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Discovering Thoughts, Inventing Future

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Balance and Fall Risk Outcome Measures for Patients 65 Years or Older in the Outpatient Physical Therapy Setting: What are the Current Trends?

By Debra R. McDowell, PT, PhD, Denise Gobert, PT, MEd. PhD, Tate Jarzombek, DPT, Taylor Koudela, DPT, Katelynn McGrath, DPT & Rachel Raulerson, DPT

Texas State University

Abstract- *Background & Objectives:* Occurrence of falls in older adults contributes to increased morbidity and mortality, exponential healthcare costs, and reduced quality of life. Utilization of outcome measures for screening and assessing fall risk in older patients contributes to reduced fall-related injuries, deaths, and healthcare costs, while promoting improved mobility and health status. The purpose of this study was to explore the utilization of outcome measures assessing balance and fall risk in patients 65 years and up within the outpatient physical therapy setting. Secondary aims included determining the most frequently used outcome measures as well as examining any associations between demographic variables and clinicians' screening habits.

Keywords: *older adults, geriatrics, falls, balance, outcome measures, screening, physical therapy practice.*

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Balance and Fall Risk Outcome Measures for Patients 65 Years or Older in the Outpatient Physical Therapy Setting: What are the Current Trends?

Debra R. McDowell, PT, PhD [α], Denise Gobert, PT, MEd. PhD [σ], Tate Jarzombek, DPT [ρ], Taylor Koudela, DPT [ω], Katelynn McGrath, DPT [¥] & Rachel Raulerson, DPT [§]

Abstract- Background & Objectives: Occurrence of falls in older adults contributes to increased morbidity and mortality, exponential healthcare costs, and reduced quality of life. Utilization of outcome measures for screening and assessing fall risk in older patients contributes to reduced fall-related injuries, deaths, and healthcare costs, while promoting improved mobility and health status. The purpose of this study was to explore the utilization of outcome measures assessing balance and fall risk in patients 65 years and up within the outpatient physical therapy setting. Secondary aims included determining the most frequently used outcome measures as well as examining any associations between demographic variables and clinicians' screening habits.

Methods and Measures: Physical therapists and physical therapist assistants were contacted via email with a link to an online survey that included questions regarding demographic data, physical therapy practice, and utilization of outcome measures for balance and fall risk. Frequency distributions were generated to illustrate demographic variables and Pearson Chi-squared analysis was used to explore associations between demographic variables and the utilization of outcome measures to screen balance in patients 65 years and older.

Keywords: older adults, geriatrics, falls, balance, outcome measures, screening, physical therapy practice.

Abstract- Background and Objectives: Occurrence of falls in older adults contributes to increased morbidity and mortality, exponential healthcare costs, and reduced quality of life. Utilization of outcome measures for screening and assessing fall risk in older patients for implementation of plan of care contributes to reduced fall-related injuries, deaths, and healthcare costs, while promoting improved mobility, function, and health status. These outcome measures are described and recommended by the American Geriatric Society, American Physical Therapy Association, Academy of Neurologic Physical Therapy, and Academy of Geriatric Physical Therapy. The first purpose of this study was to explore the utilization of outcome measures that assess balance and fall risk in patients who are adults 65 years and older within the outpatient physical therapy setting. Secondary purposes included determining the most frequently used outcome measures and examining associations between demographic variables and clinicians' screening habits.

Methods and Measures: This study consisted of a confidential short survey distributed from November 2019 to April 2020 using Qualtrics Survey Software. A convenience sample of 205 licensed physical therapists (PTs) (n=185) and physical therapist assistants (PTAs) (n=20) who practice in an outpatient physical therapy setting and treat older adults in Texas. Participants identified through a Texas Physical Therapy Association database of licensed PTs and PTAs completed the survey with questions regarding demographic data, physical therapy practice, and utilization of outcome measures for balance and fall risk. Frequency distributions were generated to illustrate demographic variables and Chi square analyses (p=0.05) were used to explore associations between demographic variables and utilization of the outcome measures.

Results: Most respondents (66.83%) reported screening all older adults 65 years and older for balance and fall risk, regardless of diagnosis or condition. A significant positive relationship was found between the Years of Practice category and whether or not patients were screened and between the Percentage of Elders Treated in Practice categories and whether or not a clinician screened all elders over 65 for fall risk. The outcome measures most frequently utilized were the Timed Up and Go (86.57%), Berg Balance Scale (68.16%), and 5 Time Sit to Stand (64.18%).

Conclusion: This study indicated that nearly 1/3 (33.17%) of practicing PTs and PTAs in the outpatient physical therapy setting are not assessing adults 65 years and over for balance dysfunction and fall risk despite current recommendations, thus potentially neglecting to identify at-risk patients. The 3 diagnostic tests and measures most often utilized to assess fall risk were the Timed Up & Go (86.57%), Berg Balance Scale (68.16%), and the 5-times sit-to-stand (64.18%).

Clinical Relevance: Results may assist practicing PTs and PTAs with recognizing that it is essential that utilization of balance and fall risk outcome measures are incorporated into clinicians' practice to improve the standard of care when treating adults 65 years and older. Furthermore, this study may guide PTs and PTAs with the selection of continuing education that addresses the appropriate outcome measures that are recommended for evidenced-based practice.

Keywords: older adults, falls, balance, outcome measures, screening, physical therapy practice.

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I. Introduction

The rising occurrence of falls in older adults is a major public health concern due to its impact on health outcomes, quality of life, and treatment costs.[1-5] Proper screening and assessment by physical therapy practitioners with the implementation of appropriate outcome measures to identify at-risk patients can greatly reduce the occurrence of falls in older adults. This study was designed to explore physical therapists' and physical therapist assistants' utilization of evidence-based outcome measures to screen and assess for balance and fall risk in adults 65 years and up.

II. Background

Nearly ⅓ of all adults 65 years and older fall annually secondary to numerous intrinsic and extrinsic factors, including neuromuscular impairments, functional mobility deficits, lower extremity muscle weakness, medication side effects, and environmental obstacles.[1-5] This subsequently leads to an increased risk of recurrent falls by 50 percent. Falling incidents are the leading cause of unintentional death and are the most common mechanism for fractures and traumatic brain injuries for patients 65 years and older.[6-8] Previous literature has established that well-designed exercise interventions significantly prevent falls in the general older adult population with some studies indicating a 30% decrease in falls in the group receiving exercise intervention compared to the control group. [9-12]Decreasing falls to this extent results in a potential decrease in healthcare expenditure by 94 to 422 million dollars annually.[13] Additionally, falls are not only responsible for exponential healthcare costs and increased morbidity and mortality rates, but they also lead to decreased community mobility, a fear of falling, and an increased likelihood of early admission to long-term care facilities or nursing homes.[14]

Screening, assessment, and management of patients who may be at a risk of falling is within the scope of physical therapy practice and is recommended to be implemented as part of the plan of care in order to improve overall health outcomes for the geriatric population.[15]Numerous representatives for this population, including the American Geriatric Society (AGS), American Physical Therapy Association (APTA), Academy of Neurologic Physical Therapy (ANPT), Academy of Geriatric Physical Therapy (AGPT), and the Centers for Disease Control and Prevention (CDC), state that all individuals over the age of 65 years should be screened for risk of falling, regardless of their condition or diagnosis. Several of these institutions have also released best practice recommendations or clinical prediction guidelines designed to assist healthcare individuals during the screening and assessment process, which include the implementation of outcome measures targeted for balance and fall risk.[4,10,14-17]

A significant number of fall risk assessment tools have been identified as having good reliability and good validity for identifying fall potential with community-dwelling older adults. Park (2018) performed a systemic review and meta-analysis on diagnostic studies through June 2016 to assess which of these tools best predict the risk of falls in the elderly. Results suggested that two assessment tools used in combination as opposed to a single assessment tool maximizes the characteristics and predictability of each test. Furthermore, it was concluded that for assessing the risk of falls among community-dwelling older adults, the Timed Up and Go (TUG) test and the Berg Balance Scale (BBS) should be used in combination to increase diagnostic accuracy of the older adult's fall risk.[18] Lusardi, et al (2017) also performed a systematic review and meta-analysis using posttest probability of the existing literature to assist clinicians with selecting the best diagnostic tool(s) to examine an older adult's risk of falling. They concluded that the BBS, TUG, and the 5-times sit-to-stand (FTSTS) test are currently the most evidence-supported functional measures to determine the risk of future falls for community-dwelling older adults.[19]

Research has previously established that physical therapist or physical therapist assistant utilization of outcome measures to screen and provide a multifactorial assessment of balance and fall risk in patients 65 years and older is an essential aspect of their rehabilitation. This practice aids in the reduction of falls, fall-related injuries, fall-related deaths, and healthcare expenses, while promoting patient quality of life, community mobility, and social participation. However, more research is needed to determine whether these measures are consistently being utilized in outpatient physical therapy practice.

Therefore, the primary purpose of this study was to explore the utilization of outcome measures to assess balance and fall risk in patients 65 years and up within the outpatient physical therapy setting. Secondary aims included determining the most frequently used outcome measures as well as association between clinician demographic variables and screening habits. Our primary research question was: Is there sufficient utilization of standardized outcome measures to assess balance and fall risk in geriatric patients treated in the outpatient physical therapy setting? Our second research question was: Are common practice, standardized outcome measures utilized by PTs and PTAs in outpatient settings the same tools recommended by current research evidence?

III. Methods

The study was conducted from November 2019 to April 2020 by four Doctor of Physical Therapy (DPT)

students at Texas State University. Participants were recruited by means of non-probability, convenience sampling through a physical therapist and physical therapist assistant licensure database provided by the Texas Physical Therapist Association. All participants were sent a survey which included informed consent prior to participation and informed about their right to withdraw at any point during the survey process. Inclusion criteria required that participants needed to be a licensed, practicing physical therapist or physical therapist assistant, practice in an outpatient physical therapy setting, and be involved in the treatment of patients aged 65 years or older. This study was approved by the Institutional Review Board (IRB) of Texas State University, San Marcos, Texas on August 30, 2019.

Qualtrics Survey Software was used for survey distribution and collection of participant responses. This system requires a two-step login process to further ensure participant confidentiality. The 23-item survey consisted of closed-ended multiple-choice questions with options to provide additional open-ended responses on select questions to gain as much pertinent information as possible. The survey also provided outcome measures as answer choices for clinical utilization based on recommendations regarding screening and assessing balance in those 65 years and older from several organizations, including the APTA, ANPT, AGPT, AGS, and the CDC.[6,14-18] In addition, the survey also included items regarding level of education, APTA sections, and postgraduate training, such as continuing education, board certifications, residency training, or fellowships, developed based on information retrieved from the American Board of Physical Therapy Residency and Fellowship Education (ABPTRFE) website.[19-20] Demographic data was included in the survey, however no personal identifiable information was collected. All responses were recorded anonymously and confidentiality was maintained according to the IRB protocol.

a) Data Analysis

All survey responses were either nominal or ordinal data measurement levels therefore non-parametric statistical analysis methods were conducted using SPSS (IBM vs. 26). Statistical analysis included Pearson's Chi Square frequency contingency tables to explore demographic and clinic data in terms of descriptive trends and bivariate relationships with an alpha level set at $p = 0.05$.

IV. Results

A total of 574 survey responses were recorded, with 205 participants meeting the inclusion criteria for this study. Demographic data was collected for each member, which consisted of age, gender, professional license, level of education, state of education, state of practice, number of years in practice, and APTA membership status (Figures 1, 2). Of the 205 responses, 185 (90.24%) were licensed physical therapists and 20 (9.76%) were licensed physical therapist assistants. The majority of the participants received their education (65.69%) and practiced (93.17%) in the state of Texas. Participants were asked to report their entry-level physical therapy degree as well as any additional PT degrees earned (Figure3).Out of the participants surveyed, 21.95% were board certified specialists in at least one area, 7.32% completed residency programs, and 3.9% completed fellowship programs.

Of the 205 participants, 51.71% reported that at least 50% of their caseloads involved patients who are 65 years or older. Only 66.83% of participants reported that they screen balance and fall risk on all patients age 65 and older, regardless of their diagnosis or condition. When questioned what percentage of 65+ year old patients are treated for balance and fall risk, regardless of their diagnosis or condition, 2 respondents stated 0%, 52 stated 1-25%, 63 stated 25-50%, 54 stated 51-75%, and 34 stated 75-100% (Figures 4-6)

Participants were prompted to select all balance outcome measures that they regularly utilized in practice for screening and assessing balance. Of those selected, the Timed Up and Go (TUG), Berg Balance Scale (BBS), and the 5-Time Sit to Stand (FTSTS) were the three most frequently utilized measures, with rates of 86.57%, 68.16%, and 64.18%, respectively. When asked to select the top three most utilized outcome measures, the top responses remained the TUG (145/197 respondents), BBS (102/197 respondents), and FTSTS (101/197 respondents). (Tables 1,2)

Results from Pearson's Chi Square analysis indicated that there was no significant association between whether clinicians screened patients for balance and fall risk regardless of diagnosis or condition and APTA membership status ($p=0.137$), age groups ($p=0.152$), highest physical therapy degree earned ($p=0.432$), or whether the clinician was a PT or PTA ($p=0.237$). However, there was a significant positive relationship found between years of practice category and whether or not patients were screened for balance and fall risk regardless of diagnosis or condition ($X^2 = 24.70$, $p = 0.018$).

There was also a significant predictive relationship between the Percentage of Elders Treated in Practice categories and whether or not a clinician screened all elders over 65 for balance problems ($X^2 = 34.551$, $p < 0.001$) with a large effect size as indicated by the Phi Coefficient ($\Phi = 0.411$, $p < 0.001$).

It must also be noted that 67.8% of respondents in our sample were biased towards younger ages or between 20 and 50 years of age categories ($X^2 = 95.029$, $p < 0.001$). In addition, a significant proportion of our sample or 48.8% were in practice less than 15 years (Categories: 11-15, 6-10, 1-5 and <1 years)($X^2 =$

72.122, $p < 0.001$). Other findings indicated a significant bias to one primary area of practice, Orthopaedics ($X^2 = 557.015$, $p < 0.001$). What was surprising is that a significant number of respondents (62%) were not members of the APTA ($X^2 = 3.352$, $p = 0.001$). Finally, it was good to note that results indicated that a significant number of clinicians (65.8%) did screen elders 65 and older for balance and fall risks ($X^2 = 4.749$, $p < 0.001$).

V. Discussion

The findings of this study indicate that while many outpatient physical therapists are utilizing outcome measures to screen or assess balance and fall risk in patients 65+ years, nearly ⅓ of clinicians do not. Additional trends as presented in this study indicate that the most widely utilized outcome measures for assessing balance are the BBS,TUG and FTSTS though there are many other valid, reliable, and recommended outcome measures also being implemented. Utilization of the aforementioned outcome measures is consistent with recommendations regarding best practice and may contribute to an enhanced overall plan of care for this patient population.[15]

Findings about trends with high percent use of BBS, TUG and FTSTS aligned with findings of Park (2018) who indicated evidence-based value of combination of tests.[21]The trends from this study also agree with Lusardi, et al (2017) who concluded that these 3 diagnostic tools are currently the most evidence-supported functional measures to determine the risk of future falls for community-dwelling adults.[19] Additionally, clinician years' experience and practice appear to influence whether or not patients 65 and over were screened for falls. This is in agreement with Stroud's study that included 316 physical therapist respondents.[23]

APTA membership did not appear to influence whether or not screening took place however results may have been biased due to low proportion of memberships in general. Previous evidence is conflicting with Stroud (2014) having a positive association with APTA membership and the utilization of outcome measures, yet Anderson et. al. (2015) found outcome measures utilization was not significantly correlated with APTA membership.[23,24]

The lack of implementation of these screening tools into practice could potentially lead to an increased occurrence of falls in this patient population, thus resulting in increased healthcare expenditure, morbidity, and mortality rates, and decreased independence and quality of life.

Clinical Implications

This study raises consequential clinical implications for outpatient physical therapists and physical therapist assistants. To assist in the prevention of falls, it is essential that all outpatient physical therapy practitioners incorporate a component of screening and assessing balance and fall risk for all patients 65+ years old into their clinical practice. These clinicians have the potential to make a significant impact on numerous personal facets for this patient population, as well as on global and national healthcare expenditure. PTs and PTAs have the responsibility for continued education and maintenance of knowledge regarding best clinical practice guidelines concerning screening and multifactorial assessments for balance of fall risk in order to improve the standard of care for the geriatric patient population.

The use of these tools will also become increasingly important as reimbursement models shift from quantity-based care to quality-based care, as they provide quantitative data on a patient's progression throughout the course of treatment, which directly translates to justification of services.[18] With Medicare's recent implementation of the Quality Payment Program (QPP), Merit-Based Incentive Payment Systems (MIPS) will become one of the focal means of justifying treatment to obtain reimbursement of services. This system utilizes outcome measures, specifically those relating to fall risk, to illustrate medical necessity and patient progress, which then determines reimbursement rates. Therefore, Medicare reimbursement rates are directly related to participation in MIPS and the utilization of outcome measures, thus reinforcing the importance of adopting regular screening protocols into clinicians' physical therapy practice.[25,26]

Limitations

This study is limited in terms of generalizability as the sample was biased largely towards clinicians practicing in Texas secondary to the convenience sampling method utilized. Recent graduates with physical therapy degrees were also largely underrepresented. In addition, this study was limited to the outpatient setting only, which does not account for the utilization of these tools in other practice environments, such as skilled nursing facilities and hospital-based, inpatient rehabilitation units. Additionally, the survey was only offered in English, thus potentially eliminating participants due to a language barrier. Finally, statistical analysis methods used only non-parametric statistics. Future studies should consider more parametric measures to support multivariate regression prediction models about population trends.

VI. Conclusion

Incorporation of outcome measures to screen and assess balance and fall risk for all patients 65 years or older, regardless of their diagnosis or condition, is vital for the prevention of falls in this patient population. Despite numerous professional organizations'

recommendations to screen balance and fall risk in all patients 65 years and older, this study shows that only ⅔ of outpatient physical therapists are doing so. The failure to incorporate this into practice could potentially result in practitioners neglecting to identify a significant portion of the population that may be at risk for falls. Further research should be conducted to encompass a broader sample of outpatient physical therapists and physical therapist assistants to determine the incorporation of this practice in other regions across the United States. Moreover, potential future research to discern the clinical rationale for outcome measure selection would also be beneficial for the profession of physical therapy regarding the rehabilitation of the geriatric population.

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Abbreviations Used in Article

Abbreviations	Definitions
ABPTRFE	American Board of Physical Therapy Residency and Fellowship Education
AGPT	Academy of Geriatric Physical Therapy
AGS	American Geriatric Society
ANPT	Academy of Neurologic Physical Therapy
APTA	American Physical Therapy Association
BBS	Berg Balance Scale
CDC	Centers for Disease Control and Prevention
FTSTS	5-Times Sit-to-Stand
IRB	Institutional Review Board
MIPS	Merit-Based Incentive Payment Systems
PTAs	Physical Therapist Assistants
PTs	Physical Therapists
QPP	Quality Payment System
TUG	Timed Up and Go

