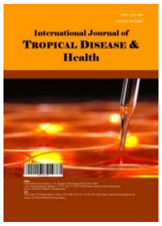


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# Covid 19: Determination of the Relationship between Sex, Having Handkerchief or Staying Indoor and Facial Touch

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Author SAA designed the study, collected the data and performed the statistical analysis. He together with authors SSA and OSB wrote the protocol and the first draft of the manuscript. All authors managed the literature searches, read and approved the final manuscript.*

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## ABSTRACT

**Background:** Covid-19 outbreak is the current pandemic confronting nations in the world. The virus had caused so much loss of lives, loss of jobs and serious damages to global economy. One major way of preventing the spread of the virus and guide against being infected is to avoid face touching with unwashed hand(s).
**Objective:** The objective of this study is to investigate the association between sex, having handkerchief or staying indoor and number of time a person touches face (mouth, eyes or nose).
**Methodology:** A sample size of n = 130 people were randomly selected and observed obliviously for 120 seconds. The number of times they touched their faces were recorded with other variables like sex, having handkerchief and staying indoor or outdoor. Since the response variable is count, appropriate models for such data were used.

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**Results and Conclusion:** The Poisson results shown that there exist overdispersion, hence, a model that can account for the dispersion parameter was used to obtain accurate results. The results of the analysis shown that there is no association between the number of time a person touches face and sex, having handkerchief or staying indoor. The expected number time people touch their faces within 120 seconds is twice while the minimum and maximum number of times are zero and eight respectively.

**Recommendation:** It is recommended that there ought to be adequate public enlightenment and sensitization on the peril of the novel COVID-19 pandemic and the reason why individuals ought to stick carefully to the exhortation of abstaining from touching of faces (without washing with soap and water) so as to forestall its spread. If a person's hands are contaminated with the virus, he/she isn't infected until he/she touches the face (nose, eye or mouth) with the hands unwashed.

*Keywords: Covid-19; poisson; negative binomial; pandemic; overdispersion.*

## 1. INTRODUCTION

Human history is going through one of the most turbulent time fighting the invisible enemy; the novel COVID-19 coronavirus [1]. Three human coronaviruses are known to exist: human coronavirus 229E (HCoV-229E), HCoV-OC43 and severe acute respiratory syndrome (SARS)-associated coronavirus (SARS-CoV) [2].

The first reports of the viral infection attracted attention in late December 2019 in Wuhan, the capital of Hubei, China [3]. By early January, terms like “the new coronavirus” and “Wuhan coronavirus” were in common use [3]. On February 11, 2020, a taxonomic designation “severe acute respiratory syndrome coronavirus 2” (SARS-CoV-2) became the official means to refer to the virus strain, that was previously termed as 2019-nCoV and Wuhan coronavirus. Within a few hours on the same day, the WHO officially renamed the disease as COVID-19 [3].

COVID-19 is a zoonotic virus. From phylogenetics analyses undertaken with available full genome sequences, bats appear to be the reservoir of COVID-19 virus, but the intermediate host(s) has not yet been identified [4].

While a lot is still unknown about the virus that causes COVID-19, we do know that it is transmitted through direct contact with respiratory droplets of an infected person (generated through coughing and sneezing) [4]. Individuals can also be infected from touching surfaces contaminated with the virus and touching their face (i.e, eyes, nose or mouth).

The outbreak of coronavirus disease has been declared a Public Health Emergency of International Concern (PHEIC) and the virus has now spread to many countries in the globe [5].

As at 19$^{th}$ April, 2020, there are 2,358, 360 Coronavirus cases, with 161,904 deaths while 606,654 have recovered (https://www.worldometers.info/coronavirus/).

Liu et al. [6] studied the factors associated with disease outcomes in hospitalized patients with Covid-19. They discovered that factors that led to the progression of COVID-19 pneumonia were age, history of smoking, maximum body temperature on admission, respiratory failure, albumin and C-reactive protein. A previous study found that highest temperature, dyspnea, respiratory rate, white blood cell count, neutrophil count, lymphocyte count, D-dimer, albumin, procalcitonin were risk factors for ICU care in patients with COVID-19 [6,7].

While COVID-19 continues to spread it is important that communities take action to prevent further transmission, reduce the impacts of the outbreak and support control measures [5].

