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AI Based Personalized Healthcare Application to Keep Up the Well-Being of People by Boost the Immunity through Food and Physical Activity during Pandemic

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Abstract

In recent times Covid-19, a worldwide pandemic affecting people globally. As on August 31, 2020 more than 25,118,689 cases were confirmed worldwide. In India 3,621,245 confirmed cases with 64,469 deaths were reported. Epidemiological specialistssuggest that the spreading of the virus can be controlled only by imposing quarantine status (i.eself-Isolation, self-quarantine, maintain socialdistancing and home confinement) for the majority of the population. During pandemic situation all the public activities are depressed. The prolonged closure and home confinement during a disease outbreak might have negative impact not only on the people's physical health but also on their and mental health too.There exists a direct associationamong diet, physical activity, and healthof the citizen. To keep up the wellbeing of the people and for preventing other kinds of diseases there is a need to maintain both their physical and mental health. An adequate, well balanced diet combined with regular physical activity is thebase for good health. Poor nutrition can lead to reduced immunity, increased susceptibility to various diseases, damage the physical and mental health of the people, and reduced their productivity.In this paper, an AI based personalized healthcare application is designed and develop tosuggest suitable nutrients through food to improve their immunity for all categories of people based on their age and health condition and to teach simple exercises and yoga asanato strengthen both physical and mental health of the citizen.The information is gathered from the domain experts to create a knowledge base. Knowledge base also interfaces with the pre-built system for authorized procedure for diagnosis, treatment process, condition-specific guidelines, and promoting the use of best practice with the help of experts. Personalized medication is suggested based on the inferences derived from the engine.Details of every person are stored regularly in terms of

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different facts.These would help us to derive the decisions and provide suggestions to the people in a consistent way.Machine learning algorithms are used to learn data patterns and derive relevant insights as inferences that would be helpful in treating the people in a healthier way.Personalized Health dashboard capture real-time data and analyze data patterns effectively. It would produce precise and timely report following government standards that help in improving patients' health. The Application give recommendation related to the kind of food that can be taken for improving immunity based on their health and give simple exercises to improve their health system during any kind of pandemics.

Keywords:

Personalized healthcare application, artificial intelligence, machine learning, inference rule,personalized medication, personalized workouts.

1. INTRODUCTION

COVID-19 is an infectious disease caused by Novel corona virus rooted its origin from Wuhan, China, in December 2019. Later WHO announces COVID-19 as a worldwide pandemic. More than 25,118,689cases were confirmed as on August 31, 2020, with 844,312 deaths worldwide and 3,621,245 confirmed cases with 64,469 deaths in India [6-7]. The common symptoms of COVID-19 are fever, dry cough, and tiredness. Other symptoms include aches and pains, nasal congestion, headache, conjunctivitis, sore throat, diarrhea, loss of taste or smell or a rash on skin or discoloration of fingers or toes. Children and adolescents are just as likely to become infected as any other age group and can spread the disease. Epidemiologist suggests that the spreading of the virus can be controlled only by imposing quarantine / isolating the people who are exposed to this virus. The people at high risk are aged person, people with hypertension / diabetes / cardiovascular problem or respiratory diseases. The wellbeing of the people has a direct association with the diet and amount of physical activity. Healthy diet plays a vital role on people's physical and mental health. Recommendations given by WHO related to physical activities are:

- Infants under 1 year with few times of physical activity per day.
- Children under 5 years with 180 minutes of moderate to vigorous activity per day.

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- Children and adolescents between 5 and 17 years with 60 minutes of moderate to vigorous activity at least 3 days a week.
- Adults more than 18 years with 150 minutes of moderate to 75 minutes of vigorous activity throughout the week.

The main objective of this paper is to designed and develop an AI based personalized healthcare application to suggest suitable nutrients through food to improve immunity for all categories of people based on their age and health condition and to teach simple exercises to strengthen both physical and mental health of the citizen.Applications (web or mobile) are individual software with limited function to serve users with a specified task. Applications are visible to the customer all the time and improve the customer engagement. Healthy and well balanced diet plays a vital role on people's physical and mental health. The paper is organized as, section 2 describes the literature survey, section 3 describes the proposed system, section 4 describes the experimentations carried to show the importance of food and their physical activities and section 5 finally concludes the work.

