to inputs like seeds, fertilizers, and low-cost farming equipment for reducing drudgery in weeding and post-harvest operations in the village. Moreover, training and capacity building programme need to be conducted for adopting improved technologies among farmers for production enhancement. Moreover, farmer producer organizations (FPOs) can be promoted to enhance knowledge and skills of millet growers to take up training and capacity building programme as well as forward and backward marketing linkages in the villages to ensure income, food and nutrition security of the communities. There is need of policy level interventions for supply of quality seeds, including well performing successful local varieties, subsidy support for high cost inputs, support for low cost farming implements, support for farmers' producer organisations for collective marketing and value addition on millets, increase public funding for research on millets, support for establishment of millets processing

units, support for small scale entrepreneur on highly specialised products (capital subsidy, credit and tax exemption) etc.

CONCLUSION

Millet-based agroecology plays an important role for ensuring food and nutrition security among the tribal communities. However, farmers faced various constraints related to its production, post-harvest operations, processing, and marketing opportunity. For enhancing production, farmers need to adopt for sustainable agriculture practices through proper training and capacity building programme facilitated by the state training institutions with collaboration of civil society organization and agricultural institutions. Moreover, there is a need of support for supply of quality seeds, subsidy support for high-cost inputs in farming implements, establishment of millets processing units, small scale entrepreneurship on developing value added food products etc. Massive awareness programme on health and nutrition benefits of millets is required for increasing household level consumption with diversified and nutritious recipes. Farmer producer companies can be promoted for sustainable production enhancement as well as marketing linkages throughout the year.

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DIABETIC RETINOPATHY DETECTION USING DEEP LEARNING – QUICK LOOK

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ABSTRACT

Diabetic retinopathy (DR) is a vision-threatening chronic eye disease that is most common in diabetics. Generally, the presence of this disease in people is detected by the presence of microaneurysms in the retinal region of the eye through the fundus imaging. Unfortunately, there are no symptoms experienced by patients and so it can be found only by the periodic clinical diagnosis. Clinical photographs of the patient's fundus could be difficult for clinicians to manually inspect and evaluate at times, and the process could be laborious. Convolution neural networks (CNN) have been used to this problem in numerous ways as deep learning approaches have grown in popularity. Also, deep learning algorithms had done great work on proving their superiority on image recognition, image classification, object detection with high accuracy. Thus, the false detections can also be eliminated and also reduces the risks of patient's health with an automated systems through early diagnosis. This is an automated approach of detecting diabetic retinopathy using a single image of the retina. A simple and useful description of the application of CNN for the identification of DR in human eyes is detailed in this paper which experiences you about the limitations and also gives a review on the thoughts of experimenting an another architecture, Capsule Networks that serves to be a better replacement that knocks out the downsides of Convolutional Neural Networks .The abstract is to be in fully-justified bold and italic text, at the top of the left-hand column as it is here, below the authors' information. Use the word "Abstract" as the title, in 12-point times new roman, boldface type and initially capitalized. The contents of abstract are to be in 9-point, bold and italic face.

Keywords: Diabetic Retinopathy, microaneurysms, convolution neural networks, fundus imaging.

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1.INTRODUCTION

After diabetes-related macular degeneration, diabetic retinopathy is the second most common condition in humans, according to the WHO-UN report.[1]. DR had put several people into permanent blindness across the world. According to statistics from the International Diabetes Federation (IDF), there were 366 million persons with diabetes worldwide in 2011 and 552 million by 2030. [2].

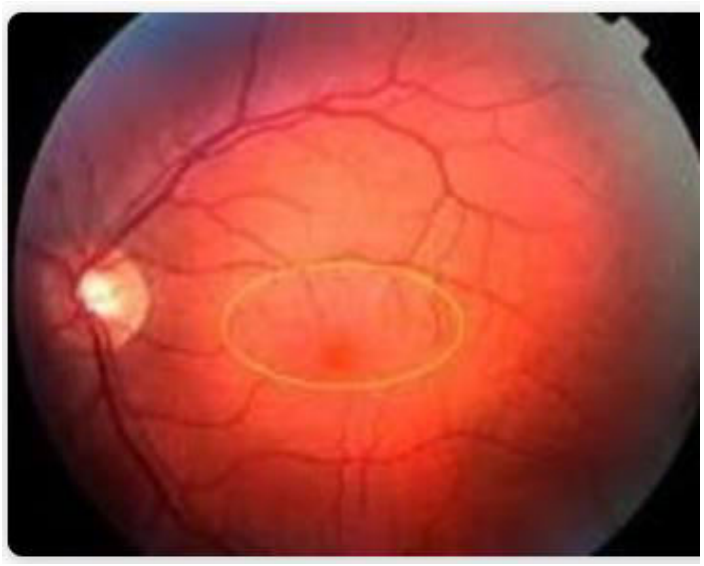

Figure 1. Microaneurysms in retinal part of eye

The initial stages of diabetic retinopathy are found to be the microaneurysms in the retinal area. These microaneurysms are kind of red spots along the side of blood vessels or a swelling [3]. A sample example for microaneurysms is shown in Fig. 1. As mentioned earlier, there are no kind of symptoms experiences like itching or even reddishness because of microaneurysms. Later on, this condition will lead to leakage of fluids from eyes called exudates and sometimes there can be a possibility of even bleeding. This kind of abnormality is known to be haemorrhages.[3] .

A sample example for exudates and growth of abnormal blood vessels is given in Fig. 2 and Fig. 3, respectively. Also abnormal growth of blood vessels arises to form scar tissue that blocks the flow of oxygen and thus leading to vision loss. The intensity of blood vessels will be as equal as the intensity of microaneurysms. Therefore classifying these two is a crucial point. There may be chances that a blood vessels may be considered as a microaneurysms, which could lead to false detections. To distinguish

or classify these two paradigms, the image has to undergo several preprocessing techniques in order to pick the right microaneurysms for the accurate detections.

paper format font should be 10 in times new roman with single spacing.In recent years, the accessing of multimedia data or digital data has become very easy because of the fast development of the Internet. In other words, this development makes unauthorized distribution of multimedia data. For the protection of multimedia data, a solution known as watermarking is used. After the approximate 20 years' research, different kinds of watermarking algorithm based on different theory concepts were introduced [1-3]. A digital watermark encodes the owner's license information and embeds it into data. Watermarking may be used to identify the image of owners' license information and to track illegal copies.

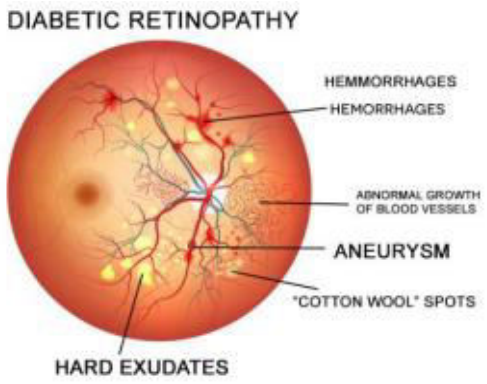

Figure 2. Release of exudates in the retinal area

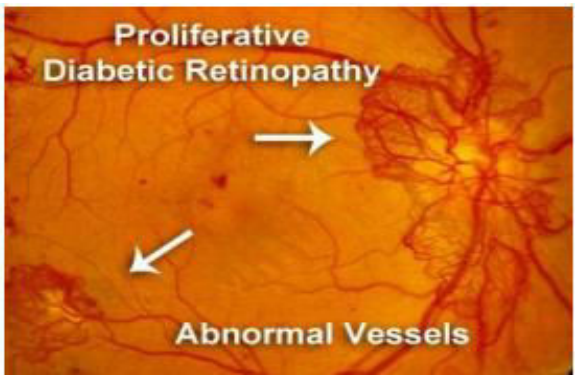

Figure 3. Growth of abnormal blood vessels

Typically, DR occurs due to rise in blood glucose level. The four DR categories can be broken down into mild to moderate in the beginning, moderate to severe in the middle, severe/nonproliferative in the pre-final stage, and proliferative in the final stage[4].

Swelling in the form of a small balloon will be present during the mild phase. The blood vessels are then damaged in the second stage as a result of the high blood glucose levels. To consider the non-proliferative section, as the blood vessels are damaged, blocks the blood flow in the retina. Without appropriate supply of oxygen in the eye, extra blood vessels will start appearing in the proliferative phase, ending with permanent blindness.

Manual detection does not yields better accuracy and even if there is good rendition of detecting DR, it is time consuming. Yet another issue is shortage of retinal specialists. Thus an automated approach meets the requirements of this problem and helping the people to acknowledge DR in themselves effortlessly. The first rule is that the input image has to undergo augmentation and preprocessing techniques to improve the image contrast and crop it in the image. Next, features have been extracted and the model has been trained with several datasets and learning happens automatically to improve the accuracy. In this study, we present a deep learning-based CNN approach for classifying DR in fundus images. According to previous research, this is a growingly important area of medical imaging for diagnosing diseases.

The rest of the paper is organized as follows. Review of Diabetic Retinopathy detection are explained in section II. DR detection methodology are presented in section III. Challenges are given in section IV. Architecture better than CNN is given in section V. Conclusion is in section V1

2.REVIEW OF DIABETIC RETINOPATHY DETECTION

The problem of DR detection has been the subject of numerous studies involving everything from computer-aided diagnosis (CAD) to neural networks [5] to [13]. In the past, optometrists and eye technicians have used traditional methods of screening for retinopathy, such as fundus examinations with conventional mydriatic or non-mydriatic fundus cameras. Many CADs have been used to look for DR. This research focused on the recognition of DR and normal images using features like the area of EXs, MAs, veins, texture and node points in CAD by Mookiah et al. [6][7].

When blood flows out of the retinal vessels, HMs occur. Fundus images can be made brighter or darker using a nonlinear curve and HSV colour space. This technique uses

gamma correction to highlight brown areas in the three-bit images that make up the image. HMs and blood vessels were depicted as brown regions. According to Hatanaka [8], the method was put to the test on 125 fundus photos, 90 normal photos, and 35 photos with HMs. One of the more recent and affordable ways of testing for retinopathy in the community is retinal imaging using smartphones, as proposed by Rajalakshmi et al. [9]. Despite all imaging advances, until now a trained specialist had to do the grading, and retinal imaging would fail to clearly define DR unless done with a specialised ophthalmologist. However, given the rapid rise in the number of diabetics and the scarcity of retinal experts and graders of retinal photographic images, an automated process involving a computer-based analysis of fundus images would alleviate the health-care burden.

There have been many more discoveries and research projects in recent years related to the development of automated retinal image analysis software that uses machine learning/artificial intelligence (AI)/deep neuronal learning [10][11]. ANN is a specialised field in which machines are taught to recognise patterns using artificial neural networks. Different technical tasks have made use of it, such as accurate image classification at high resolution. To grade DR, a machine can use AI because the machine learns to detect and classify DR via many annotated retinal images. The self-learning tool in this ideology enables retinal specialists and graders to be avoided [12]. On millions of patients and hundreds of thousands of images around the world, the EyeArt system has proven to be the most widely validated AI for detecting DR without help from doctors[13]. This screening system enables primary care practises, diabetes centres, and optometric offices to perform in-clinic, real-time DR screening by quickly and accurately identifying referable DR patients during a diabetic patient's regular exam.

EXs are a warning sign of DR and can be caught early with proper screening [14]. Here are a few examples of EX detection methods already in use. Garca et al. devised a method for automatically detecting DR in digital fundus images. As a result, a neural network-based approach is suggested [15].

An layout of i/p neurons characterises a neural network system, which can be represented by the pixels of an i/p fundus retinal image. Second, these pixels are weighted and changed by a suitable kernel or filter, and the result of these artificial neurons is offered as i/p to different neighbouring neurons. The procedure is repeated until an o/p neuron is activated at the end.

3.DIABETIC RETINOPATHY DETECTION METHODOLOGY

The latest proposed methodology has been divided into three phases for the detection of DR. The building blocks of the architecture is as follows.

- Data augmentation
- Preprocessing
- CNN architecture.

Figure 4. CNN architecture

The fundal images are not directly inputted to CNN. These kind of executions like augmentation and pre-processing have been made before the image is fed to the model, which is to be trained. Furthermore, these are one of the reasons for higher accuracy results at the end.

3.1Data Augmentation

The input datasets are more probably to be blurred and even the contrast and sizes of the images will be different, giving non-clarity of input images. . Figure 5a is shows normal image of Non –DR and 5c depicts normal image of DR[16].It is impossible to figure out the presence of microaneurysms in those kind of blurred images. So, some contrast adjustments and brightness adjustments will be made to get better view of the images. Therefore, augmentation has been applied to the training datasets before the image is inputted to the CNN.

3.2 Pre-Processing

The cause for pre-processing images could be of greater dimensions at times and so a lot of time will be consumed on applying filters on the input data. So that, using pre-processing algorithms, resizing of images is done. The images had a high resolution, which meant they took up a lot of memory and processed quickly. Figure 5b shows a pre-processed image of Non –DR and 5d depicts the pre-processed image of DR[16].

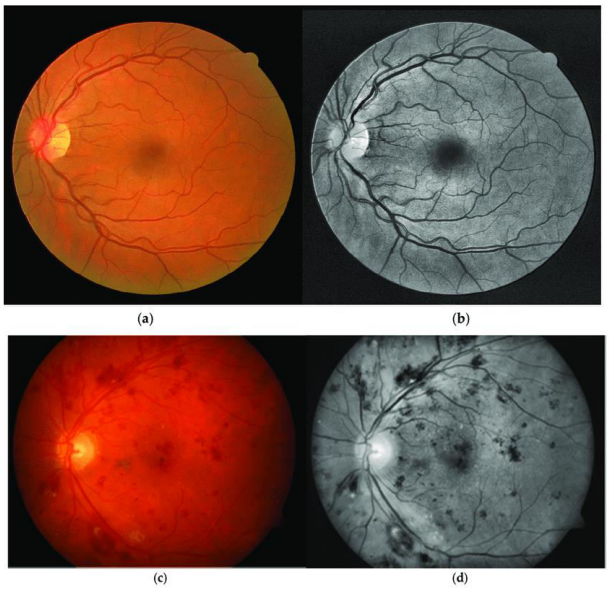

Figure 5. Normal images and preprocessed images

Typically in neural networks, computation of some variables with the help of input features is the work done and passes to the bunch of hidden layers to get the desired output. This type of phenomenon is known to be forward propagation. One of the intermediate variables is the loss function, which is the difference of output received and target goal, is calculated during forward propagation. To minimize this error, it has been propagated from backwards in the reverse order from output to the input layer. As the name suggests, this is known to be backward propagation. By doing so, the system learns to bring the received output close to the target output.

3.3 CNN Architecture

CNN is a type of ANN where the connectivity patterns is inspired from the human brain network. As like ANN, the basic structure of CNN contains input layer, set of hidden layers and an output layer. The architecture is shown in the figure 4:[17].As per the following problem statement, the basic strategy is initiated with recognition of microaneurysms in the retinal images. CNN architecture is applied here since it overcomes the problems of traditional approaches such as spatial property and translation. And moreover, there are variety of layers deployed in the construction of this architecture. The layers are as follows:

- Convolution
- Pooling
- ReLU
- Dropout
- Fully connected
- Classification

The convolution layer is the foundation upon which the CNN's convolution operation is performed in order to obtain features from an image. It is an intermediate operation in which two functions are multiplied together to produce a third function. Filter sliding over the image creates a matrix that calculates the dot product, which is known as an activation map or a feature map. The MxM input image has been filtered through a FxF filter to distort it. So the convolution function will have a size of (M-F+1) x (M-

F+1).This outputted matrix is the result for the centre pixels of the image whereas, the border pixels are unconsidered.

If there is a necessity that information at the border pixels are significant and to be considered, then padding can be implemented. Padding is used to preserve the original dimensions of the input. Here, yet another layer of pixels are introduced around the border pixels. The number of layers depends upon the size of the filter. For instance, if MxM input image undergoes padding whereas the padding size (P) is set to 1, then the convolution feature will be of size, (M+2P-F+1) x (M+2P-F+1). In case of drastically decreasing the dimensions of output matrix, striding is done on the input image of greater dimensions. Striding is the process of skipping few pixels on the input image during when the filter slides over the image. Skipping pixels on the images of higher dimensions does not lead to information loss. But skipping pixels on the images of smaller dimensions will generate loss of information. The MxM input image is convoluted with FxF filter where stride is set to 3, the activation map will be of size

Floor(M +2P-F/S +1) x Floor (M +2P-F/S +1).

The purpose of pooling is to gradually reduce the size of the activation map's spatial region so that the network's parameters and computations are also reduced. It also divides the activation maps into rectangles and collects the most significant value in each one of those rectangles. It's nothing more than a downsizing of pixels with added functionality. For example, if the input layer is MxM, the output layer will be M/K x M/K. Hidden units become sparse as a result of the activation function ReLU. Also, compared to sigmoid and logistic regression activation functions, the CNN can be trained more efficiently. The dropout layer is a regularisation technique used to deal with the parameters that are generated by the stacked layers. The removal of some neurons from one layer triggered changes in the next. A fully connected layer connects every neuron in the previous layer to every other neuron in the network. The fundus image is classified using a softmax layer, which is then output after the fully connected layer. The deciding authority for classifying the DR presence or absence is acknowledged and interpreted in this case. In other words, the first convolution layer is

responsible for extracting the features, while the final convolution layer interprets the classification of the DR.

As a result, the model starts with convolution blocks and an activation function that is supported at every step. All of the max pooling is done with 3x3 filters and 2x2 strides. As soon as the final convolution layer is completed, the single dimension is flattened. To avoid overfitting, we dropout dense layers till the we achieve the dense network of classification stage, which classifies the DR categories using a softmax activation function.

3.3.1 Performance Evaluation

The performance measure defines the real essence of automated approaches. There are four parameters, which states the decision of the network model by how perfection it is. The parameters are as follows:

- Sensitivity
- Specificity
- Accuracy
- precision

The sensitivity of a test indicates the likelihood that it will be positive in individuals with a DR. The specificity (actual negative rate) of a test indicates how likely it is that the individual does not have the DR. Precision is another term for positive predictive value. Accuracy is determined by comparing DR and non-DR patients in the database.

❖ SE=TP/(TP+FN)

❖ SP=TN /(TN+FP)

❖ Accuracy=TP+FN/(TP+TN+FP+FN)

❖ Precision=TP/(TP+FP)

The necessities which are needed to perform these evaluation are as follows:

True Positivie (TP) - Images of DR that have been correctly identified

True Negative (TN) - Images that have been correctly identified as Non-DR.

False Positive(FP) - The number of non-DR photos that are mistakenly identified as DR images

False Negative (FN): A large number of DR photos are mistakenly classified as non-DR images.

Sensitivity (SE) is the ratio of the number of successfully detected DR images to the sum of the correctly detected DR photos and the DR images incorrectly detected as non-DR images. Specificity (SP) is the ratio of correctly detected Non-DR images to the sum of successfully detected Non-DR images and Non-DR images mistakenly detected as DR images. Precision is defined as the number of correctly recognised DR images to the total of correctly detected DR images and Non-DR photos incorrectly detected as DR images. The entire sum of TP,TN, FP,FN is equal to the number of correctly detected DR images plus the number of correctly detected Non-DR photos.

4.DIABETIC RETINOPATHY DETECTION CHALLENGES

There are situations which turned out researching as fishing a bit for the researchers. Some of the ticklish times are mentioned below:

(i) High resolution images and image pre-processing units: Generally, image datasets in medicine will have high resolution images. Working on high resolution images with this architecture will take more time. As there will many variations as pictures have been taken from different cameras. To top it off, image processing systems will handle images of standard shape. So cropping and resizing of images is implemented in such a way that there is no loss of information. This was quite computationally challenging.

(ii) Impossible computations in normal hardware: Second of all, with the modern GPUs deep learning computations are applicable fortunately. This means that training these kind of training sets of high resolutions is impossible on the standard hardware.

(iii) Information loss on pooling: Pooling layers would be a huge mistake sometimes as because lots of valuable information, which affects the performance of the deep learning systems. Pooling is optional and also it beneficial when used at appropriate and necessary situations.

(iv) Change in orientation affects recognition and classification: The neuron that is meant to recognise an object may not fire if its orientation or position changes slightly. Although data augmentation partially addresses the issue, it does not completely eliminate it.

(v) Problem of overfitting: Unfortunately, CNNs are hampered by the abundance of data that is fed into them. It is expected that the CNNs will function badly if there is insufficient data.

CNNs contain millions of parameters to compute and, with a small dataset, might encounter an over-fitting problem because to their hunger for large amounts of data. As a result, when given a large amount of data, CNNs get stronger and more inclined to perform well.

A comparison table of the correct detection rate of DR with the previous well known CNN based approaches

Table 1 Experiment Result

Experimented by	**Accuracy %**	**Sensitivity %**	**Specificity %**
Harry Pratt [17]	75	30	95
Gardner [18]	95	88.4	83.5
Borys Tymchenko [19]	90	81	97
Xu K and Feng D [20]	94.5	83.4	87.6
Parmer [21]	85	85	81

5. ARCHITECTURE BETTER THAN CNN

Besides having a great prediction about images, CNN has a dark side in terms of data loss through pooling and rotational invariance. Our human brain has the power of recognising an image of a cat even when it is tilted to some angle or inverted. But this is not happening with CNN. Each image that we feed into the network has to be given with all possible orientations and rotations , only then network can learn better. Obviously , images get huge ,huger and hugest that would bring the roof down.

Capsule Networks tackles these problems by using a feature called Equivariance, which eliminates the need to input the network distinct photos of rotated objects when training it. Figure 6 depicts the capsule network as a whole. When the capsules are learning, one of the parameters they pick up is rotation, or how many degrees an object has been turned.

