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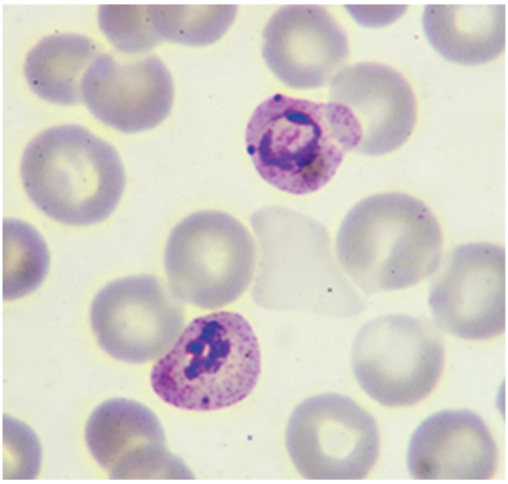
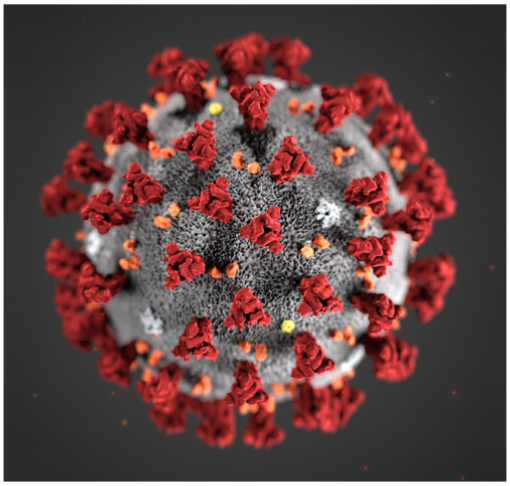
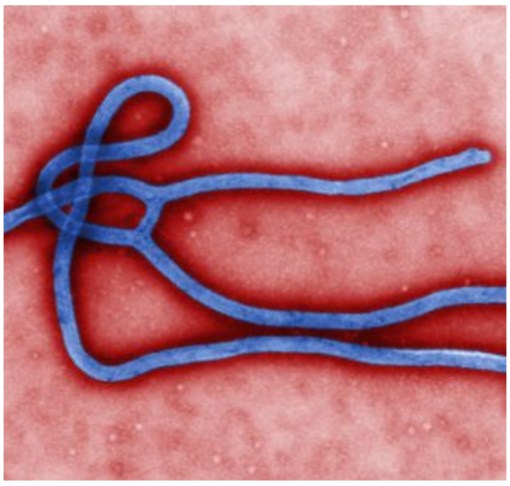






the med

The FIS Medical Journal

Pandemic Edition

In this issue:


THE
MED

EDITOR'S NOTE

Dear Medical Journal Readers,

Welcome to the 2020-2021 Medical Journal Volume 1,

We would personally like to thank all the people involved in this edition of the med journal, especially Simone Mitra (Y12) Ryan Ning (Y12) and Madhavi Charkravorty (Y12).

This edition is something that is close to us all, an in-depth look into pandemics and their trends, their comparison to our modern time. For this we travel back in time to the Ebola epidemic and even further back to the Black Death.

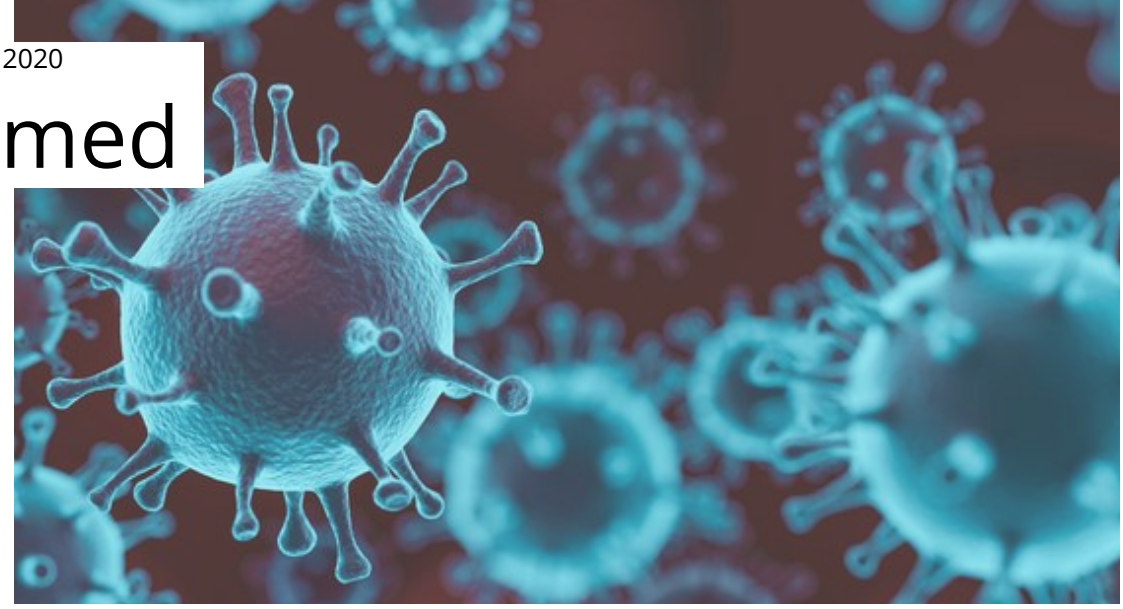
We hope this edition will hit a chord close to home, and possibly grant you some more insight into the current affairs.

We hope you are staying safe and we wish you to remain healthy.

Saisha Parakkat and Kabir Mehta (Y12)

OCTOBER 2020

the med



Featured Articles

Diagnosisof the month

University Guidance


THE
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A MASKED FUTURE

BY RYAN NING (Y12B)

The whole world has now been in the midst of the coronavirus pandemic for more than 6 months now. Wearing face masks has become the new norm and social distancing has become a household term. With all of these restrictions, there has been high hopes placed on the vaccine, that we will be able to return to the way things were after this vaccine has been developed or at least enough people will have contracted the virus to provide some form of herd immunity (enough people in the community are immune to protect those are not immune).

However, we will most likely be wearing masks for a long time to come - Ben Cowling, the head of epidemiology at the University of Hong Kong's School of Public Health, recommends

"wearing masks on public transport or in crowded areas even after social distancing restrictions are lifted".

Similar sentiments are echoed by Trish Greenhalgh, a primary-care professor at the University of Oxford, who said masks should be worn in public

"until there are no new cases, or very few cases,"

And there are no signs of the virus slowing down. While this is the first time in modern history that we have faced a pandemic on the scale of COVID-19, we can draw parallels with a similar virus of the past: measles. Both COVID and measles are transmitted through the air, and are highly contagious. However, according to the World Health Organization, even though there is a safe and cost-effective vaccine available to measles, in 2018, there were more than **140,000 measles deaths** globally.

But does wearing masks really help fight the virus? With the majority of experts advising that the public don masks and a minority saying that "masks are not necessary among healthy people", what does this mean that you should do?

According to a study done by Ars Technica, published on an article of YaleGlobal (a website produced by current Yale University students), the data agrees with the effectiveness of masks. Wearing a cotton mask can block up to 35% of airborne particles while wearing a N95 respirator can stop close to 100% of particles from being expelled into the air! However for the majority of people (excluding doctors, etc.) it is not necessary to wear a N95 respirator because most of the airborne particles that transmit COVID-19 are already absorbed by a surgical grade mask.