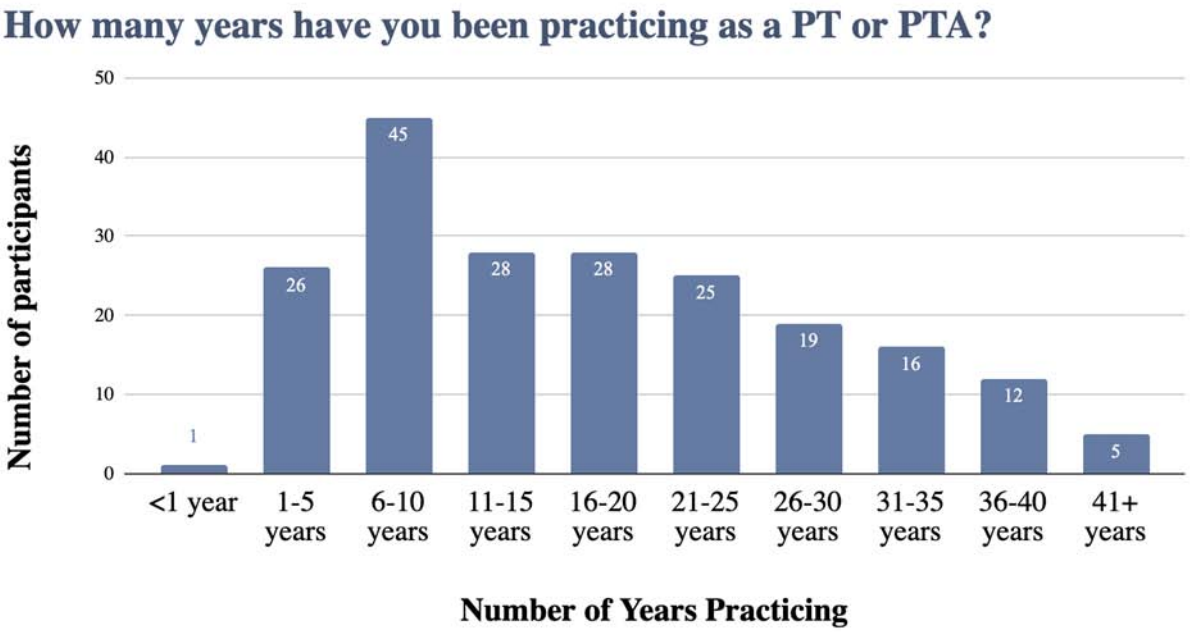

Figure 1: Number of Years Practicing

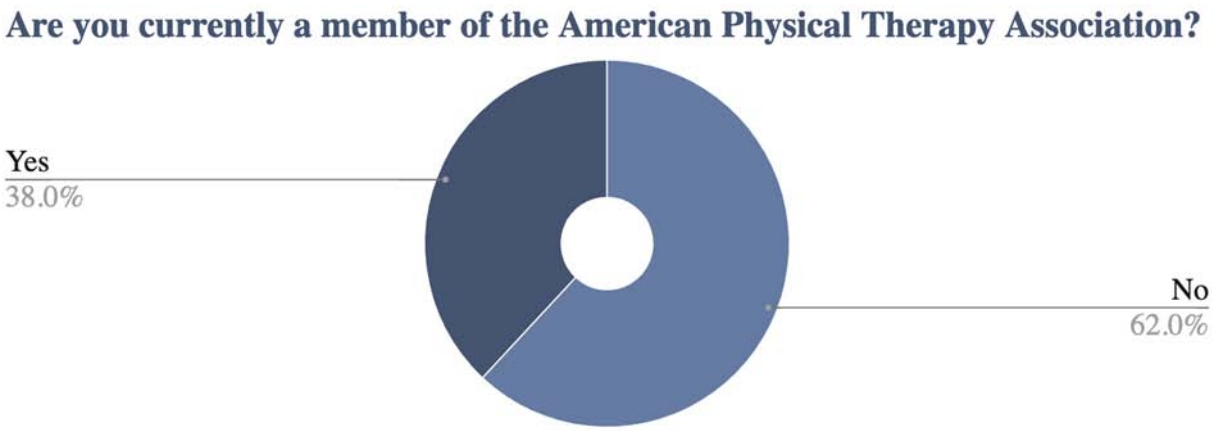

Figure 2: APTA Membership

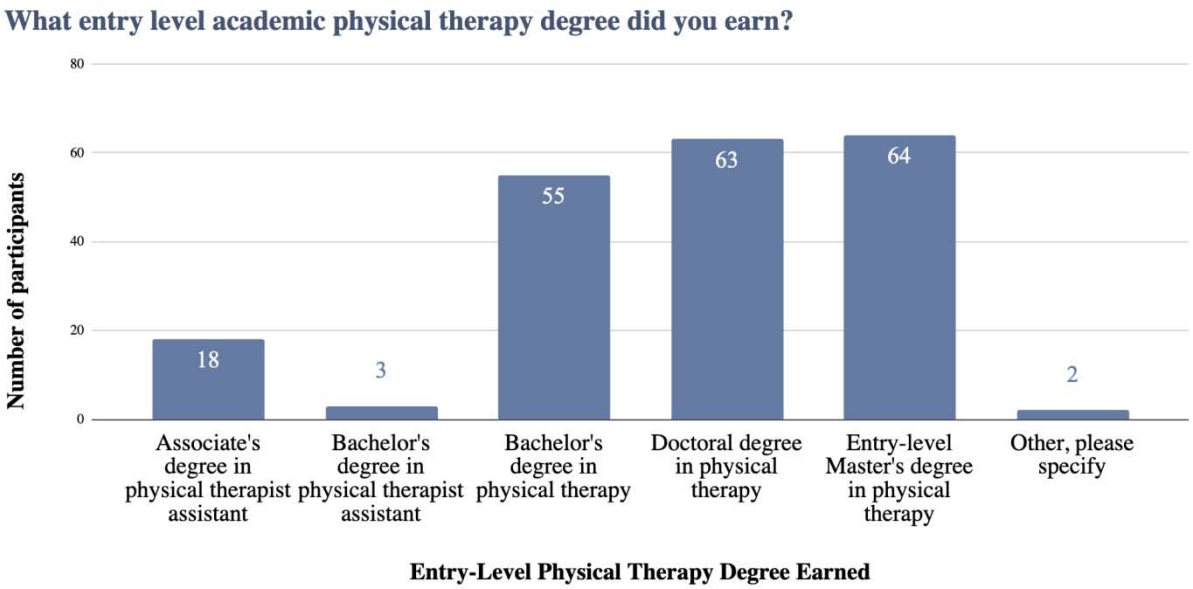

Figure 3: Entry – Level Physical Therapy Degree

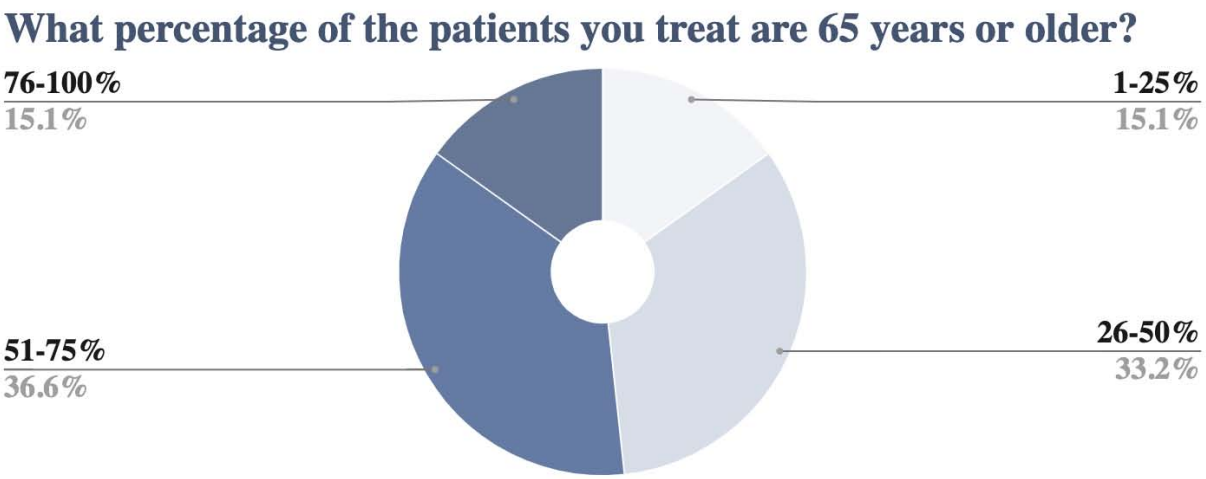

Figure 4: Caseload Age

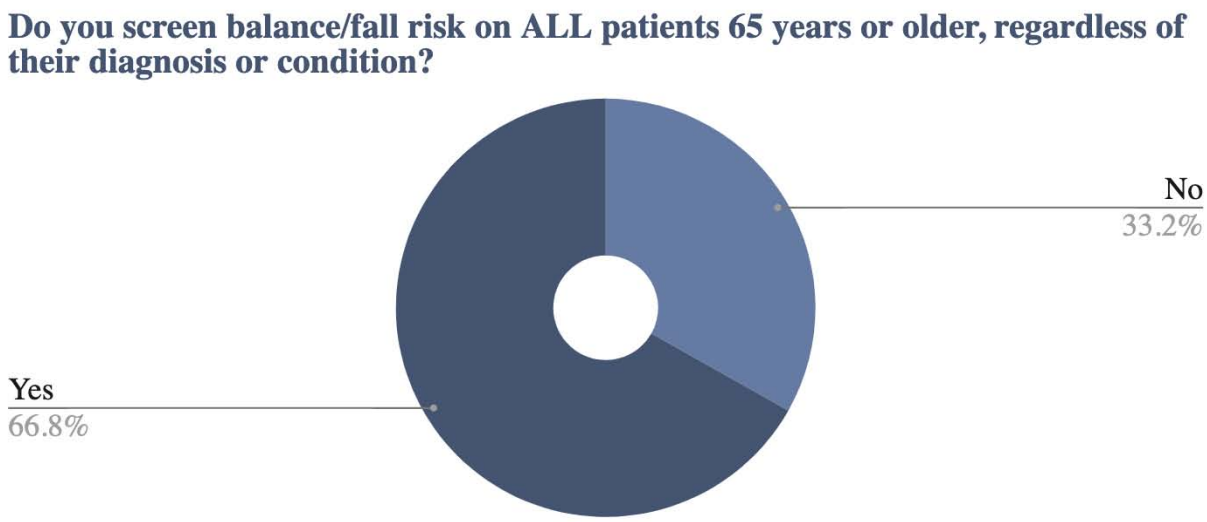

Figure 5: Screen Balance/Fall Risk

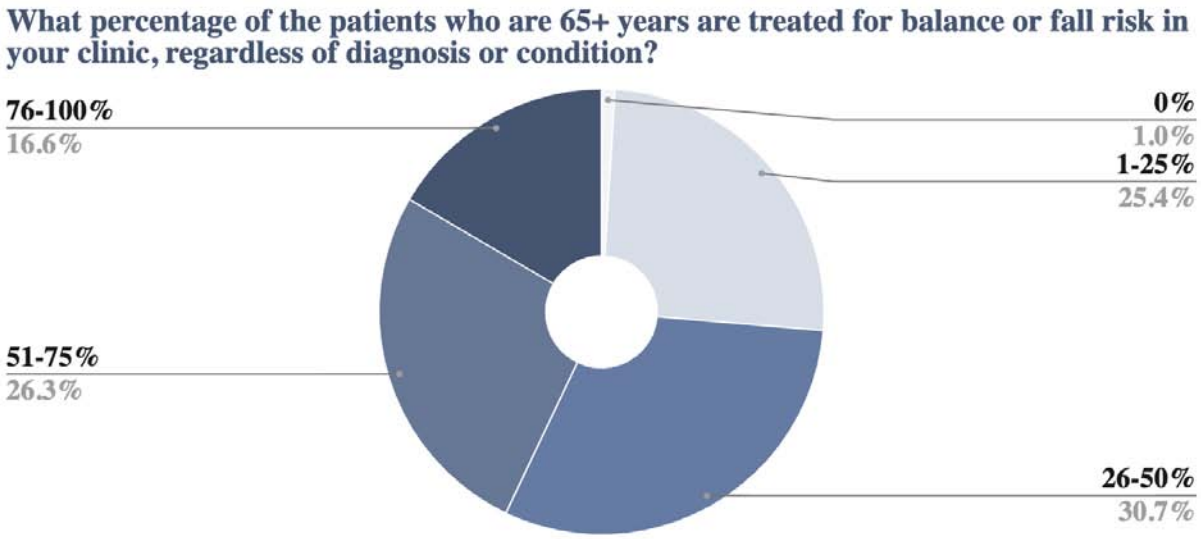

Figure 6: Treat Balance/Fall Risk

Table 1: All Utilized Balance Outcome Measures

Q22 Which outcome measures do you regularly utilize in your practice?	Count	Percent of n
Activities Specific Balance Confidence Scale (ABC)	57	28.36%
Balance Evaluation Systems Test (BEST)	10	4.98%
Berg Balance Scale (BBS)	137	68.16%
Clinical Test of Sensory Integration of Balance (CTSIB)	39	19.40%
Dynamic Gait Index (DGI)	90	44.78%
5 Time Sit to Stand (FSTS)	129	64.18%
Fullerton Advanced Balance Scale (FAB)	3	1.49%
Functional Reach Test	40	19.90%
Functional Gait Assessment (FGA)	45	22.39%
MiniBEST	27	13.43%
Performance Oriented Mobility Assessment (POMA)	8	3.98%

10 Meter Walk Test (10MWT)	39	19.40%
Timed Up and Go (TUG)	174	86.57%
Other, please specify	48	23.88%
Grand Total of Responses	**846**	
Total Number of Participants (n)	**201**	

Table 2: Top Three Utilized Balance Outcome Measures

Q23 Of the outcome measures that you selected in the previous question, please select the three measures that you most frequently utilize clinically.	Count	Percent of n
Activities Specific Balance Confidence Scale (ABC)	29	14.72%
Balance Evaluation Systems Test (BEST)	3	1.52%
Berg Balance Scale (BBS)	102	51.78%
Clinical Test of Sensory Integration of Balance (CTSIB)	16	8.12%
Dynamic Gait Index (DGI)	47	23.86%
5 Time Sit to Stand (FSTS)	101	51.27%
Fullerton Advanced Balance Scale (FAB)	0	0.00%
Functional Reach Test	7	3.55%
Functional Gait Assessment (FGA)	22	11.17%
MiniBEST	12	6.09%
Performance Oriented Mobility Assessment (POMA)	5	2.54%
10 Meter Walk Test (10MWT)	19	9.64%
Timed Up and Go (TUG)	145	73.60%
Other, please specify	32	16.24%
Grand Total of Responses	**540**	
Total Number of Participants (n)	**197**	

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Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food-Universal Design Food: UDF (Can be Crushed with Gums)

By Mayumi Hirabayashi, Shoko Kondo & Naomi Katayama

Nagoya Women's University

Abstract- In Japan, a super-aging society, there is much debate about how to provide safe home care in the future. To provide safe nursing care food, it is necessary to consider not only the nutritional aspect of the diet but also the dietary form. In the case of diminished or impaired swallowing function, it is useful that the viscosity of the diet matches the ability of the care recipient to swallow the food. Therefore, in this study, we report the viscosity measurement using a commercially available thickener and a commercially available universal design food (which can crush with gums) by changing the blending amount and combination of them. In this study, we used commercially available thickener A, and thickener B, which can purchase at pharmacies and three types of commercially available universal design foods (which can crush with gums) can purchase at pharmacies. In the case of foods having a large amounts of carbohydrates, the thickener B (high in thickening polysaccharides) can stabilize the viscosity and is suitable for adjusting the viscosity.

Keywords: *thickener, nursing food, viscosity test.*

GJMR-K Classification: *NLMC Code: QT 235*

Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food-Universal Design Food: UDF (Can be Crushed with Gums)

Mayumi Hirabayashi [α], Shoko Kondo [σ] & Naomi Katayama [ρ]

Abstract- In Japan, a super-aging society, there is much debate about how to provide safe home care in the future. To provide safe nursing care food, it is necessary to consider not only the nutritional aspect of the diet but also the dietary form. In the case of diminished or impaired swallowing function, it is useful that the viscosity of the diet matches the ability of the care recipient to swallow the food. Therefore, in this study, we report the viscosity measurement using a commercially available thickener and a commercially available universal design food (which can crush with gums) by changing the blending amount and combination of them. In this study, we used commercially available thickener A, and thickener B, which can purchase at pharmacies and three types of commercially available universal design foods (which can crush with gums) can purchase at pharmacies. In the case of foods having a large amounts of carbohydrates, the thickener B (high in thickening polysaccharides) can stabilize the viscosity and is suitable for adjusting the viscosity.

On the other hand, in the case of foods having a small number of carbohydrates, the thickener A (high in water-soluble dietary fiber) can stabilize the viscosity and is suitable for adjusting the viscosity. After all, there is thickener that is compatible with food materials and nutrients contained in foods. In the future, we could like to measure the viscosity of more food materials and thickener combinations.

Keywords: thickener, nursing food, viscosity test.

I. Introduction

Older adults in need of nursing care may have problems with the oral cavity, lose their teeth, and cannot chew food sufficiently, resulting in reduced food intake and malnutrition. Therefore, physical dysfunction due to lack of muscle mass such as sarcopenia and flail due to lack of protein may occur. There is a meal that can be crushed with games in the universal design food (UDF) on the market. Since it can purchased at pharmacies, it is a useful consumption for home care. However, since the health condition of the subject in need of long-term care changes daily, it is difficult to adjust the shape and viscosity of the meal in the case of long-term care at home. Also, there are many types of thickener sold in pharmacies and the like, and the amount of viscosity adjustment varies. Therefore, it is necessary to consider the compatibility with the target food to adjust the viscosity, and we would like a report on the combination of the food and the thickener, and the amount of the thickener added as a guide. This study reports the results of measuring the viscosity by combining a commercially available universal design food and a commercially available thickener.

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II. Material and Methods

a) Commercially Available Thickeners

The two thickeners obtained at the pharmacy. The price of thickener A was 1296 yen (12 USD), and thickener B was 1274 yen (11.54 USD), which were almost the same price. Both contained 50 individual packages of 3 grams. The raw material of the thickener is that thickener A is 8.1kcal energy, 0g protein, 0g lipid, 2.04g sugar, 0.75g dietary fiber, and 18.6mg sodium per 3g, and thickener B is 7.9kcal energy, 0g protein, 0g lipid, 1.9g sugar, 0.7g dietary fiber and 16mg sodium per 3g.

b) Commercially Available Nursing food

Three types of products used from the can be crushed with gums of the universal design food (UDF) on the market. These are Sukiyaki, Sardine dumpling and Creamed chicken. All of them are 100g retort pouches and sold for 180 yen (1.67 USD). The nutritional value of Sukiyaki was 74 kcal, 3.1g protein, 3.2g lipid, 8.2g carbohydrates, and 0.96g salt equivalent per 100 grams. The nutritional value of Sardine dumpling was 45kcal, 1.8g protein, 1.3g lipid, 6.5g carbohydrates, and 0.68g salt equivalent per 100 grams. The nutritional value of Creamed chicken was 77 kcal, 3.5g protein, 4.0g lipid, 6.8g carbohydrates, and 0.78g salt equivalent per 100 grams.

c) Sample (food with thickener added) adjustment

Each of the three foods prepared as five samples.

1) The viscosity of the food product itself measured without any modification.
2) The food was pulverized for 20 seconds using a mixer into a liquid state, and the viscosity was measured.
3) The viscosity measured after adding 1 gram of thickener (A or B) to the food (100g) ground for 20 seconds with a mixer and stirring for 5 minutes.
4) The viscosity measured after adding 2 grams of thickener (A or B) to the food (100g) ground for 20 seconds with a mixer and stirring for 5 minutes.
5) The viscosity measured after adding 3 grams of thickener (A or B) to the food (100g) ground for 20 seconds with a mixer and stirring for 5 minutes.

d) Viscosity measurement method

The viscosity of each food was measured using the Line Spread Test Start Kit (LST) manufactured by SARAYA. The measurement procedure is as follows. The viscosity test performed at 24 degrees (room temperature). The test repeated three times, and the average value calculated.

1. Place the sheet on a level surface. Place a ring with an inner diameter of 30mm in the center of the concentric circles.
2. Add the liquid to be measured to the full thickness of thering (20ml) and let stand for 30 seconds.
3. Lift the ring vertically and, after 30 seconds, measure the spread distance of the solution. Since there are a total of 6 points to measure, the average value of them used as the LST value.
4. After still standing for 5 minutes, the spread of the samples is measured again at 6 points, and the average value recorded as the LST value.

e) Criteria for viscosity

There are three levels of classification by LST value[1)]. The first stage is the mildly thick with a viscosity that falls within the range of 43mm to 36mm (50-150 mPa・s). As for the properties, when the spoon is tilted, it flows down quickly[1)]. The second stage is moderately thick with a viscosity that falls within the range of 36mm to 32mm (150-300 mPa・s). As for the properties, when you tilt the spoon, it flows to the surface[1)]. The third stage is extremely thick with a viscosity that falls within the range of 32mm to 30mm (300-500 mPa・s). Even if the spoon is tilted, the shape maintained to some extent, and it does not flow easily[1)].

f) Statistical processing

This study was statistically processed using statistical processing software, Excel 2010 (SSRI Co., Ltd). The data to be compared were first tested for normal distribution by F-test. For comparisons between correlated data, the paired Student t-test used for normally distributed data. Wilcoxon test used for non-normally distributed data. For comparisons between uncorrelated data, the unpaired Student t-test used for non-normally distributed data. Mann-Whitney test used for non-normally distributed data.

III. Result

a) Result of Sukiyaki LST test

Table 1 shows the results of viscosity measurement performed by adding the thickener Ain Sukiyaki. As a result of measuring the viscosity of commercial care food without treatment, it found to be the stage 3 (Extremely thick) after 30 seconds, but after 5 minutes, the stage changed the stage 2 (Moderately thick). The result of viscosity measurement after the mixer treatment was also the stage 3 (Extremely thick) after 30 seconds, but after 5 minutes age changed stage 1 (Mildly thick). It found that there is a statistical advantage after 5 minutes rather than 30 seconds, and the viscosity loosens and spreads. However, when the thickener A was added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 2 shows the results of the viscosity measurement performed by adding the thickener B in Sukiyaki. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 1. Universal Design Food : UDF(Can be crushed with gums) Sukiyaki (Thickener A)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 min
Average value	29.3	33.3	30.7	46.4	29.9	30.6	24.1	24.2	21.6	22.3
SD	3.0	2.8	2.9	47.6	1.4	1.0	5.3	5.4	6.2	7.1
F test	P=0.386		P=0.0001**		P=0.125		P=0.481		P=0.302	
Paired Student-t	p=0.0001**				p=0.049*		P=0.579		P=0.012*	
Wilcoxon			p=0.001**							

* P<0.05, ** P<0.01

Table 2. Universal Design Food : UDF(Can be crushed with gums) Sukiyaki (Thickener B)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 min
Average value	29.3	33.3	30.7	46.4	25.9	28.4	22.9	25.0	21.9	21.4
SD	29.3	33.3	30.7	46.4	25.9	28.4	22.9	25.0	21.9	21.4
F test	P=0.306		P=0.0001**		P=0.371		P=0.474		P=0.433	
Paired Student-t	p=0.0001**				P=0.0001**		P=0.001**		P=0..461	
Wilcoxon			p=0..001**							

* P<0.05, ** P<0.01

b) Result of Sardine dumpling LST test

Table 3 shows the results of viscosity measurement performed by adding the thickener A in Sardine dumpling. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 2 after 30 seconds and Stage 1 after 5 minutes. The viscosity after the mixer treatment was in stage 1 after 30 seconds and in stage 1 after 5 minutes. When 1g of thickener A added, the viscosity was Stage 2 after 30 seconds and after 5 minutes. When the thickener A added in 2g or 3g at the food, the viscosity was in Stage 3 after 30 seconds and 5 minutes.

Table 4 shows the results of viscosity measurement performed by adding the thickener B in Sardine dumpling. When 1g of thickener B added, the viscosity was Stage 2 after 30 seconds and Stage 1 after 5 minutes. The viscosity when the thickener B added in 2g or 3g was in Stage 3 after 30 seconds and 5 minutes.

Table 3. Universal Design Food : UDF(Can be crushed with gums) Sardine dumpling (Thickener A)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 min
Average value	35.9	38.6	36.3	40.2	32.3	35.2	24.2	25.4	22.9	22.8
SD	5.2	5.2	2.9	3.3	1.2	1.4	6.5	7.0	8.5	9.1
F test	P=0.498		P=0.270		P=0.304		P=0.389		P=0.383	
Paired Student-t	P=0.003**		P=0.0001**		P=0.0001**		P=0.OO0**		P=0.805	
Wilcoxon										

* P<0.05, ** P<0.01

Table 4. Universal Design Food : UDF(Can be crushed with gums) Sardine dumpling (Thickener **B**)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 min
Average value	35.1	38.6	36.3	40.2	35.4	38.0	25.8	26.6	22.1	22.6
SD	5.4	5.2	2.9	3.3	2.8	1.9	6.8	7.1	8.1	8.3
F test	P=0.419		P=0.270		P=0.057		P=0.434		P=0.455	
Paired Student-t	P=0.0001***		P=0.0001**		P=0.001**		P=0.415		P=0..626	
Wilcoxon										

* P<0.05, ** P<0.01

c) Result of Creamed chicken LST test

Table 5 shows the results of the viscosity measurement performed by adding the thickener A in Creamed chicken. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 2 after 5 minutes. The viscosity after the mixer treatment was in stage 2 after 30 seconds and in stage 1 after 5 minutes. The thickener A added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 6 shows the results of the viscosity measurement performed by adding the thickener B in Creamed chicken. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 5. Universal Design Food : UDF(Can be crushed with gums) Creamed chicken (Thickener A)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 min
Average value	29.1	32.1	35.7	38.9	27.8	28.6	24.3	25.2	20.6	21.9
SD	3.3	3.6	3.1	1.2	2.2	2.4	6.0	6.4	7.8	8.3
F test	P=0.358		P=0.0001**		P=0.405		P=0.405		P=0.389	
Paired Student-t	P=0.0001**		P=0.0001**		P=0.012*		P=0.0001**		P=0.215	
Wilcoxon										

* P<0.05, ** P<0.01

Table 6. Universal Design Food : UDF(Can be crushed with gums) Creamed chicken (Thickener **B**)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 se	After 5 mir	After 30 se	After 5 min	After 30 se	After 5 mir	After 30 se	After 5 mir	After 30 se	After 5 min
Average value	29.1	32.1	35.7	38.9	27.9	29.1	23.6	22.9	20.9	21.3
SD	3.3	3.6	3.1	1.2	1.8	2.6	5.0	6.8	7.9	8.3
F test	P=0.358		P=0.0001**		P=0.068		P=0.098		P=0.407	
Paired Student-t	P=0.0001**		P=0.0001**		P=0.041		P=0.690		P=0..006**	
Wilcoxon										

* P<0.05, ** P<0.01

d) Results of comparison of two thickeners

The result of comparing the stability of the two types of thickeners shown in Table 7, 8, and 9.

In the case of the Sukiyaki, when 1g of thickener added, both thickeners A and B became Stage 3 after 30 seconds and after 5 minutes. Thickener B was statistically significantly more stable than A. (to see Table 7).

In the case of Sardine dumplings, when 1g of thickener added, both thickeners A and B became Stage 2 after 30 seconds. After 5 minutes, thickener A was Stage 2, but thickener B was Stage 1. Thickener A was statistically significantly more stable than B. When a thickener added 2g or 3g, the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3 (see Table 8).

In the case of Creamed chicken, when the thickener A or B was added (1g or 2g or 3g), the LST value did not change stably even after 30 seconds or after 5 minutes as compared with both thickener. The viscosity was within Stage 3 (see Table 9).

Table 7. Comparison of viscosities with two thickeners (A and B) in Sukiyaki

	1g thickener, After 30		1g thickener, After 5		2g thickener, After 30		2g thickener, After 5		3g thickener, After 30		3g thickener, After 5	
	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener
Average value	29.9	25.9	30.6	28.4	24.1	22.9	24.2	25.0	21.6	21.9	22.3	21.4
SD	1.4	4.5	1.0	4.9	5.3	9.2	5.4	9.4	6.2	9.4	7.1	9.0
F test	P=0.0001**		P=0.0001**		P=0.012 *		P=0.011*		P=0.047*		P=0.157	
Unpaired Student-t											P=-0.743	
Wilcoxon	p=0.003**		P=0.050*		p=0.234		p=0.668		p=0.461			

* P<0.05, ** P<0.01

Table 8. Comparison of viscosities with two thickeners (A and B) in Sardine dumpling

	1g thickener, After 30		1g thickener, After 5		2g thickener, After 30		2g thickener, After 5		3g thickener, After 30		3g thickener, After 5	
	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener
Average value	32.3	35.4	35.2	38.0	24.2	25.8	25.4	26.6	22.9	22.1	22.8	22.6
SD	1.2	2.8	1.4	1.9	6.5	6.8	7.0	7.1	8.5	8.1	9.1	8.3
F test	P=0.0001**		P=0.082		P=0.421		P=0.467		P=0.467		P=0.355	
Unpaired Student-t			P=0.0001**		P=0.477		P=0.624		P=0.624		P=-0.939	
Wilcoxon	P=0.0001**											

* P<0.05, ** P<0.01

Table 9. Comparison of viscosities with two thickeners (A and B) in Creamed chicken

	1g thickener, After 30		1g thickener, After 5		2g thickener, After 30		2g thickener, After 5		3g thickener, After 30		3g thickener, After 5	
	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener	Thickener
Average value	27.8	27.9	28.6	29.1	24.3	23.6	25.2	22.9	20.6	20.9	21.9	21.3
SD	2.2	1.8	2.4	2.6	6.0	5.0	6.4	6.8	7.8	7.9	8.3	8.3
F test	P=0.178		P=0.370		P=0.207		P=0.395		P=0.478		P=0.497	
Unpaired Student-t	P=0.902		P=0.552		P=0.700		P=0.299		P=0.916		P=-0.839	
Wilcoxon												

* P<0.05, ** P<0.01

IV. Discussion

The viscosity test results of universal design foods that can crushed with gums were Stage 2 or 3 when untreated. Therefore, it considered better to add a thickener to stabilize the physical properties, but neither of the two types of thickeners used this time could maintain Stage 3 with 1g. When 2g or 3g of the two types of thickeners used this time were added to food, Stage 3 could maintain. Further, in the case of foods having a large number of carbohydrates (Sukiyaki in this study), the thickener B (high in thickening polysaccharides) can stabilize the viscosity and is suitable for adjusting the viscosity. On the other hand, in the case of foods having a small number of carbohydrates (Sardine dumpling in this study), the thickener A (high in water-soluble dietary fiber) can stabilize the viscosity and is suitable for adjusting the viscosity. Safe dietary intake is important in the field of nursing[2]. A guideline for the combination and amount of foods and thickeners is required so that safe and adjustable nursing foods can be prepared even at home. If the care recipients do not eat enough, there is an increased risk of malnutrition and flail[3-9], or protein deficiency leading to sarcopenia[10,11]. We think it is good to continue research on nutritional supplemental drink[12,] and many other drinks[13] for senior citizens and patients. In the future, we would like to report useful data that can be used in ordinary households by measuring the combination and blending ratio of more commercially available thickeners and commercially available universal design foods.

V. Conclusions

Viscosity measured in different combinations of two commercially available thickeners and three commercially available care foods (the can crushed with gums of the universal design food) result. The viscosity stabilized by adding a thickener. Thickener B (high in thickening polysaccharides) had a higher viscosity than thickener A (high in water-soluble dietary fiber) when 1g of thickener added when the number of carbohydrates in the food was high. Vice versa, thickener A had a higher viscosity than thickener B when 1g of thickener added when the number of carbohydrates in the food was low. After all, there is thickener that is compatible with food materials and nutrients contained in foods. In the future, we could like to measure the viscosity of more food materials and thickener combinations.

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Vaccine, Emergence, Termination, Sunspot Number as ON-OFF Switch for COVID-19 Pandemic with 25 Worst-Hit Countries

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Abstract- COVID-19 vaccine sample at Arctic Ocean and Antarctic Peninsula, plasmas from recovered people and CMV infected cetaceans, and modified MMR vaccines with the cetacean host. The present study proposes that the11-year cyclic sunspot number is analogous to a SWITCH, turning on and off an epidemic, inducing a public-health crisis. The ON period by the minimum (maximum) sunspot number initiated mutant viruses (AIV, SARS, MERS-CoV, and COVID-19) to transmit from the Poles to Continents by migratory birds and humpback whales. The first COVID-19 arrival dates in China, USA, Japan, Mexico, and Hawaii, determined by the distance between feeding grounds and breeding areas of humpback whale habitats. The OFF period occurs during the high sunspot number (>25-50) and may terminate COVID-19 in September (optimistic prediction) or in November, 2020 (pessimistic prediction) with three cases. Leather tanning industry (R^2 = 0.8514), global coastline (R^2 = 0.7864), USA coastline (R^2 = 0.3099), USA refinery (R^2 = 0.4874),CO_2 emissions (R^2 = 0.7627), population (R^2 = 0.3748), and minimum sunspot number (R^2 = 0.8907) showed high linearity with COVID-19 pandemic, as major causes in the 25worst-hit countries. COVID-19 can globally decrease by reducing toxic chemicals during the leather industry.

Keywords: *cetacean host vaccine, emergence, termination, sunspot number, ON-OFF Switch, COVID-19 Pandemic, 25 Worst-Hit Countries.*

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I. Introduction

The coronavirus (COVID-19) has infected 188 countries and regions with more than 13,765,713 total and 589,192 deaths as of July 17, 2020 (JOHNS HOPKINS, 2020), to becoming the worst public-health crisis in a century (CALLAWAY et al., 2020). The coronavirus (COVID-19) is spreading around the world, but there are still no vaccines to protect the body against the COVID-19. Ten candidate vaccines are in clinical evaluation while 123 candidate vaccines are in preclinical evaluation (WHO, 2020). The COVID-19 might be an evolutionary virus mixed between species of humans and cetaceans (porpoises, dolphins and whales) (KIM, 2020). Therefore, the transmitters of the COVID-19 are multi-species- humans and cetaceans, which could be why 188 countries and regions suddenly suffered from the COVID-19 within a few months.

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The present study proposes vaccine, protection, emergence, propagation, and termination associated with the coronavirus (COVID-19) pandemic. Furthermore, the fundamental causes of COVID-19 are to investigate parameters such as leather tanning and processing, oil refineries, gas- and coal-powered plants, safe latitude with total ozone, vehicles, population, carbon dioxide emissions, humpback whale districts, volcanic regions, migratory birds, dolphins with coastline, and preventive measures. The case study for the 25 worst-hit countries includes 1. USA, 2. Brazil, 3. India, 4. Russia, 5.Peru, 6. Chile, 7. The United Kingdom,8. Mexico, 9. Spain, 10. Iran, 12. Italy, 15. Turkey, 16. France, 17. Germany, 20. Canada, 23. China, 25. Sweden, 26. Indonesia, 29. Ecuador, 30. Belgium, 35. Philippines, 37. Netherlands, 44. Israel, 56. Japan, and64. South Korea, with a number of the global, confirmed rank as of July 10, 2020.