Our goal therefore is to study how often people touch their faces and how is this associated with gender, having handkerchief and staying indoors or outdoors as explanatory variables. Obviously, avoiding touching of faces (nose, mouth or eyes) is one of the key ways in controlling the spread of the Covid-19.

In this paper, after specifying the Poisson and negative binomial (NB) model for this study (section 2), we described the Model assessment (Goodness of fit) of the test (Section 3). In section 4, we present the result of analysing the Poisson and NB model on the primary data obtained from the observation of 130 people in Ilorin Kwara State. Finally, we compare the result of the Poisson and NB model to measure the relationship between the explanatory and response variable.

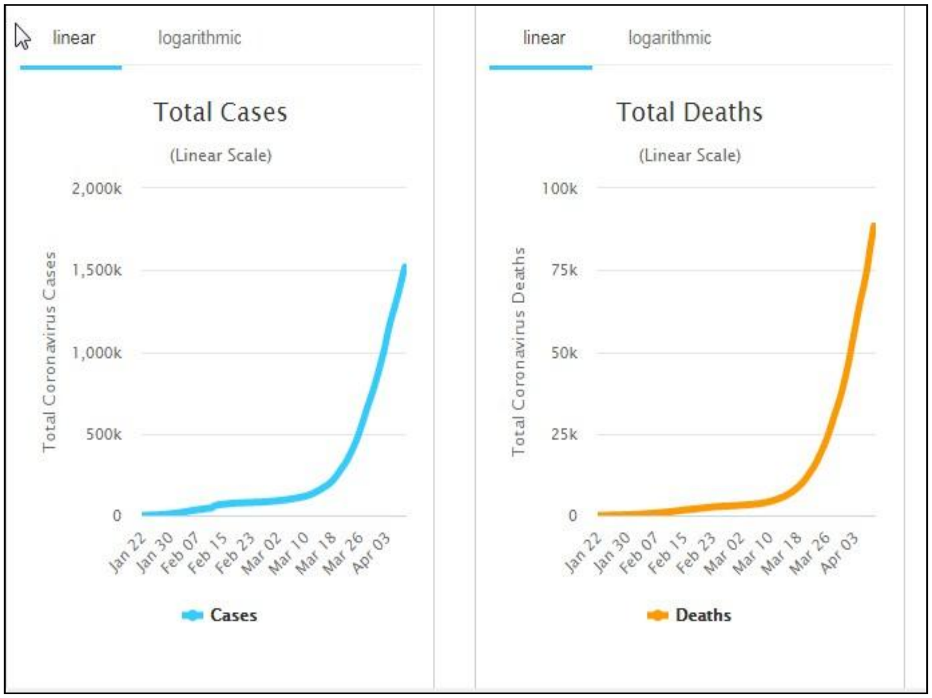


**Fig. 1. Total cases and total deaths of Coronavirus**

*Source: (https://www.worldometers.info/coronavirus/)*

## 2. MODEL SPECIFICATION

One of the challenges involved in analysing this relationship is the overdispersion, which is common to count data modeling. In a Poisson model, when the amount of variation for each sampling unit is typically higher than expected by a pure Poisson model, this is termed as overdispersion [8]. If the overdispersion is ignored, statistical inference results in an inaccurate conclusion by underestimating the variability of the data [9]. There are two major approaches to adjust for over-dispersion. First, the simplest adjustment approach is to scale the variance of the Poisson distribution by introducing a dispersion parameter and multiplying it to the variance [9]. The other approach is to introduce a new probability distribution to handle the dispersion, such as the NB [9].

### 2.1 Poisson Regression

Zeileis et al. [10] stated that the classical Poisson and NB regression models which is a count data belongs to the family of generalized linear models.

Poisson distribution is a tool that helps to predict the probability of certain events from happening when you know how often the event has occurred. It gives us the probability of a given number of events happening in a fixed interval of time. The density function is given as

$$P(Y) = \frac{e^{-\mu}\mu^{x}}{x!}, x = 0,1,2, \dots, n$$

The mean and the variance of the distribution is $\mu$.

However, when there exist overdispersion in the data, it is apparent to consider model that can account for the dispersion. In this case NB model has been recommended prominently in literatures.

