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Contents of the Issue

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Results of Salt Cognition Test using SALSAVE since 67 Female University Students

By Naomi Katayama, Akemi Ito & Mayumi Hirabayashi

Nagoya Women's University

Abstract- In Japan, salt reduction is encouraged to prevent high blood pressure. However, it is difficult to reduce salt, and good salt intake per day did not fail to the target value. In this study, we report a saltiness cognitive threshold test using female university students. The participant is 67 female university students. Participants were subjected to a salty cognitive threshold test using SALSAVE (manufactured by Advantech). The saltiness test started from a light taste and tried a strong taste in order. The salt concentration is 0.6%, 0.8%, 1.0%, 1.2%, 1.4%, 1.6%. We also conducted a questionnaire survey on eating habits. As a result, 62 out of 67 female university students who felt salty at a concentration of 0.6% were92% of all participants. However, two female university students did not feel taste even with a salt concentration of 1.6%.They are3% of all participants. As a result of the questionnaire survey, female university students answered that they had a good taste and secreted saliva well, and they usually had a rather light diet. In the future, we would like to increase the number of participants and compare more detailed dietary habits with SALSAVE results.

Keywords: *saltiness test, cognition, threshold, salsave, university student.*

GJMR-K Classification: *NLMC Code: QU 84*

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I. Introduction

Japanese Dietary Intake Standards in the 2020 version, the daily intake of salt for females in recommended to be 6.5g or less. Salt intake is decreasing with each revision of dietary standards. In the near future, it is expected that salt intake in Japannese dietary intake standards will lower to the international standard of 6.0g. By reducing salt, it expected to prevent illness from various diseases (high blood pressure, kidney disease, heart disease, etc.). Therefore, the purpose of this study was to conduct a salt concentration cognition test on Japanese people to understand the actual condition of the cognitive threshold for salt, and to use it as future data. To begin with, we report that a healthy female university student underwent a salt concentration recognition test.

II. Materials and Methods

a) Participants

The participant is 67 female university students. Their average age ± standard deviation(SD) was 29.6±0.6, average height ±SD was 158.9 ± 5.7cm, and average weight ± SD was 50.3 ± 4.5 kg (Table 1).

Table 1: Average ± Standard diviation (SD) of participant's age and body composition (n=67)

Participants	Age	Height	Weight
Average	20.6	158.9	50.3
S D	0.6	5.7	4.5

b) Assessment of salt taste identification

Participants were subjected to a salty cognitive threshold test using SOLSAVE (manufactured by Advantech). The saltiness test started from a light taste and tried a strong taste in order. The saltiness test starts form 0.6%, and the concentration increases by 0.2% in 6 steps up to 1.6%. Participants put a filter paper impregnated with salt in their mouth to check the taste, and then answered to the inspector what the teste was. The inspector recorded the answers of the participants.

We also conducted a questionnaire survey on dietary habits. There are four questions, 1) Does saliva come our? 2) Do you feel the taste? 3) Frequency of purchase of restaurants and commercial food, 4) Regular seasoning (for food was salty or thin) (Table 2).

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Table 2: Questionnaire survey items

	Question 1	Question 2	Question 3	Question 4
	Saliva secretion	Taste perception	Use of restaurants and commercial food	Favorite food salt taste
1	Very well	Very well	every day	Strong salt taste
2	Well	Well	four or five times a week	rather strong salt teste
3	Not good	Not good	two or three times a week	rather light salt teste
4	Do not know		once a week	light salt taste
5			two or three times a month	
6			Hardly used	

c) Ethical review board

This study conducted with the approval of the Ethics Committee (Nagoya women's university 'hitowo mochiita kennkyuuni kansuru iinnkai'). The approval number is 30-14.

III. Results

a) Saltiness recognition test result

Sixty-seven female university students underwent a saltiness cognitive threshold test using SALSAVE. As a result, 62 out of 67 female university students who felt salty at a concentration of 0.6% were 92% of all participants. And, three female university students felt a salt concentration of 0.8%, were 4.5% of all participants. However, two female university students did not feel taste even with a salt concentration of 1.6%. This is 3% of all participants (Table3).

Table 3: Female University students Saltiness cognitive threshold test results (n=67)

	0.60%	0.80%	1.00%	1.20%	1.40%	1.60%	1.6%以上
Participants（number of students）	62	3	0	0	0	0	2
Participants（%）	92.5	4.5	0.0	0.0	0.0	0.0	3.0

b) Questionnaire results

Table 4 shows the results of the questionnaire survey. When asked if they had enough saliva, most female university students replied that they had enough or normal secretions. None of the female university students answered that they had none or poorsaliva. In response to the question of feeling the taste, most female university students answered that they could well or understand the taste. None of the female university students answered that they didn't understand the question of whether they would feel the teste. When asked about the frequency of use of restaurants and groceries, female university students answered that they would use 2-3 times a week or once a week. When asked if the usual seasoning for food was salty or not too much salty, female university students answered that they were the lightly salted.

Table 4: Results of Questionnaire survey conducted on female university students (n=67)

	Saliva secretion	Taste perception	Use of restaurants and commercial food	Favorite food salt taste
Average	1.3	1.5	3.8	2.3
S D	0.7	0.5	1.0	0.7

IV. Discussion

Many researchers have reported the relationship between salt intake and blood pressure [1)] and the relationship between hypertension [2,3,4)]. There are also reports on diet and salt intake in the younger generation [5)]. We also reported the results of the saltiness cognition threshold test conducted by Yakumo Study on the elderly [6,7)]. There are also reports on the relationship between salt intake and blood pressure overseas [8,9)], as well as educational effects on salt intekae [10,11)]. Currently, many new drugs for lowering blood pressure have developed for people with high blood pressure [12)], but dietary food habits also desirable can be improved their blood pressure. The drug also has side effects and that costs a lot to keep taking it. In Alzheimer's dementia, the taste is not known, and the value of the salty cognitive threshold teat also deteriorates [13)]. Therefore, it is highly likely that the dietary intake will be high, which may raise blood pressure. A low saltiness recognition threshold means that the saltiness of the meal can reduced. Keeping the salty cognitive threshold low makes sense for a healthy diet. We conducted a saltiness cognition threshold test on 67 young female university students. As a result, they recognized 0.6% saltiness, and with included 0.8% recognized students, the total number of recognized was 96.5%.The result of the dietary habit questionnaire showed that saliva was well secreted, the taste of the meal was well understood, and the dietary intake was

light. However, two female university students did not feel taste even with a salt concentration of 1.6%. This is 3% of all participants.

In the future, we would like to conduct a more detailed questionnaire survey on dietary intake and compare it with the salty cognitive threshold test results.

V. Conclusions

The results of this test show that most female university students (92%) feel salty at 0.6%. Also, female university students were eating a light taste in their daily life. Moreover, the use of restaurants and the use of commercially available foods were once or 2-3 times a week. The effect of the salt reduction awareness campaign in Japan, which has continued for over 20 years, is good for the younger generation. However, on the other hand, among the female university students who participated in this study, two students could not recognize 1.6% saltiness, so it is necessary to investigate the dietary habits of the participants is more detail.

Acknowledgements

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Causes and Preventions of Coronavirus (COVID-19)

By Tai-Jin Kim

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Abstract- Parameter is causing the coronavirus (COVID-19) pandemic was CO_2 emissions, correlated with total cases (R^2=0.8064) and deaths (R^2=0.7627). CO_2 emissions produced by coal and gas-powered plants, oil refineries, vehicle, metropolitan food waste gas, human exhalation, leather-tannery industry, and organic dye industry. Cetaceans, including whales, dolphins, and porpoises, transmitted the globe with the coronavirus. The sudden spread of the coronavirus could cause by the 14 habitats of humpback whales, linked to millions of dolphins as well as the global leather tanning industry. It is necessary to monitor the sunspot number to prepare for the effects of cyclic minimum sunspot number in 2031. Because the top 2 countries of CO_2 emissions are China and the USA, a new pandemic in 2031 may initiate either from China or from the USA, as H1N1 (the USA, 2009) or as COVID-19 (China, 2020). The preventive phenomena of the third pandemic in 2031 can be monitored at humpback whale districts, as happened in 130 dead dolphins in Cape Verde, at least three months earlier before COVID-19 in China. UV-B radiation is the most efficient method to kill the virus itself.

Keywords: coronavirus (COVID-19), causes, preventions, carbon dioxide emission, tanning leather, dolphin, minimum sunspot number.

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Keywords: coronavirus (COVID-19), causes, preventions, carbon dioxide emission, tanning leather, dolphin, minimum sunspot number.

I. Introduction

There was a sudden increase of the coronavirus (COVID-19) in February of 2020, which turned into a global pandemic. Kim (2019) proposed that the porpoises in the Yangtze River in Wuhan, China, were the initiator of the coronavirus outbreak. The coronavirus (COVID-19) first identified in Wuhan city in Hubei province in China. It postulates that cetaceans, including whales, dolphins, and porpoises, spread the coronavirus around the globe reaching over 213 countries and territories with 6,447,564 total and 380,630 deaths as of June 03. However, no one has yet proposed the fundamental causes and the protective means except the face mask and social distancing. The present study investigated the principal causes of the coronavirus, along with its preventive means. Parameters investigated are in the areas of leather tanning and processing, oil refineries, gas- and coal-powered plants, total ozone and the ozone hole, skin cancer rate, vehicles, population, carbon dioxide emissions, volcanic regions, migratory birds-humpback whales habitats, dolphins, and preventive means including vaccine development and phenomena for the coming pandemic in 2031.

II. Experiment

a) Hydrogen Sulfide

Hydrogen sulfide (H_2S) produces during the processes of tannery, leather, footwear, textiles, and garment industries. Decomposed microorganisms in the metropolitan area produce H_2S. The flue gas in the natural gas or coal-powered power plants, the stack gas in oil refineries, and volcanic gas generate H_2S. Hydrogen sulfide is very toxic, causing pulmonary disease resulting in death. The effect of H_2S compounds upon the growth of phytoplankton experimentally examined as follows. H_2S generated by the decomposed white of the egg was prepared to see its removal of iron (Fe) in JM medium with EDTA-Fe as sedimentary iron sulfide (FeS). Fig.1 proved the growth curves of phytoplankton in the JM medium with various volumes of the decomposed egg solution. Such a phenomenon was due to the addition of the decomposed egg solution producing dissolved hydrogen sulfide (H_2S) to the present JM culture media. It was evident that the phytoplankton growth was retarded when increasing the volume of the decomposed egg solution, generating H_2S to remove Fe from the JM medium with EDTA-Fe as sedimentary iron sulfide (FeS), from 0 ml, 10 ml, 30 ml, 40 ml among total balanced 150 ml JM culture media. Figure 1 clearly showed that dissolved H_2S from the decomposed egg solution reacted with Fe in the JM media to be Fe-limited as increasing volumes of the decomposed egg solution.

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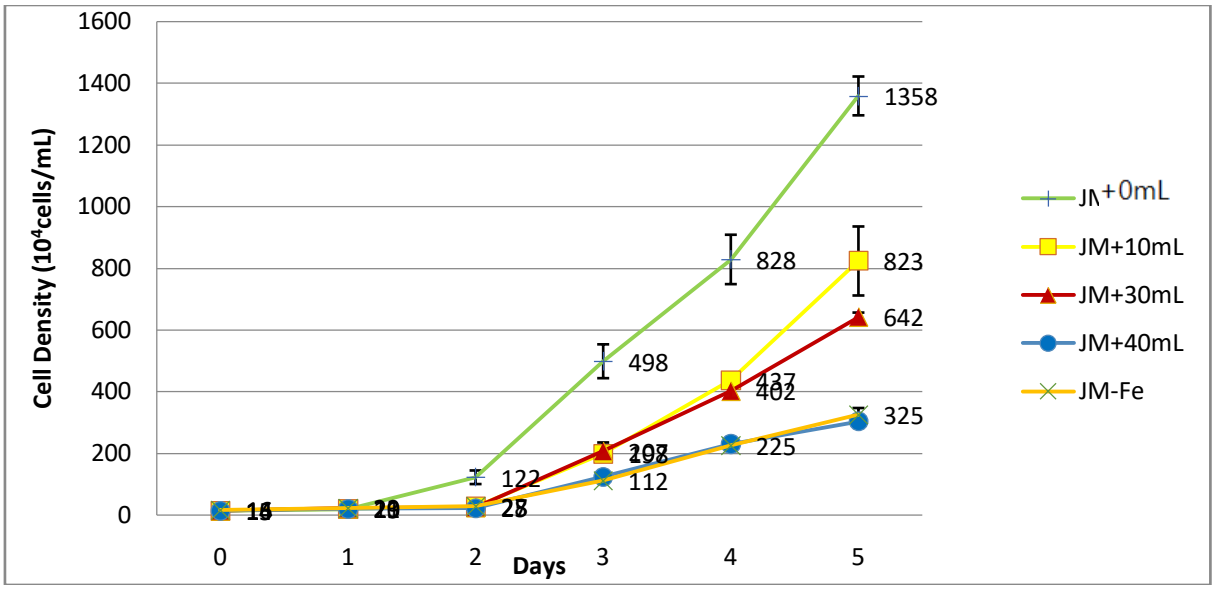


Figure 1: Aerobic culture of *Chlorella vulgaris* in JM media with various percent volumes of the decomposed egg solution; with its own Fe and without decomposed egg solution (0%) (JM+0ml, -+-) for the mixture of 140 ml JM and 10 ml decomposed egg solution (7%) (JM+10ml, -■-) for 120 ml JM and 30 ml decomposed egg solution (21%) (JM+30ml, -▲-) for 110 ml JM and 40 ml decomposed solution (28%) (JM+40ml, -●-), and without its own Fe (JM-Fe, -x-).

b) Iron Fertilization for Reduction of Atmospheric Carbon Dioxide

Carbon dioxide used by plants in the forestry and the farmland for the photosynthesis of pure oxygen in the sunlight. 71% of the Earth covers by the oceans containing 40% diatoms as phytoplankton. Since John Martin proposed the iron hypothesis in 1988, fourteen previous iron enrichment experiments from 1993 to 2012 have conducted in the Southern Ocean, Equatorial Pacific, and Subarctic Pacific. They all failed in selecting an appropriate location for the decrease in atmospheric carbon dioxide concentration. Kim (2020, in press) recently proposed the appropriate location and deployment method for iron fertilization. The decrease in carbon dioxide concentration is important since carbon dioxide emissions increase every year in the Antarctic. Although 14 iron fertilization experiments during the last 27 years have been conducted (KIM, 2020), such experiments have never experimented at a location that is free from serial volcanic eruptions for the removal of volcanogenic sulfur. It recommends that the appropriate iron fertilization experiment be conducted far from sulfur sources such as volcanoes and boundaries of tectonic plates to maximize the availability of dissolved Fe to phytoplankton for maximal CO_2 consumption. The deployment of the Fe-replete composite configures on the streamline of the ACC (~4km/h) to have a high momentum flux for efficient dispersion of Fe-replete composite on the ocean surface where diatom, copepods, krill, and humpback whale stay together (~100m). The fast sinking rate of diatom (0.96 m d-1) (BIENFANG et al., 1984) is very suitable for the sequestration of CO_2.

c) Total Ozone and Latitude

The ozone in the stratosphere absorbs a large part of the Sun's biologically harmful ultraviolet radiation. UV-B radiation (280-315nm wavelength) from the Sun is strongly absorbed. The amount of UV-B radiating on the earth's surface greatly reduces. The values of total ozone are the lowest in the tropics in all seasons because the thickness of the ozone layer is smallest there (www.theozone.com/twenty.htm). There is little variation of the total ozone in the tropics (20°N-20°S latitudes), leading to high ultraviolet-B radiation, creating a safe zone from the coronavirus outbreak. Countries are listed below in the rough order of deaths caused by the coronavirus, as of May 2020, with country latitude in parenthesis. 17,983 Brazil (11), 1,242 Indonesia (6), 2,839 Ecuador (2), 2,303 India (21), 5,666 Mexico (19), 842 Philippines (14), 2,914 Peru (10), 441 Dominican Republic (18), 281 Panama (9), 114 Malaysia (3), 56 Thailand (15), 51 Burkina Faso (12), 147 Honduras (15), 61 Democratic Republic of Congo (4), 189 Bolivia (17), 140 Cameroon (6), 55 Niger (18), 10 Mauritius (20), 10 Venezuela (5), 8 Trinidad and Tobago (10), 22 Singapore (1), 192 Nigeria (10), 9 Sri Lanka (7), 50 Kenya (0), 53 Mali (17), 189 Ghana (10), 31 El Salvador (13), 125 Guyana (5), 15 Republic of Congo (0), 23 Liberia (6), 7 Barbados (13), 9 Jamaica (18), 10 Costa Rica (10), 28 Oman (23), 28 Ivory Coast (7), 43 Guatemala (14), 12 Togo (8), 5 Ethiopia (9), 21 Tanzania

(-7), 4 Zimbabwe (20), 30 Senegal (14), 7 Zambia (-13), 22 Haiti (19), 3 Antigua and Barbuda (17), 3 Angola (12), 111 Sudan (15), 2 Belize (17), 7 Djibouti (11), 1 Brunei (4), 12 Gabon (1).

In contrast, there are countries near to the Artic and the Antarctic Circles that have high skin cancer rates (KIM, 2018) induced by strong UV-B, as listed below with the death cases on the left and the country latitude in parenthesis: 3,743 Sweden (62), 234 Norway (60), 2,942 Russia (60), 301 Finland (64), 10 Iceland (64), 21 New Zealand (-41).

When comparing the two groups of the tropics and Poles, the tropics area has been a safer zone during the coronavirus outbreak. Such a result caused little variation in total ozone throughout the seasons resulting UV-B radiation acting as a shield, leading to the inhibition of coronavirus activity. On the other hand, New Zealand and Iceland have 11 and 136 volcanoes, respectively. Their volcanic fumes inactivate COVID-19 resulting in smaller deaths than other regions.

d) Skin Cancer Rates Leading to Less Coronavirus Cases

Skin cancer in each country caused by UV-B radiation on the skin. The coronavirus death cases (as of April 14, 2020) in each country were reversely proportional to the skin cancer rates with $R^2=0.2098$. Therefore, more coronavirus deaths expect when skin cancer rates are low or, UVB radiation is low. This happened to Italy (ranked 20th in the world of skin cancer rate) with 32,169 deaths, the USA (ranked 17th) with 93,558 deaths, France (ranked 16th) with 28,022 deaths, and the UK (ranked 14th) with 35,341 deaths because of the coronavirus, as of May 20, 2020. The prevention of the coronavirus outbreak is possible by increasing UV-B radiation. For long-term projects, it requires to reduce carbon dioxide emissions so that the ozone hole area and UV-B radiation decreases (NIH, 1989). For short-term projects, ultraviolet lamps with 280-315 nm can use to provide UV-B in an indoor space to kill the coronavirus (KIM, 2019). The countries with high skin cancer rates are as follows while coronavirus deaths in parenthesis, as of May 20, 2020.

Australia (100), New Zealand (21), Bolivia (189), Senegal (30), Liberia (23), Gabon (12), Angola (3), South Africa (312), Zambia (7), Norway (234). Australia, Bolivia, South Africa, and Norway had relatively high coronavirus casualties in comparison with other skin cancer rate countries, implying that the coronavirus was strong enough to endure UV-B radiation in the skin cancer countries. Other countries, including New Zealand, much closer to the Antarctic, and African countries in the safe latitude zone, might have enough ozone content to protect people from the coronavirus during UV-radiation. It concludes that the coronavirus (COVID-19) casualties can reduce by proper strength UV-B radiation, which can vary from the low latitude of the equator to the high one of the Poles. For example, the country located at a low latitude country can use low strength UV-B radiators while the middle latitude countries with extremely high casualties can use strong UV-B radiators to protect people from the coronavirus. UV-B ones should be avoided not to directly radiate humans but positioned indirectly not to radiate human eyes and skins.

e) Prevention

The following locations can act as an asylum from the coronavirus.

i. *Tropical Latitude 20°*

Since the ozone concentration is low in the tropical area, and UV-B radiation is strong enough to protect people from the coronavirus.

ii. *Active Volcanoes*

Volcanic gases during eruptions contain very toxic components such as SO_2, CO, H_2S, HCl, HF, and CO_2. However, when volcanoes are not in eruptive mode, minor gases are released enough to protect people from the coronavirus activity. Since Indonesia is one of the main manufacturers of leather with its own tanneries, there could be more casualties in Indonesia, even though it locates on the equator with 127 active volcanoes. Japan has 130 active volcanoes and has 146 recorded coronavirus deaths with the 39th global rank. Japan is the 5th most CO_2 emissions country and famous for the leather-textile industry, which has led to the coronavirus outbreak. Japan might have fewer cases and casualties due to the presence of volcanoes.

iii. *Artificial Volcanic Gases*

The toxic volcanic sulfur gases are SO_2 and H_2S. A small number of such gases can be prepared artificially by heating sulfur (S) powder over burning charcoal to produce SO_2 gas. Decomposed food waste produces H_2S gas in an ambient condition. Any of these two gases of SO_2 and H_2S can be spread once a week at a low level of 1ppm to protect from the coronavirus outbreak.

iv. *UV-B Radiation*

UV-B radiation is the most simple, safe, cheap, and efficient method to kill the coronavirus itself. A portable UV-B radiator was used with two 50-Watt UVB lamps in a room while other large sizes 60-watt UVB lamps were used in an office to kill 100% within 50 minutes (KIM, 2019).

v. *Warm and Humid Environment*

The virus is not active at temperatures above 55°C and relative humidity of above 40% (KIM, 2018) with a heater, humidifier, and UV-B radiator installed together to expel the coronavirus.

vi. *Curcumin*

India has three major areas for tanneries. India's far lower rate of 3,303 deaths as of May 2020 could be caused by their daily food intake of curcumin. Curcumin has shown to exhibit antioxidant, anti-inflammatory,

antiviral properties (AGGARWAL et al., 2007), which can help protect against the coronavirus. Consuming Indian curcumin as often as possible is recommended to shield the pulmonary alveolus from the coronavirus attack.

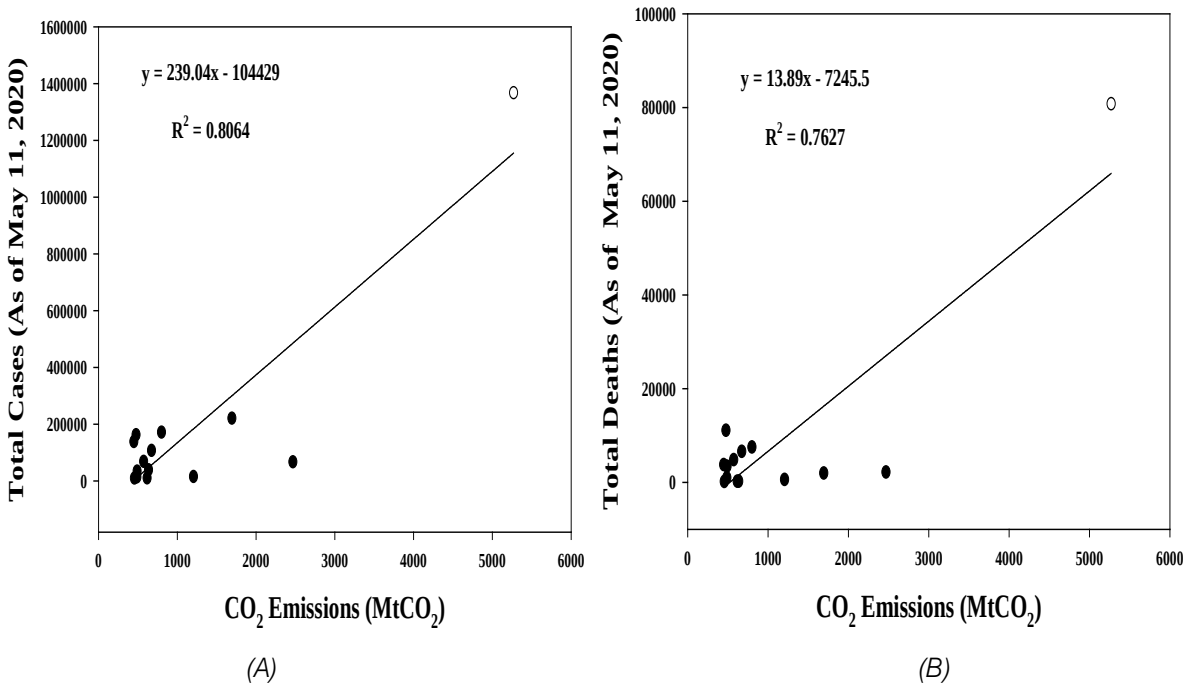
vii. *Vegetable Tanning and Natural Chemicals*

Most of the coronavirus outbreak occurred in the 213 countries and territories associated with tannery, leather, footwear, textiles, and garment industries. It spread through human contact in these industries from Wenzhou in China, using toxic chemicals in the tannery-leather process, to Wuhan in China. They emigrated to Milan in Italy and Europe, and eventually to New York City in the USA. However, in Ecuador, one company out of 50 companies uses natural tanneries without toxic chemicals resulting in no casualties in such an area.

III. Causes

a) Carbon Dioxide (CO_2)

CO_2 emissions in Fig. 2 commonly produced by coal- and gas-powered power plants, oil refineries, vehicle exhaust gas, metropolitan food waste gas, human respiration, the leather-tannery industry, and the dye industry. On the other hand, CO_2 can be consumed by the forest and the farmland while most of the decrease can accomplish by the iron fertilization, initiated by John Martin in 1988 (KIM, 2020 in press).



(A) *(B)*

Figure 2: Global CO_2 emissions with (A) the total cases (R^2=0.8064) and (B) deaths (R^2=0.7627), as of May 11, 2020

Global CO_2 emissions in metric tons correlated with the total cases (R^2=0.8064) and deaths (R^2=0.7627) in Fig. 2. European CO_2 emissions correlated with total cases (R^2=0.6142) and with deaths (R^2=0.4763). USA State CO_2 emissions correlated with total cases (R^2=0.6065) and with deaths (R^2=0.4401). USA State oil refinery capacity producing CO_2 gases in stack gas correlated with total cases (R^2=0.4003) and with deaths (R^2= 0.6413). The global vehicle number producing CO_2 exhaust gases correlated with total cases (R^2=0.6068) and with deaths (R^2=0.6313). Global population number producing CO_2 gases as human exhaling gas correlated with total cases (R^2=0.6373) and with deaths (R^2=0.4642). CO_2 emissions from various sources have increased UV-B radiation on the earth (KIM, 2019). Global rankings for CO_2 emissions in 2017 is listed below with the rank of coronavirus cases as of May 7, 2020 in -number: China (9,838 metric tons) -13, USA (5,270) -1, India (2,467) - 11, Russian Federation (1,693) -2, Japan (1,205) -39, Germany (799) -8, Iran (672) -10, Saudi Arabia (635) -15, South Korea (616) -45, Canada (573) -14, Brazil (500) -4, Mexico (490) -17, Indonesia (487) -33, South Africa (456) -36, Turkey (448) -9, Australia (413) -54, United Kingdom (385) -5, France (356) -5, Italy (355) -6, Thailand (331) -70, Poland (327) -31, Kazakhstan (293) -57. A detailed analysis of the above statistical data can be summarized for these countries as follows:

1. China is supposed to be ranked first for coronavirus cases accounting for its being the country of origin of the coronavirus and having the largest population. Their coronavirus data seems to be inaccurate.