II. Experiment

a) *The Vaccine with Cetacean Host*

i. *Step 1. Search of Host.* Viruses are roughly spherical (80∼120 nm) with glycoprotein spikes on the surface and genome consisting of eight RNA fragments that encode 10 proteins. Since there is currently 18 hemagglutinin (HA), and 11 neuraminidase (NA) subtypes and matrix (M2) proteins embed in the envelope lipid bilayer derived from the host cell, 198 combinations with 4 strains of A, B, C and D (CDC, 2017). The requirements of low titers of vaccines and safe production without causing SARS-like diseases (SINOBIOLOGICAL, 2020) are met if searching the right host for theCOVID-19. Several animals such as bats, rodents, cattle, swine, and dromedary camels considered as hosts and sources of six endemic human coronaviruses (CORMAN et al., 2018). However, no one has yet proposed the cetaceans (porpoises, dolphins, and whales) as reservoirs of the COVID-19, while recent works (KIM, 2019 and 2020) illustrated the cetaceans as the host of the COVID-19 pandemic. Most of the coronavirus vaccine development concentrated on the coronavirus SARS-CoV-2(CALLAWAY, 2020) and SARS-CoV vaccine (SINOBIOLOGICAL, 2020). The

induction by viruses for SARS and MERS-CoV was the coronavirus. At the same time ,each transmission reservoir was the bat for SARS in China in 2002-2003 and the bat/dromedary camel in Saudi Arabia in 2012, respectively (KIM, 2019). The humpback whales were the transmitter of the avian influenza virus (AIV), while their stranding along the Atlantic Coast from 1992 to 2016 related (R^2 = 0.6128) with CO_2 emissions from the states on the Atlantic Coast in the USA (KIM, 2018). Furthermore, Kim (2019) proposed that humpback whales in Site # 3 among 14 habitats were the source of the COVID-19 in Wuhan in China. Kim (2020) revealed warning phenomena, originally referred to by Ward (2019) and Sorace (2019), stating that there were over 100 and 136 dead dolphins found stranded on the beach of Cape Verde of West Africa (Site # 2) (KIM, 2020) on September 28 and 30, respectively, 2019, which happened ahead of the COVID-19 emergence on November 17 in Wuhan in China. The sudden spread of the COVID-19 in 2020 could have caused by the 14 habitats of humpback whales, linked to millions of dolphins(KIM, 2020). The COVID-19 deaths cases of the top 15 worst-hit countries were proportional (R^2 = 0.7864) to the lengths of swimming coastlines (Fig. 5) along which cetaceans swim. It is clear that cetaceans, including porpoises (KIM, 2019), dolphins, and whales (KIM, 2020), are the host and the source of the COVID-19 pandemic. The COVID-19 vaccine should thus develop not in the limited realm of SARS-CoV-2 coronavirus, but the wide domain of cetacean coronaviruses such as the cetacean morbillivirus (CMV). CMV has a high propensity for interspecies transmission (JO et al., 2018). CMV is RNA viruses, as is the case of the COVID-19, recognized in 1988 with several distinct viral strains (LEGER et al., 2018) such as;1. Porpoise morbillivirus (PMV), 2. Dolphin morbillivirus (DMV), 3. Pilot whale morbillivirus (PWMV), 4. Beaked whale morbillivirus (BWMV), 5. Long-finned pilot Longman's beaked whale, 6. Guinea dolphin, and 7. Indo-Pacific bottlenose dolphin, the latter caused the COVID-19 pandemic in Wuhan in China (KIM, 2019).

ii. *Step 2. Screenings.*1) Human blood test for the presence of a non-segmented, single-stranded RNA genome (MODROW et al., 2013) of negative polarity for the COVID-19, may allow the initial screening of the confirmed cases by blood kit. 2) The final confirmation can decide by CT (computerized tomography) film for pulmonary calcification. 3) The COVID-19 induces pneumonia, inflaming the alveoli in the lung filled with pus, causing a smell from toxic gases such as H_2S, SO_2, NH_3, and mercaptans. A portable H_2S detector in a ppm unit for the foul smell of pus from human exhaled air, quickly screens the degree of lung inflammation, caused by the COVID-19. H_2S is also available from volcanic gas (0.04 - 0.68 %) (KIM, 2020) and biogas (0.5 – 2 %) (DUMONT, 2015), so that the concentration of pus smell is within a toxic allowance of 10 ppm or 0.001 %. Therefore, a commercial portable H_2S detector easily monitors the foul smell of pus from human exhaled air, if infected by the COVID-19. 4) Those whose body temperature show higher than 37.5°C (99.5°F),should be separated from the normal group for accurate measurement. Such simple screenings of physical (body temperature), chemical (H_2S detector), biological (blood test), and radiological (computerized tomography) kits may quickly separate patients infected from the COVID-19 from the healthy ones.

iii. *Step 3.COVID-19 Vaccine.*1) Vaccines can develop with virus samples collected at the Chukchi Sea of the Arctic Ocean for the feeding grounds of gray whales and at the Baffin Bay of the Arctic Ocean for the ones of humpback whales, respectively. Virus samples can also collect at the Antarctic Peninsula of the Antarctic with the warmest areas by the potent UV-B radiation. 2) Culturing plasma from people recovered from COVID-19 (PIECHOTTA et al., 2020) and plasma from CMV infected cetaceans.3) 4 kinds of plasma preparations depending on the source (humans and cetaceans) and virus diseases (COVID-19 and CMV) as; fresh human plasma, human plasma infected by COVID-19, fresh cetacean plasma, and cetacean one infected by CMV.4) Plasma inoculates and incubates at 37°C, as for CMV (WENDY et al., 2018). The virus inactivates at a temperature to use as one of 5 types of vaccines (CDC, 2018); 1. live attenuated vaccines, 2. inactivated ones, 3. toxic ones, 4. subunit ones, and 5. conjugate ones.5) The vaccine application to humans can follow by the stepwise methods *in vitro* P3 Lab test at petri dish, for the initial efficacy of curing the human lung cell infected by the COVID-19. *In vivo* tests for confirmed, recovered, and healthy people, determine the final efficacy and the stability of the developed COVID-19 vaccines to prevent the COVID-19. 6) Finally, the developed vaccines should examine to protect the human body's immune system for the mass reduction of the COVID-19 symptoms (CALLAWAY et al., 2020).Cetacean morbillivirus (CMV) and measles morbillivirus (MV) belong to morbillivirus. Since MV have humans as hosts, the MMR (Measles, Mumps, and Rubella) vaccine can be a good candidate to protect humans from the COVID-19.The genetic modification of MMR vaccines with the cetaceans host, may allow the low titers of the attenuated COVID-19 vaccines to last long and be safe.

b) Emergence of COVID-19

As for the emergence of COVID-19, the breeding period of the humpback whales14 habitats (KIM, 2020) begins from December to April (NOAA, 2015). The human incubation period is from 2-14 days to possible outliners 0-27 days (WORLDOMETER, 2020). Adding one month for the human incubation period of COVID-19 to December, it expects that the COVID-19 would emerge in January 2020. On January 19, 2020, a 35-year-old man in Seattle of Washington was the first case of COVID-19 in the USA (CGTN AMERICA, 2020), while on January 16, 2020, there was the first case of COVID-19 in Japan (WHO, 2020). The feeding grounds of humpback whales are the same Bering Sea in Alaska, while their breeding grounds distribute in Japan, China, Taiwan, and South Korea (Site #3), Hawaii (# 4), and Baja Mexico (#5) (KIM, 2020). The coastline of Washington is 4,870 km and the 11thlongest in the USA. Due to the proximity of whale feeding grounds in Alaska and Seattle (2,641 km), it is not necessary to add another month to January as a migratory period. Such an additional month added to January can be applicable if the route is from Alaska to another breeding area of Baja California of Mexico with a distance of 4,374 km. Thus, the first case of COVID-19 in Mexico was February 28, 2020 cited as arrival date (WHO, 2020), which was close to one month added to the case of Seattle (January 19, 2020). The distance between Hawaii (# 4) and the Bering Sea in Alaska is 4,486 km, which is a little farther than Baja California of Mexico (# 5). If we subtract 4,374 km in Baja California in Mexico (February 28, 2020) from 4,486 km in Hawaii, the answer is five additional days to February 28, 2020, considering the average whale swimming speed of 22 km per hour. The result means an exact match with the first arrival date of March 6, 2020, in Hawaii (WHO, 2020).

It can conclude that the arrival dates of the COVID-19 in Seattle in the USA, Japan, Mexico, and Hawaii, can determine by the swimming distance between the feeding ground and the breeding ones of humpback whale habitats. As for China, there was the first case of COVID-19 in Wuhan on November 17, 2019 (WHO, 2020). Ward (2019) observed over 100 dead dolphins found dead on the beach of Cape Verde of West Africa on September 28, 2019. The distance between Cape Verde and Wuhan in China can determine as follows: Cape Verde to South Africa (7,098 km), from South Africa to Shanghai in China (12,434 km), from Shanghai to Wuhan in China (690 km). The total is 20,222 km. The distance of 20,222 km, divided by 22 km per hour for whale speed, provides the 38.3 days required as traveling time from Cape Verde to Wuhan. If 38.3 days add to the observed date by Ward (2019), September 28, 2019, the resulting time was November 7, 2019. Since the human incubation period of the COVID-19 was 2-14 days (WHO, 2020), the expected date of the COVID-19's emergence in Wuhan in China was between November 9, 2019 and November 21, 2019 while actual emergence date in China was November 17, 2019. It is certain that the date of the COVID-19 emergence in Wuhan in China agrees with distance swam by cetaceans from Cape Verde to Wuhan in China. China has the largest CO_2emissions which might cause the largest ozone hole area and the highest UV-B radiation (NIH, 1989) for the earliest emergence of the coronavirus (COVID-19) in the world (KIM, 2019).

c) Propagation of COVID-19

The coronavirus (COVID-19) has infected188 countries and regions with more than 13,765,713 total cases and 589,192 deaths as of July 17, 2020 (JOHNS HOPKINS, 2020), becoming the worst public-health crisis in a century (CALLAWAY et al., 2020).The population of the 25 worst-hit countries in the present study was proportional (R^2 = 0.3748) to the COVID-19 deaths cases, as shown in Fig. 1. China (1,390 million) and India (1,340 million) excluded due to being out of range. Fig. 1 showed that the more populated countries showed more COVID-19 deaths. In the rank of deaths as of July 10, 2020, the population of each country was as follows; 1. USA 325 million, 2. Brazil 209, 3. India 134, 4. Russia 145, 5. Peru 32, 6. Chile 18, 7. U.K. 66,8. Mexico 130, 9. Spain 47, 10. Iran 81, 11. Italy 61, 15. Turkey 81, 16. France 67, 17. Germany 83, 20. Canada. 37, 23. China 1,390, 25. Sweden 10,26. Indonesia 264, 29. Ecuador 17,30. Belgium 12, 35. Philippines 107, 37. Netherlands 17, 44. Israel 9,56. Japan 127, 64. South Korea 52.

The top 5 CO_2 emitting countries are; 1. China, 2. USA, 3. India, 4. Russia, 5. Japan, while CO_2 emissions correlated with total cases (R^2=0.8064) and deaths (R^2=0.7627) of the COVID-19 (KIM, 2020).It is necessary to reduce the global population to decrease CO_2 emissions as well as the COVID-19, as shown in Fig. 1.

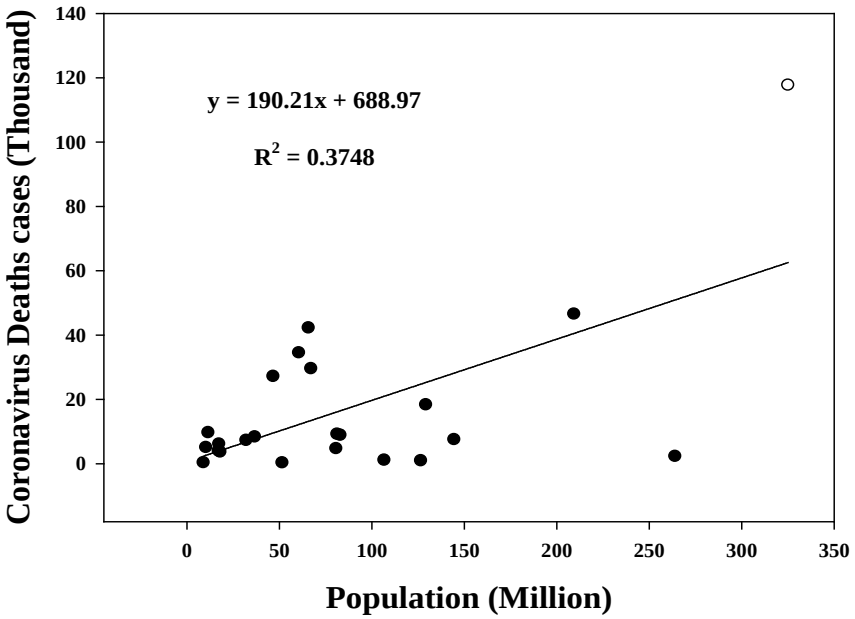


Figure 1: The population (million) of 25 worst-hit countries was proportional (R^2 = 0.3748) to the COVID-19 deaths cases (thousand).

Table 1 showed that the highest linearity of COVID-19 deaths with the leather tanning industry (R^2 = 0.8514) and the coastline (cetaceans) (R^2 = 0.7864), while COVID-19 deaths linearly correlated with the lumped parameter of CO_2 emissions (R^2 = 0.7627). It is necessary to reduce the global COVID-19 deaths by the controllable variable of CO_2 emissions, which originated from leather tanning, oil refineries, vehicles, coal- and gas-powered plants, population, and metropolitan food waste gas. Since the parameters such as coastlines or cetaceans, ozone hole area, and minimum sunspot number are not controllable variables, the most effective parameter (R^2 = 0.8514) of the leather tanning industry can globally decrease the COVID-19 deaths by reducing toxic chemicals during the leather tanning process.

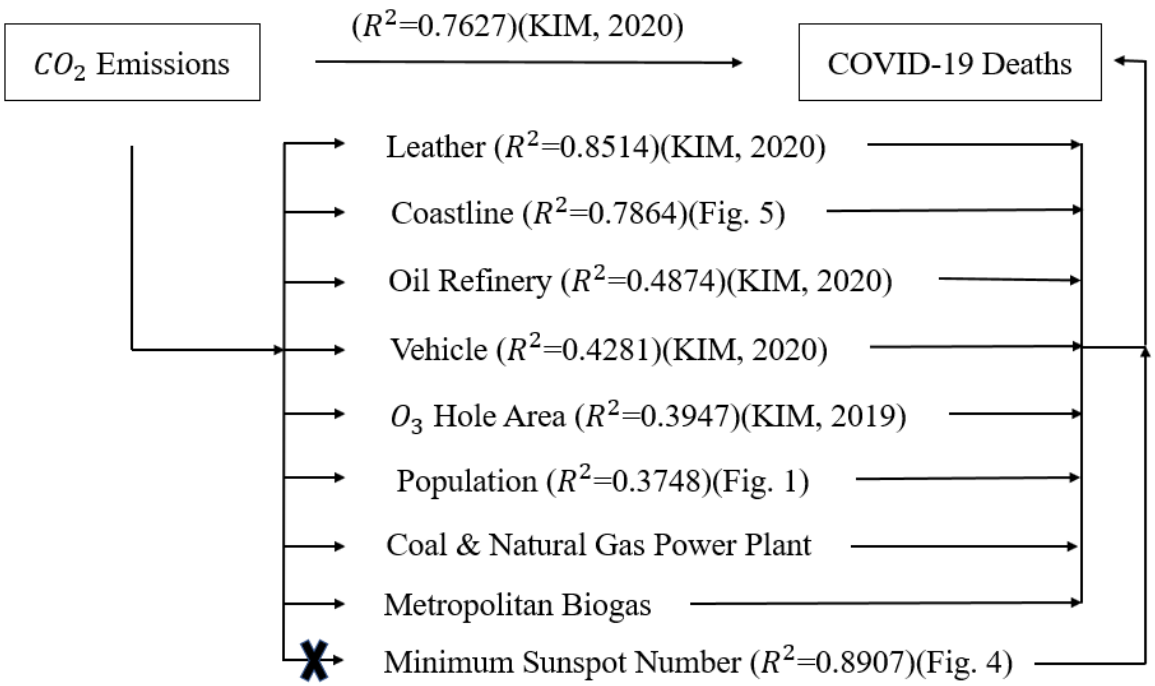


Table 1: CO_2 emissions proportional to the COVID-19 deaths (R^2 = 0.7627), where the COVID-19 deaths originated from leather tanning industry (R^2 = 0.8514) (KIM, 2020), population (R^2 = 0.3748)(Fig. 1), coastline (cetaceans) (R^2

= 0.7864) (Fig. 5), oil refineries (R^2 = 0.4874) (KIM, 2020), vehicles (R^2 = 0.4281) (KIM, 2020), coal- and natural gas-powered plants, and metropolitan biogas. The minimum sunspot number was proportional (R^2 = 0.8907) to theCOVID-19 (total confirmed cases) (Fig. 4) from July 2019 to July 2020, depending only on the 11-year cyclic sunspot number.

d) Termination of COVID-19

The breeding period of the whales is from December to April, while the feeding period is from May to September (or from June to October) (NOAA FISHERIES, 2015). The human incubation period is from 2-14 days to possible outliners 0-27 days (WORLDOMETER, 2020). Therefore, the termination of COVID-19 is expected in June (or July) with an additional one month of human incubation to May (or June). However, it takes another month for whale migration as described below: The blue whale typically swims at a speed of 14 miles or 22 km per hour (www.worldanimalfoundation.net). The migratory distance covered by gray whales along the Pacific Coast between the Bering Sea in Alaska and Baja California in Mexico is 5,551 km. The migratory distance covered by humpback whales along the Atlantic Coast between the Dominican Republic and Greenland is 6,151 km. Both distances can be approximated as 6,000 km divided by 22 km to have 272 hours or 12 days. Approximately one month is considered as the additional migratory period to June (or July) for July (or August) as the termination period of the COVID-19 pandemic in the USA.

The OFF SWITCH for termination of the COVID-19 depends on the high sunspot number (> around 25-50), which may require a few more months to pass beyond July (or August).Besides, Fig. 2A showed the bell distribution of the COVID-19 for the New York City from March to July with the peak on April 12, 2020, which took four months to be ON and OFFSWITCH of the COVID-19 distribution, respectively. Thus, two months later from July (or August) changes to September to November (or October to December)so that the sunspot number (SPACE WEATHER PREDICTION CENTER, 2020) may provide high sunspot number (> around 25-50), as observed in2018 for MERS-CoV (25) (KIM, 2019) and 2003 for AIV (50) (KIM, 2018),to possibly turn OFF SWITCH for the COVID-19 pandemic.

Ward (2019) and Sorace (2019) observed warning phenomena that 100 and 136 dolphins found dead on beach of Cape Verde (Site # 2 of 14 humpback whale habitats) of West Africa in September 28 and 30, respectively, 2019. Two months later, there was the coronavirus (COVID-19) pandemic in Wuhan city of China, near to Site #3 of Western North Pacific (KIM, 2019) onNovember17 of 2019 (WHO, 2020).

Similarly, new type of virus may appear in September of 2020 from the Poles either to 14 humpback whale habitats (KIM, 2020) or one of top 5 countries(BLOKHIN, 2019), creating most of the world's CO_2 emissions (China, United States, India, Russia, and Japan). There can be a competition of virus survival between the COVID-19 and the newly arrived virus at such locations for a few months so that the COVID-19 may competitively inhibit the new virus and fade away, as used to occur in toxic cyano bacteria in the lake (WATANABE, 1994). The OFF period occurs during the high sunspot number (> around 25-50) and may terminate COVID-19 in September (optimistic prediction) or in November 2020 (pessimistic one).

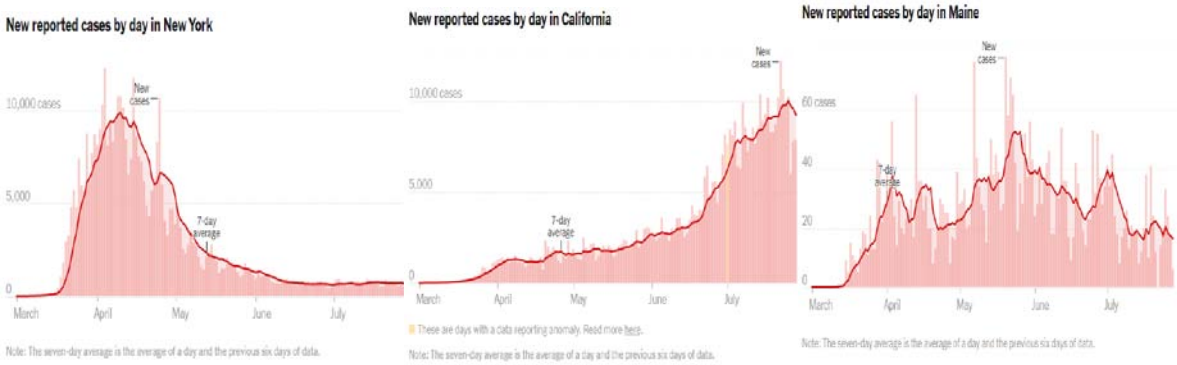
There were three typical cases of COVID-19 termination, based on the new daily reported cases coronavirus map and case count by the New York Times (July 29, 2020) as follows.

Case1 in Fig. 2A with bell curve decrease; NYC-Fig. 2A, Germany, U.K., Italy, Spain, France, Canada, USA (NYC, NJ, RI, NH, MD, MA, CT, AZ, UT, DC),

Case 2 in Fig. 2B with stepwise increase; Brazil, Mexico, India, Russia, Peru, Ecuador, Chile, Belgium, USA (CA- Fig. 2B, FL, NC, SC, GA, OR,TX, AL, ID, TN, WI, MI, MO, AR, KY, NV, NE, WY, AK, PR),

Case 3 in Fig. 2C with see-saw increase; Tokyo, Israel, USA (ME- Fig. 2C, VA, PA, DE, WA, CO, MI, IL, VT, LA, OH, IN, MN, IA, KS, WV, SD, ND, HI).

The maine parameters caused by the COVID-19 are; Case 1 could be the cetaceans, including whales, dolphins, and porpoises. Cetaceans began to migrate to the Poles in April and complete their journey in June, whose COVID-19 may last the shortest period till September2020. Case 2 could be the leather tannery industry, exporting hides to other countries, whose COVID-19 may last the middle period till October 2020. Case 3 for the mixed causes with multi sources such as leather tanning, cetaceans, oil refinery, vehicle, coal- and gas-powered plants, whose COVID-19 may last the longest period till November 2020. The Maine one in Fig. 2C is the intermediate stopover of humpback whales from the Dominican Republic toward the final destination of the Arctic Ocean. Case 3 could cause by partly coming in from the breeding ground of the Dominican Republic and going out to the feeding ground of the Arctic Ocean. In general, the COVID-19 is in decreasing mode in Fig. 2. Furthermore, Fig. 4 displays the linear (R^2 = 0.8907) increase of the minimum sunspot number (23 as of July 31, 2020) (SPACE WEATHER SERVICES, 2020) for turning OFFSWITCH (sunspot number > around 25-50)for the COVID-19 pandemic. When sunspot increases, ozone concentration increases to decrease UV-B radiation (NIH, 1989) so that COVID-19 decreases to terminate.



(A) (B) (C)

Figure 2: (A). for Case 1.Coronavirus maps and new reported cases by day in New York City, (B). for Case 2.California, and (C).for Case 3. Maine, by The New York Times (July 29, 2020).

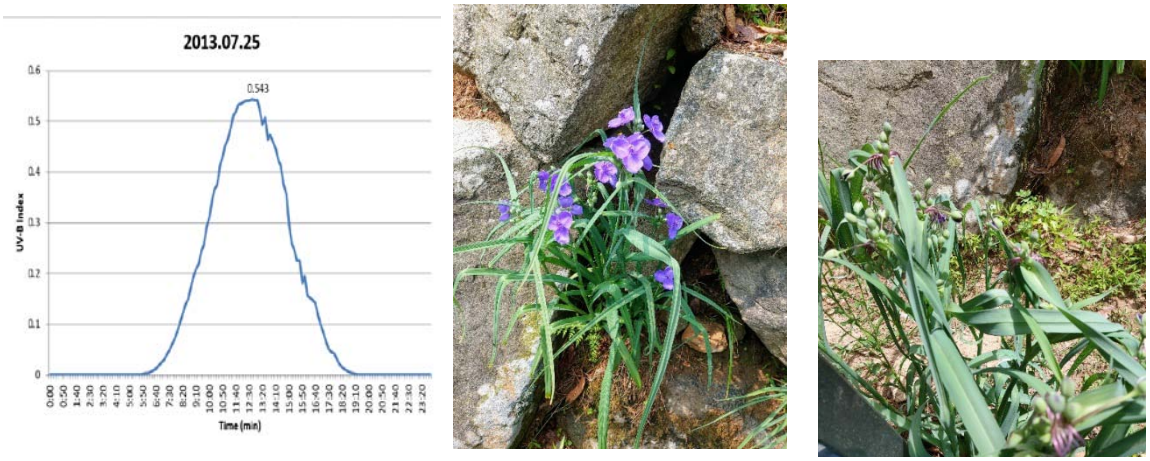
Fig. 2 A describes the reported daily infections from March 1 to July 1 in New York City (New York Times, 2020), with a peak reached on April 12, 2020. New York City is on the migratory routes of humpback whales (Site # 1 for New York City) (KIM, 2020). Fig. 2 implied that the humpback whales have begun to migrate from New York City (Fig. 2A) to the Baffin Bay/ Labrador Sea in the Arctic Ocean. The cases caused by the humpback whales may begin to decline as they swam from the breeding grounds (the Dominican Republic, # 1), passing through Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New York, New Jersey, Connecticut, Massachusetts, New Hampshire, and Maine-Fig. 2C, to feeding grounds (Iceland, Labrador Sea, Baffin Bay, and the Arctic Ocean). The cases of the COVID-19 caused by the gray whales in the Pacific Coast (WOLFE, 2019), may begin to decline from the breeding grounds (Baja California of Mexico, # 5), passing through California (Fig. 2B) (San Diego, Los Angeles, Point Piedras Blancas), Oregon (Depoe Bay), Washington (Seattle), Canada (Vancouver), and Alaska (Gulf of Alaska), to feeding grounds (Bering Sea, Chukchi Sea, and the Arctic Ocean).

e) Personal Protection from COVID-19

Japanese areas near volcanic regions were much safer than regions with no volcanoes in the vicinity in the section of III *-y) Japan*. Therefore, in non-volcanic countries, people can easily protect themselves from the COVID-19 by spraying small amounts of artificial volcanic gases such as H_2S and SO_2, as shown in Equation (2). Hydrogen sulfide (H_2S) is a typical gas with duality for the COVID-19. Its anti-inflammatory responses in respiratory diseases studied by the NIH grant (CASOLA, 2018), which is applicable to cure the confirmed COVID-19 patients. The artificially rotten eggs can use to generate minor amounts of H_2S gas. Garlic compounds metabolize to H_2S (UNIVERSITY OF ALABAMA, 2007). A few easy preparation steps with volcanic gases can protect people from the COVID-19 as 1) Use rotten egg (KIM, 2020) to generate minor amounts of H_2S indoors, 2)Eat a piece of garlic per day for minor generation of metabolic H_2S, 3) Eat curcumin (HE et al.,2015)and garlic together as food to protect the respiratory systems from the COVID-19, 4) SO_2 can prepare by putting sulfur (S) powder on the burning charcoal hotter than 500°C. Such artificial volcanic gases of H_2S and $SO_2$are necessary indoors while keeping proper ventilation,5)Do not go outside for prevention of the COVID-19 when either negligible UV-B radiation (Fig. 3A) is available from the sunset to the next sunrise or the flower of *Tradescantia* closes (Fig. 3C). Since UV-B radiation disinfects the virus (KIM, 2019), it is necessary to go outside only during the daytime with potent UV-B radiation (Fig. 3A) or during the open flower period of *Tradescantia* (Fig. 3B), as a bio-indicator against the COVID-19, 6) Clean up the food waste as often as possible due to its harmful biogas (DUMONT, 2015), 7) Do not use the subway but use the bus with the sunlight and UV-B radiation, killing the virus (KIM, 2019), 8) Do not stay in the underground floors but in the upper floors with the sunlight to kill the COVID-19 by the solar UV-B radiation,9) Do not stand behind the running vehicle muffler with toxic gases,10) Stay at the green region with forest and agricultural lands, 11) Stay within a tropic whose latitude is less than 20, and 12) Stay above Arctic Circle with latitude of66, for the powerful UV-B radiation killing the COVID-19.