The author contribution towards the AI based personalized health care application are:

1. Design and Development of a Knowledgebase
2. A Training model for providing the importance of the physical activity.
3. A Training model for identifying the low calories food ingredience
4. Design of an Inference Engine

2. LITERATURE SURVEY

ChakrabortyIndranil et al 2020 [8] describe the global and societal impact of COVID-19. He also describes the possible ways by which the disease can be controlled. A new infectious respiratory disease namely SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) emerged from Wuhan during the month of December 2019. Since the outbreak it has affected more that 5206614 people and killed more than 337,736 people in more than 200 countries throughout the world [6]. No clinically approved antiviral drugs or vaccines available still. The rapid spread of this diseases leads to enormous health, economic, environmental and social challenges to the entire human population. Every nation struggles in controlling the transmission of this disease. They impose either partial or complete lockdown, restrict the mass gathering of people, quarantining suspected persons etc.

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Wang Guanghai et al [9] discuss the effects of home confinement on children during the pandemic situation. During pandemic situation all the public activities are discouraged. Children and adolescents are confined to their homes. Efforts are taken to conduct online courses and deliver them through internet. The virtual classes are started in many parts of the country. Children and adolescents physical and mental health are affected because of the prolonged closure of school and home confinement. Impacts of prolonged closure results in minimal physical activity, irregular sleep, gaining of weight and psychosocial stress.

Luc Goethals et al [2]describes the impact of Home Quarantine among old adults. Physical activity is important to maintain their level of independence, mental health, and well-being. Reduction in physical activity during quarantine period will affect both the mental and emotional health of older adults. The author proposes a way to continue their physical activities (exercise)by referring to various video clips from different website even during this home quarantine days.

Pedro Silva Moreira et al [3] describes how to take care of the mental health for the people of Portuguese during the COVID-19. The factors influencing the mental health of the people are online work, absence of physical exercise, psychological factors like anxiety, depression, stress and obsessive-compulsive symptoms[1]. He explores the possible ways to reduce the negative impact of long time quarantine.

In the United States (US), the COVID-19 Pandemic's New Epicenter, a dedicated Lifeline (the National Suicide Prevention Lifeline) was activated for emotional distress related to COVID-19 to prevent suicide.

In-order to control the Covid-19a worldwide pandemic epidemiologist suggests that the spreading of the virus can be controlled only by imposingquarantine / isolating the people who are exposed to this virus. Quarantine leads to a negative impact among the isolated patients especially who are at high risk category. This may change the lifestyle of a variety of population.The people at high risk are aged person, people with hypertension / diabetes / cardiovascular problem or respiratory diseases. The wellbeing of the people has a direct association with the diet and amount of physical activity. Healthy diet plays a vital role on people's physical and mental health.

The World Health Organization (WHO) declared COVID-19 as a global pandemic. COVID can cause emotional distress and anxiety among common people. COVID-19

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traumatization general public, members, and non-members of in medical staff helping with COVID-19 control [12]. Even Medical staffs undergo various stress related issues due to their high workload and lack of protective devices. In Italy two infected nurses committed suicide and such cases were reported in different countries due to the fear of COVID-19, anxiety, falling sick or helplessness.

Rajesh Singh [11] underlines the importance of age and social contact structures during COVID 19 pandemic among three different countries data such as India, China andItaly. To study the growth of COVID-19 cases in India, the authorapplies Bayesian assertion on the age-structured SIR model with social contact matrices. He investigates the impact of social distancing, closure of schools and workplace and lockdown.

KaustuvChatterjee et al [10]develop a stochastic compartmental SEIR model where individuals are compartmentalized using a set of differential equations with different possible scenario. MATLAB with Monte Carlo simulation is applied for about 1000 runs. SimVoi software models the possible different need for Hospitalization, intensive care unit (ICU) requirements during this pandemic time. Even the impacts of non-pharmacological interventions (NPIs) of the epidemic were estimated.