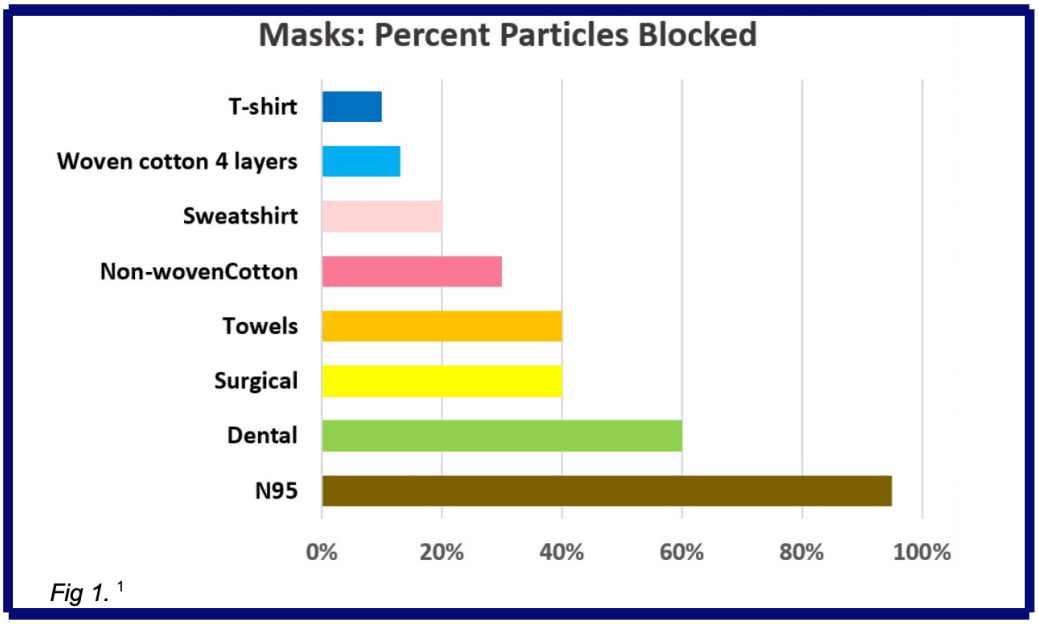


Fig 1. [1]

And in a real life example, according to a study done by researchers from various universities (including Brown, MIT and Hong Kong Baptist University), they discovered a link between mask wearing and death rates in countries who have endorsed mask wearing and countries who have refuted it.

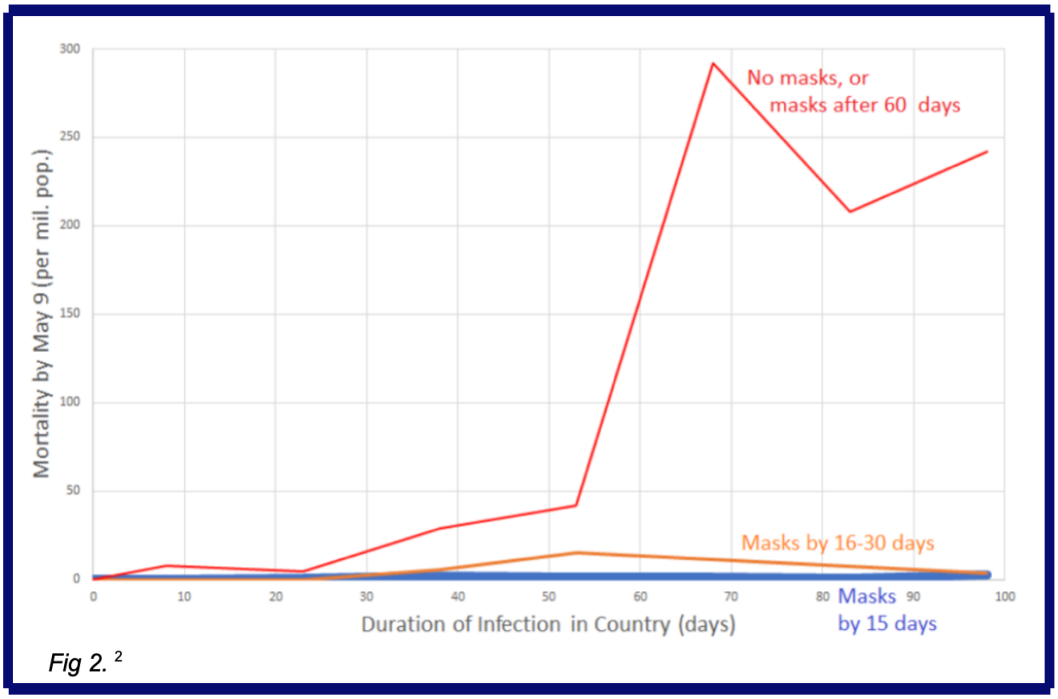


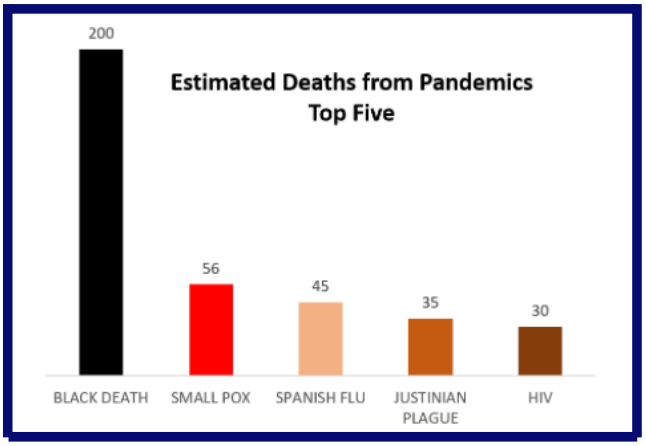
Fig 2. [2]

As seen on fig 2, countries that had mandated mask regulations by 15 days had a lower mortality rate (per million) than countries that had not implemented a mask policy or were late to do so. Correlation doesn't always equal causation but in this case the evidence is overwhelmingly conclusive.

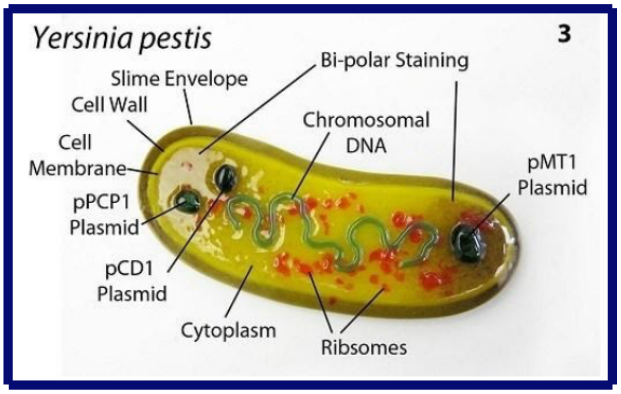
COVID-19 is an unprecedented pandemic which has caused long-lasting and severe economic/social impacts. However, by working together to support the medical workers fighting for us on the frontlines by wearing masks and social distancing, we will find a way to prevail through this disease and reach the light at the end of the tunnel. And who knows, for those tired of not being able to see each other's faces, maybe one bright day in the future we'll be able to take off our masks or if not, there are always face shields.

THE BLACK DEATH

BY MADHAVI CHAKRAVORTY (Y12B)



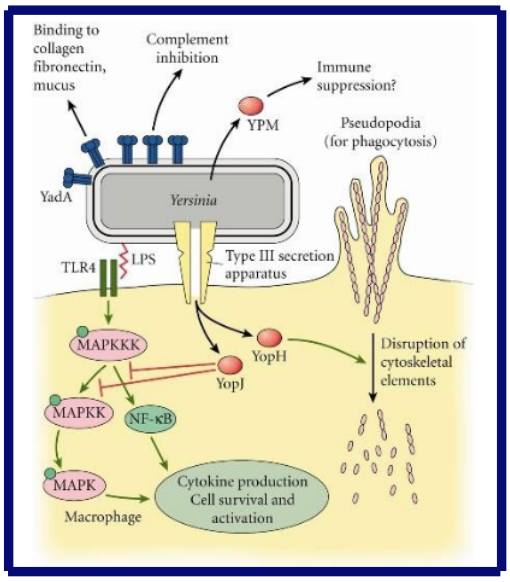
The Black Death is the deadliest pandemic recorded in human history. The most vicious period of the pandemic occurred in Europe between 1347 and 1351. A range of 75-200 million people are thought to have been killed. This accounted for 45%-60% of the population of Europe. Half of Paris' population of 100,00 died, the population of Florence fell from 120,000 to 50,000, at-least 60% of the population of Hamburg, Bremen and London are thought to have perished. It is believed that the plague was introduced via Genoese traders from their port city of Karffa in Crimea in 1347. The outbreak in Crimea was transmitted through rodents with infected fleas in the fleeing merchant ships to Italy in October 1347. From Italy the disease spread northwest across Europe striking France, Spain, Portugal and England by June 1348, then spread east and north through Germany, Scotland and Scandinavia from 1348 to 1350. Finally, it spread to Russia in 1351. It was spread mainly by trade, so some isolated regions of Europe were not affected.