This is significant because it minimises the amount of images required to train a capsule network when compared to a convolutional neural network, which is beneficial. Furthermore, because there is less data, the computing time will be reduced as well. As a result, it produces greater precision in a shorter period of time in the Capsule Network. Though, CNN cannot achieve rotational invariance , it handles the translational variance well.

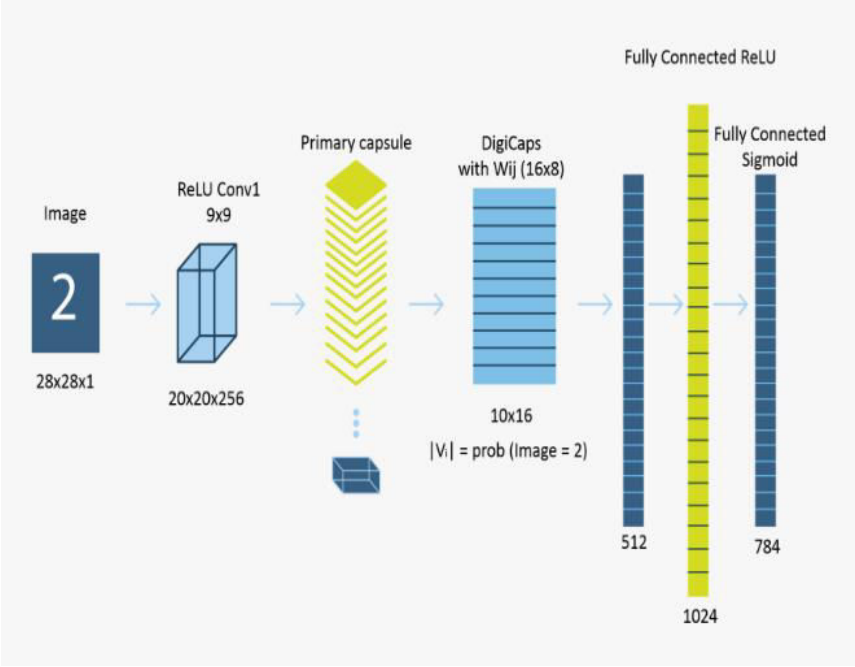

Figure 6. Overview of a Capsule network

A translational variance is the ability to detect the object irrespective of its relative position. Say , an example , if you are building a model to detect living things , all you need to detect is whether eyes are present or not, nose is present or not it's exact position is not necessary. The pooling layer is used to lower the data dimension and to obtain spatial invariance, which is identical to translational invariance in that it reduces the data dimension. Spatial invariance refers to the fact that the object may be identified

and classified regardless of where it is located in the image. While this is an interesting notion, it does have certain disadvantages. A major disadvantage of pooling is that it tends to lose a significant amount of information, which can be quite beneficial when doing tasks such as image segmentation and object detection. When the pooling layer fails to provide the necessary spatial information about the object's rotation, location, scale, and other positional features, the process of object detection and segmentation becomes extremely difficult. Pooling informs the layers on the presence of a part but not about its relative position among other parts. The Pooling layer eliminates this information in order to achieve translational invariance, which is the ability of a network to recognise an object regardless of where it is located in the image.

6. CONCLUSION

A deep learning based automated system for microaneurysm detection is the methodology proposed in this paper. Deep learning tools could potentially make the analysis easier and faster. The application of deep learning in the field of medicine has proven to be one of the greatest applications so far. It is pretty much sure that these healthcare systems could change personal healthcare experiences of millions. Many experiments have shown that CNNs can be taught to recognise DR characteristics in fundus images using training data. In the future, CNNs may prove invaluable to DR practitioners. Finally, a brief evaluation of the detection model for DR disease and previous research efforts is offered in a nutshell in this study, which may encourage researchers to look for flaws and fix them in order to achieve new advances in artificial intelligence.The main title is centred, and in times new roman 14-point, boldface type. Only the first letter of the first word in the title needs to be capitalized except for the letters and words that are originally capitalized. Leave one blank lines after the title.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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PREDICTION OF CARDIOVASCULAR DISEASE USING MACHINE LEARNING AND DATA SCIENCE.

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ABSTRACT

Heart disease describes a range of conditions that affect your heart. Today, cardiovascular diseases are the leading cause of death worldwide with 17.9 million deaths annually, as per the World Health Organization reports.

Heart Disease is the most dangerous life-threatening chronic disease globally.

Nowadays it is well known that machine learning and artificial intelligence are playing a huge role in the medical industry. We can use different machine learning algorithms to predict cardiovascular diseases. There are many open sources ont the internet for accessing the patient's records.

The objective of the work is to predicts the occurrence of heart disease of a patient using various Machine learning algorithms like KNN, Random Forest, Logistic Regression etc.

We will first collect, prepare and clean the dataset which is the first step for any data science project. We would be using Python libraries like Numpy and Panda for Data preparation and cleaning.

We will also visualize our dataset through various data visualization plots. Data visualization would be achieved with the help of Pyplot and Sklearn.

After training and successfully running our ML models we would calculate the efficiencies of all the ML algorithms used. Finally we will compare all the models using confusion matrix and classification report to get to know which ML algorithm is the best. Given a dataset, we will predict whether a given person is suffering from heart disease or not.The dataset will contain information like age, sex, chest pain, blood pressure, cholesterol level etc.

Hence in this study, we have discussed the heart disease and its risk factors and explained machine learning techniques. Using that machine learning techniques, we have predicted heart disease and provided a comparative analysis of the algorithms for machine learning used for the experiment of the prediction. The goal or objective of this research is completely related to the prediction of heart disease via a machine learning technique and analysis of them.

INTRODUCTION

[0] When the blood supply to the heart is significantly impeded or blocked, a heart attack happens. Usually, an accumulation of fat, cholesterol, and other substances in the heart's (coronary) arteries causes the blockage. Plaques are the name given to the fatty, cholesterol-containing deposits.

Atherosclerosis is the name for the process of plaque accumulation.

A plaque may occasionally burst and generate a clot that restricts blood flow. Part of the heart muscle can be harmed or destroyed by a lack of blood flow. A myocardial infarction is another name for a heart attack. Heart attack symptoms can vary. Mild symptoms are present in some people. Others display serious symptoms. Some individuals show no symptom

[1]Common heart attack symptoms include:

- Chest pain that may feel like pressure, tightness, pain, squeezing or aching
- Pain or discomfort that spreads to the shoulder, arm, back, neck, jaw, teeth or sometimes the upper belly
- Fatigue
- Heartburn or Indigestion
- Lightheadedness or sudden diziness
- Nausea

Atypical symptoms in women can include back, arm, or neck discomfort that is sudden or acute. Sudden cardiac arrest can occasionally be the initial indication of a heart attack.

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Heart attacks can happen suddenly. However, many people have warning symptoms and signals hours, days, or even weeks in advance. [1.5]An early warning sign of angina is persistent chest pressure or pain that doesn't go away with rest. A temporary reduction in blood flow to the heart is what causes angina. [2] In the past few years, numerous amounts of data were collected and stored because of the digital revolution. Monitoring and other data collection devices are available in modern hospitals and are being used every day, and abundant amounts of data are being gathered. It is very hard or even impossible for humans to derive useful information from these massive amounts of data that is why machine learning is widely used nowadays to analyze these data and diagnose problems in the healthcare field. [7] Machine learning (ML) has been shown to be effective in assisting in making decisions and predictions from the large quantity of data produced by the healthcare industry. We have also seen ML techniques being used in recent developments in different areas of the Internet of Things (IoT). Various studies give only a glimpse into predicting heart disease with ML techniques.

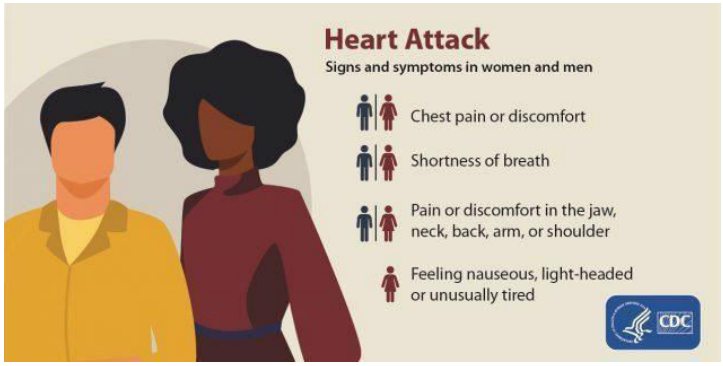

Figure 1. Centers for Disease Control and Prevention

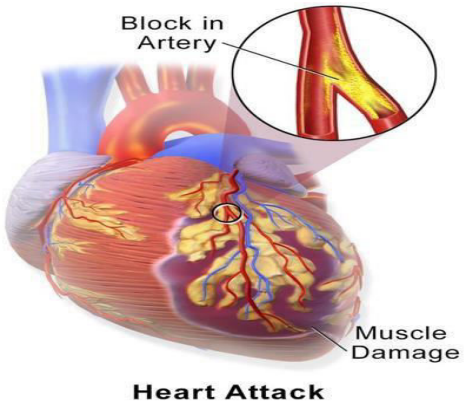

Figure 2. Mayo Clinic

[2.5] The heart is the most important organ of the human body because it pumps our blood and circulates to the entire body. The heart is protected by a rib cage and it is surrounded by two-layered tissue membranes.

It is a four-chambered organ that separates oxygenated and deoxygenated blood. The heart is having the five types of blood vessels: arteries, veins, capillaries, arterioles, venules and the size of the human heart is about the size of the fist.

DATA DESCRIPTION

[3] Several aspects have been identified as risk factors such as, Age, sex, Thalach, Exang, Oldpeak, Slope, Ca, Thal, Nun and genetic risk factors such as high blood pressure and diabetes also lead to heart disease. Apart from these factors, lifestyle habits such as eating habits, physical inactivity, and obesity are also considered to be major risk factors.

With diabetes, there are other reasons which contribute to heart disease. Smoking which raises the danger of developing heart condition, high vital sign makes the guts work harder to pump blood and it can strain heart and damage blood vessels, abnormal cholesterol levels also contribute to heart disease.

We performed computer simulation on one dataset. Our dataset is a csv dataset named heart.csv. The dataset contains 1025 samples (rows) and 14 input features (columns). The features describe Health records of various patients. The output feature tells whether a person has a heart disease or not.

A list of all features is given in Table .

age	The Age of the patient in years.
sex	The Gender of the patient. 1 denotes a male and 0 denotes a female.
cp	Chest pain type — Value 0: asymptomatic — Value 1: atypical angina — Value 2: non-anginal pain Value 3: typical angina

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trestbps	The person's resting blood pressure (mm Hg on admission to the hospital.)
chol	The person's cholesterol measurement in mg/dl.
fbs	The person's fasting blood sugar (> 120 mg/dl, 1 = true; 0 = false).
restecg	Resting electrocardiographic results — Value 0: showing probable or definite left ventricular hypertrophy by Estes' criteria — Value 1: normal Value 2: having ST-T wave abnormality (T wave inversions and/or ST elevation or depression of > 0.05mV).
thalach	The person's maximum heart rate achieved.
exang	Exercise induced angina (1 = yes; 0 = no).
oldpeak	ST depression induced by exercise relative to rest ('ST' relates to positions on the ECG plot.
slope	The slope of the peak exercise ST segment — 0: downsloping; 1: flat; 2: upsloping0: downsloping; 1: flat; 2: upsloping
ca	The number of major vessels (0–3).
thal	A blood disorder called thalassemia Value 0: NULL (dropped from the dataset previouslyValue 1: fixed defect (no blood flow in some part of the heart) Value 2: normal blood flow Value 3: reversible defect (a blood flow is observed but it is not normal)
target	Heart disease (1 = no, 0= yes).

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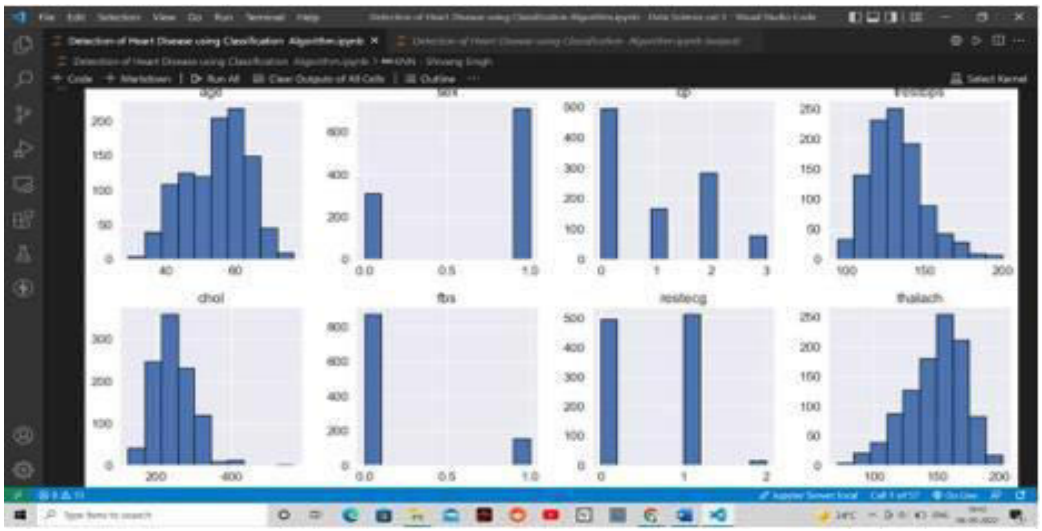
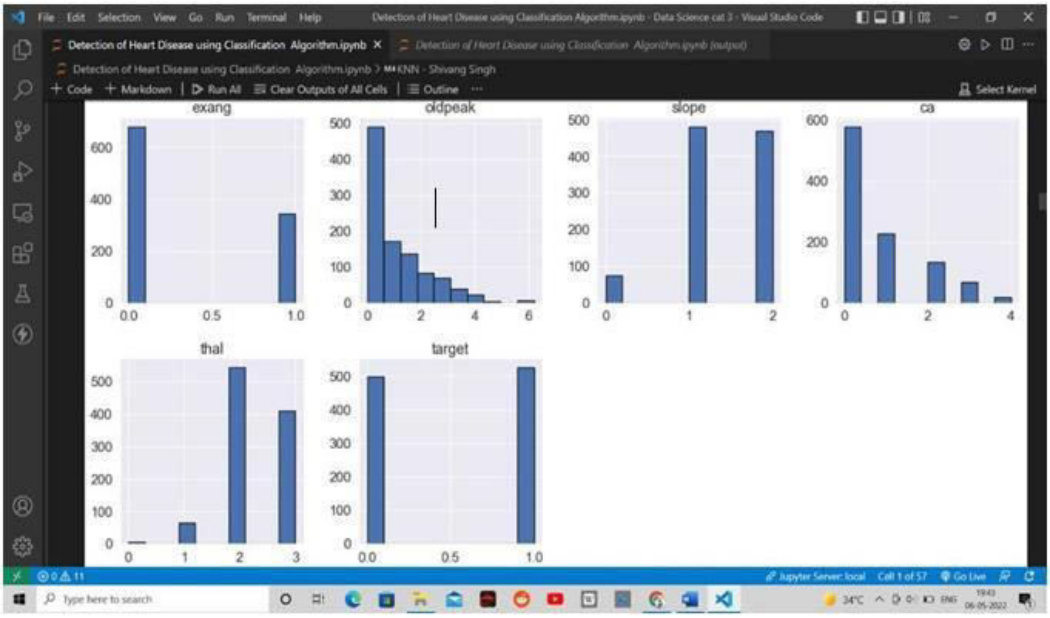
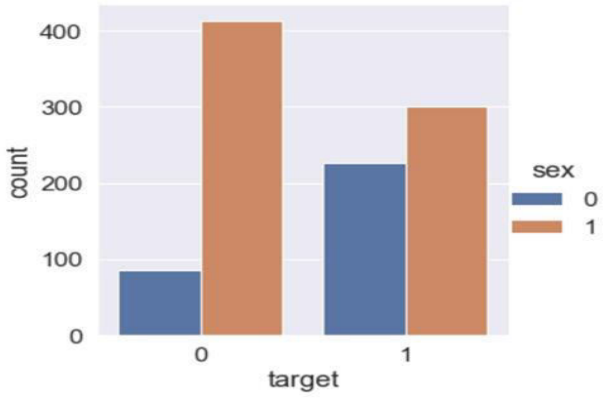
Visualizing our Dataset





Facetgrid



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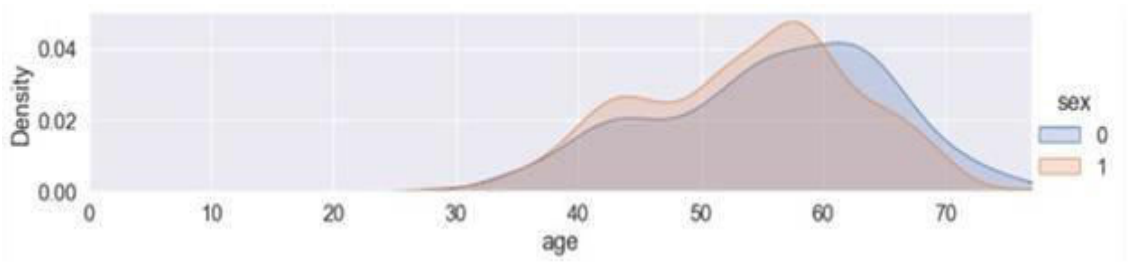
Axisgrid



ML Algorithm used KNN

KNN neighbor is one of the simplest machine learning algorithms. It is based on Supervised learning technique. KNN algorithm is an instance-based learning algorithm. It means it will not learn from the training data but it will memorize the training data. We also call it a lazy learner because it is very lazy to process the data or information. KNN is a non- parametric algorithm, it means that the KNN algorithm model does not make assumptions on underlying data KNN algorithm can be understood by calculating euclidean distance for a given data query.

We select those nearest neighbors who are minimal and close to the value of 'K'. Therefore, it's typically used as a classification algorithm, working off the idea that similar points will be found near each other.

For classification problems, a category label is assigned on the idea of a majority vote—i.e., the label that's most often represented around a given piece of information is employed. While this can be technically considered "plurality voting", the term "majority vote" is more commonly employed in literature. The distinction between these two terms is that "majority voting" technically requires a majority of greater than 50%, which primarily works when there are only two categories. After you have multiple classes—e.g., four classes, you don't necessarily need 50% of the vote to form a conclusion of a couple of classes; you may assign a category label with a vote of greater than 25%.

Implementation of KNN algorithm on our heart disease dataset:

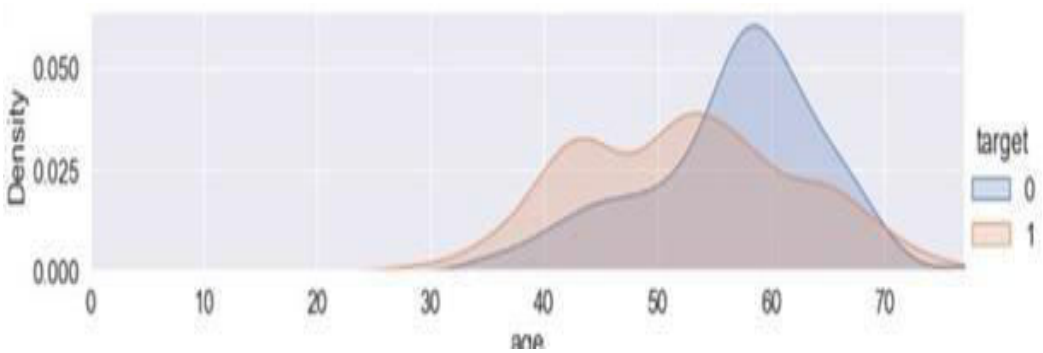
1. We will import all the libraries.
2. We will read the heart disease dataset.

3. Then we will perform KNN by splitting to train and test the set.
4. We will calculate for the best value of K.
5. And then we will apply the KNN Algorithm.
6. After all the above process we will test the accuracy. Acc- ording to the accuracy we will perform more hyperparameter tuning for improvement.

Logistic Regression

Just like KNN algorithm Logistic regression is also based on supervised learning technique. This type of statistical model (also mentioned as a logit model) is usually used for classification and predictive analytics. Logistic regression estimates the probability of an event occurring, like voting or not voting, supported by a given dataset of independent variables. Since the top result may be a probability, the variable is bounded between 0 and 1. In logistic regression, a logit transformation is applied to the odds—that is, the probability of success divided by the probability of failure. The logistic function is represented by the given formula:

Y = 1/1+e^(-x)



The logistic function is also known as sigmoid function which simply converts the independent variable into an expression of probability that ranges between 0 and 1 with respect to the dependant variable. In logistic regression whatever the prediction are made they are converted into a probability whose range is between 0 and 1. Within machine learning, logistic regression belongs to the family of supervised machine learning models. It is also regarded as a discriminative model, implying that it attempts to distinguish between classes (or categories).

A particular type of logistic function is the sigmoid function. The following mathematical formula yields it. Graphically, we can represent the sigmoid function with the following graph.