3. PROPOSED SYSTEM

AI based personalized Health application is designed and developed to strengthen both physical and mental health of the citizen. The overall system is designed to give suggestion related to the kind of food that can be taken for improving immunity based on their health condition and give simple exercises to improve the overall physical health their by overcoming the issues related to mental health during such kind of lock down.The main objective of this application shown in figure 1are: (1) Suggest suitable nutrients through food to improve immunity for all categories of people based on their age and health condition and (2) To teach simple exercises in-order to increase the well being of physical and mental strength.The complete system architecture is given in figure 2.

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Figure1a. Physical Activity Features focused on Health Plus app

Figure1b. Immunity boosting food focused on Health Plus app

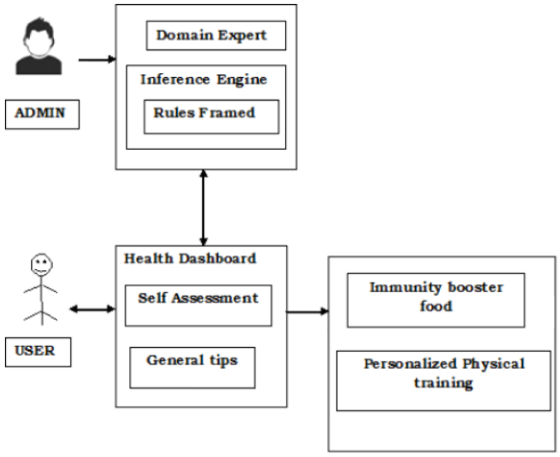

Figure2. System Architecture of AI based Personalized Health application

The four major modules of this application includes

5. Design and Development of a Knowledgebase

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6. A Training model for improving physical health through traditional food, Yoga and fitness practices
7. Design of an Inference Engine
8. Personalized dashboard for prediction of health level using Big Data Analytics

3.1 DESIGN AND DEVELOPMENT OF A KNOWLEDGEBASE:

Design and development of the knowledge base plays a vital role in developing the Personalized Health application. The information is gathered from the domain experts. Information related to well-balanced, simple homemade food is prescribed by the Nutrition and Dietetics. Personalized home based physical activities are suggested by the yoga trainer and Fitness Trainers. Domain experts designs the treatment plan, procedures for diagnosis, guidelines to be followed for specific condition and promoting the use of best practice. The following are the attributes to be considered for knowledgebase development:

- Videos to performing physical activity at home
- Video clips on exercises to reduce bodyweight
- Video clips related to simple aerobic exercises
- Video on preparing simple immune support food item preparation
- Videos on respiratory related asana and breathing exercises

3.2 TRAINING MODEL FOR IMPROVING PHYSICAL HEALTH THROUGH TRADITIONAL FOOD:

A balanced and healthy diet is not common to all. It depends on various factors such as age, gender, lifestyle, amount of physical activity, cultural foods and dietary customs. Due to home confinement people started consuming more high in energy, fats and sugars based food. They often forget to take enough fruits, vegetables and dietary fibers. This leads to an imbalanced diet which paves way for various health issues. Poor nutrition can lead to reduced immunity, increased the vulnerability to different types of disease, mess up physical and mental health and reduced productivity.A balanced diet is one which contains a variety of foods with enough quantities and proportion that has enough nutrients in adequately level for maintaining health.

Healthy dietary consists of different kinds of foods; the emphasis has been shifted from taste to nutrient orientation food based approach. Nutrition is important for everyone.However, the

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requirements are different for infant, growing child, adults ,pregnantwomen and elderly people.Foods can be categorized according to the function as:

- Energy rich foods which are good source of carbohydrates and fats. The list of food items includes whole grain, cereals, millets, vegetable oils, ghee, nuts etc.
- Body building foods which are good source of proteins. Food item includes pulses, nuts, milk and milk products, meat, fish, poultry etc.
- Protective foods good source of vitamins and mineral. Food item includes green and leafy vegetables, fruits, eggs, milk and milk products etc [4-5].

3.3 TRAINING MODEL FOR IMPROVING PHYSICAL HEALTH THROUGH FITNESS TRAINER:

Physical activity and persons health has a direct association among each other. A healthy person is always active in his/her work. Proper, balanced physical activity preventing many diseases too.The American Heart Association recommends at least 150 minutes of moderate or at least 75 minutes of vigorous physical activity, per week for adults There are many ways you can make yourself active, even during such a lock down situation and gym are closed and you are practicing social distancing. Experts such as fitness trainer are identified and a list of simple exercise has been conceptualized and planned based on the personal need and the same has been operationalized based on their interest.