Plague is caused by Yersinia Pestis (Y. Pestis), a gram negative bacterium, discovered by Alexander Yersin, a pupil of Louis Pasteur, during an outbreak of bubonic plague in Hong Kong in 1894. Plague is a zoonotic disease and humans play no role in the long term survival of Y. Pestis. Transmission between rodents is accomplished by their associated fleas.

Fleas acquire Y. Pestis from an infected blood meal. Infection in the flea is restricted to the alimentary canal. Two days after an infected blood meal, the stomach exhibits clusters of brown specks containing Y. Pestis.

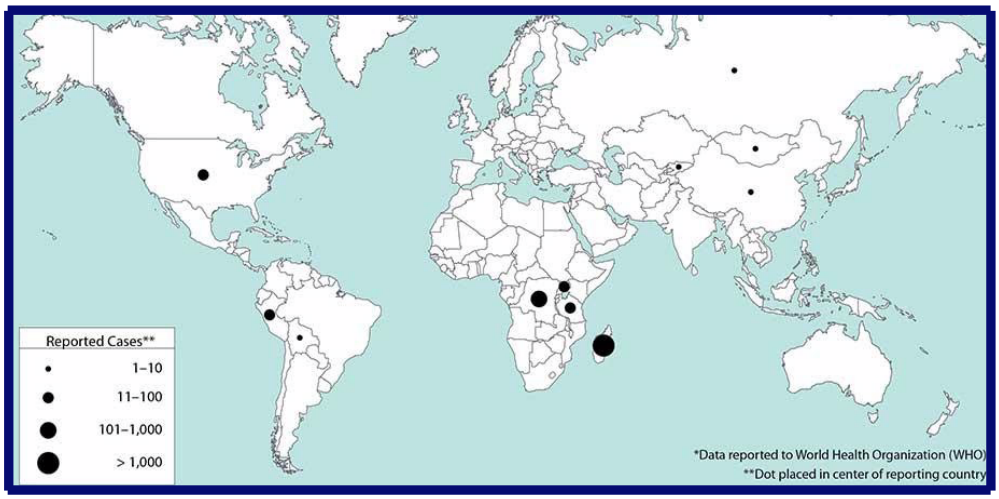
These develop into dark brown masses which extend throughout the stomach. Between days 3 and 9 after the infected blood meal, the bacterial masses prevent ingested blood from reaching the stomach. As the hungry flea repeatedly attempts teed, the blood sucked from the mammalian host mixes with bacilli and is regurgitated into the mammalian host.



In the mammalian host, the YOP proteins (Yersinia Outer Proteins) are delivered directly to host cells by a needle-like structure called the "injectisome". A number of YOP proteins (YopH, YopE. YopT) and a gelatinous envelope (the F1 capsule) prevent phagocytosis, the process of an immune cell engulfing and destroying a pathogen. The YopJ protein prevents the production of inflammatory molecules, causing some immune cells to apoptosis. The Y. Pestis quickly spreads to the draining lymph nodes, which become hot, swollen, tender, and hemorrhagic. The swelling together with the haemorrhaged blood gives rise to the characteristic **black buboes of bubonic plague**.

The incubation time of this form of plague is 2-6 days. Within hours of the initial flea bite, the infection spills out into the bloodstream, leading to severe infection of the liver, spleen, and lungs. The patient also develops a severe bacterial pneumonia, exhaling large numbers of organisms into the air during coughing fits. Left untreated, the plagues shifts into a predominately pneumonic form (**pneumonic plague**) which can be transmitted from human to human via aerosols. If an uninfected person inhales enough organisms they will develop pneumonic plague in 1-3 days.

All patients suspected of having bubonic plague should be placed in isolation until 2 days after starting antibiotic treatment to prevent the potential spread of the disease should the patient develop secondary plague pneumonia. Streptomycin has been used to treat plague for over 45 years and remains the drug of choice. Due to its toxicity, patients are not usually maintained on streptomycin for the full 10-day treatment regimen but are gradually switched to one of the other antibiotics, usually tetracycline. Antibiotic-resistant strains are rare and are not increasing in frequency.



As an animal disease, plague is found in all continents, except Oceania as can be seen from the chart from CDC which shows reported cases from 2013-2018. There is a risk of human plague wherever the presence of plague natural foci (the bacteria, an animal reservoir and a vector) and human population co-exist. Plague epidemics have occurred in Africa, Asia, and South America; but since the 1990s, most human cases have occurred in Africa. The three most endemic countries are the Democratic Republic of Congo, Madagascar, and Peru. In Madagascar cases of bubonic plague are reported nearly every year, during the epidemic season (between September and April).

VACCINES

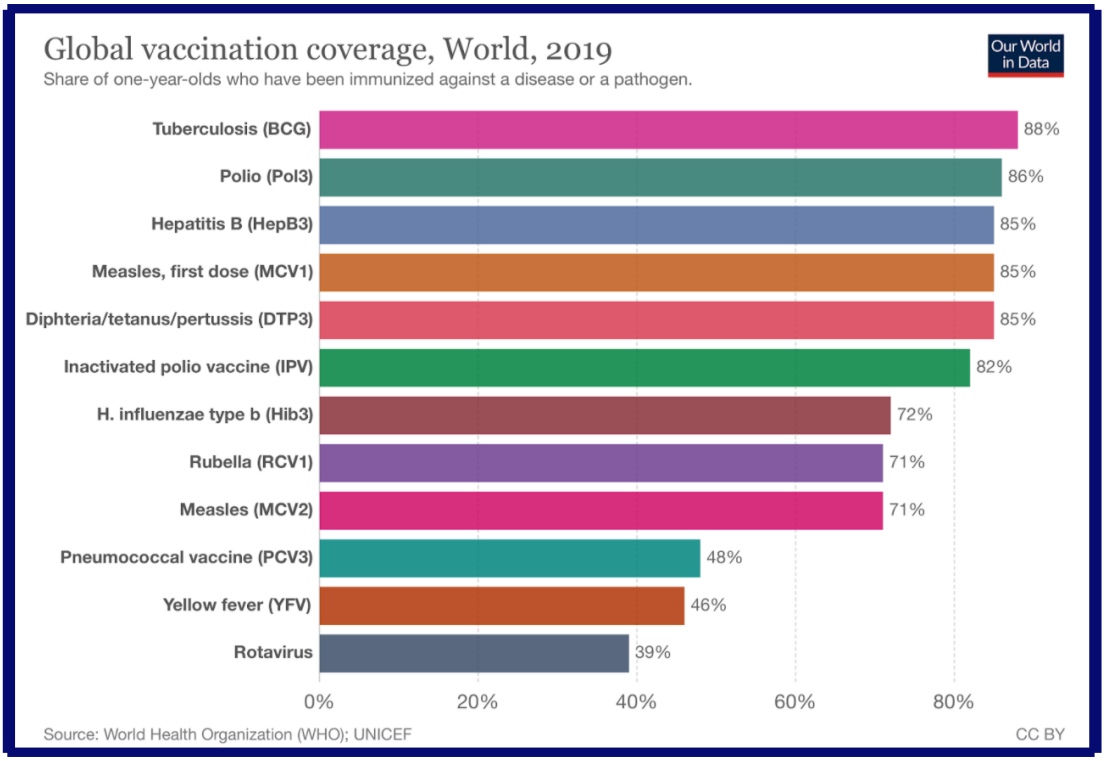
BY KABIR MEHTA & SAISHA PARAKKAT (Y12B)

A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease. A vaccine typically contains an agent that resembles a disease-causing microorganism and is often made from weakened or killed forms of the microbe, its toxins, or one of its surface proteins.