Unlike a generative algorithm, like nave Bayes[11], it cannot, as the name implies, generate information, sort of a picture, of the category that it's trying to predict (e.g. a picture of a cat). Working of logistic Regression:

The Logistic Regression algorithm works as follows –

Logistic regression maps the real values of the independent

Decision Boundary

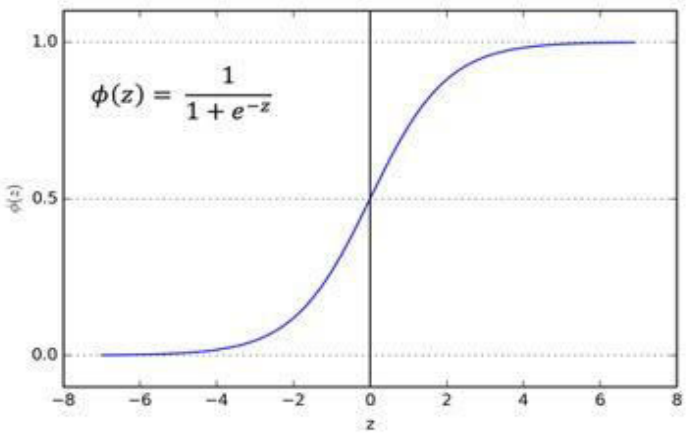


Figure 3. Towards Data Science

Variable between the interval of 0 and 1. The cutoff point is on 0.5. So, there will be the values which will be lying above 0.5 and there will be the values which will be lying below 0.5 cutoff. Therefore, logistic regression classifies the below cutoff values as class B which will indicate there is very low possibility of a certain occurrence and above cutoff values as class A which will indicate that there is a high possibility of certain occurrence.

Implement Linear Equation

Logistic Regression algorithm works by implementing a linear equation with independent or explanatory variables to predict a response value. For example, we consider the example of number of hours studied and probability of passing the exam. Here, number of hours studied is the explanatory variable and it is denoted by x1.

Probability of passing the exam is the response or target variable and it is denoted by z.

If we have one explanatory variable (x1) and one response variable (z), then the linear equation would be given mathematically with the following equation-

$z = \beta 0 + \beta 1x1$

Here, the coefficients β0 and β1 are the parameters of the model.

If there are multiple explanatory variables, then the above equation can be extended to $z = \beta 0 + \beta 1x1 + \beta 2x2 + \beta nxn$

Here, the coefficients β0, β1, β2, and βn are the parameters of the model.

Sigmoid Function

The projected response value, represented by the symbol z, is then translated into a probability value, which ranges from 0 to 1. In order to convert predicted values into probability values, we employ the sigmoid function. Any real number is subsequently converted by this sigmoid function into a probability value between 0 and 1.

The sigmoid function is used in machine learning to convert predictions into probabilities. An S-shaped curve can be seen in the sigmoid function. It also goes by the name sigmoid curve.

The sigmoid function returns a probability value between 0 and 1. This probability value is then mapped to a discrete class which is either "0" or "1". In order to map this probability value to a discrete class (pass/fail, yes/no, true/false), we select a threshold value. This threshold value is called the Decision boundary. Above this threshold value, we will map the probability values into class 1 and below which we will map values into class 0.

Mathematically, it can be expressed as follows:-

$p \geq 0.5 \Rightarrow$ class = 1 $p < 0.5 \Rightarrow$ class = 0

Generally, the decision boundary is set to be 0.5. So if the probability value is 0.8 (>0.5), we will map the observation to class 1.

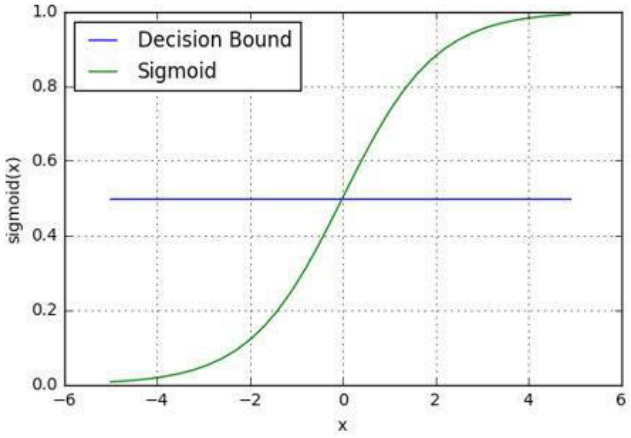


Figure 4. https://medium.com/analytics-vidhya/decision- boundary-for-classifiers-an-introduction-cc67c6d3da0e

Similarly, if the probability value is 0.2 (< 0.5), we will map this observation to class 0.

Random Forest:

A Random Forest is a widely used machine learning technique that aggregates the outputs of various decision trees to produce a single result. Leo Breiman [9] and Adele Cutler[10] have registered the Random Forest trademark. Since it can deal with both classification and regression issues, its adaptability and simplicity have been a driving force in its popularity.

To increase the dataset's predicted accuracy, a Random Forest uses a number of decision trees on different subsets of the provided dataset and takes the average of them. The more trees there are in the forest, the higher the accuracy and less overfitting there will be.

A decision tree is a decision assistance tool that employs a graph or model of decisions and potential outcomes, including utility, resource costs, and chance event outcomes. It is one method of showing an algorithm. Decision trees are a common technique for machine learning and are typically used in operations research, specifically in decision analysis, to find the method most likely to achieve an aim. By learning straightforward decision rules inferred from previous data, a Decision Tree is used to create a training model that can be used to predict the class or value of the target variable (training data).

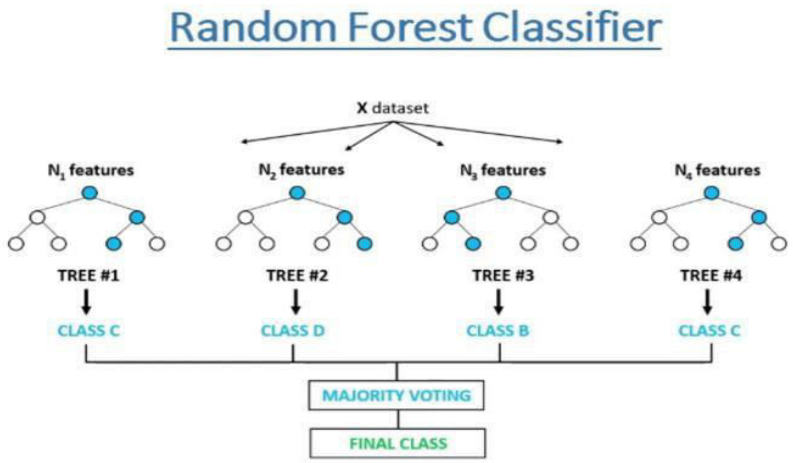


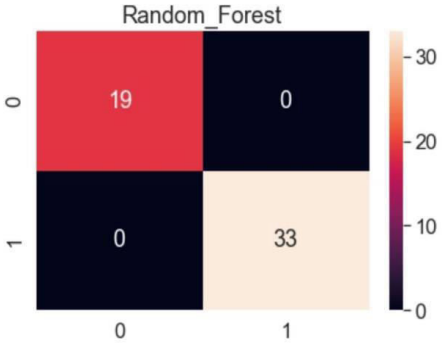
Figure 5. freeCodeCamp

Comparison of Algorithm used

Classification report for KNN

Classification report for Random Forest

	precision	recall	f1-score	support
0	1.00	1.00	1.00	20
1	1.00	1.00	1.00	33
accuracy			1.00	52
macro avg	1.00	1.00	1.00	52
weighted	1.00	1.00	1.00	52



Classification report for Logistic Regression-

	precision	**recall**	**f1-score**	**support**
0	0.52	0.55	0.54	20
1	0.71	0.69	0.70	33

	precisio	**recall**	**f1-score**	**support**
0	0.80	0.80	0.80	20
1	0.88	0.88	0.88	33

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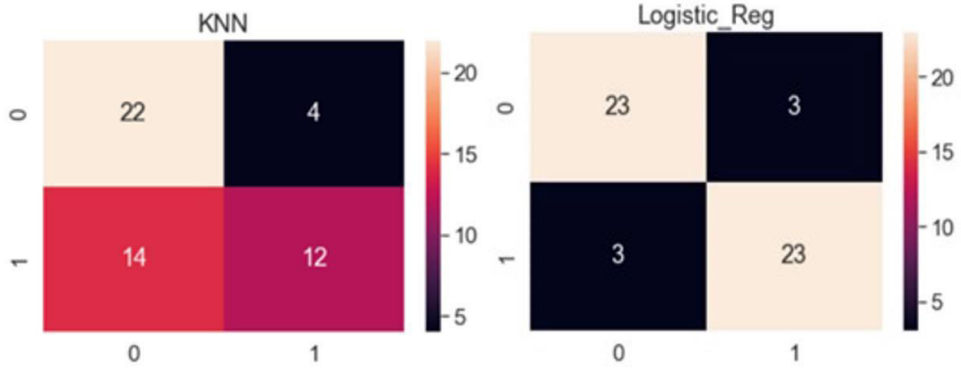
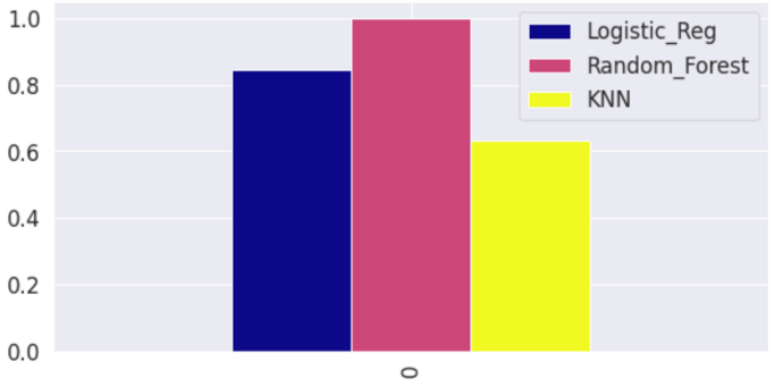
accuracy			0.63	52
macro avg	0.62	0.62	0.62	52
weighted	0.64	0.63	0.64	52

accuracy			0.85	52
macro avg	0.84	0.84	0.84	52
weighted	0.85	0.85	0.85	52



Accuracy Comparison

Logistic Regression	Random Forest	KNN
0.85	1.00	0.63



CONCLUSION AND FUTURE SCOPE

As we can see from the data above, Random forest, followed by Logistic Regression and KNN, is the most accurate Machine Learning method for predicting cardiovascular illness. As a result, we draw the conclusion that Random forest, out of the three algorithms, is the best at predicting heart disease in patients.

Numerous algorithms, including Support vector machines and the Naive Bayes method, are included in the machine learning field. By employing techniques like feature engineering and modifying hyperparameters, these algorithms can be made better.

As a result, we can conclude that in order to get even better results, the same problem should be tackled using different ML algorithms.

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TRADITIONAL STREET FOODS OF MADURAI – A STORE HOUSE OF BACTERIA

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ABSTRACT

Microbial contamination of the street foods sold by street vendors has become a global health problem. The present study was under taken to investigate the microbiological quality of various street vended foods sold in Madurai surrounding. Totally 10 different varieties of sample (UllunthaVada.AamaVada, Onion Vada, Bonda, Sweet BondaMolahabajii. Fish Fry, Chicken Fry, Cauliflower fry, Aapam) were collected for 80 varieties of street foods from surrounding of Madurai. Sample analyzed werecollected aseptically from surroundings of Madurai. Informal observations of the vendors and the vending site were also done. All the samples were subjected to coliform and pathogenic bacteria analysis. The standard procedure of isolation of bacteria from the collected sample in plates was done. This was followed by identification of bacteria using Gram's staining and biochemical test. The identifications were confirmed on selective media. The bacterial colonies were sequential order of assessment the cultured colonies were plated on selective media for confirmation of test. Such as Klebsiella, Salmonella, Bacillus, Enterobacter, Citrobacter, Staphylococcus.Totally the highest count was 16.6×10^{6} *cfu/g in ullunthavadai which was unacceptable and the lowest count was* 11.7×10^{6} *cfu/g in chicken fry. Viable counts of cauliflower fry should* 13.7×10^{9} *cfu/further to this Bonda* 14.2×10^{9} *cfu/g and onion bonda* 13.2×10^{6} *cfu/g, Aapam showed* 13.8×10^{7} *cfu/g.*

Key words: Street food-busy areas- microbial analysis- enteric pathogenic-bacteria- count.

INTRODUCTION

Street-vended foods or its equivalent "street foods" which are defined as foods and beverages prepared and sold by vendors on streets and other public places for immediate consumption or consumption at a later time without further processing or preparation.The accessibility and relatively low prices of street-vended foods relative to the processed and already- packaged foods have increased their reliability to customers [7]. This has also increased their popularity and preference by low- and medium-income earners in developing countries [8].

The Food and Agricultural Organization defines street foods as ready-to-eat foods and beverages prepared and/or sold by vendors and hawkers, especially in streets and other similar public places (1). Street foods provide ready - to - eat and fairly inexpensive priced snacks and meals for a wide variety of people (2, 3). According to (4), temporary food service, such as mobile unit may operate on a more regular basis, but unlike modern food service establishments operate under less than optimum conditions.

Safety of street foods is questionable as in most cases they are prepared under unsanitary conditions by the vendors who are by and large illiterate and have poor personal hygiene. The chances of contamination of these foods increase greatly due to extremely poor environmental condition in which they are prepared and served (7). Street foods are the cause of several types of food - borne disease. The water used for drinking and cleaning purposes is often contaminated due to unhygienic storage and handling. Moreover uses of artificial colours, like metanil yellow, are the cause of serious health

It is suggested that proper hygienic and sanitary conditions has to maintain both personally and institutionally. A continuous monitoring in each activity i.e. from pre-preparation to cleaning is required in street food centers to avoid any food born pathogenic outbreaks in future.

Thus prior to the above research finding an attempt was made for the assessment of bacterial pathogen prevalently in almost consumed street foods.

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MATERIALS AND METHODS

Sample collection

Bacteriological investigations of varieties of street vended foods in surroundings of Madurai were performed. Eighty street food vendors operating in the major streets, colleges, schools and markets of Samples analyzed were **AamaVadai, Ullunthavadai, bonda,Bachji, Cauliflower fry, Fish fry, Cauliflower fry, Chicken fry, and Sweet bonda.** The vending site was a crowded market place with heavy traffic. Vending sites hygiene was determined through observations. Vendors of street foods in the major streets, markets and two schools were recruited. There were approximately 80 vending sites; the persons in charge of the vending points (subsequently referred to as the vendors) were the main subjects of study. Therefore an observational study was used in the assessment of food safety practices (food preparation, cooking and serving) by street food vendors during their trade. The status of nails, smoking, handling of food and money without washing hands in between were observed.

Samples of about 5 g of each food on sale were placed in separate sterile containers and transported to the laboratory once within two hours of collection. A total of 80 samples were collected from selected vending sites in sterile containers. All samples were examined the same day.

Fig: 1. Sample collection - Bacteriological investigations of varieties of street vended foods in surroundings of Madurai

Processing of sample

Five gram of solid portions were taken in a motor and pestle and homogenized with 10ml of phosphate-buffered saline. The small volumes of several diluted samples were mixed with liquid agar that has been cooled to about 45^0c.Total bacterial counts were made by means of plate count method. Around 30–300 colonies were selected and counted after incubation.

Microbiologicalanalysis included enumeration and identification of potentialpathogens according to standard procedures for the number ofheterotrophic bacteria i.e. *E. coli* and *S. typhi*(**8).** All plateswere incubated under aerobic conditions at 36±1°C for 24 – 48hrs. The calculated number of colonies was expressed as colonyforming units (cfu)/100 ml.

COLIFORM COUNT

Coliform counts of the street food were determined by using membrane filter technique.

The plates were incubated at 35°C for 24 hours and colonies of coliforms were determined. (9)

RESULT

Street vended foods are analyzed for bacteriologicalexaminations from different locations of Madurai. In thisstudy, the bacteriological condition of different portions of food samples was studied where, we found that the pathogenic bacteria such aswas present abundantly in number than theviable count of the aerobic bacteria are also studied which washigher in the numbers, thus most of the food samples were within acceptable range but not satisfactory.

The highest count was 16.6×10^6cfu/g in UlundhaVadai which was unacceptable and the lowest count was 11.7×10^6cfu/g in chicken fry. It showed that chicken burger sample contained a variety of bacterial load. Viable count of Cauliflower fry exhibited 13.7×10^9cfu/g, further to this Bonda 14.2×10^9cfu/g and onion Bonda 13.2×10^6cfu/g, Aapam showed 13.8×10^7cfu/g showed respectively. (Table: 1)

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S. No	Food samples	Total bacterial count (CFU/ml)	Total Coliform count (CFU/ml)
1.	UllunthaVadai	1.66×10^{7}	-
2.	AamaVadai	1.27×10^{6}	1.17×10^{3}
3.	Bonda	14.2×10^{9}	1.07×10^{4}
4.	Sweet Bonda	1.32×10^{5}	-
5.	MolahaBajii	1.54×10^{9}	-
6.	Fish fry	1.21×10^{8}	-
7.	Chicken Fry	1.17×10^{7}	-
8.	Cauliflower Fry	13.7×10^{9}	1.0×10^{3}
9.	Aapam	1.38×10^{8}	-
10	Onion vadai	1.32×10^{7}	1.2×10^{3}

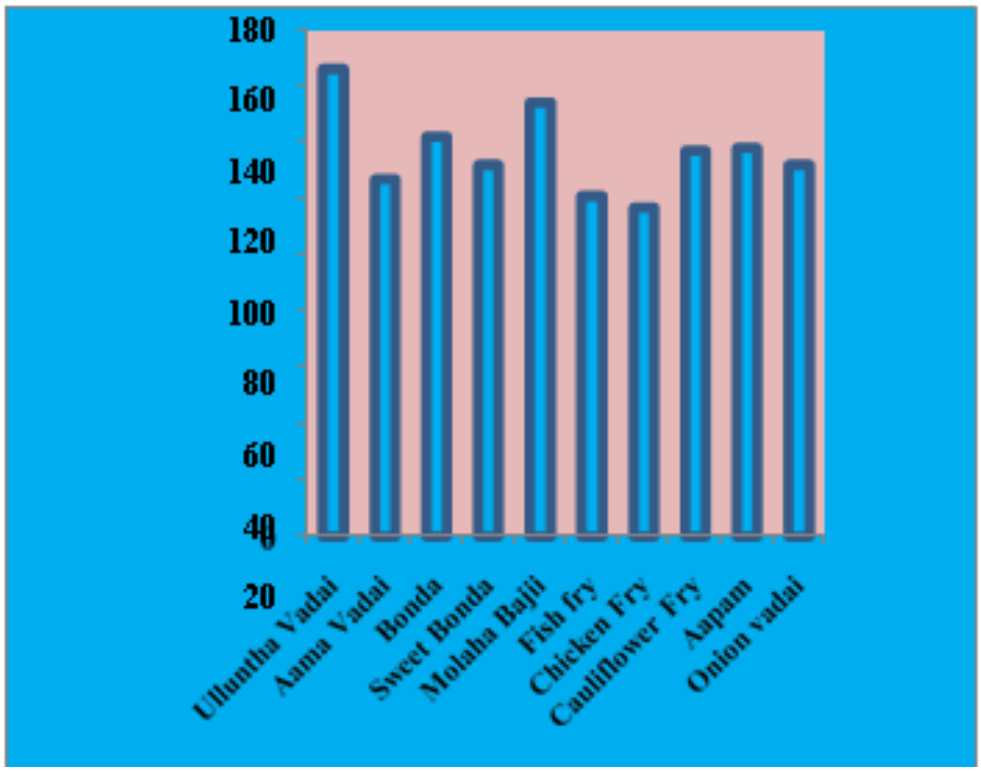

Table: 1. Total number of colonies present in street foods

The bacterial count was performed by standard method. Total viable bacterial count (TVBC) was done by the standard plate count method following the method described (10) using nutrient agar (NA). MacConkey Agar (MAC) was used for the detection of coliforms &fecalcoliforms; Xylose-Lysine-Deoxycholate (XLD) agar for isolation of *Salmonella* sp. and for

***E. coli* Eosin Methylene Blue (EMB) agar was also used.**

Bacterial isolates were identified by their microscopic, cultural and biochemical characteristics according to the Bergey's Manual of Systematic Bacteriology.

The results indicates the presence of pathogenic microorganisms belonging to the genera ***Staphylococcus, Klebsiella, Salmonella, Actinobacillus, Enterobacteriaceae and Citrobacter***. The results were tabulated in Table: 2.

Table: 2. Morphological and Biochemical characteristics of bacterial isolates collected from street foods.

Parameters	**Organisms**					
	Isolate 1		Isolate 1		Isolate 1	
Gram Staining	Positive	Gram Staining	Positive	Gram Staining	Positive	Gram Staining
Shape	Cluster Cocci	Shape	Cluster Cocci	Shape	Cluster Cocci	Shape
Catalase Test	Positive	Catalase Test	Positive	Catalase Test	Positive	Catalase Test
Citrate Test	Negative	Citrate Test	Negative	Citrate Test	Negative	Citrate Test
Indole Test	Negative	Indole Test	Negative	Indole Test	Negative	Indole Test
Methyl-Red Test	Negative	Methyl-Red Test	Negative	Methyl-Red Test	Negative	Methyl-Red Test
Voges-Proskaue Test	Negative	Voges-Proskaue Test	Negative	Voges-Proskaue Test	Negative	Voges-Proskaue Test
Triple Sugar Iron Test	Negative	Triple Sugar Iron Test	Negative	Triple Sugar Iron Test	Negative	Triple Sugar Iron Test
Growth In Mannitol	Bright Yellow	Growth In Mannitol	Bright Yellow	Growth In Mannitol	Bright Yellow	Growth In Mannitol

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Salt Agar		Salt Agar		Salt Agar		Salt Agar
Xylose Lysine Dextrose Agar	Pink Colour	Xylose Lysine Dextrose Agar	Pink Colour	Xylose Lysine Dextrose Agar	Pink Colour	Xylose Lysine Dextrose Agar
Genus	*Staphylococcus aureus*	Genus	*Staphylococcus aureus*	Genus	*Staphylococcus aureus*	Genus

DISCUSSION

Selling of street foods is an indispensables component of food distribution systems in many csities in developing countries, contributing significantly to food security and nutrition.