### 2.2 NB Model

The NB model is derived as a mixture of both Poisson and Gamma distribution. The distribution is therefore expressed as

$$P(y_i/x_i) = \frac{\Gamma(y_i + \alpha^{-1})}{y_i\Gamma(\alpha^{-1})}\left[\frac{1}{1+\alpha\theta_i}\right]^{\alpha^{-1}}\left[\frac{\alpha\theta_i}{1+\alpha\theta_i}\right]^{y_i}$$

Where $\theta_i = exp(x_i'\beta)$

The following are the conditional mean and variance of NB distribution:

$$E(y_i/x_i) = \theta_i$$

and $Var(y_i/x_i) = \theta_i(1 + \alpha\theta_i) > E(y_i/x_i)$, respectively.

This has more desirable characteristics than the Poisson model [11]. This is as a result of the variance of the NB being significantly greater than the mean.

A simple case of Poisson regression will be considered in this work is

$$\log_e(count) = \beta_0 + \beta_1(sex = 1) + \beta_1(k = 1) + \beta_1(place = 1).$$

This expresses the log outcome rate as a linear function of a set of predictors.

## 3. MATERIALS AND METHODS

Primary data was obtained by observing 130 people were observed for 120 seconds to count how many times they touched their nose, mouth or eyes. Time: 24th March 2020, Zone Temperature: about 34°C, around 10am – 12noon in Kwara State. Nigeria. The dependent variable is the number of touches and Independent variables are Gender (Male and Female), having handkerchief (Yes or No) and staying indoors (Yes or No).

The analysis was done using STATA 16 statistical software [12].

**Table 1. Data summary**

| Variables | Details |
|---|---|
| Count of touch | Y = 0, 1, 2,… |
| $x_1$ = sex | Male = 0, Female = 1 |
| $x_2$ = Had handkerchief? | Yes = 1 N0 = 0 |
| $x_3$ = Person was Outside? | Yes = 1 N0 = 0 |

Fig. 2 shown that within 120 seconds, out of 130 people 33 (25.4%) did not touched their faces and the same percentage touched their face once. Similarly, 23.8%, 10.0%, 6.2%, 3.8%, 3.1% and 2.3% of the observed sample touched their faces twice, three, four, five, six and eight times respectively.

## 4. RESULTS AND DISCUSSION

The results from Table 2 represent Poisson model's output. To check for the unique assumption of the model which is equal-dispersion, we obtain dispersion parameter by dividing "Residual deviance" (RD) by the "degree of freedom" (d.f), that is, 407.02/126 = 3.23. The result is far larger than 1, which indicates overdispersion in the data. This problem leads to underestimation of the standard error (S.E) of the covariates and p-values for testing the significance of the included covariates will be correspondingly too low. This would very likely lead to incorrect inference, hence, the need for NB model, which can account for the overdispersion in the data.

