To what extent do COVID-19 mortality rates and their perception correlate with relative deprivation in Greater London?

Table of Contents

Introduction

Context of Investigation

The Great Acceleration is the dramatic continuous and roughly simultaneous surge in growth rate across an extensive range of human activity measures, first recorded in the mid-20th century. Though the acceleration encompasses almost every aspect of life on this planet, the two primary strata are socioeconomic trends and Earth system trends. Socioeconomic trends include the rapid growth in the human population, real GDP and international tourism. Earth system trends include increasing atmospheric carbon dioxide quantities, accelerating terrestrial biosphere degradation, and the rapid expansion of domesticated land (Steffen, et al., 2004).

The Great Acceleration has resulted in increased globalisation and time-space compression. Consequently, the global economy has become ever more interdependent and interconnected and flows of money and people have increased exponentially.

Simultaneously, humanities intrusion on the natural environment has increased interaction with previously undisturbed flora and fauna, resulting in the increased likelihood of spillover transmission of zoonotic diseases to humans. Estimates suggest that, globally, about one billion cases of illness and millions of deaths occur every year from zoonoses and that some 60 per cent of reported emerging infectious diseases globally are zoonoses (Jones, et al., 2008). Considering these circumstances, though unprecedented, it is unsurprising that humans have contracted and spread rapidly and widely a novel communicable disease, COVID-19 (Daszak, et al., 2020).

> *"Infectious disease outbreaks, whether natural, intentional or accidental, are still among the foremost dangers to human health and the global economy. With patterns of global travel and trade, disease can spread nearly anywhere within 24 hours" – Tom Frieden, Director of the Center for Disease Control and Prevention (OCR, 2020)*

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (Coronaviridae Study Group of the International Committee on Taxonomy of Viruses, 2020). It was first identified in December 2019 in Wuhan, Hubei, China, and has resulted in an ongoing pandemic, roughly following the diffusion theory set out in the Hägerstrand model. Evidence suggests that the virus is zoonotic, originating through spillover infection (Andersen, et al., 2020).

SARS-CoV-2 is primarily transmitted between people through respiratory (droplet and aerosol) and contact routes, and transmission risk is highest where people are in close proximity (within 2 metres). Airborne transmission can occur in health and care settings where procedures or support treatments that generate aerosols are performed. Airborne transmission may also occur in poorly ventilated indoor spaces, particularly if individuals are in the same room together for an extended time (Public Health England, 2020).

The research questions in this investigation are as follows:

1. To what extent do COVID-19 mortality rates correlate with relative deprivation in Greater London?
2. To what extent does the perception of COVID-19 mortality rates vary with deprivation?
3. What other factors do Londoners perceive to influence COVID-19 mortality rates?

The research topic was chosen due to a personal interest in studying the local patterns of communicable diseases as well as COVID-19's evident contemporary relevance, meaning that data is readily available. The topic is also designed to scrutinise the perception that "diseases don't discriminate" while investigating the link between disease and economic development set out in the OCR specification.

The first research question is designed to use large datasets to explore the potential quantitative correlations in the patterns of COVID-19 deaths with various types of relative deprivation, therefore developing on the disease dilemmas specification topic. The other research questions also focus on this topic. The second question examines the perceptions of COVID-19 mortality, allowing for the investigation of factors such as the perceived likelihood of exposure to SAS-CoV-2 and then the perceived mortality risk. Furthermore, it also allows for insight into the types of relative deprivation the public perceives to influence COVID-19 mortality rates. Moreover, these perceptions can be challenged using the analysis of the correlations produced in research question one. The third research question is designed to open up the investigation and reflect on the public perception of COVID-19 mortality from a broader geographical perspective.

These questions are based directly on the Disease Dilemmas topic of the OCR specification, specifically the "prevalence, incidence and patterns of … a communicable disease". However, as outlined in this contextualisation of the investigation, the questions will require responses from a wide range of specification topics, including "Changing Spaces; Making Places" and "Global Connections", as it will be necessary to access the demographic, socioeconomic, cultural, political, built and natural characteristics that shape the place identity of areas in Greater London.

Literature Review

This literature review will aim to investigate the existing literature on COVID-19 mortality rates and their perception. It is important to note that the contemporary nature of the topic means that literature may be less established, and that emerging literature could rapidly change the prevailing geographical and scientific consensus on matters discussed in this literature review, as well as throughout the rest of this project.