Physical activities can be performed even at home with limited space and with no large or special equipments. Simple exercises to be followed are listed below:

- Walking on a line
- Sitting and getting up from the chair
- Going up and down a step
- Dancing, playing with children
- Reduce your sitting time by standing up whenever possible.

3.4TRAINING MODEL FOR IMPROVING PHYSICAL HEALTH THROUGH YOGA

Yoga acts as vital instrumentin improve respiratory health and immunity among different age group of people. Yoga can be performed on a simple mat, or on a chair, 20 min-

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Pranayama.People of all age groups can practice these kinds of asana to improve their physical and mental health.Practicing yoga and Asana especially breathing exercises helps inimproving the respiratory system. The various factors to be considered are:

- Yoga and asana to boosts the immune
- Yoga and asana to prevent weight gain
- Yoga and asana to reduce stress and anxiety
- Yoga and asana to improves sleep

3.4 DESIGN OF INFERENCE ENGINE

The role of the inference engine is to deduce new information on applying logical rules to the knowledge base. Inference system extracts useful information from a large volume of healthcare data from different patient population and predicts the risk by using the real-time data of the patient. In this paper various inputs are taken from different experts like physician,therapist,dieticianetc.by using sophisticated artificial intelligence algorithms useful insights are derived in order to assist clinical practice. Machine learning algorithms are used to learn data patterns and derive relevant insights as inferences that would be helpful in treating the people in a healthier way. The common rules to be followed in order to find whether a person suffers from obesity or not is given below.

Rule 1: If BMI < 18.5 then categories the person as underweight

Rule 2: IfBMI >=18.5and BMI<25, then categories the person as normal

Rule 3: If BMI>25.0 and BMI <30, then categories the person as overweight

Rule 4: If BMI > 30.0 then categories the person as obese.

Patients suffering from obesity have a threat for type 2 diabetes. A proper diabetic meal plan helps them in controlling their high blood sugar levels. In order to promote weight loss and to maintain ideal body weight 1,500 to 1,800 calorie diet per day can be suggested.

Rule 5: If Obese→choose 1200 caloriediet plan

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3.5 PERSONALIZED DASHBOARD FOR PREDICTION THEIR HEALTH LEVEL USING BIG DATA ANALYTICS

In this digital era people use personalized healthcare dashboard.Personalization refers to the delivery of right diagnosis and treatment for every individual person. A personalized healthcare dashboard integrates crucial patient-related and other operational data into a seamless interface which will make their life easier. Personalized medication is suggested based on the inferences derived from the engine. Details of every person are stored regularly in terms of different facts. These would help us to derive the decisions and provide suggestions to the people in a consistent way.Real-time data are analyzedand accurateremedies are suggested based on the prescribed standards which help in improving patient experiences.

4. RESULT AND DISCUSSION

4.1 DATA SET:

Two data sets were used in this work. First one consist of two CSV files with details related to user and their gender, age, weight, height, duration of workouts, heart rate, body temperature and the calories burnt. It isfrom www.kaggle.com/fmendes. The second dataset used consist of 5 CSV files out of which we used NutritionalFacts_Fruit_Vegetables_Seafood.CSV file obtained from ---.

4.2 EXPREMENTATION

Thefmendes data set used in this work has details related to user and their gender, age, weight, height, duration of workouts, heart rate, body temperature and the calories burnt. Figure 3 below shows the correlation betweencalories burnt due to workouts and duration of workouts, heart rate, height and weight.