2. The USA has the highest total coronavirus deaths in the world. They have a little tannery-leather industry polluting rivers and lakes. Cetaceans and migratory birds transmitted the coronavirus. Power plants (coal and gas- powered) and oil refineries produced toxic gases (SO_2, H_2S), which are very harmful to the pulmonary disease elderly with the coronavirus attacking the lungs directly, inducing pneumonia.
3. India is supposed to be high in coronavirus cases so far as its active tannery-leather industry and having the largest oil refinery in the world. Favorable parameters are Indian latitude location (8-37°N) with a safe zone within 20 degrees for the coronavirus. Most Indians eat curry containing curcumin, which provides anti-inflammatory benefits. It is beneficial since the coronavirus inflames the lungs and results in the air sacs filling with pus (ELDRIDGE, 2019). India's favorite food being curry could have saved the nation from the coronavirus.
4. Japan has much lower casualties than would be supposed. Their 129 volcanoes could have partly blocked the coronavirus cases.
5. South Korea had a relatively low level of coronavirus cases. 70% of land of South Korea is covered by mountains as well as having four large rivers with no water pollution. Oil refineries are spread over the country and located on the coast to disperse the toxic stack gases to the sea atmosphere. Most importantly, Koreans wore face masks for protection from the coronavirus. The terribly contaminated location was Daegu city, where the textile coloring with toxic chemicals has made for many years in a designated complex. Such wastewater effluents contain toxic organic dyes and caustic soda, deteriorating the rivers and eco-system, which was why Korea was in the top ranks until March.
6. Indonesia has 127 active volcanoes whose latitude is 6°N. These two positive factors could have saved Indonesia from the coronavirus. Indonesia has negative factors such as tannery-leather production, oil refineries, population, vehicles, and power plants.
7. South Africa and Australia locate at the boundary of the Antarctic ozone hole, where UV-B radiation is strong enough to protect from the coronavirus.
8. The United Kingdom (5), France (7), Italy (6) more highly ranked in total cases as of May 20, 2020, than expected by CO_2 emissions of (17), (18),(19), respectively, which could additionally caused by the tannery-leather industry and dolphins in each country.
9. Thailand, Poland, and Kazakhstan showed agricultural lands of 43%, 47%, and 80% in 2016, respectively. Since agricultural land converts harmful air CO_2 to good air O_2 (oxygen) as fresh air, the coronavirus activity inhibits, resulting in much lower coronavirus casualties under low CO_2 and thus high UV-B radiation. It is essential to increase the portions of agricultural land and forestry, especially in New York City and other metropolitan cities (Milan, Washington D.C., Paris, London, Tehran, Istanbul, Tokyo, Beijing, and Daegu*).*

b) The Ozone Hole

The ozone is a gas that forms a naturally occurring layer in the stratosphere, protecting the Earth from the Sun's ultraviolet (UV) light. The ozone hole over Antarctica is affected in Argentina (393 deaths from coronavirus, as of May 20, 2020), Chile (509), South Africa (312), New Zealand (21), and Australia (100), which were relatively low compared to other countries. There is excessive UV-B radiation in the tropical area, while the large ozone holes in the Polar areas have excessive UV-B radiation. In the middle latitude area, UV-B radiation is not strong enough to inhibit the activity of the coronavirus. Global ranking of coronavirus cases with latitude as follows: USA 38°N, Spain 40°N, Italy 43°N, France 47°N, Germany 52°N, UK 54°N, Turkey 41°N, Iran 36°N, Russia 60°N, China 35°N, Canada 56°N, Belgium 51°N, Netherlands 52°N, Switzerland 47°N, Portugal 39°N, Ireland 33°N, Sweden 62°N, Saudi Arabia 24°N, Israel 31°N, Austria 47°N, Mexico 39°N, Japan 36°N, Chile 30°S, Pakistan 30°N, Poland 52°N, Romania 46°N, Belarus 53°N, S. Korea 37°N, UAE 25°N, Qatar 25°N, Ukraine 48°N, Denmark 56°N, Serbia 44°N, Norway 60°N, Czechia 49°N, Argentina 35°S. Various latitudes lead to different ozone concentrations affecting the strength of UV-B radiation. Therefore, there were coronavirus cases with fewer casualties in the tropical areas and in the Poles.

There is a question as to why the coronavirus occurred in Wuhan city in Hubei province, China. Why not anywhere else? Chinese foam manufacturers released ozone-destroying chemical-chlorofluorocarbons (CFC-11) used in refrigerators and air-conditioners (RIGBY et al., 2019). China produced the highest carbon dioxide emissions in the world (9.8 billion metric tons in 2017). Besides, China used to use banned ozone-depleting chemicals of CFC-11. Industrialized Wuhan, with 11 million people, is the capital of Hubei province with polluted water and air, generating a mutant virus under excessive UV-B radiation during the minimum sunspot number. The simultaneous conditions of the ozone hole increased as well as harmful UV-B radiation during the minimal sunspot number, induced the potent mutation of the evolutionary virus in the form of the coronavirus (COVID-19) in Wuhan in China.

c) Sunspot Number

Solar flare (sunspots) with an 11-year cycle alter the amount of ultraviolet radiation (UVR) reaching the Earth. Solar flares increase ozone concentration in the stratosphere (above 50km), thereby absorbing the amount of surface UVB, which is known to cause skin cancer and suppress the immune system. The thinning

of the ozone layer (about 3mm in thickness) over Antarctica was caused by ozone depleting chemicals of CFCs in eastern China (RIGBY et al., 2019). When solar flares are inactive and minimal, there is a decrease in the ozone concentration, allowing increased UVB to penetrate to the Earth's surface (NIH, 1989). Fig. 3 showed that the sunspot number from 1979 to 2019 was reversely proportional to the ozone hole area (million km^2) with $R^2 = 0.2668$.

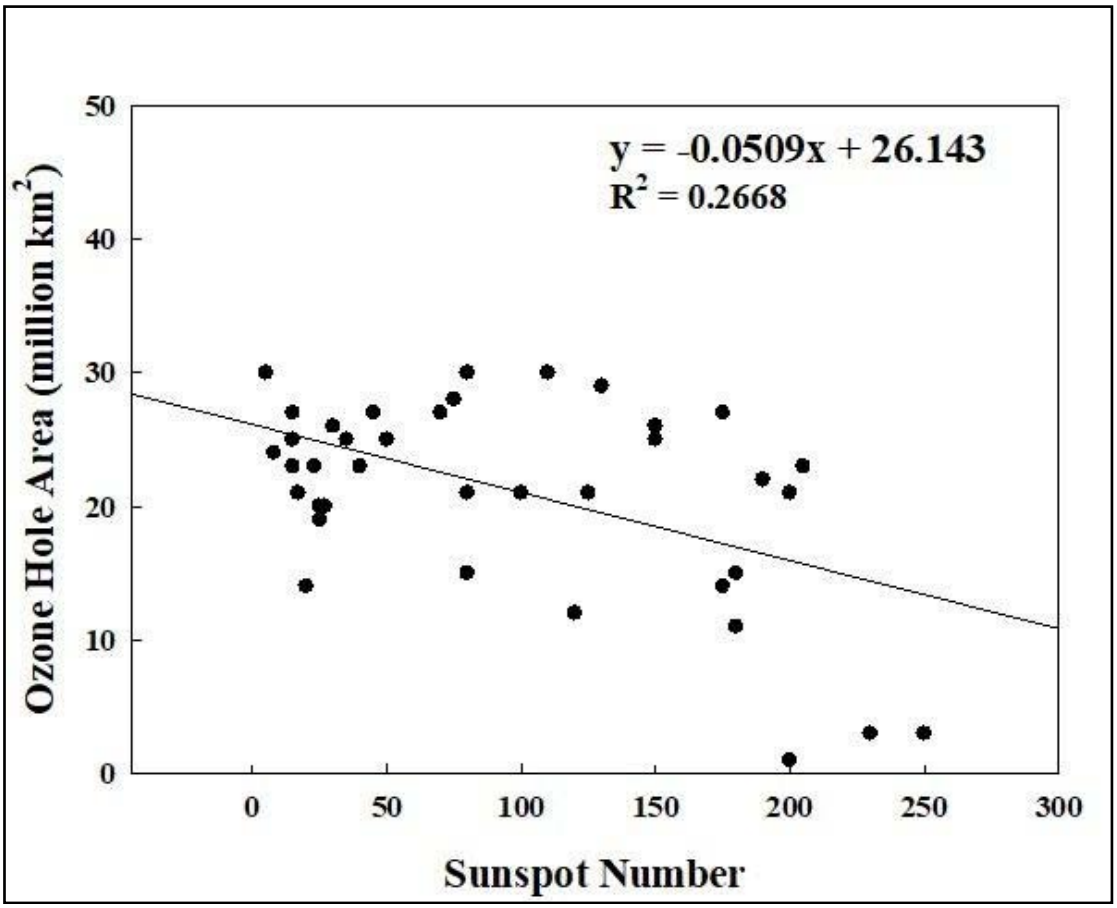


Figure 3: Sunspot numbers from 1979 to 2019 correlated with the ozone hole area (million km^2) with $R^2 = 0.2668$

The minimum sunspot number induced a high ozone hole area, leading to high CO_2 emissions (KIM, 2019). A significant viral mutation was therefore occurred in the period of the minimum sunspot number in a location with the highest CO_2 emissions and ozone hole areas, which was the case of the COVID-19 outbreak from 2019 to the present day in the metropolitan Wuhan of China as well as in other large cities, including New York City, Madrid, Paris, London, Milan, Bavaria, Istanbul, Tehran, Tokyo, and 213 countries and territories.

The number reached the minimum sunspot number from 2019 (sunspot number 0.8) to 2020 (6.0). The solar UV-B becomes excessive for the activation of the coronavirus, especially in the middle latitude countries with less total ozone content than the tropical or Polar countries. The ozone hole is big in the Antarctic while it is small in the Arctic. As a consequence, New Zealand, which locates near to the Antarctic, was hit weaker by the coronavirus pandemic than Sweden, which is near to the Arctic. It is, therefore necessary to monitor the sunspot number, especially when approaching the period of minimum sunspot number, to prepare for the effects of another cyclic minimum sunspot number in 2031.

d) Cyclic Emergence of Harmful Viruses

Human coronavirus compared to their significant virus in chronic order with deaths in parenthesis are as follows (BAKER et al., 2020). In 1976 identified Ebola (13,562 deaths) plus 11 years later, H1N1 AIV in 1988 plus 10 years later, Nipah in 1998 (398) plus 11 years later, the first pandemic in 2009 H1N1 swine virus mutated to infect humans and spread by humans (284,000) plus 11 years later, the second pandemic in 2020 coronavirus (COVID-19) humans (380,630 deaths as of June 03). These viruses have occurred either during the maximum sunspot number (SARS, 774 deaths in 2002 and MERS, 858 deaths in 2012) or during the minimum sunspot number (Ebola, Nipah, AIVs, COVID-19). The sunspot number has an 11-year cycle plus 14 months standard deviation

(HATAWAY, 2010). If assuming 12 years as one cycle, every six years provide the maximum or the minimum points. During the minimum sunspot number and the highest CO_2 emissions, as is in 2020 with the coronavirus (COVID-19) pandemic, the ozone hole area is increased causing the potent UV-B radiation on the Earth (NIH, 1989) for the active virus mutant in the form of the coronavirus (COVID-19) pandemic with terribly high casualties in 213 countries and territories. It expects that disastrous outbreaks of viruses occur in 2020 plus 11 years later of, 2031 as the third pandemic via either humans, birds, cetaceans, pigs, or other species. Cetaceans such as humpback whale/dolphin/porpoise were proposed as the transmitters of MERS-CoV stranded humpback whales in the Persian Gulf coast in Saudi Arabia (KIM, 2019) as well as of the coronavirus (COVID-19) stranded porpoises in the Yangtze River in China (KIM, 2019), respectively. The ultimate causes of the coronavirus for future viruses are CO_2 emissions. Therefore, all countries that were hit by the coronavirus (COVID-19) should reduce their CO_2 emissions from the leather-tannery-textile garment industry, oil refineries, gas, and coal-powered plants, vehicle exhaust, metropolitan food waste biogas for clean water and air with less toxic chemicals on the Earth.

e) Migratory Birds and Humpback Whales Habitats

Humpback whales feed on krill and small fish in Antarctica and Arctica while migrating to tropical or subtropical waters during the winter breeding in Northern and Southern Hemispheres, as shown in Fig. 4.

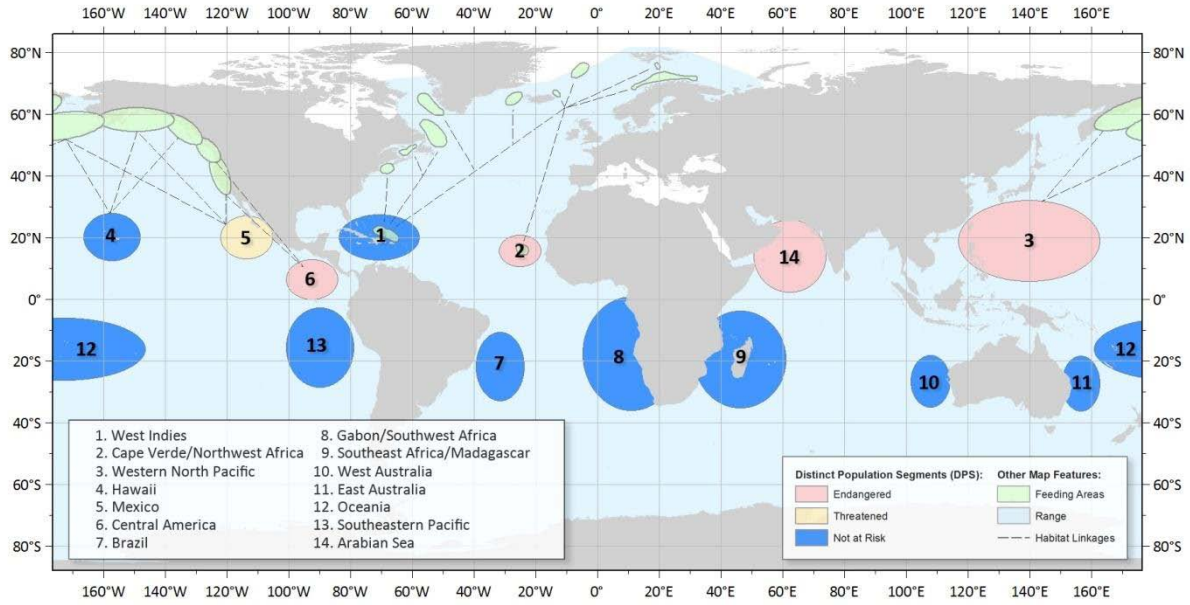


Figure 4: The distribution of 14 identified humpback whale district population segments is for the breeding zone from December to April while the feeding zone in the Arctic and the Antarctic during the winter (NOAA, 2015)

Mutant viruses persisting in host cells of aquatic bacteria are food web prey of algae, krill, small fish, squid, and finally penguin and humpback whales. It is interesting to note that marine mammals such as harbor seals, elephant seals, and pilot whales were infected by evolutionary AIV near the habitats of the coastal line (YOON et al., 2014) while the humpback whale prefers to stay at the coast less than 50 m underwater. Since penguins are birds while humpback whales are marine mammals, their strains of AIV cannot be the same. Therefore, marine mammals with AIV such as harbor seals (H3N3, H3N8, H4N5, H4N6, H7N7), elephant seals (H1N1), and pilot whales (H3, H4, H7, H13) could directly infect by humpback whale feces and indirectly transmit by wild aquatic birds. There are aquatic food web cycles from viruses, bacteria, phytoplankton, zooplankton, krill, small fish, squid, penguin, and humpback whale. Therefore, if there is the germicidal UV radiation during the CO_2 emission increase and the minimal sunspot number period, the aquatic virus is mutated.

Consequently, penguins and humpback whales are easily infected by mutant AIV through food web cycles. It can postulate that mutant krill are the main reservoir of AIV whose mutant virus, induced by the germicidal UV-B radiation during the 11-year periodic minimal sunspot number are transmitted from penguins in Antarctica and guillemot in Arctica to Continents by migratory birds with AIV (KIM, 2018) and humpback whales with cetacean morbillivirus (CMV) (KIM, 2019).

Mixed mutant virus was in the form of the coronavirus (COVID-19) in Wuhan in China (KIM, 2019) to be retrospectively transmitted to cetaceans (porpoises, dolphins, whales) and humans in 2020. Fig. 5 shows that migratory flyways of wild birds overlap with the routes of humpback whales (14 habitats in Fig. 4) to suggest that AIV may transmit, not only by commonly known migratory birds flyways but also by humpback whales habitats (KIM, 2018).

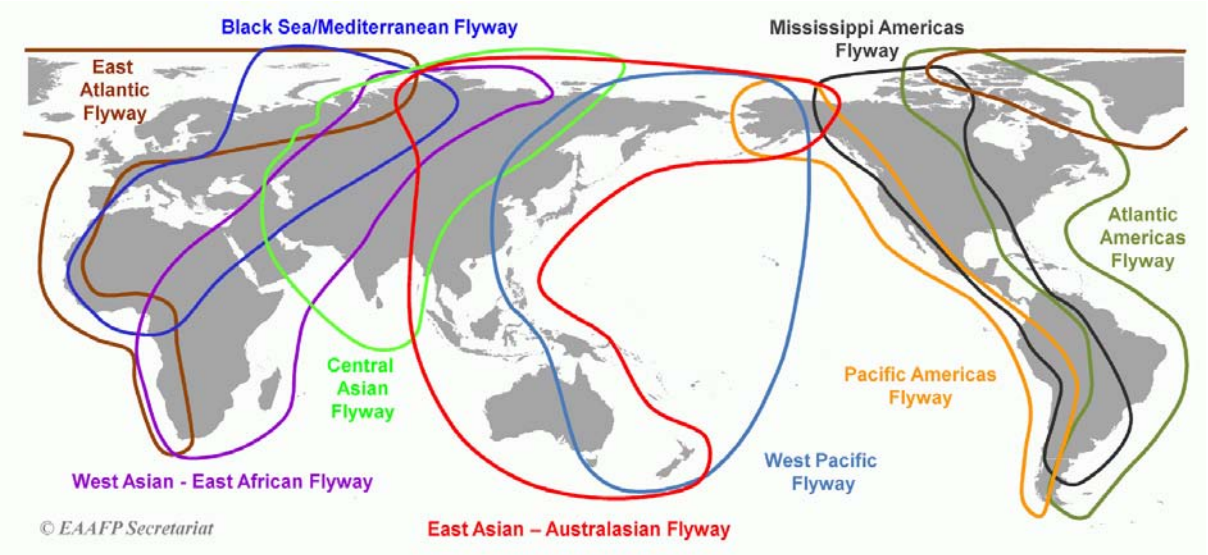


Figure 5: Migratory flyways of wild bird populations with corresponding numbers of humpback whale habitats in Fig. 4 to indicate similar routes between migratory birds and humpback whales

f) Transmission of Coronavirus

There were sudden increases in global coronavirus cases since February of 2020. It postulates that cetaceans, including whales, dolphins, and porpoises, surround the globe with the coronavirus disaster in over 213 countries and territories. Transmissions of coronavirus (COVID-19) from the aquatic virus mutant in the Poles through infected migratory humpback whales to coastal animals and humans, were pictorially described in Fig. 6.

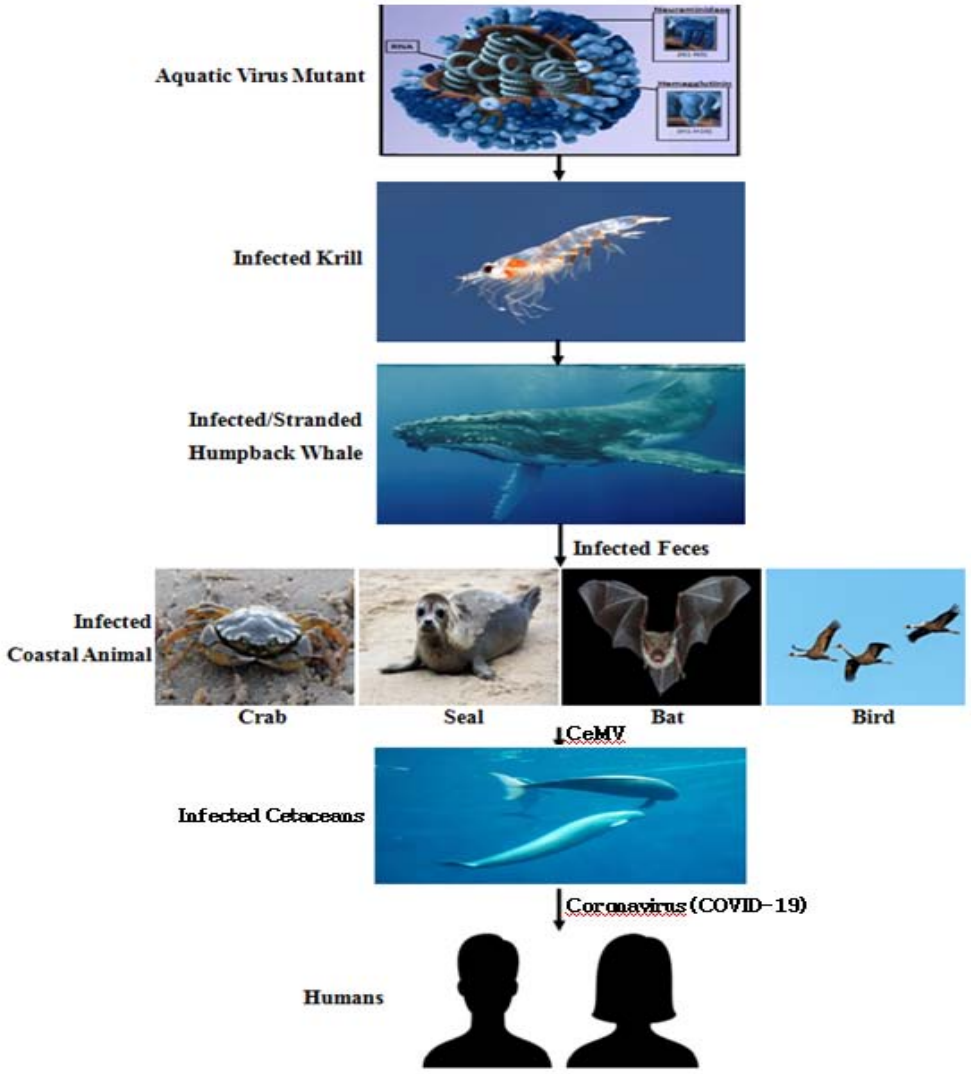


Figure 6: Pictorial presentation for transmissions of the coronavirus (COVID-19) from the aquatic virus mutant through infected migratory humpback whales to coastal animals (crab, seal, bat, bird, porpoise, dolphin, whale) and humans

g) Dolphins

Since humpback whales feed on the krill infected by the mutant aquatic virus and small fish, infected humpback whales might be the reservoir of the CMV in the form of infected feces from the Poles to Continents through their regular migratory behaviors in Fig. 4. Released feces infected porpoises and dolphins in the 14 districts in Fig. 4, including the Yangtze River and East Sea (Site 3 among 14 in Fig. 4) to be evolutionally transmitted to humans in Wuhan of China as the COVID-19 (KIM, 2019). Bottlenose dolphins are found in almost every ocean and sea, other than the coldest waters toward /the Poles (wwhandbook.iwc.int/en/species/bottle.), as shown in Fig. 7. Bottlenose dolphins in the United States are protected under the marine mammal protection act. Bottlenose dolphins find in temperate and tropical waters around the world. They are also found in coastal and offshore waters along the East Coast from New York to Florida, throughout the Gulf of Mexico, and in the Caribbean (www.fisheries.noaa.gov/species/comm.,). The worldwide population of common dolphins is about 600,000. The global estimated population size of the striped dolphin is over 2 million, while the short-beaked common dolphin is estimated to number around 4 million. There are 80,000 humpback whales. Striped dolphins have been the victims of several mass die-offs caused by a virus called morbillivirus, which induced as cetacean morbillivirus (CMV) due to high levels of contaminants and other environmental factors. Kim (2019) proposed that CMV is the source of the COVID-19 initiated by the highest CO_2 emissions, polluted water, and air in Wuhan in China during the minimum sunspot number, which maximized the virus mutation capability under the germicidal UV-B

radiation. Since dolphins swim in shallow areas less than 25 feet, it advises not to go to the beach since air infection by CMV infected dolphins can be transmitted to people, as is the case with the coronavirus. Fig. 7 shows that dolphins are spread all around the world except Poles. Common bottlenose dolphins (wwhandbook.iwc.int/en/ species/bottle.) occur in all almost tropical and temperate regions, and can find in both coastal and offshore (wwhandbook.iwc.int/ en/species/bottle.) waters. They are found in most enclosed or semi-enclosed seas (e.g. North Sea, Mediterranean, Black Sea, Persian Gulf), and bays, lagoons, channels and river (wwhandbook.iwc.int /en/species/bottle.) mouths. Indo-Pacific bottlenose dolphins have a more restricted range with boundaries at the southern tip of Africa to the west, and the Solomon Islands/ New Caledonia to the east. They are generally limited to coastal and inshore waters on the continental shelf, although they are also found around some Indo-Pacific island (wwhandbook. iwc.int/en/species/bottle.) groups. Common Bottlenose dolphins are native to the following countries: Albania; Algeria American Samoa; Angola /Anguilla Antigua and Barbuda; Argentina, Aruba; Australia; Bahamas; Bahrain; Bangladesh; Barbados; Belgium; Belize; Benin; Bermuda; Bonaire, Sint Eustatius and Saba (Saba, Sint Eustatius); Bosnia and Herzegovina; Brazil; Brunei Darussalam; Bulgaria; Cambodia; Cameroon; Canada; Cape Verde; Cayman Islands; Chile; (wwhandbook.iwc. int/en/species/bottle.) Cocos (Keeling) Islands; Colombia· Comoros; Cook Islands; Costa Rica; Cote d'ivoire; Croatia; Cuba; Curacao; Cyprus; Denmark; Djibouti ; Dominica; Dominican Republic; Ecuador; Egypt; El Salvador; Falkland islands (Malvinas); Faroe Islands; Fiji; France; French Guinea; French Polynesia; Gabon; Gambia; Georgia; Germany; Ghana; Gibraltar; Greece; Grenada; Guadeloupe; Guam; Guatemala; Guernsey; Guinea; Guinea-Bissau, Guyana; Haiti; Honduras; Hong Kong; India; Indonesia; Iran, Islamic Republic of; Ireland; Isle of Man; Israel; Italy; Jamaica; Japan; Jersey; Kenya; Kiribati; Korea, Republic of; Kuwait;; Lebanon; Liberia; Libya, Madagascar, Malaysia, Maldives, Malta (wwhandbook.iwc.int/en/ species/bottle.),