The first research question calls for an analysis of the quantitative data behind COVID-19. Because of this, it is important to first note that COVID-19, up to the 31st July 2020, had a 13.5 per cent case fatality rate in the United Kingdom (Public Health England & NHSX, 2020). However, this number is likely not reflective of the actual mortality rate due to national testing shortages (Our World in Data, 2020).

According to data compiled by the Office for National Statistics (figure 1), the age-standardised mortality rate of COVID-19 across England varies significantly with deprivation. In England's most deprived areas, the mortality rate was 2.2 times the mortality rate in the least deprived areas between March and July. This difference is also statistically significant across all causes of mortality in England, though the difference of 1.9 times higher in deprived areas is less pronounced (Office for National Statistics, 2020).

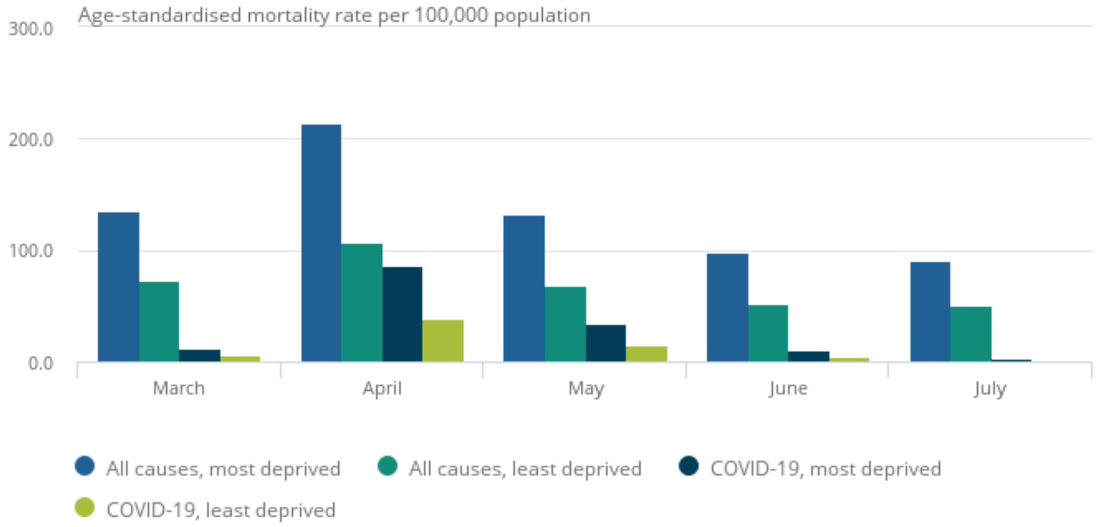

Figure 1 *Clustered bar chart showing age-standardised mortality rates, all deaths and deaths involving the coronavirus (COVID-19), Index of Multiple Deprivation, England, deaths occurring between 1 March and 31 July 2020 (Office for National Statistics, 2020)*

This data suggests that there is likely to be a strong negative correlation between relative deprivation (as measured by the Multiple Index of Deprivation where a lower rank implies a more deprived area) and COVID-19 mortality rates in Greater London. This is despite more deprived areas often having a younger population.

Looking to the second research question, many factors may contribute to this pattern, between deprivation and COVID-19 mortality rates, though it is challenging to disentangle causation and correlation for individual aspects. Theorised causes of the trend, however, include increased population density, decreased access to services, increased prevalence of potential comorbidities and increased rates of smoking and obesity in deprived areas (Public Health England, 2020) (Williamson, et al., 2020) (Singh & Singh, 2008).

The strongest correlation between the individual Indices of Deprivation and COVID-19 deaths is likely to be the 'Health Deprivation and Disability' index. This is a reasonably intuitive conclusion as individuals with underlying health conditions are often cited as being most at risk of dying from COVID-19.

Of the 33,841 deaths between March and June 2020 involving COVID-19 in England and Wales, 30,577 (90.4%) had at least one pre-existing condition, while only 3,264 (9.6%) had none. The most common "main" pre-existing conditions in England and Wales were Dementia and Alzheimer disease, with 6,887 deaths (20.4% of all deaths involving COVID-19) and Ischaemic heart diseases, with 3,647 deaths (10.8% of all deaths involving COVID-19) (Office for National Statistics, 2020).

