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Research Article

# Covid-19 Prediction Model (COVID-19-PM) For Social Distancing: The Height Perspective

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**Abstract:** The outbreak of the coronavirus in Wuhan city, China in December 2019 has taken a different dimension that the World Health Organization declared it PANDEMIC in January 2020. The virus was later code named Covid-19. Covid-19 is now a global concern ravaging the world. Different suggestions on possibilities to control the spread of the virus have been advanced in recent times. Nonpharmaceutical approaches such as partial lockdown, total lockdown, and social distancing have been adopted to reduce the spread of the Covid-19. This study focused on how effective social distancing is to curtail the spread of Covid-19. The objective of this study is to determine the social distancing value measured in meters that could help reduce the spread of the virus. In this study, we proposed a prediction model based on social distancing value and height to investigate whether social distancing will help curtail the spread of the virus. The model is classified as detection and prediction phases. The prediction phase utilizes information from the detection phase to analyse the effect of social distancing value on the spread of Covid-19. The study revealed that as the social distancing value increases, the probability of spread decreases. The result also showed that as the social distancing values increases, the probability of safety from been infected increases. The study concludes that increasing the social distancing value up to three or four meters could reduce the probability of spread and increase the probability of safety from been infected by the virus.

**Keywords:** Covid-19, Social Distancing, Lockdown, Mean, Height.

## 1. INTRODUCTION

The outbreak of the coronavirus in Wuhan city in December 2019 was initially associated with the local seafood market [1-2]. China officially closed the seafood market for sanitation and disinfection on 1st January 2020. From December 31st to January 3rd about 44 cases were reported by the Chinese officials to World Health Organization (WHO) [1]. The first exported cases outside China were reported in Thailand, Japan, and the Korea Republic in that sequence in January 2020 [1,3]. However, the narratives changed when the World Health Organization proclaimed it Pandemic and code-named it Covid-19 in January 2020 [2]. The origin (ground zero) of the virus is continentally debated by China and the United States of America. Covid-19 is now a global concern ravaging the entire human race. Unfortunately, with the efforts of scientists, no vaccine is yet available to curtail the spread of the virus. The global infection rate surpasses four hundred thousand with recorded death above eighteen thousand [2,4].

At the beginning of the Covid-19 crisis, Hubei province in China was the epicenter. China recorded

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over 81,000 confirmed cases with approximately 3,267 deaths. Fortunately for the Chinese people, they reported on the 20th of March 2020 that no new cases were recorded with just 6,013 receiving treatment. It is ironic to note that most of the Covid-19 cases were exported from Wuhan city to the rest part of the world [1,5,6]. Covid-19 is considered the fastest exported virus in human history and it is expected to infect over one hundred million and millions of deaths by the end of 2021.

Regrettably, the virus is ravaging entire Europe with Italy as the epicenter of Covid-19 with over 4,000 deaths recorded and over 58,000 confirmed cases [7]. The death rate in Italy has surpassed that of China [7]. Globally, the European region has the highest level of confirmed cases as of the 22nd of March 2020 [7]. Recent reports showed that more nations are joining the league of Covid-19 infection with over 192 countries and territories and one international conveyance (Diamond Princess cruise ship) [2, 8-10]. WHO has rated Covid-19 global level very high [7].

Although, without an existing vaccine for the treatment of the virus, medical experts are using existing medical practices to treat infected people. In recent days, different nations have shown interest in the possibility of developing vaccines for the virus. More recently, Chloroquine phosphate, Chloroquine, and Hydroxychloroquine, and Remdesivir [11-15] have been suggested as possible means to treat infected persons. However, this option is subject to clinical trials and approval by the relevant health and food agencies across the world. Since no existing vaccine to tame the virus, WHO has initiated different procedures to control the spread of the virus, such measures include partial lockdown, complete lockdown, and social distancing.

Recently, a predictive model using susceptible exposed infectious recovered (SEIR) epidemic model for corona tracker and sentimental analysis based on newsgathering has been reported [16-17]. In this study, we considered how to curtail the spread of the coronavirus using the nonpharmaceutical approach such as social distancing. We also discussed the effect of social distancing in the perspective of height to predict the rate of spread of Covid-19. The objective of this study is to apply the proposed model to determine the best social distancing values that could reduce the probability of spread of the coronavirus and improve the probability of safety from been infected by the virus.

The rest of this paper is organized as follows. The proposed prediction model and data collection are discussed in Section 2. Section 3 contains results and discussions while conclusions follow in section 4.