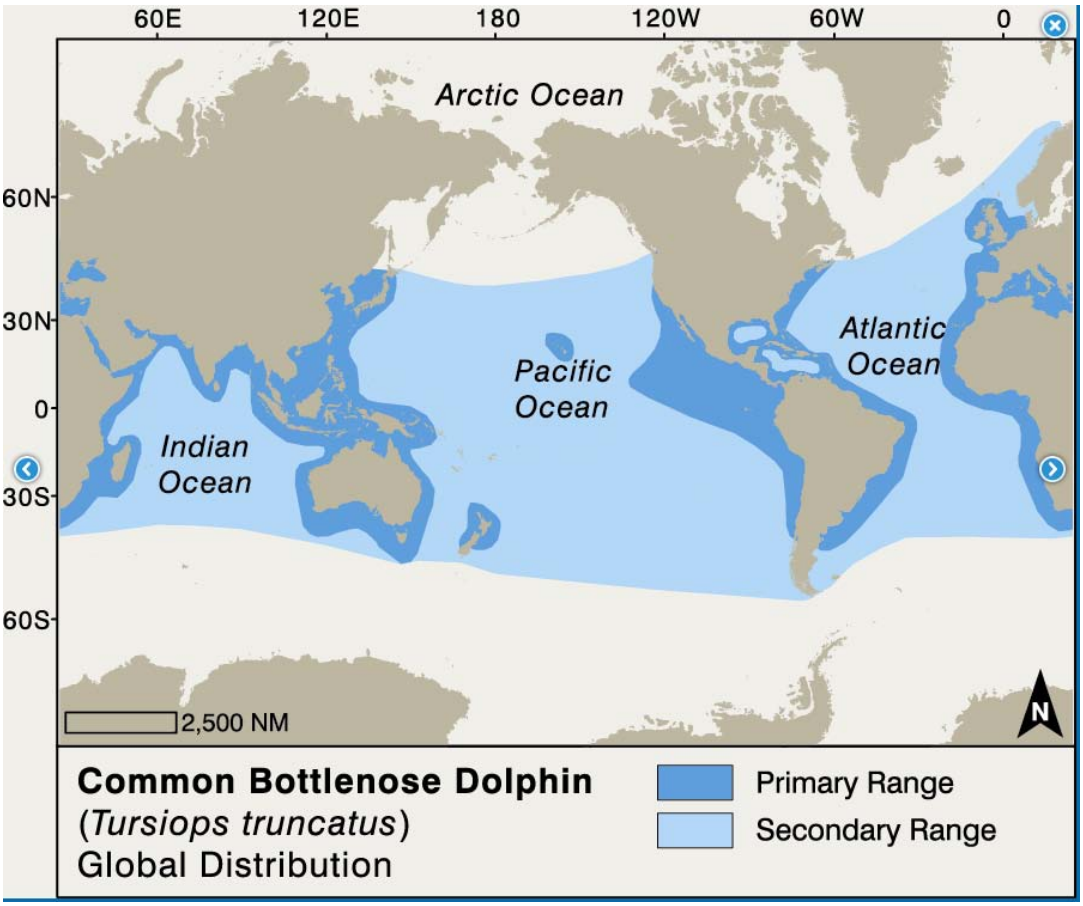


Figure 7: Known range of bottlenose dolphins are indicated in dark blue (JEFFERSON et al., 2015)

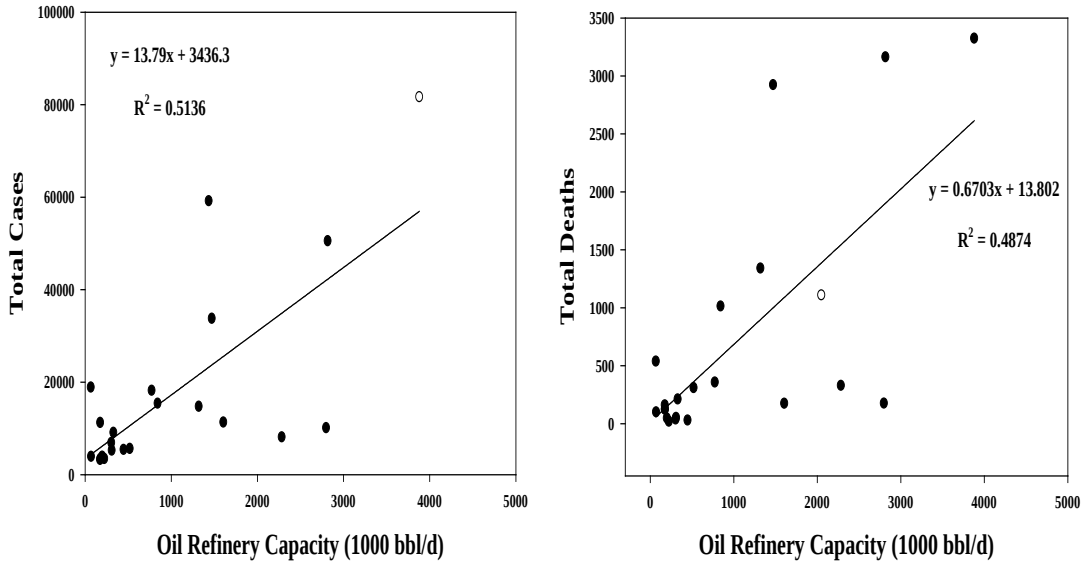
Marshall Islands; Martinique; Mauritania; Mayotte; Mexico; Micronesia, Federated States of; Monaco; Montenegro; Morocco; Mozambique; Myanmar; Namibia; Naurus; Netherlands; New Caledonia; New Zealand; Nicaragua; Nigeria, Niue; Northern Mariana Islands; Oman; Pakistan; Palau; Panama; Papa New Guinea; Peru; Philippines; Pitcairn; Portugal; Puerto Rico; Qatar; Reunion; Romania;

Russian Federation; Saint Helena; Ascension and Tristan da Cunha; Saint Kitts and Nevis; Saint Lucia; Saint Martin (French part; Saint Pierre and Miquelon; Saint Vincent and the Grenadines; Samoa; Sao Tome and Principe; Saudi Arabia; Senegal; Seychelles; Singapore; Sint Maarten (Dutch part); Slovenia; Solomon Islands; Somalia; South Africa; Spain; Sri Lanka; Suriname; Syrian Arab Republic; Taiwan; Tanzania, United Republic of, Thailand; Togo; Tonga; Trinidad and Tobago; Tunisia, Turkey; Turks and Caicos Islands; Ukraine; United Arab Emirates; United Kingdom; Uruguay; Vanuatu, Venezuela, Bolivarian Republic of (wwhandbook.iwc.int /en/species/bottle.); Vietnam, United States; Wallis and Futuna; Western Sahara; Yemen. Indo-Pacific humpback dolphins are native to Australia; Bahrain; Bangladesh; Brunei Darussalam; Cambodia; China; Comoros; Egypt; Eritrea; India; Indonesia; Iran, Islamic Republic of; Japan; Kenya; Madagascar; Malaysia; Mayotte; Mozambique; Myanmar; Oman; Pakistan; Papua New Guinea; Philippines; Saudi Arabia; Singapore; Solomon Islands; Somalia; South Africa; Sri Lanka; Taiwan, Province of China; Tanzania, the United Republic of; Thailand; Timor-Leste; United Arab Emirates; Yemen (wwhandbook.iwc.int/en/species/ bottle.).

Dolphins cover most of the seawater in the world, as shown in Fig. 7, which agrees well with results that there were sudden increases in global coronavirus cases since February of 2020. It postulates that cetaceans, including whales (Fig. 4), dolphins (Fig. 7), and porpoises transmit the globe with the coronavirus (COVID-19) pandemic in over 213 countries and territories (Fig. 14 B).

h) Oil Refineries and Power Plants

Refining involves reducing sulfur to form H_2S while kerosene, butane, and propane are washed in a caustic soda. It expects that petroleum refineries cause water pollution by cooling water as well as the air pollution by stack gas, which was why coronavirus cases were proportional to oil refinery capacity in Fig. 8. Total coronavirus cases by country, as of April 3, 2020, were linearly proportional to oil refinery capacity as R^2= 0.5136 for the total cases and R^2= 0.4874 for the deaths, respectively. Stack gases from petroleum refineries are toxic gases (CO_2, SO_2, O_3, H_2S, NOx) burnt at stack to be less harmful. 91% of water requirements were for cooling for 95% makeup-water requirements with impurities of H_2S, CO_2, O_2, suspended solids, sulfate, silica and other corrosive chemicals (OTTS 1963). These pollutants cause both air pollution and water pollution for the coronavirus outbreak due to enhanced CO_2 emissions for the active COVID-19.



(A) *(B)*

Figure 8: Linear relations of COVID-19 with oil refinery capacity (1,000 bbl/d) by the country while (A). R^2 = 0.5136 for the total cases and (B). R^2 = 0.4874 for the deaths cases, respectively

i) Cetacean Morbillivirus

Cetacean morbillivirus (CMV) is a virus that infects dolphins, porpoises, and whales (BARRET, 1999). Large groups of gregarious species found to be the likely reservoirs and sources of CMV infection in susceptible species in the Atlantic and Pacific Oceans (VAN BRESSEM et al., 2014). RNA viruses showed the coronavirus in cetaceans for species of bottlenose dolphin and beluga whale (LEGER et al., 2018). Unusual mortality event linked to CMV has caused death

in stranded dolphins (GROCH et al., 2018), porpoises, and whales (WVEC, 2017). In the event of an Unusual Mortality Event (UME), there have been humpback whales stranded in the Atlantic Coast (NARK, 2019) and gray whales (OFFICE OF PROTECTED RESOURCES, 2020)) stranding in the Pacific Coast. CMV inoculated and incubated at 37°C (WENDY et al., 2018). It is interesting to note that both breeding areas of migratory gray whales in the Pacific Coast and humpback whales in the Atlantic Coast have the same seawater temperature of 29°C; Baja Peninsula in Mexico from the Pacific Coast and Dominican Republic from the Atlantic Coast of the USA, respectively. As for whale calf breeding, such a temperature of 29°C could be appropriate. However, the 29°C is too close to the inoculation temperature of 37°C (WENDY et al., 2018) for infection by CMV.

Therefore, the situation of such typical breeding areas, from December to April, showed the casualties by the coronavirus as follows: Baja California in Mexico-gray whale breeding, had 3,944 cases of the coronavirus (COVID-19), as of May 22, 2020. The Dominican Republic-humpback whale breeding, had 12,725 cases and 434 deaths, as of May 17, 2020. Puerto Rico- humpback whale breeding, had 3,100 cases with 127 deaths, as of May 24, 2020. China might come across the faster emergence of COVID-19 than any other countries such as South Korea, Japan, Italy, and the USA; the latter showed the same COVID-19 with a lag time of one month or so. The humpback and gray whale breeding areas were infected by the coronavirus (COVID-19) in 2020 during the minimum sunspot number. Such infected whales released their evolutionally mutant virus of the coronavirus-infected feces. The transmission of the coronavirus by infected whales continued the spread of the coronavirus on the USA coastline after it had initially appeared in Wuhan in China, which has the highest CO_2 emissions in China, during the minimum sunspot number. The coronavirus might not come from China, rather COVID-19 as an evolutionary virus from CMV spread to humans from the multi-sources of 14 humpback whale habitats in Fig. 4 around the world. China has favorable environments for the coronavirus emergence such as sufficient water in 164 lakes, warm weather, highest CO_2 emissions, toxic effluents from 4,000 industrial factories, Wenzhou people for toxic leather tannery and textile coloring industry along the Yangtze River, vehicles, and 11 million people in the metropolitan city of Wuhan in China. China produced the highest carbon dioxide emissions in the world (9.8 billion metric tons in 2017). Besides, China used to use banned ozone-depleting chemicals of CFC-11 (RIGBY et al., 2019). These bad Chinese environments facilitated CO_2 emissions to induce the increases of the ozone hole area and UV-B radiation for the emergence of the coronavirus (COVID-19) pandemic. Humpback whales in 14 habitats in Fig. 4 spread their infected feces to millions of dolphins around the world in Fig. 7. The transmission of COVID-19 by cetaceans could explain the initial casualties in China, the USA, Italy, Spain, Iran, Turkey, Brazil, and other countries. Dolphins are one of the primary causes of the coronavirus (COVID-19) pandemic. The feces of dolphins and porpoises transmit the coronavirus (COVID-19) to the people in the USA on the Pacific Coast, including parameters of toxic gases from an oil refinery, power plant, tanning leather textile, vehicle, food waste biogas, and population as; California (67,917), Oregon (3,228), Washington (17,610) and on the Atlantic Coast; Florida (40,596), Georgia (33,508), South Carolina (7,653), North Carolina (14,939), Virginia (24,081), Maryland (32,587), District of Columbia (6,272), Delaware (6,447), New Jersey (140,008), New York (345,406), Connecticut (33,554), Massachusetts (77,793), New Hampshire (3,071), Maine (1,436) with total confirmed cases in parenthesis, as of May 11, 2020. The presence of the migratory whale breeding areas near the USA and migration to feeding areas in the Arctic Sea, through the Pacific Coast (Baja California of Mexico) and Atlantic Coast (Dominican Republic) of the USA, could be why USA had the highest coronavirus (COVID-19) casualty in the world. Also, the USA is also the second-highest country, producing CO_2 emissions. Kim (2018) showed that the stranded humpback whale number on the Atlantic coast was proportional to the State of CO_2 emissions with linear relation of $R^2 = 0.6128$ during the years of 2016 to 2018 with the minimum sunspot number in parenthesis as; 2016 (15), 2017 (10), and 2018 (0). It can partly conclude that the humpback whales have already infected by CMV in the breeding areas during the minimum sunspot number. Wuhan environments with water pollutions and millions of migratory birds along with cetaceans might evolutionally transmit CMV to humans as the coronavirus (COVID-19) in Wuhan in China. The coronavirus (COVID-19) could again transmit to cetaceans (porpoises, dolphins, and whales) in the Yangtze River and East Sea. From there, it can spread around the world as shown in Fig. 7 by dolphins.

j) Metropolitan Area Coronavirus Outbreak

Terrible coronavirus casualties observed in metropolitan areas around the world. CO_2 emissions from many people and vehicles, along with many factories and wastewater effluents in the large cities induce a favorable environment for the coronavirus outbreak due to the advanced ozone hole area and UVR. Oil refineries, gas and coal-powered plants, metropolitan waste foods, the textile industry, and the tanning leather industry, produce CO_2 gas. Food wastes, oil refineries, natural gas- and coal-powered plants, the tanning leather industry, and vehicle exhaust, produce toxic hydrogen sulfide (H_2S). H_2S is harmful to people in the gas phase (above ten ppm). In the liquid

phase (3,000 ppm solubility), H_2S reacts with iron (Fe) in the water to sediment as FeS_2/ FeS (KIM et al., 2019) so that phytoplankton in the aquatic system is retarded not to convert the dissolved CO_2 as pure O_2. Therefore, H_2S produced from factories in the metropolitan area is polluting the water in the river and drinking water, which caused the coronavirus outbreak. Transmission of the coronavirus through the leather industry via people coming from Wenzhou/Wuhan in China to high CO_2 emission countries including Wenzhou-Wuhan in China, Milan in Italy, metropolitan areas of New York City in the USA, Madrid in Spain, Paris in France, Bavaria in Germany, London in the UK, Istanbul in Turkey, Tehran in Iran and Tokyo in Japan. CO_2 emissions and H_2S gases from people, vehicles, oil refineries, gas or coal-powered plants, factories- leather, tanning, textiles, garments, footwear, and organic dyes, cause the increase of the ozone hole area and UVR in the Earth, leading to the potent virus mutation. It proposed that migratory birds and humpback whales (KIM, 2018) were the carriers of the mutant virus from the Poles to the Continents. Wuhan in China, with a population of 11 million, had the highest CO_2 emissions, a large ozone hole area, use of banned ozone-depleting chemicals of CFC-11, high UVR, millions of migratory birds at Dongting Lake, porpoises/ dolphins/ whales at the Yangtze River and the East Sea, and a tanning-leather industry operated by Wenzhou/ Wuhan Chinese. These could be the primary factors that initiated the coronavirus (COVID-19) pandemic in Wuhan in China.

Bad air CO_2 is converted to good air O_2 by photosynthesis as shown in Reaction (1). Aerobic microorganism converts O_2 to CO_2 and get bioenergy (ATP) in Reaction (2). Cyanobacteria in lakes and rivers consume O_2, growing cells, and generating CO_2 in Reaction (3) for algal blooms (KIM, 2018). If freshwater in the lakes and rivers polluted by tannery effluents, oil refinery make-up water, and agricultural fertilizer enriched water, O_2 in the water is converted to CO_2 in the water in Reaction (3) and the atmosphere. The enhanced CO_2 emissions lead to the increase of the ozone hole area with UV-B radiation, as explained by NIH (NIH, 1989). Such high CO_2 emissions and the minimum sunspot number are a good environment for the coronavirus (COVID-19) pandemic. There are air and water pollutions which help induce the coronavirus. Air pollution of CO_2 emissions and toxic gases (H_2S, SO_2, HF, HCl) produce from the vehicle exhaust gas, stack gas from oil refineries, flue gas from coal- and gas-powered power plants, food waste, volcanoes, and tanneries. The photosynthesis by chlorophyll-*a* and microorganism synthesis, are given as follows:

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2 \text{- - -} \quad (1)$$

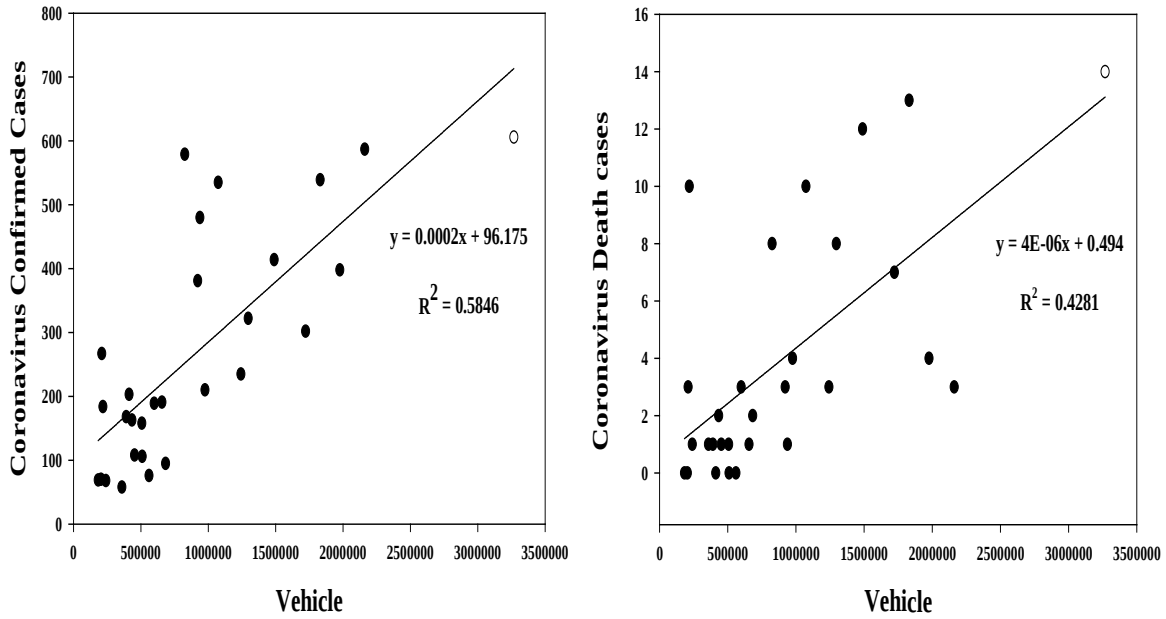
$$6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O + 38ATP \quad \text{- - -} \quad (2)$$

$$C_6H_{12}O_6 + \alpha_1O_2 + \alpha_2NH_3 \rightarrow \beta_1C_{4.4}H_{7.3}N_{0.86}O_{1.2} + \beta_2CO_2 + \beta_3H_2O \cdots \text{- - -} \quad (3)$$

These processes can have deadly effects on older adults with pulmonary disease in metropolitan areas. Older adults have to move from the metropolitan areas to the urban areas with forests and farmland for fresh air in Reaction (1). Also, water pollution caused by carcinogens, toxic chemicals, chromium complex from tannery effluents, and make-up water from oil refineries can also have an extremely harmful effect on elderly people in metropolitan areas. This air and water pollutions in metropolitan areas could be critical to older adults in huge cities such as New York City, Milan, Paris, London, Tokyo, Tehran, Wuhan as well as other huge cities are especially vulnerable.

k) Vehicles

Vehicle exhaust emissions create when the air-fuel mixture burning inside internal combustion engines release carbon dioxide back into the atmosphere causing health problems (AZO CLEANTECH, 2019). A 2013 study by MIT indicates that 53,000 early deaths occur per year in the United States alone because of vehicle emissions (CAIAZZO, 2013). Every day a person inhales 15,000-20,000 liter of air, so even relatively small amounts of any harmful substances, long inhaled with contaminated atmospheric air, adversely affect health, to cause various diseases of the respiratory system, eye, digestion, heart, and blood vessels. Composition of exhaust gases is N_2, O_2, H_2O, CO, CO_2, NO_x, SO_2, benzene, aldehydes, O_3, particular matter (PM) (SKYBRARY, 2019). World vehicles by country in 2015 were available from the International Organization of Motor Vehicle Manufacturers. The information was correlated with coronavirus cases and deaths as of March 29, 2010, and a list of countries and their carbon dioxide emissions. The relationship between vehicle numbers and CO_2 emissions showed a linear coefficient of R^2=0.6313 to indicate that CO_2 emissions were proportional to vehicle numbers. Coronavirus confirmed cases and deaths were also proportional to vehicle numbers as R^2= 0.5846 (Fig. 9A) and R^2=0.4281(Fig. 9B), respectively. It was evident that halting the spread of the coronavirus could be achieved using the following schemes: 1) Use of the electric vehicle rather than gasoline, natural gas, biodiesel, diesel or coal combustion. 2) The elderly should leave large cities for small cities with clean air and water.

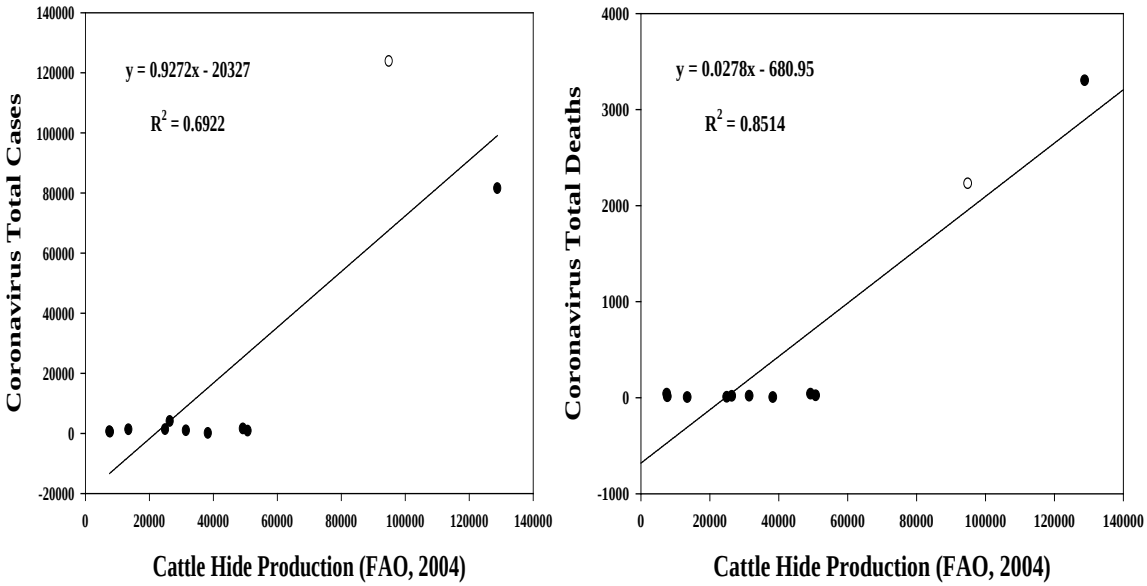


(A) *(B)*

Figure 9: Vehicle number in each country related with (A). coronavirus confirmed cases ($R^2 = 0.5846$) and (B).death cases ($R^2 = 0.4281$)

l) The Leather Industry

Leather manufacturing can simplify as; merchant providing hides and skins locally or from importing, pretreatment, tanning (vegetable or chromium), leathering goods, footwear goods (shoemaking), luxurious Gucci handbags, merchant selling and exporting, wastewater treatment of tanneries to cope with environmental regulation. These steps are highly sophisticated and require a lot of experience and knowledge of the tannery leathering industry. Materials from bovine hides and sheep and goat skins use for soles, belts, straps, bags, coats and shoes. The global rank of leather production is as follows; 1. China, 2. Brazil, 3. Italy, 4. Russia, 5. India (BUFFALO JACKSON, 2020). The major chemicals used during leather production are as follows: Pentachlorophenol, di-butyl phthalate, benzyl butyl phthalate, bis (2-Ethylhexyl) phthalate chlorinated paraffin, anthracene (a carcinogen) nonyl phenol, N-methyl pyrrolidone, methyl isothiazolinone (carcinogen, dibutyl tin carcinogen), azo dyes (a carcinogen hexachlorobenzene), chromium (a carcinogen), formaldehyde (a carcinogen), arsenic (a carcinogen), sodium dichromate, cobalt dichloride, cadmium sulfate, lead chromate (DIXIT et al., 2015). Leather chemicals (biocides, surfactants, chromium sulfate, polyurethane resins, sodium bicarbonate, sodium sulfide, formic acid) sell in the US, Mexico, Canada, Italy, Spain, France, Turkey, China, India, Japan, Brazil, Saudi Arabia (GRAND VIEW RESEARCH, 2019). These major leather chemicals suppliers are all the major countries with coronavirus cases. Bovine hide productions in each leather country in 2004 correlated with the total coronavirus cases (R^2=0.6922) and the total coronavirus deaths (R^2= 0.8514) in Fig. 10(A) and 10(B), respectively, based on data from FAO 2004. In this case was in India, Brazil, Russia, Argentina, Pakistan, Australia, Mexico, Ukraine, Italy, Egypt, Sudan, South Africa and other countries (MEMODOVIC, 2008). The leading exporters of leather footwear are China, Italy, Spain, Germany, USA, Belgium, Portugal, Brazil, Romania, France, Indonesia, and the Netherlands, all of which are the major countries of the coronavirus outbreak.