Street food is convenient and economically accessible and nutrient needs, while at the same generates employment in urban areas. This is important in alleviate daily poverty as the major causative factor in food in security (11).

Under cover of flies, rain, wind wastes are dispersed can be transported to uncover street-vended foods and cause the physical and microbiological contaminations. Considering the number of daily consumers of street foods, the number of diseased people will be important in case of consumption of contaminated foods. Thus street food importance has consequence suchas is association in case of microbiological equality failure (12)

These street foods provide an affordable source of nutrients to most of the lower income sectors of the population who appreciate the food due to its taste, low price, and availability at the right time (5). However, street foods are frequently associated with diarrheal diseases due to improper handling and serving practices (13,14,15).

The highest frequencies of occurrence of bacterial pathogens were *Pseudomonas aeruginisa* In samosa (25%), E.coli in kachori(32%) *S.aureus* in kachori (27%).Proteus.sp in palakwada (45%) and 36% salmonella's in samosa. All food samples were contaminated with bacterial pathogens with a total of 92 enteric isolates identified.

In accordance with our present several previous researchers has reported the presence of coli forms in meat products. (18)

The bacterial isolates from all samples collected were*B.cereus,S.aureus,E.coli* and *K.pneumonia .B.cereus and E.coli* were the prevalent bacteria isolates. Both microorganisms were present in 37.5% of the samples.The*S.cerevisae* and*A.niger* occurred in 50 and 12.5% of samples respectively. The results displayed that fried rice contains more microorganisms(*B.cereus* and *S.aureus*) in comparison with other rice preparations. And the higher colony count (1.2×10^6) this result is similar to that reported (16,17,).

CONCLUSION

Our result intimate that most of street fried foods samples examined did not meet bacteriological quality standards. Those pathogenic bacteria are readily available in vendedfood products. These bacteria are liable to cause food infections, food intoxications and /orfood poisoning. Further studies are required on the seasonal prevalence of these bacteria inthe different food samples and the antibiotic sensitivity or resistance patterns of the isolates.These results may be helpful to public health officers to identify foods that are of high risk tocause infections and to advice food hawkers on good hygienic practices. Hence we suggest improving the hygienic measures and the conservation practices in order to minimize the microbial contamination.

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MODELLING THE PREY-PREDATOR DYNAMICS INVOLVING COMMENSAL SPECIES UNDER THE EFFECT OF TIME LAG

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ABSTRACT

This study develops a multi-species system with delay, in which two competitive animals and a predator species that is somehow connected to alternate prey, and the predator species is meant to help commensal species. The state variables under discussion are P_1 P_2, *and*P_d. *The internal equilibrium point is computed. A local satiability analysis is conducted on the feasible interior equilibrium. The effect of the delay parameter on the behaviour is studied. When the delay parameter surpasses a certain value, Hopf bifurcation occurs. The Centre manifold theorem is also used to determine direction. MATLAB was utilized to graphically support analytical results.*

Keywords: Prey-Predator population, Stability, Equilibrium point, Delay parameter, Hopf bifurcation.

1. INTRODUCTION

The importance of the system's species interactions, such as qualitatively stability, time dependent, predation, mutualism, commensalism etc., are interesting essential issue to research. Several prey-predator models have been investigated in terms of various types of functional responses (May, (1973), Cushing, (1977), Goh, (1979), Dickman, (1992), Prasad et al. (2012), Chakraborty et al. (2013), Kumar et al. (2022)) etc.

The researcher concluded that how to investigate a scenario when its major results appear to be empirically wrong. Because the theory is analytically correct and, in a way, tautological, the author attempted to determine what happened to cause its empirical falsification Hutchinson, (1961). The writers found that when investigating the dynamics of the predator-prey relationship, they used two key paths. The authors also remarked that while this technique is undoubtedly important for a comprehensive knowledge of every individual predator-prey relationship, it is ineffective for making broad conclusions about two major ecological issues (Rosenzweig et al. 1963). Author

discovered a link between complexity and sustainability in multispecies ecosystems, May, (1973).

The basic hypothesis that the coefficients are periodic functions of time modifies the overall system of differential equations representing predator-prey dynamics. Author also calculated that system has periodic solution, Cushing, (1977). The author concluded extremely generic nonlinear mutualism models and some easy tests to evaluate a nonlinear mutualism model if it is globally stable or stable in a finite region. Author also discovered that mutualistic systems are more accessible to mathematical study than competition and prey-predator dynamics, Goh, (1979). The author presented that Hydra plays a significant role in prey population control. The author observed that hydra population density increased from June to a peak in late July or early August, then remained stable or slightly decreased through late August (Cuker et al. 1981). Commensal and mutualistic interactions occur often across terrestrial vertebrate species and have significant but mostly unmeasured consequences on individual fitness. Because all commensal and mutualistic relationships among terrestrial vertebrates occurs naturally, Dickman (1992). Researchers used a chaotic ecological model to improve ecological intuition, and it was concluded that simplified arithmetic models have served and will continue to play an important role in comprehending exactly what kinds of behaviors may occur in natural habitats (Sabin et al. 1993). Authors used the press perturbation approach to evaluate the intensity of overall impacts of connections among phytoplankton and bacteria at the stable state under these coexistence circumstances. This implies that a mutualistic condition might arise as a result of the reason when element carbon pass from phytoplankton to bacteria, even though phytoplankton and bacteria fight for the same resource, inorganic phosphorus (Aota et al. 2001).

Dingoes affected the previous human economy through competition for big prey because they have such a severe impact on kangaroo population reduction in modern ecology and the human economy. Authors acknowledge that there is a problem in isolating all independent circumstances and individuals who collaborate to generate an example of this kind in our hypothesis archaeological query (Fillios et al. 2010).

Researchers observed that, when surrounding fluctuations are considered, the provision of more food is insufficient to govern the behaviour of a predator-prey ecosystem (Sahoo et al. 2011). Authors used a multi-framework with Holling II impulse response with two delays. Explicit equations used for calculating the course of the Hopf bifurcation. For stability of bifurcating periodic solutions author used the normal form approach and the Centre manifold theorem (Meng et al. 2011). Authors demonstrated that a continuous pace of resource harvesting results in a decline in commensal density, which eventually diminishes the intensity of commensal mediation (Prasad et al. 2012). Authors focused to analysis a Multiple Species Sync an environment having Commensal Predator-Prey Couple and Host Predator-Prey Pair (Normal Steady state). The system includes of a Predator and a prey that depends only on prey to survived, and two Carriers for whom above prey predator are commensal. The Regular Constant Condition has been formed. If all of eigen values are negative, if values are real, and have negative real character, if the values are not real (complex), the solution is sustainable (Chakraborty et al. 2013).

The functional mechanisms that happen when invasive commensal species intrude on native forest observed (Banks et al. 2015). The authors demonstrated a numerical investigation on an ecological model that includes a commensal and a host with restricted resources. This model takes into account a wide range of values for the parameters and numerous restrictions are depicted. The interactions of the organisms have been found (Rao et al. 2015). Authors used multiple sync-ecosystem which consists of a commensal predator & two hosts with assumption species have a plenty of food. Using the model equations, all viable equilibrium states are discovered in two phases, and conditions for its stability are addressed, Prasad, (2015). Researchers investigates the viability of a multiple sync eco-system with a commensal death rate. The system is made up of a commensal and multiple hosts. The global stability is established using an appropriately designed Lyapunov's function-pair, and the organisms' increases are statistically determined using the R-K Forth order technique (Prasad et al. 2015).

A multiple system with two competing species that are logistically developing in a vicinity studied. Using numerical modelling, the reason of coexistence was determined to be commensalism (Gakkhar et al. 2016). Authors studied a multiple ecosystem wherein two organisms associate directly and the other is a predator organism that predates on both mutual organisms, all while dealing with limited resources. Researchers examined the effect of increasing values of the inhibition coefficient of the second mutual organisms and solve this model by R-K forth order (Kumar et al. 2017). Authors assessed the behaviour of land use changes between 2007 and 2016, identifying the impact of these changes on the vegetation of the Atlantic Forest. In the Land Change Modeler, the evaluation of land use changes and ecological losses was modelled, and the benefits and losses for each category, as well as their future scenarios, were determined. Landscape metrics were calculated using the ArcGIS V-LATE plugin (Lopes et al. 2018). Author proposed and investigated a multiple commensal relationship model with Allee effect and one party that cannot exist alone. Sufficient criteria are discovered to ensure the border equilibrium's and positive equilibrium's local and global stability, respectively. The Allee effect causes instability in the system, although it is controllable, Chen, (2018). Authors used AB fractional derivative to analyze specific computational properties of a three-species prey–predator model in mathematical biology, Ghanbari, (2020). Delay play an important role in such type of mathematical model, so delay should be included in such cases to study the dynamical behaviour of these types of mathematical model systems (Kumar et al. 2022).

2. MATHEMATICAL MODEL

We proposed a three-species model with time lag, which includes two competitive populations P_1, P_2 and a predator species P_d that is partly tied to alternate prey and is expected to help commensal species. The mathematical model is represented by following non-linear ordinary differential equations:

$$\frac{dP_1}{dt} = p_1 P_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_1 P_2 + b_1 P_1 P_d \qquad (1)$$

$$\frac{dP_2}{dt} = p_2 P_2 \left(1 - \frac{P_2}{K_2}\right) - y_1 P_1 P_2 - A_1 c_1 P_2 P_d \qquad (2)$$

$$\frac{dP_d}{dt} = A_1 c_1 e_1 P_2(t-\tau)P_d + (1-A_1)P_d - z_1 P_d - z_2 P_d^2 \qquad (3)$$

Where $\tau > 0$ is the time lag necessary for predator's gestation period. Where P_1(commensal species), P_2(focal prey species) and P_d(predator) populations at any time(t).

All of the parameters have positive values, i.e.,$p_1, p_2, x_1, y_1, b_1, A_1, c_1, e_1, z_1 \; and \; z_2$are more than zero. $A_1$is a constant which does not depend of time and its origin is alternative resource. If $A_1 = 1$ the predator totally depends on prey species. $A_1 = 0$, then no interaction between prey and predator. In this condition, predation of prey is zero and predator population depends on alternate food source. Here we are not considered such type of model. A predator which depends on two sources for food is given by $0 < A_1 < 1$.

The parameters and variables used in the model are described in Table 1.

Table 1. Description of the parameters and variables:

Variables/Parameters	Description
P_1	Density of commensal species
P_2	Prey population
P_d	Predator population
p_1	Natural growth rate of P_1
p_2	Natural growth rate of P_2
K_1	Environmental carrying capacity for P_1
K_2	Environmental carrying capacity for P_2
x_1	Interspecific competition coefficient between P_1 and P_2
y_1	Interspecific competition coefficient between P_1 and P_2
b_1	Interspecific commensalism coefficient due to presence of predator
z_1	Death rate of predator species
z_2	Intraspecific competition rate of predator species
τ	Gestation period of Predator
c_1	Predation rate of predator

e_1	Conversion rate of the prey biomass to predator biomass
A_1	Time independent constant

Equilibrium Point

$$\frac{dP_d}{dt} = 0$$

$$A_1c_1e_1P_2P_d + (1 - A_1)P_d - z_1P_d - z_2P_d^2 = 0$$

$$P_d[A_1c_1e_1P_2 + (1 - A_1) - z_1 - z_2P_d] = 0$$

Either $P_d = 0$ or $A_1c_1e_1P_2 + (1 - A_1) - z_1 - z_2P_d = 0$

$$A_1c_1e_1P_2 = -(1 - A_1) + z_1 + z_2P_d$$

$$P_2 = \frac{-(1 - A_1) + z_1 + z_2P_d}{A_1c_1e_1} \qquad (4)$$

$$\frac{dP_2}{dt} = 0$$

$$p_2P_2\left(1 - \frac{P_2}{K_2}\right) - y_1P_1P_2 - A_1c_1P_2P_d = 0$$

$$P_2\ [\ p_2\left(1 - \frac{P_2}{K_2}\right) - y_1P_1 - A_1c_1P_d] = 0$$

Either $P_2 = 0$ or $[\ p_2\left(1 - \frac{P_2}{K_2}\right) - y_1P_1 - A_1c_1P_d] = 0$

$$[\ p_2\left(1 - \frac{P_2}{K_2}\right) - y_1P_1 - A_1c_1P_d] = 0$$

Substitute the value of P_2 from equation (4)

$$[\ p_2\left(1 - \frac{\frac{-(1 - A_1) + z_1 + z_2P_d}{A_1c_1e_1}}{K_2}\right) - y_1P_1 - A_1c_1P_d] = 0$$

$$[\ p_2\left(1 - \{\frac{-(1 - A_1) + z_1 + z_2P_d}{A_1c_1e_1K_2}\}\right) - y_1P_1 - A_1c_1P_d] = 0$$

$$p_2[A_1c_1e_1K_2 + (1 - A_1) - z_1 - z_2P_d] - A_1c_1e_1K_2y_1P_1 - A_1^2\ c_1^2e_1K_2\ P_d = 0$$

$$(-A_1^2\, c_1^2 e_1 K_2\, P_d - p_2 z_2)P_d - A_1 c_1 e_1 K_2 y_1 P_1 + p_2 A_1 c_1 e_1 K_2 + p_2(1 - A_1) - p_2 z_1 = 0 \quad (5)$$

$$\frac{dP_1}{dt} = 0$$

$$p_1 P_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_1 P_2 + b_1 P_1 P_d = 0$$

$$P_1[p_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_2 + b_1 P_d\ ] = 0$$

Either$P_1 = 0\ or\ [p_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_2 + b_1 P_d\ ] = 0$

$$[p_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_2 + b_1 P_d\ ] = 0$$

$$[p_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_2 + b_1 P_d\ ] = 0$$

$$P_1[p_1 \left(1 - \frac{P_1}{K_1}\right) - x_1 P_2 + b_1 P_d\ ] = 0$$

Substitute the value of P_2 from from equation (4)

$$P_1[p_1 \left(1 - \frac{P_1}{K_1}\right) - x_1\{\frac{-(1 - A_1) + z_1 + z_2 P_d}{A_1 c_1 e_1}\} + b_1 P_d\ ] = 0$$

$$(A_1 c_1 e_1 K_1 b_1 - x_1 K_1 z_2)P_d - A_1 p_1 c_1 e_1 P_1 + A_1 e_1 p_1 c_1 K_1 + x_1 K_1 (1 - A_1) - x_1 K_1 z_1 = 0 \quad (6)$$

Multiply (5) by $-p_1$ and (6) by $K_2 y_1$ then add we get

$$P_d = \frac{(1-A_1)(p_1 p_2 - K_2 K_1 x_1 y_1) + A_1 K_2 p_1 p_2 e_1 c_1 - A_1 K_2 p_1 p_2 e_1 c_1 - A_1 K_1 K_2 p_1 y_1 e_1 c_1 + K_2 K_1 x_1 y_1 z_1}{p_1 p_2 z_2 + K_2 A_1^2\, c_1^2 p_1 e_1 + A_1 K_1 K_2 b_1 y_1 e_1 c_1 - K_1 K_2 x_1 y_1 z_2}$$

(7)

2.2Equilibrium points of the system

The system of equation (1)-(3) have eight feasible equilibrium point

a) Trivial (Improper) Equilibrium point $E_1 \equiv (0,0,0)$

b) Axial Equilibrium point

Put $P_2 = 0$ and $P_d = 0$ in equation (1)

$$p_1 P_1 \left(1 - \frac{P_1}{K_1}\right) = 0$$

$$\left(1 - \frac{P_1}{K_1}\right) = 0$$

$$1 = \frac{P_1}{K_1}$$

$$P_1 = K_1$$

$$E_2 \equiv (K_1, 0, 0)$$

Put $P_1 = 0$ and $P_d = 0$ in equation (2)

$$p_2 P_2 \left(1 - \frac{P_2}{K_2}\right) = 0$$

$$\left(1 - \frac{P_2}{K_2}\right) = 0$$

$$P_2 = K_2$$

$$E_3 \equiv (0, K_2, 0)$$

Put $P_1 = 0$ and $P_2 = 0$ in equation (3)

$$(1 - A_1)P_d - z_1 P_d - z_2 P_d^2 = 0$$

$$[(1 - A_1) - z_1 - z_2 P_d]P_d = 0$$

$$(1 - A_1) - z_1 - z_2 P_d = 0 \quad \text{as } P_d \neq 0$$

$$(1 - A_1) - z_1 = z_2 P_d$$

$$P_d = \frac{(1 - A_1) - z_1}{z_2} \quad \text{let } m_1 = (1 - A_1) - z_1$$

$$E_4 \equiv \left(0, 0, \frac{m_1}{z_2}\right) \quad \text{exists if } A_1 + z_1$$

$$< 1 \qquad (8)$$

c) Boundary equilibrium point:

When $P_2 = 0$ from equation (3)

we get $P_d = \frac{m_1}{z_2}$

From equation (1) we get

$$p_1 P_1 \left(1 - \frac{P_1}{K_1}\right) + b_1 P_1 P_d = 0$$

$$\left[p_1 \left(1 - \frac{P_1}{K_1}\right) + b_1 P_d\right] P_d = 0$$

$$p_1 \left(1 - \frac{P_1}{K_1}\right) + b_1 \frac{m_1}{z_2} = 0$$

$$p_1 \left(1 - \frac{P_1}{K_1}\right) = -b_1 \frac{m_1}{z_2}$$

$$P_1 = \frac{b_1 m_1 K_1 + p_1 K_1 z_2}{p_1 z_2}$$

$$E_5 \equiv \left(\frac{b_1 m_1 K_1 + p_1 K_1 z_2}{p_1 z_2}, 0, \frac{m_1}{z_2}\right) = (X_1, 0, Z_1) \qquad (9)$$

Thus E_5 exists if (8) is satisfied.

Similarly, when $P_d = 0$ we obtain

$$E_6 \equiv \left(\frac{-p_2 x_1 K_2 K_1 + p_1 K_1 p_2}{p_1 p_2 - y_1 x_1 K_2 K_1}, \frac{-p_1 y_1 K_2 K_1 + p_1 K_2 p_2}{p_1 p_2 - y_1 x_1 K_2 K_1}, 0\right) = (X_2, Y_{2,} 0) \qquad (10)$$

Thus E_6 exists only if

$$p_2 > y_1 K_1 \qquad (11)$$

$$p_1 > x_1 K_2 \qquad (12)$$

And when $P_1 = 0$ we obtain

$$E_7 \equiv \left(0, \frac{-c_1 m_1 K_2 A_1 + z_2 K_2 p_2}{z_2 p_2 + A_1^2 c_1^2 e_1 K_2}, \frac{c_1 e_1 p_2 K_2 A_1 + m_1 p_2}{z_2 p_2 + A_1^2 c_1^2 e_1 K_2}, 0\right) = (0, Y_{3,} Z_3)$$

d) $E_8 \equiv (P_1^*, P_2^*, P_d^*) \equiv (X_4, Y_{4,} Z_4)$ interior equilibrium point.

Substitute the value of P_d in (6) to find the value of P_1 we get

$P_1^* = \frac{B_1}{B_2}$, $P_2^* = \frac{B_3}{B_2}$, $P_d^* = \frac{B_5}{B_6}$ where

$$B_1 = (A_1K_1b_1e_1c_1 - x_2K_1z_2)\{A_1K_2p_1p_2e_1c_1 + p_1p_2(1 - A_1) - A_1K_1K_2p_1e_1c_1y_1 - K_1K_2x_2y_1(1 - A_1) + K_1K_2x_2z_1y_1\} + (p_1p_2z_2 + A_1^2\, c_1^2p_1e_1K_2 + K_1K_2A_1b_1y_1e_1c_1 - K_1K_2x_2y_1z_2)(A_1K_1p_1e_1c_1 + K_1x_2(1 - A_1) - x_2K_1z_1)$$

$$B_2 = (p_1p_2z_2 + A_1^2\, c_1^2p_1e_1K_2 + A_1K_1K_2b_1e_1c_1y_1 - K_1K_2x_2y_1z_2)(A_1p_1e_1c_1)$$

$$B_3 = \{-(1 - A_1) + z_1\}(p_1p_2z_2 + A_1^2\, c_1^2p_1e_1K_2 + A_1K_1K_2b_1e_1c_1y_1 - K_1K_2x_2z_2y_1) + z_2\{A_1K_2p_1e_1c_1p_2 + p_1p_2(1 - A_1) - p_1p_2z_1 - A_1K_1K_2p_1e_1c_1y_1 - K_1K_2x_2y_1(1 - A_1) + K_1K_2y_1x_2z_1$$

$$B_5 = (1 - A_1)(p_1p_2 - K_2K_1x_1y_1) + A_1K_2p_1p_2e_1c_1 - A_1K_2p_1p_2e_1c_1 - A_1K_1K_2p_1y_1e_1c_1 + K_2K_1x_1y_1z_1$$

$$B_6 = p_1p_2z_2 + K_2A_1^2\, c_1^2p_1e_1 + A_1K_1K_2b_1y_1e_1c_1 - K_1K_2x_1y_1z_2$$

2.3 Stability

Now stability of above system of equation is calculated

$$n_1 = p_1 - \frac{2p_1P_1}{K_1} - x_1P_2 + b_1P_d$$

$$n_2 = -y_1P_2$$

$$n_3 = 0$$

$$n_4 = -x_1P_1$$

$$n_5 = p_2 - \frac{2p_2P_2}{K_2} - y_1P_1 - A_1c_1P_d$$

$$n_6 = A_1c_1e_1P_de^{-\lambda\tau}$$

$$n_7 = b_1P_1$$

$$n_8 = -A_1c_1P_2$$

$$\mathrm{n_9} = (1 - \mathrm{A_1}) - \mathrm{z_1} - 2\mathrm{z_2P_d}$$

3. Dynamical behaviour when $\tau = 0$

variational matrix for system (1)-(3) is

W=

$$\begin{vmatrix} p_1 - \frac{2p_1P_1}{K_1} - x_1P_2 + b_1P_d & -y_1P_2 & 0 \\ -x_1P_1 & p_2 - \frac{2p_2P_2}{K_2} - y_1P_1 - A_1c_1P_d & A_1c_1e_1P_de^{-\lambda\tau} \\ b_1P_1 & -A_1c_1P_2 & (1-A_1) - z_1 - 2z_2P_d \end{vmatrix} =$$

0

At $E_1 \equiv (0,0,0)$ variational matrix reduced to

$$W_1 = \begin{vmatrix} p_1 & 0 & 0 \\ 0 & p_2 & 0 \\ 0 & 0 & (1-A_1) - z_1 \end{vmatrix} = 0$$

The latent values of the characteristic matrix W_1at equilibrium point $E_1$are p_1, p_2 and $(1-A_1) - z_1$, so the critical value E_1 of the system (1)-(3) is not stable.