This evidence for this hypothesis is reinforced by the National Health Service's advice that those classified as 'clinically extremely vulnerable' should have been shielding during the heights of the COVID-19 epidemic in the United Kingdom (National Health Service, 2020). Furthermore, the government guidance also described those aged 70 and older as 'clinically venerable', suggesting that the index 'Income Deprivation Affecting Older People' will likely be more strongly correlated with COVID-19 mortality rates than the income deprivation affecting children index.

On the other hand, the 'Crime' domain will likely see less correlation with mortality rates as no literature has found links suggesting that crime can lead to significant increases in COVID-19 deaths. However, despite this lack of direct causation, there will likely be a correlation link as increased crime is associated with increased deprivation (Shannon, 2009). Hence, there will probably still be a weak negative correlation between crime and mortality rates.

No conclusive literature exists on the impact of socioeconomic deprivation on the perception of COVID-19 mortality rates and what causes influences them. However, individuals from less deprived areas may have more knowledge of the disease due to increased media interaction (Helsper, 2017). This will likely translate into a more accurate perception of the mortality rates of COVID-19 and what influences them. It may also mean that affluent respondents can give more potential reasons for trends in COVID-19 mortality data and the factors that may influence them.

It is challenging to hypothesise which sample will believe itself to be more at risk of dying from COVID-19, as although affluent populations are likely to be at less risk theoretically, they are also likely to have higher a higher average age. Populations with a higher age, regardless of their relative deprivation level, may perceive themselves as more at risk due to the public health messaging surrounding the link between age and increased mortality rates.

The final research question is likely to see a broad range of responses, but the most common will likely be blaming Her Majesty's Government for poorly handling the epidemic or blaming the general public for failing to follow the public health guidelines (Vaughan, 2020) (Elgot, 2020). Other hypothesised responses include the perceived risk to ethnic minorities as well as the increased risk to older populations, especially those living in care homes.

Geographical Location

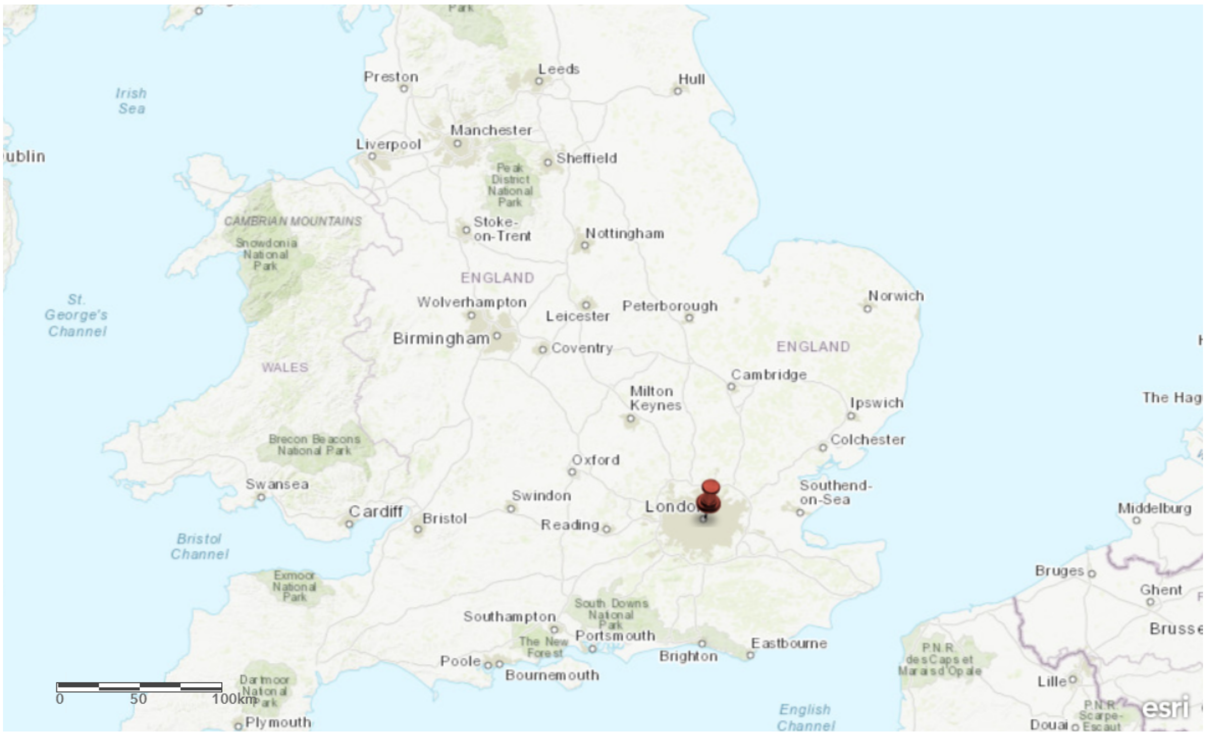

Figure 2 *Map showing national level overview of the location of London. London is identified by a red pushpin symbol*