What vaccines accomplish: The World Health Organisation (WHO) suggests that vaccination prevents 2-3 million deaths each year.One example that makes this clear is to consider the impact of the smallpox vaccine: Smallpox was once an extremely common and deadly infectious disease, but it has been eradicated globally back in 1977 thanks to the vaccination against the disease. Vaccines create immunity in an individual by introducing a weakened or killed form of the pathogen that makes us ill ,such as bacteria or viruses ,or its toxins or one of its surface proteins.
For most diseases, the greater the proportion of people who are immunised, the better protected is everyone in the population as the disease transmission can be reduced or stopped. Herd immunity is a community protection that is created when a high percentage of the population is vaccinated, such that it is less likely that the infectious disease spreads.Herd immunity provides a protective barrier, especially also for those who cannot be vaccinated.

Herd Immunity Thresholds of vaccine-preventable diseases[6]

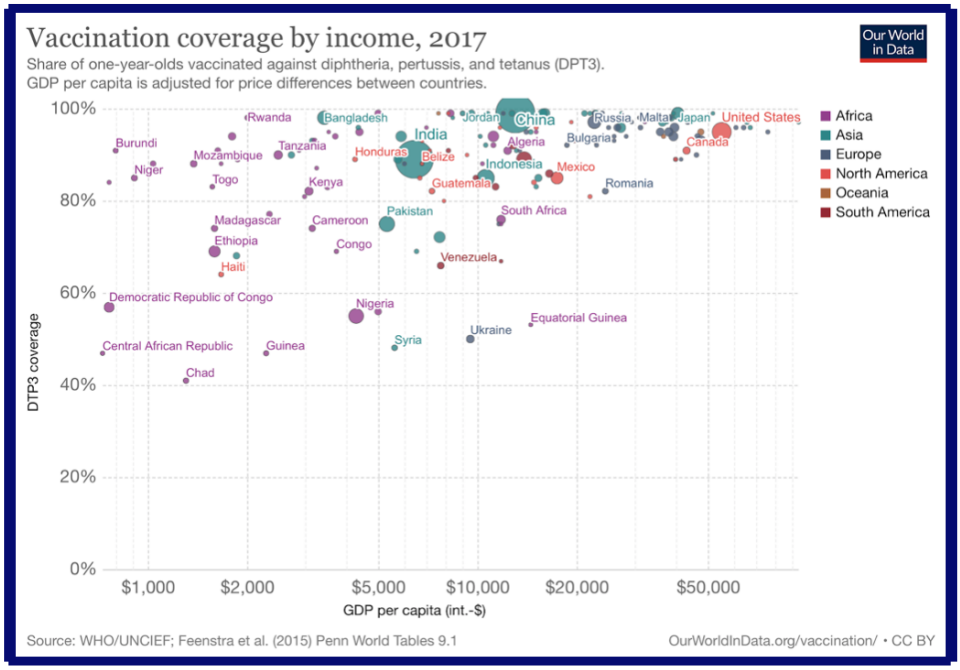
Disease	Transmission	Basic reproduction number	Herd Immunity Threshold
Measles	Airborne	12–18	92–95%
Pertussis	Airborne droplet	12–17	92–94%
Diphtheria	Saliva	6–7	83–86%
Rubella	Airborne droplet	6–7	83–86%
Smallpox	Airborne droplet	5–7	80–86%
Polio	Fecal-oral route	5–7	80–86%
Mumps	Airborne droplet	4–7	75–86%
SARS	Airborne droplet	2–5	50–80%
Ebola	Bodily fluids	1.5–2.5	33–60%
Influenza	Airborne droplet	1.5–1.8	33–44%



Graph showing global trend in vaccine usage

The coverage of the first dose of DTP was 90% indicating that 13.5 million children were not vaccinated in 2018.In 2018, only 35% of children globally received the rotavirus vaccine, which protects children from diarrheal diseases,one of the leading causes of child mortality.pneumococcal vaccine that protects children from pneumonia , the leading cause of child mortality , only reached 47% of one-year-olds. From the above we can also see that more and more children are being immunised to diseases like Polio and Rubella, diseases that once plagued the world.

Affect of income on use of vaccines (in 2017).

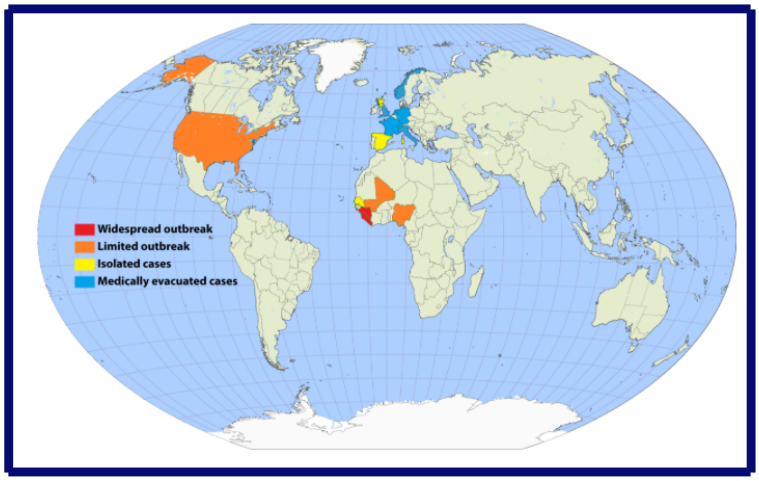


In poor countries where vaccination coverage is low since there are many people who can not afford to pay the money it costs to do a full vaccination for their children/child. Whereas rich countries (spe have vaccination coverage rates of more than 90%. It is in low- and middle-income countries where coverage is low – in some countries below 50%. For example some poor countries – like Burundi, Rwanda, and Bangladesh – achieve high coverage rates. Similarly, countries in which a large share of the population is living in extreme poverty often – but not always – have lower immunisation rates, these numbers are not always true as some countries receive medical aid from the UN and WHO.

How vaccines are developed and distributed.

Vaccines are made by taking viruses or bacteria and weakening them so that they can't reproduce. Children who are given vaccines are exposed to enough of the virus or bacteria to develop immunity, but not enough to make them infected by the virus. This is usually done through 4 main ways :

- Change the virus blueprint (or genes) so that the virus replicates poorly.
- Destroy the virus blueprint (or genes) so that the virus can't replicate at all
- Use only a part of the virus or bacteria.
- Take the toxin that is released from the bacteria, purify it, and neutralise it so it cannot do any harm.



During Phase I, small groups of people receive the trial vaccine. In Phase II, the clinical study is expanded and vaccines are given to people who have characteristics (such as age and physical health) similar to those for whom the new vaccine is intended. In Phase III, the vaccine is given to thousands of people and tested for efficacy and safety. Each vaccine contains a small amount of the disease germ (virus or bacteria) or parts of the germ. Examples are the measles virus, pertussis (whooping cough) bacteria, and tetanus toxoid. Vaccines do not cause disease because the germs are either dead or weakened and the toxoids are inactive.

Many vaccines undergo Phase IV formal, ongoing studies after the vaccine is approved and licensed. This is then distributed to patients around the world.

Ebola (EBOV) is a virus that affects how your blood clots. It is known as hemorrhagic fever virus, because clotting eventually develops into internal bleeding. The virus also causes inflammation and tissue damage. Five different species/strands of the virus have been found.Ebola is spread through direct contact with bodily fluids such as blood, saliva, sweat, tears, mucus, vomit, feces, breast milk, urine, and semen. Some strands can also be passed down from mother to child through the placenta, if the mother suffers severely from the virus.The Ebola virus was named after the River Ebola after it broke out in several West African Countries. Many WHO researchers believe that this virus was contracted from Bush meat, such as bats and monkey meat.The Ebola virus had its first reported case in 1976 in the Democratic Republic of Congo [Previously known as Zaire].

Ebola virus vaccine:

- Ervebo (Recombinant vesicular stomatitis virus–Zaire Ebola virus (rVSV-ZEBOV)), the first FDA-approved vaccine for the prevention of Ebola virus disease (EVD)
- It consists of a vesicular stomatitis virus (VSV), which has been genetically engineered to express a glycoprotein from the Zaire Ebola virus so as to provoke a neutralising immune response to the Ebola virus.
- The WHO published the preliminary results of its research, in association with the DRC's Institut National pour la Recherche Biomédicale, into the effectiveness of the ring vaccination program, stating that the rVSV-ZEBOV-GP vaccine had been 97.5% effective at stopping Ebola transmission.