At $E_2 \equiv (K_1, 0,0)$ the characteristic matrix transformed to

$$W_2 = \begin{vmatrix} p_1 - \frac{2p_1K_1}{K_1} & -x_1K_1 & b_1K_1 \\ 0 & p_2 - y_1K_1 & 0 \\ 0 & 0 & (1-A_1) - z_1 \end{vmatrix} = 0$$

The latent root of the system is $-p_1$, $p_2 - y_1K_1$ and $(1-A_1) - z_1$ and the system (1)-(3) is stable if $p_2 - y_1K_1 < 0$ that is $p_2 < y_1K_1$ and $(1-A_1) - z_1 < 0$.

At $E_3 \equiv (0, K_2, 0)$ the characteristic matrix is transformed to

$$W_3 = \begin{vmatrix} p_1 - x_1K_2 & 0 & 0 \\ -y_1K_2 & -p_2 & -A_1c_1K_2 \\ 0 & 0 & (1-A_1) - z_1 \end{vmatrix} = 0$$

The latent root of the system is $p_1 - x_1K_2$, $-p_2$and $(1-A_1) - z_1$ and system (1)-(3) is stable if

$p_1 - x_1K_2 < 0$ and $(1-A_1) - z_1 < 0$.

At $E_4 \equiv \left(0,0,\frac{m_1}{z_2}\right)$ the characteristic matrix transformed to

$$W_4=\begin{vmatrix} p_1+\frac{b_1 m_1}{z_2} & 0 & 0 \\ 0 & p_2-c_1A_1\frac{m_1}{z_2} & 0 \\ 0 & c_1e_1A_1\frac{m_1}{z_2} & (1-A_1)-z_1-2m_1 \end{vmatrix}=0$$

The latent roots of the characteristic matrix W_4 at equilibrium point E_4 are $p_1+\frac{b_1m_1}{z_2}$, $p_2-c_1A_1\frac{m_1}{z_2}$ and $(1-A_1)-z_1-2m_1$, so equilibrium point of the system (1)-(3) is not stable.

At E_5 the latent roots are $-p_1X_1$, $p_2-y_1X_1-c_1Z_1A_1$and $-z_2Z_1$ so the critical values of the system (1)-(3) stable only if $p_2<y_1X_1+c_1Z_1A_1$.

At equilibrium point E_6, the characteristic equation of W is:

$$(c_1e_1A_1Y_2+m_1-\lambda)(\lambda^2+\left(p_1\frac{X_2}{K_1}+p_2\frac{Y_2}{K_2}\right)\lambda+p_1p_2\frac{X_2Y_2}{K_1K_2}-x_1y_1X_2Y_2)=0$$

(13)

The equilibrium point E_6 is locally asymptotically stable if $c_1e_1A_1Y_2+1<A_1+z_1$.

At equilibrium point E_7, the characteristic equation of W is:

$$(p_1-x_1Y_3+b_1Z_3-\lambda)\left(\lambda^2+\left(p_2\frac{Y_3}{K_2}+z_2Z_3\right)\lambda+p_2\frac{Y_3}{K_2}z_2Z_3+A_1^2\,c_1^2e_1Y_3Z_3\right)=0$$

(14)

The equilibrium point E_7 is locally asymptotically stable if $p_1+b_1Z_3<x_1Y_3$.

Now, using the Gerschgorin circle of the variational matrix W at equilibrium point E_8, determine if the eigenvalues have a negative real portion.

$$\frac{p_1}{K_1}>x_1+b_1 \qquad (15)$$

$$\frac{p_2}{K_2}>y_1+c_1A_1 \qquad (16)$$

$$z_2>e_1c_1A_1 \qquad (17)$$

Following are some observations based on the preceding discussion:

a. The sum of the commensalism rate (b_1) and interspecific competition rate $(x_1)$of P_1 are less than the ratio of its intrinsic growth rate and carrying capacity.

b. The sum of interspecific competition rate (y_1)and the product of predation rate (c_1)of P_2 with alternative food source constant $A_1$is less than the ratio of its intrinsic growth rate and carrying capacity.

c. The product of predation rate (c_1), conversion efficiency of predator and alternative food source constant A_1 is less than the intraspecific competition rate of predator.

3.1 The behaviour of system when delay $\tau > 0$

The system's characteristic equations (1)-(3) at the equilibrium point E_8 is

$$\begin{vmatrix} -\frac{p_1 X_4}{K_1} - \lambda & -x_1 X_4 & b_1 X_4 \\ -y_1 Y_4 & -\frac{p_2 Y_4}{K_2} - \lambda & -c_1 A_1 Y_4 \\ 0 & A_1 c_1 e_1 Z_4 e^{-\lambda\tau} & -z_2 Z_4 - \lambda \end{vmatrix} = 0$$

The characteristic equation is

$$\lambda^3 + T_1\lambda^2 + T_2\lambda + T_3 + e^{-\lambda\tau}(L_1\lambda + L_2) = 0 \qquad (18)$$

Where $T_1 = \frac{p_1 X_4}{K_1} + \frac{p_2 Y_4}{K_2} + z_2 Z_4$

$$T_2 = -x_1 y_1 X_4 Y_4 + \frac{p_1 p_2 X_4 Y_4}{K_1 K_2} + \frac{p_1 z_2 X_4 Z_4}{K_1} + \frac{p_2 z_2 Y_4 Z_4}{K_2}$$

$$T_2 = -x_1 y_1 z_2 X_4 Y_4 Z_4 + \frac{z_2 p_1 p_2 X_4 Y_4 Z_4}{K_1 K_2}$$

$$L_1 = A_1^2\, c_1^2 e_1 Y_4 Z_4$$

$$L_2 = A_1 e_1 b_1 y_1 c_1 X_4 Y_4 Z_4 + \frac{A_1^2\, c_1^2 e_1 p_1 X_4 Y_4 Z_4}{K_1}$$

Equilibrium point is stable if all latent values of (18) must have negative real part. It is not easy to find the condition when all eigen values of equation (18) have negative real part. When delay is zero($\tau = 0$) then equation (18) reduces to

$$\lambda^3 + T_1\lambda^2 + (T_2 + L_1)\lambda + (T_3 + L_2) = 0 \qquad (19)$$

By Routh-Hurwitz criterion

$(\boldsymbol{H_1})$ $if\ T_1 > 0,\ (T_3 + L_2) > 0,\ T_1(T_2 + L_1) > (T_3 + L_2)\ hold$ only if all eigen values of equation (19) have negative real value.

Let us assume $\lambda = 0$ is solution of (18) then $(T_3 + L_2) = 0$. Thus, this result opposes to the second assumption given in $(\boldsymbol{H_1})$. So, $\lambda = 0$ does not satisfy equation (18). Let us consider that for some $\tau \geq 0$, $i\omega$ with $\omega > 0$ is a solution of (18), then

$$-i\,\omega^3 - T_1\omega^2 + iT_2\omega + T_3 + e^{-\omega\tau}(iL_1\omega + L_2) = 0$$

$$-i\,\omega^3 - T_1\omega^2 + iT_2\omega + T_3 + (cos\,\omega\tau - isin\,\omega\tau)(iL_1\omega + L_2) = 0 \qquad (20)$$

Separating imaginary and real parts

$$-T_1\omega^2 + T_3 + L_2 cos\,\omega\tau + L_1 isin\,\omega\tau = 0 \qquad (21)$$

$$-\omega^3 + T_2\omega + L_1 \cos\omega\tau - L_2 isin\,\omega = 0 \qquad (22)$$

Which gives

$$\omega^6 + f\omega^4 + g\omega^2 + h = 0 \qquad (23)$$

Where $f = T_1^2 - 2\mathrm{T}_2$, $g = T_2^2 - L_1^2 - 2\mathrm{T}_1\mathrm{T}_3$, $h = T_3^2 - L_2^2$.

Let $u = \omega^2$, equation (23) becomes,

$$u^3 + fu^2 + gu + h = 0 \qquad (24)$$

$$k(u) = u^3 + fu^2 + gu + h$$

Lemma1. we have the following results, for the polynomial equation (24)

1) If $z\ less\ then\ 0$,so equation (24) has at least one positive root.

2) If $z\ greater\ then\ equal\ to\ 0$ and $(x^2 - 3y) \leq 0$, so equation (24) has only negative root.

3) if $z\ greater\ then\ equal\ to\ 0$ and $(x^2 - 3y) > 0$, so equation (24) has no negative root iff

$$\upsilon = \frac{-x \pm (x^2 - 3y)}{3} > 0\ and\ h(\upsilon) \leq 0$$

Proof. Let us assume that at least one positive root for equation (24)

$$\mu_0 = \sqrt{\alpha_0}$$

From equation (21) and equation (22), we obtain,

$$\cos \mu_0 \tau = \frac{-\left(L_1 \mu_0^2 (T_2 - \mu_0^2) + (T_3 - T_1 \mu_0^2)(L_2)\right)}{(L_2)^2 + (L_1 \mu_0)^2} \tag{25}$$

$$\tau_j = \frac{1}{\mu_0}\, a\gamma c \cos\left(\frac{-\left(L_1 \mu_0^2 (T_2 - \mu_0^2) + (T_3 - T_1 \mu_0^2)(L_2)\right)}{(L_2)^2 + (L_1 \mu_0)^2} + 2j\pi\right) \tag{26}$$

where j takes values 0, 1, 2,3...

Lemma 2. Consider $k(u_0) = \left(3{u_0}^2 + 2fu_0 + g\right) \neq 0$ and the assumption in ($\boldsymbol{H_1}$) is satisfied. For the values of (j takes values 0,1,2,3,4...), denote $\mu\eta(\tau) = \alpha(\tau) + i\mu(\tau)$ be a solution of equation (4) which satisfies $\alpha(\tau_j) = 0, \mu(\tau_j) = \mu_0$, where

$$\tau_j = \frac{1}{\mu}\, a\gamma c \cos\left(\frac{-\left(L_1 \mu^2 (T_2 - \mu^2) + (T_3 - T_1 \mu^2)(L_2)\right)}{(L_2)^2 + (L_1 \mu_0)^2} + 2j\pi\right)$$

then $\pm i\mu_0$ are simple roots. If the transversality condition

($\boldsymbol{H_2}$) $\alpha^j(\tau_j) = \frac{R_e \eta(\tau)}{d\tau}\Big|_{\eta = i\,\mu_0} \neq 0$

Hopf bifurcation occurs for the system of equations (1)- (3) whenever $\tau = \tau_j$.

Proof. Assume that root of the equation (19) is $\eta = \eta(\tau)$. Put $\eta(\tau)$ in eq. (19) then differentiating equation with respect to τ, it results into

$$\left[(3\eta^2 + 2T_1\eta + T_2) + \left((\eta^2 L_1 + \eta L_2)(-\tau) + L_1\right)e^{-\eta\tau}\right]\frac{d\mu}{d\tau} = \eta(\eta L_1 + L_2)e^{-\eta\tau}$$

Thus

$$\left(\frac{d\eta}{d\tau}\right)^{-1} == \frac{(3\eta^2 + 2T_1 + T_2)}{\eta(\eta L_1 + L_2)} + \frac{(L_1)}{\eta(\eta L_1 + L_2)} - \frac{\tau}{\eta}$$

From (21)-(23), we have

$$a^j(\tau_0) = R_e\left[\frac{(3\eta^2 + 2T_1\eta + T_2)e^{\eta\tau}}{\eta(\eta L_1 + L_2)}\right] + R_e\left[\frac{(L_1)}{\eta(\eta L_1 + L_2)}\right]$$

$$= \frac{1}{\Delta}\left[3\mu^6 + 2\left({T_1}^2 - 2T_2\right)\mu^4 + (T_2^2 - L_1^2 - 2T_1T_3)\mu^2\right]$$

$$= \frac{1}{\Delta}(3\mu^6 + 2\mu^4 + g\mu^2)$$

$= \frac{\mu_0^2}{\Delta}\, k'(u)$

where $\Delta = L_1^2\mu_0^2 + L_2^2$.Notice that $\Delta > 0$ and $\mu_0 > 0$, we observed that $\text{sign}\left[\alpha^j(\tau_0)\right] = \text{sign}\left[k^j(u_0)\right]$

Hence the lemma proved.

By lemma number 2, We can obtain the results on the stability and bifurcation of the system of equations (1)-(3).

4. Direction And Stability of The Hopf-Bifurcation Solution

We shift the value of interior equilibrium $E_8 \equiv (P_1^*, P_2^*, P_d^*)$ to the origin by the translation $v_1(t) = P_1(t) - P_1^*,\ v_2(t) = P_2(t) - P_2^*,\ v_3(t) = P_d(t) - P_d^*$ and then normalizing the delay parameter τ by the time scaling $t \longrightarrow \frac{t}{\tau}$ of the model, then system (1)-(3) transformed into

$$\frac{dv_1}{dt} = c_{11}v_1 + c_{12}v_2 + c_{13}v_3 + c_{14}v_1^2 + c_{15}v_1v_2 + c_{16}v_1v_3 \qquad (27)$$

$$\frac{dv_2}{dt} = c_{21}v_1 + c_{22}v_2 + c_{23}v_3 + c_{24}v_2^2 + c_{25}v_1v_2 + c_{26}v_2v_3 \qquad (28)$$

$$\frac{dv_3}{dt} = c_{31}v_2(t-1) + c_{32}v_3 + c_{33}v_3^2 + c_{34}v_2(t-1)\,v_3 \qquad (29)$$

Where $c_{11} = -\frac{p_1P_1^*}{K_1}$, $c_{12} = -x_1P_1^*$, $c_{13} = b_1P_1^*$, $c_{14} = -\frac{p_1}{K_1}$, $c_{15} = -x_1$, $c_{16} = b_1$, $c_{21} = -y_1P_2^*$, $c_{22} = -\frac{p_2P_2^*}{K_2}$, $c_{23} = -c_1A_1P_2^*$, $c_{24} = -\frac{p_2}{K_2}$, , $c_{25} = -y_1$, $c_{26} = -c_1A_1$, $c_{31} = c_1A_1e_1P_d^*$,$c_{32} = -z_2P_d^*$, $c_{33} = -z_2$, $c_{34} = -c_1A_1e_1$.

Thus, we can proceed our calculation in the phase $C = C((-1,0), R_+^3)$. WLOG, denote the critical value $\tau_j$by τ_0. Let $\tau = \tau_0 + \delta$, then $\delta = 0$ is value of Hopf bifurcation to the system (29)-(31). For the simplicity of representation, we write (29)-(31) as

$$v'(t) = H_\delta(v_t) + G(\delta, v_t) \qquad (30)$$

Where $v(t) = (v_1(t), v_2(t), v_3(t))^T \epsilon R^3, v_t(\theta)\epsilon C$ is defined as $v_t(\theta) = v(t+\theta)$, and $H_\delta: C \to R$, $G: C \times R \to R$, given by respectively.

$H_\delta\xi = (\tau_0 + \delta)E_1\xi(0) + (\tau_0 + \delta)E_2\xi(-1)$ where E_1 *and* E_2 are defined as

$$E_1 = \begin{vmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ 0 & 0 & c_{32} \end{vmatrix}, E_2 = \begin{vmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & c_{31} & 0 \end{vmatrix} \text{ and } G(\delta, \xi) = (\tau_0 + \delta)\begin{bmatrix} G_1 \\ G_2 \\ G_3 \end{bmatrix}$$

$$G_1 = c_{14}\xi_1^2(0) + c_{15}\xi_1(0)\xi_2(0) + c_{16}\xi_1(0)\xi_3(0),$$

$$G_2 = c_{24}\xi_2^2(0) + c_{25}\xi_1(0)\xi_2(0) + c_{26}\xi_2(0)\xi_3(0),$$

$$G_3 = c_{33}\xi_3^2(0) + c_{34}\xi_2(-1)\xi_3(0),$$

where$\xi(\theta) = (\xi_1(\theta), \xi_2(\theta), \xi_3(\theta))^T \epsilon\, C((-1,0), R)$. Use of Riesz representation theorem, help us to find a function ε(θ,δ) of the bounded variation for θ *belong in the interval* $[-1, 0]$, such that

$$H_\delta\xi = \int_{-1}^{0} d\varepsilon(\theta, 0)\, \xi(\theta) for\ \xi\ \epsilon\ C.$$

We can choose $\varepsilon(\theta, 0) = \begin{cases} \frac{d\xi(\theta)}{d\theta} & \theta \epsilon [-1,0) \\ \int_{-1}^{0} d\varepsilon(\theta, 0)\, \xi(\theta) & \theta = 0 \end{cases}$

and J (δ) $\xi = \begin{cases} 0 & \theta \epsilon [-1, 0) \\ G(\delta, \xi) & \theta = 0 \end{cases}$

the system (30) is equivalent to

$$v_t' = I(\delta)v_t + J(\delta)v_t.$$

For $\varphi\ \epsilon\ C'([-1,0], R_+^3)$, define

$$I^*\varphi(s) = \begin{cases} \dfrac{-d\varphi(s)}{d\theta} & s \epsilon [-1,0), \\ \displaystyle\int_{-1}^{0} d\varepsilon^T(-t, 0)\varphi(-t) & s = 0 \end{cases}$$

And bilinear inner product.

$< \varphi(s), \xi(\theta) > = \bar{\varphi}(0)\,\xi(0) - \int_{-1}^{0}\int_{v=0}^{0} \bar{\varphi}(\xi-\theta)d\varepsilon(\theta)\xi(\zeta)d\zeta.$

Since I^* and $I = I(0)$ are adjoint operators. Then by above discussion, we observed that $i\omega_0$ is an eigen values of $I(0)$. Thus, we conclude that this is an eigen values of I^*. Let us assume that

$g(\theta) = g(0)e^{i\omega_0}$ is an eigen vector of $I(0)$ which is obtained for eigen value $-i\omega_0$. Then $adjoint\ operator\ I(0) = i\omega_0\, g(\theta)$. When $\theta = 0$, we obtain $\left[i\omega_0 I - \int_{-1}^{0} d\varepsilon(\theta)e^{i\omega_0}\right] g(0) = 0$, which gives $g(0) = (1, \sigma_1, \rho_1)^T$ where

$$\sigma_1 = \frac{c_{31}c_{21} + c_{23}(i\omega_0 - c_{11})}{c_{12}c_{23} + c_{13}(i\omega_0 - c_{22})} \tag{31}$$

$$\rho_1 = \frac{(i\omega_0 - c_{11})(i\omega_0 - c_{22}) - c_{12}c_{21}}{c_{12}c_{23} + c_{13}(i\omega_0 - c_{22})} \tag{32}$$

Same, it can be calculated that

$g^*(s) = D((1, \sigma_2, \rho_2)e^{i\omega_0\tau_0 S}$ is the latent vector of I^*corresponding to $-i\omega_0\tau_0$ where

$$\sigma_2 = \frac{c_{31}c_{21} - c_{23}(i\omega_0 + c_{11})}{c_{12}c_{23} - c_{13}(i\omega_0 + c_{22})} \tag{33}$$

$$\rho_2 = \frac{(i\omega_0 + c_{11})(i\omega_0 + c_{22}) - c_{12}c_{21}}{c_{12}c_{23} - c_{13}(i\omega_0 + c_{22})} \tag{34}$$

Where

$$\bar{E} = \frac{1}{(1 + \sigma_1\bar{\sigma}_2 + \rho_1\bar{\rho}_2 + \tau_0\bar{\rho}_2\rho_1 c_{31}e^{-i\omega_0\tau_0})}$$

$$< g^*(s), g(\theta) >= 1, < g^*(s), \bar{g}\,(\theta) >= 0$$

Now we calculate the coefficients, specifying important quantities of the periodic solution. We use the same calculation process as done by [6] in Hssard et al.

