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The correlation between fish consumption and the incidence of COVID-19 infection worldwide

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Abstract

Introduction: It is well known now that the emergence of Coronavirus disease of 2019 (COVID-19) started the grand fish market of Wuhan, China. According to official reports, fish consumption differs widely between countries; likewise, the spread of SARS-Cov-2 is highly variable in different parts of the world. **Objectives:** In this article correlation between fish consumption and the incidence of Covid-19 infection was performed, in addition to general descriptive statistics of the two variables. **Study design:** A cross-sectional comparative record-based study. **Materials and Methods:** The study was performed by tracking the reports of Covid-19 progression and the United Nations Food and Agricultural Organisation (FAO) reports on Fish consumption. Countries that had been excluded for been absent from the FAO report or the Covid-19 map (or both), were 14. A total of 174 countries worldwide were included in this research. Correlations between the variables were performed on a global prospect and each continent individually. **Results:** The average fish consumption per capita worldwide was 19.02+/-16.82 kilograms; the average incidence per million for Covid-19 was 1432+/-2372 cases per million population (CPM); and the correlation between fish consumption per capita and Covid-19 incidence worldwide was 0.089573896; a very weak positive correlation. Apart from Europe, all correlations between the two variables: fish consumption and the incidences of Covid-19, were weak or very weak. **Conclusion:** The assumption of Covid-19 being a zoonotic disease does not seem to fit for fish. Discordant statistics of correlation between fish-eating and the spread of the pandemic was against this theory.

Keywords: COVID-19, Fish consumption, Zoonosis.

INTRODUCTION

It's well known now that the emergence of Coronavirus disease of 2019 (COVID-19) started the grand fish market of Wuhan, China. The virus was isolated from the cutting plates. Soon after that, fish trade was negatively affected, and consumers were considerably repelled [1, 2]. Fish and marine scientists were obliged to respond in defense against these allegations. Bondad-Rentaso *et al* mentioned in the Asian Fisheries periodical that Coronaviridae family of viruses are not known to infest nor infect seafood, rather, they infect mammals [3]. The authors also linked this outbreak to human factors; the fishers or the labors of the market being infected or contaminated in cloth or fishing tools.

According to official reports, fish consumption differs widely between countries; likewise, the spread of SARS-Cov-2 is highly variable in different parts of the world. In this article, the author aimed to make a correlative comparison between the fish consumption and incidence of Covid-19 worldwide and individually on the six continents. The study offered a statistic approach in the prospect of fish consumption being a risk factor for SARS-Cov-2 transmission.

MATERIALS AND METHODS

Study Design and Study Area

This was a cross-sectional record-based study performed within the period from 1st – 8th July 2020. The study was performed by tracking the reports of Covid-19 progression and the United Nations Food and Agricultural Organization (FAO) reports on Fish and fisheries.

Study participants

The worldwide population was involved. Countries that had been excluded for been absent from the FAO report or the Covid-19 map (or both), were 14. A total of 174 countries worldwide were included in this research.

Data Collection Method

Data were obtained from the internet. The data concerning worldwide fish consumption were obtained from the records of the United Nations Food and Agricultural Organization (FAO) [4]. The Covid-19 disease incidence and distribution in different countries was obtained from Google Covid-19 map [5]. The fish consumption, per-capita, was expressed in Kilograms per year (Kg), and the incidences of Covid-19 were expressed in Cases per million population (CPM).

Data Analysis

General descriptive statistics were performed. Correlation between fish consumption and the incidence of Covid-19 was performed worldwide, and also for each continent individually by Pearson's correlation coefficient. Analysis of variance-ANOVA was performed to compare the significance of differences between the six continents in fish consumption and Covid-19 incidence. Data were exhibited in tables, figures, and text.

RESULTS

The average fish consumption per capita worldwide was 19.02 ±16.82 kilograms, the minimum being 0.25 kilograms in Afghanistan and the maximum being 90.71 kilograms in Iceland. The average incidence per million for Covid-19 was 1432±2372 CPM, the least incidence was zero cases in Vanuatu, Turkmenistan, Swaziland, Solomon Islands, Samoa, and North Korea, and the maximum being 14246 CPM in Kuwait. The correlation between fish consumption per capita and Covid-19 incidence worldwide was 0.089573896; a very weak positive correlation.