Coronavirus vaccine [Covid-19]:

Coronavirus, a disease similar to the severe acute respiratory syndrome (SARS) and the Middle East Respiratory Syndrome (MERS), is a virus in which respiratory ducts in your body get infected. The virus first comes in contact with the mucous membranes, the nose, mouth and eyes, it then enters and uses the healthy cells in order to produce new virus parts. The virus is then capable of multiplying and infecting nearby cells.

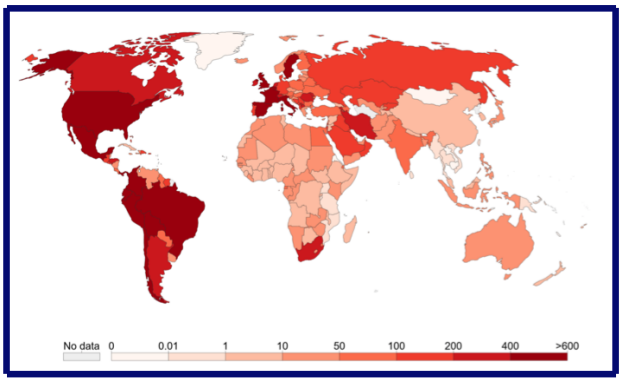


Image showing cases of Covid-19 throughout the world

Covid-19 virus can infect both the upper and the lower part of the respiratory tract which causes the lining to get irritated or inflamed. In more severe cases, the alveoli in the lungs, which are responsible for transporting oxygen into the capillaries, get infected. When alveoli gets infected, dead cells and fluid enter which restricts oxygen molecules from diffusing into the capillaries. Coronavirus is transmitted through respiratory droplets, produced by breathing, talking, sneezing and coughing, and through contact. The initial cases arose in Wuhan, China from a wholesale food market and consisted of people who were stall owners, market employers and people who often visited the market.. The first case was reported to be on November 17th, 2019 but Doctors only started noting the cases in December.

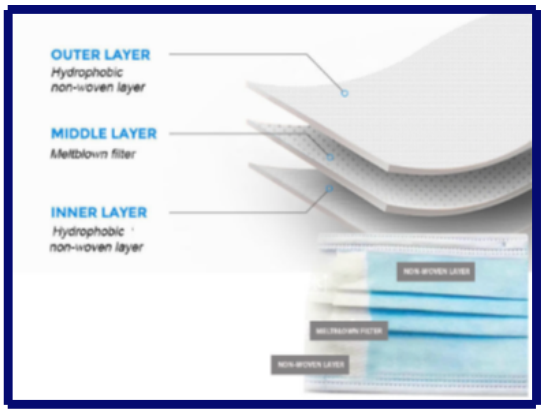
So far, there is no fully approved covid-19 vaccine, with many vaccine trials in Phase 3 of vaccine creation, one particular part of the virus that's thought to trigger an immune response – the spike protein, which sticks up on the virus's surface can be used to possibly create a stable vaccine. There are two leading COVID-19 vaccines, which both focus on getting the body to produce these key spike proteins, to train the immune system to recognise them and destroy any viral particles that exhibit them in the future. These are currently in Phase 2 of vaccine development.

Effect of wearing masks on recovery rate during moderate exercise ?

BY MARTINA ANGLADA CALDA, CHARLIE PETERS & KIAN KARBASSIAN (Y11)

RESEARCH QUESTION:
How does wearing a mask during moderate exercise affect recovery rate?

INTRODUCTION:
COVID-19 is a newly discovered coronavirus which appeared in Wuhan, China in late 2019. It causes mild to severe respiratory problems, which are occasionally fatal. The main symptoms developed consist of a fever, a dry cough and tiredness. Although it has a fairly low mortality rate of approximately 1.4% (according to HKU med), it has proved to be a large threat to human civilization as the number of cases are increasing exponentially world-wide due to its high infectability. The World Health organization report on COVID-19 states that 'Data from published epidemiology and virology studies provide evidence that COVID-19 is primarily transmitted from symptomatic people to others who are in close contact through respiratory droplets, by direct contact with infected persons, or by contact with contaminated objects and surfaces.'



The virus is such a global threat that the World Health Organization (WHO) declared it a pandemic on the 11 of March 2020. There have been over 19 million cases and 720,000 deaths worldwide (7 August 2020), impacting our daily lives massively. Some have lost family members and friends but as well as this it has changed the way most of us congregate, work, exercise, communicate and take care of our hygiene. Furthermore, as a vaccine and treatment is yet to be developed, it has been crucial to minimize the diffusion of the virus by taking several measures.

Due to the severity and contagiousness of the virus, more than 50 countries have decided to make mask-wearing mandatory in public. This is because masks help prevent people from spreading the virus as well as receiving it. Masks cover the mouth and nose creating a physical barrier for fluids and large particle droplets, reducing significantly the risk of transmission. Most people use surgical masks. Surgical masks consist of 3 layers. The outer layer is made up of hydrophobic non-woven fabric that helps absorb moisture. The middle layer is made up of melt-down filter paper which is a barrier to harmful particles and finally, the inner layer is a soft-absorbent non-woven layer which absorbs the moisture you inhale.

We are individuals who are passionate with sports, doing more than 10 hours of sport per week, performing both indoors and outdoors. We mostly play team sports such as football, netball, rugby and field hockey, however, we also go running and improve our overall fitness in gyms. Coronavirus has largely impacted our sports performance. On 15th of July 2020, all sports facilities closed in Hong Kong for the second time and on the 23rd July 2020 wearing masks was made compulsory in all public areas. The new safety measures do not exempt people who are running or doing sport outdoors from wearing masks.

However, we understand the importance of sports not only towards our physical well-being but our mental and social well-being. Furthermore, we were curious whether the use of masks would affect our athletic performance. Consequently, we decided to investigate whether wearing a surgical mask during moderate intensity exercise affects recovery rate. By recovery rate, we are implying the time it takes for the subject's heart rate to return to resting after the exercise. This allows us to see whether the surgical mask restricts airflow, as if it is the case, there will be a significant increase in the percentage change of heart rate, as a decrease in airflow, will increase the buildup of CO 2 in the blood, dropping the pH of the blood which would activate receptor cells to make the heart beat more quickly. We believe this is essential knowledge for people who want to try high intensity exercise with a mask on which will then prevent people from risking their health.

Respiration is a chemical process that involves the breakdown of nutrient molecules in order to use the energy that is stored in the bonds of these molecules.

There are 2 ways in which the body respires:

- Aerobic respiration: This form of respiration occurs when the body has enough oxygen to convert its glucose to the 2 waste products (Water and Carbon Dioxide) and energy. This is beneficial for the body as there is a lot more energy released when compared to anaerobic respiration (Up to 38 ATP per glucose for aerobic respiration vs. Up to 2 ATP per glucose for anaerobic respiration)

Glucose + Oxygen → Carbon Dioxide + Water + Energy ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$)

- Anaerobic respiration: This form of respiration occurs when the body doesn't have sufficient oxygen to be able to respire aerobically. In anaerobic respiration, the body will convert its oxygen to lactic acid and energy. This lactic acid is also called oxygen debt'. This 'oxygen debt' is poisonous if kept in the body or too long therefore the body needs to remove it as soon as possible. The body can remove it by reacting the lactic acid with oxygen. This is why the heart keeps pumping at a faster rate and the body's breathing rate also remains constantly high after the exercise is completed.

Glucose → Lactic Acid + Energy ($C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + ATP$)

We did this by using a treadmill at an incline of 2% at 6km/h in a room temperature controlled room, with controlled humidity. We first measured resting heart rate before getting on the treadmill both with and without a mask on with a heart rate monitor. Then the student began to walk/slowly jog for 3 minutes without a mask. After 3 minutes the student stopped walking/jogging and we measured the recovery rate (how long it took for heart rate to return to normal). This was repeated again but the next time wearing a mask.

This allowed us to conduct an experiment to explore our aim of: to be able to determine if there is an effect of mask usage on the wearer's recovery rate when performing moderate intensity exercise.