$$l_{20} = 2\bar{E}(N_{11} + \bar{\sigma}_2 N_{21} + \bar{\rho}_2 N_{31})$$

$$l_{11} = \bar{E}(N_{12} + \bar{\sigma}_2 N_{22} + \bar{\rho}_2 N_{32})$$

$$l_{02} = 2\bar{E}(N_{13} + \bar{\sigma}_2 N_{23} + \bar{\rho}_2 N_{33})$$

$$l_{21} = 2\bar{E}(N_{14} + \bar{\sigma}_2 N_{24} + \bar{\rho}_2 N_{34})\ Where$$

$$N_{11} = c_{14} + c_{16}\rho_1 + c_{15}\sigma_1$$

$$N_{13} = c_{14} + c_{16}\bar{\rho}_1 + c_{15}\bar{\sigma}_1$$

$$N_{12} = 2c_{14} + c_{16}\rho_1 + c_{16}\bar{\rho}_1 + c_{15}\sigma_1 + c_{15}\bar{\sigma}_1$$

$$N_{14} = 2c_{14}M_{11}^{(1)}(0) + c_{15}M_{11}^{(2)}(0) + c_{16}M_{11}^{(3)}(0) + c_{14}M_{20}^{(1)}(0) + c_{15}\frac{M_{20}^{(2)}(0)}{2} + c_{16}\frac{M_{20}^{(3)}(0)}{2} + c_{16}M_{11}^{(1)}(0)\rho_1 + c_{15}\frac{M_{20}^{(1)}(0)}{2}\bar{\rho}_1 + c_{15}M_{11}^{(1)}(0)\sigma_1 + c_{15}\frac{M_{20}^{(1)}(0)}{2}\bar{\sigma}_1$$

$$N_{21} = c_{25}\sigma_1 + c_{26}\rho_1\sigma_1 + c_{24}\sigma_1^2$$

$$N_{22} = c_{25}\sigma_1 + c_{26}\bar{\rho}_1\sigma_1 + c_{25}\bar{\sigma}_1 + c_{26}\rho_1\bar{\sigma}_1 + 2c_{24}\sigma_1\bar{\sigma}_1$$

$$N_{23} = c_{25}\bar{\sigma}_1 + c_{26}\bar{\rho}_1 + c_{24}\bar{\sigma}_1^2$$

$$N_{24} = c_{25}M_{11}^{(2)}(0) + c_{25}\frac{M_{20}^{(2)}(0)}{2} + c_{26}M_{11}^{(2)}(0)\rho_1 + c_{26}\frac{M_{20}^{(2)}(0)}{2}\bar{\rho}_1 + c_{25}M_{11}^{(1)}(0)\sigma_1 + 2c_{24}M_{11}^{(2)}(0)\sigma_1 + c_{26}M_{11}^{(3)}(0)\sigma_1 + c_{25}\frac{M_{20}^{(1)}(0)}{2}\bar{\sigma}_1 + c_{24}M_{20}^{(2)}(0)\bar{\sigma}_1 + c_{26}\frac{M_{20}^{(3)}(0)}{2}\bar{\sigma}_1$$

$$N_{31} = c_{33}\rho_1^2 + c_{34}e^{-i\omega_0\tau_0}\rho_1\sigma_1$$

$$N_{32} = 2c_{33}\rho_1\bar{\rho}_1 + c_{34}e^{-i\omega_0\tau_0}\bar{\rho}_1\sigma_1 + c_{34}e^{-i\omega_0\tau_0}\rho_1\bar{\sigma}_1$$

$$N_{33} = c_{33}\bar{\rho}_1{}^2 + c_{34}e^{-i\omega_0\tau_0}\bar{\rho}_1\bar{\sigma}_1$$

$$N_{34} = c_{34}M_{11}^{(2)}(-1)\rho_1 + 2c_{33}M_{11}^{(3)}(0)\rho_1 + c_{34}\frac{M_{20}^{(2)}(-1)}{2}\bar{\rho}_1 + c_{33}M_{20}^{(3)}(0)\bar{\rho}_1 + c_{34}e^{-i\omega_0\tau_0}M_{11}^{(3)}(0)\sigma_1 + \frac{1}{2}c_{34}e^{-i\omega_0\tau_0}M_{20}^{(3)}(0)\bar{\sigma}_1$$

However

$$M_{20}(\theta) = \frac{il_{20}}{\omega_0\tau_0}t(0)\ e^{i\omega_0\tau_0\theta} + \frac{i\bar{g}_{02}\bar{q}(0)}{3\omega_0\tau_0}\ e^{-i\omega_0\tau_0\theta} + F_1 e^{2i\omega_0\tau_0\theta}$$

And

$$M_{11}(\theta) = \frac{-ig_{11}}{\omega_0\tau_0} q(0)\, e^{i\omega_0\tau_0\theta} + \frac{i\bar{g}_{11}\bar{q}(0)}{\omega_0\tau_0}\, e^{-i\omega_0\tau_0\theta} + F_2,$$

Where F_1 *and* F_2 are both three-dimensional vector quantity, and can be calculated by

$$\begin{vmatrix} 2i\omega_0 - c_{11} & -c_{12} & -c_{13} \\ -c_{21} & 2i\omega_0 - c_{22} & -c_{23} \\ 0 & -c_{31}e^{-2i\omega_0\tau_0\theta} & 2i\omega_0 - c_{32} \end{vmatrix} F_1 = 2\begin{bmatrix} N_{11} \\ N_{21} \\ N_{31} \end{bmatrix}$$

And

$$\begin{vmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ 0 & c_{31} & c_{32} \end{vmatrix} F_2 = -2\begin{bmatrix} N_{12} \\ N_{22} \\ N_{32} \end{bmatrix}$$

Then l_{21} can be written by the use of parameters.

From the above discussion, we can observe that every l_{ij} determined by parameters used. Thus, we obtain the result:

$$D_1(0) = \frac{i}{2\omega_0\tau_0}\left(l_{11}\, l_{20} - 2l_{11}^2 - \frac{l_{02}^2}{3}\right) + \frac{l_{21}}{2},$$

$$n_1 = -\frac{Re\{C_1(0)\}}{Re\{\lambda'(\tau_0)\}}$$

$$n_2 = 2Re\{C_1(0)\}.$$

$$T_2 = -\frac{Im\{C_1(0)\} + n_1 Im\{\lambda'(\tau_0)\}}{\omega_0\tau_0} \qquad (35)$$

Which determines the variables of bifurcation periodic solutions in the Centre manifold at critical values at τ_0. Result obtained by (Hassard et al. 1981) we have the following

Theorem 1. $n_1$determines propagation of the Hopf-bifurcation: if $n_1 > 0$ the Hopf - bifurcation is supercritical and if $n_1 < 0$ the Hopf- bifurcation is subcritical. Bifurcating period solutions exits if $delay(\tau) > \tau_0$ ($delay(\tau) < \tau_0$); n_2 determines stability of bifurcating periodic solutions. Bifurcating periodic solutions are arbitically asymptotically stable when $n_2 < 0$ and periodic solutions are arbitically unstable if

$n_1 > 0; and\ T_2$ finds the bifurcating periodic solution. The period of bifurcation increases when $T_2 > 0$ and the period of bifurcation decreases when $T_2 < 0$.

5. NUMIRICAL EXAMPLED

In this part, we used MATLAB to do a numerical simulation of system [1]-[3]. We use these parametric values:

$$p_1 = 3\ p_2 = 3\ K_1 = 5\ b_1 = 0.9$$

$$e_1 = 0.5\ y_1 = 0.6\ z_1 = 0.2\ A_1 = 0.91$$

$$z_2 = 0.5\ K_2 = 4\ x_1 = 0.14\ c_1 = 1.8$$

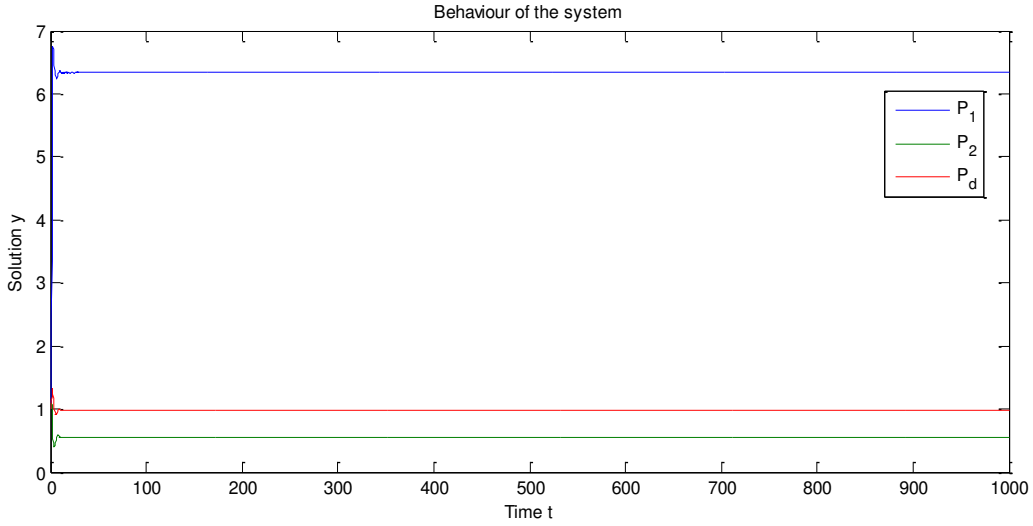

Figure 1. In absence of delay the system is stable

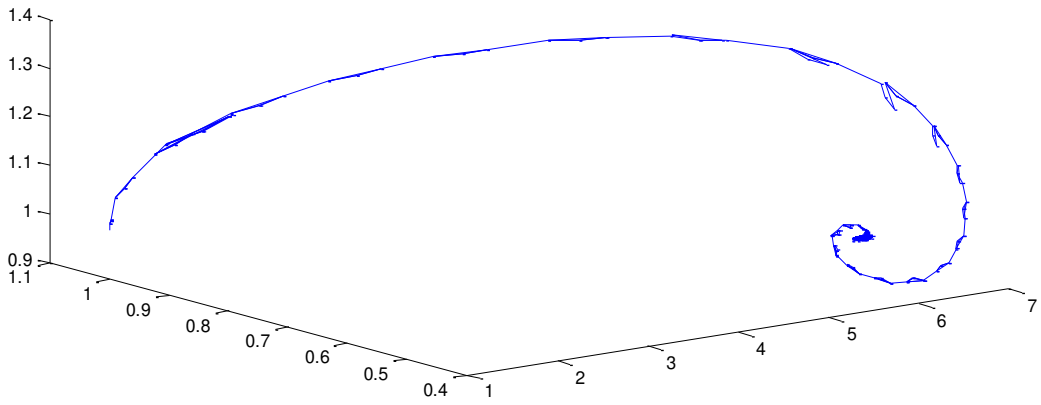

Figure 1.1 Phase plane graph in absence of delay

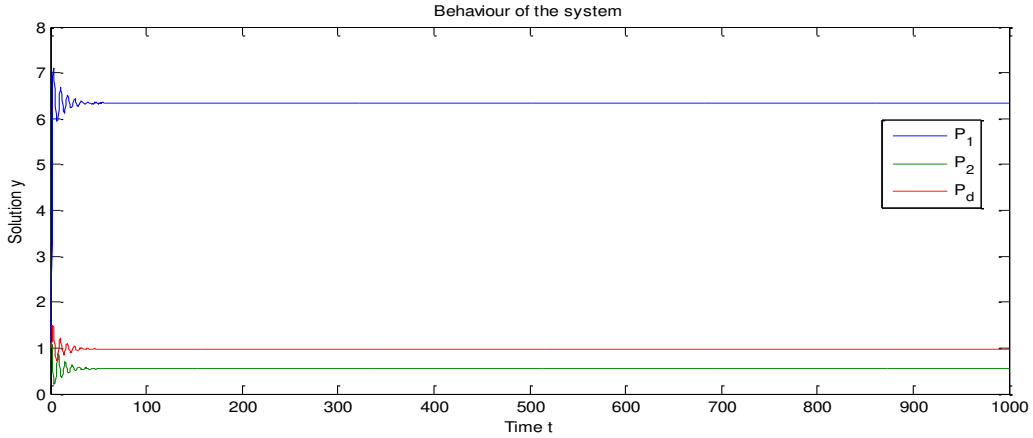

Figure 2. Asymptotically stable when $\tau = 0.8 < \tau_0 = 1.30997$

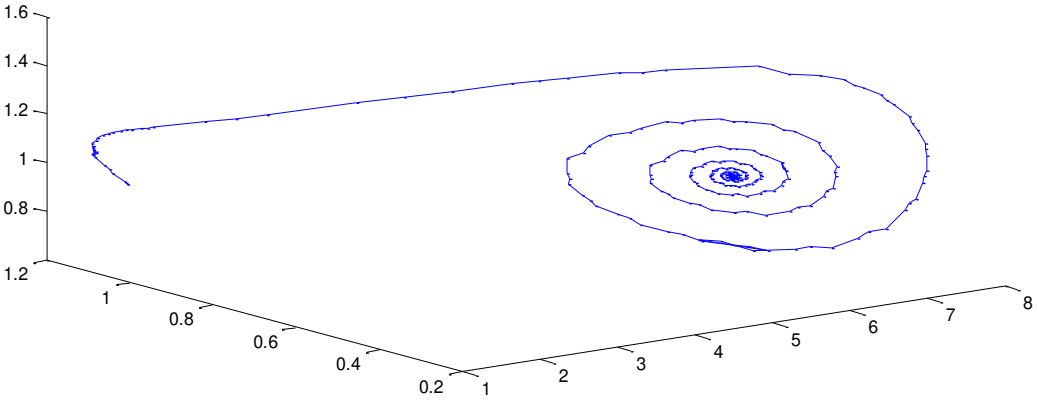

Figure 2.1 Phase plane graph for Asymptotically stable when $\tau = 0.8 < \tau_0 = 1.30997$

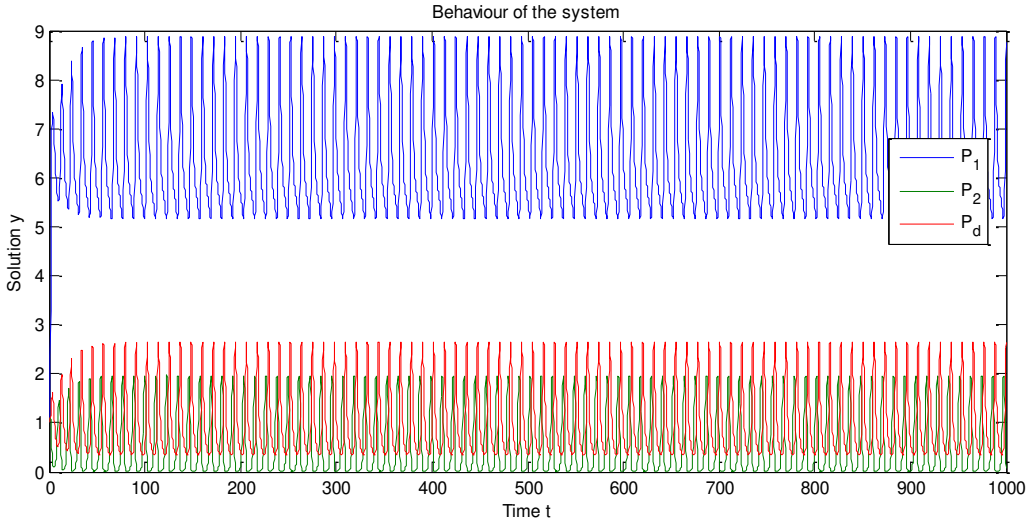

Figure 3. Hopf Bifurcation when $\tau = 1.7 > \tau_0 = 1.30997$

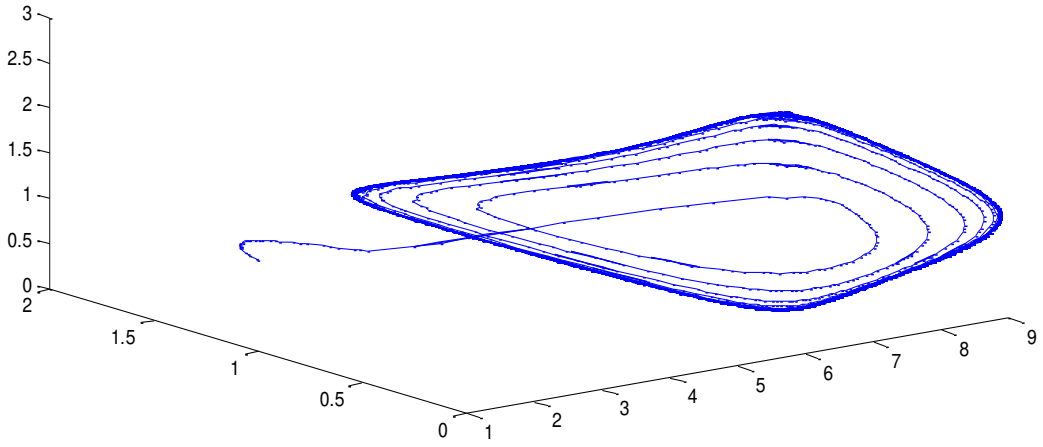

Figure 3.1 Phase plane graph for Hopf Bifurcation when $\tau = 1.7 > \tau_0 = 1.30997$

6. CONCLUSION

We presented a multi-species model with delay in this work, which contains two competing prey species and a predator organism that is partly related to other prey and help to benefit commensal species. Initially, the system shows stable coexisting, but when alternate food is introduced, the system oscillates. This research, on the other hand, shows that supplying a variety of diets does not lead the system to oscillate. The extra foodstuffs may increase or decrease the possibility of coexisting equilibrium level, according to analytic and statistical analysis (see Fig. 1-3.1). When the time delay introduced, limit cycles observed for the interior equilibrium value whenever delay exceeds 1.30997 the critical value. Observation shows that as the numerical value of A_1 increases, so does the critical value of the delay parameter.

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CHANGING LIFESTYLE AND CHALLENGES IN MEDICAL SCIENCES

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ABSTRACT

Introduction: A healthy lifestyle composed of sound and rational day behaviors and functions of individuals in job, activities, fun, and diet is considered the key to maintain health. There is a positive relation between lifestyle-induced specific diseases with grossly hampered individual health and quality of life, according to WHO[1]. The current global crisis of Pandemic vigorously demands to re-think of existing lifestyle patterns and treatment modalities or preventative strategies in the medical field & health care to cope with health issues originating from them by searching for alternative effective but safe options in Alternative sciences like Ayurveda.

Aim & Objectives: Through this paper, a novel effort has been made to highlight various challenges in Medical Sciences due to the current drastic changing lifestyle in the competitive world and develop a specific health care system based on the interdisciplinary approach considering the demands of society.

Material and method – It is analytical review study done from multiple research articles from databases, e.g., Pubmed, Google scholar; etc. and existing information on public domain.

Observations & Results: The information collected elaborated under and complied under different heads such as an impact of Current unhealthy lifestyle on the human health and possible solutions.

Discussion: The critical analysis of the current scenario in the Medical profession shows that challenges in Medical Sciences are the adverse gift of today's fast, hectic and unhealthy lifestyle as it makes the person away from nature. These challenges are not limited only to suffering, i.e., patients, but also adversely affect the top to bottom of

society, i.e., health care providers, policymakers, Health professionals, and Infrastructure providers.

Conclusion: Recommendations can be done based on integration, and coordination among many sectors, such as health, sports, education and culture policy, media and information, transport, urban planning, local governments, and financial and economic planning, to cope with medical challenges induced by current lifestyle.

Keywords: Current, Lifestyle, Medical ,Challenges, Preventive Strategies

INTRODUCTION

A healthy lifestyle composed of sound and rational day behaviors and functions of individuals in job, activities, fun, and diet is considered the key to maintain health. Malnutrition, unhealthy diet, smoking, alcohol consumption, drug abuse or overuse of drugs(Pain relievers, eye drops, and antibiotics), stress, and the lives of citizens face new challenges, e.g., emerging new technologies within I.T. such as the internet and virtual communication networks, overuse, and misuse of the technology and so on are presentations of an unhealthy lifestyle that generates numerous health issues, e.g., physical (metabolic diseases, joint and skeletal problems, cardiovascular diseases, hypertension, overweight, violence), mental illness, disability, and even death.

NEED OF THE TOPIC

There is a positive relation between lifestyle-induced specific diseases with grossly hampered individual health and quality of life, according to WHO[1]. These diseases can be termed Western diseases, diseases of affluence, and non-communicable and chronic diseases, which have an integral role in weakening the body's immune system. The current global crisis of Pandemic vigorously demands to re-think of existing lifestyle patterns and treatment modalities or preventative strategies in the medical field & health care to cope with health issues originating from them by searching for alternative effective but safe options in Alternative sciences like Ayurveda, Yoga, etc. for the same where existing has limitations or lacunas.

The critical analysis of the current scenario in the Medical profession shows that challenges in Medical Sciences are the adverse gift of today's fast, hectic and unhealthy lifestyle as it makes the person away from nature. These challenges are not limited only

to suffering, i.e., patients, but also adversely affect the top to bottom of society, i.e., health care providers, policymakers, Health professionals, and Infrastructure providers. Considering the limitations of existing preventative, treatment, and rehabilitative strategies for such lifestyle disorders, it is not optimum to adhere to any single science in solving such a global issue; instead, more emphasis should be given to adopting a multidisciplinary or interdisciplinary medical approach for holistic care. Though India is the pioneer of ancient healing sciences such as Ayurveda & Yoga, society is still unaware of its applicability or encouraging results in different lifestyle disorders. Therefore, many people can not undergo such alternative medicines though these are effective. Moreover, the rationale for medical challenges due to current lifestyle and the Interdisciplinary or collaborative approach for improvising existing medical facilities to overcome them is still poorly explored due to scattered, limited textual references and inadequate clinical data.

Through this essay, a novel effort has been made to highlight various challenges in Medical Sciences due to the current drastic changing lifestyle in the competitive world and develop a specific health care system based on the interdisciplinary approach considering the demands of society. It is also has attempted to clarify the doctrine of the impact of Changing lifestyle in the context of *Medovaha Strotodushti Vikara* in *Ayurveda* based on the scientific background. This essay's third primary objective is to identify the pressures, burdens, and psychological demands of society and the healthcare profession across health systems and disciplines, along with focusing on renewed efforts to mitigate these challenges among those working on the frontline.