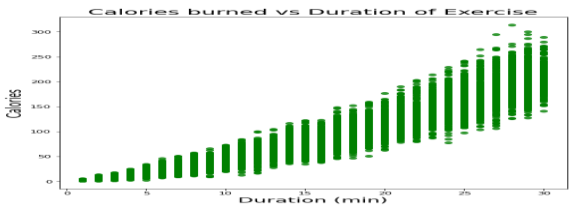

Figure 3a.Calories burnt vs duration of workouts

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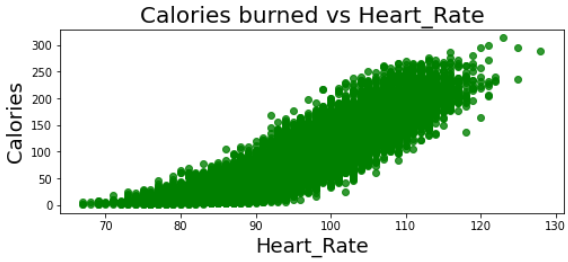


Figure 3b.Calories burnt vs Heart rate

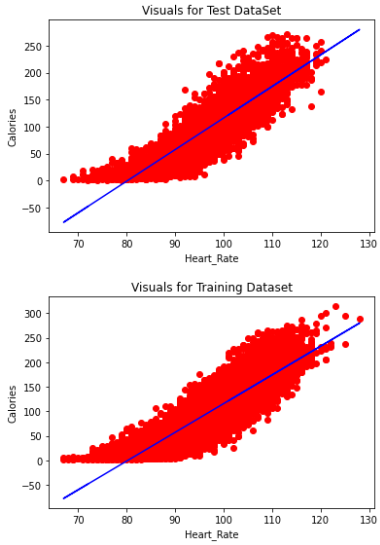
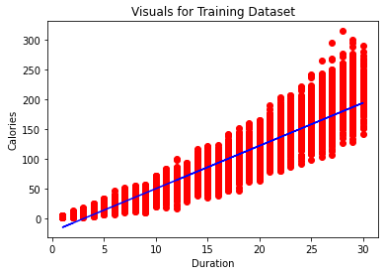


Figure 4a.Linear correlation among Calories burnt vs Heart rate

Linear regression otherwise called as linear model identifies a linear relationship among one or more input variables and a single output variable. The dataset is divided into training and testing data and a linear regression model is applied and is depicted in figure 4a and 4b. Among the various attributes present on the dataset two positive correlations can be found and are depicted in figure 4a and 4b. First one among the amount of workouts carried out and the calories burnt. Second one among the heart rate and calories burnt.



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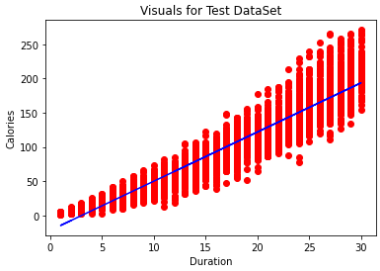

Figure 4b.Linear correlation among Calories burnt vs duration of workouts

The statistical measureR^2 describes the closeness of the data to its fitted regression line. Its value lies between 0 to 100%

Table 1:R^2 Value for different attributes

Features	R^2Value
Duration Vs Calories	91.62%
Heart Rate Vs Calories	80.15%

Clustering high energy food

The food items are grouped based on their nutritional value. Figure 5 represents the percentage of food on each category of calories from low to high. The dataset used for this purpose isNutritionalFacts_Fruit_Vegetables_Seafood.Table 2 illustrate the Sample Nutritional Facts from the data set used.

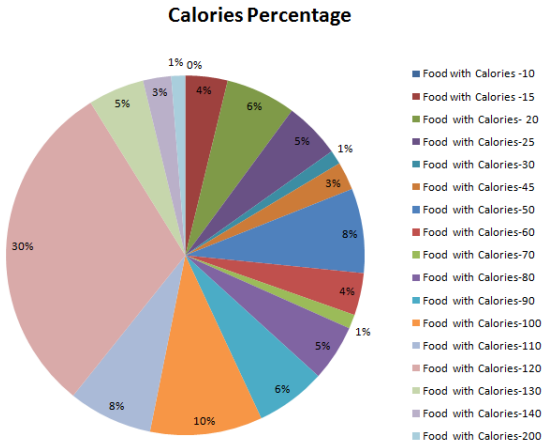

Figure 5.Percentage of ---Nutritional Facts (Calories) of the food item

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Table 2: Sample Nutritional Facts