(A) *(B)*

Figure 10: (A). Linear relationship of total coronavirus cases (R^2= 0.6922) and (B). total deaths (R^2 = 0.8514) with cattle hide production in each country (FAO, 2004)

65% of global leather production sources from bovine (cattle), 15% sheep, 11% pigs, and 9% from goats. Most of the leather in the US and Europe comes from China (13), USA (1), Brazil (4), India (11), Argentina (48). European countries exporting leather goods are Italy (6), Spain (3), France (7), Belgium (16), where the numbering in parenthesis implies the rank of global coronavirus cases as of May 20, 2020. All the top 10 countries of the coronavirus outbreak, including Germany (8), Iran (10), UK (5), Switzerland (25), and Turkey (9), are associated with the global leather industry. Since the leather industry uses very toxic chemicals during leather production, its impact is to kill people with carcinogenic and derivatives, having an acute and chronic effect on both water and air. This could be why so many 70-75 year old's were died by the coronavirus ever since 100,000 Chinse immigrants from Wenzhou in China, famous for leather and textile industries, arrived in Prato in Italy in the 1980s and 1990s. Wenzhou people moved to Wuhan, which is the seventh-largest city in China. As for the leather and textile industries, a sufficient supply of water is very critical. The Yangtze River and Han River in Wuhan have deteriorated by Wenzhou people who caused the coronavirus outbreak. They went back to Wenzhou after the coronavirus outbreak in Wuhan in China. They came back to Italy, Europe and the USA to escape from the coronavirus (COVID-19) pandemic. It can conclude that the starting point of the coronavirus outbreak was due to the toxic chemicals used in the leather and textile industries by the Wenzhou people in Wuhan. They have a long history of leather production and shoemaking dating back over 500 years from the Qing Dynasty (1796-1820) (MURAKAWA, 2006). To prevent further damage by the leather and textile industries, global regulations have to firmly set up to limit the kinds and dosages of chemicals in the leather tannery industry. The number of European leather industry companies in Sweden (4 companies), United Kingdom (22), Germany (50), France (47), Italy (1,309), Spain (113), and Romania (91) showed the linear relationship (R^2= 0.7826) with coronavirus cases, as of April 9, 2020 as shown in Fig. 11.

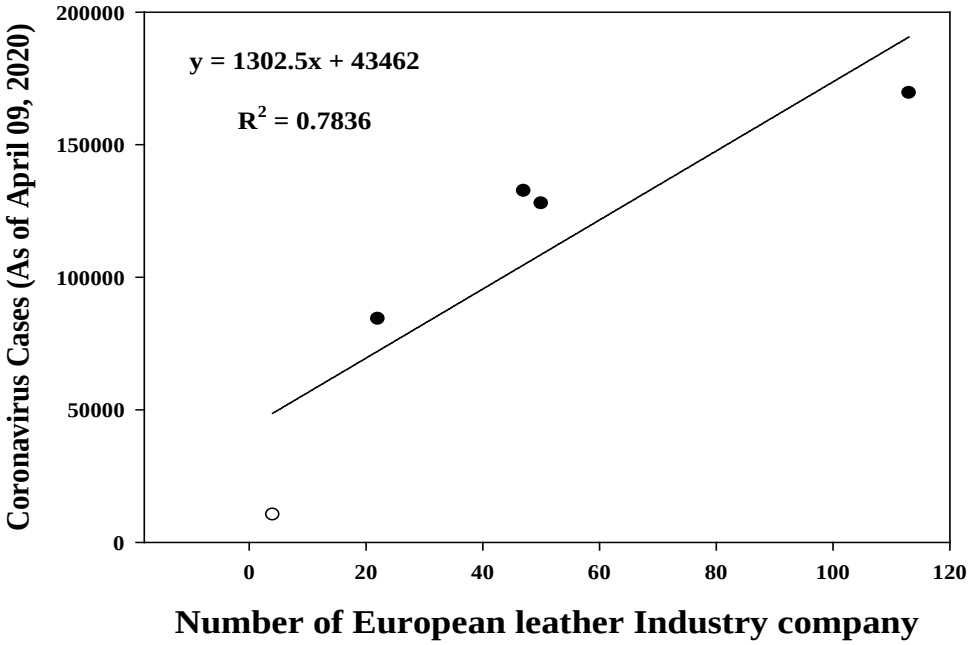


Figure 11: Linear relationship (R^2 = 0.7826) between the number of European leather industry companies and Coronavirus cases as of April 09, 2020

The regional outlook from 2014-2025 was as follows (GRAND VIEW, 2019) while the parenthesized number was the ranking in terms of global coronavirus confirmed cases as of May 5, 2020. Typical tanneries at Fez of Morocco are shown in Fig. 12.

North America; USA (1), Canada (12), Mexico (21), Europe; Italy (3), Spain (2), UK (4) France (5), Germany (6) Turkey (8), Asia Pacific: China (11), Japan (31), India(15), Central and South America; Brazil (9), Ecuador (17), Middle East and Africa; Iran (10), Saudi Arabia (19), Israel (28), South Africa (46). The global organic pigments market includes azo phthalocyanine, quinacridone, and others with application areas of paints and coatings, plastics, inks and other applications. Major market players are located in the United States (1), Canada (12), Germany (6), Belgium (13), Sweden (22), Switzerland (18), Spain (2), Luxembourg (58), Netherlands (16), Czech Republic (45), United Kingdom (4), India (15), Hong Kong (88), China (11), Japan (31), and Singapore (26). The parenthesized numbers are the coronavirus ranking as of May 5, 2020. The chemicals from the leather tanning industry and organic pigments in tannery wastewater caused serious soil and water pollution resulting in dangerous health hazards to both humans and animal life (SAXENA et al., 2016). The chemicals used in the leather industry are pentachlorophenol, dibutyl benzyl butyl phthalate, bis (2-Ethylhexyl phthalate), short-chain, chlorinated paraffin, anthracene, nonylphenol, N-methyl pyrrolidone methyl isothiazolinone, organotin compounds (dibutyltin), which are partly carcinogen and less biodegradable. It is therefore evident that chemicals from the leather industry and organic pigments deteriorate freshwater in rivers and lakes such as Mohawk River; Hudson River (New York), Mississippi River (Minnesota (28), Wisconsin (25), Iowa (21), Illinois (4), Missouri (24), Kentucky (35), Tennessee (19), Arkansas (39), Mississippi (27), Louisiana (11), New York (1). Lakes; Erie, Ontario, Oneida, Seneca, Cayuga (New York (1)), Lake Michigan (Wisconsin (25), Illinois (4), Indiana (14), and Michigan (7)). The leather industry in Milwaukee in Wisconsin used to pollute Lake Michigan. Los Angeles River (CA(5)), Colorado River (Colorado (17), Arizona (23), California (5)). The parenthesis numbers are the State rank of the coronavirus cases, as of May 5, 2020. It is necessary to purify the water quality of rivers and lakes from pollution-induced by tannery wastewater, which ultimately contributed to the catastrophic coronavirus outbreak. Toxic chemicals deteriorate freshwater in rivers and lakes, breaking down the food web cycle in freshwater in Reaction (3). Plankton cannot produce clean oxygen from carbon dioxide by photosynthesis in Reaction (1). Therefore, carbon dioxide (CO_2) accumulates in the water as well as in the air. Accumulated CO_2 induces the increase of the ozone hole area for less ultraviolet absorption by the ozone layer.

Figure 12: The tanneries at Fez of Morocco produce leathers.

Consequently, ultraviolet radiation becomes strong, which enhances the activity of the coronavirus. To stop the propagation of the coronavirus (accyukon.com March 19, 2020), it is necessary to decrease the number of chemicals in the leather industry and organic pigments as well as clean the water in rivers and lakes; for example, by bioremediation approaches, as suggested by Saxena (2016). In the European leather industry, Italy (71%) and Spain (11.1%) are the two main contributors to the value of production of the sample. Over 1,600 companies with 1,300 tanneries, Italy's share in the sample is 80%. The European leather industry in 2011 was tannery companies 1,783, footwear 11,692 companies, and leather goods 10,710 companies (SOCIAL AND ENVIRONMENT). The countries handling tannery and leather goods are the same, showing a high number of COVID-19 deaths. It can, therefore theorize that toxic chemicals used for the tanning process have polluted the water as well as the air, eventually causing acute and chronic respiratory problems resulting in coronavirus deaths. The toxic chemicals polluted the ecosystem in the rivers and lakes so that normal photosynthesis was no longer possible, and carbon dioxide accumulated in the water as well as in the air. Carbon dioxide emissions are proportional to coronavirus cases. Upper rivers deteriorate by tannery chemicals to cause the coronavirus casualties, as were at the Yangtze River in Wuhan, China, the Po River in Milan in Italy, and the Hudson River in New York City in the USA. One key factor of the coronavirus outbreak is that the tanning leather industries are spread all around the world. Chromium is used in about 90% of tanning operations worldwide. Tanneries are so toxic that 95% of the US tanneries have moved overseas. India has minimal regulations to use 69,000 tons of chrome salts annually in 1,600 Indian tanneries. Typical chrome pollution countries had coronavirus deaths as follows: India (3,303), Indonesia (1,242), Pakistan (985), Colombia (613) and Bangladesh (386), as of May 20, 2202, and Hubei in China (3,212), as of May 5, 2020, as shown in global chromium pollution from tanneries for 95 sites (https://leathersustainability.weebly.com/). There is the global chromium pollution from tanneries in South America (Guatemala, Columbia, Uruguay), Africa (Niger, Kenya, Tanzania, Ethiopia), Asia (India, Bangladesh, Indonesia, China) deaths.

m) Leather Dyes

Leather dyes are non-water-soluble dyes (sulfur dyes) and soluble dyes (anionic acid dyes, atmospheric metal complex dyes, triphenyl (methane dyes)). Benzene uses as an emulsifier. China and India are emerging international leather players with high pollution levels. The leather color processes by dyeing the leather with dyes and pigmentation by aniline dye while azo dyes are very harmful to health (LEATHER DIRECTIONARY). China is the world's largest leather producer in shoes, clothing, bags, and luggage. Leather for the car industry comes from Brazil (22%), Mexico (15%), China (13%), Argentina (10%) and Austria (5%), while Mexico (28%), China and Italy (14%), Austria (8%), Germany, South Korea, South Africa and the United Kingdom (4%) for finished leather (LEATHER INDUSTRY, 2015). 53.5% of final products using leather as footwear are produced by the USA, Switzerland, and

Germany, while 8.2% of automotive leather goods produce by the USA, Japan, Germany, and France. 38.3% of luggage and goods are manufactured in all of the above countries. Dyes alter the color of textiles and leather. Europe is one of the most important markets from colorants (28% in 2019). The key countries with major dye markets are the UK, France, Spain, Germany, Italy, Russia, Sweden, Denmark, Switzerland, Netherlands, Turkey, Czech Republic (EUROPE DYES MARKET, 2019). Since tannery leather and textile industries use very harmful chemicals and carcinogens, every country with such industries is now confronting the high death rate of the coronavirus outbreak. The rank of the coronavirus (COVID-19) pandemic was as follow: UK 5, France 7, Spain 3, Germany 8, Italy 6, Russia 2, Sweden 24, Denmark 44, Switzerland 25, Netherlands 20, Turkey 9, and Czech Republic 49, as of May 20, 2020. It is very much certain that organic dyes altering the color of textiles and leather are the most critical parameters causing the coronavirus (COVID-19) pandemic.

n) Footwear Industry

Global leather production countries are as follows with deaths in parenthesis, as of April 11, 2020). Algeria (561), Argentina (393), Australia (100), Canada (5,912), Bangladesh (386), Brazil (17,983), Chile (509), China (4,634), Egypt (659), Ethiopia (5), India (3,303), Japan (768), Kenya (50), South Korea (263), Morocco (194), Nepal (-), Nigeria (192), Mexico (5,666), New Zealand (21), Malaysia (114), Pakistan (985), Paraguay (11), Philippines (842), Germany (8,193), Indonesia (1,242), Russia (2,972), South Africa (312), Taiwan (7), Tanzania (21), Tunisia (47), Ukraine (564), Thailand (56), USA (93,558), Uruguay (20), Vietnam **(-),** Zimbabwe (4). Most of the countries producing leather had a significant number of coronavirus deaths, although there were minor exceptions. The NIH lists 246 hazardous chemicals associated with leather processing. Groundwater near tanneries showed the presence of sulfuric acid, arsenic, chromium, lead, and zinc, while toxic gases like ammonia, hydrogen sulfide, and carcinogenic arylamines emit from tanneries. Hexavalent chromium is a carcinogen, whose long-term effects include lung cancer, impaired immune system, and reproductive problems.

IV. Prevention

a) Volcanic Regions

The volcanic gas (H_2O, CO_2, SO_2, CO, H_2S, HCl, HF) inhibits the activity of the coronavirus carried by some microorganisms due to the toxicity and the acidity of volcanic gases. As of May 20, 2020, there were reported coronavirus cases (deaths) in the volcanic countries as follows: Peru 99,483 (2,914), Chile 49,579 (509), Ecuador 34,151 (2,839), Columbia 16,935 (613), Costa Rica 882 (10), El Salvador 1,571 (31), Guatemala 2,133 (43), Honduras 2,955 (147), Nicaragua 254 (17), Mexico 54,346 (5,666), Panama 9,867 (281), Kuwait 17,568 (124), Bahrain 7,532 (12), Saudi Arabia 59,854 (329), Qatar 37,097 (16), UAE 25,063 (227), Indonesia 19,189 (1,242), Japan 16,367 (768), Taiwan 440 (7), Oman 6,043 (28), DR Congo 1,731 (61), Iceland 1,802 (10), Greenland 11 (0), Philippines 13,221 (842), New Zealand 1,503 (21). South American countries with active volcanoes showed minimal deaths: Costa Rica 882 (10), El Salvador 1,571 (31), Guatemala 2,133 (43) while other countries such as Peru, Chile, Ecuador, Columbia, Honduras, Mexico, and Panama produced hides to export leather to the USA, Europe, and China, leading to excessive outbreaks of the coronavirus. Middle Eastern countries with active volcanoes and oil refineries had a lower amount of deaths. There is, however, tanned and dressed leather production in Saudi Arabia, at the same time the UAE spent on luxury leather goods with toxic chemicals as preservatives, which could be why there were more casualties in such countries than other volcanic countries including additional parameters of oil refineries, gas-powered power plants, and dolphins. Japan and Indonesia have 130 and 127 active volcanoes, respectively. Indonesia is an exporter of leather raw material to the world, while Japan has good technology in the dyeing and textile industry. Their volcanic gas inhibitions were not sufficient to block the toxic chemical hazards induced by the tannery leather industry including additional parameters of oil refineries, gas-powered power plants, and dolphins for the coronavirus outbreak.

b) Preventive Measures

The following locations can be asylum from the coronavirus (COVID-19) pandemic.

i. *Tropical latitudes of 20°*

Since the ozone concentration is low in the tropical area, UV-B radiation is strong enough to protect people from the coronavirus

ii. *Active Volcanoes*

Volcanic gases during eruptions contain very toxic components such as SO_2, CO, H_2S, HCl, HF, and CO_2. However, when volcanoes are not in eruptive mode, minor gases are continuously released enough to protect people from the coronavirus. Indonesia is located at the equator (0°), with 127 active volcanoes. Since Indonesia is one of the major manufacturers of leather with its tanneries, there could be more casualties in Indonesia, even though it locates on the equator with many active volcanoes. Japan has 130 active volcanoes. Japan is famous for the leather-textile industry, leading to the coronavirus outbreak. Japan might have fewer cases and casualties due to the presence of volcanoes. The same principle applies to Iceland (10), New Zealand (21), Guatemala (43), El Salvador (31), Greenland (0), Nicaragua (17), Papua New Guinea (0).

iii. *Artificial Volcanic Gases*

The major toxic volcanic gases are SO_2 and H_2S. A small number of such gases can be prepared artificially by heating sulfur (S) powder over burning charcoal to produce SO_2 gas. Decomposed food waste produces H_2S gas in an ambient condition by microorganisms. Any of these two gases of SO_2 and H_2S can be spread once a week at a low level of 1ppm to protect people from the coronavirus outbreak.

iv. *UV-B Radiation*

UV-B radiation is the most simple, safe, cheap, and efficient method to kill the coronavirus itself. A portable UV-B radiator (Fig. 13) was used with two 50-Watt UVB lamps in an office while six other large sizes 50-watt UVB lamps were used in 500 chickens cage for more than a year to kill 100% of the virus within 50 minutes (KIM, 2019).

.

(A)

(B)

Figure 13: (A) Portable UV-B radiator. (B) Pilot Scale UV-B radiator, killing 100% of the virus within 50 minutes by six 50W UV-B lamps (KIM, 2019). A and B have been run at the indoor working office and an outdoor 500 chickens cage for more than a year, respectively

v. *Warm and Humid Environment*

The virus is not active at temperatures above 55°C and relative humidity above 40% (Kim, 2018) with a heater, humidifier, and UV-B radiator installed together to expel the coronavirus.

vi. *Curcumin*

India has 3 major areas for tanneries. India's far lower rate of 3,303 deaths, as of May 20, 2020, could be caused by their daily food intake of curcumin. Curcumin has shown to exhibit antioxidant, anti-inflammatory, antiviral properties (AGGARWAL et al., 2007), which might help people not to contact the coronavirus. Eating Indian curcumin as often as possible, is recommended to protect the pulmonary alveolus from the coronavirus attack.

vii. *Vegetable Tanning and Natural Chemicals*

Most of the coronavirus outbreak occurred in 213 countries and territories associated with a tannery, leather, footwear, textiles, and garment industries, spreading through human contact from Wenzhou to Wuhan in China, Milan in Italy and Europe, and eventually in New York City in the USA. It suggests to use vegetable tanning, not the chromium salts, for safe tanning.

viii. *Green Zone*

Forestry, farmland, and clean lakes and rivers provide phytoplankton, chlorophyll-*a* photosynthesis, converting harmful air of CO_2 to good air of O_2 during sunlight. Since the coronavirus is inhibited by the fresh oxygen produced in Reaction (1) for reduction of CO_2, the green zone is essential in the metropolitan area.

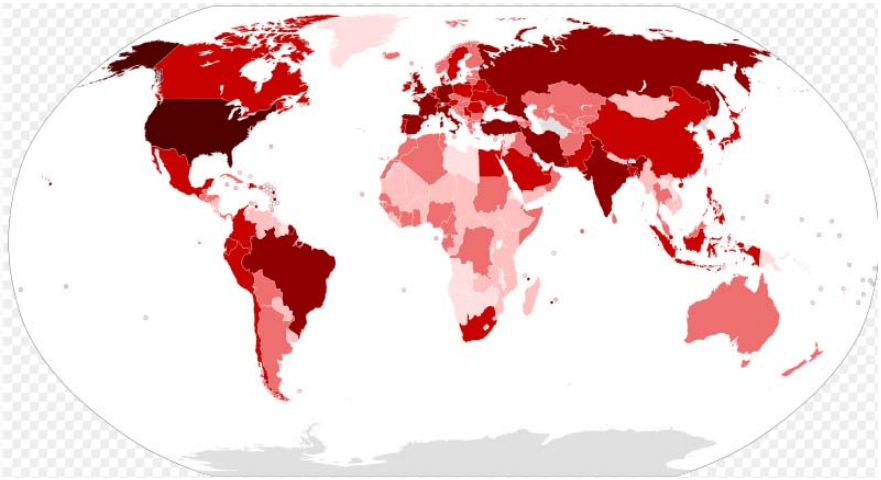
c) Total Ozone and Latitude

The ozone in the stratosphere absorbs a large part of the Sun's biologically harmful ultraviolet radiation. The ozone layer resides in the stratosphere and surrounds the entire Earth. UV-B radiation (280-315 nm wavelength) (www.esrl.noaa.gov/csl) from the Sun is strongly absorbed, so that the amount of UV-B radiating on the Earth's surface is significantly reduced.

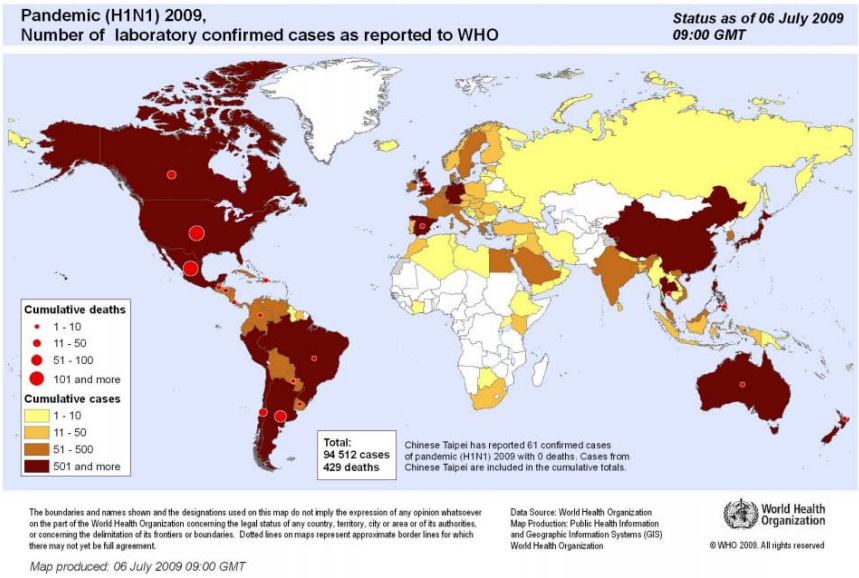
The total ozone at any location on the globe is defined as the sum of all the ozone in the atmosphere directly above that location. Total ozone varies strongly with latitude over the globe, with the large values occurring at middle and high latitudes during all seasons. The values of total ozone are the lowest in the tropics in all seasons because the thickness of the ozone layer is smallest there (www.theozonehole.com/twenty.htm), with little variation of the total ozone in the tropics (20°N-20°S latitudes) leading to high ultraviolet-B radiation, creating a safe zone from the coronavirus outbreak. Countries are listed below in the order of global deaths caused by the coronavirus, as of May 20, 2020, with country latitude in parenthesis.

17,983 Brazil (11), 1,242 Indonesia (6), 2,839 Ecuador (2), 3,303 India (21), 5,666 Mexico (19), 842 Philippines (14), 2,914 Peru (10), 441 Dominican

Republic (18), 281 Panama (9), 114 Malaysia (3), 56 Thailand (15), 51 Burkina Faso (12), 147 Honduras (15), 61 Democratic Republic of Congo (4), 189 Bolivia (17), 140 Cameroon (6), 55 Niger (18), 10 Mauritius (20), 10 Venezuela (5), 8 Trinidad and Tobago (10), 22 Singapore (1), 192 Nigeria (10), 9 Sri Lanka (7), 50 Kenya (0), 53 Mali (17), 31 Ghana (10), 31 El Salvador (13), 10 Guyana (5), 15 Republic of Congo (0), 23 Liberia (6), 7 Barbados (13), 9 Jamaica (18), 10 Costa Rica (10), 28 Oman (23), 28 Ivory Coast (7), 43 Guatemala (14), 12 Togo (8), 5 Ethiopia (9), 21 Tanzania (-7), 4 Zimbabwe (20), 30 Senegal (14), 7 Zambia (-13), 22 Haiti (19), 3 Antigua and Barbuda (17), 3 Angola (12), 111 Sudan (15), 2 Belize (17), 7 Djibouti (11), 1 Brunei (4), 12 Gabon (1), which are all located in the tropics (20°N-20°S latitude). Their locations seem relatively safe compared to other countries between the tropics and the Polar region.



(A) (H1N1) Pandemic in 2009



(B) Coronavirus (COVID-19) Outbreak World Map

Figure 14: Global distribution maps of: (A). H1N1 pandemic with 284,000 deaths in 2009. (B). Coronavirus (COVID-19) pandemic with 380,630 deaths, as of June 02, 2020

The first pandemic caused 284,000 deaths (Fig. 14 A). It occurred in the form of the 2009 swine flu virus H1N1, coming from both pigs and birds and then transmitted readily to and among humans. The second pandemic was in 2020 in the form of the coronavirus (COVID-19) with high deaths of 380,630 as of June 02, 2020. Those pandemics both happened during the minimum sunspot number with an 11-year cyclic pattern. Fig. Fourteen showed that the global distributions between H1N1 in 2009 (Fig. 14 A) and coronavirus (COVID-19) in 2020 (Fig. 14 B) were very similar to each other. Since there have been H1N1 human casualties in 2009, a future pandemic can expect in 2031when the sunspot number reaches its minimum.