## 2. MATERIALS AND METHODS

This study focused on how effective social distancing is to curtail the spread of Covid-19. We looked at social distancing based upon height perspective by developing a prediction model (PM). When the data set on height measurement is inputted into the detection phase, the detection phase would classify the output as varying height or equivalent height. The output of the detection phase is used as input for the prediction phase controlled by the social distancing value. The output from the prediction phase would determine whether the probability of spread is increasing or decreasing. The probability of safety also depends on the social distancing values.

### 2.1 Prediction Model (PM)

The proposed prediction model consists of two phases: the detection phase and the prediction phase. The detection phase is described as Equation (1) to Equation (3) [18].

$$Y = (G \times U) \tag{1}$$

$$G = (X_i - \bar{X})^{\emptyset} \tag{2}$$

$$U = \frac{1}{\sqrt{S}} \tag{3}$$

where Y denote the detection value, $X_i$, $i$=1,2,3,…..,n, is independent randomly measured height data set. From Equation (2), the mean height is derived from the input data set $Xi$, that is

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n} \tag{4}$$

where $n$ is the sample size and Ø is the social distancing value which varies with the initial value of 1.5 meters. The standard deviation (S) is stated as Equation (5).

$$S = \sqrt{\frac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}} \qquad (5)$$

Equation (5) shows how spread the input data set is to the mean.

The prediction phase uses the exponential function [19-20] which relies on the information from the detection phase. This can be stated as

$$G(\emptyset) = \pi e^{-\pi Y} \qquad (6)$$

Where G(Ø) is the prediction function and $\pi$ is the proportion of spread based on Y [18] and is defined as

$$\pi = \left(\frac{\Delta}{n}\right) \times 100, \Delta = \sum_i X_i \leq \bar{X}.$$

Equation (6) enables us to explain whether social distancing values will help reduce the probability of spread of Covid-19 or otherwise. On the other hand, Equation (7) below explains the probability of safety based on the social distancing values. Therefore, it is used to determine the probability of safety from been infected based on the social distancing values,

$$\alpha = \nabla - G\left(\emptyset_{k(m)}\right) \qquad (7)$$

Where $\nabla$ denote the spread benchmark, which has probability one. The implication of Equation (7) is that we compare the prediction function value with the spread benchmark to obtain the probability of safety (α) based on the assigned social distancing values.

* In this study, we adopt the definitions of suspect, probable confirmed cases based on WHO [21].

### 2.2. Data Collection

The data set used for this study is self-measured data on height. The data set is classified into two categories. In the first segment, about 1,200 people were projected to participate in the self-measured data. However, about 918 (76.5%) persons responded by disclosing their height measurement in meter (m). The data set is a self-reported case, implying that the participants measured their height and reported the value. The average age of respondents is 29 years old with 57.7% male and 42.3% female.

Segment two of the data set consists of waist up to head measurement. The data set is based on the seating height position of individual seating on the dining table or conference room. The focus is to determine eye level to eye level contact, which translates to seating height. We initially projected 700 participants on a volunteer basis but only 459 (65.6%) responded. However, the percentage of male and female respondents was not documented due to response style. In both segments, the respondents are from the Africa continent, Nigeria. The social distancing value means the distance between contact A and contact B in meter(s).

## 3. RESULTS AND DISCUSSIONS

The data set on height measurement was inputted into the prediction model, and the output from the model is reported in Table 1. Figure 1 shows that as the social distancing values increase, the probability of spread reduces. Theta(Ø) is the social distancing values and (G(Ø)) is the prediction value, Equation (6). The probability of spread reported in Table 1 is visualized in Figure 1 to Figure 3, respectively. From Figure 2, we observed that as the value of theta increases the probability of spread reduces. The analysis showed that social distancing is an effective way to curtail or reduce the probability of spread of Covid-19. Figure 3 displays the comparison between the two measured data sets. The result showed that the standing position has a higher probability of spread than the seating position. Table 2 shows the probability of safety based on the social distancing values. The analysis showed that as the social distancing values increase the probability of safety increases.The result reported in this study corroborate with previous studies reported in Okwonu, Arunaye, and Ahad [18].