In Europe, the average fish consumption per capita was 19.22 ±16.86 kilograms. The average incidence per million for Covid-19 was 2256±2055CPM. The correlation between fish consumption per capita and COVID incidence was 0.40058027; a moderate positive correlation.

In Asia, the average fish consumption per capita was 22.3±21.66 kilograms. The average incidence per million for Covid-19 was 1382±2842CPM. The correlation between fish consumption per capita and Covid-19 incidence was 0.03765965; a very weak positive correlation.

In Africa, the average fish consumption per capita was 11.39±8.52kilograms. The average incidence per million for Covid-19 was 418±897CPM. The correlation between fish consumption per capita and COVID incidence was 0.0328832; a very weak positive correlation.

In North America and the Caribbean, the average fish consumption per capita was 20.69±14.00 kilograms. The average incidence per million for Covid-19 was 2136±2604CPM. The correlation between fish consumption per capita and COVID incidence was -0.157485708; a very weak negative correlation.

In Central and South America, the average fish consumption per capita was 12.54±9.11 kilograms. The average incidence per million for Covid-19 was 2135±3512CPM. The correlation between fish consumption per capita and COVID incidence was 0.222330811; a weak positive correlation.

In Oceania, the average fish consumption per capita was 32.67±9.38 kilograms. The average incidence per million for Covid-19 was 111±134CPM. The correlation between fish consumption per capita and Covid-19 incidence was -0.210022899; a weak negative correlation.

The differences between continents in the fish consumption were significant (P value= 0.001498901; Calculated F value= 4.118328614; critical F value= 2.268931718), also differences in Covid-19 incidences were also significant (P value= 0.002181871; Calculated F value= 3.920492599; critical F value= 2.267940459). Results are summarized in table (1). Table (2) presents the ANOVA test for difference between the continents in Covid-19 incidence and annual \fish consumption. Figure (1) is a bar chart, compares the Fish per capita and incidence of Covid-19 in the six continents.

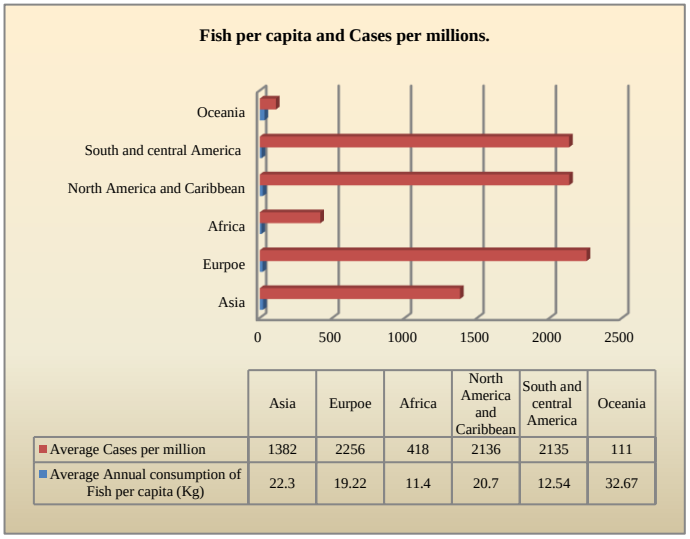

Figure 1: A bar comparison between the Fish per capita consumption and incidence of Covid-19 in the six continents.