The minimum sunspot number allows the excessive UV-B radiation on the Earth (NIH, 1989) for simple mutation of viruses. If global CO_2 emissions reduce, the ozone hole areas will also decrease, leading to reduced UV-B radiation on the Earth, with fewer chances of virus mutation. Therefore, it is essential to reduce CO_2 emissions globally to prevent a new pandemic in 2031. CO_2 emissions can reduce in leather-tannery chemicals, from chrome salts to natural tannins, coal- and gas-power plants to nuclear plants, vehicles from gasoline to electric, iron fertilization in oceans, forestry, and farming.

d) Vaccine and Medication Development

A vaccine is simple but hard to be developed quickly in efficacy. Since most biological species have natural enemies, such new viruses can block by pre-existing vaccines or natural enemies. However, this provides partial and incomplete protection, at best. The virus behavior before the potent solar UV-B mutation during the minimum sunspot number can be monitored in the Arctic and in the Antarctic before the beginning of the migration of birds and humpback whales from the Poles to the Continents. Virus, bacteria, phytoplankton, and krill are food web cycles for penguins, migrating birds, and humpback whales. Once the mutant virus generates by the strong UV-B in the Poles, it is impossible to stop the natural transmission of mutant virus to transmitters from birds and whales, and ultimately to humans and cetaceans in the Continents, as happened in the 2020 coronavirus (COVID-19) pandemic. The reduction of CO_2 emissions in the Continents allows the low UV-B radiation in the Poles with a less and weak outbreak of mutant virus due to the decreased ozone hole area (KIM, 2019). Phytoplankton grows beneath the iceberg during the winter of the Poles, which is fed by krill. When phytoplankton is not sufficient enough, krill eats its own body so that the body weight is shrinking. To keep krill healthy enough not infected by mutant virus, a few artificial schemes of phytoplankton supply can attempt at the habitat of Adélie penguins, a vital part of the Antarctic food chain eating krill, in the Antarctic Peninsula. Firstly, phytoplankton blooms are artificially induced during the autumn or early winter in 2029, 2030, and 2031 till 2032 using algal blooming technology proposed by Kim (2018 and 2020) for algal blooms. Secondly, phytoplankton grown by biotechnology above the iceberg, before sea ice melted by climate change, is supplied into the seawater to feed krill and minimize the infection of krill by the mutant virus, generated during the minimum sunspot number (from 2030 to 2032). Such weak mutant virus infecting krill, penguin, migratory birds, and humpback whales can low pathogenically transmit to the Continents in China and USA, located at high CO_2 emissions and middle latitudes with less UV-B radiation. Such schemes may allow us to avoid the terrible pandemic as experienced in 2020.

e) Phenomena of Coming Pandemic in 2031

There were over 130 dead dolphins that were stranded on a beach in Cape Verde (Site number 2 of humpback whale habitat in Fig. 4) near the Canary Islands in West Africa on September 28, 2019 (WARD, 2019).

The ozone hole reached its peak on September 8 and then shrank (NASA, 2019). UV-B radiation also reached its peak. Furthermore, the minimum sunspot number allows the strong radiation (NIH, 1989). Therefore, UV-B radiation is the most powerful during the 11-year cycle of the sunspot number from 2019 to 2020. The highest UV-B radiation on the Poles caused the strongest mutation to cetaceans for CeMV. Humpback whales have 14 common habitat districts segments (NOAA, 2015) including Baja California (Site number 5) and the West Indies (Site number 1 in Fig. 4), with the coasts of the USA, as well as Cape Verde in West Africa, on the migratory routes between 14 breeding habitats and feeding areas of the Poles in Fig. 4. It is most likely that humpback whales, infected by CMV, migrated to the 14 habitats on the Continents, including the USA (Site 1 and 5), China (Site 3) and Cape Verde (Site 2). Infected humpback whales release their CMV-infected feces which are consumed by dolphins so that dolphins in the USA, China, Cape Verde in West Africa and Europe, were infected by CMV and died of pneumonia.

Kim (2019) proposed that the coronavirus (COVID-19) initiated by the stallholders for wet meat of stranded porpoises. The present study, however, suggests that there were 14 starting points of the coronavirus (COVID-19) by the 14 habitat districts (Fig. 4) of the humpback whales (1. West Indies, 2. Cape Verde, 3. China, 4. Hawaii, 5. Mexico, 6. Central America, 7. Brazil, 8. Gabon, 9. Madagascar, 10. Western Australia, 11. Eastern Australia, 12. Oceania, 13. Southeastern Pacific, 14. Arabian Sea). The sudden spread of the coronavirus can cause by the 14 worldwide habitats of humpback whales (Fig. 4) and a wide range of dolphins (Fig. 7) as well as the leather tanning industry (Fig. 12).

On the other hand, Wuhan in China has plenty of water in the Yangtze River and Dongting Lake for migratory birds and cetaceans with warm ambient temperatures. Wuhan is one of the highest CO_2 emitting cities with polluted water. These environments around Wuhan caused the powerful UV-B radiation for the evolutionary mutation from the CMV in cetaceans to the human coronavirus (COVID-19). Chinese people from Wuhan/Wenzhou can be responsible for spreading the toxic leather tanning dye industry around the world, which is one of the significant parameters for the coronavirus outbreak. China should decrease CO_2

emissions as well as water pollution by the elimination toxic chromium salts from the leather tanning industry. More than 130 dead dolphins in Cape Verde in September of 2019 (WARD, 2019) could be the preventive phenomena for the coronavirus outbreak in Wuhan at the end of December 2019, with at least three months lag time. The coming third pandemic in 2031 can prepare in advance by monitoring the 14 habitats in the humpback whale districts, as happened in 130 dead dolphins in Cape Verde in September of 2019 (WARD, 2019). The third pandemic of low pathogenic virus disease may initiate either from China or from the USA in the year of 2031, spreading all around the world either by birds, pigs, and humans (H1N1, USA, 2009) or by cetaceans and humans (COVID-19, China, 2020). Vaccines or medication, such as Tamiflu or Relenza, can be developed during years from 2029 to 2030 with virus samples collected at the Alaska of the Arctic and the Antarctic Peninsula of the Antarctic with the warmest areas by the potent UV-B radiation.

V. Conclusion

Parameters spreading the coronavirus around the world in 213 countries and territories with 6,302,999 coronavirus cases and 375,559 deaths as of June 02, 2020 were investigated. The areas were leather tanning and processing, oil refineries, gas- and coal-powered plants, total ozone and the ozone hole, skin cancer rate, vehicles, population, carbon dioxide emissions, volcanic regions, migratory birds-humpback whales districts, dolphins, and preventive means, including vaccine development and phenomena of coming the third pandemic in 2031. Hydrogen sulfide (H_2S) produces during the processes of the tannery, leather, footwear, textiles, and garment industries, decomposed microorganisms in the metropolitan area, flue gas in the natural gas- or coal-powered plants, stack gas in oil refineries and volcanic gas. Hydrogen sulfide is very toxic, causing pulmonary disease resulting in death and retarding the phytoplankton growth. The appropriate iron fertilization experiment suggests to maximize the availability of dissolved iron (Fe) to phytoplankton for maximal CO_2 consumption by diatoms. There is little variation in total ozone throughout the seasons resulting UV-B radiation acting as a shield, leading to the inhibition of coronavirus activity in the safe tropics area. The coronavirus (COVID-19) casualties can reduce by proper strength UV-B radiation, which can be varied from the low latitude of the equator to the high latitude of the Poles. CO_2 emissions produced by coal-and-gas-powered power plants, oil refineries, vehicle exhaust gas, metropolitan food waste gas, human exhalation, the leather-tannery industry, and the dye industry. On the other hand, CO_2 can minimally consume by the forest and the farmland. Global CO_2 emissions were correlated with the total cases (R^2=0.6693) and deaths (R^2=0.7081. European CO_2 emissions were correlated with total cases (R^2=0.6142) and with deaths (R^2=0.4763). USA State CO_2 emissions were correlated with total cases (R^2=0.6065) and with deaths (R^2=0.4401). USA State oil refinery capacity producing CO_2 gases in stack gas was correlated with total cases (R^2=0.4003) and with deaths (R^2= 0.6413). The global vehicle number producing CO_2 exhaust gases was correlated with total cases (R^2=0.6068) and with deaths (R^2=0.6313). Global population number producing CO_2 gases as human exhaling gas was correlated with total cases (R^2=0.6373) and with deaths (R^2=0.4642). CO_2 emissions from various sources have increased the UV-B radiation on Earth. The sunspot number from 1979 to 2019 was reversely proportional to the ozone hole area (million km^2) with R^2= 0.2668. It is important to monitor the sunspot number, especially when approaching the period of minimum sunspot number, to prepare for the effects of another cyclic minimum sunspot number in 2031. It expects that serious outbreaks of viruses occur in 2020 plus 11 years later of 2031 as the third pandemic via either humans, birds, cetaceans, pigs, or other species. Cetaceans such as humpback whale/dolphin/porpoise were proposed as the initial transmitters of 2012 MERS-CoV stranded in the Persian Gulf coast in Saudi Arabia as well as of the 2020 coronavirus (COVID-19) stranded in the Yangtze River in China, respectively. Migratory flyways of wild bird overlap with the routes of migratory humpback whales to suggest that AIV may be transmitted, not only by commonly known migratory birds flyways, but also by humpback whales habitats. Dolphins cover most of the seawater in the world, which agrees well with results that there were sudden increases in global coronavirus cases. It postulates that cetaceans, including whales, dolphins, and porpoises transmit the globe with the coronavirus (COVID-19) pandemic in over 213 countries and territories. The humpback and gray whale breeding areas were infected by the coronavirus (COVID-19) in 2020 during the minimum sunspot number. Such infected whales released their evolutionally mutant virus of the coronavirus-infected feces, leading to the spread of the coronavirus on the US coastline after it had originally appeared in Wuhan in China. The coronavirus might not come from China, rather COVID-19 as an evolutionary virus from CMV spread to humans from the multi-sources of 14 humpback whale habitats around the world. China having good environments for the coronavirus outbreak, such as rich water, warm weather, highest CO_2 emissions, 4,000 industrial factories, Wenzhou people for toxic leather tannery and textile coloring, might allow the earliest emergence of the coronavirus in China among 14 humpback whales districts. Transmission of the coronavirus through the leather industry via people coming from Wenzhou/Wuhan in China to high CO_2 emission countries including Milan in Italy, metropolitan areas of

New York City in the USA, Madrid in Spain, Paris in France, Bavaria in Germany, London in the UK, Istanbul in Turkey, Tehran in Iran and Tokyo in Japan. CO_2 emissions and H_2S gases from people, vehicles, oil refineries, gas- or coal-powered plants, factories-leather, tanning, textiles, garments, footwear, and organic dyes, cause the increase of the ozone hole area and UV-B radiation (UVR) in the Earth, leading to the increase of virus mutation for the coronavirus. Coronavirus confirmed cases and deaths were linear to vehicle numbers as R^2= 0.5846 and R^2=0.4281, respectively. Total coronavirus cases by country were linearly proportional to oil refinery capacity by country as R^2= 0.5136 for the total cases and R^2= 0.4874 for the deaths, respectively. Major leather chemicals suppliers are all the major countries with coronavirus cases. Bovine hide productions in each leather country were correlated with the total coronavirus cases (R^2=0.6922) and the total coronavirus deaths (R^2= 0.8514), respectively. Carbon dioxide emissions are proportional to coronavirus cases. Upper rivers deteriorate by tannery chemicals to cause the coronavirus casualties, as were at the Yangtze River in Wuhan, China, the Po River in Milan in Italy, and the Hudson River in New York City. The values of total ozone are the lowest in the tropics in all seasons because the thickness of the ozone layer is smallest there (www.theozonehole.com/twenty.htm), with little variation of the total ozone in the tropics (20°N-20°S latitudes) leading to high ultraviolet-B radiation, creating a safe zone from the coronavirus outbreak. The UV-B radiation is the most simple, safe, cheap and efficient method to kill the coronavirus itself. The virus is not active at temperatures above 55°C and relative humidity of above 40% with a heater, humidifier, and UV-B radiator installed together to expel the coronavirus. Consuming Indian curcumin as often as possible is recommended to protect the pulmonary alveolus from the coronavirus attack. Organic dyes altering the color of textiles and leather, are the most critical parameters causing the coronavirus. The number of European leather industry companies in Sweden, the United Kingdom, Germany, France, Italy, Spain, and Romania showed the linear relationship (R^2= 0.7826) with coronavirus cases. UV-B radiation is the strongest during the 11-year cycle of the sunspot number from 2019 to 2020. The highest UV-B radiation on the Poles caused the strongest mutation to cetaceans for CMV. Humpback whales have 14 common habitat districts segments including Baja California (Site 5) and the West Indies (Site 1), with the coasts of the USA, as well as Cape Verde in West Africa, on the migratory routes between 14 breeding habitats and feeding areas of the Poles. Humpback whales, infected by CMV, migrated to the 14 habitats on the Continents, including the USA (Site 1 and 5), China (Site 3) and Cape Verde (Site 2) for West Africa and Europe. Infected humpback whales release their CeMV-infected feces, which are consumed by dolphins so that dolphins in the USA, China, Cape Verde in West Africa and Europe, were infected by CMV and died of pneumonia. The present study suggests that there were 14 starting points of the coronavirus (COVID-19) by the 14 habitat districts of the humpback whales (1. West Indies, 2. Cape Verde, 3. China, 4. Hawaii, 5. Mexico, 6. Central America, 7. Brazil, 8. Gabon, 9. Madagascar, 10. Western Australia, 11. Eastern Australia, 12. Oceania, 13. Southeastern Pacific, 14. Arabian Sea). The sudden spread of the coronavirus could cause by the simultaneous transmission of COVID-19 from 14 worldwide habitats of humpback whales, linked to millions of dolphins as well as the global leather tanning industry. The third pandemic of low pathogenic virus disease may be initiated either from China or from the USA in the year of 2031, spreading all around the world either by birds, pigs, and humans (H1N1, USA, 2009) or by cetaceans and humans (COVID-19, China, 2020). Vaccines or medication, such as Tamiflu or Relenza, can be developed during years from 2029 to 2030 with virus samples collected at the Alaska of the Arctic and the Antarctic Peninsula of the Antarctic with the warmest areas by the strong UV-B radiation. The preventive phenomena for the third pandemic in 2031 can be monitored at 14 habitats in the humpback whale districts, as happened in 130 dead dolphins in Cape Verde in September of 2019, at least three months earlier than COVID-19 in Wuhan in China. UV-B radiation is the most simple, safe, cheap, and efficient method to kill the coronavirus itself.

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Result of the Threshold Test for Saltiness Perception of 35 People Who Participated in the Saltiness Test using Test-Disk at the University Festival

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Abstract- Hypertension is one of the causes of many lifestyle-related diseases. In Japan, too, we are raising awareness about dietary salt reduction for hypertensive patients. Therefore, the purpose of this study was to understand the results of the salty cognitive threshold test in a wide range of age. This result can be useful data for future salt reduction instruction. Thirty-five people participated in the saltiness cognition threshold test at the university festival. The participants this time had a wide range of ages from the teens to the eighties. Participants answered that they eat out 2-3 times a week. Also, they said that the seasoning they liketo eat is a little salty. Most participants (88.6%) perceived saltiness below 1.25%. Four participants (one male and three females) recognized saltiness in 5.0%. There was no participant didn't recognize the saltiness of all. In the future, it will be better to conduct a questionnaire survey on dietary habits and compare it with the saltiness cognitive threshold test results.

Keywords: *saltiness test, cognition, threshold, test-disk, university festival.*

GJMR-K Classification: *NLMC Code: W 20.5*

Strictly as per the compliance and regulations of:

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Keywords: saltiness test, cognition, threshold, test-disk, university festival.

I. Introduction

The target daily intake of salt in the world is 6g or less. However, in Japan, the desirable daily intake of salt for adult males is 7g or less, and females it is 6.5g or less. The target amount of salt intake per day may be higher than in the world, but it is very hard for Japanese people to lower the salt intake to this level. However, from the perspective of preventing high blood pressure, the Japanese continue to make every effort to keep this target. Therefore, the purpose of this study was to collect data on the threshold level of salt concentration cognition using Taste-disks for neighboring residents who participated in the university festival and to use it as future data.

II. Materials and Methods

a) Participants

Participants were 11 males and 24 females. Table 1 shows the distribution of the participant's gender and age.

Table 1: Participant gender and age composition (number of participants)

	10's	20's	30's	40's	50's	60's	70's	80's
Male (n=11)	**7**	**0**	**1**	**2**	**0**	**1**	**0**	**0**
Female (n=24)	**5**	**10**	**0**	**5**	**1**	**2**	**1**	**0**
Total (n=35)	**12**	**10**	**1**	**7**	**1**	**3**	**1**	**0**

b) Assessment of salt taste identification

Participants were subjected to a salty cognitive threshold test using Taste-disc (made by Sanwa Chemical Research Institute). The saltiness test started from a light taste and tried a strong taste in order. The saltiness test starts form 0.3%, and the concentration increases in 5 steps up to 20.0% (0.3%, 1.25%, 5.0%, 10.0%, 20.0%). Participants placed the salt-soaked disc on the chords innervation area 2cm above the below the tongue for 3 seconds to confirm the taste. And then, participants answered to the inspector what the teste was. The inspector recorded the answers of the participants.

We also conducted a questionnaire survey on dietary habits. There are four questions, 1) Does saliva comeour? 2) Do you feel the taste? 3) Frequency of purchase of restaurants and commercial food, 4) Regular seasoning (for food was salty or thin) (Table 2).

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Table 2: Questionnaire about subjective teste (Circle te applicable answer items)

	Question1	Question2	Question3	Question4
	Saliva secretion	Fee of the taste	Rrequency of purchase of restaurants and commercial products	The taste of the meal you usuallyu eat
1	Well secreted	Well feel	Almost every day	Strong taste
2	secreted	feel	4-5 times a week	Slightly dtrong taste
3	not secreted	not feel	2-3 times a week	Slightly light taste
4	so not know		once a week	Light taste
5			2-3 a month	
6			Hardly used	

c) Ethical review board

This study conducted with the approval of the Ethics Committee (Nagoya women's university 'hito wo mochiita kennkyuu ni kansuru iinnkai'). The approval number is 30-14.

III. Results

a) Saltiness recognition test result

The age distribution of the participants was seven in the teens, two in the '30s, two in the '40s, and one in the'60s, for a total of eleven males. The age distribution of the participants was five in the teens, one in the '20s, seven in the '40s, one in the '50s, three in the '60s, and one in the '70s, for a total of 24 females. Table 3 shows the results of the salty cognitive threshold test. Nine participants (four males and five females) recognized saltiness at the lowest saltiness concentration of 0.3%. Twenty-two participants (six males and 16 females) recognized saltiness in 1.25%, and four participants (one male and three females) recognized saltiness in 5.0%. The acceptable range (what we call the normal range) was 31, with 88.6% of the total. There was no participant didn't cognition of the saltiness of all (To see Table 4 and Table 5).

Table 3: Saltiness perception threshold test (TASTE DISC) results (number of participants

	0.30%	1.25%	5.00%	10.00%	20.00%	20.0% or more
Male (n=11)	4	6	1	0	0	0
Female (n=24)	5	16	3	0	0	0
Total (n=35)	9	22	4	0	0	0

Table 4: Saltiness recognition threshold test (TASTE DISC) result judgment (number of perticipants)

	Normal	Observation	Consultation
	0.3%－1.25%	5.0%－10.0%	20.0% or more
Male (n=11)	10	1	0
Female (n=24)	21	3	0
Total (n=35)	31	4	0

Table 5: Saltiness recognition threshold test (TASTE DISC) t result judgment (%)

	Normal	Observation	Consultation
	0.3%－1.25%	5.0%－10.0%	20.0% or more
Male (n=11)	90.00%	9.10%	0.00%
Female (n=24)	87.50%	12.50%	0.00%
Total (n=35)	88.60%	11.40%	0.00%

The four participants recognized at a salty concentration of 5.0% were a 45-year-old male, two 21-year-old females, and a 68-year-old female (to see Table 6).

Table 6: Breakdown of people whose salt cognition threshold test (TASTE DISC) results are outside the normal range

Observation		Consultation	
5.00%	10.00%	20.00%	20.0% or more
male age 45			
female age 68			
female age 21			
female age 21			

b) Questionnaire results

The results of the questionnaire shown in Table 7-10. Most participants (n=32) answered that salivary secretion was very good (see Table 7). Twenty-two participants answered that taste detection was very well, and 12 participants answered that taste detection was well (see Table 8). The frequency of eating out was the large number of participants 2-3 times a week, with 19 (five males and 14 females) participants (see Table 9). Most of the participants (seven males and 16 females) answered that the food that they usually like to eat is light salty (see Table 10).

Table 7: Questionnaire survey items Question 1 (Saliva secretion)

	Very well	Well	Not good	Do not know	No answer
Male (n=11)	10	0	0	0	1
Female (n=24)	22	1	1	0	0

Table 8: Questionnaire survey items Question 2 (Taste perception)

	Very well	Well	Not good	No answer
Male (n=11)	8	2	0	1
Female (n=24)	14	10	0	0

Table 9: Questionnaire survey items Question 3 (Use of restaurants and commercial food)

	every day	four or five times a week	two or three times a week	once a week	two or three times a month	Hardly used	No answer
Male (n=11)	2	3	5	0	0	0	1
Female (n=24)	0	0	14	4	6	0	0

Table 10: Questionnaire survey items Question 4 (Favourite food salt taste)

	Strong salt taste	rather strong salt teste	rather light salt teste	light salt taste	No answer
Male (n=11)	1	7	2	0	1
Female (n=24)	0	16	5	1	2

IV. Discussion

Participants ranged in age from 10's to 80's. However, no one could understand the taste unless it had a strong salty taste. Four participants felt the taste with a slightly salty teste, and the age ranged from '20s to '80s. Many participants replied that the usual seasoning was a little bit strong, and it may be necessary to teach how to reduce salt. Since most participants responded that they eat out 2-3 times a week, it may be well to guide them in choosing a diet with low salt content. Based on these results, it is better to conduct a detailed questionnaire survey on dietary habits in the future and compare it with the results of the usual seasoning and salty cognitive threshold test. Since salt reduction helps prevent high blood pressure[1,2,3,4]) and other lifestyle-related diseases, we would like to continue to raise awareness. It has reported from inside and outside[5, 6]) of Japan that the effect of salt reduction can applied to both young[7]) and old people[8, 9]). It has also reported that guidance on salt reduction is effective[10.11]). We would like to provide recipes for cooking meals with low saltiness, hold cooking classes, and teach how to reduce salt.

V. Conclusions

We reported the results obtained from 35 people who participated in the saltiness cognition threshold test at the university festival. The participants this time had a wide range of ages from the teens to the eighties. The salty cognitive threshold test performed using a Taste-Disc. As a result, 88.6% of participants were able to perceive saltiness at a concentration of 1.25% or less. Participants responded to the questionnaire that they had well saliva secretion and taste. Participants answered that they eat out 2-3 times a week. Also, they said that the seasoning they like to eat is a little salty. In the future, it will be better to conduct a questionnaire survey on dietary habits and compare it with the saltiness cognitive threshold test results. We also thought it would be good to increase the number of participants and consider them.

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The Social and Cultural Factors Affecting Obesity Rates in America

By Meghan Harduk

Introduction- Obesity is a national epidemic in the United States (4). Obesity is determined by BMI, dividing height (kg) by weight (m^2). These measures are taken to determine weight status which can either be Underweight (<18.5 kg/m^2), Normal Weight (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2) or Obese (30.0 and above kg/m^2). Starting around the 1970s and 80s, we start to see an increase in obesity rates within the United States, as shown in Figure 1. Through the use of NHANES and other national surveys, we see not only increases in obesity but also extreme obesity. Adult obesity was only 13.4%, and child obesity was 5% in 1980. (53, 55).

Today, adult obesity has risen to an alarming 39.6%, and childhood obesity has risen to 18.5%. These figures are1 in every three adults, and 1 in every six children (4, 72). We can see that the South has the highest obesity rates at 33.6%, as displayed in Figure 2. There are disparities in obesity rates depending on your age, gender, race, education, socioeconomic status, and the built environment one lives within. Blacks (46.8%) and Latinos (47.0%) have higher obesity rates than Whites (37.9%) and Asians (12.7%). These numbers are consistently disproportionate across both adults and children (3, 23, 72).

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I. Introduction

Obesity is a national epidemic in the United States (4). Obesity is determined by BMI, dividing height (kg) by weight (m^2). These measures are taken to determine weight status which can either be Underweight (<18.5 kg/m^2), Normal Weight (18.5-24.9 kg/m^2), Overweight (25.0-29.9 kg/m^2) or Obese (30.0 and above kg/m^2). Starting around the 1970s and 80s, we start to see an increase in obesity rates within the United States, as shown in Figure 1. Through the use of NHANES and other national surveys, we see not only increases in obesity but also extreme obesity. Adult obesity was only 13.4%, and child obesity was 5% in 1980. (53, 55).

Today, adult obesity has risen to an alarming 39.6%, and childhood obesity has risen to 18.5%. These figures are1 in every three adults, and 1 in every six children (4, 72). We can see that the South has the highest obesity rates at 33.6%, as displayed in Figure 2. There are disparities in obesity rates depending on your age, gender, race, education, socioeconomic status, and the built environment one lives within. Blacks (46.8%) and Latinos (47.0%) have higher obesity rates than Whites (37.9%) and Asians (12.7%). These numbers are consistently disproportionate across both adults and children (3, 23, 72). Adult women are more like to be obese at 41.1% in comparison to adult males at 37.9% (23). Adults with a college degree are less likely to be obese than those with only a high school diploma (22.2% vs. 33.1%), and both are less obese than those who do not have a high school diploma (35.0%) (2, 3, 23). Tied to education are socioeconomic status and financial income. Individuals with a higher income are less likely to be obese in all of the groups mentioned above at about 29.7% (2, 3, 23). The physical environment of where individuals live also can impact their obesity rates. Those living in more rural areas are more likely to be obese compared to those in metropolitan areas, 34.2%, and 28.7%, respectively (23, 72). The age of an individual also says a lot about obesity prevalence. Middle aged to older adults are more obese (42.8% and 41.0%) when compared to young adults (35.7%) (2, 3). Moreover, one of the most striking statistics is that of childhood obesity. Childhood obesity has increased drastically over the years at alarming rates among all groups and all income levels all over the world. The US is estimated to have some of the highest obesity and overweight levels in the world, seeing an increase last year to 18.4% of overweight children ages 5-19 years old (36). Of children ages 2-19 years in the US, 16.9% qualified as obese (4, 54).

These numbers are especially troubling because of associations with negative health outcomes. Individuals suffering from obesity are at higher risks of several other diseases. This includes: diabetes, cardiovascular disease, hypertension, strokes, certain cancers, mental illness, and many more (1, 4, 36). Thus, it is critical to gain a better understanding of the causes of obesity, including those derived from socio-cultural circumstances such as class, race, gender, region, or age.