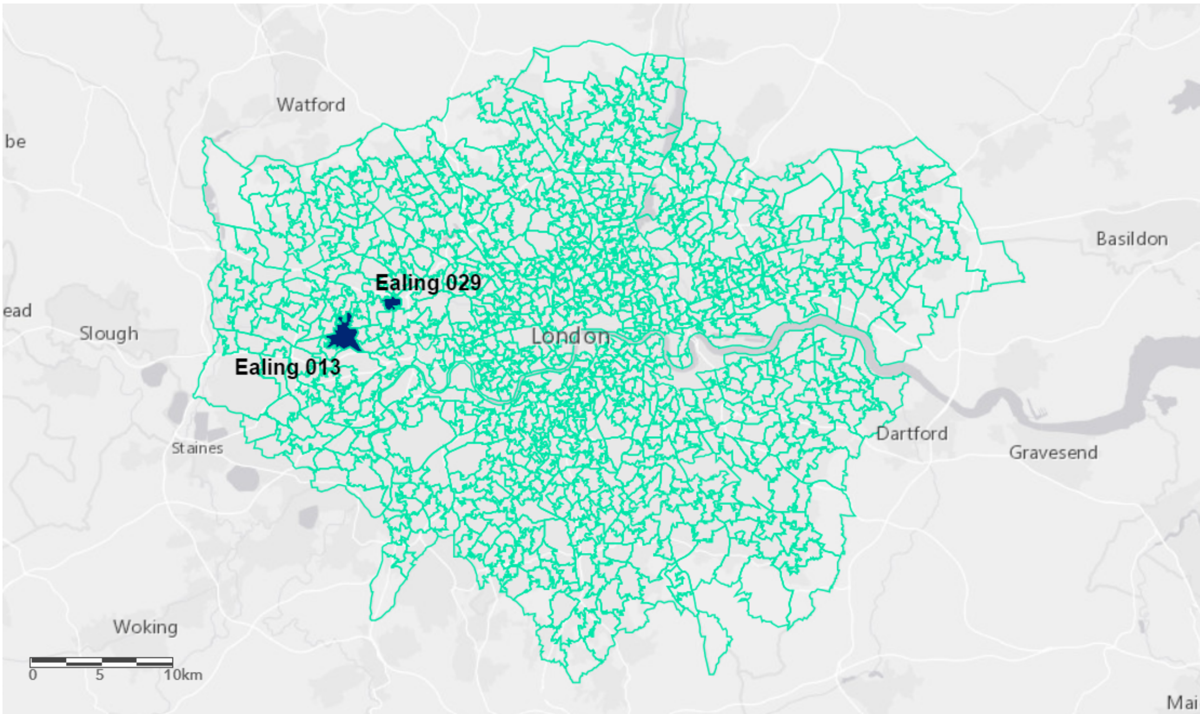

Figure 3 *Map showing regional location of London. The light blue lines represent the boundaries of the Middle Super Output Areas in Greater London. The blue shaded areas represent the selected MSOAs for surveying, namely Ealing 013 and Ealing 029*