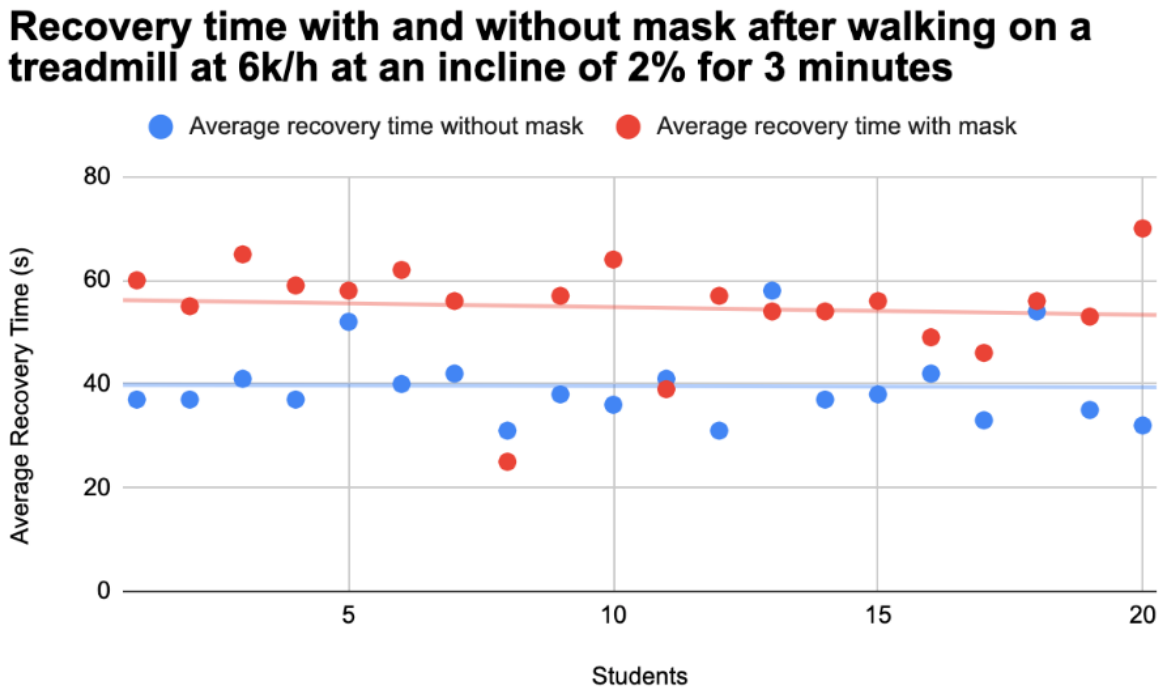
RESULTS/DATA:

Table 1: *Recovery time with and without masks after walking on a treadmill at 6km/h at an incline of 2% for 3 minutes*

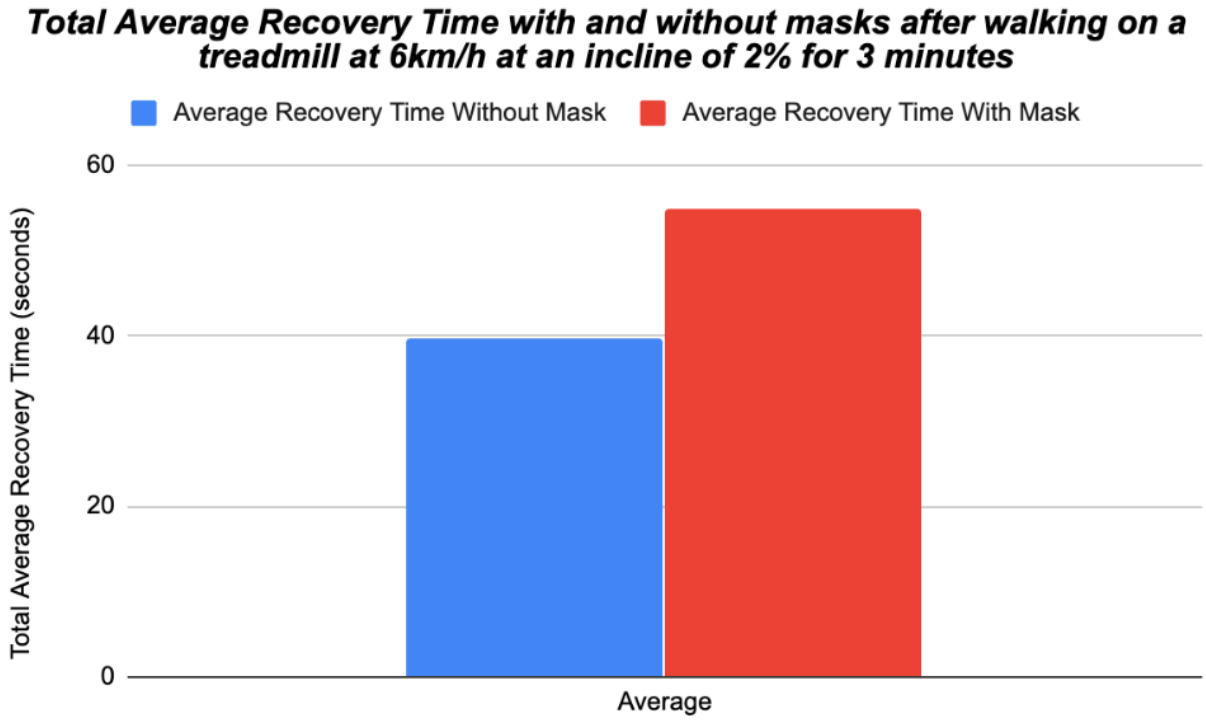
Student	Recovery time without mask after walking on a treadmill at 6km/h at an incline of 2% for 3 minutes (seconds)				Recovery time with mask after walking on a treadmill at 6km/h at an incline of 2% for 3 minutes (seconds)				Change in recovery rate when wearing mask compared to recovery time without mask (%)
	Trial 1	Trial 2	Trial 3	Average	Trial 1	Trial 2	Trial 3	Average	
1	34	38	40	37	55	64	62	60	+62
2	39	45	26	37	69	51	46	55	+49
3	33	44	46	41	42	78	74	65	+55
4	36	31	43	37	52	53	71	59	+37
5	34	67	54	52	54	67	54	58	+11
6	56	27	37	40	48	76	63	62	+55
7	47	53	25	42	70	46	53	56	+33
8	25	24	44	31	22	34	20	25	-19
9	28	52	33	38	68	42	61	57	+50
10	37	25	45	36	72	62	58	64	+78
11	53	49	22	41	44	35	38	39	-5
12	32	23	37	31	65	45	61	57	+83
13	57	52	66	58	59	52	50	54	-7
14	36	31	45	37	54	39	70	54	+46
15	29	44	40	38	76	40	51	56	+47
16	25	50	50	42	41	51	55	49	+17
17	33s	31	36	33	56	38	44	46	+39
18	41	59	62	54	78	47	43	56	+4
19	51	24	31	35	53	49	56	53	+51
20	46	32	19	32	69	72	68	70	+119
Average				39.60				54.75	+38.26

GRAPH:

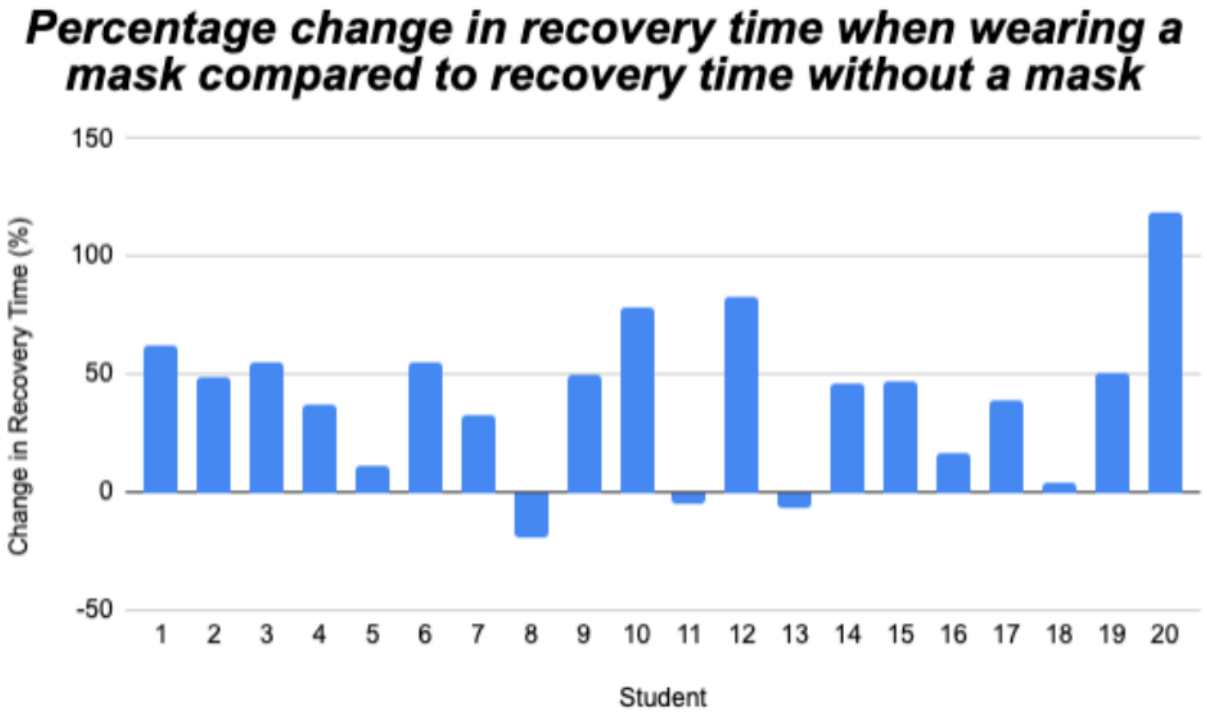
Graph 1: *Relationship between recovery time with and without wearing a surgical mask after fast-walking on a treadmill at 6km/h at an incline of 2% for 3 minutes.*



Graph 2: *Relationship between average recovery time with and without wearing a surgical mask after fast-walking on a treadmill at 6km/h at an incline of 2% for 3 minutes.*



Graph 3: *Percentage change in recovery time with and without wearing a surgical mask after fast-walking on a treadmill at 6km/h at an incline of 2% for 3 minutes.*



CONCLUSION:

In this experiment, we used a treadmill set at a certain pace and incline to determine whether wearing a mask affects recovery rate. Through this, we discovered that the utilization of a mask increases the recovery rate of an individual during moderate exercise.This is suggested by the results obtained during this experiment, as seen in Graph 1: Relationship between recovery time with and without wearing a surgical mask after fast-walking on a treadmill at 6km/h at an incline of 2% for 3 minutes. It shows the recovery time for all twenty individuals in both scenarios. Observing the trend lines, it is evident that the average recovery rate of an individual with a mask on was higher than the average recovery rate of an individual without a mask.

This is also clearly shown in Graph 2: Relationship between average recovery time with and without wearing a surgical mask after fast-walking on a treadmill at 6km/h at an incline of 2% for 3 minutes, as it displays that without a mask the average recovery rate was 39.6s while with a mask the average recovery rate was 54.75s showing there was a 38.26 % increase in recovery heart rate.

In addition, as seen on Graph 3: Percentage change in recovery time with and without wearing a surgical mask after fast-walking on a treadmill at 6km/h at an incline of 2% for 3 minutes, the distribution of the results concretizes this as 85% of participants showed an increase in percentage change which further exemplifies how wearing a mask had a negative effect on recovery time as excluding the minor anomalies of some points having a negative percentage change, it increased the heart recovery rate considerably. Furthermore, the anomalies, with participant number 8, 11 and 13 who in fact had a quicker recovery rate when wearing the mask, seen through the percentage change in recovery rate, which was a decrease of 19%, 5% and 7%. This may have occurred due to errors during the process of measuring the recovery rate such as the malfunctioning or lagging of the heart rate monitors used, or simply reading the measurement wrong.

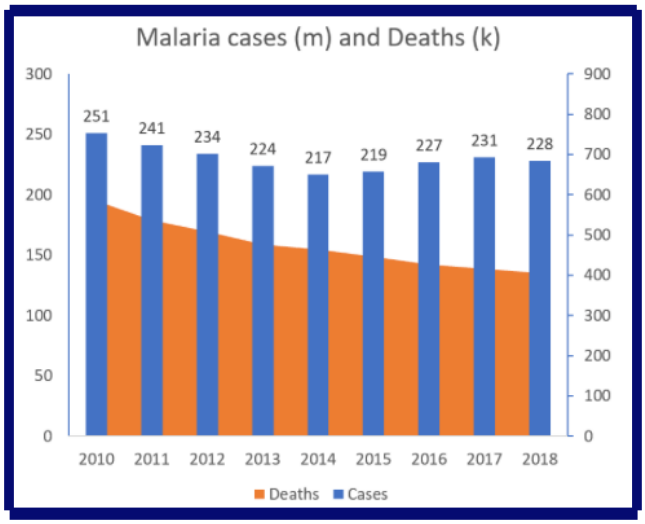
This trend occurred as wearing a mask covers both the nose and the mouth creating not only a physical barrier between the respiratory system organs and the external atmosphere but a moisture barrier caused by buildup of water vapour, dirt, carbon dioxide and excess waste in the body that cannot be efficiently used nor released. This further blocks the carbon dioxide escaping and oxygen entering. Furthermore, due to the nature of masks, a physical barrier is created for fluids and large particle droplets, reducing significantly the risk of transmission. Consequently, it has been a major part of our daily lives wearing a mask day in day out.

This investigation concluded that by wearing a mask, our recovery rate is greater meaning that oxygen intake is less and there is a greater buildup of carbon dioxide and waste in the body as airflow is restricted. This depicts how wearing a mask in everyday life during the COVID 19 period has affected the way we exercise. Furthermore, this shows the dangers of doing high intensity exercise whilst wearing a mask particularly if you have health conditions such as asthma, due to the fact that recovery rate and thus heart rate increases considerably more when wearing a mask. This reflects how during the pandemic restrictions such as in Hong Kong when wearing a mask in public even when exercising became compulsory, it did in fact put individuals at risk and was thus detrimental to health. Despite this, in such conditions of the pandemic it was in fact necessary to take these precautions to prevent the spread of the global virus. Thus, in conclusion, it is evident that there is an effect of mask usage on the wearer's recovery rate when performing moderate intensity exercise.

MALARIA

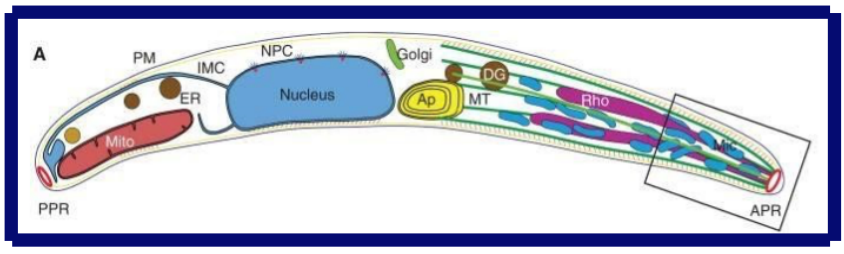
BY MADHAVI CHAKRAVORTY (Y12B)

Malaria cases were estimated at 228m worldwide in 2018 (World Malaria Report 2019, 4-10) compared with 251m cases in 2010 and 262m cases in 2000. The incidence rate of malaria fell from 71 to 57 cases per 1,000 of population at risk between 2010 and 2018, however, no significant reduction was observed after 2014. There were an estimated 405k deaths in 2018, compared to 585k in 2010 and 839k in 2000. All these statistics point to malaria being one of the most widespread and deadly infectious diseases.

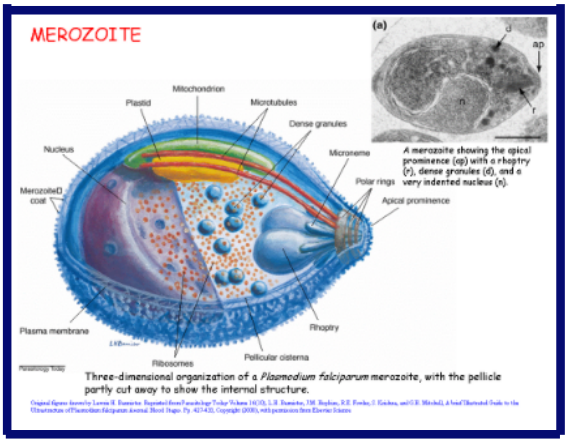


Malaria is a vector borne disease spread by the bite of the female anopheles mosquito. It is caused by a unicellular eukaryote, Plasmodium of the phylum Apicomplexa. The Plasmodium life cycle involves three stages: (1) infection of a human with sporozoites; (2) asexual reproduction; and (3) sexual reproduction. The first two stages occur exclusively in the human body, the third starts in the human body and completes in the mosquito.