African Americans ages 18-49 years are twice as likely to die from heart disease or stroke in comparison to their white peers. African American men and women are more than 40% more likely to suffer from high blood pressure and 80% more likely to be diagnosed with diabetes, both of which are risk factors for other health problems (51, 52). Asian Americans suffer at lower rates of obesity (12.7%) but still suffer from obesity-related diseases. Asian Americans are 10% more likely to be diagnosed with diabetes in comparison to whites. Roughly 20% of Asian Americans have high blood pressure with 6% having coronary heart disease (39, 45, 46). Hispanics are at higher rates of obesity (47.0%) compared to their white peers. Hispanic adults are diagnosed with diabetes 12.2% of the time compared to their white peers at 7.3%, which is almost 2x as high (47, 48, 49, 50).

So why do we see such disparities in obesity rates from the past to now and between groups? Several reasons have contributed to the rising obesity rates over the past few decades. Let's first take a look at food and how it has changed over the past few years. Compared to the 1970s, Americans consume more food away from home at restaurants and fast food establishments. When food is consumed at home, less time is spent on cooking. Americans spend more money on fast food now compared to the 1970s (32). Foods prepared away from home are higher in calories, saturated fats, sodium, cholesterol, and carbonated soft drinks. Inversely, they contain fewer vitamins, minerals, fiber, fruits, vegetables, and milk. A few studies also found that more calories came from additional snacking (e.g., salty snacks, cheeseburgers, pizza) throughout

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the day, especially in adolescents (22, 41, 42, 57, 65, 67).

Consuming larger portions of food signifies an increase in total calories consumed. Individually or combined with a decrease in energy expenditure (i.e., physical activity and exercise), individuals gain more fat mass and can become overweight and obese (40, 61, 62, 76). We've collectively agreed that portion sizes over the years have increased. Now we have to empirically prove that sizes have indeed changed. Many researchers have been interested in this question and decided to empirically prove (or disprove) the commonly accepted belief about portion sizes. Portion size information was obtained from companies from the past and the present. Having the size difference information, the studies were able to analyze factors of change like total calorie intake, sodium, cholesterol, vitamins, minerals, carbonated beverages, etc. The research indicates increased consumption of "bad" foods and decreased consumption of "healthy" foods. Since the 1970s, individuals are eating higher amounts of sodium, cholesterol, saturated fats, etc., and fewer amounts of fresh fruits, vegetables, etc. Alongside this change in the type of food consumed, these studies found that portion sizes have increased over time, some even being 2-3x as big as the original food product. This size increase has been noted inside and outside the home. It is not just a problem when dining in a restaurant, it is a societal issue (40, 61, 65, 66, 76). However, obesity is not a uni-causal issue. The multi-level complexity of obesity encompasses both the change in the type of food consumed as well as the portion size of foods consumed, but they are only pieces of a much bigger puzzle.

Another piece of this puzzle is sedentarism. Sedentary behavior is characterized as an individual spending excess time in low energy expenditure activities like sitting or lying down and very little time in moderate to vigorous energy expenditure activities (20, 26). Sedentary behavior and physical activity and exercise are inversely related. As sedentarism increases, physical activity and exercise decrease. There has been major concern in the scientific community as well as the public regarding overweight and obese individuals. As America has seen a great increase in overweight and obese individuals, we have also seen rises in other related health conditions such as cardiovascular disease and diabetes. Both sedentarism and a lack of physical activity and exercise have been linked to obesity and other related diseases (25, 26, 34, 56).

Several factors contribute to sedentary behavior, including jobs and technology. Back in the 1960s and 1970s, America was a massive agricultural society. Farming is a laborious job that requires a lot of moderate-to-vigorous physical activity. Since that time, we have seen an occupational shift to desk jobs, i.e., sedentary jobs (15). The American Heart Association estimates sedentary jobs have increased by 83% since 1950 (16, 71). A decrease in the amounts of moderate-to-vigorous physical activity follows the rise of sedentary jobs. One study estimated that there has been an average decrease of 100 calories per day in job-related energy expenditure compared to 50 years ago (11). Approximately 13.7% of jobs require "heavy work," according to the U.S. Bureau of Labor Statistics (8). The 13.7% of heavy work jobs here were related to construction and other related forms of manual labor. At the same time, approximately 13.5% of jobs are sedentary, with the most prevalent being legal and administrative positions. This occupational shift has contributed to the rising levels of sedentary behaviors and, consequently, obesity.

In addition to occupational shifts, we have also seen an increase in technology. The television (TV) had been invented back in the late 1920s by Philo Farnsworth. Still, it didn't gain popularity until the 1950s, after World War I. TV had become one of the most popular forms of entertainment and user consumption grew drastically. This rise led to approximately 12 million homes having a TV by 1951 (70, 78). Today, leisure activities include watching tv, browsing on other screens (computers, phones, tablets, etc.), or playing video games. Not only do we see increases in sedentary leisure-time behaviors, but we see a decrease in physical activity leisure time (11, 15). A study of 6,329 participants found that people spend more than half their time (54.9%) in sedentary behaviors – that is approximately 7.7 hours per day (in an averaged 13.9-hour day) (35, 71). In addition to TV and phones, we also see a rise in technological progress regarding transportation, namely automobiles (aka cars). Cars became popular in the early 1900s through historical figure Henry Ford. As popularity increased, the need for roadways and interstates grew. In 1956, President Eisenhower signed the Interstate Highway Act, creating thousands of miles of highway across the country (18). This increase in car mobility has added to the rising rates of sedentarism.

An increase in sedentarism has contributed to the rising obesity rates, but inversely we see a decrease in physical activity as another contributor to rising obesity rates. These rising inactivity levels are associated with higher risks for obesity and other health-related diseases (20, 25, 26, 34, 56). The U.S. Department of Health and Human Services has issued a *Physical Activity Guidelines* booklet, highlighting the recommended minimum physical activity requirements to stay healthy. For adults, this includes 150 minutes-300 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic exercises plus 2+ days of muscle-strengthening activities - involving all the major muscle groups -each week (74). Less than 25% of Americans are meeting both aerobic and muscle-strengthening guidelines (Figure 3). Approximately 28%

of Americans meet muscle-strengthening guidelines alone, and 37.4% meet aerobic guidelines alone (10, 74).Again, we see disparities in one's physical environment (Colorado is the most physically active), age (55+ are less active than younger adults), race (Hispanics are the least active), gender (males are more active), education (college graduates are the most active), and socioeconomic status (lower incomes are less active).

With this overall decline in physical activity, we also take note of the decline in sport participation, especially in adolescents. The Aspen Institute and the Sports & Fitness Industry Association (SFIA) partner together to gather data on youth participation through Project Play, which focuses on kids ages 6-12. The data shows the overall percentage of kids who played a team sport regularly has decreased from 41.5% in 2011 to 37.0% in 2017 (28, 31). Interestingly enough, the percent of team sports has increased (from 55.5% to 56.5%) while the percent of individual sports has decreased (73.0% to 69.1%). There is a difference in male vs. female participation rates, although the percentage of female participants has increased from 49.4% to 52.3% (compared to males from 61.3% to 61.9%). Income status also affected youth sport participation. In general, lower-income status children participate less in sport. One study looked at the commitment to sports and observed tennis players and their club memberships. They found that skill level was a major factor in the level of commitment an individual had in playing the sport (9). Another study done in the South Caucasus proposed that family culture was a major source of influence on sport participation before the age of 16 (6).

It is proposed that while all the issues above contribute to obesity rates, they are all connected to and influenced by one's social class. An individual's social class, referred to as one's socioeconomic status, is often measured by their income, education, and occupation (68). These factors heavily impact the decisions to be made by individuals regarding their diet and activity. Many studies have found that social class does impact rates of obesity, with higher rates in girls than boys (19, 30, 38). For example, an individual on a strict budget won't have time or money to spend on gym memberships, groceries, or houses/apartments near playgrounds or walkways. If an individual cannot afford to be near physical activity promoting infrastructure, will they be encouraged to be physically active?

Obesity, physical inactivity, sedentarism, unhealthy diets – it is obvious we have a problem. With these rising rates of unhealthy behaviors, we see negative health consequences arising that are affecting the livelihood and well-being of Americans. What are we supposed to do then? The obesity epidemic and all the health issues that follow it are rising and harming people's lives. How do we propose to stop it? There are two aspects of this we need to address: societal changes and personal changes. As individuals, we are responsible for the decisions that we make. We are capable of choosing healthier options that can improve the odds of health problems. We also see the need for society to change, given we have certain structures and institutions in play that feed the obesity epidemic. It is therefore imperative that medical and health professionals address both sides of this issue, including both physical activity and diet behaviors, on a personal and societal level (27).

First, let's look at some personal decision's individuals can make to improve their health and decrease their risks of obesity and other health problems. Simply put, Americans need to become more physically active. While this does include exercise, it more broadly includes physical activity, which is activity throughout a day. This is compared to small, high energy bursts of exercise at the end of an 8-hour workday, having sat at a desk, staring at a computer screen. As we've seen before, sitting too much is dangerous for our health, yet we do it far too often. Changing our sitting habits is a necessity (7, 21). Leaving your desk to move around more often on breaks is suggested to disrupt the amount of time we spend sitting (especially those with desk jobs). We can also make small decisions like taking the stairs, walking farther in a parking lot, or biking or walking to places instead of driving. These are small, simple changes that could drastically change how physically active we are. There is evidence to suggest that holding membership in a club sport also increases your overall physical activity (77). Holding the membership is good, but the relationships formed in that group are vital to the continuation of an individual playing that sport. Whether friends or family are encouraging group membership, our relationships influence our motivations and desires to engage in physical activity (73). Physical activity not only helps with the obesity crisis but can encourage positive psychological and social health (13).

While there are many personal decisions an individual can make to become more active, there are also societal changes that can improve rates of activity when implemented. One of the most popular issues here is recess. Over the past few years, we have seen a decrease in time allotted for recess, a time for children to have unstructured playtime to "burn off" their energy after sitting in a classroom all day. Several laws (e.g., No Child Left Behind Law, Every Student Succeeds Act) passed within the past 20 years have taken a focus more on education than on physical activity. This focus towards course curriculum has forced educators to decrease the amounts of time in physical activity to prepare their students for upcoming mandatory testing despite research informing us of the benefits of recess, especially unstructured playtime (14, 29, 43). Research has looked into not only allotting time for children to have recess, but also the provision of equipment.

Children tend to be more active during recess and after school when they are encouraged by their teachers and given access to equipment that aids in free-time play (5, 58, 59, 75). The conclusion here is to bring back recess in appropriate amounts to balance both the physical activity and the educational needs of children.

Another societal change to observe in physical activity is infrastructure. Individuals are influenced by their environment. A city built to be more active will see people become more active, whereas a city built to accommodate technological advances may prove to be more dangerous for the occurrence of physical activity. Some examples of infrastructure could be sidewalks, bike lanes, parks/playgrounds, etc. For cities that do not build these infrastructures into their city plan, not only is it more dangerous for people to be active (having to walk/run on the road, children playing in the streets), but it doesn't promote physical activity. Many studies have looked at infrastructure and generally find that places without these infrastructures in place tend to promote inactivity (12, 17, 33).

Obesity is multi-causal. Physical activity is good, but only a piece of the solution. We also have to consider the diet aspect of obesity. As we have previously seen, Americans are over-consuming in amounts and types. Many studies have observed the changes that occur when small changes are made to diet (they also increase physical activity). These studies most commonly decrease sugar intake (60). The time of day food eaten is another factor being explored. Sofer, Stark, and Madar (2014) conducted a study regarding the time of day and suggested that timing (and what is consumed at that time) might play a big role in abdominal obesity (69). Researchers have also explored different types of diets (e.g., Mediterranean Diet) to find associations between diet and decreased obesity and disease rates (37). While many of these studies are promising in providing possible solutions, it is ultimately up to the individual to enact these changes in their own life.

The 2015-2020 Dietary Guidelines for Americans help to outline a healthy diet for Americans to follow by reducing the bad and increasing the good. These national guidelines put forth by the U.S. Department of Health and Human Services are an effort to provide directions for Americans to make healthy personal decisions regarding their diet (24). It is up to an individual to decide how much, what type, where, and when to eat. But we can provide resources for individuals to consider when they are making this choice.

Studies have observed when small changes are implemented in the diet, like reduced sugar intake, the health and well-being of individuals increases. In response to this, many have posed the question of taxing sugar to help reduce rising rates of obesity. Some countries have started implementing this (63, 64). However, the effectiveness of this tactic is questioned. It does not appear to bring out the desired effect. Instead of imposing negative consequences on undesirable behaviors, society should focus on discouraging these behaviors while encouraging and emphasizing positive, healthy behaviors.

Certainly, this is not an exhaustive list of problems and solutions. The obesity epidemic is a complex situation that requires a complex answer. It does cause one to ponder, however, why some of these changes occurred in the first place. We noted that increased portion sizes and the use of saturated fats and sugars have contributed to the growing obesity problem. In comparison to the 1950s, we consume larger portions and foods laden with calories but lacking appropriate nutrients. Why? There are so many studies looking at the effects of portion size and food type, but there are none to show why the nation started making these changes in the first place. What caused the shift in our diets? We see the reasons for shifts in physical activity and exercise, but we have not seen the reasons behind restaurants and families increasing portion sizes. Future research should include these questions as part of their study. If we are unable to locate the source of the problem, how do we expect to fix it? One cannot treat an issue symptomatically and assume the underlying cause will be cured. Understanding the reasons why these changes occurred can help to produce a whole solution versus the symptomatic solutions we currently have.

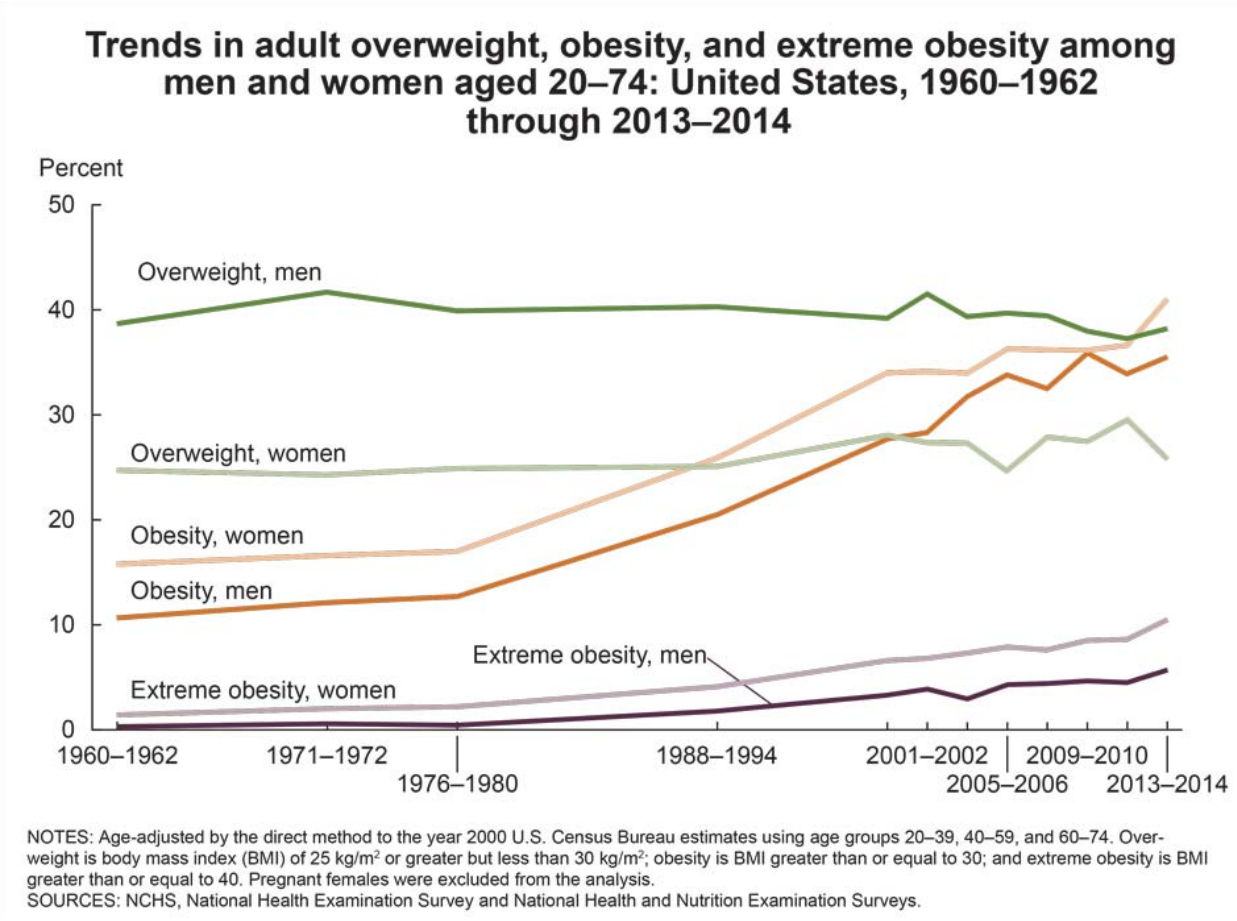

Figure 1: Obesity Trends in America Over Time

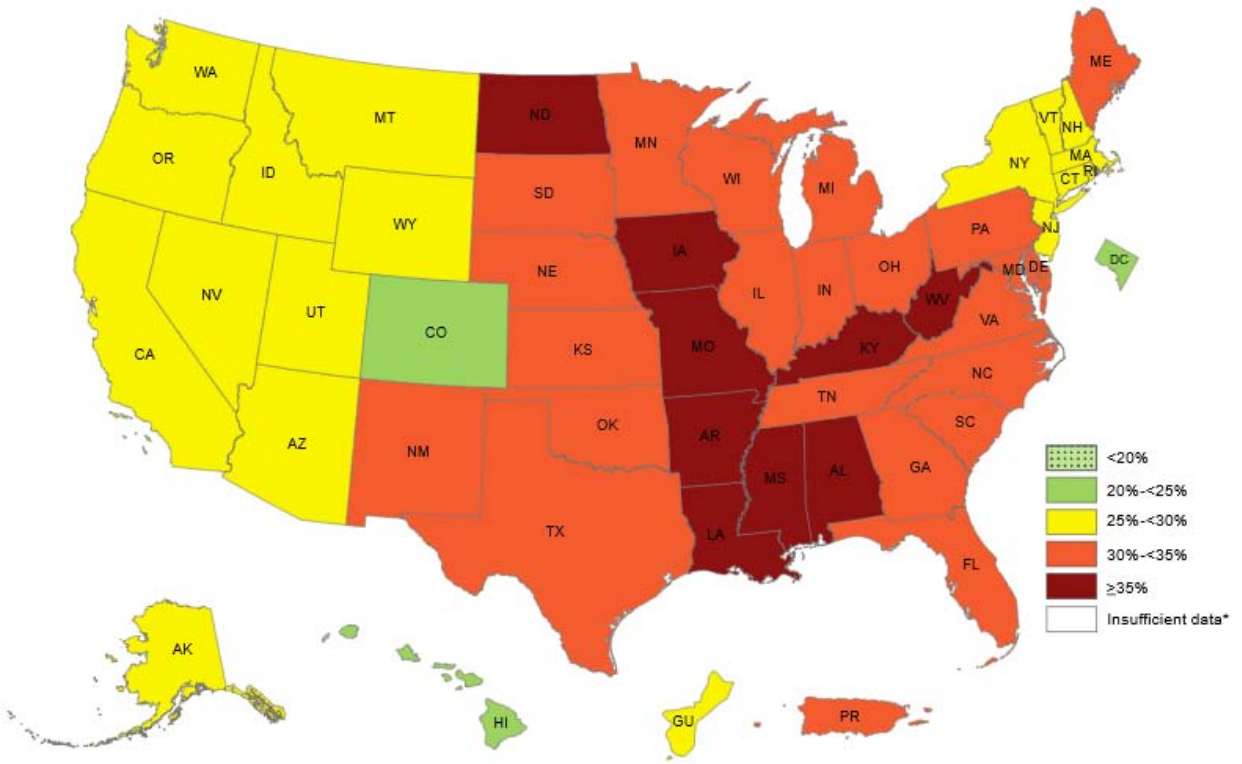

Figure 2: Obesity Prevalence in the US 2018

2008 Physical Activity Guidelines for Americans

Trends in Meeting the 2008 Physical Activity Guidelines, 2008—2018 Percentage (95% Confidence Interval)												
2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Overall Trend*	Period-Specific Trends*
Adults engaging in no leisure-time physical activity												
36.2 (35.0-37.4)	32.3 (31.3-33.3)	32.4 (31.5-33.3)	31.6 (30.7-32.5)	29.6 (28.8-30.5)	30.3 (29.5-31.1)	30.0 (29.1-30.9)	30.0 (29.2-30.9)	26.9 (25.7-28.1)	25.9 (24.6-27.2)	25.4 (24.3-26.6)	↓ -0.9/year	None
Adults meeting minimum aerobic physical activity guideline—Moderate-intensity for ≥ 150 minutes/week, or vigorous-intensity for ≥ 75 minutes/week, or an equivalent combination												
43.5 (42.4-44.6)	47.2 (46.2-48.2)	47.1 (46.2-48.0)	48.8 (47.9-49.7)	50.0 (49.1-50.8)	49.9 (49.1-50.8)	49.9 (49.0-50.8)	49.8 (48.9-50.6)	52.6 (51.5-53.7)	54.1 (52.9-55.2)	54.2 (53.2-55.3)	↑ 0.9/year	None
Adults meeting high aerobic physical activity guideline—Moderate-intensity for > 300 minutes/week, or vigorous-intensity for > 150 minutes/week, or an equivalent combination												
28.4 (27.5-29.4)	31.2 (30.4-32.1)	31.7 (30.9-32.5)	33.1 (32.4-34.0)	34.3 (33.5-35.1)	34.3 (33.5-35.2)	34.0 (33.2-34.9)	33.6 (32.7-34.4)	35.9 (34.9-36.9)	37.0 (36.0-38.1)	37.4 (36.4-38.4)	↑ 0.7/year	↑2008-2012 (1.3/year) ↔ 2012-2015 ↑2015-2018 (1.2/year)
Adults meeting muscle-strengthening guideline—Muscle-strengthening activities ≥ 2 days/week												
21.9 (21.2-22.7)	22.6 (21.8-23.3)	24.2 (23.4-24.9)	24.2 (23.5-24.9)	23.9 (23.2-24.5)	24.1 (23.4-24.9)	24.4 (23.7-25.2)	24.8 (24.2-25.5)	26.0 (25.1-26.9)	27.7 (26.8-28.6)	27.6 (26.8-28.5)	↑ 0.5/year	↑2008—2010 (1.1/year) ↔ 2010—2014 ↑2014—2018 (0.9/year)
Adults meeting guidelines for aerobic physical activity and muscle-strengthening activity												
18.2 (17.5-19.0)	19.0 (18.3-19.7)	20.6 (19.9-21.3)	20.8 (20.2-21.5)	20.6 (20.0-21.2)	20.8 (20.1-21.4)	21.3 (20.6-22.0)	21.4 (20.8-22.1)	22.5 (21.7-23.3)	24.3 (23.5-25.2)	24.0 (23.2-24.9)	↑ 0.5/year	None
Adolescents meeting aerobic physical activity guideline—Physically active ≥ 60 minutes per day on 7 days/week												
-	-	-	28.7 (27.1-30.3)	-	27.1 (25.5-28.8)	-	27.1 (25.4–28.8)	-	26.1 (24.1–28.3)	-	↔	None
Adolescents meeting guideline for muscle-strengthening activity—Muscle-strengthening activities on ≥ 3 days/week												
-	-	-	55.6 (53.6-57.5)	-	51.7 (49.6-53.9)	-	53.4 (51.1–55.6)	-	51.1 (47.5–54.7)	-	↔	None
Adolescents meeting guidelines for aerobic physical activity and muscle-strengthening activity												
-	-	-	21.9 (19.9-23.9)	-	21.6 (19.6-23.8)	-	20.5 (18.4-22.7)	-	20.0 (17.2, 23.0)	-	↔	None

Figure 3: Physical Activity Guidelines

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Hospital Efficiency: An Application of Data Envelopment Analysis

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Abstract- The objective of this work is to determine the Technical Efficiency for a set of Hospitals of the National Health System of Chile for the periods 2015 and 2016. The methodology to be used is the DEA-CCR data analysis and DEA-BCC Orientation Inputs. The inputs variables are the number of doctors, dentists, nutritionists, nurses, kinesiologists, midwives, medical technicians, paramedics, and number of beds. As Output hospital discharges. The results showed that, in the case of Model 1 DEA-CCR, the hospitals that improved their efficiency scores were Tarapacá (100), Coquimbo (91) and Araucanía (100). In the other Regions there has been a decrease in their efficiency scores. In the second phase of the study, a linear regression model was used to quantify the effect of the variable medical personnel and hospital discharges. The results found a positive and statistically significant effect of the medical staff variable on hospital discharges. In other words, with an increase of one percentage point in medical personnel, hospital discharges would increase by 36.1 percentage points. On the other hand, the same analysis did not find that an increase in the medical staff will improve efficiency rates.

Keywords: *efficiency, public hospitals, envelope data analysis.*

GJMR-K Classification: *NLMC Code: WW 26.5*

Strictly as per the compliance and regulations of:

Hospital Efficiency: An Application of Data Envelopment Analysis

Planck Barahona U. α & Manuel Barahona D. σ

Resumen- El objetivo de este trabajo es determinar la Eficiencia Técnica para un conjunto de Hospitales del Sistema Nacional de Salud de Chile para los períodos 2015 y 2016. La metodología utilizada es el Análisis envolvente de datos DEA-CCR y DEA-BCC Orientación Inputs. Como variables Inputs se utilizaron la cantidad de médicos, dentistas, nutricionistas, enfermeras, kinesiólogos, matronas, técnicos médicos, paramédicos y número de camas. Como variable Output egresos hospitalarios. Los resultados pusieron de manifiesto que, en el caso del Modelo 1 DEA-CCR, los hospitales de las Regiones del país que mejoraron sus puntajes de eficiencia fueron Tarapacá (100), Coquimbo (91) y la Araucanía (100).En las demás Regiones ha habido una disminución en sus puntajes de eficiencia. En la segunda fase del estudio se hizo uso de un modelo de Regresión lineal para cuantificar el efecto de la variable personal médico y egresos hospitalarios. Los resultados encontraronque con un incremento en un punto porcentual en el personal médico los egresos hospitalarios se incrementarían en 36,1 puntos porcentuales. Por otro lado, el mismo análisis no encontró una relación concluyente que nos haga pensar que un aumento en la dotación médica *per se* vaya a mejorar los índices de eficiencia.

Palabras claves: eficiencia, hospitales públicos, análisis envolvente de datos.