Considering the above-said need, various literature is searched from classical books of Ayurveda, multiple research articles from databases, e.g., Pubmed, Google scholar; etc. and complied under different heads such as an impact of Current unhealthy lifestyle on the human health and possible solutions to deal or cope with them.

IMPACT OF CURRENT UNHEALTHY LIFESTYLE ON THE HUMAN HEALTH

Considering the increasing graph of high prevalence and incidence rate of various lifestyle disorders in the current scenario, it should be wise as a medical professional to

focus on the pathophysiology of such diseases in terms of Ayurveda and recent findings as mentioned in figure no.1. It may be helpful to prevent or treat them effectively based on fundamental concepts in Ayurveda. In Ayurveda, such ailments can be compared with *Medovaha Strotodushtijanya Vikara,* in which putative or Penta-bio purificatory procedures in *Ayurveda* have proved their efficiency.

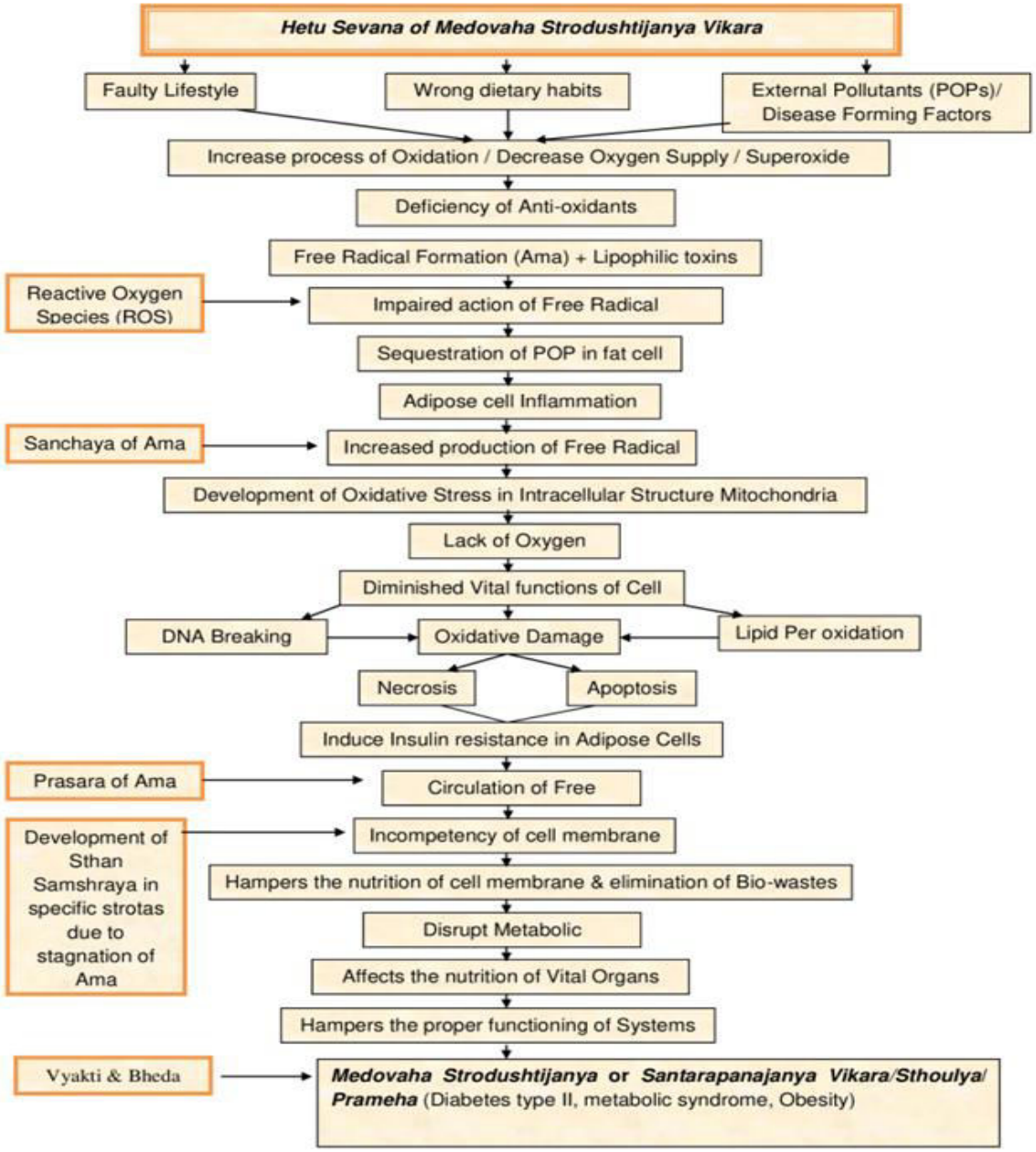

Figure No.1: Pathophysiology of Lifestyle disorders (*Medovaha Strodushtijanya Vikara)*

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CHALLENGES /GLOBAL ISSUES DUE TO CHANGING LIFESTYLES:

The current changing lifestyle patterns adversely influence society and health care workers, including doctors, nursing and paramedical staff, etc., and it gives rise to multiple challenges in the medical sector. Challenges developed due to adverse Impact of Current Lifestyle on Physical, Mental Health, Social Health, the economy of nation or individual existing medical facilities/Clinical services, the future generation/ Upcoming Medical graduates are tabulated in table no.,1,2,3,4,5, & 6 respectively[2,3,4,5,6,7].

Table no.1: Impact of Current Lifestyle on Physical Health

S.N.	Adverse Impact creating Challenges	Society	Health Workers / Medical Professional
1	Increasing prevalence and incidence rate of lifestyle disorders/metabolic /systemic disorders, e.g., obesity, Metabolic syndrome, Cardiovascular diseases, Hormonal disorders, e.g., P.C.O.D., Infertility, Autoimmune, Allergic disorders, Cancer, etc. due to nutrition problems as a result of fast foods and poor foods and Poor or lack of exercise due to lack of time that leads to excessive burden over health care system**(Mohanty A *et al.*,2019)**	✓	✓
2	Lack of sleep or disturbed sleep pattern due to a stressful and competitive lifestyle has strong influences on social, psychological, economic, and healthy consequences	✓	✓
3	Higher Mortality rates as a result of cerebrovascular disease, accidents, and extreme suicidal tendencies due to their unwholesome personal health habits or wrong lifestyle choices due to stress	✓	✓
4	Dysfunction of sex relation directly leads to adverse mental and physical health effects. due to unavailability of Quality time or stress	✓	✓
5	Substance abuse or addictions like Smoking and alcohol leads to cardiovascular disease, asthma, cancer, brain injury, etc.	✓	✓
6	Medication abuse[self-treatment(antibiotics or Birth control and hormone replacement therapy (H.R.T.), performance-enhancing drugs), sharing medication, medications without prescription due to lack of time leads to severe complications or kidney or liver failure or negative effect on the immune system or drug resistance	✓	-
7	Irrational use of Medication abuse (Prescribing too many drugs, prescribing a large number of each drug for quick relief, unnecessary drugs, bad handwriting in prescription, disregarding the contradictory drugs, disregard for harmful effects of drugs, not explaining the effects of drugs)	-	✓

8	Slips, trips and or falls, Accident, Fractures due to hurry work due to challenging working conditions	✓	✓
9	Due to patient handling, increasing incidences of musculoskeletal disorders in health care workers are compounded by the growing number of obese patients.	-	✓
10	Rapidly expanding knowledge base and lack of time to update knowledge due to lack of time as a result of excessive workload.	-	✓
11	Consanguinity in some ethnicity is a dominant form of lifestyle that leads to the genetic disorders	✓	-
12	Application of modern technologies, e.g., Computer vision syndrome, depression, sleep disturbances	✓	✓
13	Reduction in life expectancy due to Comorbidity	✓	✓

Table no.2: Impact of Current Lifestyle on Mental Health

S.N.	Adverse Impact creating Challenges	Society	Health Workers/Medical Professional
1	Increasing incidences of stress-induced /health-induced issues, e.g., Insomnia, loneliness, sleep disorder, mental depression, anxiety, personality-related disorders, e.g., O.C.D., Schizophrenia, Mental exhaustion, depersonalization, and a decreased sense of personal accomplishment. etc. as a result of the excessive workload or job consequences and related stress	✓	✓
2	Physician burnout, i.e., Psychological stress due to Failure to balance personal and professional lives due to lack of quality time, alcohol and drug abuse, divorce, Suicide, medical errors, attrition, large patient volumes of patients, Insufficient resources, or feeling poorly managed), lack of control, challenging working conditions, absenteeism, low organizational commitment, increased turnover of skilled staff and greater patient dissatisfaction.	-	✓
3	Influence of intoxicants such as drugs and alcohol, metabolic disorders, psychosis leading to increased stress levels in patients and relatives, long waiting hours, unrestricted visitor access, overcrowding, and workplace violence	✓	-
4	Increasing tendencies for Suicide or suicidal ideation, substance misuse due to dissatisfaction, burnout, high rates of depression, and increased suicide risk due to adjusting for age, sex, relationship status, and hours worked per week, Failure of personal accomplishments, over-reliance on self-treatment, low peer support—including ostracization and judgment from co-workers if disclosure **(Dutheil F et al.2019)**	✓	✓
5	Suboptimal patient care practices doubled the risk of Self-perceived significant medical error. They increased the odds of being named in a medical malpractice suit with associated distress due to Physician Burn out.	-	✓
6	Ethical dilemmas and moral injury occur due to psychological distress that results from actions, or their absence, that violate someone's moral or ethical code**(Søvold LE et al.2021)**	✓	✓
7	Vicarious traumatization or secondary traumatic stress (loss of appetite, fatigue, irritability, inattention, numbness, sleep disorders, fear, and despair) is derived from healthcare workers' sympathy toward people experiencing primary trauma.	-	✓

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8	High risk of infection coupled with inadequate protective measures, managing patient anxiety, and facing ambiguity regarding how to treat and react to complicated viral presentations effectively.	-	✓
9	Difficulties in fast-changing to changes in patient load, increasing expectations, clinical roles, new technologies, and working methods**(Søvold et al.)**	-	✓
10	Stress due to uncertainty and higher demands, competition in the corporate sector	✓	✓
11	Fear of revoking their medical license due to increased government requirements and the stigma connected with "stress" and "mental illness."	-	✓
12	Malpractice suits due to craving for excessive money to maintain a lavish lifestyle	-	✓
13	Social Exclusion/Stigmatization	-	✓
14	Absence Of Coordination by Peer due to unhealthy mutual competition and Proper Management During Their Service	-	✓

Table no.3: Impact of Current Lifestyle on Economic Burden/ economy of the nation

S.N.	Adverse Impact creating Challenges	Society	Health Workers/Medical Professional
1	Expenditure on life-long medications for the increasing global burden of lifestyle disorders or associated side effects of drugs and Radio-Chemotherapy with related hospitalization, expensive surgical interventions **(Al-Maskari F et al.2010)**	✓	✓
2	Significant financial burden as a result of loss of independence, extended infirmity, or death due to lifestyle disorders	✓	✓
3	Increased healthcare costs	✓	✓
4	Lack Of Incentives	-	✓
5	Reduction in growth rate in the economy	✓	-
6	Expenditure over the generation of resources and facilities for clinical services	✓	-

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Table no.4: Impact of Current Lifestyle on existing medical facilities/Clinical services

S.N.	Adverse Impact creating Challenges	Society	Health Workers/Medical Professional
1	Lack of quality health services	✓	-
2	Unavailability/ Limited Clinical services in rural places or unavailability of resources in abundant quantity	✓	-
3	Suboptimal patient care	✓	-
4	Lower patient satisfaction rate and decreased access to care	✓	-
5	Lack of awareness regarding the Impact of modernization on lifestyle	✓	-
6	Failure to fulfill the norms for quality control of existing clinical facilities	✓	-
7	Lack of trained human resources/Skillful staff	✓	-
8	Limited government and corporate micro-management of healthcare delivery	✓	-
9	Higher workload	-	✓
10	Shortage of quality personal protective measures, e.g., P.P.E.	-	✓
11	Unclear or inaccessible preventative policies for Health Care workers	-	✓

Table no.5: Impact of Current Lifestyle on the future generation/ Upcoming Medical graduates / Social burden

S.N.	Adverse Impact creating Challenges	Society	Health Workers/Medical Professional
1	Anxiety attacks as well as frustration due to a lack of knowledge, environmental changes, and fear of infection both by themselves and by their family members	-	✓
2	Psychological distress to maintain physical distance from their family members to reduce the risk of contagion	-	✓
3	Development disorders in children due to lack of attention and care by parents in the medical professional or busy or hectic professions due to Nuclear or Isolated families or single parenting due to an increase in the percentage of divorce	✓	✓
4	Addiction issue –Isolated nature and self-centered tendency	✓	✓
5	Increase in victims, i.e., rate of Addiction in teenagers/Youngsters	✓	✓
6	Attitude problem	✓	✓

Table no.6: Miscellaneous Challenges due to Current Lifestyle

S.N.	Adverse Impact creating Challenges	Society	Health Workers/Medical Professional
1	Sensationalist media reports medical errors and unethical physician conduct	-	✓
2	Challenges to authority and skills by patients and other health care providers	✓	✓
3	Hampering Quality of life	✓	✓
4	Radiation hazards for H.C.W. due to an increase in Ionizing radiation from X-ray machines, fluoroscopes, and computed tomography used for diagnostic and therapeutic procedures, image-guided procedures, cardiac catheterization, angiograms, and pain management, which are routinely done at a large scale	-	✓
5	Exposure to reproductive hazards in the workplace, e.g., menstruation, ovulation, fertility, and Quality of life, and effects on the fetus, e.g., infertility, miscarriage, and congenital disabilities, due to the overburdened and stressful profession	✓	✓

According to Razu SR et al.2021, Apart from the above challenges, some specific challenges in the medical profession are enhanced due to COVID Pandemic, e.g., higher workload by the active medical workforce in public and private facilities[8].

POSSIBLE SOLUTIONS OR COPING STRATEGIES FOR CHALLENGES

The following points should be considered while establishing a novel platform to combat these challenges and make our nation or globe competent and sound in a rational, more economical, and acceptable manner. A maximum population is situated in rural places in India. Therefore, more emphasis should be given to the awareness of the rural population against such medical challenges and their probable preventative and curative strategies for the medical professionals and society as mentioned in figure no. 3 &4 respectively [9,10,11,12,13,14].

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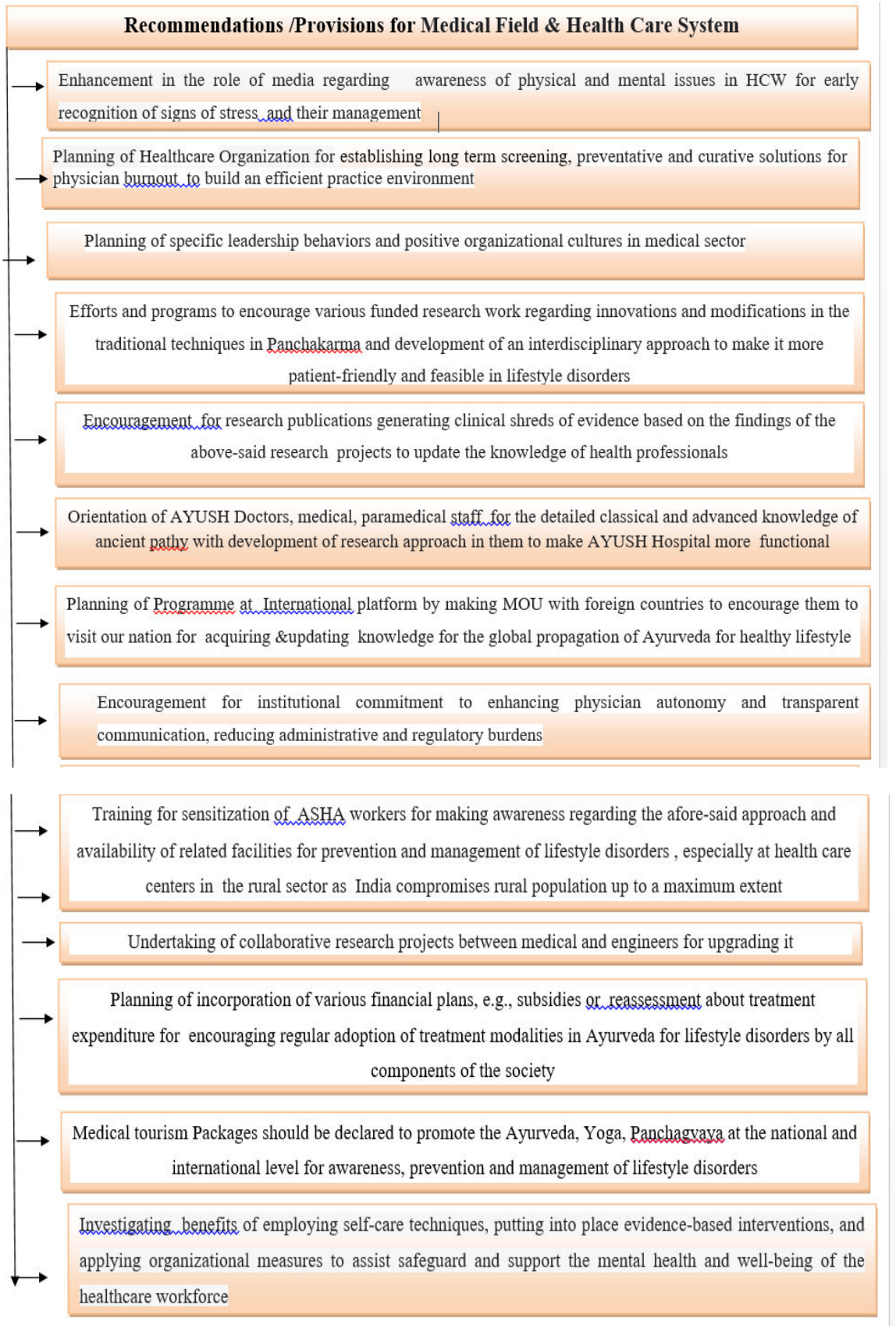