Table 1: Summary of the results of worldwide fish consumption and incidence of Covid-19 per million populations. The correlation coefficient between fish consumption and Covid-19 incidence is also written. CPM: Cases per million population; SD: standard deviation

Area	Average fish consumption per capita (Year)	Average Covid-19 CPM*	Correlation coefficient: fish consumption versus Covid-19 incidence.	Comments.
World	19.02 ±16.82 Kg.	1432±2372 Cases.	0.089573896	High SD value
Asia	22.3±21.66 Kg	1382±2842 Cases	0.03765965	High SD value
Africa	11.39±8.52 Kg	418±897 Cases	0.0328832	High SD value
Europe	19.22 ±16.86 Kg	2256±2055 Cases	0.40058027	High SD value
North America and the Caribbean	20.69±14.00 Kg	2136±2604 Cases	-0.157485708	High SD value; negative correlation
South and Central America	12.54±9.11 Kg	2135±3512 Cases	0.222330811	High SD value
Oceania	32.67±9.38 Kg	111±134 Cases	-0.210022899	Negative correlation

Table 2: A summary of the ANOVA test of significance to assess the difference between the six continents in Fish consumption per capita, also differ in the incidences of Covid-19 infection per million.

Difference parameter	Calculated f value	Critical f value	P-value	Comment(s)
Annual fish consumption per capita.	4.118328614	2.268931718	0.001498901	Significant difference.
Covid-19 CPM incidence.	3.920492599	2.267940459	0.002181871	Significant difference.

DISCUSSION

This cross-sectional study was performed to assess the correlation between fish consumption worldwide and the incidence of Covid-19 infection. Statistical descriptive analysis, testing the significance of differences, and the correlation between these two variables was performed worldwide as well as in each continent separately. It had been found that the correlation between fish consumption per capita and the incidence of Covid-19 infection worldwide was a very weak correlation, despite being positive. In Europe, a moderate positive correlation had been found between the two variables. European citizens consume on average 19.22 Kg of fish per capita, which is very close to the global average consumption; 19.02 kg. Europe, however, bears the load of the highest average CPM of Covid-19; 2256 cases, with a standard deviation of ± 2055.

It had been noticed that all standard deviation values are high, and in some occasions larger than the mean itself, and this is probably due to the widespread of the data values; as an example, the global range of values of fish consumption is 90.71 Kg, while the range of incidence of Covid-19 infection is 14246 CPM.

It worth mention that China, the mainland of the Covid-19 outbreak, is the number one producer and exporter of fish (either captured or aqua-cultured fish), and six of the ten biggest importers of fish are European countries [6]. This is not an assumption of fish-borne transmission possibility of SARS-Cov-2; rather it's an approximation. The correlation between variables was weakly positive in South and Central America, and the weak positive correlation will not fit in the previous explanation of Europe being a large scale importer of fish. South and Central America are not a big market for fish import, and two of the South American countries; Chile and Peru, are within the top ten fish Exporters [7], moreover, most of these countries have long coasts for fish capture.

While Asia and Africa's statistics presented a very weak positive correlation between fish consumption and Covid-19 incidence, both Oceania and North America (with the Caribbean) presented a weak and a very weak negative correlation, respectively. The negative correlation of Oceania could be due to the proximity between the two values (average fish consumption and incidence of Covid-19). In this area of the world, Fish consumption per capita was the highest and the incidence of Covid-19 was the lowest per million populations.

It is difficult to relate fish consumption with the Covid-19 infection partly because the Chinese trade of fish is the largest worldwide, and partly because Coronaviruses are not known to infect fish [3] no fish infecting virus is been reported to be transmitted to human [8, 9]. Bondad-Rentaso *et al*. (2020) postulated that the possibility of SARS-Cov-2 to enter the Fish cells is widely remote because the Angiotensin-converting enzyme 2 (ACE 2) receptor which is used by the virus to enter cells [10] is 40% non-identical to the human ACE 2 receptor [3, 11], also the chance to be infected with a cooked fish is seemingly impossible because the virus dies with cooking [12].

CONCLUSION

This was across sectional study aimed to assess the correlation between fish consumption per capita and the incidence of the emerging Covid-19. A worldwide and a separate statistic for each continent were performed. It had been found that apart from Europe, all correlations between fish consumption and the incidence of Covid-19 (including the global correlation) are weak, and in North America and Oceania, the correlation was negative. When considering the incidence of Covid-19 per million capita, Kuwait has the highest number.

Conflicts of Interest

The author has no competing interests.

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