Abstract- The objective of this work is to determine the Technical Efficiency for a set of Hospitals of the National Health System of Chile for the periods 2015 and 2016. The methodology to be used is the DEA-CCR data analysis and DEA-BCC Orientation Inputs. The inputs variables are the number of doctors, dentists, nutritionists, nurses, kinesiologists, midwives, medical technicians, paramedics, and number of beds. As Output hospital discharges. The results showed that, in the case of Model 1 DEA-CCR, the hospitals that improved their efficiency scores were Tarapacá (100), Coquimbo (91) and Araucanía (100). In the other Regions there has been a decrease in their efficiency scores. In the second phase of the study, a linear regression model was used to quantify the effect of the variable medical personnel and hospital discharges. The results found a positive and statistically significant effect of the medical staff variable on hospital discharges. In other words, with an increase of one percentage point in medical personnel, hospital discharges would increase by 36.1 percentage points. On the other hand, the same analysis did not find that an increase in the medical staff will improve efficiency rates.

Keywords: efficiency, public hospitals, envelope data analysis.

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I. Introduction

En las últimas décadas Chile ha experimentado un importante aumento en el gasto en salud. Según datos del Ministerio de Salud (2018) y contrastado con el informe de la Dirección de Presupuesto (DIPRES, 2013), el gasto público en salud como porcentaje del PIB se ha triplicado entre 1990 y 2016, incrementándose desde 1,6% a un 4,3% respectivamente. Las razones del gasto en salud tienen que ver con cambios epidemiológicos, el envejeciendo de la población, prestaciones más costosas, incremento de la capacidad instalada y recursos humanos más especializados. En este contexto de alta demanda de recursosmédicos, los hospitales Públicos están siendo objeto de importantes transformaciones en sus modelos de gestión de parte del Estado exigiendo criterios de racionalidad y eficiencia económica. Igualmente con la entrega de los recursos, se requiere garantizar dos aspectos indisolubles, la calidad de los servicios de salud públicoyla eficiencia. Cuando hablamos de eficiencia tiene que ver en cómo alcanzar a un mínimo costo un nivel dado de producción *(Ouputs*) con una combinación concreta de factores de producción (*Inputs).* La importancia radica en establecer cuáles de las unidades hospitalarias han hecho un uso adecuado de sus recursos en un contexto donde las autoridades persiguen objetivos de eficiencia en la asignación de los recursos del sector público.

El Análisis de eficiencia fue propuesto por Charnes et al. (1978) basándose en el trabajo de Farrel (1957). La metodología propuesta es el análisis envolvente de datos (AED), una técnica no paramétrica que proporciona una medida satisfactoria de eficiencia productiva que considera todos los inputs (entradas) que se emplean y los Outputs (salidas) que se generan.

El objetivo de este trabajo es determinar la eficiencia técnica para un conjunto de Hospitales Públicos en el período 2015 y 2016. La metodología utilizada es el Análisis envolvente de datos rendimiento constantes a escala DEA-CCR y DEA-BCC rendimientos creciente a escala, Orientación Inputs.Como variables Inputs se utilizaron la cantidad de médicos, dentistas, nutricionistas, enfermeras, kinesiólogos, matronas, técnicos médico, paramédicos y número de camas. Como variable Output los egresos hospitalarios.

II. Literature Review

Un paso previo para garantizar la calidad de cualquier servicio de salud público es determinar la manera en que se está llevando a cabo una adecuada gestión de los recursos hospitalarios. En este sentido, se espera que todo modelo de gestión hospitalaria cumpla con el propósito de organizar y combinar los recursos de manera tal que cumpla con el objetivo de mejorar la eficiencia. La evidencia científica ha encontrado que el personal médico es un agente esencial en la consecución de los objetivos de eficiencia. En este contexto, los autores Reyes et al. (1993) llevaron a cabo un estudio de medición de eficiencia hospitalaria para 7 establecimientos de salud de medicina preventiva de la provincia de Andalucía, España. Como variables de entrada se escogieron el salario mensual del personal médico y salario de personal no médico y como variables outputs, la formación médico interno residente de la especialidad, y los exámenes de salud realizados. Los resultados mostraron que de los siete servicios estudiados, tres mostraron algún tipo de ineficiencia relativa, esto es un índice de eficiencia menor a 1. Se encontró que las unidades quefracasaronen alcanzar los mejores niveles posibles de eficiencia era cuando pretendían emplear un uso excesivo de inputs. En un estudio más reciente, y en la misma línea de investigación, los autores Ligarda y Naccha (2006) llevaron a cabo una estimación de eficiencia para un conjunto de hospitales del Perú. Los autores consideraron como variables de entrada el personal médico, enfermeras, obstetricias, odontólogos, técnico de enfermería, consumo de medicamentos y como variables outputs, atenciones médicas y actividades preventivas. Los resultados identificaron que nueve micro-redes tuvieron nivel de eficiencia técnica global del 100%, mientras que las restantes se mantuvieron bajo el nivel de eficiencia. La eficiencia media de las micro-redes estudiadas fue de un 97,9%, lo que mostró que para alcanzar la frontera eficiencia tendrían que reducir sus inputs en un 3%.Otros trabajos han centrado su atención en la relación calidad y eficiencia de los servicios hospitalarios. Es así, queen un estudio llevado a cabo por los autores Nayar y Ozcan (2008) examinaron los resultados de la calidad y eficiencia técnica de 177 hospitales de la ciudad Virginia, Estados Unidos. Como variables outputs incluyeron el total de pacientes dados de alta, total de visitas de pacientes externos provenientes de emergencias y formación médica a tiempo completo. Como inputs se utilizó el tamaño del hospital, la cantidad de gastos operacionales y de capital, el personal a tiempo completoy total de activos. La calidad de los servicios hospitalarios se midió a través del porcentaje de pacientes que fueron atendidos oportunamente. En términos generales los resultados mostraron que los hospitales que producían de manera eficiente, también mostraron resultados de calidad en sus servicios hospitalarios. Es decir, se encontró, que los hospitales pueden mejorar su eficiencia sin comprometer la calidad [Seth, 2014; Mutter et al. 2010; Valdmanis et al. 2008].En cuanto a estudios relacionados con la eficiencia del gasto en personal y la producción del Recursos Humanos (personal médico y no medico), tenemos el trabajo de Rodríguez y Tokman (2000). En concreto, el trabajo de los autores analiza la eficiencia hospitalariaen ambos aspectos para el período 1992-1999. Los resultados mostraron una relación inversamente proporcional entre el gasto del personal y los índices de eficiencia, es decir a medida que aumentó el gasto del personal se observó una disminución de la eficiencia, o en otros términos, una reducción en el gasto en salud no necesariamente reduce la eficiencia si el aspecto operativo y técnico del sistema de salud se mejoran [Daruwana y Daneshva, 2018]. Con respecto a la eficiencia en la producción valorada de los recursos humanos, se hallóque un aumento en la dotación del recurso humano nocondujo aun aumento de la eficiencia, por el contrario se observaron períodos de ineficiencias [Alexander et al. 2003; Harrison et. al 2004; Fatulescu et al.2014].

III. Method Data Envelopment Analysis (DEA)

El análisis envolvente de datos (AED) es un método de programación matemática que convierte múltiples inputs y output medidos en una sola suma de productividad eficiente. Es una técnica no-paramétrica que recurre a la programación matemática. El AED está basado en la eficiencia relativa, concepto propuesto por Farrel (1957) y extendido posteriormente por Banker, Charner y Cooper (1984) (DEA-BCC). Es decir, estos autores relajan el supuesto de AED en la cual se asumía rendimientos constantes de escala (DEA-CCR) permitiendo que la topología de rendimiento a escala se caracterice por una tecnología variable, esto es constante, creciente o decreciente. En este sentido, en la clasificación de modelos se debe tener presente que los rendimientos de escala reflejan la respuesta del producto total cuando todos los factores se incrementan proporcionalmente. Sin embargo, se pueden encontrar los siguientes tipos de rendimientos asociados a estos modelos: Modelo de rendimientos contantes de escala: se presenta cuando la cantidad utilizada de todos los factores y la cantidad obtenida de producto varían en la misma proporción. Modelo de rendimientos crecientes: sucede cuando al variar la cantidad utilizada de todos los factores en una determinada proporción, la cantidad obtenida del producto varía en una pro-porción mayor. Modelo de rendimientos de escala decrecientes: se presenta cuando al variar la cantidad utilizada de todos los factores en una proporción determinada, la cantidad obtenida de producto varía en una proporción menor.

a) *Basic Model the Charnes, Cooper y Rhodes: DEA-CCR*

El modelo DEA-CCR proporciona medidas de eficiencia proporcional, con orientación inputs u outputs de rendimiento constante a escala que nos ayudará a construir lo que se denomina superficie envolvente, frontera eficiente o función de producción del conjunto de entidades que están siendo objeto de análisis. Aquellas entidades que determinan la envolvente se denominarán entidades eficientes y permitirán la evaluación de la eficiencia relativa de cada una de las entidades. Formalmente, para calcular el puntaje de productividad eficiente según el modelo DEA-CCR (cálculo de la Eficiencia técnica Global), se efectúa solucionando el siguiente problema de programación lineal. Sea N el número de unidades a analizar, los cuales utilizan una cantidad determinada de M inputs para producir S *outputs*. Para la i-ésima unidad se obtiene una matriz x de tamaño (Mx1) *inputs* y una matriz y de tamaño (Sx1) *outputs*. Por lo tanto, la matriz X (MxN) *inputs*, y la matriz Y (SxN) *outputs* representan los datos para el total de unidades analizadas. La representación del modelo como un problema de optimización lineal asumiendo rendimientos constantes de escala se puede expresar de la siguiente forma (modelo DEA-CCR):

$$\begin{aligned} &Min_{\emptyset,\alpha}\emptyset \\ &s.a - y_i + Y\alpha \geq 0 \\ &\emptyset X_i - X \propto \geq 0 \\ &\propto \geq 0 \end{aligned} \qquad (1)$$

donde el término ϕ es un escalar que multiplica al vector de inputs y representa el factor que pondera los *inputs* de la unidad evaluada, y su valor mide la eficiencia de la unidad i, x_i representan los inputs de la i-ésima unidad a ser evaluada, y_i representa los outputs de la i-ésima región a ser evaluada, X es la matriz de inputs MxN, Y es una matriz de outputs SxN, λ es un vector de constantes Nx1 que multiplica a la matriz X e Y que describe la importancia de las unidades que se toman en consideración para determinar el productor virtual o unidad de referencia que sirve de comparación para evaluar el i-ésima unidad, por último N es el número de unidades. Debemos señalar que el problema dual permite ilustrar acerca de la naturaleza de la eficiencia relativa dado que se obtienen, en el caso de que existan, las holguras (*slacks)* o reducciones no radiales de *inputs* (Charnes et al., 1978, pp. 429-444*)*. Para que una unidad sea eficiente en el sentido de Farrel (1957, pp. 253-290), ϕ será igual a 1y las holguras serán igual a 0, esto es, la unidad observada se encontrara produciendo en la frontera óptima de producción.

b) *Model Banker, Charnes and Cooper: DEA-BBC*

Con el fin de calcular la eficiencia técnica pura modificamos el planteamiento anterior para incluir la posibilidad de rendimientos variables de escala, de acuerdo con la extensión al modelo de Farrel (1957) y según la propuesta de Banker, Charnes y Cooper (1984) [modelo AED-BCC]:

$$\begin{aligned} &Min_{\emptyset,\alpha}\emptyset \\ &s.a - y_i + Y\alpha \geq 0 \\ &\emptyset X_i - X \propto \geq 0 \\ &N1\acute{}\alpha = 1 \\ &\propto \geq 0 \end{aligned} \qquad (2)$$

en este modelo se incluye una restricción de convexidad ($N1`\lambda = 1$), donde $N1$, es vector unitario Nx1. Esta modificación permite descomponer la eficiencia en dos, por un lado la eficiencia técnica pura (ETP), calculada bajo el método BCC y por otro lado la eficiencia de escala que es el resultado del cociente de los coeficientes de eficiencia calculados con el modelo CCR y el modelo BCC. Cabe señalar que si existen diferencias entre la dos mediciones de eficiencia para una unidad (en nuestro caso regiones), entonces significa que dicha unidad posee ineficiencia de escala. Formalmente podemos determinar residualmente la eficiencia a escala como,

$$EE_{(x_i,y_i)} = \frac{ETG_{(xi,y_i)}}{ETP_{(xi,y_i)}} \qquad (3)$$

donde ETG es la eficiencia técnica global calculada mediante el método DEA- CCR, ETP calculada mediante el método DEA-BCC, x_i y y_i, son los *inputs* de la unidad i y los *outputs* de la unidad i respectivamente. Cabe hacer hincapié que el método Análisis Envolvente de Datos (AED) se adapta a múltiples inputs y outputs, evita la imposición de una forma funcional entre las variables, ofrece una información detallada y minuciosa, permite variables expresadas en distintas unidades. Sin embargo, como toda técnica, tiene inconvenientes esto es: es un modelo determinístico que obliga a analizar unidades homogéneas. En el cuadro 1 se esquematiza las ventajas y desventajas del modelo.

Cuadro 1: Ventajas y desventajas Modelo Análisis Envolvente de Datos (AED)

Ventajas	Desventajas
Permite múltiples entradas y salidas.	Modelo determinístico
Evita la imposición de una forma funcional para evaluar las unidades.	Evita la imposición de una forma funcional
Permite establecer metas de mejoramiento cuantitativas y alcanzables	Homogeneidad en las unidades analizadas
Identifica pares de referencia para el mejoramiento de unidades ineficientes	Resultados sensibles a la especificación
Permite variables expresadas en distintas unidades de medida	Necesidad proporción óptima de variables

Fuente: Elaboración propia en base a Coll y Blasco (2007).

c) Medical personnel gap in Chileand Health expenditure.

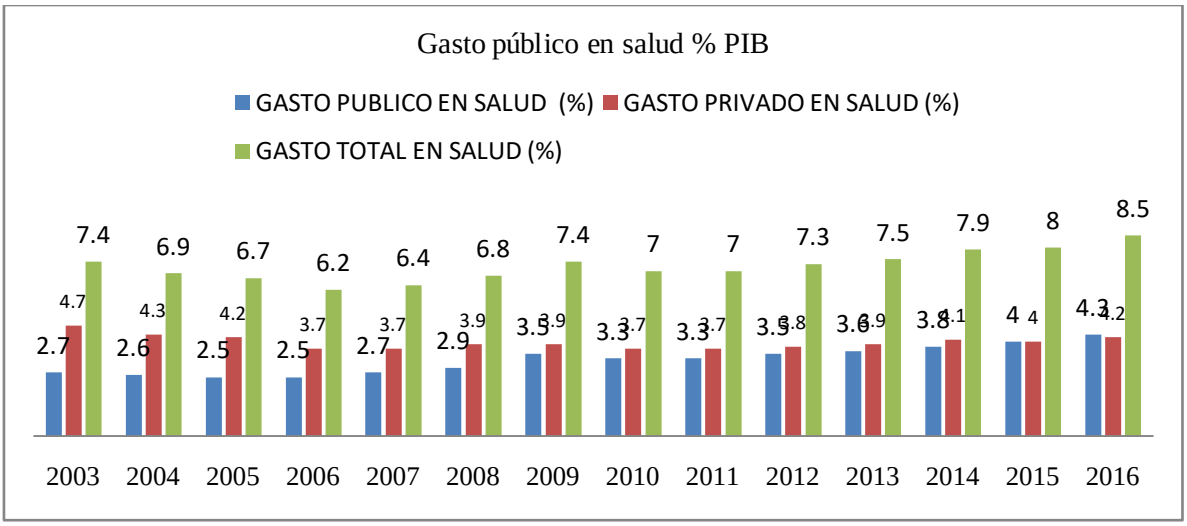
En Chile existe una brecha importanteen el número de médicos entre regiones. Según el último informe del Ministerio de Salud (2017) sobre brechas de personal sanitario, Chile se mantiene muy lejos del promedio de la Organización para la Cooperación y el Desarrollo Económicos (OCDE) en médicos por habitante, 16 médicos por 10 mil habitantes versus un promedio de 34 en los países de la OCDE. En el cuadro 1 se observa el detallede la brecha de médicos en el sistema público. Obsérvese que la región con menor número de médicos especialistas por habitantes es Maule (4,6), seguido de la región de Atacama (4,6) y Tarapacá (4,8). De las regiones del Norte de Chile, Antofagasta (6,3) presenta la mayor tasa de número de médicos por habitantes. En general las regiones del sur presentan una mayor cantidad de médicos especialistas. Esta inequidad territorial ha causado enormes problemas a las regiones en términos de cobertura médica. Otros de los problemas del sistema sanitario en chile es la migración de médicos al sector privado de salud.

Cuadro 1: Brecha médicos especialistas cada 10 mil habitantes por Región.Año 2015.

Región	Ratio (Médicos /10 mil hab.)
Arica y Parinacota	6,5
Tarapacá	4,8
Antofagasta	6,3
Atacama	4,6
Coquimbo	5,4
Valparaíso	7,6
Metropolitana	13,5
O'Higgins	5,4
Maule	4,6
Biobío	6,9
La Araucanía	7,9
Los Ríos	8,3
Los Lagos	7,6
Aysén	8,9
Magallanes	10,3

Fuente. Elaboración propia en base a informe Ministerio Salud (2017). Información al año 2015.

A partir de la década del año ´90, y con el propósito de ampliar la cobertura médica, el gasto público en salud ha experimentado un importante aumento. Los motivos del incremento en el gasto tienen que ver principalmente con cambios epidemiológicos, el envejeciendo de la población, prestaciones más costosas, incremento de la capacidad instalada y recursos humanos más especializados. En el gráfico 1 se puede observar la evolución que ha tenido el gasto. Sin embargo, según un informe de la OCDE (2019) el gasto tanto privado como público está por debajo de los países miembros de la OCDE, 3994 US$ per cápita y 2182US$ per cápita respectivamente.



Fuente. Informe Ministerio de salud (2018).

Grafico 1: Gasto público en salud % PIB. Período 2003-2016.

IV. Data and Variables

En la elaboración de este trabajo losdatos fueron obtenidos a partir de los informes del Instituto Nacional de Estadísticas 2017 y 2018 y del Reporte del Ministerio de salud de Chile (MINSAL). Las unidades en estudio son los Hospitales del Sistema Nacional de Salud de las distintas Regiones de Chile. Se propone como variables Inputs, el número de dentistas, médicos, nutricionistas, enfermeras, kinesiólogos, matronas, tecnólogos médicos, paramédicos y número de camas por millones de habitante. Cabe señalar que nofue posible obtener información de las horas trabajadas del personal médico. Como variables Outputs lacantidad de egresos hospitalarios. El egreso hospitalarioes el procedimientoque se realiza cuando el paciente abandona el hospital. Seplantea un modelo DEA-CCR Orientado Inputs con rendimientos constante a escala y un modelo BCC con rendimientos crecientes a escala. La selección de estos modelos se basa en determinar, dado un nivel de egresos, la máxima reducción proporcional en el vector de inputs mientras permanece en la frontera de posibilidades de producción.

a) Description of the main variables

El Sistema Nacional de Servicios de Salud (SNSS) cuenta con 29 Servicios de Salud territoriales distribuidos en 15 Regiones del país. Debido a que los hospitales del SNSS están sujetos a un presupuesto relativamente acotado, el modelo de gestión tiene como objetivo organizar y combinar los recursos cuya finalidad es cumplir con políticas de eficiencia (Artaza et al. 2019). En este sentido, la evidencia ha encontrado que el uso adecuado del personal médico es determinante en los resultados de eficiencia de los servicios de salud [Alexander et al. 2013; Rodríguez y Tokman 2000; Harrison et. al 2004].

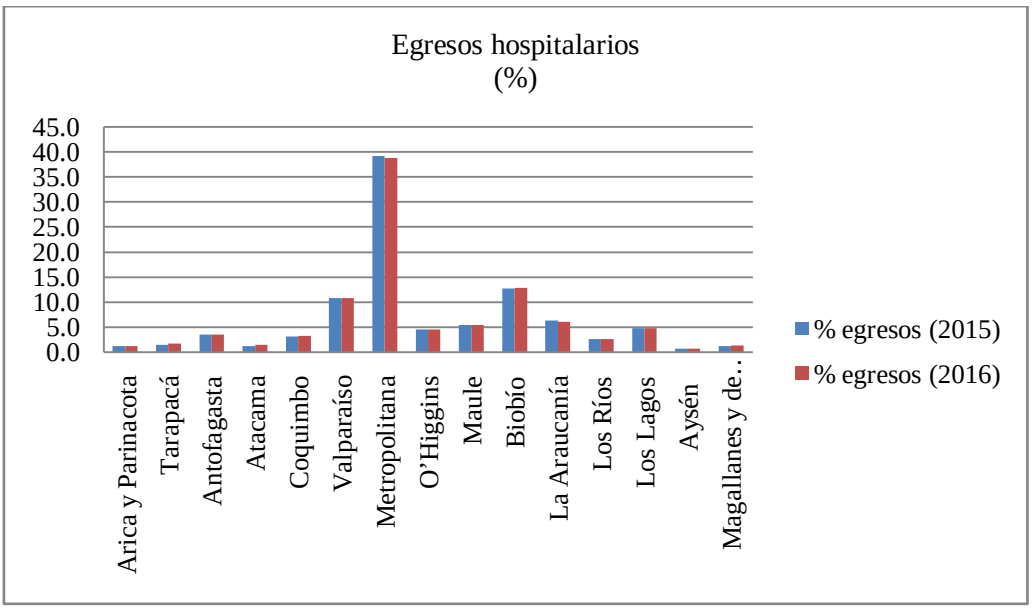
En un primer análisis descriptivo podemos observar el incrementodel personal médico de los servicios de salud entre el período 2015-2016 (cuadro 1). Por ejemplo, los servicios de salud de la Región de Arica y Parinacota aumentaron en 12 su dotación de médicos, 5dentistas, 1 farmacéutico y bioquímicos, 1 nutricionista, 3 Kinesiólogos, 1 matrona, 2 técnicos médicos y 369 paramédicos. La Región de Atacama, norte del país, experimentó un incremento de 19 médicos, 20 enfermeras y 208 paramédicos. En el sur de Chile, la regióncon el mayor incremento en su dotación médica fue la Región de Biobío con 175 médicos. En términos generalestodas las regiones aumentaron su dotación de personal. De acuerdo al mismo cuadro, los nutricionistas (0,43%), farmacéuticos (0,68%), dentistas (1%), matronas (1%) y tecnólogos médicos (1%) representan la menor cantidad de personal en términos porcentuales.

Cuadro 1: Incremento del personal médico Regiones del país. Variación (2015-2016).

Regiones	Médicos	Dentistas	Farm.	Nutric.	Enfermeras	Kinesiólogos	Matronas	Tec.Médicos	Paramédicos
Arica y Parinacota	12,00	5,00	1,00	1,00	0,00	3,00	1,00	2,00	369,00
Tarapacá	21,00	6,00	2,00	0,00	11,00	1,00	3,00	4,00	38,00
Antofagasta	1,00	7,00	1,00	1,00	20,00	1,00	8,00	4,00	208,00
Atacama	19,00	1,00	11,00	1,00	18,00	3,00	3,00	3,00	223,00
Coquimbo	39,00	5,00	4,00	1,00	13,00	8,00	2,00	2,00	713,00
Valparaíso	23,00	16,00	6,00	12,00	107,00	19,00	16,00	6,00	1428,00
Metropolitana	167,00	45,00	44,00	19,00	178,00	45,00	65,00	50,00	4172,00
O'Higgins	95,00	10,00	15,00	1,00	90,00	16,00	9,00	13,00	459,00
Maule	95,00	6,00	3,00	2,00	75,00	17,00	14,00	19,00	1456,00
Biobío	175,00	22,00	13,00	10,00	155,00	44,00	32,00	23,00	2984,00
La Araucanía	61,00	18,00	5,00	7,00	58,00	11,00	10,00	15,00	281,00
Los Ríos	49,00	9,00	3,00	0,00	19,00	4,00	4,00	3,00	634,00
Los Lagos	87,00	18,00	10,00	17,00	139,00	25,00	21,00	26,00	1335,00
Aysén	14,00	7,00	0,00	2,00	13,00	6,00	3,00	6,00	314,00
Magallanes	19,00	5,00	3,00	3,00	14,00	4,00	5,00	2,00	314,00
Total personal medico	877,00	180,00	121,00	77,00	910,00	205,00	196,00	178,00	14928,00
Porcentaje (%)	4,96	1	0,68	0,43	5,1	1,1	1	1	84,47

Fuente. Elaboración propia. Calculo en base a datos proporcionados por informes del INE (2017-2018).

Por otro lado, en el gráfico 1 se observa la evolución delos egresos hospitalarios de las regiones. Las Regiones de O'Higgins, la Araucanía y Región Metropolitana disminuyeron sus egresos hospitalarios. Por el contrario, las Regiones Tarapacá, Atacama, Coquimbo, Biobío y Aysén aumentaron sus egresos. Las regiones Arica y Parinacota, Antofagasta, Valparaíso, Maule, Los Ríos y Los Lagos no experimentaron incrementos en la cantidad de egresos. Un hallazgo que llama la atención es queen el año 2015 hubo un total de 1.666.007 egresos hospitalarios con una dotación médica de 52.823 y en el año 20161.633.431egresos con unadotación de personal médico de 70495. Es decir, en términos generales, un incremento en el número de personal médico en el año 2016, no significó un aumento en el número total de egresos.



Fuente. Elaboración propia. Datos proporcionados por INE (2017-2018).

Grafico 1: Egresos hospitalarios. Período 2015-2016.

V. Results and Discussions Model DEA-CCR y DEA-BCC

En esta sección se proponen los modelos DEA-CCR Orientación Inputs con rendimientos constante a escala y un modelo DEA-BCC con rendimientos crecientes a escala (tabla 1). Como variables de entrada: número de dentistas, médicos, nutricionistas, enfermeras, kinesiólogos, matronas, técnicos médicos, paramédicos y número de camas por millones de habitante. Como variables de salida la cantidad de egresos hospitalarios. La selección de estos modelos se basa en determinar, dado un nivel de egresos, la máxima reducción proporcional en el vector de inputs mientras permanece en la frontera de posibilidades de producción.