**Table 1.** Probability of spread based on social distancing values (Equation (6))

| $k(m)$ | $1.5$ | $2$ | $3$ | $4$ | $5$ |
|---|---|---|---|---|---|
| $G(kH)$ | 0.81 | 0.63 | 0.07 | 0.06 | 0.01 |
| $G(kSH)$ | 0.78 | 0.44 | 0.015 | 0.004 | 0.00 |

$G(kH)$: probability based on standing height; $G(kSH)$: probability based on seating height

**Table 2.** Probability of safety based on social distancing values (Equation (7))

| $k(m)$ | $\mathbf{1.5}$ | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| $\alpha_{G(kH)}$ | 0.19 | 0.37 | 0.993 | 0.994 | 0.99 |
| $\alpha_{G(kSH)}$ | 0.22 | 0.56 | 0.985 | 0.996 | 1 |

$\alpha_{G(kH)}$: probability of safety based on standing height;
$\alpha_{G(kSH)}$: probability based on seating height

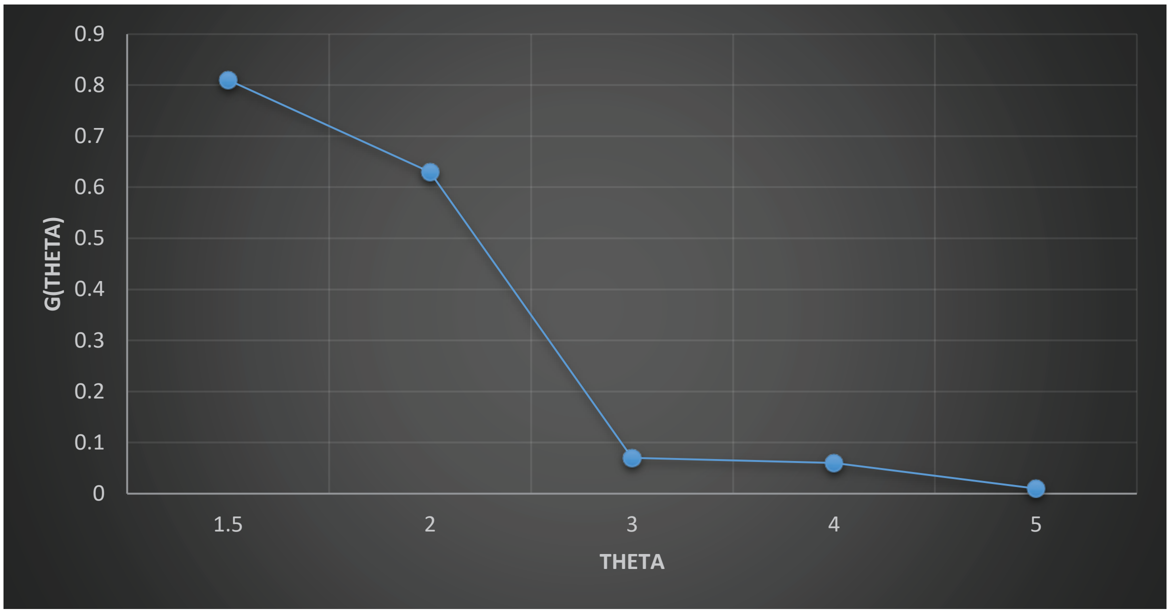


**Fig 1.** Influence of social distancing value on probability of spread based on height data

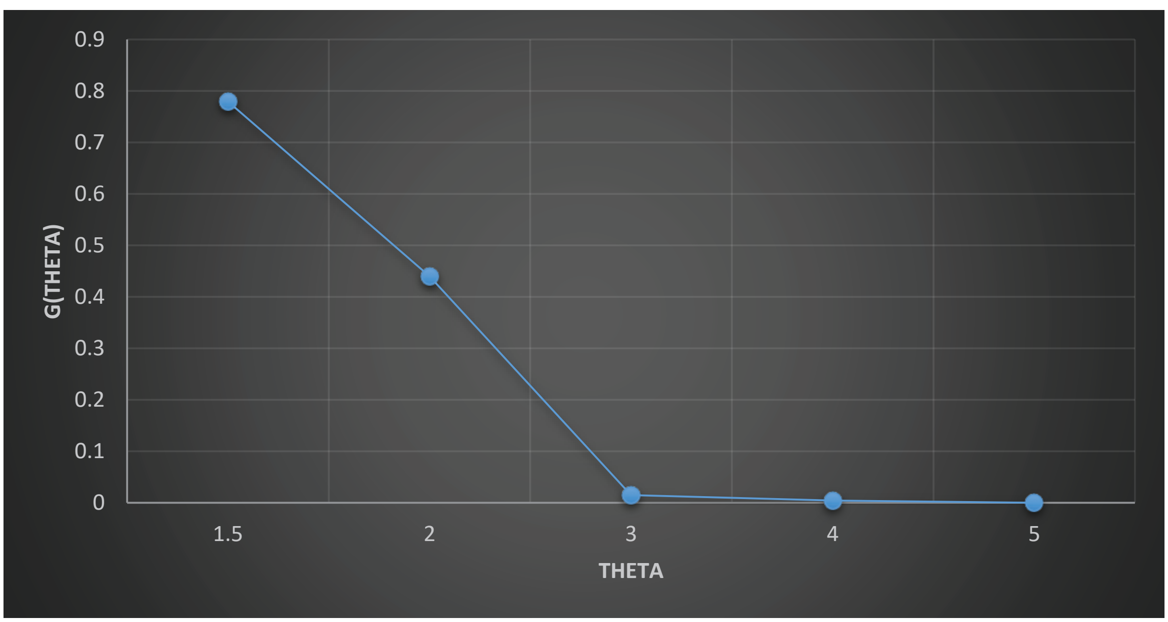


**Fig 2.** Influence of social distancing value on the probability of spread based on seating height data.

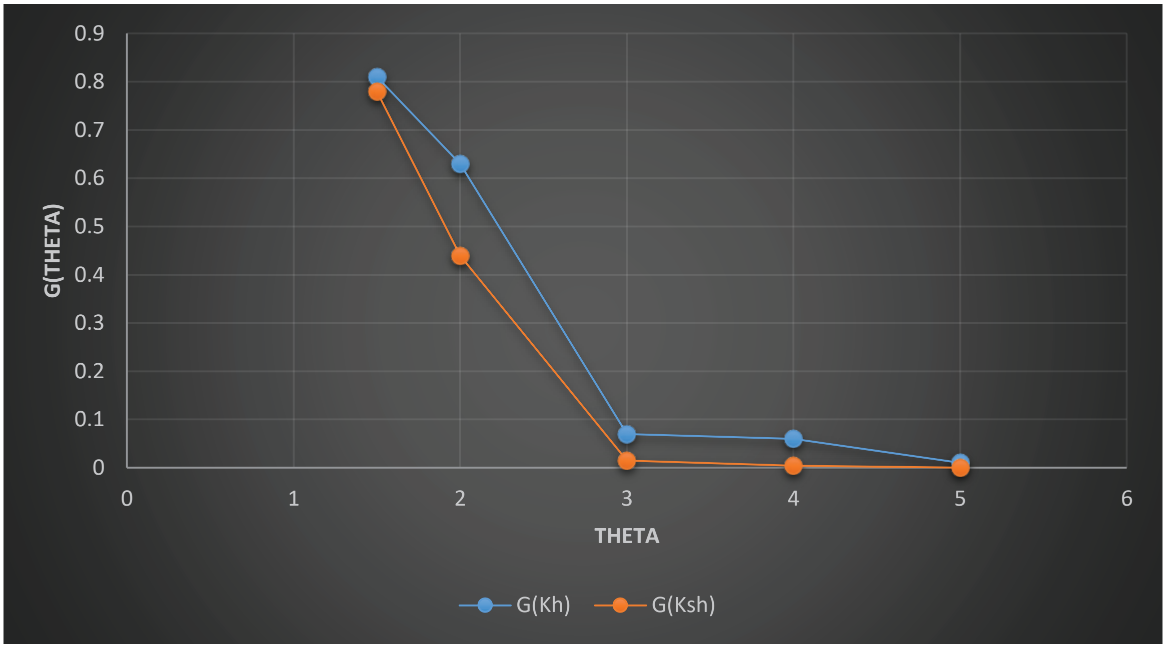


**Fig 3.** Comparison of the probability of spread by height and seating height position

## 4. CONCLUSIONS

The study showed that Covid-19 could be transmitted from human to human in standing position and seating position. However, the investigation revealed that with social distancing, people of similar height should be far away from each other more than the prescribed social distancing value of one meter. The analysis revealed that social distancing is an effective way to reduce the spread of the virus. Based on our study, as the social distancing value increases, the probability of spread reduces, and the probability of safety increases. This study recommends that the social distancing value should be three or four meters to reduce the rate of spread and increase the probability of safety. The analysis implies that social distancing could effectively reduce the spread of the virus.

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