The Korea Meteorological Administration at Ulsan city in South Korea showed a typical UV-B Index during the 24-hour variation in Fig. 3A with the peak value at noon with minimal at both of the sunrise and the sunset, as of July 25, 2013. COVID-19 decreases as UV-B radiation increases (KIM, 2020). *Tradescantia* is exposed to low-level gamma rays and has linear relationship with the somatic mutation frequency (ICHIKAWA et al., 1981). The present work observed that *Tradescantia* (Fig. 3) opened its flower at dawn and closed at around 4 pm till the next dawn. *Tradescantia* with open flower (Fig. 3B) as a bio-indicator,

corresponded to a safe daytime due to potent UV-B radiation (Fig. 3A) acting against the COVID-19. On the other hand, the closed flower(Fig. 3C)during the insufficient UV-B radiation (Fig. 3A), indicated an unsafe period inducing the COVID-19.The flowering of *Tradescantia* was proportional to the UV-B radiation while the COVID-19 decreases as the UV-B radiation increases (KIM, 2020). It recommends not to stay outside for prevention of the COVID-19 pandemic when either UV-B radiation is negligible from the sunset to the next dawn (Fig. 3A) or the flower of *Tradescantia*c loses (Fig. 3C).



(A) (B) (C)

Figure 3: (A). UV-B Index from Korea Meteorological Administration at Ulsan city in South Korea showed the peak value at noon while minimal ones at both of the sunrise and the sunset during the 24-hour variation, as of July 25, 2013. (B). The open flower of *Tradescantia,* as a bio-indicator in the morning, indicated a safe environment with potent UV-B radiation against COVID-19. (C). A closed flower one in the late afternoon, with insufficient UV-B radiation, indicated an unsafe period inducing the COVID-19.

UV-B radiation (Fig. 3A) or UV-B radiator (KIM, 2019) is a simple tool to protect people from the COVID-19. The installation of UV-B radiation, in the subway, undergrounds, churches, schools, hospitals, offices, homes, streetlamps, and drinking water, is necessary to kill all the viruses (KIM, 2019),including the COVID-19 pandemic.

The artificial volcanic gas (H_2S or SO_2)minimizes the COVID-19 casualties, as was the case in volcanic countries. The number of active volcanoes is shown in parenthesis, while the global rank of the COVID-19 for the 25 worst-hit countries is given as of July 2020: 1. USA (169), 2. Brazil (0), 3. India (7), 4. Russia (12), 5. Peru (21), 6. Chile (3), 7. U.K. (0), 8. Mexico (48), 9. Spain (11), 10. Iran (14), 11. Italy (48), 12. Turkey (10), 16. France (13), 17. Germany (4), 20. Canada (5), 25. Sweden (0), 26. Indonesia (141), 29. Ecuador (27), 35. Philippines (23), 37. Netherlands (2), 44. Israel (0), 56. Japan (110), 64. South Korea (0). Most of volcanoes in the USA are in Alaska, Hawaii, and the Pacific Coast. Thus, the volcanoes in the USA did not contribute to the decrease of the COVID-19. On the other hand, Japanese volcanoes saved Japan, ranked 56th, from the crisis of the COVID-19, as shown in the section of III *-y) Japan*. The active volcanoes in volcanic countries such as 26. Indonesia (141), 29. Ecuador (27), 35. Philippines (23), and 37. Netherlands (2),showed the reduced casualties by the COVID-19, which is explained by the effect of volcanic gases in Equation (2).

f) Sunspot Number

UV-B causes skin cancer and suppresses the immune system. The thinning of the ozone layer (about 3mm in thickness)over Antarctica caused by ozone depleting chemicals (CFCs)in eastern China (RIGBY, 2019). A significant viral mutation occurred in the period of the minimum sunspot number in a location with the highest CO_2 emissions and ozone hole areas. As was the case with the COVID-19 outbreak from 2019 to the present August of 2020 in Wuhan of China, other large cities occurred in New York City, Madrid, Paris, London, Milan, Bavaria, Istanbul, Tehran, Tokyo, and 188 countries and regions.

The increases in CO_2, O_3 hole area, and UV-B caused the proportional increase with the COVID-19(R^2 = 0.8064) (KIM, 2020). The O_3 hole area showed a reversely proportional relationship with the sunspot number (R^2 = 0.2668) (KIM, 2020) while a linear relationship with CO_2 emissions (R^2=0.3947) (KIM, 2019). Since the sunspot number begins to increase with time(R^2 = 0.8907) in Fig. 4, the O_3 hole area, UV-B, and the COVID-19 began to decrease due to their reverse proportionalities with the sunspot number.

The sunspot number was as follows; July 2019 (sunspot number 0.7), August (0.7), September (0.8), October (0.7), November (0.8), December (1.9), January 2020 (5.9), February (0.4), March (1.2), April (4.8), May (0), June (5.9), July 4 (12), to July 31 (23). There was a linear relationship (R^2 = 0.8907) between total

coronavirus (COVID-19) cases and the sunspot number (SPACE WEATHER PREDICTION CENTER, 2020) from July 2019 to July 2020, as shown in Fig. 4.

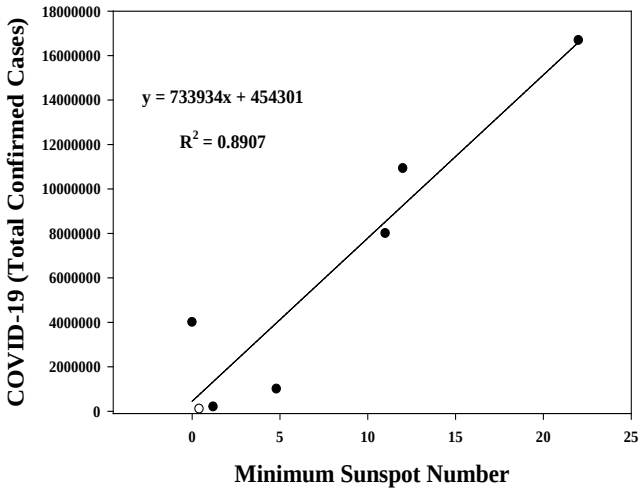


Figure 4: Linear relationship(R^2 = 0.8907) of total coronavirus confirmed cases with the minimum sunspot number from July 2019 to July 2020.

The COVID-19 pandemic began in November 2019 in Wuhan of China with a sunspot number of 2(SPACE WEATHER SERVICES, 2020) as ON SWITCH mechanism for the COVID-19. OFF SWITCH mechanism for terminating the COVID-19 pandemic began to increase the minimum sunspot number from 23 as of July 31, 2020 to around 25-50 in the future. Previous sunspot numbers for the OFF SWITCH mechanism were 50 for AIV in 2003 (KIM, 2018) and 25 for MERS-CoV in 2018 (KIM, 2019). During the minimum sunspot number, UV-B is so strong that the virus in the Poles changes into the dangerous mutant virus, carried by migratory birds (H1N1, 2008)(KIM, 2018) orhumpback whales for AIV (KIM, 2018) and COVID-19 (KIM, 2020). The years of 2019-2020 fall within the period of the minimum sunspot number, showing significant linearity with the previous works about AIV outbreaks (R^2=0.9967) (KIM, 2018), humpback whale stranding (R^2=0.6128) (KIM, 2018), record low temperatures in Chicago (R^2=0.9995) and La Nina Index (R^2=0.9922) (KIM, 2019), and the COVID-19 (total confirmed cases) (R^2 = 0.8917) in Fig. 4.

The present study proposes that the sunspot number is analogous to a SWITCH, turning an epidemic ON and OFF 11-year cyclic virus from the Poles to the Continents with TRANSITION state inducing a public-health crisis such as,

1) ON SWITCH mechanism during minimum (maximum) sunspot number in the parenthesis and high UV-B radiation, emerges the mutant virus from the Poles to the Continents, transmitted by migratory birds (KIM, 2018) and humpback whales for 2002 SARS (125) and 2012 MERS-CoV(110) (KIM, 2019) during maximum sunspot number. During minimum sunspot number (KIM, 2019), there were 1966 Hong Kong Flu(0), 1976 Ebola (14), 1985AIV-Victoria (18), 1996 H5N1AIV (8), 2008 H1N1pandemic (4) (SOLAR DYNAMICS OBSERVATORY, 2008), and 2019 COVID-19pandemic (2)(SPACE WEATHER SERVICES, 2020).
2) OFF SWITCH mechanism during high sunspot number (> 25-50) for possible termination of the COVID-19 pandemic, which switched ON in Wuhan in China under minimum sunspot number (2)(SPACE WEATHER SERVICES, 2020),
3) OFF SWITCH mechanism during low sunspot number for terminations of 2003 SARS (80) and 2018 MERS-CoV (25), which switched ON under the maximum sunspot number for SARS (125) and MERS-CoV (110) (KIM, 2019),
4) TRANSITION state (0 <Sunspot Number< 25-50)to become the public-health crisis, as was the case in the COVID-19 pandemic.

The minimum sunspot number (COVID-19 pandemic (713,845 deaths as of August 7, 2020) caused much more strong casualties than those during the maximum sunspot number of 774 SARS and858MERS-CoV.

During the sunspot number of the11-year cycle with 14 months of standard deviation (HATAWAY, 2010), there are always maximum or minimum points of the sunspot number. In each case, there can be ON, Transition, and OFFSWITCH mechanisms. Major casualty expects during transition period.

Once turned ON SWITCH(emergence of the epidemic) by either minimum sunspot number or maximum sunspot number, causing virus mutation in the Poles during the potent UV-B radiation under the

highest CO_2 emissions, it is impossible to turn OFF SWITCH(termination of the epidemic) intentionally until turned OFF by global environments. CO_2 emissions increase continuously over the years (R^2 = 0.9497). The ozone absorbs solar UV radiation to decrease the UV-B (NIH, 1989). CO_2 emissions were proportional (R^2 = 0.4116) to the ozone hole area, and thus, CO_2 emissions lead to powerful UV-B radiation on the Earth (KIM, 2019).

The sunspot number is controlled by the Sun, while the solar radiation on the Earth can minimize by the reduction of global CO_2 emissions. It is thus necessary not to turn ON SWITCH of the sunspot number for minimization of the11-year cyclic epidemic. The reduction of global CO_2 emissions should follow in the areas of the leather tanning industry, oil refineries, vehicles, coal- and gas-powered plants, population, and metropolitan food waste gas.

g) Coastline

It postulated that cetaceans, including whales, dolphins, and porpoises, that swim off coastlines globally, were a contributory factor in inducing the COVID-19 disaster in over 188 countries and regions (KIM, 2020). Infected humpback whales might be the reservoir of the cetacean morbillivirus (CMV) in the form of infected feces (KIM, 2020) through their migratory behaviors (JO et al., 2018). Released feces infected porpoises and dolphinsin the 14 humpback whale districts (KIM, 2020), including the Yangtze River and East Sea (Site # 3 among 14 habitats) being then evolutionally transmitted to humans in Wuhan in China as COVID-19 (KIM, 2019). The sudden spread of the coronavirus could be traced to the 14 habitats of humpback whales, linked to millions of dolphins (KIM, 2020). Coastline data in km is available from Field Listing-Coastline (CIA, 2020). COVID-19 deaths, as of June 18, 2020, are in parenthesis for the top 15 countries hit by COVID-19; USA 19,924 km (117,694), Brazil 7,491 km (46,510), U.K. 12,429 km (42,238), Italy 7,600 km (34,448), France 4,853 km (29,578), Spain 4,964 km (27,136), Mexico 9,330 km (18,310), India 7,000 km (11,903), Belgium 66.5 km (9,675), Iran 2,440 km (9,185), Germany 2,389 km (8,851), Canada 202,080 km (8,312), Russia 37,653 km (7,468), Peru 2,414 km (7,257), and Netherlands 451 km (6,093). Fig. 5 shows that the coastline of each country is proportional (R^2 = 0.7864) to COVID-19 deaths. Countries with very long coastlines along the Arctic such as Russia and Canada excluded from the correlation. At the same time, countries with very short coastlines such as Belgium and Netherlands also excluded in Fig. 5. It is therefore clear that dolphins and humpback whales spread COVID-19 around the world while swimming at the coastlines of each country.

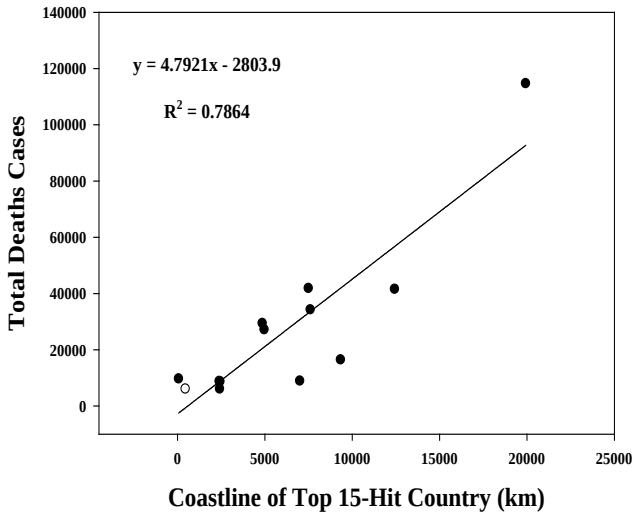


Figure 5: Coastline of 15 countries hit by the coronavirus (COVID-19) was proportional (R^2 = 0.7864) to the COVID-19 deaths, showing the importance of the coastline, where cetaceans swim in shallow (25 ft) water.

III. Case Studies

a) USA

The USA ranked second globally forCO_2 emissions (5,269 Mt CO_2) and has a population of 325.1 million in 2017 (FROHLICH, 2019). CO_2 emissions produced by coal- and gas-powered plants, oil refineries, vehicle exhaust gas, metropolitan food waste gas, human exhalation, leather-tannery industry, and the organic dye industry. The coastline of the USA is 19,924 km (CIA, 2020).Fig. 6 shows that the coastline of each country is proportional (R^2 = 0.3099) to COVID-19 deaths. Since cetacean morbillivirus (CMV) induced the coronavirus (COVID-19) pandemic (KIM, 2019), the Pacific Coast and the Atlantic Coast of the USA were also open to the danger of the COVID-19.There are 169 volcanoes in the USA. The USA has 264,194,000 registered vehicles. The latitude of the USA is 38°N and thus an unsafe zone from the COVID-19.

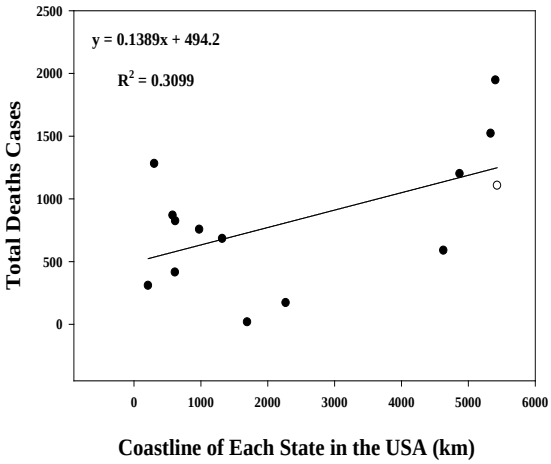


Figure 6: The coastline of each state in the USA is proportional ($R^2 = 0.3099$) to the COVID-19 deaths case.

Leather is a multi-billiondollar global industry with criticism of its severe environmental impact (LEATHER PRODUCTION SUSTAINABILITY, 2018). Chemicals from the leather tanning industry and organic pigments in tannery wastewater, caused soil and water pollution, resulting in dangerous health hazards to both humans and animal life(SAXENA et al., 2016). Chemicals from the leather industry and organic pigments pollute freshwater in rivers and lakes such as the Mohawk River; Hudson River (New York), Mississippi River (Minnesota (20), Wisconsin (25), Iowa (24), Illinois (4), Missouri (29), Kentucky (33), Tennessee (19), Arkansas (32), Mississippi (26), Louisiana (13), Los Angeles River (CA (3)), Colorado River (Colorado (21), Arizona (18), California (3)),and New York (1). Lakes; Erie, Ontario, Oneida, Seneca, Cayuga (New York (1)), Lake Michigan (Wisconsin (25), Illinois (4), Indiana (17), and Michigan (9)).The parenthesis numbers are the State rank of the COVID-19deaths, as of June 18, 2020. Milwaukee's leather industry had a tremendous impact on the city's environment, polluting Milwaukee's rivers as well as Lake Michigan with industrial chemicals (WALZER, 2016) (https://emke.uwm.edu/entry/leather-industry/). There are 111 leather tanning facilities in the USA, and the Northeast and Midwest states; Pennsylvania (9), Massachusetts (7), New York (1), and Wisconsin (21) have almost half of the facilities (MAX, 2018).In Gloversville, New York, the former old leather tannery (Fig. 7A) poses a threat to public health and welfare. Since it still contains toxic chemicals, the facility should be demolished thoroughly not to contaminate the Hudson River, which is the main river in the region, passing through New York City and New Jersey State (Fig. 7B). Those metropolitan areas were the first and second most hit regions by COVID-19 in the USA.

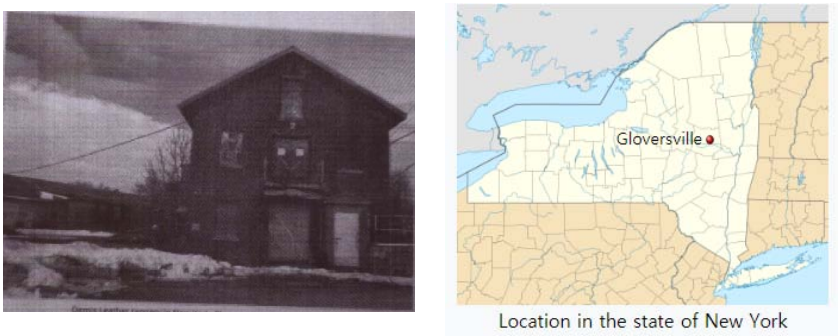


Figure 7: (A) Old tannery in NY. (B) Gloversville in NY, connected with Hudson River.

Recently California (3), Michigan (9), Illinois (4), Ohio (16), have leather tanning facilities while the numbering in parentheses is the rank of coronavirus cases as of June 18, 2020.The leather industry has polluted the water and the air causing the spread of the coronavirus in the USA. Typical tannery industry chemicals that contain246 hazardous agents might have deteriorated the water of the Hudson River and have emitted toxic gases (NH_3, H_2S and carcinogenic arylamines) into the air (ECOPOL-Home, 2020) (https://leathersustainability.weebly.com/). This tannery might pollute the Hudson River with toxic chemicals that

could have caused New York (31,046) and New Jersey (12,891) deaths (as of June 18, 2020). Other causes of death could be the stack gases from 6 oil refineries in New Jersey, flue gases from 3 natural gas-powered plants in New York, two coal-powered plants, and ten gas-powered plants in New Jersey. Flue gas from power plants and stack gas from oil refineries emit toxic gases (SO_2, CO_2, NOx, H_2S). Dolphins in the Hudson River and whales in the Atlantic Coast could also transmit the coronavirus causing the deaths of residents in New York Harbor and New Jersey. Also, metropolitan people and vehicles produce high CO_2 emissions in New York City, increasing the number of deaths. The decline of the glove industry meant people left the city, so old tanneries were still left or abandoned (Fig. 7A). The effluents from the abandoned tanneries with toxic residual chemicals flow into the Mohawk River, which is the largest tributary of the Hudson River (Fig. 7B). New York State capital Albany, locates where the Mohawk and Hudson Rivers converge. Albany, in the upper stream of the Hudson River, had 108 deaths, while New York City, farther downstream, had 21,856 deaths. In the Atlantic Ocean, New Jersey had 15,057 deaths and Connecticut 4,307 deaths, as of June 27, 2020. Since New York City, New Jersey, and Connecticut are on the Atlantic Coast, dolphins might transmit the coronavirus to these coastal states.

There are 161 volcanoes (USGS, 2020): 18 very high threat, 39 high threat, 49 moderate threat, 34 low threat, and 21 very low threat volcanoes. The volcanoes are in Alaska (50), Arizona (18), California (3), Colorado (21), Hawaii (49), Idaho (43), Nevada (34), New Mexico (37), Oregon (40), Utah (31), Washington (22), and Wyoming (48).The states with volcanoes were shown to be under little threat, as of June 18, 2020, except California, Washington, and Colorado. Numberings of power plants and oil refineries are indicated in parenthesis in California (30), Washington (5), and Colorado (57), with toxic gases in the flue gas from power plants and in the stack gas from oil refineries. The total amount of inhaling rate of ($\dot{M}$) of volcanic gas (CO_2, H_2O, H_2S, H_2SO_4, SO_2, HCl, HF, particulate matter) relates with volcanic gas concentration (C), human inhaling volume rate ($\dot{V}$= 8 liter/min= 8,000 cm^3/min), and exposuretime (Δt) as Equation (1),

$$\dot{M} = C\dot{V}\Delta t \quad \text{- - - - ----} \qquad (1)$$

There are dual behaviors of volcanic gas and toxic gas, the latter originated from leather tanning industry, oil refinery stack gas, coal-powered and natural gas-powered flue gases, vehicle, population, and metropolitan biogas, associated with the coronavirus (COVID-19) pandemic as follows:

CASE 1. Prevention of the coronavirus (COVID-19) pandemic by shielding volcanic gases with a low amount of inhalation rate ($\dot{M}\downarrow$), low gas concentration(C↓),for short-term acute exposure($\Delta t\downarrow$). The coronavirus activity inhibited by the toxic volcanic gas, as shown in volcanic countries and regions in Sicily in Italy, Kyushu in Japan, Philippines, Indonesia, Taiwan, and Alaska.

$$(\dot{M}\downarrow) = (C\downarrow)\,\dot{V}\,(\Delta t\downarrow) \text{- - - - - -} \qquad (2)$$

Minor amounts ($\dot{M}\downarrow$) of gases in CASE 1protect people from the coronavirus (COVID-19), shown in Equation (2). Therefore, in non-volcanic countries, people can easily protect themselves from the coronavirus (COVID-19) pandemic by spraying small amounts of artificial volcanic gases such as H_2SorSO_2.

CASE 2. Casualties suffering from ahighinhalation rate($\dot{M}\uparrow$)have their respiratory systems damaged by toxic gas from the leather tanning industry, oil refinery stack gas, coal-powered and natural gas-powered flue gases, vehicle, population, and metropolitan biogas. Case 2 is in a high concentration(C↑) for long-term exposure ($\Delta t\uparrow$). This leads to a high number of the coronavirus (COVID-19) pandemic deaths forolder adults, as observed in Lombardy in Italy, Wuhan in China, New York City in the USA, Tokyo in Japan, Teheran in Iran, Daegu in South Korea, as shown in Equation (3).

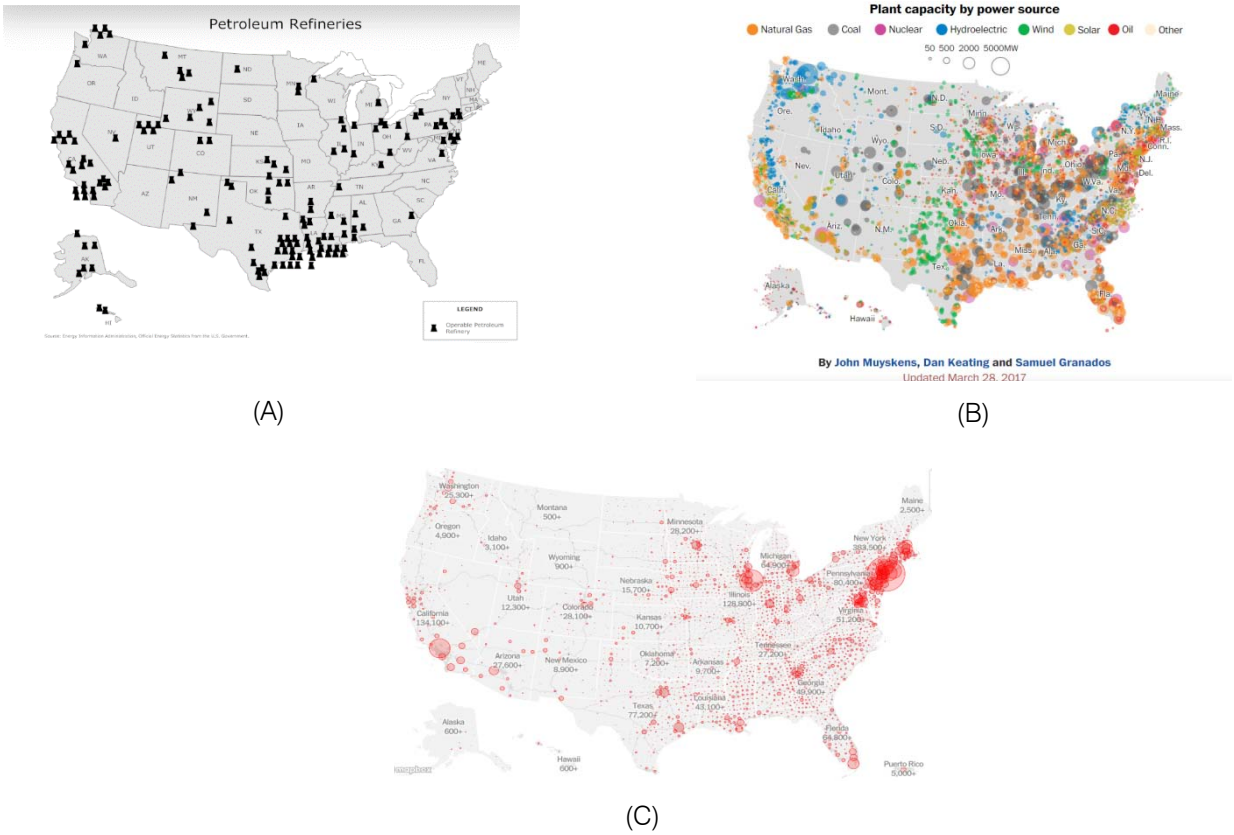
$$(\dot{M}\uparrow) = (C\uparrow)\,\dot{V}\,(\Delta t\uparrow) \quad \text{- - - - -} \qquad (3)$$

Vehicle exhaust emissions create when the air-fuel mixture burning inside internal combustion engines releases carbon dioxide back into the atmosphere, causing health problems (AZO CLEANTECH, 2019).The composition of exhaust gases is N_2,O_2, H_2O, CO, CO_2, NO_x, SO_2, benzene, aldehydes, O_3, particular matter (SKYBRARY, 2017).The relationship between vehicle numbers and CO_2 emissions was linear (R^2=0.6313). The vehicles of the USA in 2018 amounted to279.1 millionunits.

The power plants of the United States are nuclear (9.0%), hydro (9.1%), wind and solar (13.5%), coal (20.7%), and natural gas (43.2%) (BLUEGOLD RESEARCH, 2020). Flue gases contain harmful substances such as particulate matter, phenol, furfural, glycols, H_2S, NH_3, C_6H_6, NaOH, H_2SO_4, HCl, HF, SO_2, NO_x, CO, heavy metals, and harmful chemicals (GIUGLIANO et al., 2016).One hundred thirty-five petroleum refineries in the USA (2019) were shown in Fig.8A with 2 units in NJ (2), 18 in CA (3), 4 in IL (4), 13 in PA (7), 12 in MI (9), 16 in FL (8), 47 in TX (6), 19 in LA (13), 18 in OH (16), 5 in WA (22), 15 in GA (11), and 12 in IN (17). The numberings in the parenthesis are the state rank of total COVID-19 cases in the USA, as of June 18, 2020. It is clear that 135 petroleum refineries in the USA are critical to cause the coronavirus (COVID-19) pandemic deaths (R^2=0.4874). .