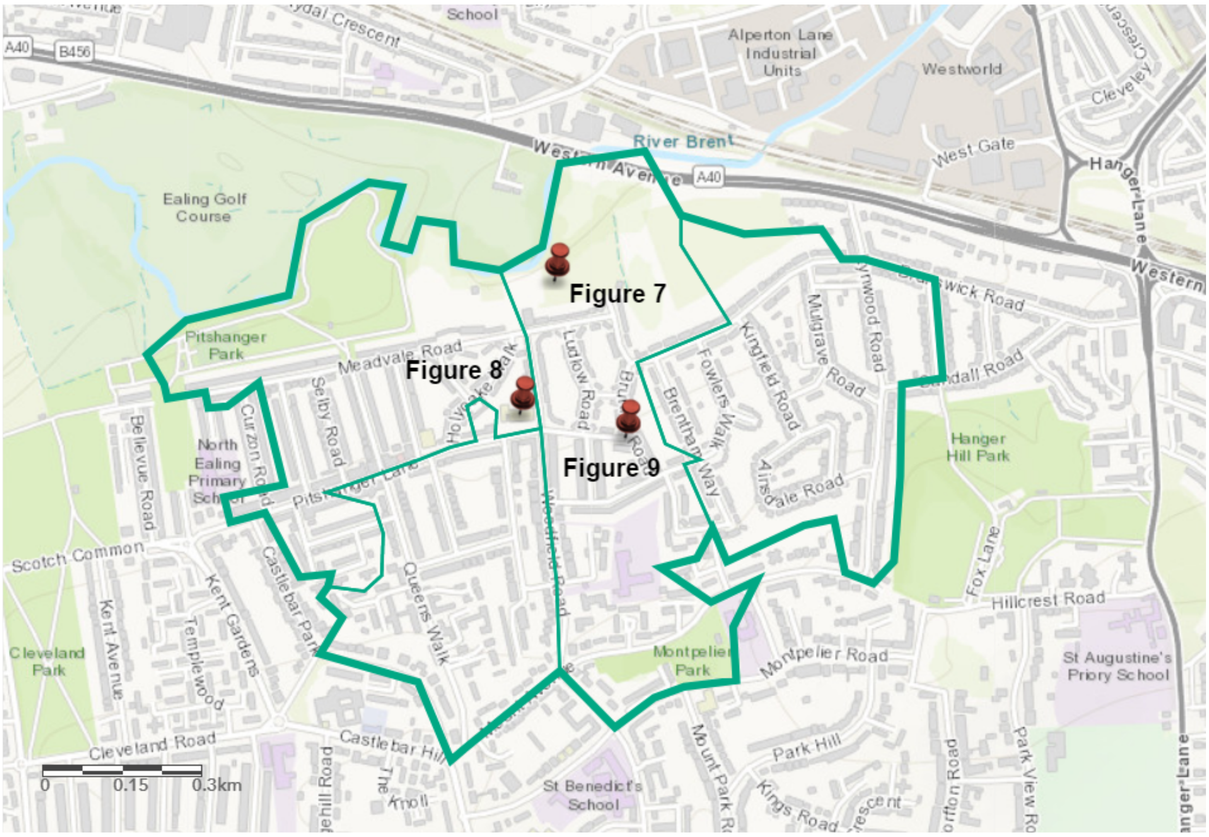

Figure 4 Map showing the MSOA Ealing 013 (thick blue line) and its four Lower Super Output Areas (thin blue lines)