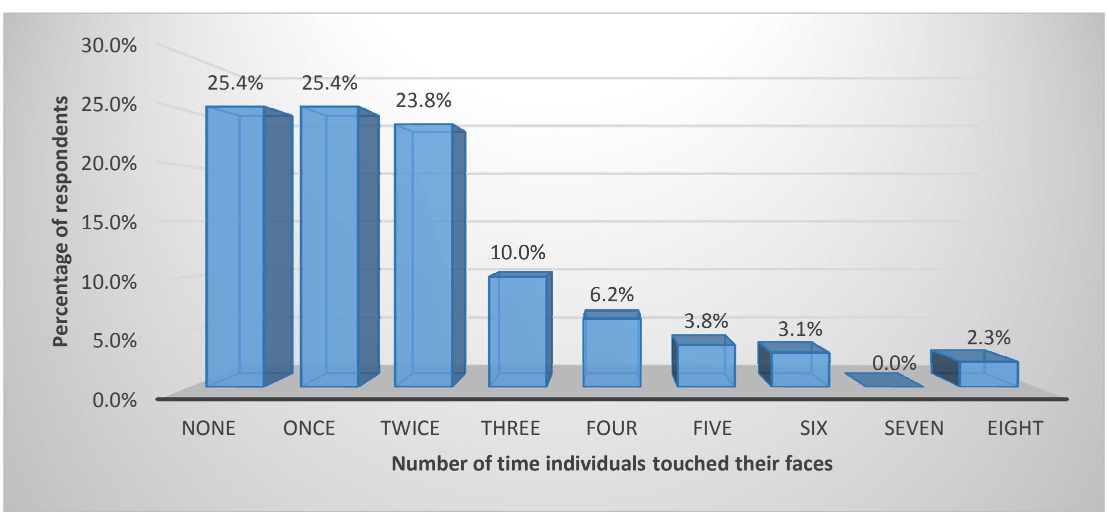


**Fig. 2. The bar chart of summary of the response variable**

**Table 2. Results from NB regression analysis**

| **Poisson regression** | | | | | **Number of obs** = 130<br>**LR chi2(3)** = 8.50<br>**Prob > chi2** = 0.0367 |
|---|---|---|---|---|---|
| **Log likelihood** = -241.48728 | | | | | **Pseudo R2** = 0.0173 |
| **Count** | **Coef.** | **Std. Err.** | **Z** | **P>z** | **[95% Conf. Interval]** |
| $x_1 = 1$ | 0.0979 | 0.1319 | 0.74 | 0.4580 | -0.1606, 0.3564 |
| $x_2 = 1$ | 0.3496 | 0.1608 | 2.17 | 0.0297 | 0.0344, 0.6648 |
| $x_3 = 1$ | 0.2014 | 0.1327 | 1.52 | 0.1290 | -0.0586, 0.4614 |
| _cons | 0.3933 | 0.1157 | 3.40 | 0.0007 | 0.1666, 0.6201 |

*Null deviance: 423.61 on 129 degrees of freedom; Residual deviance: 407.02 on 126 degrees of freedom; AIC: 527.3*

**Table 3. Results from NB regression analysis**

| **NB regression** | | | | | **Number of obs** = 130<br>**LR chi2(3)** = 4.84<br>**Prob > chi2** = 0.1841 | |
|---|---|---|---|---|---|---|
| **Log likelihood** = -231.67261 | | | | | **Pseudo R2** = 0.0103 | |
| **Count** | **Coef.** | **Std.Err.** | **Z** | **P>z** | **[95% Conf. Interval]** | |
| $x_1 = 1$ | 0.1081 | 0.1711 | 0.632 | 0.5275 | -0.2272 | 0.4434 |
| $x_2 = 1$ | 0.3506 | 0.2208 | 1.588 | 0.1122 | -0.0821 | 0.7833 |
| $x_3 = 1$ | 0.1999 | 0.1717 | 1.164 | 0.2443 | -0.1367 | 0.5366 |
| _cons | 0.3885 | 0.1486 | 2.613 | 0.0090 | 0.0971 | 0.6798 |

*Null deviance: 150.86 on 129 degrees of freedom; Residual deviance: 145.91 on 126 degrees of freedom AIC: 473.35*

## 5. DISCUSSION OF THE RESULTS

The regression model is:

$$\log_e(count) = 0.3885 + 0.1081(x_1 = 1) + 0.3506(x_2 = 1) + 0.1999(x_3 = 1)$$

Note that for the NB model's results in Table 3, the RD divided by d.f is, 145.91/126 $\simeq$ 1, this shows a better model. The model had corrected for the overdispersion in the data. Obviously, we can see that the S.E under Poisson model were underestimated leading to significance (p-value < 0.05) of an explanatory variable ( $x_2$ ). The variable's S.E under Poisson model is 0.1608 while it is 0.2208 under NB model and the p-value becomes 0.1122, which shows that the variable is not statistically significant in the first place but Poisson model gave a misleading result due to the presence of overdispersion.

Therefore, the results in Table 3 shown that none of the explanatory variables ($x_1, x_2$ $and$ $x_3$) was significantly associated with the number of time an individual touches face (mouth, nose or eyes).

## 6. CONCLUSION AND RECOMMENDATION

From the data obtained, the average number of time an individual touches face (mouth, nose or eyes) within 120 seconds is 2 (two). Moreover, the common problem of overdispersion in count data was well handled and an appropriate model was fitted to the data. The results shown that gender, using handkerchief or staying indoor.

Therefore, it is recommended that there should be adequate public enlightenment and sensitization on the danger of the novel COVID-19 pandemic and the reason why people should adhere strictly to the advice of avoiding touching of faces (without washing with soap and water) in order to prevent its spread. If an individual's hands are sullied with the virus, he/she is not infected until he/she touches the face (nose, eye or mouth) with the hands unwashed. We suggest further studies to consider more variables that may be associated with contracting the virus.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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