Mapping how the United States generates its electricity showed in Fig. 8B while the distribution map

of coronavirus (COVID-19) cases in the USA was in Fig.8C. The high deaths by the COVID-19 as of May 23, 2020, were in the order as follows NY, NJ, MA, CA, IL, PA, MI, CT, TX, LA, MD, OH, WA, GA, and IN.



(A) (B)

(C)

*Figure 8: (A).*Petroleum refineries map of the USA (Smart Draw).*(B).*Mapping how the United States generated its electricity in 2017 (John Muyskens, Dan Keating and Samuel Granados).*(C).*Distribution map of coronavirus (COVID-19) cases in the USA (The New York Times).

Natural gas- and coal-power plants produce main pollutions. Petroleum refineries (Fig.8A) with toxic stack gas (CO, SO_2, O_3, H_2S, NO_x, caustic soda),supply petroleum and gas to power plants, while non-renewable power plants(Fig. 8B)produce toxic flue gas (SO_2, H_2S, O_2, HF, MRL, CO_2, CO, NO_x, lead, cadmium, particulate matter).The distribution of the coronavirus (COVID-19) pandemic in the USA was shown in Fig.8C, the distribution of, which overlapped with refineries in Fig. 8A and non-renewable power plants in Fig. 8B.It can partially conclude that pollution of air and water caused by oil refineries and non-renewable power plants contributed to the coronavirus (COVID-19) pandemic in the USA. Majorly hit-states by the coronavirus in each region are listed below. Eastern part is New York City/ New York (1) and New Jersey (2)as the origin of Eastern COVID-19 in the USA, including Massachusetts (5), Pennsylvania (7), Maryland (10), Connecticut (15), and District of Columbia (38). The western part is California (3), Arizona (18), and Washington (22).The southern is Texas (6), Florida (8), Georgia (11), Virginia (12), Louisiana (13), and North Carolina (14). The middle is Illinois (4), Tennessee (19), Minnesota (20), and Colorado (21). The numberings in the parenthesis are the state rank of total COVID-19 cases in the USA, as of June 18, 2020.

The year of the avian influenza virus (AIV) outbreak was proportional to the year of minimal sunspot number from 1878 to 2016 with high linearity (R^2= 0.9967)(KIM, 2018).AIV cases(FULLER et al., 2010)along the Atlantic Coast of the USA plotted to CO_2 emissions with R^2= 0.2911(KIM, 2018).AIV cases plotted to the total coronavirus cases (R^2= 0.3793) in Fig. 9A and death cases (R^2=0.4275) in Fig. 9B in the USA (as of June 18, 2020).

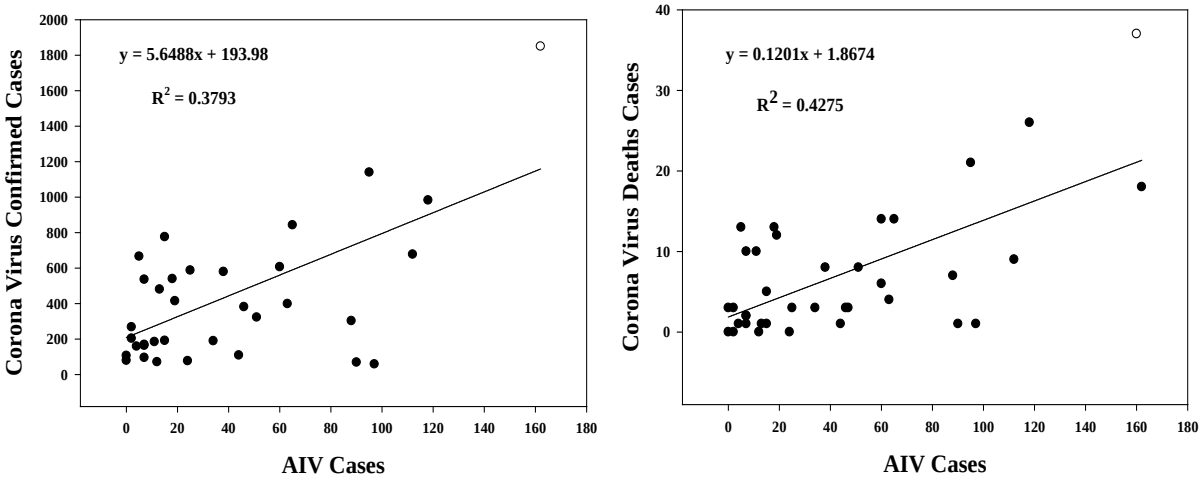


Figure 9: AIV cases (FULLER et al., 2010) plotted to. (A). coronavirus total cases (R^2= 0.3793) and(B). coronavirus total death cases (R^2=0.4275)in the USA (as of June 18, 2020).

Fig. 9 implies that AIV cases (FULLER et al., 2010) relate with coronavirus total (R^2= 0.3793) and coronavirus total deaths (R^2=0.4275) in the USA (as of June 18, 2020). During the period of the minimum sunspot number, AIV was carried by migratory birds in 2008 (KIM, 2018), and COVID-19 was carried by cetaceans in 2020 in the USA (KIM, 2020).Migratory birds and cetaceans (dolphin, porpoises, whales) are the transmitters inducing the coronavirus (COVID-19) pandemic, not only in the United States but also in the world where migratory birds and cetaceans travel (KIM, 2020).

The state of Wyoming is a vast plateau divided by mountain ranges such as the Rocky Mountains, at the base of which lie the Great Plains. As for the coronavirus (COVID-19),Wyoming ranks last with the lowest number of deaths (36) /1M population as of July10,2020. The USA surrounds by the Pacific Coast, Atlantic Coast, and Caribbean Sea with whales and dolphins, which carried CMV, which the evolutionarily changed into the coronavirus (COVID-19) in Wuhan in China (KIM, 2019). The migratory birds flyover the USA, spreading AIV (1996 H5N1, 2008 H1N1) during the minimum sunspot number. There are toxic gases from power plants, oil refineries, leather-tannery processes, textile industry, vehicle exhaust, metropolitan food waste biogas, and human exhalation gas. The virus mutates to cause diseases in humans, poultry, and animals. Viral activity enhances during the minimal sunspot number, as is the case in 2020 with an 11-year cycle. The USA was the country most affected by the coronavirus (COVID-19) in 2020. As for data of Deaths/1M pop (death per million of the population), New York (1,664), California (174), Texas (108), Florida (191), New Jersey (1,751), Illinois (580), Arizona (286), Georgia (279), Massachusetts (1,204), Pennsylvania (542), North Carolina (144), Michigan, (629), Louisiana (728), Maryland (546), Virginia (229), Ohio (260), Tennessee (106), South Carolina (180), Alabama (225), Indiana (408), Connecticut (1,220), Rhode Island (921), Delaware (531), and District of Columbia (805), showed a significant number of deaths compared to those of other states. These hit states showed the common features such as 1)Along the coastline for cetacean transmission (Fig. 6), 2) Regions of the leather tanning (Fig. 7), 3) Areas of oil refineries (Fig. 8A), 4) Regions of natural gas- and coal-powered plants (Fig. 8B), 5)Metropolitan areas (Fig. 8C), all of which producing CO_2 emissions for the coronavirus (COVID-19) pandemic.

If bad air- CO_2 in New York City is replaced with good air- O_2 in Wyoming State, the ozone hole in New York City may decrease with less UV-B radiation, as explained by NIH (1989). Therefore, compressed air with better air- $O_2$and less bad air- CO_2 in Wyoming State would inhibit the viral activity of the coronavirus (COVID-19)in metropolitan areas. Forest cover percentage of each state shows in the parenthesis with the COVID-19 deaths as follows: GA(67)- 3,168 deaths as of May 28, 2020, NY(63)- 32,490, MA(61)- 8,419, PA(59)- 7,022, MI(56)- 6,366, CT(55)- 4,396, LA(53)- 3,543, FL(51)- 4,981, WA(44)- 1,444, NJ(42)- 15,706, MD(39)- 3,377, TX(37)- 3,939, DC(34)- 460, CA(33)- 7,702, OH(31)- 3,173, IN(21)- 2,821, and IL(14)- 7,488. The recovery from theCOVID-19 expects to start from the earliest states of Georgia and New York with high forest cover percentage eventually extending to Indiana and Illinois with low forest cover percentage. The key parameters causing the COVID-19 in the USA may be the leather tanning industry, cetaceans along the long coastline, and toxic gases from oil refineries, coal- and gas-powered plants, vehicles, population, and metropolitan food waste. The USA ranked first globally for coronavirus (COVID-19) deaths (132,291) as of July 10, 2020.

b) Brazil

Brazil ranked 13th globally forCO_2 emissions (476.1 Mt CO_2).CO_2 emissions produced by 22 coal-and6 gas-powered plants, 17 oil refineries,42,743,000 registered vehicles' exhaust gases, metropolitan food waste gas, human exhalation with a population of 209.3 million, leather-tannery industry, and organic dye industry. The Brazilian coastline extends 7,491 km to induce the coronavirus (COVID-19) through dolphins and humpback whales (Site #7 Brazil) (KIM, 2020). There is no active volcano. The latitude is 11°S and thus within the safe zone from the COVID-19. However, Brazil exports the leather tanning industry, causing pollutions in water as well as in air, leading to the spread of the COVID-19. Brazil ranked 2nd globally for coronavirus (COVID-19) deaths (69,184) as of July 10, 2020, even though it locates at a safe latitude.

c) India

The coastline is 7,000 km with7 volcanoes. The latitude is 21°N and thus near the safe latitude range. India ranked 3rd globally for CO_2 emissions (2,466.8 Mt CO_2) and has a population of 1,340 million. India has 28,860,000 registered vehicles, 23 oil refineries, 24 coal-based power stations (57 %), and gas power stations (7%) with disastrous air pollution. India is the fifth biggest exporter of leather goods in the world. The leather industry in India accounts for 13% of the world's leather production, 9% of the world's and 2nd largest footwear production with 20% of the world's cattle and buffalo, and 11% of the world's goat and sheep population. The Indian leather industry locates in northern, central, and southern parts of India, as shown in Fig. 10. India has terrible water pollution caused by leather tanneries, which permanently deteriorate the soil.

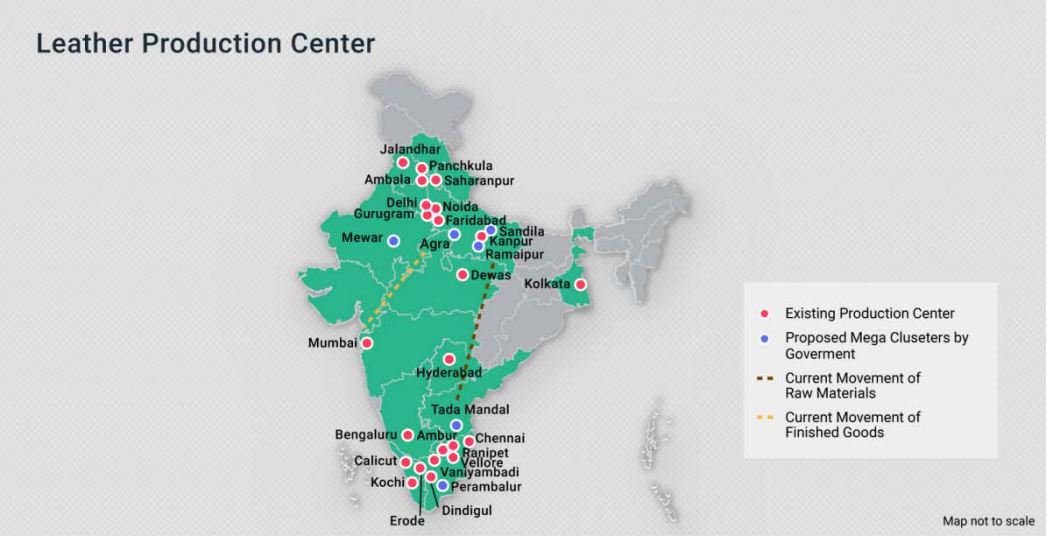


Figure 10: India-leather production center (INSTA REVISION PLAN 2.0, 2020).

India ranks 3rd internationally for CO_2 emissions after China and the USA. The main reason for India being ranked 3rd for coronavirus (COVID-19) cases as of July 10, 2020, is the negative parameters of the leather industry and CO_2 emissions from oil refineries, power stations, vehicles, and densely populated areas. Positive factors against the coronavirus are curcumin food, volcanoes, and partial safe latitude range near 20°N (8-37°N). Curcuminis a natural anti-inflammatory compound (HE et al.,2015). The COVID-19 induces pneumonia, inflaming the alveoli in the lungs which fill with pus affecting the exchange of oxygen and carbon dioxide molecules to and from the bloodstream, resulting in a shortage of oxygen in the blood culminating in a heart attack (KIM, 2019). Curcumin should eat to prevent the inflammation caused by the COVID-19 that results in lung disorder. The distribution of coronavirus cases in India is very close to those of the leather industries in India (Fig.10). The COVID-19 in India caused by the leather industry using toxic chemicals and carcinogens, which polluted the biosystem in the river and contaminated the water for drinking water. India ranked 3rd globally for deaths (21,604) as of July 10, 2020.

d) Russian Federation

The Russian Federation ranked 4th globally for CO_2 emissions (1,692.8 Mt CO_2).CO_2 emissions produced by 25 coal-and gas-powered plants, oil refineries,51,355,000 registered vehicles' exhaust gases, metropolitan food waste gas, human exhalation with population of 144.5 million, leather-tannery industry, and the organic dye industry. Russian electricity bases on gas (46%), coal (18%), hydro (18%), and nuclear (17%) power. There are twelve volcanoes in Russian Federation. The global Russian rank of the leather production is the fourth (BUFFALO JACKSON, 2020).

The Russian Federation has the longest coastline measuring 37,653 km to induce the COVID-19through dolphins and humpback whales (Site # 1 West Indies, # 2 Cape Verde, # 4 Hawaii, #5 Mexico, # 6 Southeastern Pacific) (KIM, 2020), migrating to the Arctic Ocean. Since most of the Russian coastline is above the Arctic Circle (66°N), the impact of the COVID-19 reduces by the potent UV-B radiation due to the Arctic ozone depletion (OZONE HOLE, 2019). Even though the Russian Federation has a leather tanning industry and its CO_2 emissions ranked 4th in the world, it had relatively few COVID-19 deaths due to the high latitude (60°N), ranking 4th with 11,000 deaths as of July 10, 2020.

e) Peru

CO_2 emissions were 57.7 million metric tons from one coal-and sevengas-powered plants, 36 oil refineries, 2,444,000 registered vehicles' exhaust gases, metropolitan food waste gas, human exhalation from a population of 32 million, leather-tannery industry, and the organic dye industry. Peru produced hides to export leather to the USA, Europe, and China, leading to excessive outbreaks of the coronavirus. There are twenty-one active volcanoes. The volcanic gas(H_2O, CO_2, SO_2,CO, H_2S, HCl, HF) inhibits the activity of the COVID-19.Thelatitude is 10°S and thus within the safe zone from the COVID-19. The coastline is 2,414 km, which induces the COVID-19 through dolphins and humpback whales (Site # 13 in the Southeastern Pacific) (KIM, 2020), as shown in Fig. 5.Peru ranked 5th globally for deaths (11,314) as of July 10, 2020.

f) Chile

Chile had a population of 18 million and the coastline extending 6,435 km. CO_2 emissions were 90.326 million metric tons, produced by coal-and gas-powered plants, oil refineries,4,445,000 registered vehicles' exhaust gas, metropolitan food waste gas, human exhalation, leather-tannery industry, and organic dye industry. There are 3 active volcanoes. Chile produced hides to export leather to the USA, Europe, and China, leading to excessive outbreaks of the coronavirus. The latitude is 30°S and thus not safe from the COVID-19. Chile ranked6thglobally for deaths (6,682) as of July 10, 2020.

g) The United Kingdom

The United Kingdom ranked 17th globally for CO_2 emissions. There is no active volcano. The United Kingdom produces 1,472,000 bbl/d oil in its refineries and has CO_2 emissions of 364.1 million tons. There are 42 natural gas-fired power stations in England along with five coal-powered stations. There were 38.2 million licensed vehicles. Demand for quality leathers increases across the garment, footwear, and leather goods industries. The Stahl Neo company only produces 1,100 leather tanning chemicals. Most tanning does within a few months. In contrast, the traditional tanning process takes 12 months to make expensive, but better leather using the oak bark method. The last oak 13 tanneries in the UK buy top quality hides, using a traditional tanning process, and producing the leather for shoe, saddle and harness makers, which export to China, Turkey, and Italy. Chrome tanning, adding chrome salt to the animal skin, is still the principal method used by 85% of tanneries because it is fast. Alternatives are the synthetic tanning with glutaraldehyde and vegetable tanning with the tannic acids. There are 12 leather federation associates and 15 UK leather federation members. Effluents from the unhairing and liming processes contain high concentrations of sulfur compounds from the sodium sulfide if the pH is below 9.5, toxic hydrogen sulfide (H_2S) gas evolves. The latitude is 51.5°N and thus not safe from the COVID-19. Since the United Kingdom produces less CO_2 emissions than the top 15 countries, it should expect to have less COVID-19 cases. This discrepancy could cause by the active leather tanning industry and toxic chemical manufacturing along with the long coastline of the United Kingdom (4,964 km) where dolphins can swim, as shown in Fig. 5. These combined factors could be responsible for the UK ranked 7th globally for COVID-19 deaths (44,687) as of July 10, 2020.

h) Mexico

Mexico ranked 11h for CO_2 emissions (490.3 Mt CO_2). The Mexican coastline of9,330 km is long enough to induce the COVID-19,through dolphins and whales (Site #5 Mexico, # 6 Southeastern Pacific) (KIM, 2020), migrating to the Arctic Ocean. There are 48 volcanoes. Mexico produced hides to export leather to the USA, Europe, and China, leading to excessive outbreaks of the coronavirus (COVID-19). Mexico ranked 8th globally for COVID-19 deaths (33,526) as of July 10, 2020, even though it locates at a safe latitude (19°N).

i) Spain

Spain ranked 23rd globally for CO_2 emissions (281.4 Mt CO_2) and has a population of 46.6 million. There are 11 volcanoes. The latitude is 40°N and thus unsafe from the COVID-19. There are seven volcanoes, 2,436 coronavirus cases and 162 deaths (as of July 10, 2020) on the Canary Islands of Spain. Even though there are many volcanoes, not enough fumes are present to prevent the propagation of the coronavirus outbreak. It is, therefore, important to have an active volcano with volcanic gas fumes to inhibit the activity of the coronavirus, as in Japan. Spain has a long coastline of 2,300km.The relatively high number of deaths could partly cause by its close proximity (1,595 km from the Canary Islands) to Cape Verde, which is the humpback whale breeding region in Northwest Africa (Site # 2)(KIM, 2020). Humpback whale feces can infect the dolphins, which happened in Wuhan in China (KIM, 2019).Spain has 27,463,000 registered vehicles and a

population of 46.94 million, producing CO_2 emissions. The refinery water consumption estimated (SUN et al.,2018). Spain has an oil refinery capacity of 15, 515,000 bbl/d with ten refineries, which produce toxic gases (H_2S,SO_2) as stack gas and polluted water during the process of crude oil, leading to the coronavirus (COVID-19). There are six coal-powered plants and three natural gas-powered plants in Spain to release harmful flue gases (H_2S,SO_2) as a by-product, contributing to the COVID-19. One hundred eighteen companies operated the tanning industry, employing 2,689 workers (SPANISH TANNERS CONFEDERATION, 2008). Tanned Spanish leather intends for footwear followed by leather garments, leather goods, and upholstery, which export to Hong Kong, Italy, France, and Morocco. Leather tanning with chromium salts yields a soft, supple leather that can dye in multiple colors. The key parameter causing the COVID-19 in Spain may be the leather industry and the organic dye industry. The Marshallian Industrial Districts (MID) in Spain produces textile products (46 MID and 85,000 employees) and leather and footwear (23 MID and 73,000 employees). Its main axis extends from the north of Catalonia to Valencia and Murcia. Catalonia, Valencia, and Murcia control by a MID basis for better wastewater treatment of polluted effluents from tanned Spanish leather, which could be why such areas showed lower coronavirus cases. High numbers of confirmed cases in other areas could cause by running small factories in residential locations which infect more people due to water pollution as well as air pollution. Such a regional distribution could have caused the high number of deaths in a similar way to Lombardy in Italy, Wuhan in China, and New York City in the USA. Those that have died in Spain could be older than 70 as in other countries. Their respiratory systems had deteriorated for 10-20 years due to air and water pollution in Spain. Their alveoli could no longer exhale CO_2 from their bodies, and O_2 could not inhale because of chronic calcification by toxic gas pollution (H_2S) from refineries, power plants, vehicles, food waste, and tanneries. However, when affected by the COVID-19, the lung is very weak since the coronavirus calcifies the alveoli of the lung very quickly. Therefore, older adults can die easily unless the oxygen generator supplies in time. The residence time of the COVID-19 can determine with data (KIM, 2020)as follows;

Number of alveoli in lung $= 300x10^6$

- Human inhaling rate (Q) $= 8$ L/min
- Spherical volume calculation (V) $= \frac{4}{3}\pi R^3$

Calculation;

Radius of alveolus (R), $R= 100x10^{-4}$cm

Total Volume $V = (3x10^8)\ (\frac{4}{3}\pi)(10^{-6}cm^3)$

$= 4\pi\ x10^2\ cm^3$

Residence Time, $\tau = (V) / (Q)$

$$= \frac{4\ \pi x10^2 cm^2}{8000\ cm^3/min}$$

$= 0.157$ min

$\tau = 10$ seconds

Therefore, the effect of the COVID-19 is equivalent to giving a straight jab in boxing to an older adult every 10 seconds of residence time (one cycle of air inhalation and air exhalation in the lung), which is very difficult to endure for older adults with high death rate in Europe, China, and the USA. Spain has 282 Metric tons CO_2. On the other hand, Spain is the 9th worst-hit country by the COVID-19 with deaths of 28,401, as of July 10, 2020. It thus suggests that the parameters causing the COVID-19 in Spain are in the significant order of leather-tannery-textile industry, dolphins, oil refineries, power plants, and CO_2 emissions.

j) Iran

Iran ranked 7th globally for CO_2 emissions (672.3 Mt CO_2).The coastline of Iran is 2,440 km. There are 14 volcanoes in Iran. The positive parameter against the COVID-19is 14 volcanoes producing volcanic gases (SO_2, H_2S,HCl,HF, CO_2, CO, H_2O) with two very active sulfur fumaroles in SE Iran, which inhibit the coronavirus activity with weak COVID-19 observed in such regions. The negative parameters are the whale habitat and leather industry. MERS-CoV caused by stranded humpback whales in the Persian Gulf, Gulf of Oman, and Arabian Sea(Kim, 2019).Tabriz with Lake Urmia has the problem of air pollution due to power plants and oil refineries. There are ten oil refineries and 400 power plant units in Iran. The leather industry began with 170 leather companies trading raw hides and skins. The most important parameter is the leather industry (SHAFAEI et al., 2019). Therefore, Iran has high coronavirus casualties due to negative parameters such as the leather industry, oil refineries, power plants,

vehicles, population density in metropolitan areas of Tehran, water and air pollution, and humpback whales/ dolphins. The latitude of Iran is 32°N and thus an unsafe zone from the COVID-19. Iran ranked 10th in the world for deaths (12,447) as of July 10, 2020.

k) Italy

Italy ranked 19th globally for CO_2 emissions (60.5 Mt CO_2) and had a population of 60.5 million. The coastline of Italy is 7,600 km. There are 48 volcanoes. The latitude is 43°N and thus not safe from the COVID-19. Italy has 42,242,000 registered vehicles. There are three major parameters (leather-tannery, dolphins, volcanoes) governing the COVID-19 in Italy. Firstly, leather and textile industries have polluted the PO River (Fig. 11) ever since the Chinese immigrants emigrated Tuscany in Prato (MAX, 2019). Veneto has a total of 1,751 Chinese owned factories. The owner's places of origin are Wenzhou (67.9%) in China with cloth products. Chinese working conditions were residential areas causing pollution (WUet al., 2011). Since toxic chemicals use for tanning in the leather industry as organic dyes in the textile industry, cities that the PO River passing through (Fig.11),are polluted.

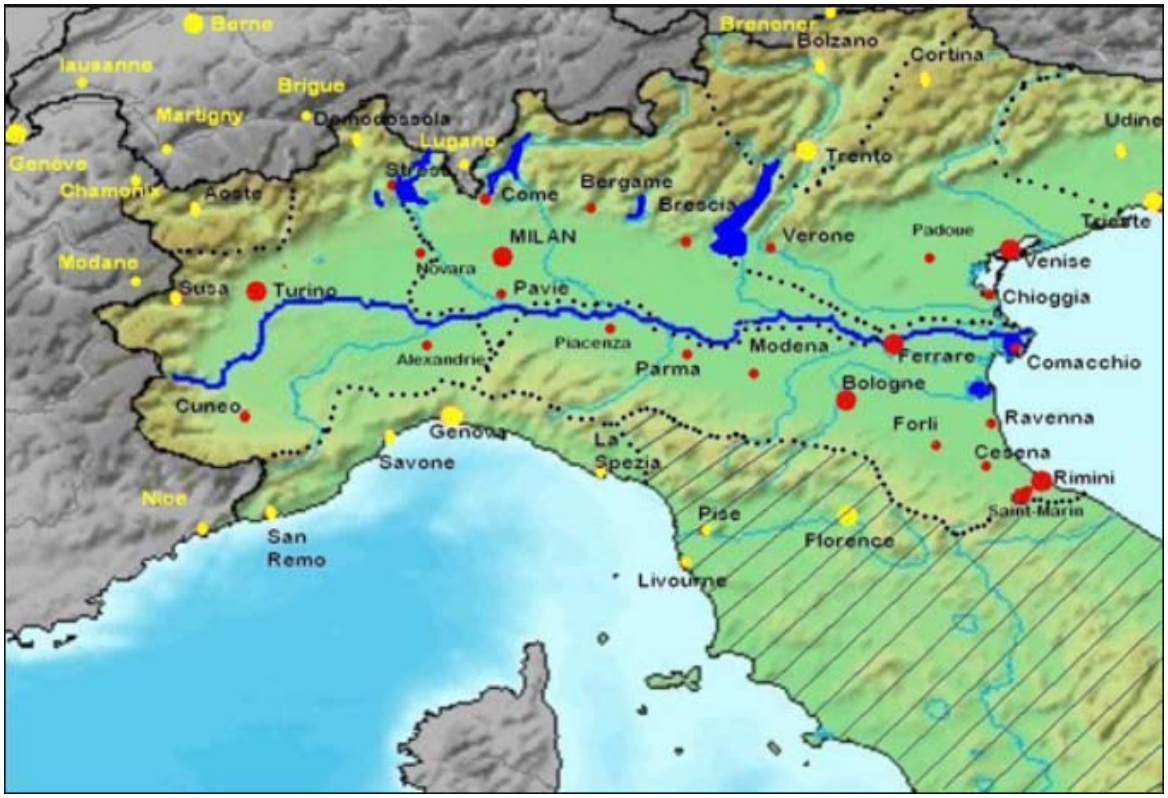


Figure 11: A map of the PO River(from Premier River Cruises by a Travel of America Company), highlighting major Provinces in Italy with confirmed coronavirus cases (deaths);Lombardy 85,775 (15,662), Emilia-Romagna 27,364 (4,008), Piedmont 29,885 (3,718), Veneto 19,030 (1,832), Tuscany 9,982 (998), Marche 6,677 (987), Liguria 9,289 (1,386), Lazio 7,533 (647), Trentino-Alto Adige 4,368 (455), Campania 4,714 (401), and Apulia 4,407 (478) with more than 10% of deaths. These Provinces have 82% of Italy's total coronavirus outbreak of 222,364 cases and 32,330 deaths as of May 7, 2020.