De la tabla 1 se puedeadvertirqueen el modelo DEA-CCR, las Regiones que presentaron un puntaje de eficiencia menor a 1 son: Tarapacá, Coquimbo, el Maule, Biobío, los Lagos y Magallanes. En el caso particular de los Hospitales de la Región de Tarapacá deberían reducir sus inputs en un 11,9% para situarse en la frontera eficiente. Respecto de la Región de Coquimbo deberían reducir sus inputs en un 16,4% para mejorar su puntaje de eficiencia. La región de los Lagos presenta el menor puntaje de eficiencia (71,8), lo que se recomienda que reduzca sus inputs en un 28,2% de modo que pueda hacer un uso eficiente de sus recursos. En el Modelo 2 DEA –BCC, se puede observar que las regiones mejoraron sus puntajes de eficiencia fueron: Tarapacá, Atacama, Aysén y Magallanes.

Tabla 1: Resultados Eficiencia Hospitales Regionales. Año 2015.

UNIDAD	DEA-CCR Rendimientos constante a escala Modelo 1 *Puntuaciones de eficiencia (%)*	DEA- BCC Rendimientos crecientes a escala Modelo 2 *Puntuaciones de eficiencia (%)*	Eficiencia de Escala (EE)
Arica y Parinacota	100	100	100
Tarapacá	88,1	100	100
Antofagasta	100	100	100
Atacama	81,1	100	81,1
Coquimbo	83,6	95,7	87,3
Valparaíso	100	100	100
Metropolitana	100	100	100
O'Higgins	100	100	100
Maule	97,7	100	97,7
Biobío	96,1	97,2	98,8
La Araucanía	98,9	99,2	99,3
Los Ríos	100	100	100
Los Lagos	71,8	72,7	98,7
Aysén	63,1	100	63,1
Magallanes y de la Antártica Chilena	88,4	100	88,4

Fuente. Elaboración propia en base a resultados Frontier Analysis

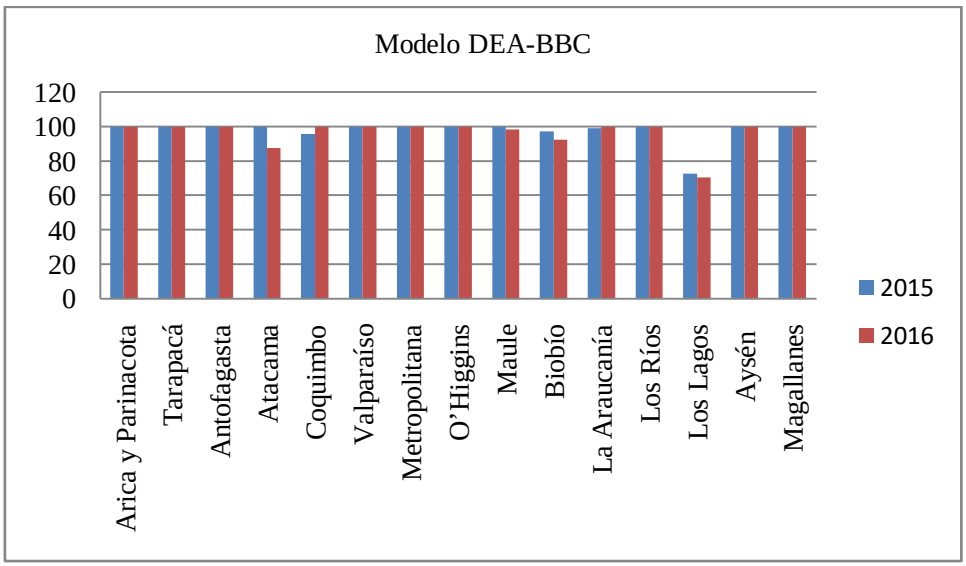
En la tabla 2 se observan el comportamiento de los puntajes de eficiencia en el período 2016. Las Regiones que mejoraron su eficiencia son, Tarapacá (100), Coquimbo (91) y la Araucanía (100), es decir se ha observado un progreso en el uso eficiente de sus recursos. En las demás Regiones ha habido una disminución en sus puntajes de eficiencia. El caso más emblemático es la Región de Aysén con un puntaje de eficiencia de 57,2. Lo siguen las Regiones del Biobío (91,4), Atacama (74,4), el Maule (96,3), los Lagos (64,1) y Magallanes (82).En la misma tabla se observan los resultados del Modelo 2 con algunas Regiones que han mejorado sus puntajes de eficiencia.

Tabla 2: Resultados Eficiencia Hospitales Regionales. Año 2016.

UNIDAD	DEA-CCR Rendimientos constante a escala Modelo 1 *Puntuaciones de eficiencia (%)*	DEA- BCC Rendimientos crecientes a escala Modelo 2 *Puntuaciones de eficiencia (%)*	Eficiencia de Escala (EE)
Arica y Parinacota	97,6	100	97,6
Tarapacá	100	100	100
Antofagasta	100	100	100
Atacama	74,4	87,7	84,8
Coquimbo	91	99,9	90,1
Valparaíso	100	100	100
Metropolitana	100	100	100
O'Higgins	100	100	100
Maule	96,3	98,5	97,7
Biobío	91,4	92,6	98,7
La Araucanía	100	100	100
Los Ríos	100	100	100
Los Lagos	64,1	70,6	98,8
Aysén	57,2	100	57,2
Magallanes y de la Antártica Chilena	82	100	82

Fuente. Elaboración propia en base a resultados Frontier Analysis.

Para obtener una visión global del comportamiento de los puntajes de eficiencia hemos graficado la evolución de los puntajes para el caso del Rendimientos crecientes a escala en los años 2015 y 2016 (gráfico 2). Se puede advertir una mejorade los sus puntajes de eficiencia de muchas de las regiones. Preocupa la Región de los Lagos que ha tenido un pobre desempeño en términos de eficiencia. Igualmente sucede con la Región de Atacama queexperimentó una disminución en su puntaje de eficiencia (100 a 87,7). La Región del Biobío disminuyó su puntaje de eficiencia (97,2 a 92,6). En el grafico 2 se pueden ver los detalles de los resultados.



Fuente. Elaboración propia en base a Frontier Analysis.

Gráfico 2: Evolución puntajes de eficiencia modelo DEA-BBC. Período 2015-2016.

VI. Aplicación Método Paramétrico

El propósito de esta apartadoes estimar y cuantificarla relación existente entre los puntajes de eficiencia DEA-CCR, personal médico y egresos hospitalarios. La característica de los métodos paramétricos es que deben ajustarse a supuestos

estadísticos rigurosos lo que los hace más ventajoso respecto de otros métodos noparamétricos.

a) Matriz de correlación de Pearson[1]

En el cuadro 1 se puede observar una relación directa y estadísticamente significativa entre el número de personal médico y los egresos hospitalarios, es decir a medida que aumenta el personal médico se observa un incremento en el número de egresos hospitalarios. El mismo análisis muestra una relación directa no estadísticamente significativa (0,315) entre el personal médico y elíndice de eficiencia. En este último casono se encontró un resultado concluyente que nos haga pensar que un aumento de la dotación médica vaya a mejorar los puntajes de eficiencia.

Cuadro 1: Matiz de Correlaciones de Pearson DEA-CCR. Año 2015.

		personal médico	egresos hosp	índice eficiencia DEA-CCR
personal médico	Correlación de Pearson	1	0,994**	0,315
	Sig. (bilateral)		0,000	0,252
	N	15	15	15
egresos hosp	Correlación de Pearson	0,994**	1	0,332
	Sig. (bilateral)	0,000		0,226
	N	15	15	15
índice eficiencia	Correlación de Pearson	0,315	0,332	1
	Sig. (bilateral)	0,252	0,226	
	N	15	15	15

*Fuente: Elaboración propia en base a SPSS. Nivel de Significancia ** 0,01 (bilateral).*

b) Análisis modelo de regresión múltiple

Para proseguir con el análisis, nos interesa cuantificar el efecto que tiene el personal médico sobre los egresos hospitalarios, para ello se hará uso del modelo de regresión lineal simple,

Formalmente el modelo econométrico se expresa de la siguiente forma,

$$Y_t = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_{kt} + \varepsilon_t \text{ con } t = 1,2,3\ldots T \quad (4)$$

Donde $\beta_1, \beta_2, \beta_k$ denotan la magnitud del efecto que las variables explicativas (x) tienen sobre la variable dependiente (y). El coeficiente β_0 se denomina término constante. El término ε_t se denomina término error del modelo con media cero, $E(\varepsilon) = 0$, varianza constante, $Var(\varepsilon) = \sigma^2$, y las perturbaciones no correlacionadas, $Cov(\varepsilon_t, \varepsilon_s) = 0$, para todo $\forall t \neq s$.

El resultado del cuadro 2 muestra un buen ajuste del modelo, con un coeficiente de determinación de 0,98. Es decir, la variable personal médico explicaría el 98% de los egresos hospitalarios. En cuanto a los supuestos del modelo, se obtuvo un valor del estadístico Durbin-Watson de2,06,lo queestaría indicando la no existencia de auto correlación de los residuos.

Cuadro 2: Resumen delmodelo

Modelo	R cuadrado	R cuadrado ajustado	Sig. Cambio en F	Durbin-Watson
1	,988	,987	,000	2,026

Fuente: Elaboracionpropiaen base a resultados SPSS.

En el cuadro 3, y consistente con el resultado encontrado en la matriz de correlación de Pearson, se puede apreciar un efecto positivo y estadísticamente significativo (0,000) de la variable personal médico sobre los egresos hospitalarios. Es decir, un incremento en un punto porcentual en el personal médico los egresos hospitalarios se incrementarían en 36,1 puntos porcentuales. Cabe señalar que este resultado sólo nos indica el efecto no así el uso adecuado de los recursos.

[1] $\rho_{xy} = \frac{Cov(x,y)}{\sqrt{Var(x)}\sqrt{Var(y)}}$ Donde $Cov(x,y)$ indica la covarianza $Var(x,y)$ y de las variables x, y.

Cuadro 3: Modeloregresión multiple

Modelo		Coeficientes no estandarizados		Coeficientes estandarizados	Sig.
		B	Error estándar	Beta	
1	(Constante)	-16245,112	6052,772		,019
	personal médico	36,153	1,091	,994	,000*
a. Variable dependiente: egresos hosp.					

Fuente: Elaboracionpropiaen base a resultados SPSS. Significanciae stadistica p<1%*

Respecto a los resultados del cuadro 4, no se encontró un efecto estadísticamente significativo entre las variables personal médico y el índice de eficiencia. Este resultado nos podría estar indicando que, por sí mismo, un aumento de la dotación de personal médico no trae consigo un incremento en el puntaje de eficiencia.

Cuadro 4: Modelo regresión múltiple

Modelo		Coeficientes no estandarizados		Coeficientes estandarizados	Sig.
		B	Error estándar	Beta	
1	(Constante)	88,311	3,868		,000
	personal medico	,001	,001	,315	,252
a. Variable dependiente: índice eficiencia b. Durbin-Watson 1,56 c. R cuadrado 0,099					

Fuente: Elaboración propia en base a resultados SPSS. No se encontró Significancia estadística.

VII. Conclusions

El gasto público en salud en Chile como porcentaje del PIB se ha triplicado a lo largo de los años, incrementándose desde 1,6% en el año 1990 a un 4,3% en el año 2016. Este incremento en el gasto público ha hecho que el Estado exija a los hospitales mayores esfuerzos en el manejo adecuado de los recursos en un contexto donde el personal médico se enfrenta diariamente a un intrincado y complejo manejo de recursos hospitalarios.

En un primer análisis descriptivo los resultados pusieron de manifiesto que entre el año 2015 y 2016 los hospitales de regionales incrementaron su dotación de personal médico en un 133,4%. Sin embargo, el análisis de eficiencia DEA-CCR halló queen el año 2015 los hospitales quepresentaron un puntaje de eficiencia menor a 1 fueron, Tarapacá, Coquimbo, Maule, Biobío, los Lagos y Magallanes y sólo algunos hospitales mejoraron su puntaje de eficiencia al año siguiente esto es, Tarapacá, Coquimbo y Araucanía. Esto pone de manifiesto que una muestra importante de hospitales no hizo un uso eficiente de sus recursos.

En la segunda parte del estudio, y consistente con el análisis de Correlación de Pearson, se encontró que con un incremento en un punto porcentual en la cantidad de personal médico los egresos hospitalarios se incrementarían en un 36,1 puntos porcentuales. Sin embargo, el mismo análisis econométrico no encontró una relación concluyente que nos haga pensar que un aumento de la dotación médica*per se* vaya a mejorar los índices de eficiencia. Los resultados sugierenque un aumento en la dotación médicadebería ir acompañada de medidas de gestión que logren mejorar los índices de eficiencia.

VIII. Limitations

Las limitaciones tienen que ver con la ausencia de micro datosde los centros hospitalarios. Una segunda limitación es la carencia de otras variables en el modelo esto es; presupuesto, gastos operacionales y gastos de capital. La ausencia de variables podría generar problemas de especificación.

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Some Specific Features of Abbreviations using in Medical Terminology in English and Uzbek (On the Example of Dermatovenereological Vocabulary)

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Abstract- Abbreviations are frequently used in medicine. They can be found in hospital documentation, medical papers and case reports. Abbreviations are short and serve to save time, but misunderstanding can cause serious outcomes.

The article discusses the lexical and semantic features of medical terminology and medical abbreviations of the English language as a means of lexical objectification of the medical concept sphere.

Keywords: medical terminology, semantic, abbreviation, medical concept sphere, omoacronyms, synonymy, diagnostics, acronym system, typology of abbreviations dermatovenerology.

GJMR-K Classification: NLMC Code: QX 15

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Dilfuza Sapaeva [α] & Nilufar Sadullaeva [σ]

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I. Introduction

Medicine is one of the most ancient areas of human knowledge. Medical terminology reflects the history of the development of world civilization: the terms that have come down to us through the ages are imprints of that culture, world view, professional medical concept sphere, within which they were a means of transmitting, perceiving and storing information about various medical phenomena.

The concepts that form the medical concept sphere, according to their individual attributes, enter into systemic relationships of similarity, difference and hierarchy with other concepts. All this is reflected in the language.

Establishing the full verbal richness of medicine seems to be a difficult task, because it is extremely impossible to clearly define the boundaries of its functioning, which is further expanded due to the “butt”, borderline with medicine, areas and common vocabulary.

Medical terminology in a meaningful aspect is represented by concepts denoting the conditions and processes that occur in the human body, diseases and their manifestations, pathological conditions of a person, methods of diagnosis, prevention and treatment of diseases and their symptoms, surgical operations, medical equipment, tools, drugs, etc.

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Modern medical terminology is characterized by “precisely developed and internationally unified anatomical nomenclature” and “non-standardized terminology of individual clinical branches”.[15] The main reason for the terminological disorder in medicine is the fast pace of development of scientific knowledge and the need to promptly name new diseases, diagnostic and treatment methods, surgical operations, devices, equipment, etc. [14:192]

Indeed, medical texts abound in terminology, and, being a specific layer of vocabulary that differs from commonly used words, terminological units present special difficulties in the process of translation from English into Uzbek and from Uzbek into English, in view of their specific features.

As noted earlier, medicine has an extended and very rich terminology, which has its own characteristic features. So, first of all, it should be noted that in the semantics of medical terms there is no expression and emotional coloring and stylistic neutrality is observed, this is confirmed by the fact that medical texts absolutely do not contain metaphors and other stylistic devices. [19:256]

The term “abbreviation” we understand and use in our work in the broad sense, that is, like any abbreviation. In abbreviations, information is transmitted by fewer characters, so the "capacity" of each character is greater than in the corresponding original units, which gives reason to consider abbreviation as one of the types of optimization of voice communication. However, despite the “simplification of the formal structure of the linguistic unit”, abbreviations are often the most difficult to understand and translate elements of oral and written language. Professional translation is in demand in all fields of activity, but literate translation is of particular importance in a field such as medicine. Inadequate translation of abbreviations found in medical documents, as well as in oral speech, can cost a person life, so the issue of education and streamlining of abbreviations is especially acute. As a result of studies conducted by American scientists, it was found that only half of all abbreviations used by doctors of one specialty are correctly understood by specialists in other branches of medicine1. About half of all medical errors that occurred in hospitals are associated with problems of communication, understanding and interaction.

Abbreviation is one of the indicators of language development. The source of the development of language lies in the confrontation between the changing picture of the world and the growing needs of society in a more adequate expression of thoughts, on the one hand, and the realization of the possibilities of language in this historical era, on the other hand.

II. Materials and Methods

In the article was used such research methods as the method of component analysis of values based on vocabulary definitions, the method of contextual analysis of the values of abbreviations, revealing their situational relevance. Sample quantitative calculations were also used. The corpus of examples was revealed by a continuous selection of the studied units from scientific medical texts.

The material for the study was more than 20,000 English medical abbreviations. The units studied were selected from articles in the periodical literature on medicine and related branches of science, from explanatory, encyclopedic English-language dictionaries and rare dictionaries of medical abbreviations, as well as gleaned from the internet.

III. Results

First of all, the result should be clear to others. Each result should be written in a simple and understandable language, indicating what the student should be able to do - even a person unfamiliar with this area of knowledge and skills should understand what is required of the students. [21]

The obtained results point out to the modernity of studies in the field of clinical and experimental dermatology, which is due to the fact that this is the oldest terminology, by the example of which it is possible to trace the ways of formation, development and improvement of terms, the realization of semantic processes, certain trends, ways and means of word formation.

Medical terminology is very diverse and can be classified according to various criteria. In the framework of this study, the following classifications were selected to understand the features of English medical terminology.

In accordance with the stratification classification of Z. I. Komarova, on the basis of normativity, normativity, medical terms can be divided into two groups: normative and normative.

The normative layer of the language includes literary and colloquial vocabulary, corresponding to the norms of literary and colloquial speech accepted in society [10:134], respectively, to the regulatory medical terms include: proper terms and subject terms. [10:136].

Actually, terms are conceptual terms in which the sign comes to the fore (*kidney failure–buyrakyetishmovchiligi, systolic-sistolik, respiratory distress – nafasqisishi)* take first place in the number of words in medicine, since most of them describe the physical and mental human conditions, diseases, procedures.

Subject terms, or nomenclature, that is, those whose main component is a denotative value (for example, *MRI- MRG, CT scan – kompyutertomografiyasi, colon - ichak, epiphyseal plate – epifizalplastinka, acyclovir - asiklovir*), in most cases, indicate the subjects of study: human organs, equipment, drugs, pathogens and carriers of diseases, etc.

Profanity lexical units make up a large and heterogeneous layer of vocabulary; however, it is not included in the dictionaries. Non-normative medical terminology includes professionalism, as well as termoids and individually figurative expressions, which are rarely used in medicine. [10:21].

According to Komarova professionalism is a special word with three characteristic features: “non-normative use, stylistic marking (colloquial nature) and the presence of emotionally expressive coloring” [10:18]. In his work, S.P.Khizhnyak draws attention to the limited scope of the use of professionalism, which is closely related to colloquial speech of specialists in an informal setting and the presence of emotional coloring and expressive connotations. Medical professionalism is not found in official documents, but with oral communication it is quite appropriate (for example, *baby catcher - obstetrician*). [11:36]

The classification of medical terminology according to the morphological and syntactic structure is based on the classification of R.Y.Kobrin and B.N.Golovin, which subdivide all terms into phrases and word terms, which are divided into derivatives, non-derivatives, complex and abbreviations. [7:32]

Some linguists classify medical terms according to the method of word formation, among which are morphological (word production, word composition, abbreviation), syntactic (the formation of phrases and phrases from several words), semantic (as a narrowing or refinement of the meaning of common words, and metaphorical and metonymic transfer of the old meaning), and borrowing words from other languages. [5:27]

In connection with the development of scientific research, medical discourse is constantly replenished with cognitive information, which makes it necessary to save language resources. The language tends to compression, to compression, i.e. It creates precisely those formations that transmit the greatest amount of information in a condensed and at the same time accessible form. The main methods of text compression are abbreviations. Abbreviation is a word-formation method aimed at creating shorter words compared to

the original structures. As a result of abbreviation, the word consists of the names of the initial letters included in the original phrase. For example:

ACTH - adrenocorticotropic hormone,

EBM - evidence-based medicine,

DNA - deoxyribonucleic acid,

MAP - mean arterial pressure.

The essential components of the abbreviation can be characterized as follows:

1. Making the abbreviation graphic means. One way to manipulate the means of graphics in this way is to replace capital letters with lowercase. For example, SPECT- single-photon emission computed tomography.
2. Participation in the process of word formation as part of the word-formation type as an element.

PDGF - platelet-derived growth factor;

The functioning of the abbreviation as part of a compound word also ensures its transition to another part of speech:

PDGF - deficient;

PDGF - deficiency;

PDGF - lacking, part, etc.

3. Adaptation to the phonetic features of the language.

For example, CDC- The Center for Disease Control and Prevention. The greater the number of elements in the abbreviation, the more their shape is reduced.

As a result of lexicalization, the abbreviation acquires “its own formative paradigm and does not differ in this sense from the ordinary word”. For example, OD - OD_S “patients with over dosage of some drug".

The lexical abbreviation can serve as the basis for the following acts of word formation: FACP - Fellow of the American College of Physicians.

We must not forget about the mixed type of lexical abbreviations, which when translated become either semi-alphabets or semi-acronyms:

DDSO [di: di: sou] “diamino-diphenyl-sulphoxide";

TRITC [tri: ti: si:] “tetramethylrhodamineisothiocyanate”.

Another variety of the mixed type is the lexeme, where one component is initials, the other is the full word: H disease “Hart's disease"; L-dopa “levodopa”.

It seems quite difficult for us to understand the class of truncations formed on the basis of a word combination. It can be like truncation of each component:

- bat fat – battle fatigue;
- pharm chem – pharmaceutical chemistry;
- dent chem – dental chemistry,

As well as truncation of one of the components with complete omission of the second:

- hype - hypodermic syringe;
- duo - duodenal ulcer;
- rehab - rehabilitation center.

Obviously, the second case presents great difficulties, because a significant portion of information is omitted and there is only a hint of the term, that semantic clot that reflexively recalls the corresponding term in the recipient's memory.

Finally, a group of syntactic abbreviations is represented by elliptic abbreviations. Ellipsis is characterized by the omission of one of the components of the phrase, however, unlike the previous types of truncation, the remaining component does not undergo defective changes in its morphemic structure, but only “condenses the semantics of the whole phrase”:

Gastric - gastric ulcer;

Cord - spinal cord.

Ellipsis as a linguistic phenomenon is quite common in professional groups associated with social activities. This is easily explained by the stereotypical situations of production activities. Compared to other types of truncations, the ellipsis is stylistically fairly neutral. Elliptical formations can pass from informal, colloquial to official speech, if the word loses its narrow professional attachment. Attributive phrases (A + N) are usually exposed to an ellipse. However, there are two possible outcomes. In the first case, the noun is omitted and the adjective is substantiated. Moreover, the meaning of the whole phrase is condensed in the attribute:

Abdominal (N) (- abdominal case) “disease (organ) of the abdominal cavity”;

Attending (N) (- attending physician);

Central (N) (- central emergency).

Proof of the adjective's transition to the category of nouns is the acquisition of all the attributes of a noun, for example, endings:

Vitals - vital signs (temperature, pulse, respiration).

The abbreviation process has certain laws, knowing which you can organize and regulate the spontaneous abbreviation of the terms. Such patterns are especially clearly seen in the structural classification (for example, the names of drugs are mainly formed by contraction). Moreover, these patterns are similar in both english and Uzbek.

Bcc (Basal Cell Carcinoma)– BHK (bazalhujayralikarsinoma)

Hsv (Herpes Simplex Virus) – OVG (oddiyvirusligerpes)

Aids (Acquired Immunodeficiency Syndrome) – OITS (orttirilganimmunitettanqisligisindromi)

Omm (Oral Melanotic Macule) – OBMM (og'izbo'shlig'idagimelanotikmakula)

Information about the field of reference of medical abbreviations is presented by us in the form of

their thematic classification. It clearly shows how medical abbreviations objectify a fragment of the conceptosphere, relevant for English-speaking medical specialists. Using the data on medical abbreviations also in Uzbek, we conclude that the abbreviation as a means of verbalizing a medical concept-concept, as a way of reflecting a professional picture of the world, most fully realizes itself in English.

Medical abbreviations appear extremely quickly, as evidenced by the appendix, where we provide medical abbreviations that are not registered in dictionaries. We believe that our glossaries of English omoacronyms and English abbreviations that are not included in the dictionaries will be useful for revealing their subject meaning, and the glossary of Uzbek medical abbreviations will be the first step in streamlining and modeling Uzbek abbreviations in medicine.

The synonymy of English medical abbreviations has both positive aspects (brings wealth and diversity to the context of scientific speech, expresses the shades of the diversity of the world around us, reflects the development of a professional picture of the world), and negative aspects (increases the amount of "collapsed" information, reducing its availability due to simultaneous functioning several signifiers to indicate the same signified).

Based on the classification criterion, the level of coincidence of the volume and the qualitative side (semantics) of synonyms abbreviations, we distinguish two large classes of English medical synonyms: full synonyms (abbreviations with full semantic interchangeability) and incomplete synonyms (abbreviations that express different shades of one and the same concept or related concepts of different sizes). Incomplete synonyms enrich the medical discourse with new shades, fixing different signs of the same concept, due to which a more complete picture is formed about it.

PUPPP – Pruritic Urticarial Papules Plaques of Pregnancy

PV – Pemphigus Vulgaris

Antonymy of the English medical abbreviation helps to balance the signs within the acronym system. Most often, antonyms form pairs, building the extreme points of a particular attribute on either side of a particular criterion. According to the semantic characteristics, the abbreviations antonyms can also be divided into full (characterizing opposite poles of one characteristic, they have an equal volume of values) and incomplete (differ in volume of values, overlapping only part of the value of their antagonist)

IV. Conclusion

The results of the research on the above mentioned sublanguage of clinical medicine at the level of linguistic observations of the functioning in dictionaries and scientific works will not only highlight the linguistic aspects of professional medical terms, but also will help the linguists to master the etymology of professional terms.

Streamlining abbreviations in the field of medicine can be achieved by means of a more thorough study of medical abbreviations, training of medical specialists in their competent use, as well as through modeling, fixing the most convenient, short and capacious structures in medical discourse.

These terms not only enrich the language, demonstrating the vitality and power of its expression, but also are associated with medicine, which basically have an influence in a person's life.

The results of the study can be used in the preparation of medical students studying English in higher educational institutions, as well as in the teaching of translation disciplines in the preparation of students of linguistic universities.

The materials of this study can also be used in compiling a special English-Uzbek dictionary of medical abbreviations.

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Fellows/Associates of Medical Research Council

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21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

INDEX

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