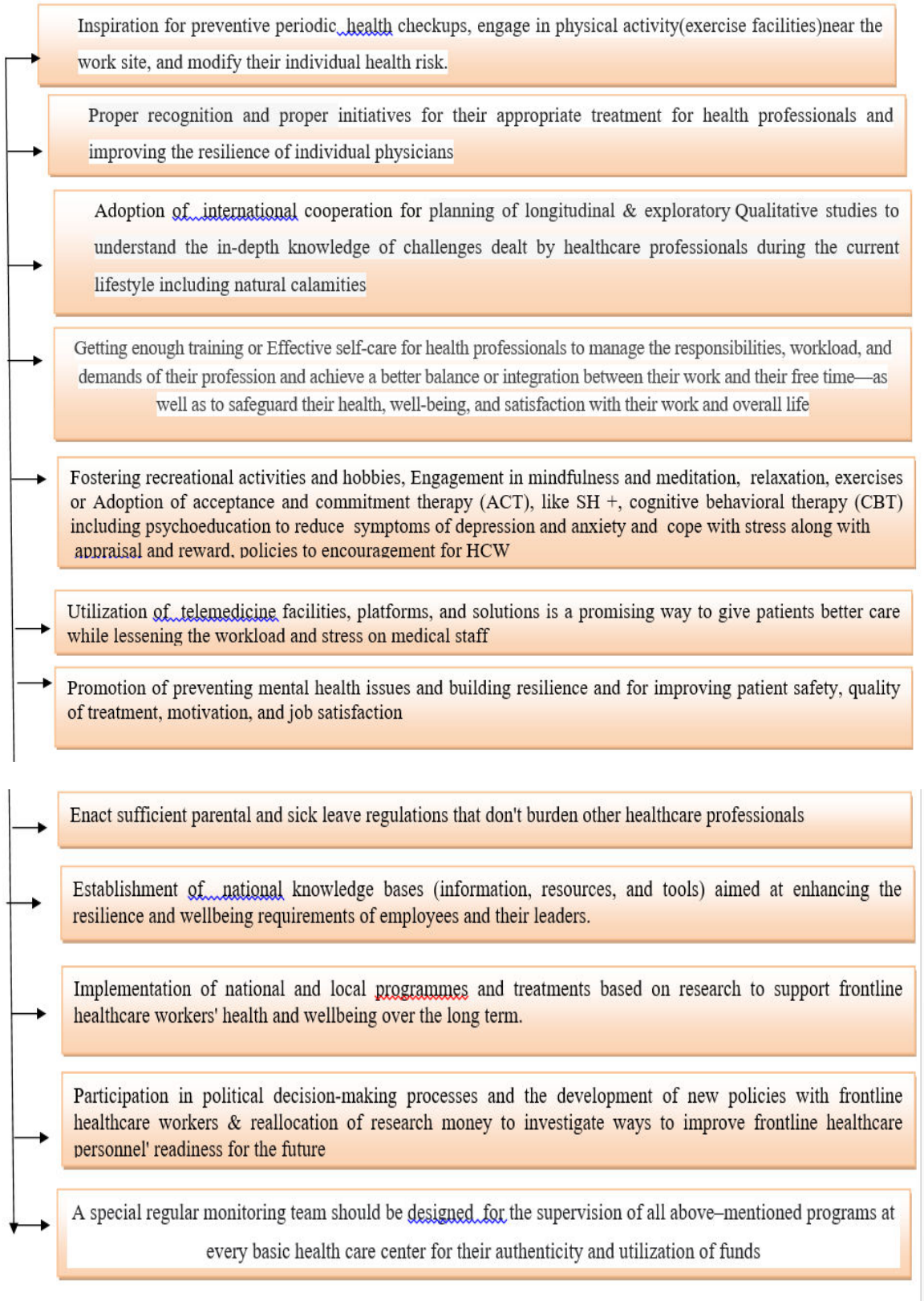

Figure no.2: Strategies for Medical Professionals to deal with Challenges

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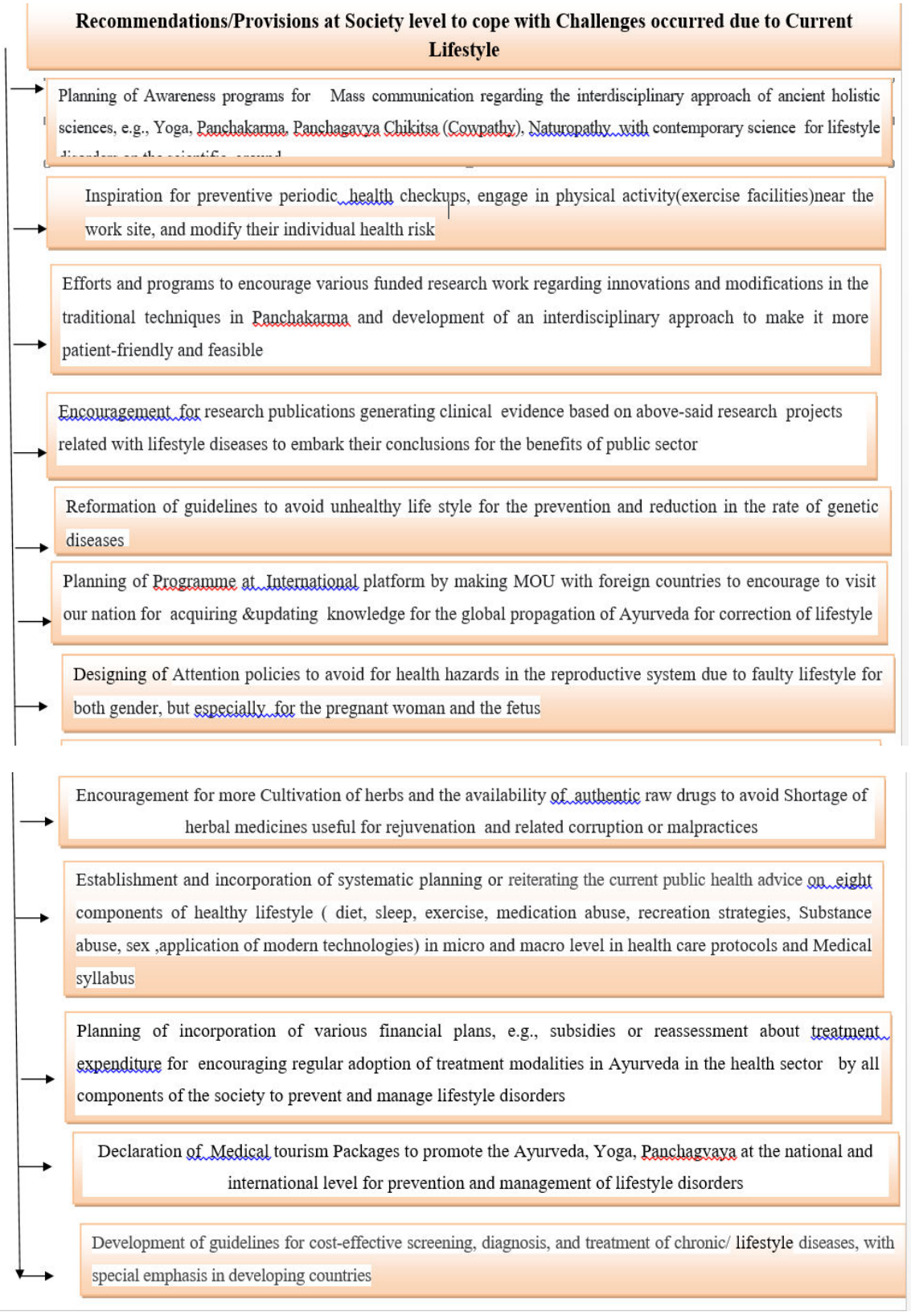
Strategies for Society to deal with Challenges are as follows:



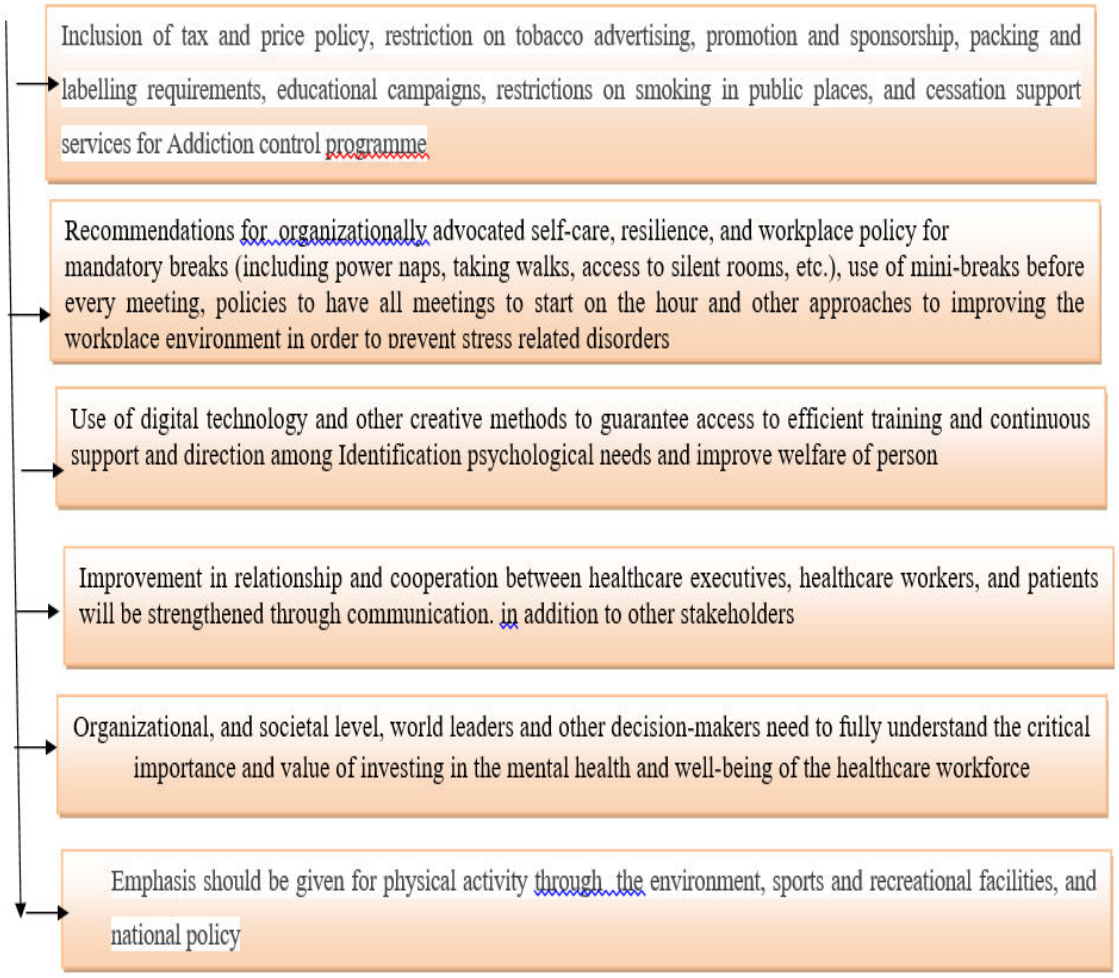


Figure no.3: Strategies for Society to deal with Challenges

Every part of society should be considered while making a road map of such health facilities in the medical field. Moreover, the implementation of these programs should be monitored regularly with appropriate amendments as per geographical, environmental, demographic, medical, and financial status. However, to adopt these various recommendations, integration, and coordination among many sectors, such as health, sports, education and culture policy, media and information, transport, urban planning, local governments, and financial and economic planning, is highly expected. While planning these measures, some heterogeneous needs among healthcare workers should be considered based on specific challenges, predispositions, socio-economic factors, gender, and race. Incorporating all the above suggestions into the existing health services can play a crucial role in changing the current dreadful health scenario or

challenges, especially preventing and managing lifestyle, auto-immune, and other challenging disorders. It can give sound direction to future health policies or coping strategies to address such barriers across the globe.

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BACK MASSING INTERVENTION EFFECTIVE TO REDUCE THE INTENSITY OF LABOR PAIN ACTIVE PHASE 1

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INTRODUCTION

Labor pain is a physiological condition generally experienced by almost all maternity mothers. Pregnant women expect to be able to give birth without pain. According to Danuatmaja (2008), most mothers begin to feel pain or pain at the time of delivery which is the first stage of the active phase. The mother feels tremendous pain because the uterine activity becomes more active. In this phase, the contractions get stronger and more frequent. The condition of severe pain in the first stage of labor allows mothers to tend to choose the easiest and fastest way to relieve pain. The results of Hartiningsih's research (2011) state that the high rate of cesarean section is one of the reasons why mothers prefer relatively painless labor. According to Sarmana (2004), 96.5% of non-medical determinants were the most dominant encouraging mothers to ask for cesarean delivery due to pain during delivery.

Labor is often described as one of the most intense causes of pain ever experienced. The strength of the fear and anxiety experienced by the mother is related to the more significant pain experienced. Fear causes tension in the body, especially in the uterus. This condition can hinder the natural delivery process, prolong labor, and cause severe pain. (Camann, 2005). According to Lally JE (2008), the pain that arises indicates that the labor process has begun. The development of health science emphasizes a holistic approach by paying attention to the psycho-neuro-endocrine immune (PNEI) aspect, which explains that the misalignment of the

soul and mind will lead to disturbances in the balance of nerves hormones, and ultimately the body's immune system.

Prasetyo (2010) states that developments in childbirth care, the care that is now being provided, aim to give a sense of comfort, security, and fun and reduce stressful anxiety.

In Febriyatie's research (2013), many pregnant women currently pay more attention to the pain that may be faced during childbirth and the available pain relief methods during birth. Two ways can relieve pain: pharmacological methods (administration of analgesic drugs, opiates) and non-pharmacological/natural methods (massage, acupuncture, relaxation, hydrotherapy, hypnosis, music). This natural method can help mothers stay relaxed and in control in dealing with pain (Rudra A, 2009). Midwives in practice providing delivery care are expected to provide comfort during labor. For this reason, it is necessary to control pain during work with non-pharmacological techniques, one of which is massage. Massage can promote relaxation of the body and reduce stress. Besides that, massage is an effective, safe, simple care and does not cause adverse effects on both the mother and the fetus. (Aryani Y, 2015).

The back massage method is one of the relatively easy interventions for health workers and their families to help mothers reduce labor pain levels. Strategies to minimize labor pain are needed to reduce complications for the mother and fetus during and after delivery to reduce maternal morbidity and mortality, which indirectly impacts reducing vulnerability and overcoming the effects of the disease. (Rezeki S, 2014). Massage on the back during labor can function as an epidural analgesic that can reduce pain and stress and can provide comfort to the mother in delivery. Therefore, essential care is needed for mothers during childbirth to reduce pain and stress due to delivery, improving midwifery care for mothers in labor. (Lally JE, 2008) According to Nolan (2003), rubbing causes the body to release natural pain relievers called endorphins. Massage is a more sophisticated form of rubbing. Many women in labor find it helpful to get a massage on their lower back. Some moms-to-be love having their tailbone pressed hard to balance the force of contractions and relax them. The study results (Aryani Y, 2015) stated that the endorphin levels of cooked mothers were higher than those that were not cooked. The higher the level of endorphins, the lower the intensity of pain felt by the mother in labor.

METHOD

The research design used is pre-experimental. The study was conducted in the working area of the Landing Health Center in July 2021. The sample was selected using a

consecutive sampling technique in normal delivery mothers who had entered the first stage of labor, the active phase, maximum acceleration (4-9 cm dilation), adequate hysteria (3x in 10 minutes duration > 40 sec) documented on partograph, 3742 weeks gestation, singleton fetus, back of a head presentation. The sampling technique was carried out by proportional random sampling. At the time of data collection, the midwife observed (Pre Test) how the respondent's pain level was with the observation sheet before the massage, namely by asking the subject to cross the pain score that had been provided according to the strength of the pain felt during contractions before the intervention. Then do the massage within 30 minutes according to the steps on the treatment instrument. The last observation was carried out again at the end of the study on the observation sheet after the massage, namely, when the contractions decreased, the midwife asked the subject to cross the pain felt when there was a contraction on the pain score provided. The statistical test used is the Wilcoxon test.

FINDING AND DISCUSSION

1. Characteristics of Respondents

The study results found that most of the respondents were aged 30-35 years (77%), 60% had secondary education and above, 57% were multigravida.

The results showed that the most significant frequency of maternal age who became respondents in this study was the period 30-35 years. This indicates that most of the respondents are of healthy reproductive age, and physiologically at that age, the mother can still be strong enough to withstand one's coping pain in the face of despair. Younger mothers tend to express their pain verbally during labor. However, a person's pain response is very individual and is influenced by various factors such as environment, race, specific actions, and also the pattern of older mothers who tend to express their pain nonverbally (Phumdoung, 2003)

Another study stated that younger mothers reported experiencing higher pain intensity than old age, but the research subjects consisted of primiparas and multiparas in this study. (Febriyatie, 2013) The power of pain in elderly mothers can be explained; Older people are usually multiparous, and if so, multiparas usually have hist that is not as strong as in primiparas. A softer cervix is less sensitive than younger mothers.

The results also showed that most of the respondents (57%) were multigravida, meaning they had previous childbirth experience and had experience dealing with pain in last deliveries. However, labor pain is influenced by many factors and is individual. (Rejeki, 2014) This condition may also be caused by personal distress. Pain during labor is influenced by physiological factors (uterine contractions, cervical dilatation, the pressure of the fetal head on the pelvis, stretching of the birth canal) and psychosocial factors (anxiety, fear, education level, ability to cope with the mother, physical environment, culture and ethnicity, and emotional support).). (Febriyatie, 2013)

Pain is everything that a person says about the pain and can be felt any time he feels pain. Pain is subjective, so only the person who feels it is the most accurate and precise in defining pain. (Prasetyo SN, 2010) Labor pain is often described as the most intense pain ever experienced. A Canadian study found that labor pain scores in both primiparas and multiparas were very high compared to the pain in fractures or toothaches.

Various psychosocial factors have influenced maternal pain perception and ability to cope. Pain is very subjective. This is because humans are unique individuals; everyone observes, experiences, and responds to pain in their way. The sympathetic and parasympathetic systems are triggered when the mother experiences stress, fear, or surprise. Excessive anxiety also increases levels of catecholamines in the blood, resulting in increased blood flow to the pelvis and increased muscle tension. The body responds by constricting and blocking the flow of blood and oxygen so that it affects the work of the uterine muscles. The muscles under the uterus that should work to relax and open are even stiffer so that the baby cannot descend into the birth canal. This causes severe pain felt by the mother. (Mongan MF, 2007)

Complex perceptual and cognitive processes in the central nervous system influence nociceptive impulses so that these impulses are interpreted with emotions, beliefs, and expectations in the current situation. As a result of this process, the meaning, quality, and intensity of pain, as well as behavioral and psychological responses to pain, are related to a person's personality, cultural background, past experiences, and the psychological context in which pain has been experienced (Simkin, 2005).

Psychosocial factors influence the birth experience, culture, ethnicity, level of education, and the ability to cope with mothers are often used as variables that significantly affect the intensity of labor pain. The physical and cultural environment of childbirth and the emotional support provided by the family and midwife can influence pain perception. Fear and anxiety can produce muscle tension and increase a person's perception of pain. (Abbasi M, 2010).

2. Pain Intensity in 1st Stage of Labor

The study results found that the intensity of pain in the first stage of labor before the massage was carried out was 57.1% felt severe pain, whereas, after the massage, 60% of the intensity of the pain was mild. Pain in labor is experienced especially during contractions. Perception of labor pain intensity varies for each woman, usually described as the most extreme pain ever experienced. Several physiological and psychological factors influence pain. (Abasi M, 2010) Pain in labor has a reasonably predictable pattern. The location of the pain continues to change throughout the labor process. The intensity and frequency of pain increase with increasing uterine contractions. (Prasetyo SN, 2010) Massage is a non-pharmacological method used to reduce labor pain.

3. Differences in Pain Intensity during 1 Delivery Before and After Back Massage

The results showed that the P-value < 0.01 means that statistically, there is a statistically significant difference in the mean intensity of pain before and after the back massage is performed on women giving birth. This shows that back massage affects the intensity of pain in the 1st stage of labor. Back massage in maternity mothers will reduce the intensity of labor pain in the first stage.

This success shows that massage can provide pressure to prevent or inhibit pain impulses originating from the cervix and uterine corpus using the gate control theory. By using force, pain that radiates from afferent fibers to get to the thalamus becomes blocked. This can happen because delta A and delta C pain afferent cells that come from receptors throughout the body when pain transmission must enter the spinal cord through the back roots and synapse in the spinal cord. galatinosa lamina II and lamina III are blocked so that the synapse does not spread to the thalamus so that the quality

and intensity of pain reduction. Pain sensations are transmitted along the sensory nerves to the brain, and only a certain number of feelings or messages can be transmitted through these nerve pathways at a time. By using the neural pathway massage technique for the perception of pain, this can be inhibited or reduced, then the intensity of pain felt by the mother is reduced, and tension does not occur, so that ineffective uterine contractions due to pain can be prevented, so that prolonged labor does not happen.

Massage is one way that can be done to reduce pain during labor, and massage can stimulate endogenous analgesics (endorphins) and interfere with pain transmission by increasing the circulation of neurotransmitters produced naturally by the body at neural synapses in the pathways of the central nervous system. (Rokade, 2011). The body has built-in natural mechanisms to reduce the sensation of pain. The body produces neuromodulators in response to stress and pain by inhibiting the release of excitatory neurotransmitters. Neuromodulators are categorized into three main groups: beta-lipoproteins, enkephalins, and dynorphins. (Mander, 2004)

Beta-endorphins (beta lipotropin subgroup) inhibit the formation of prostaglandins and reduce their effect. This substance is activated by stress and labor pains produced by the pituitary gland. This substance is closely related to opiate receptors and works as a chemical messenger and works like analgesia by inhibiting substance P, a nociceptive neurotransmitter, inhibiting impulse transmission.

The results showed that massage on the back for 30 minutes could reduce pain in the first stage of normal labor. These results are in line with the opinion of Mander (2004) and Sherwood (2011), who state that the pressure can activate large-diameter nerve fibers to close the gate of pain transmission carried by small-diameter nerve fibers so that pain transmission is completed to the cerebral cortex and results in reduced pain. This result is also consistent with Price and Wilson (2006), which state that massage for 30 minutes will inhibit the transmission of pain through the fibers.

The results of Aryani's research (2015) concluded that back massage affected endorphin levels in the first stage of labor during the latent phase of everyday labor. This indicates a strong relationship between endorphin levels and pain intensity in the first stage of work. Endorphins act as neuromodulators that inhibit the sending of pain messages.

These studies differ in terms of research time, study design, number of research subjects and interventions used, intervention providers, but comprehensive studies consistently support the benefits of massage to reduce labor pain.

Massage is one of the non-pharmacological methods used to reduce labor pain. Pain is one of the natural defense mechanisms of the human body, which is a warning of danger. In pregnancy, pain attacks tell the mother that she has entered the labor phase. Pain during labor does not need to be eliminated, but it is imperative to manage pain well individually. (Simkin P, 2005).

Everyone's perception of pain is different. If not addressed, it will cause other problems, namely increasing fear and anxiety in the mother. Pregnant women often worry about the pain they will experience during childbirth and how they will react to dealing with the pain. Emotional tension from anxiety to fear will exacerbate pain perception during labor. Maternity pain can cause a physiological response, namely, reducing the ability of the uterus to contract, thereby prolonging the time of delivery.

Several studies have shown that pain can increase catecholamines by 20±40%, the same as under stressful conditions. The increased sympathetic response will ultimately cause increased peripheral resistance, increased cardiac output, and increased blood pressure and maternal oxygen consumption at the time of delivery. Hyperventilation, in turn, caused respiratory alkalosis and high adrenaline levels and decreased uterine blood flow. The uterine activity becomes uncoordinated, which will lead to prolonged labor. Increased plasma cortisol can decrease maternal and fetal immune responses. The secretion of catecholamines that pass to the fetus via the placental bloodstream can result in fetal acidosis. (Lally, 2008). This situation will undoubtedly be hazardous for the mother and fetus. These consequences can be carried over to the postpartum period, such as slow healing of labor wounds and impaired breast milk (ASI) production, which can interfere with the baby's growth (Camann W, 2005).

CONCLUSION

Based on the study results, most of them were aged 20-35 years, with higher education level, and most were multigravida, and back massage in laboring mothers affected the intensity of pain in the first stage of labor. Therefore, for Puskesmas (Health

Institutions) to always carry out the Ministry of Health's program, namely maternal care to provide comfort during childbirth by controlling pain during labor through non-pharmacological techniques. Likewise, midwives in the field as birth attendants apply methods of relieving labor pain naturally and teach families how to massage to reduce pain during the 1st stage of labor. Especially for midwife education, to continue to equip students with theories and skills in providing childbirth care, especially skills to reduce labor pain naturally and become one of the competencies that must be possessed in childbirth care.

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She has to her credits author & co-author to a number of books in the field of Commerce & Management. She has been appointed as an External Referee and Evaluated 8 Ph.D. Thesis. She is a Member of Indian Commerce Association, All India Principal Association and Editorial Board Member of International Journal in Management & Social Science. She has also been appointed as NAAC PEER Team Member.

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