The distribution of dolphins in Italy can cause the propagation of theCOVID-19, as shown in Fig. 5. Bottlenose dolphins carried the coronavirus (LEGER et al. 2018). Dolphins, with a worldwide population of about 600,000, swim in shallow areas (25 feet) and are well-distributed in Italy (BAS et al., 2018). Countries that border the Adriatic Sea are as follows with the coronavirus deaths in parenthesis as of June 18, 2020. Italy (34,448), Croatia (107), Slovenia (109), Bosnia and Herzegovina (168), Montenegro (9), and Albania (38). The contribution of the dolphins to the COVID-19 in Italy was moderate while major portions of the Italian coronavirus cases caused by the leather tanneries along the PO River (Fig. 11) in Northern Italy. The impact of the COVID-19to people is very critical, as shown in Fig. 1, especially the case with older adults who have exposed to air pollution for 20 years by Wenzhou immigrants from China with skills in leather and textile coloring. There are seven active volcanoes (CampiFlegrei, Vesuvius, Stromboli, Panarea, Vulcano, Etna, CampiFlegrei del Mar di Sicilia). Although there were no recent volcanic eruptions, the volcanic activity produced the toxic volcanic chemicals (SO_2, H_2S, HCl, HF, H_2SO_4) (USGS, 2011). Provinces near volcanoes showed low confirmed coronavirus cases and (deaths): Sicily 3,411 (268), Umbria 1,427 (74), Calabria 1,156 (96), Basilicata 393

(27), Molise 422 (22) as of May 7, 2020. However, regions of leather and textile industries showed high cases and deaths %; Lombardy 85,775 (48.4 %), Emilia-Romagna 27,364 (12.4 %), Piedmont 29,885 (11.5 %), Veneto 19,030 (5.7%), Tuscany 9,982 (3.1%), Marche 6,677 (3.1%), Liguria 9,269 (4.3%), Lazio 7,533 (2.0%), which are all the regions of the PO River in Fig. 11. Most of the Italian Provinces are in coastal waters where bottlenose dolphins transmit the COVID-19, as proposed by Kim (2020).As for Italy, there are a few features that caused the sudden rise of the coronavirus with high cases and deaths; 1) Italy is famous for its leather and textile industries, which follow the toxic chemical contamination of the PO River, especially by Chinese immigrants in the 1990s in residential areas rather than in industrial complexes. 2) Italy is a Peninsula country having a long coastline of 7,600 km with an average depth of 252.5m while the Strait of Sicily is 365m deep. Dolphins prefer the shallow coast with a depth of 25 ft. It appears that the casualties of the Italian coronavirus (COVID-19) mainly occurred in the region of Lombardy Province with the PO River, polluted by chemicals from leather and textile industries including the regions of Emilia-Romagna, Piedmont, Veneto, Tuscany, and Marche. Dual tracks of the inland leather industry and dolphins off the Italian coasts might have caused the heavy casualties of the coronavirus outbreak in Italy. Furthermore, 100,000 Chinese immigrants from mainly Wenzhou, producing cloth products, polluted residential areas in the region of the PORiver. Besides, Italy has oil refineries with a capacity of 1,898, 000 bbl/d. Stack gases such as SO_2, H_2S, CO, O_3, CO_2,and hazardous material in oil refineries, induce air pollution with CO_2 emissions. Italy ranked 11th globally for deaths (34,926) as of July 10, 2020.

l) Turkey

Turkey ranked 15th in the world for CO_2 emissions (447.9 Mt CO_2). Leather chemicals sell in Turkey (GRAND VIEW RESEARCH, 2019). The leather industry uses very toxic chemicals during leather production, with carcinogenic and derivatives, causing the COVID-19.Turkeyhas 10 volcanoes. The coastline extends for 7,200 km. The latitude is 41°N and thus not safe from the COVID-19 resulting in the nation ranked 15th for deaths (5,300) as of July 10, 2020.

m) France

France ranked 18th globally for CO_2 emissions (356.3 Mt CO_2). The length of the coastline is 4,853 km. There are 13active volcanoes. The key parameter causing the COVID-19 in France may be the leather industry and the organic dye industry. The latitude is 48.9°N and thus out of the safe latitude range. Consequently, France ranked16th globally for deaths (29,982) as of July 10, 2020.

n) Germany

There are four volcanoes near Frankfurt. Major coal sites are Ruhr, Essen, Saar near Frankfurt with the Rhine River. The central German area where the Elbe River passes through, is near Leipzig, Lusatia, and Helmstedt areas. There are coal-powered plants nearby. There are gas-powered plants all over Germany, and the Inn and Danube Rivers flow through Augsburg and Munich. The latitude of Germany is 51.5°N and thus out of the safe latitude range. Germany has the leather textile industry to generate polluted waters, and the oil refineries produce 2,050,000 bbl/d, which in turn to produce toxic stack gases. Dolphins are distributed along the German coastline, which runs for 2,389 km with the North Sea and Baltic Sea spreading the COVID-19. The population of Germany was 82.9 million, with 63.7 million registered cars, which produced CO_2 emissions of 811 million net tons (meaning a global rank of 6th).There are 1,800 small scale factories and medium-to-large-sized enterprises in the German cloth textile industry with 1,204,500 professional workers (KOPTYUG, 2019).Most German textile companies base in the following regions: North Rhine-Westphalia 202, Baden-Wurttemberg 125, Bavaria 124, Saxony 100, Hessen 43 (https://dw.com/en/love-for-textiles-still-sewn-into-the-fabric-of-saxony-in-eastern_germany).

Major German textile companies correlated with the coronavirus cases distribution along with those of coal- and gas-powered plants. German COVID-19 casualties were mainly caused by the leather textile industry, oil refineries, power stations, vehicle exhaust, and metropolitan food waste biogas. Germany ranked 17th globally for deaths (9,062) from the COVID-19 as of July 10, 2020.

o) Canada

Canada places 10th in the world for CO_2 emissions (572.8 Mt CO_2). Canada is one of the major market players of global organic pigments. The coastline extends for 4,964 km. There are five active volcanoes. The latitude of Canada is 53.8°N and thus out of the safe latitude range. Since a major part of the Canadian coastline is above the Arctic Circle (66°N), the impact of the COVID-19reduces by the potent UV-B radiation due to the Arctic ozone depletion (OZONE HOLE, 2019). Canada involves in the leather tanning industry. However, with a high latitude (53.8°N), it had relatively few COVID-19 deaths (8,797) as of July 10, 2020, ranking 20th in the world. The coastline is on the routes of whale migrations to the feeding grounds of the Arctic Ocean in Canada (Humpback whale breeding grounds of Site # 1 West Indies, # 4 Hawaii; Gray whale breeding grounds of #5 Mexico, # 6 Southeastern Pacific) (KIM, 2020).The major parameters causing the COVID-19 in Canada may be the leather production with toxic chemicals as well as the long coastline for cetacean transmission.

p) China

China produces the highest amount of CO_2 emissions in the world (9,838.8 Mt CO_2) and has 162,845,000 registered vehicles. As of 2019, China had the highest number of installed coal-powered plants, amounting to about 1,005 gigawatts. There are 210 oil refineries. China has 39 volcanoes. But no active volcanoes are present. The population was1.39 billion in 2017. The coastline is 14,500 km. Cetaceans, including whales, dolphins and porpoises, transmitted the COVID-19 pandemic(KIM, 2020).The latitude is 35°N,and thus, out of the safe latitude range from the COVID-19. China ranked 23th globally for deaths (4,641) as of July 10, 2020.China released news of 82,929 coronavirus cases with, 6,633 deaths as of May 14, 2020. On the other hand, China announced 84,992 total cases with 4,641 deaths as of July 10, 2020. The number of deaths has significantly reduced since the earlier data of 6,633 on May 14, 2020. Since China produces the highest CO_2 emissions, such data is not in agreement with other countries.CO_2 emissions in China amount to 9.8 billion metric tons. The USA (5.3 billion metric tons) was the worst-hit by the coronavirus (COVID-19) pandemic with 3,118,168total cases and 132,291 deaths as of July 10, 2020. Since there was a linear relationship between the CO_2 emissions and the coronavirus casualties with correlation coefficients of total cases (R^2= 0.8064) and deaths (R^2= 0.7627)(KIM, 2020), the actual China cases can estimate approximately as follows:

$$CO_2 \text{ Ratio} = \frac{9.8 \text{ (China)}}{5.3 \text{ (USA)}} = 1.85$$

China's total cases approximate as,

(USA3,118,168) X (CO_2 Ratio = 1.85)

= 5,768,610 (while China official announcement; 84,992 as of July 10, 2020)

= 68-fold, fewer total cases, announced than those supposed to be in China.

China's deaths cases approximate as,

(USA132,291) X (1.85)

= 244,738(while China official announcement;4,641as of July 10, 2020)

= 53-fold, fewer deaths cases, announced than those supposed to be in China.

It appears that China may have announced68-fold fewer casualties, for total cases, and 53-fold fewer ones for deaths cases, of the COVID-19 pandemic than those of actual cases in China.

q) Sweden

CO_2 emissions in Sweden were 63.8 million metric tons in 2018. CO_2 emissions produced by 46 coal-, two fuel oil-, and1 gas-powered plant, four oil refineries, 4.8 million vehicles' exhaust gases, metropolitan food waste gas, human exhalation from a population of 10.23 million, four leather-tannery factories, and the organic dye industry. There are no active volcanoes. The latitude is 62°N and thus out of the safe latitude range. Since a major part of the Swedish coastline is near the Arctic Circle (66°N), the impact of the COVID-19 pandemic reduces by the potent UV-B radiation due to the Arctic ozone depletion. Even though Sweden involves in the leather tanning industry and its CO_2 emissions were 63.8 million metric tons, the country showed a relatively high level of COVID-19 cases, ranking25th globally for deaths (5,500) as of July 10, 2020. Good parameters against theCOVID-19 are as follows: Arctic Circle of Norrbotten county has rich forest area covering 68.92% of land area and agricultural land covering 7.44% of land area. The key parameters causing the COVID-19 in Sweden may be the leather production with toxic chemicals as well as the long coastline stretching 3,218 km for cetacean transmission. Residual hazardous chemicals from 20 manufacturers of leather and related products were released into the 12 rivers in Stockholm county, which polluted the water quality and emitted CO_2 ,originated from the flue gas of refineries (454,000 bbl/d, 2018) but also from the deteriorated water, similar to the case in Wuhan in China. Organic dyes altering the color of textiles and leather, are the most critical parameters causing the COVID-19 pandemic. There are bottlenose dolphins around in t he Baltic Sea. A significant feature of the top 10 counties with coronavirus COVID-19 deaths was a long coastline, which applies to Sweden, as shown in Fig. 5. Coronavirus deaths in Sweden, as of June 04, 2020, indicate per region in parenthesis as follows: Stockholm (12,060), Vastra Gotaland (5,773), Ostergotland (1,975), Uppsala (1,883), Orebro (1,795), Skane (1,704), Sodermanland (1,623), Jonkoping (1,508), Vastmanland (1,264), Gavleborg (1,258), while

Orebro, Jonkoping, and Vastmanland counties are not in contact with the coastline. It can conclude that the COVID-19 in those three counties are caused purely by the tannery leather and textile industries while the spread of the COVID-19 in the other seven ones caused by mixed types of the leather industry and cetacean transmission. There are 4.8 million vehicles, as well as a total population of 10 million in Sweden. Vehicle exhaust gases and personal exhalation produce CO_2 emissions, which increase the COVID-19 cases. The automobile industry is of major importance for Sweden. The map ofCOVID-19 confirmed cases in Sweden completely matched with the figures of the automotive industry in Sweden 2015 (POHL, 2017). It can conclude that the COVID-19 in Sweden caused by the automobile industry using leather goods as interior seats of automobiles, including tannery goods. At the same time, dolphins transmitted the COVID-19 to the counties on the coast of the Baltic Sea. These dual tracks from the land of the automobile industry with leather tanning and from the sea by dolphins, for the coronavirus (COVID-19)transmission, might be why Sweden ranked 25th for COVID-19 cases, as of July 10, 2020, which is despite Sweden being ranked far down the international list in 70th for CO_2 emissions (44.8 Mt CO_2/ year).

r) Indonesia

Indonesia ranked 10th globally for CO_2 emissions (486.8 Mt CO_2). There are 76 active volcanoes. Indonesia has 1,057,000 bbl/d of oil refinery capacity, which produces toxic stack gases, inhibiting the activity of the coronavirus. Other negative parameters inducing the COVID-19 are dolphin residency, and Chinese people arriving on business from Wuhan in China. There is a high population of Chinese Indonesians (nearly 3 million), 38 coal-, 15 oil-, and natural gas-powered plants, nine oil refineries, 22,513,000 registered vehicles, a high population of 264 million. Indonesia has dolphins along the 54,716 km coastline. Indonesia is an exporter of raw leather material to the world, which causes pollution in the water as well as in the air, leading to its global rank of 26th for deaths (3,469) as of July 10, 2020. Its rank reduced by the safe latitude (6°N),active volcanoes (76 actives), and enough forest (52.1%) and agricultural land (31.46%) to convert harmfulCO_2 to good O_2against the COVID-19 pandemic.

s) Ecuador

CO_2 emissions were 40.0 million metric tons. The coastline is 2,237 km. There are 27 volcanoes. The latitude is 2°S and thus within the safe latitude range from the COVID-19.There are three oil refineries with a net capacity of 175,000 bbl/d. Volcanic gases and stack gases from oil refineries such as H_2S and SO_2help reduce the coronavirus cases, as explained in Equation (2) for New Zealand (22) and Iceland (10) with deaths in parenthesis. One out of 50 firms used the traditional vegetable tanning without chemicals (GERULAITYTE, 2018). Provinces near Cotacachi, such as Esmeraldas (43) and Imbabura (11), had a relatively low number of deaths. There were many deaths in the provinces of Guayas (1,059), Manabi (252), Pichincha (105) via Los Rio (76), and El Oro (114), as of May 14, 2020. Those provinces are all in contact with either the Pacific Coast, estuaries or rivers. Dolphins live off the Ecuadorian Coasts and in the Rivers. The high casualties in Ecuador were all shown in the areas of the coast, the estuarine, or where dolphins can approach. Ecuador ranked 29th globally with 64,221 total cases and4,900 total deaths as of July 10, 2020.

t) Belgium

CO_2 emissions in Belgium were 94.7 million metric tons, produced by three coal-poweredand18 gas-powered plants, four oil refineries,6,426,000 registered vehicles producing exhaust gases, metropolitan food waste gas, human exhalation gas from a population of 11.5 million, seven leather-tannery factories, and the organic dye industry. Belgium is one of the leading exporters of leather footwear. The key parameters causing the COVID-19 in Belgium may be the leather industry and the dye industry. Belgium ranked 30th globally with 62,357 total cases and9,781 deaths as of July 10, 2020.

u) The Philippines

The Philippines had a population of 106.7 million and produced 157.6 million metric tons of CO_2 emissions. The Philippines have 23 active volcanoes, the volcanic fumes of which might reduce further casualties in the Philippines. Good parameters for the Philippines against the COVID-19 are volcanoes and a safe latitude location. Negative ones in favor of the COVID-19are CO_2 emissions, dolphins along the 36,289 km coastline, the population of 105 million, 19 coal-powered plants, ten diesel-powered plants, five gas-powered plants, three oil refineries, and the leather industry. There are many Chinese people from Wuhan of China working in the leather industry, which causes water pollution by toxic chemicals in the leather tanning process. The latitude of the Philippines is 14°N and thus within the safe latitude range of the COVID-19, ranked 35th globally for deaths 1,360 as of July 10, 2020.

v) The Netherlands

CO_2 emissions were 163.4 million metric tons and has a population of 17.3 million. There are two active volcanoes, nine oil refineries, 12 coal- and 12 gas-powered power plants, and dolphins causing the coronavirus outbreak. The coastline is 451 km. The latitude is 52°N and thus not safe from the COVID-19. Netherlands ranked 37th globally with6,156 deaths as of July 10, 2020.

w) Israel

CO_2 emissions in Israel were 64.6 million metric tons, produced by coal-and gas-powered plants, oil refineries,2,959,000 registered vehicles' exhaust gases, metropolitan food waste gas, human exhalation from a population of 8.88 million, and leather-tannery industry. The coastline is 273 km. There are no volcanoes. The latitude is 31°N and thus out of a safe zone from the COVID-19. In Israel, there were 7,440 workers in 2,580 firms in the leather industry in 1965. Most work was done in140 family-style workshops by 1,500 persons (ENCYCLOPEDIA JUDAICA, 2008) (https://www.jewishvirtuallibrary.org/leather-industry-trade). Principal casualties occurred in Tel Aviv, Jerusalem, and Hebron. Harmful causes stimulating the coronavirus outbreak are as follows; the leather and apparel industry, textile industry, dolphins off the Mediterranean coast, two oil refineries (305,000bbl/d), 25 natural gas-powered plants with significant gas discoveries in Israel. It is likely that the pollution caused by tanneries and shoemaking induced COVID-19 cases. The Yarkon River flows west through Tel Aviv as the largest coastal river in Israel with principal rivers of the Jordan, Qishon, and Yarkon, polluted by the tannery-leather-footwear-apparel industry to induce a significant number of COVID-19 pandemic. Israel ranked 44th globally for deaths 350 as of July 10, 2020.

x) Japan

Japan ranked 5th globally for CO_2 emissions (1,205.1 Mt CO_2) with a population of 126.8 million. The coastline of Japan is 29,751 km. There are 110 volcanoes. The latitude is 35°N and thus not safe from COVID-19 pandemic. Favorable parameters against the coronavirus are 110 active volcanoes, rich forests and mountains (67 %), and agricultural land (12.26 %). Negative parameters are as follows:

Leather. Hyogo leather's white color naturally creates by the tanning process. Japan produces textiles to cause the water pollution and worsen the coronavirus outbreak. Dolphins. Approximately 22,000 dolphins killed annually for Japanese meat. Dolphins lead to a high number of coronavirus (COVID-19) cases (KIM, 2020).Oil refineries and power plants. Japan has 23 refineries with a capacity of 3.92 million bbl/d. Japan has built two coal-burning power plants and four natural gas power plants. Stack gas from the refineries and flue gas from the power plants cause air pollution with enhanced CO_2 emissions and toxic H_2S and SO_2, inducing the COVID-19.Vehicles and population. There were 78.3 million vehicles, as well as a total population of 126.5 million. Vehicle exhaust gases and all the people produce CO_2 emissions to increase the COVID-19.

Active volcanoes. One hundred ten active volcanoes are now protecting Japan from the coronavirus disaster. Volcanic eruptions produce volcanic gases such as SO_2 and H_2S, which are very acidic, which the coronavirus does not like. When comparing the 47 Japanese Prefectures with the COVID-19 outbreak as of July10, 2020, two characteristic groups observed. The first group is Prefectures far from volcanoes with excessive casualties; Tokyo (confirmed cases 7,515/325 deaths), Osaka (1,967/86), Kanagawa (1,685/97), Chiba (1,078/46), Saitama (1,396/67), Hyogo (726/43), Fukuoka (908/33), Hokkaido (1,289/101), Aichi (531/34), Kyoto (430/18), Ishikawa (300/27), Ibaraki (196/10), Gifu (162/7). The second group is Prefectures near the volcanoes with negligible casualties; Northeast Honshu Arc area of Aomori (29/1) (Mt. Iwaki), Iwate (0/0) (Mt. Iwate), Akita (16/0) (Mt. Akita-Yakeyama), Southwest Honshu Arcarea of Tottori (4/0) (Mt. Daisen), Shimane (24/0) (Mt. Sanbe), Okayama (28/0) (Mt. Shintake), Tokushima (10/1) (Mt. Ishizuchi), Ryukyu Arcarea of Saga (47/0) (Mt. Sefuri), Nagasaki (20/1) (Mt. Unzen), Miyagi (100/1) (Mt. Kirishima), Miyazaki (17/0) (Sakurajima Volcano), Kagoshima (132/0)(Mt. Sakurajima). The second group near active volcanoes, which shown in parenthesis, had the least COVID-19 cases and a negligible number of deaths. The comparison indicated that the COVID-19 deaths were reversely proportional to the presence of active volcanoes or volcanic gases from volcanoes, as shown in CASE 1 of Equation (2). Therefore, in non-volcanic countries, people can easily protect themselves from the COVID-19 pandemic by spraying small amounts of artificial volcanic gases such as SO_2 and H_2S, as described in the section of *II. e).*Japan ranked56th globallyfor deaths 982 as of July 10, 2020.

y) South Korea

South Korea ranked 9th globallyforCO_2 emissions (616.1 Mt CO_2) and has a population of 51.5 million. There are no volcanoes. The latitude is 37.5°N and thus not safe from COVID-19. Helpful parameters are such as clean forestry and rivers with even distribution of industrial complexes along the coastline. The textile industry for coloring and dolphins. South Korea had the most casualties in Daegu city, which has 109 dyeing factories (as of 1994). They used toxic chemicals such as Chinese dyes, domestic caustic soda, sulfuric acid, hydrochloric acid, acetic acid, and surfactant, for coloring. Residual harmful chemicals released into the Geumho River in Daegu city, which polluted the water quality and emitted carbon dioxide from the flue gas. Indo-Pacific bottlenose dolphins can be found around Jeju Island in South Korea, and common dolphins can find in the coastal area of Ulsan and Pohang, and in coastal areas in the Yellow Sea between China and South Korea. Since not many dolphins approach the South Korean coast, their effect on the COVID-19 was minor. Oil refineries, natural gas- and coal-powered power plants. There are five oil refineries with a refinery capacity of 2,799,000 bbl/d.

Since they locate on the coastal areas, their stack gases fly over the East Sea or the Yellow Sea, providing toxic stack gas enough to repel the coronavirus activity. Significantly, there are no deaths in the well distributed oil refinery cities of Ulsan (East Sea), Yeosu (South Sea), Daesan (Yellow Sea middle), and Incheon(Yellow Sea top).There are 33 coal-powered plants on the coasts of the Yellow Sea and the East Sea, which emit flue gases that fly over the seas without seriously affecting the COVID-19. No power plants are present in residential areas. Vehicles and population are well-distributed around South Korea. Forest (63.35%) and agricultural lands (22%) of South Korea are covered by green zones with clean air from the conversion of harmful CO_2 to good O_2which acts against the COVID-19. South Korea is, however, vulnerable to the COVID-19because of the textile and dye industry in Daegu city, which led to significant (66%) casualties (189 deaths with 288deaths nationally) from the COVID-19 pandemic as of July 10, 2020. South Korea ranked 64th globally with deaths 288 as of July 10, 2020.

IV. Conclusion

The present study proposes vaccine, protection, emergence, propagation, and termination associated with the coronavirus (COVID-19) pandemic. The case studies for 25 worst-hit countries showed major causes such as leather tanning industry (R^2 = 0.8514),global coastline(R^2 = 0.7864), USA coastline(R^2 = 0.3099), USA refinery (R^2 = 0.4874),CO_2 emissions (R^2 = 0.7627), population (R^2 = 0.3748), and minimum sunspot number(R^2 = 0.8907)withCOVID-19pandemic. Therefore, COVID-19 can globally decrease by reducing toxic chemicals during leather industry.

The present study proposes that the11-year cyclic sunspot number is analogous to a SWITCH, turning ON and OFF an epidemic, inducing a public-health crisis. The ON period by the minimum(maximum) sunspot number initiated mutant viruses (AIV, SARS, MERS-CoV, and COVID-19) to transmit from the Poles to Continents by migratory birds and humpback whales. The firstCOVID-19arrival dates in China, USA, Japan, Mexico, and Hawaii, determined by the distance between feeding grounds and breeding areas of humpback whale habitats.

The breeding period of the whales is from December to April, while the feeding period is from May to September (or from June to October). The human incubation period is from 2-14 days to possible outliners 0-27 days. Therefore, the termination of COVID-19 expects in July with an additional one month of human incubation to June. However, it takes another one month for whale migration to be August as the ultimate termination timing of the COVID-19.

There can be a competition of virus survival between the present COVID-19 and the newly arrived virus for a few months. Similarly, a new type one may appear in September of 2020 from the Poles. There can be a competition of virus survival between the COVID-19 and the newly arrived virus at Continents for a few months so that the COVID-19 may competitively inhibit the new virus and fade away, as used to occur in toxic cyanobacteria in the lake. The OFF period occurs during the high sunspot number (> around 25-50) and may terminate the COVID-19 pandemic in September (optimistic prediction) or in November 2020 (pessimistic one).

The COVID-19 vaccines,1) sample both at the Arctic Ocean and the Antarctic Peninsula for the feeding grounds of humpback whales,2) culturing plasma from people who have recovered from COVID-19 and plasma from CMV infected cetaceans, 3) 4 kinds of plasma preparations depending on the source (humans and cetaceans) and virus diseases (COVID-19 and CMV) as; fresh human plasma, human one confirmed by COVID-19, fresh cetacean plasma, and cetacean one infected by CMV,4) inoculates and incubates at 37℃ while the virus inactivates at a high temperature, 5) use as one of 5 types of vaccines among live attenuated, inactivated, toxic, subunit, and conjugate ones,6) application to humans by the stepwise methods *in vitro* P3 Lab test at petri dish for the initial efficacy of curing the human lung cell infected by the COVID-19. *In vivo* human tests (confirmed, recovered, and healthy), determine the final efficacy and the stability of the developed COVID-19 vaccines to protect the human body's immune system to reduce the COVID-19 symptoms,7)genetic modification of the present MMR (Measles, Mumps, and Rubella) vaccine with the cetacean host, may allow the low titers of the attenuated COVID-19vaccines to last long and safe.

Screenings by physical (body temperature), chemical (H_2S detector), biological (blood test), and radiological (computerized tomography) kits may separate the infected patient from the healthy ones for the safe situation from the COVID-19 pandemic.

As for the emergence of COVID-19, the breeding period of humpback whales begins from December to April. Adding one month for the human incubation period of COVID-19 pandemic to December, it expects that the COVID-19 pandemic would emerge in January 2020. On January 19, 2020, a 35-year-old man in Seattle of Washington was the first case of COVID-19 in the USA, while on January 16, 2020 there was the first case of COVID-19 in Japan.

An additional month added to January can be applicable if the route is from Alaska to the breeding grounds of Baja California of Mexico with a distance of 4,374 km. Thus, the first case of COVID-19 in Mexico was February 28, 2020 as arrival date, which was close to one month added to the case of Seattle (January 19, 2020). The distance between Hawaii and the Bering Sea in Alaska is 4,486 km, which is a little farther than Baja

California of Mexico. If subtracting 4,374 km of Baja California of Mexico (February 28, 2020) from 4,486 km of Hawaii, the answer is 5 days additional to February 28, 2020, to be the same March 6, 2020,as the first confirmed cases of COVID-19 in Hawaii. It can conclude that the first arrival dates of the COVID-19 in Seattle in the USA, Japan, Mexico, and Hawaii, determined by the swimming distance between the feeding ground and the breeding ones of humpback whale habitats.