Calories	Food item in grams
10	Asparagus, 5 spears (93 g)
10	Bell Pepper, 1 medium (148 g)
10	Broccoli, 1 medium stalk (148 g)
10	Carrot, 1 carrot, 7" long,Ê1 1/4" diameter (78 g)
15	Cauliflower, 1/6 medium head (99 g)
15	Celery, 2 medium stalks (110 g)
15	Cucumber, 1/3 medium (99 g)
20	Green (Snap) Beans, 3/4 cup cut (83 g)
20	GreenCabbage, 1/12 medium head (84 g)
20	Green Onion, 1/4 cup chopped (25 g)
20	Iceberg Lettuce, 1/6 medium head (89 g)
20	Leaf Lettuce, 1 1/2 cups shredded (85 g)

The inferences made out of the regression and cluster analysis is in order to achieve the well being of the citizen and to keep them physical fit low calories food items are suggested as thereexist a direct relationship among the food they consume and their duration of the workouts. Higher the consumption of high energy food, duration of workouts need to be increased their by reducing the chance of obesity and be active always.

5. CONCLUSION

The containment of the communicable virus (COVID-19) is only by imposing quarantine status for the majority of the population ie. self-Isolation, self-quarantine and maintain social distancing and home confinement. During pandemic situation all the public activities are discouraged which can have a negative impact on people's physical and mental health.There exists a direct association between the diet, physical activity, and health of the people. AI based personalized Health application is designed and developed to strengthen both physical and mental health of the citizen. The overall system is designed to give suggestion related to the kind of food that can be taken for improving immunity based on their health condition and give simple exercises and asana to improve the overall physical health their by overcoming the issues related to mental health during such kind of lock down.Persons who suffer from hypertension, diabetes or cardiovascular disease (CVD), patients with respiratory diseases, aged person will be the direct beneficiaries of this application. This would improve or maintain both the physical and psychological status of the family to lead a happy and peaceful life. The main objective is to suggest suitable nutrients through simple homemadefood to improve immunity for all categories

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of people based on their age and health condition and to teach simple exercises to strengthen both physical and mental health of the citizen.Applications are visible to the customer all the time and improve the customer engagement.

6. REFERENCES

[1] Jiménez-Pavón, David, Ana Carbonell-Baeza, and Carl J. Lavie. "Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: Special focus in older people." *Progress in cardiovascular diseases* (2020).

[2] Goethals, Luc, et al. "Impact of Home Quarantine on Physical Activity Among Older Adults Living at Home During the COVID-19 Pandemic: Qualitative Interview Study." *JMIR aging* 3.1 (2020): e19007.

[3] Moreira, Pedro Silva, et al. "Protective elements of mental health status during the COVID-19 outbreak in the Portuguese population." *medRxiv* (2020).

[4] https://nutrition.org/how-to-stay-fit-and-healthy-during-coronavirus-covid-19-pandemic/

[5] https://patients.healthquest.org/exercise-is-essential-for-well-being-during-covid-19-pandemic/

[6] M.Kavitha, T.Jayasankar, P.Maheswara venkatesh, G.Mani, C.Bharatiraja, and Bhekisipho Twala, "COVID-19 Disease Diagnosis using Smart Deep Learning Techniques", *Journal of Applied Science and Engineering(2021)*,vol.24,No.3. http://dx.doi.org/10.6180/jase.202106_24(3).0001

[7] https://www.coronatracker.com/country/india/

[8] Chakraborty, Indranil, and PrasenjitMaity. "COVID-19 outbreak: Migration, effects on society, global environment and prevention." Science of The Total Environment (2020): 138882.

[9] Wang, Guanghai, et al. "Mitigate the effects of home confinement on children during the COVID-19outbreak." The Lancet 395.10228 (2020): 945-947.

[10] Chatterjee, Kaustuv, et al. "Healthcare impact of COVID-19 epidemic in India: A stochastic mathematical model." Medical Journal Armed Forces India (2020).

[11] Singh, Rajesh, and R. Adhikari. "Age-structured impact of social distancing on the COVID-19 epidemic in India." arXiv preprint arXiv:2003.12055 (2020).

[12] Montemurro, Nicola. "The emotional impact of COVID-19: From medical staff to common people." Brain, behavior, and immunity (2020).