In **Stage 1**, saliva infected with sporozoites is injected into the human. Sporozoites can locomote in any substrate using proteins known as TRAP (thrombospondin related anonymous proteins) and display gliding motility (Frischkneckt,1). They are carried by blood flow to the liver sinusoid (Yuda, 1) where they leave the blood circulation by crossing the sinusoidal cell layer to specifically differentiate in hepatocytes.

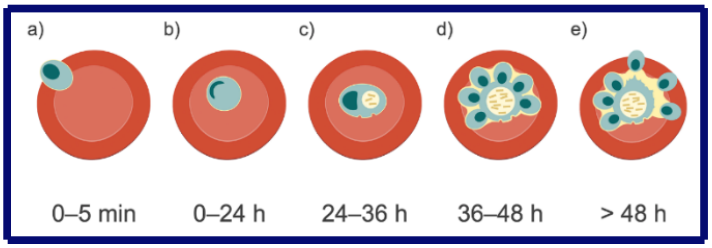


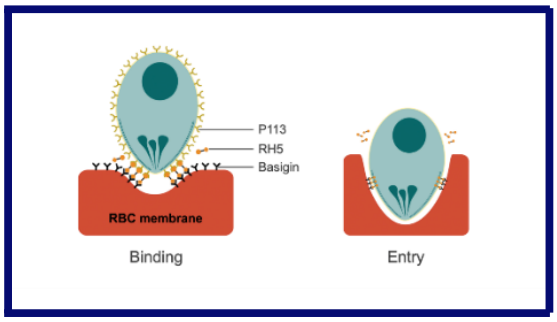
To access this niche sporozoites arrest in the sinusoids of the liver and pass through endothelial cells or Kupffer cells, liver resident macrophages, to gain access to the underlying hepatocytes. Here again, they usually migrate through a few hepatocytes before settling in one for differentiation into thousands of merozoites (Frischknecht,1) asymptomatically.



In **Stage 2**, merozoites invade the red blood cells (RBCs) through a three-stage mechanism – (1) the merozoite uses the apical complex at one end to reorient itself vertically to the RBC membrane; (2) it creates a protein complex on its surface (made from the proteins P113 and RH5) that binds to basigin, a receptor on the RBC membrane;

(3) the junction between the RBC and the merozoite moves upward, allowing the parasite to move further through the membrane until it completely enters the RBC.



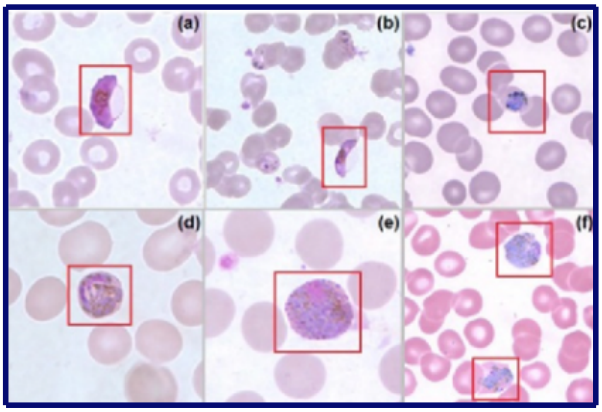


Once inside the RBC, the merozoites enter an activated feeding stage forming ring trophozoites. 24 to 36 hours after invasion, they take on an amorphous shape with a pigmented centre, hemozoin which is formed when the parasite breaks down haemoglobin and destroys the RBC.

By 36 to 48 hours after invasion, more hemozoin will appear. Active schizogony (asexual reproduction by multiple fission) takes place. At this point, the cell is called a schizont. As the schizont matures, the RBC bursts, releasing new merozoites. It is only then that the fever and chills seen clinically in malaria cases are revealed.

During Stage 2, some of the merozoites differentiate into sexual erythrocytic stages (gametocytes) leading to **Stage 3**. The gametocytes, male (microgametocytes) and female (macrogametocytes), are ingested by an Anopheles mosquito during a blood meal. While in the mosquito's stomach, the microgametes penetrate the macrogametes generating zygotes (CDC). Zygotes become motile and elongated (ookinetes) which invade the midgut wall of the mosquito where they develop into oocysts. The oocysts grow, rupture, and release the sporozoites, which make their way to the mosquito's salivary glands.

Malaria is **diagnosed** by microscopic examination of blood films, created by smearing a drop of the patient's blood and then staining it. The blood film examination is typically able to determine both the kind of malaria, as well as the extent of the disease (CDC). Where microscopes are not available, a rapid diagnostic test may be used. These detect malaria antigens (proteins) in a sample of a person's blood and indicate a positive result by a colour change on the testing strip.



The most effective **treatment** for Malaria involves the use of Artemisinin in combination with other anti-malarial drugs known as Artemisinin Combination Therapy or ACT. Artemisinin was first isolated by Chinese scientists in 1972 from Artemisia annua (sweet wormwood) for which Tu Youyou was awarded the Nobel Prize in Medicine in 2015. Artemisinin kills Plasmodium by indiscriminately binding to proteins in many of the organism's key biochemical pathways (Chemical and Engineering News).

Why should international students study medicine in the UK?

BY SIMONE MITRA

Medicine is one of the most competitive courses in the UK to gain entry on to, but every year thousands of international students are accepted into medical school. If your grades are of the highest standard, and if you can prove that you have set your heart on studying and working in this field, then applying to medicine in the UK is for you.

In the UK, the study of medicine starts at the undergraduate level. Applicants declare a course in medicine when they send their university applications. Upon getting accepted, they spend between four and six years studying core science subjects and learning everyday clinical tasks. At the point they earn their bachelor's and enter the workforce, they are considered to be junior doctors. This is advantageous over the USA or Canada since one cannot start medicine right from the undergraduate programme.

There is a wide array of Medical colleges in the UK with a strong reputation built over centuries, Oxford, Cambridge, Imperial, Kings and UCL are always found at the top of the spectrum for the top universities in the world for medicine. Studying in the UK has advantages because it is connected to 1600 NHS hospitals, clinics and other medical facilities. This helps students get attached to large hospitals with multiple departments handling simple to complex cases. This gives them critical experience in their formative years, moreover later on in their career.

Another benefit for international students studying in the UK is studying in English, communicating with patients in English and practising as a medical professional in English. In some of the other countries one would need to learn the local language and therefore proficiency in communicating with patients, which is key for any doctor, would be low. Thereby leading to risks in understanding the root cause of any illness and providing appropriate treatment.

Studying medicine in the UK is a chance to gain some professional experience while you study through the National Health Services (NHS) network. Bachelor of Medicine & Bachelor of Surgery (MBBS) incorporates patient contact from Year 1 through to graduation. From Year 3 you can be assigned your own patients during clinical placements. The course, led by expert staff and NHS education providers, is designed specifically for international students who want to study medicine in the UK.

UK comes second (behind only the US) in the world for medical research. The UK also claims the second-highest number of Nobel Prizes for medicine since 1901, just ahead of Germany. Studying medicine in the UK is a chance to benefit from world-leading expertise in research-intensive establishments.As a medical student you're unlikely to struggle to find employment upon graduation. With the NHS recently announcing plans to recruit 5,000 new doctors, nurse practitioners, clinical pharmacists and other health staff, if you do decide to stay, as well as study in the UK, you have the potential to earn a great salary with excellent benefits. After obtaining a Bachelor's degree, doctors in the UK have the opportunity to acquire Masters / Fellowship degrees in various fields of discipline, either in medicine or in surgery which are connected to reputed associations (MRCP, FRCS, etc.).

In summary, international students can opt for any college in the world but studying in the UK has a number of advantages starting from the point of entry, the exposure while studying and the broad range of career options.

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