As for China, there was the first case of COVID-19 in Wuhan on November 17, 2019. Ward observed over 100 dead dolphins found dead on the beach of Cape Verde of West Africa on September 28, 2019. The distance between Cape Verde and Wuhan in China is 20,222 km to have traveling time of 38.3 days. If adding 38.3 days to the observed date by Ward, September 28, 2019, the resultant day was November 7, 2019. Since the incubation period of the COVID-19 was 2-14 days, the expected day of the COVID-19 emergence in Wuhan in China was between November 9, 2019, and November 21, 2019, while the actual emergence date in China was November 17, 2019. It is certain that the date of the COVID-19 emergence in Wuhan in China initiated by the cetacean swimming distance from Cape Verde to Wuhan in China. The largest CO_2emissions in China might cause the largest ozone hole area and the highest UV-B radiation for the earliest emergence of COVID-19in China during the minimum sunspot number.

There were three typical cases of COVID-19 termination, based on the newly reported case by day in coronavirus map and case count by the New York Times as follows.

Case 1 with bell curve decrease; Tokyo, Germany, U.K., Italy, Spain, France, Canada, USA (NY, NJ, RI, NH, MD, MA, CT, AZ, UT, DC),Case 2 with stepwise increase; Brazil, Mexico, India, Russia, Peru, Ecuador, Chile, Belgium, USA (CA, FL, NC, SC, GA, AZ, OR,TX, AL, ID, TN, WI, MI, MO, AR, KY, NV, NE, WY, AK, PR),Case 3 with see-saw increase; Israel, USA (ME VA, PA, DE, WA, CO, MI, IL, VT, LA, OH, IN, MN, IA, KS, WV, SD, ND, HI).

The main parameters caused by the COVID-19 for Case 1 could be the cetaceans, including whales, dolphins, and porpoises. Case 2 could be the leather tannery industry; exporting hides to other countries. Case 3 for the mixed causes. Japan's virus success simply caused by the presence of volcanic gases from volcanoes, whose acidity and toxicity inhibited the coronavirus (COVID-19) pandemic, as in other volcanic countries such as Italy, Indonesia, Philippines, and Ecuador.

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Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food -Aiming for Viscosity Adjustment that can be done at Home

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Abstract- Japan is a supper-aged society, and many older adults need home care. To provide meals safely at home, the viscosity of meals suitable for the elderly required. Therefore, in this study, the viscosity was measured by combining two types of thickeners that can purchase at pharmacies and three types of care foods. The thickener used this time has almost the same price and content, but the many included material is different. Thickener A was rich in water-soluble dietary fiber, and thickener B was rich in thickening polysaccharides. The three types of foods were foods with high carbohydrate content, high lipid content, and high water content. As a result, thickening agent B, which is rich in thickening polysaccharides, was able to maintain the viscosity better than thickening agent A if a thickening agent added at a low (100g food per 1g thickening) concentration to foods rich in lipids and water. However, when the addition amount of the thickener was large, the thickener A and the thickener B showed almost the same viscosity. It will be necessary to increase the number of samples and clarify the differences due to the combinations.

Keywords: *thickener, nursing food, viscosity test.*

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Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food -Aiming for Viscosity Adjustment that can be done at Home

Mayumi Hirabayashi [α], Shoko Kondo [σ] & Naomi Katayama [ρ]

Abstract- Japan is a supper-aged society, and many older adults need home care. To provide meals safely at home, the viscosity of meals suitable for the elderly required. Therefore, in this study, the viscosity was measured by combining two types of thickeners that can purchase at pharmacies and three types of care foods. The thickener used this time has almost the same price and content, but the many included material is different. Thickener A was rich in water-soluble dietary fiber, and thickener B was rich in thickening polysaccharides. The three types of foods were foods with high carbohydrate content, high lipid content, and high water content. As a result, thickening agent B, which is rich in thickening polysaccharides, was able to maintain the viscosity better than thickening agent A if a thickening agent added at a low (100g food per 1g thickening) concentration to foods rich in lipids and water. However, when the addition amount of the thickener was large, the thickener A and the thickener B showed almost the same viscosity. It will be necessary to increase the number of samples and clarify the differences due to the combinations.

Keywords: thickener, nursing food, viscosity test.

I. Introduction

The scene of care in Japan is very severe. Japan has been aging faster than the other Asian countries since the 1970s. Due to changes in the industrial structure, the people's living environment and family structure have changed rapidly. The Japanese government worked to secure and develop human resources who are engaged in long-term care, as well as promoting various policies and systems aimed at establishing a system for providing public long-term care services. Since the establishment of the long-term care insurance system in 2000, Japanese elderly care services have expanded dramatically in both quality and quantity. However, there is no facility that can accommodate all the elderly peoples who are increasing in the future. Alao, since a large amount of money is required to move into the facility, we must consider home care in the future. It is important to have meals at the nursing care site three or more times daily, and it is necessary to provide safe and tasty meals. When considering the swallowing function, the viscosity of the meal in providing a safe diet is one of the necessary items. We focused on the viscosity in the diet. We thought that nursing care at home would be safer if ordinary households coulds imply provide the viscosity of the meal to the target person. Suppose we can measure the viscosity of the meal and then use a thickener to create a viscosity that suits the person eating the meal. We feel that home care is safe. Therefore, the purpose of this study was to create usable data for nursing food guidance that can create when a registered dietitian visits at home and in the nursing class.

II. Material and Methods

a) Commercially Available Thickeners

Two types of products sold at pharmacies used as commercially available thickeners. Thickener A was 1296 yen (12 USD), including 50 packs of 3 grams. The raw materials are dextrin, water-soluble dietary fiber, and xanthan gum. The nutritional content per 3 grams is that8.1kcal energy, 0g protein, 0g lipid, 2.04g sugar, 0.75g dietary fiber, and 18.6mg sodium. Thickener B was 1274 yen (11.54 USD), including 50 packs of 3 grams. The raw materials are dextrin, thickening polysaccharides, potassium chloride, and sucralose. The nutritional content per 3 grams is that7.9kcal energy, 0g protein, 0g lipid, 1.9g sugar, 0.7g dietary fiber, and 16mg sodium.

b) Commercially Available Nursing food

Three types of products used from the easy-to-chew category of the universal design food (UDF) on the market. These are Demiglace sauce hamburger, Boiled Fried Tofu as Kyoto style, and White meet fish dumpling with Egg Sauce. All of them are 100g retort pouches and sold for 180 yen (1.67 USD). The nutritional value of Demiglace sauce hamburger was 89 kcal, 4.3g protein, 4.0g lipid, 8.9g carbohydrates, and 0.81g salt equivalent per 100 grams. The nutritional value of Boiled Fried Tofu

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as Kyoto style was 91 kcal, 5.1g protein, 6.0g lipid, 4.1g carbohydrates, and 0.81g salt equivalent per 100 grams. The nutritional value of White meet fish dumpling with Egg Sauce was 62 kcal, 3.6g protein, 3.0g lipid, 5.2g carbohydrates and 0.92g salt equivalent per 100 grams.

c) Sample (food with a thickener added) adjustment

Each of the three foods prepared as five samples. First, the viscosity of the food product itself measured without any modification. Secondly, the food was pulverized for 20 seconds using a mixer into a liquid state, and the viscosity measured. Third, the viscosity was measured after adding 1 gram of thickener (A or B) to the food (100g) ground for 20 seconds with a mixer and stirring for 5 minutes. Fourth, the viscosity measured after adding 2 grams of thickener (A or B) to the food (100g) ground for 20 seconds with a mixer and stirring for 5 minutes. Fifth, the viscosity measured after adding 3 grams of thickener (A or B) to the food (100g) ground for 20 seconds with a mixer and stirring for 5 minutes.

d) Viscosity measurement method

The viscosity of each fod was measured using the Line Spread Test Start Kit (LST) manufactured by SARAYA. The measurement procedure is as follows. The viscosity test performed at room temperature (24 degrees). The test repeated three times and the average value calculated.

1. Place the sheet on a level surface. Place a ring with an inner diameter of 30mm in the center of the concentric circles.
2. Add the liquid to be measured to the full thickness of thering (20ml) and let stand for 30 seconds.
3. Lift the ring vertically, and after 30 seconds, measure the spread distance of the solution. Since there are a total of 6 points to measure, the average value of them used as the LST value.
4. After still standing for 5 minutes, the spread of the samples is measured again at 6 points, and the average value recorded as the LST value.

e) Criteria for viscosity

There are three levels of classification by LST value1). The first stage is the mildly thick with a viscosity that falls within the rage of 43mm to 36mm (50-150 mPa・s). As for the properties, when the spoon is tilted, it flows down quickly[1)]. The second stage is moderately thick with a viscosity that falls within the range of 36mm to 32mm (150-300 mPa・s). As for the properties, when you tilt the spoon, it flows to the surface[1)]. The third stage is extremely thick with a viscosity that falls within the range of 32mm to 30mm (300-500 mPa・s). Even if the spoon is tilted, the shape maintained to some extent and it does not flow easily[1)].

f) Statistical processing

This study was statistically processed using statistical processing software, Excel 2010 (SSRI Co., Ltd). The data to be compared were first tested for normal distribution by F-test. For comparisons between correlated data, the paired Student t-test used for normally distributed data. Wilcoxon test used for non-normally distributed data. For comparisons between uncorrelated data, the unpaired Student t-test used for non-normally distributed data. Mann-Whitney test used for non-normally distributed data.

III. Result

a) Result of Demiglace sauce hamburger LST test

Table 1 shows the results of viscosity measurement performed by adding the thickener A in Demiglace sauce hamburger. As a result of measuring the viscosity of commercial care food without treatment, it found to be the stage 3 (Extremely thick). The result of viscosity measurement after the mixer treatment was also the stage 3 (Extremely thick). However, it found that there is a statistical advantage after 5 minutes rather than 30 seconds, and the viscosity loosens and spreads. However, when the thickener A was added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 2 shows the results of viscosity measurement performed by adding the thickener B in Demiglace sauce hamburger. When the thickener Badded (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 1. Universal Design Food : UDF(Easy to bite) Demiglace sauce hamburger (Thickener A)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	21.4	23.9	27.6	30.1	20.6	21.0	19.9	20.6	19.3	20.4
SD	4.7	5.6	1.5	2.0	6.5	5.0	5.6	6.5	6.6	6.2
F test	P=0.223		P=0.147		P=0.139		P=1.000		P=1.000	
Paired Student-t	P=0.0001**		P=0.0001**		P=-.793		P=0.764		P=0.639	
Wilcoxon										

* P<0.05, ** P<0.01

Table 2. Universal Design Food : UDF(Easy to bite) Demiglace sauce hamburger (Thickener B)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	21.4	23.9	27.6	30.2	21.4	21.2	20.1	20.4	18.9	19.5
SD	4.7	5.6	1.5	1.7	7.2	8.6	5.4	5.8	4.8	4.9
F test	P=0.233		P=0.321		P=0.234		P=0.235		P=0.459	
Paired Student-t	P=0.0001**		P=0.0001**		P=0.863		P=0.105		P=0..58	
Wilcoxon										

* P<0.05, ** P<0.01

b) Result of Boiled Fried Tofu as Kyoto style LST test

Table 3 shows the results of viscosity measurement performed by adding the thickener A in Boiled Fried Tofu as Kyoto style. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 2 after 5 minutes. The viscosity after the mixer treatment was in stage 2 after 30 seconds and in stage 1 after 5 minutes. When 1g of thickener A added, the viscosity was Stage 3 after 30 seconds and Stage 2 after 5 minutes. The viscosity when the thickener A added in 2g was in Stage 3 after 30 seconds and 5 minutes. When 3g of thickener A added, the viscosity was Stage 3 after 30 seconds and Stage 2 after 5 minutes.

Table 4 shows the results of viscosity measurement performed by adding the thickener Bin Boiled Fried Tofu as Kyoto style. When 1g of thickener B added, the viscosity was Stage 3 after 30 seconds and Stage 2 after 5 minutes. The viscosity when the thickener B added in 2g was in Stage 3 after 30 seconds and 5 minutes. The viscosity when the thickener B added in 3g was in Stage 3 after 30 seconds and 5 minutes.

Table 3. Universal Design Food : UDF(Easy to bite) Boiled Fried Tofu as Kyoto style (Thickener A)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	29.7	32.2	35.7	39.5	31.2	33.9	20.5	22.2	21.9	33.2
SD	5.5	5.6	1.7	1.9	1.8	3.9	6.6	8.3	3.6	1.6
F test	P=0.470		P=0.375		P=0.001**		P=0.370		P=0.001**	
Paired Student-t	P=0.0001**		P=0.0001**				P=0.234			
Wilcoxon					P=0.0001**				P=0.0001**	

* P<0.05, ** P<0.01

Table 4. Universal Design Food : UDF(Easy to bite) Boiled Fried Tofu as Kyoto style (Thickener **B**)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	29.7	32.2	35.7	39.5	29.1	32.1	22.8	25.1	20.5	22.2
SD	5.5	5.6	1.7	1.9	3.2	4.2	3.3	4.6	6.6	8.3
F test	P=0.470		P=0.375		P=0.138		P=0.077		P=0.162	
Paired Student-t	P=0.0001**		P=0.0001**		P=0.058		P=0.003**		P=0..025*	
Wilcoxon										

* P<0.05, ** P<0.01

c) Result of White Meat fish dumpling with Egg Sauce LST test

Table 5 shows the results of viscosity measurement performed by adding the thickener A in White meatfish dumpling with Egg Sauce. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 1 after 5 minutes. The viscosity after the mixer treatment was stage 1after 30seconds and in stage 1 after 5 minutes. When 1g of thickener A added, the viscosity was Stage 3 after 30 seconds and Stage 2 after 5 minutes. The viscosity when the thickener A added in 2g was in Stage 3 after 30 seconds and 5 minutes. The viscosity when the thickener A added in 3g was in Stage 3 after 30 seconds and 5 minutes.

Table 6 shows the results of viscosity measurement performed by adding the thickener Bin White meat fish dumpling with Egg Sauce. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 5. Universal Design Food : UDF(Easy to bite) White fish dumpling with Egg Sauce (Thickener A)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	31.6	37.1	39.8	43.5	30.4	32.7	21.3	22.1	20.8	21.7
SD	9.9	5.7	1.9	2.0	2.6	1.7	8.0	8.8	6.9	7.0
F test	P=0.012 *		P=0.356		P=0.041**		P=0.201		P=0.493	
Paired Student-t			P=0.0001**				P=0.OO6**		P=0.019*	
Wilcoxon	P=0.0001**				P=0.0001**					

* P<0.05, ** P<0.01

Table 6. Universal Design Food : UDF(Easy to bite) White fish dumpling with Egg Sauce (Thickener B)

	No processing		After mixing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	31.6	37.1	39.8	43.5	28.4	30.4	23.1	24.5	21.3	22.1
SD	9.9	5.7	1.9	2.0	2.2	2.8	6.2	6.3	8.0	8.8
F test	P=0.012*		P=0.356		P=0.145		P=0.478		P=0.344	
Paired Student-t			P=0.0001**		P=0.0001**		P=0.0001**		P=0..015*	
Wilcoxon	P=0.0001**									

* P<0.05, ** P<0.01

d) Results of comparison of two thickeners

The result of comparing the stability of the two types of thickeners shown in Table 7, 8, and 9. In the case of the demiglace sauce hamburger, the stability was good when both the thickener A and the thickener B added, and all were in stage 3 (to see Table 7). In the case of Boiled Fried Tofu as Kyoto style, when 1g of thickener added, both thickeners A and B became Stage 3 after 30 seconds and Stage 2 after 5 minutes. Thickener B was statistically significantly more stable than A. When a thickener is added 2g, the thickener A was Stage 3 after 30 seconds, and Stage 2 after 5 minutes. But thickener B was in Stage 3 after 30 seconds and 5 minutes. Thickener B was statistically significantly more stable than A, again. When a thickener added 3g, both thickeners A and B became Stage 3 after 30 seconds and Stage 2 after 5 minutes (to see Table 8). In the case of White meatfish dumpling with Egg Sauce, when a thickener is added 1g, the thickener A was Stage 3 after 30 seconds, and Stage 2 after 5 minutes. But thickener B was in Stage 3 after 30 seconds and 5 minutes. Thickener B was statistically significantly more stable than A. when a thickener added 2g or 3g, both thickeners A and B became Stage 3 after 30 seconds and Stage 2 after 5 minutes (to see Table 9).

Table 7. Comparison of viscosities with two thickeners (A and B) in Demiglace sauce hamburger

	Add 1g thickener, After 30 sec.		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	20.6	21.4	21.0	21.2	19.9	20.1	20.6	20.4	19.3	18.9	20.4	19.5
SD	6.5	7.2	5.0	8.6	5.6	5.4	6.5	5.8	6.6	4.8	6.2	4.9
F test	P=0.343		P=0.015*		P=0.438		P=0.295		P=0.085		P=0.155	
Unpaired Student-t	P=0.753				P=0.894		P=908		P=0.835		P=0.629	
Mann-Whitney			P=0.788									

* P<0.05, ** P<0.01

Table 8. Comparison of viscosities with two thickeners (A and B) in Boiled Fried Tofu as Kyoto style

	Add 1g thickener, After 30 sec.		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	31.2	29.1	33.9	32.1	26.0	22.8	33.2	25.1	21.9	20.5	24.8	22.2
SD	1.8	3.2	3.9	4.2	4.6	3.3	1.6	4.6	3.6	6.6	5.0	8.3
F test	P=0.227		P=0.021*		P=0.098		P=0.037**		P=0.008**		P=0.017*	
Unpaired Student-t	P=0.018*				P=0.621							
Mann-Whitney			P=0.020*				P=0.0001**		P=0.106		P=1.000	

* P<0.05, ** P<0.01

Table 9. Comparison of viscosities with two thickeners (A and B) in White fish dumpling with Egg Sauce

	Add 1g thickener, After 30 sec.		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	30.4	28.4	32.7	30.4	24.0	23.1	25.8	24.5	20.8	21.3	21.7	22.1
SD	2.6	2.2	1.7	2.8	4.6	6.2	5.6	6.3	6.9	8.0	7.0	8.8
F test	P=0.227		P=0.021*		P=0.098		P=0.303		P=0.274		P=0.163	
Unpaired Student-t	P=0.018*				P=0.621		P=0.530		P=0.842		P=-0.876	
Mann-Whitney			P=0.020*									

* P<0.05, ** P<0.01

IV. Discussion

This time, the viscosity was measured using a line spread test to prepare an adjusted care food that can be provided at home using a commercially available thickener and using commercially available nursing food that can purchased at a pharmacy. The viscosity measured by combining two types of commercially available thickeners and three types of available thickeners and three types of commercially available nursing foods. The two thickeners have almost the same price and content. The contained materials differ between water-soluble dietary fiber (thickener A) and thickening polysaccharides (thickener B). Over 100g of commercially available nursing food, Demiglace sauce hamburger had the highest amount of carbohydrates, Boiled Fried Tofu as Kyoto style had the highest amount of lipids, and White meat fish dumpling with Egg Sauce had the highest amount of water (less energy). When the number of carbohydrates was large, the viscosity became high by applying it to a mixer. Still, since the stable content collapses over time, it is possible to enhance the safety as a nursing food by adding a thickener to stabilize the viscosity. If the number of lipids and water is large, the viscosity will decrease with time unless a thickener added, so it is necessary to add a thickener. In the combination of the thickener and the nursing food on the market this time, if 1g of the thickener added, the thickener B could stabilize the viscosity more effectively than the thickener A. Also, it is important to provide a diet high in protein to prevent sarcopenia[2,3] and flail[4-10] in nutrition. When considering the swallowing function, the viscosity of the meal in providing a safe diet is one of the important items[11]. Further studies on the combination of food and thickener that are compatible with each other and the addition amount of the thickener should continued. We think it is good to continue research on nutritional supplemental drink[12,] and many other drinks[13] for senior citizens and patients.

V. Conclusions

Viscosity measured in different combinations of two commercially available thickeners and three commercially available care foods results. The viscosity stabilized by adding a thickener. When the amount of thickener added to food was small (1g per 100g this time), thickeners containing a large number of polysaccharides made the viscosity more stable for foods containing a lot of water and lipids. However, when the added amount of thickener was large, almost the same viscosity was obtained with both the thickener

rich in water-soluble dietary fiber and the thickener rich in polysaccharide thickener. In the future, it will be necessary to increase the number of samples and clarify the differences due to the combinations.

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Research on the Combination of Commercially Available Thickeners and Commercially Available Nursing Food -By using Universal Design Food: UDF (Do not have to Bite) –

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Abstract- Assuming home care for the elderly, we aimed to create a nursing food that can be created even at home, considering the combination of thickeners and foods, and creating useful data. Therefore, we used two types of thickeners that can purchase at pharmacies and three types of commercially available nursing food that can eat without chewing. Line Spread Test Start Kit (LST) manufactured by SARAYA used for viscosity measurement. The two types of thickeners used this time became more viscous when added to the food. And the viscosity of the food could be maintained over time (this time after 5minutes). However, in the case of foods rich in lipids, the thickener B was able to maintain the viscosity more than the thickener A. It is necessary to select a thickener that is compatible with the raw material ratio of the food.

Keywords: thickener, nursing food, viscosity test.

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Keywords: thickener, nursing food, viscosity test.

I. Introduction

In recent years, the Japanese population has been declining, and the number of children is decreasing. On the other hand, the proportion of older adults has increased, and society has become super-aged. Nutritional problems in the elderly include sarcopenia and flail associated with muscle loss due to insufficient protein intake and lack of exercise. Muscle deterioration in the elderly, and the ability to swallow food declines. As a result, it is difficult to swallow and not dysphagia. It becomes easier to swallow when food makes a certain mass (food mass) in the mouth. To that end, the viscosity of food is important. Especially, smooth liquid foods are hard to swallow. Therefore, liquids with a thickness (viscosity) such as soup-like potage and ketchup can swallow more safely. In the past, Katayama et al. measured the viscosity after adding at thickener using a commercially available nutritional supplemental drink by the line spread test (LST) and reported the result[1)]. Therefore, in this study, the viscosity of nursing foods (Universal Design Food: UDF) that can be purchased at pharmacies and can eat without chewing was measured, and the viscosity with the addition of a thickener was measured using the line spread test.

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II. Material and Methods

a) Commercially Available Thickeners

We use two types of thickeners that have almost the same price and weight as those available at pharmacies. Thickener A and B were including 50 packs of 3grams. And thickener A was 1296 yen (12 USD), and thickener B was 1274 yen (11.54 USD). The raw materials, thickener A, was dextrin, water-soluble dietary fiber, and xanthan gum, and thickener B, was dextrin, thickening polysaccharides, potassium chloride, and sucralose. Each the nutritional content per 3 grams, thickener A, was 8.1kcal energy, 0g protein, 0g lipid, 2.04g sugar, 0.75g dietary fiber, and 18.6mg sodium, and thickener B, was 7.9kcal energy, 0g protein, 0g lipid, 1.9g sugar, 0.7g dietary fiber, and 16mg sodium.

b) Commercially Available Nursing food

Three types of products used from the Do Not Have to Bite category of the universal design food (UDF) on the market. These are Chicken and vegetables, Beef and vegetables, and Spinach. Chicken and vegetables, and Beef and vegetables are 100g retort pouches and sold for 180 yen (1.67 USD). Spinach is 100g retort pouches and sold for 150 yen (1.29 USD). The nutritional value of Chicken and vegetables was 49 kcal, 2.0g protein, 1.3g lipid, 8.8g carbohydrates, 3.2g dietary fiber, and 0.81g salt equivalent per 100 grams. The nutritional value of Beef and vegetables was 71 kcal, 1.7g protein, 4.3g lipid, 7.9g carbohydrates, 3.2g dietary fiber, and 0.79g salt equivalent per 100 grams. The nutritional value of Spinach was 81 kcal, 0.5g protein, 6.5g lipid, 6.5g carbohydrates, 1.9g dietary fiber, and 0.43g salt equivalent per 100 grams.

c) Sample (food with a thickener added) adjustment

Each of the three foods prepared as follows.

1) The viscosity of the food product itself measured without any modification.
2) The viscosity measured after adding 1g of thickener (A or B) to the food (100g) after stirring for 5 minutes.

3) The viscosity measured after adding 2g of thickener (A or B) to the food (100g) after stirring for 5 minutes.
4) The viscosity measured after adding 3g of thickener (A or B) to the food (100g) after stirring for 5 minutes.

d) Viscosity measurement method

By using the Line Spread Test Start Kit (LST) manufactured by SARAYA, the viscosity of each food measured. The measurement procedure is as follows. The viscosity test performed at 24 degrees (room temperature) results obtained by performing the test, which repeated three times, averaged to obtain the LST value (viscosity). The measurement method was according to Line Spread Test Start Kit (LST) manufactured by SARAYA.

1. Place the sheet on a level surface. Place a ring with an inner diameter of 30mm in the center of the concentric circles.
2. Add the liquid to be measured to the full thickness of therig (20ml) and let stand for 30 seconds.
3. Lift the ring vertically, and after 30 seconds, measure the spread distance of the solution. Since there are a total of 6 points to measure, the average value of them is used as the LST value.
4. After still standing for 5 minutes, the spread of the samples is measured again at 6 points, and the average value recorded as the LST value.

e) Criteria for viscosity

There are three levels of classification by LST value[2]. The first stage is the mildly thick with a viscosity that falls within the range of 43mm to 36mm (50-150 mPa・s). As for the properties, when the spoon is tilted, it flows down quickly[2]. The second stage is moderately thick with a viscosity that falls within the range of 36mm to 32mm (150-300 mPa・s). As for the properties, when you tilt the spoon, it flows to the surface[2]. The third stage is extremely thick with a viscosity that falls within the range of 32mm to 30mm (300-500 mPa・s). Even if the spoon is tilted, the shape maintained to some extent, and it does not flow easily[2].

f) Statistical processing

This study was statistically processed using statistical processing software, Excel 2010 (SSRI Co., Ltd). The data to be compared were first tested for normal distribution by F-test. For comparisons between correlated data, the paired Student t-test used for normally distributed data. Wilcoxon test was used for non-normally distributed data. For comparisons between uncorrelated data, the unpaired Student t-test used for non-normally distributed data. Mann-Whitney test used for non-normally distributed data.

III. Result

a) Result of Chicken and vegetables LST test

Table 1 shows the results of viscosity measurement performed by adding the thickener A in Chicken and vegetables. As a result of measuring the viscosity of commercial care food without treatment, it found to be stage 3 (Extremely thick) after 30 seconds. However, it found to be stage 2 (moderately thick) after 5 minutes. It means the viscosity loosens and spreads after taking the time. When the thickener A added 1g, the LST value found to be stage 3 after 30seconds and stage 2 after 5 minutes. However, when the thickener A added 2g or 3g, the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 2 shows the results of viscosity measurement performed by adding the thickener Bin Chicken and vegetables. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 1. Universal Design Food : UDF(Do not have to bite) Chicken and vegetables (Thickener A)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.8	34.3	28.6	32.2	26.6	28.9	23.6	26.1
SD	1.6	1.6	2.2	1.7	2.9	3.0	6.1	5.4
F test	P=0.450		P=0.154		P=0.414		P=0.286	
Paired Student-t	P=0.0001**		P=0/0001**		P=0.0001**		P=0.120	
Wilcoxon								

* P<0.05, ** P<0.01

Table 2. Universal Design Food : UDF(Do not have to bite) Chicken and vegetables (Thickener B)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.8	34.3	28.2	31.9	25.0	28.1	23.1	24.8
SD	1.6	1.6	1.5	2.1	4.3	3.3	3.9	3.8
F test	P=0.450		P=0.086		P=0.130		P=0.447	
Paired Student-t	P=0.0001**		P=0.0001**		P=0.003**		P=0.0001**	
Wilcoxon								

* P<0.05, ** P<0.01

b) Result of Beef and vegetables LST test

Table 3 shows the results of viscosity measurement performed by adding the thickener A in Beef and vegetables. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 2 after 5 minutes. When the thickener A added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 4 shows the results of viscosity measurement performed by adding the thickener Bin Beef and vegetables. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 3. Universal Design Food : UDF(Do not have to bite) Beef and vegetables (Thickener A)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	28.5	32.4	26.4	27.9	23.3	24.1	21.8	22.3
SD	1.3	2.7	2.8	2.5	4.4	4.5	6.8	7.0
F test	P=0.003**		P=0.339		P=0.490		P=0.446	
Paired Student-t			P=0/0001**		P=0.166		P=0.820	
Wilcoxon	P=0.0001**							

* P<0.05, ** P<0.01

Table 4. Universal Design Food : UDF(Do not have to bite) Beef and vegetables (Thickener **B**)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	28.5	32.4	26.4	27.9	21.8	24.9	20.3	21.0
SD	1.3	2.7	4.8	4.7	5.3	5.8	5.4	7.0
F test	P=0.003**		P=0.465		P=0.355		P=0.127	
Paired Student-t			P=0.015*		P=0.00001**		P=0.748	
Wilcoxon	P=0.0001**							

* P<0.05, ** P<0.01

c) Result of Spinach LST test

Table 5 shows the results of the viscosity measurement performed by adding the thickener Ain Spinach. As a result of measuring the viscosity as it was on the market without treatment, it was Stage 3 after 30 seconds and Stage 2 after 5 minutes. When the thickener A added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 6 shows the results of the viscosity measurement performed by adding the thickener Bin Spinach. When the thickener B added (1g or 2g or 3g), the LST value did not change stably even after 5 minutes as compared with after 30 seconds. The viscosity was within Stage 3.

Table 5. Universal Design Food : UDF(Do not have to bite) Spinach (Thickener A)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.5	33.2	28.2	29.4	27.3	28.3	25.5	26.5
SD	1.7	1.2	0.9	0.9	2.4	1.5	1.6	1.7
F test	P=0.086		P=0.467		P=0.026*		P=0.451	
Paired Student-t	P=0.0001**		P=0.0001**				P=0.0001**	
Wilcoxon					P=0.003**			

* P<0.05, ** P<0.01

Table 6. Universal Design Food : UDF(Do not have to bite) Spinach (Thickener B)

	No processing		Add 1g thickener		Add 2g thickener		Add 3g thickener	
	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.	After 30 sec.	After 5 min.
Average value	30.5	33.2	24.7	25.6	22.5	23.7	21.4	22.3
SD	1.7	1.2	3.4	2.8	2.3	2.1	3.4	3.5
F test	P=0.0186		P=0.223		P=0.333		P=0.456	
Paired Student-t	P=0.0001**		P=0.132		P=0.00001**		P=0.0001**	
Wilcoxon								

* P<0.05, ** P<0.01

d) Results of comparison of two thickeners

Comparing the stability of the two types of thickeners are shown in Table 7, 8, and 9. In chicken and vegetables and beef and vegetables, the viscosities of the two thickeners were almost the same. There was no statistically significant difference. However, in spinach, thickener B was statistically significantly more viscous thickener than thickener A all conditions.

Table 7. Comparison of viscosities with two thickeners (A and B) in Chicken and vegetables

	Add 1g thickener, After 30 sec		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	28.6	28.2	32.2	31.9	26.6	25.0	28.9	28.1	23.6	23.1	26.1	24.8
SD	2.2	1.5	1.7	2.1	2.9	4.3	3.0	3.3	6.1	3.9	5.4	3.8
F test	P=0.050*		P=0.232		P=0.048*		P=0.370		P=0.031*		P=0.073	
Unparied Student-t			P=0.663				P=0.436				P=-0.413	
Wilcoxon	P=0.318				P=0.143				P=0.889			

* P<0.05, ** P<0.01

Table 8. Comparison of viscosities with two thickeners (A and B) in Beef and vegetables

	Add 1g thickener, After 30 sec		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	26.4	26.4	27.9	27.9	23.3	21.8	24.1	24.9	21.8	20.3	22.3	21.0
SD	2.8	4.8	2.5	4.7	4.4	5.3	4.5	5.8	6.8	5.4	7.0	7.0
F test	P=0.016*		P=0.007**		P=0.234		P=0.143		P=0.160		P=0.496	
Unparied Student-t					P=0.388		P=0.619		P=0.484		P=0.589	
Wilcoxon	P=0.849		P=0.861									

* P<0.05, ** P<0.01

Table 9. Comparison of viscosities with two thickeners (A and B) in Spinach

	Add 1g thickener, After 30 sec		Add 1g thickener, After 5 min.		Add 2g thickener, After 30 sec.		Add 2g thickener, After 5 min.		Add 3g thickener, After 30 sec.		Add 3g thickener, After 5 min.	
	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B	Thickener A	Thickener B
Average value	28.2	24.7	29.4	25.6	27.3	22.5	28.3	23.7	25.5	21.4	26.5	22.3
SD	0.9	3.4	0.9	2.8	2.4	2.3	1.5	2.1	1.6	3.4	1.7	3.5
F test	P=0.0001**		P=0.0001**		P=0.436		P=0.089		P=0.001**		P=0.001**	
Unparied Student-t					P=0.0001**		P=0.0001**					
Wilcoxon	P=0.0001**		P=0.0001**						P=0.0001**		P=0.001**	

* P<0.05, ** P<0.01

IV. Discussion

There is a need to prevent sarcopenia[3,4] and flails[5-11] associated with malnutrition and lack of exercise in the elderly. Older adults also have poor swallowing, so it is necessary to adjust the viscosity in the diet[12]. In this study, the measurement of viscosity after adding a thickener to a commercially available nursing food (UDF: do not need to bite) is an area for further research in the future. The two types of thickeners used this time became more viscous when added to the food. And the viscosity of the food could be maintained over time (this time after 5minutes). However, in the case of foods rich in lipids, the thickener B was able to maintain the viscosity more than the thickener A. It is necessary to select a thickener that is compatible with the raw material ratio of the food. In the future, we would like to create useful data for creating safe nursing care foods that can create at home by checking the viscosity of more types of thickeners and combination s of many types of foods.

V. Conclusions

Viscosity measured in different combinations of two commercially available thickeners and three commercially available nursing foods results. When the amount of thickener added to food, the viscosity stabilized by adding a thickener (1g, 2g, or 3g per 100g this time). In the case of foods high in fat (Spinach), the viscosity of thickener B was more stable than that of thickener A. In the future; it will be necessary to increase the number of samples and clarify the differences due to the combinations.

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Reporting and Monitoring of Transfusion Reactions in a Tertiary Care Medical College Hospital: A Prospective Study

By Dr. Nagalakshmi Narayana-Swamy, Dr. Shubha Praveen & Dr. Gramle Amol

Abstract- *Introduction:* Blood transfusions are one of the common procedures encountered in medical practice. A lifesaving intervention although associated with variable degree of risk. The present study was done to assess the effectiveness of haemovigilance in transfusion practice and to emphasise upon the need of transfusion safety.

Methods: This was a prospective study conducted at Sapthagiri Institute of Medical Sciences, Bangalore, India. Pamphlets were distributed in order to create awareness and initiate act of reporting. The adverse events reported were documented in terms of nature, outcome, severity of the event and causality assessment.

Results: A total of 14 (0.77%) suspected transfusion adverse events were reported by the haemovigilance and surveillance system established as part of the design during the study period. The incidence of transfusion events during this period was estimated at 7.6% per 1,000 blood components distributed. The majority of the patients who experienced a transfusion-related adverse event were females (n=11, 78.57%).

Keywords: *hemovigilance; blood transfusion reaction; leucoreduction; TRALI.*

GJMR-K Classification: *NLMC Code: WW 475*

Strictly as per the compliance and regulations of:

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Conclusion: Hemovigilance serves as an effective tool for safe transfusion practice. Its implementation and enabling awareness among physicians, patients about the need for transfusion safety is at need.

Keywords: hemovigilance; blood transfusion reaction; leucoreduction; TRALI.

I. Introduction

Blood is a sparse resource which improves health and is lifesaving. Blood transfusion services are critical for the treatment of medical conditions ranging from life threatening acute haemorrhage to recalcitrant anaemia. It is crucial to replace the lost components of blood expeditiously for reviving the health.

The first intra human blood transfusion was done in the 19th century. Since then, blood transfusion has been a lifesaving therapeutic option.[1] Practice of whole blood transfusion has been subsequently decreased and use of different components of blood specific to each of the conditions has been practiced according to the clinical need and requirement. However, it can occasionally be unsafe and result in a spectrum of adverse events.

Acute Transfusion Reactions (ATRs) occur within 24 hours of transfusion administration, although majority occur during or within four hours of transfusion.[2, 3] They can be immunologic and non-immunologic reactions.[4] Blood transfusion reactions occur as a result of ineffective donor selection, contamination with infectious agents and presence of irregular antibodies which may not be detected by pre-transfusion tests.[5]

The incidence of transfusion-transmitted diseases has decreased to minimum on account of effective screening procedure. However, the incidence of adverse events due to ABO incompatibility, human errors, alloimmunization, immunomodulation phenomena and bacterial contamination remain a matter of concern. Age and the type of blood component are also associated with a specific type of blood transfusion reaction.[6] The routine use of pretransfusion medications has helped in preventing certain transfusion reactions but there are no well controlled trials to support this evidence.

The concept of Transfusion related Cardiac-Overload (TRCO), Transfusion related Acute Lung Injury (TRALI) account for most common causes for morbidity and mortality. TRALI is now the leading cause of mortality after blood transfusion and the risk factors are known to be female sex, previous history of pregnancy and presence of anti-leukocytes antibodies in blood products.[7] The exact mechanism of TRCO is not known.

Any unfavourable event occurring in a patient during or after transfusion of blood and blood components and for which no other reason can be found is labelled as a transfusion reaction. These untoward effects vary from being relatively mild to severe.

Improved donor selection and antibody screening has definitely guaranteed a safe blood supply, still a variety of transfusion reactions are encountered. These reactions are mainly non-infectious in nature and may be acute or delayed in onset. Depending on their severity, causality assessment and

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appropriate clinical response, acute reactions can be mild, moderate and severe or life threatening.

Haemovigilance is a systematic process of monitoring the transfusion related adverse events and adverse reactions throughout the transfusion process and aimed at ensuring transfusion safety.[8] It includes series of events ranging from monitoring, identification, and analysis of untoward adverse events in relation to blood transfusion.[9] It also helps to determine the trends of transfusion transmitted infections and need for surveillance of emerging infections.[10]

The purpose of this work is to show haemovigilance as an effective tool to improve transfusion safety by minimization of risks and to shed light upon the need for awareness regarding the process of blood transfusion.

II. Methods

A prospective study was conducted at Sapthagiri Institute of Medical Science and Research Centre, a Tertiary health care teaching Hospital, Bangalore. The study was carried out between June and July, after obtaining permission from the Institutional Ethical Committee.

Hospital personnel involved with dispensing and administering blood units were trained to give relevant information regarding the possible transfusion reactions related with blood transfusion. A Validated information pamphlet was distributed to the patient relatives/bystanders at the time of procuring the blood components from the blood bank. In addition, the telephone number of the person procuring the blood was also noted for future contact by the staff in charge.

The details in the pamphlet included information regarding transfusion process, possibility of adverse transfusion reactions, patient responsibility (to report adverse transfusion reactions to doctor) was provided in the pamphlet which will be bilingual (English and Kannada). Those who did not know these two languages were provided with a pamphlet in Hindi. The pamphlet also included the contact numbers of the student investigator and the Guide.

Patient/relatives and the staff in charge (treating doctor/nursing staff) were instructed to contact in-charge person immediately when any adverse reactions is noticed. Patients contacted after discharge and any missed /neglected adverse reactions were noted down.
Transfusion reactions that occurred were reported in the Transfusion Reaction Reporting Form (TRRF) for Blood and Blood products provided by IPC (Indian Pharmacopoeia Commission) under Pharmacovigilance Programme of India. The original copies of Transfusion Reaction Reporting Forms were sent to National Pharmacovigilance Centre and photo copies of the same were documented.

Patient information, transfusion product details, nature of adverse reactions, outcomes of the adverse reactions, severity of the event and causality assessment was documented.

Statistical analysis: Using Microsoft EXCEL

Inclusion criteria: All patients of either sex undergoing blood transfusion, irrespective of the disease.

Exclusion criteria: Reports not consistent with the definition shall be excluded.

Causality assessment according to a graded scale: [11]

a) Grade 4: death during or after transfusion
b) Grade 3: life threatening adverse reaction
c) Grade 2: long-term(transfusion transmitted infection and allo-immunisation)
d) Grade 1: minor adverse reaction
e) Grade 0: inappropriate transfusion of a labile blood product consecutive to one or several dysfunctions, without any clinical or biological consequence for the recipient

All 1830 reports that met the inclusion criteria were subjected to a quality evaluation to establish the completeness of all the information required. Microbiological investigations we're not done on any of the suspected blood components. Pre-transfusion haemoglobin values were reported in all the cases whilst post-transfusion haemoglobin values were not reported in seven (0.4%) cases.

III. Results

A total of 1830 blood components were distributed during the study period from 1st of June 2015 to 31st of July 2015, giving an average monthly/weekly distribution of 915/229 components. Of these blood components 664 (36.28%) were distributed as packed red blood cells, 25 (1.37%) as whole blood, 169 (9.23%) as fresh-frozen plasma and 972 (53.11%) as platelet concentrates as projected in Figure 1. There were no cryoprecipitate and paediatric packs dispatched.

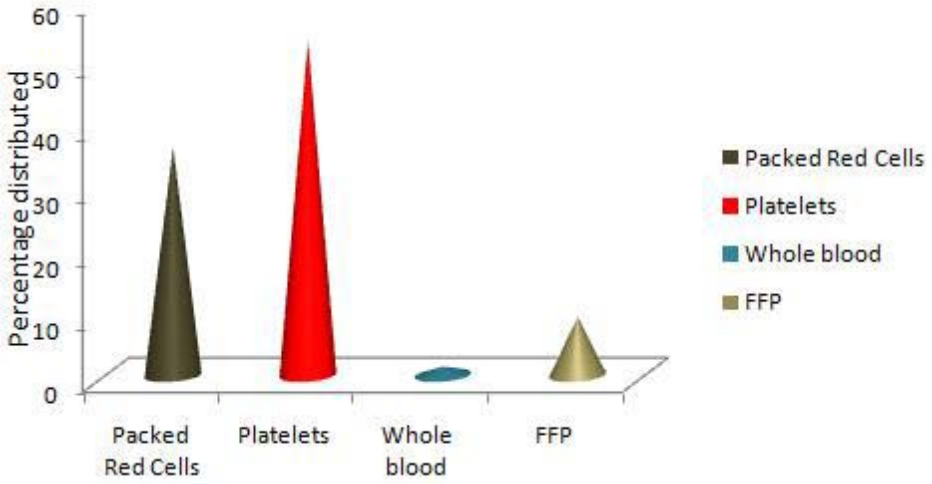

Figure 1: Graphical representation of different blood components distributed in study period

A total of 14 (0.77%) suspected transfusion adverse events were reported by the haemovigilance and surveillance system established as part of the design during the study period. On account of effective training of the reporting personnel all the reports met the inclusion criteria and were included in the analysis. The incidence of transfusion events for this period was estimated at 7.6% per 1,000 blood components distributed. The number of reports varied between 06cases in the month of June and 08 cases in the month of July. The majority of the patients who experienced a transfusion-related adverse event were females (n=11, 78.57%). The median age was 25 years (range, 8–45 years). The majority of the adverse events occurred due to transfusion with packed red cells (64.29%) followed by transfusion due to platelets (35.71%). The frequencies and incidences of transfusion adverse events by each category are shown in Table 1 and Figure 2.

Table 1: Summary of Transfusion Reactions during the study period

Transfusion Reaction	Frequency (%)
Acute Transfusion Reaction (FNHTR)	4 (28.57%)
Hypersensitivity	3 (21.43%)
Unclassified	7 (50%)

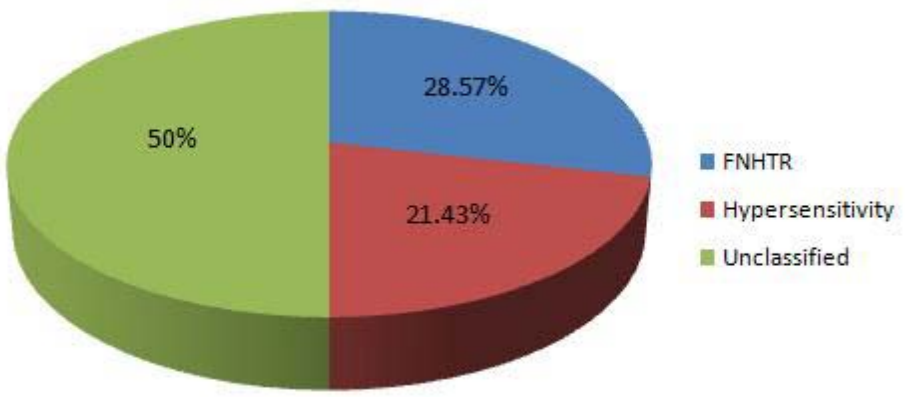

Figure 2: Graphical representation of the type of Transfusion reactions.

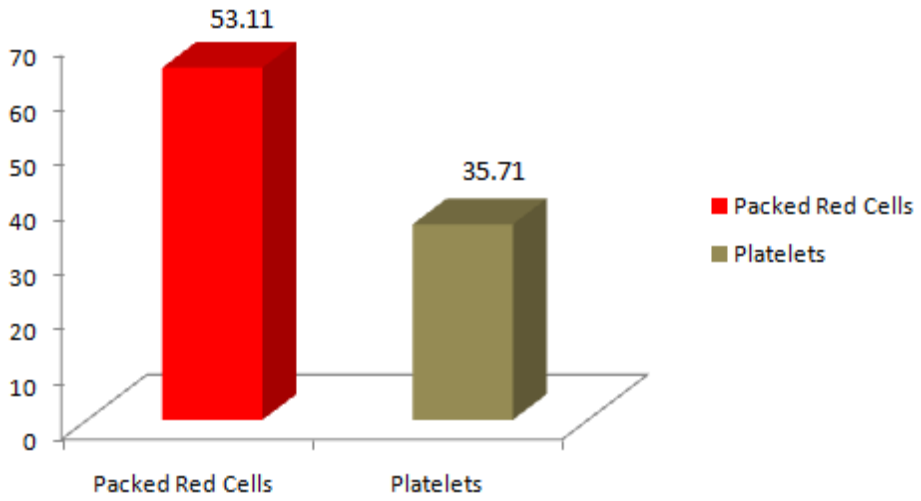

Figure 3: Graphical representation of percentage of transfusion reactions based on blood Components

The symptoms of acute transfusion reactions included pyrexia, rigors, lumbar pain and headache. No further confirmatory tests were conducted to identify the reasons. No cases of overt and dangerous hypotension reported in any of the cases. Seven of the cases(50%) were documented as unclassified due to the failure of analysis into the respective classes mentioned in the list.

Inadequate laboratory and clinical information to classify them further could also be a reason for the unclassified reports. They could probably be allergic or nonspecific reactions. It thus provides a scope for effective skill up-gradation programme for classification of the transfusion reactions.

The major blood component transfused in the study period was the platelet concentrate (n=972, 53.11%). The possible reason was the increase in Dengue cases coinciding with the monsoon season. However, the number of adverse reactions reported was less with platelets which strikes differently from other studies.

No cases of suspected bacterial contamination or fatalities were reported during the study period. The causality assessment of all the reactions was grade 1 i.e. minor adverse reaction as per the graded scale. Additionally, all the reaction occurred despite giving pre-medications except two reactions where pre-transfusion medications were not administered.

IV. Discussion

Blood transfusion is very safe and effective when used appropriately. Additionally, it is a complex multistep process involving members of several different professional groups, nurses, doctors, laboratory scientists as well as the donors and recipients. It therefore results in several risk points mandating requirement of a surveillance system for monitoring, detecting and reporting these events in the best interests of the patients overall wellbeing. There is also a scope for a national level audit programme for improving and scaling up the vigilance activities.

During the brief period of our study, a total of 1830 blood components were transfused. There is a paucity of studies available in the Indian context on Haemovigilance. However, in a study conducted by Gupta M et al, [12] 45 092 blood components were issued resulting in 190 transfusion reactions (0.42%) as against 0.77% reported in our study. The most frequent reaction reported were febrile non-haemolytic transfusion reactions (54.2%) as against 28.57% of FNHTR in our study.

FNHTR as the most commonly reported transfusion reaction. Febrile non-haemolytic transfusion reactions (FNHTRs) are defined as an unexplained rise in temperature by 1° C or more within 4 hours following transfusion and subside gradually after 48 hours with no Identifiable cause.[13] FNHTRs are noted commonly with transfusion of platelets (up to 30% of platelet transfusions) than red blood cells (RBCs) as platelets are stored at room temperature, which promotes leucocyte activation and cytokine accumulation. [14]

Additionally, there have also been studies on single transfusion reactions. As per a study by Kato H et al,[15] it was observed that First transfusion ATRs to RBCs, FFP and PCs were 1.08%, 2.84% and 3.34%, respectively. These are higher than ATR incidences to RBCs (0.69%), FFP (1.91%) and PCs (2.75%) on subsequent transfusions. Specifically, first transfusion incidences of febrile non-haemolytic transfusion reactions (FNHTRs) to RBCs (0.43%) and allergic reactions to FFP (2.51%) were higher than on subsequent transfusions (RBCs: 0.23%, FFP: 1.65%). However, first transfusion reaction events were not documented in our study but most of the events were observed in patients with subsequent history of transfusions.

WHO has laid down guidelines for and managing accordingly for acute transfusion reactions where it has been considered under three categories.

1. Category I which can be recognised by mild symptoms like localized cutaneous reaction which includes urticaria, rash pruritis (itching).
2. Category II includes moderately severe reactions like flushing, urticaria, rigors, fever restlessness, tachycardia, anxiety, pruritis, palpitation, mild dyspnoea and headache
3. Category III where life-threatening reactions like hypotension, tachycardia, haemoglobinuria, unexplained bleeding, anxiety and chest pain are included which needs transfusion to be stopped immediately.[16]

Most common cause of the preventable adverse reactions is due to clerical errors.[17] It is less difficult to identify the adverse effects within a short time of transfusion event. However, the longer the time of events to occur after the transfusion, the less likely they are to be reported (especially if they are mild and nonspecific). Transfusion reactions include infectious hazards and non-infectious hazards. Infectious hazards commonly include sepsis from bacterial contamination, which can be minimized by donor screening and infectious disease markers. Emphasis should be laid on vigilance for emerging infectious dieases (EID) like chikungunya Virus, dengue, malaria etc.[18] One of the major risk factors which are observed to be responsible for acute haemolysis is the unmonitored storage conditions. Majority of acute hemolytic reactions are due to improper storage conditions. Additionally, inappropriate storage conditions in refrigerators outside the leads to deterioration of red cell units. Therefore, awareness among the healthcare professionals is essential to reduce the risk of transfusion reactions. [19]

Haemovigilance is the term derived from Latin, where Heame means “Blood” and vigilans means “watchful”.[20] Haemovigilance is about 20 years old and was previously a part of Pharmacovigilance activities. High incidence of infections like HIV, HCV were counteracted between 1980s and 1990 due to transfusion. This disastrous incidents lead to the need for monitoring of transfusion safety in countries like UK.[21]

Haemovigilance is concerned with reactions occurring due to blood components like whole blood, packed cells, platelets and fresh frozen plasma whereas Pharmacovigilance intransfusion medicine also includes components of plasma like clotting factor concentrates immunoglobulin, albumin and other fractionated products.[22]

First work on monitoring of transfusion reaction was started in 1991 in France.[23] Later a serious hazard of transfusion scheme (SHOT) was started in 1996. Hospitals registered with the UK National External Quality Assurance Scheme (UK NEQAS) for blood transfusion laboratory practice were invited to participate and the scheme was widely advertised at meetings and with a leading article in the British Medical Journal.[24]

This scheme was a success as it leads to reduction in bacterial infections, transfusion related acute lung injury(TRALI), and transfusion related Reduction in transfusion-associated graft - versus – host disease (TAGvHD) and post-transfusion purpura (PTP).

Haemovigilance is a complete system which aids in collection, recording and evaluation of blood transfusion reactions. This system of haemovigilance functions with variability among various countries. Haemovigilance is aimed to detect and analyse all untoward effects of blood transfusion in order to correct their cause and prevent recurrence. Many countries in the developed world have established National Haemovigilance systems and a few developing countries are setting it up.

With the concept of universal leukoreduction there is dramatic risk reduction for FNHTR. The most common quoted rate for FNHTR is 0.5-1% among the general populations of patients with red cell transfusion. A comparative study on incidence of FNHTR in leukoreduced vs. nonleukoreduced blood components showed that the incidence is 0.047%% in nonleukoreduced and 0.411% in leukoreduced blood.[25]

A study by Chowdury FS et al has shown that blood transfusion reactions depend upon the frequency and unit of blood transfusion and few recommendations to reduce the incidence of blood transfusion reaction has been elucidated.[26]

In a descriptive study Sobia Nawaz et al conducted at a teaching hospital among pregnant women similar procedure as our study was adopted. The study was undertaken to determine the frequency and types of blood transfusion reactions conducted over a period of 12 months. 20.9% of cases with post transfusion reaction were noted among which 4.9% of haemolytic reactions, non haemolytic reactions in 4.2% and febrile reactions in 11.7%. The study concludes that blood transfusion should be reserved for patients who are haemodynamically unstable patients and blood bank providing the blood products should have adequate cross matching and storage facilities to ensure transfusion safety. [27]

A step to minimize the transfusion risks has been implemented in most of the developed countries. Implementation of an effective system to monitor these transfusion risks is still a challenge in developing countries. In one such report adverse events were evaluated retrospectively i.e. the data on different blood components distributed was collected the post transfusion sequelae was evaluated based on SHOT (Serious Hazards of Transfusion) classification. Such a method would be helpful in missing the cases although establishment of causal relationship in certain case was impossible. [28]

The incidence of allergic reactions to blood components vary greatly in literature and there are a few supporting figures on incidence of allergic reactions on well-designed studies in the general patient population.

Each transfusion has to be monitored carefully with prompt recognition and treatment of acute transfusion reactions to decrease transfusion-related morbidity and mortality. Data from a well-functioning haemovigilance system can be used as a quality indicator for monitoring blood transfusion safety and contribute to evidence-based transfusion medicine.

Hence careful monitoring of transfusion process will lead to early detection and reduction of severity of the reaction which can lead to reduction in morbidity and mortality. Thus haemovigilance serves as an ultimate safety tool to ensure safe transfusion process which every country needs to implement. Haemovigilance must be made an integral and a critical component in all the blood transfusion settings. Additionally, heightened awareness about various clinical features of acute transfusion reactions with an ability to assess the serious reactions on time can lead to a better prognosis. The most important concerns with the Haemovigilance is the dependence on the awareness of physicians and other health care workers to look for adverse effects and their reporting determine whether the effects could have been caused by transfusion.[29]

Observation and monitoring are required throughout the transfusion episode, more so for within first 15 min. Delayed reactions must also not be missed. There should be standard operating procedure containing the details for documentation, reporting, evaluation, and follow-up of all adverse reactions. Moreover, a "Conservative approach" of blood transfusion to reduce the number of unwanted transfusions must also be practised.

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Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Medical Research Paper

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of medical research then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

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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