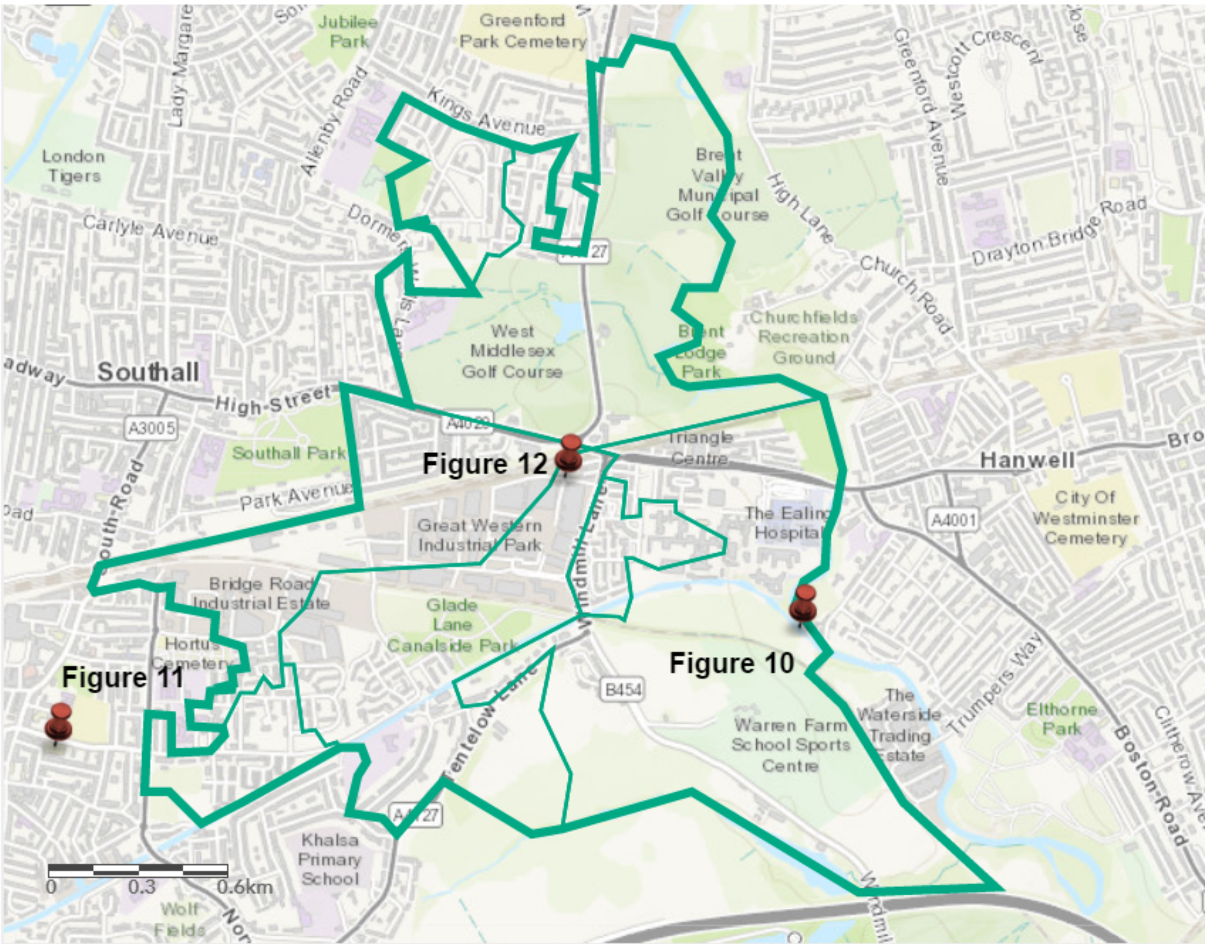

Figure 5 Map showing the MSOA Ealing 029 (thick blue line) and its seven Lower Super Output Areas (thin blue lines)

Greater London was chosen for this investigation as, at the time, it was only in the Medium Tier of the government's COVID-19 tier system, and it offered an extensive data set with vastly varied levels of deprivation.

The two Middle Super Output Areas (MSOAs) chosen for the investigation's survey are Ealing 013 (Pitshanger) and Ealing 029 (Norwood Green North & Windmill Park). These locations were chosen for their ease of access, highly varied deprivation ranks, and similar COVID-19 mortality rates.

Ealing 013 has a population of 6,225 (Office for National Statistics, 2020) and is ranked as the 27,021 most deprived MSOA on the Index of Multiple Deprivation, meaning it is in the least deprived quintile of England (Ministry of Housing, Communities and Local Government, 2019). The MSOA had a COVID-19 mortality rate of 225 per 100,000 between 1st March 2020 and 31st July 2020 (Office for National Statistics, 2020).

Ealing 029 has a population of 11,525 (Office for National Statistics, 2020) and is ranked as the 5,371 most deprived MSOA on the Index of Multiple Deprivation, meaning it is in the most deprived quintile of England (Ministry of Housing, Communities and Local Government, 2019). The MSOA had a COVID-19 mortality rate of 208 per 100,000 between 1st March 2020 and 31st July 2020 (Office for National Statistics, 2020).

The MSOAs of Ealing 013 and Ealing 029 are split into four and seven Lower Super Output Areas (LSOAs) respectively. The Index of Deprivation ranks for each of these LSOAs are given in figure 6. The figure shows that Ealing 013 is less deprived across all indices, excluding the living environment rank. While Ealing 029 has higher levels of relative deprivation, especially concerning barriers to housing and services.

ONS geography LSOA Name	IMD Rank	Income Rank	Employment Rank	Education, Skills and Training Rank	Health Deprivation and Disability Rank	Crime Rank	Barriers to Housing and Services Rank	Living Environment Rank	Income Deprivation Affecting Children Index Rank	Income Deprivation Affecting Older People Rank
Ealing 013A	28190	27365	28860	32278	29701	19145	18143	8678	29355	21264
Ealing 013B	24028	19468	23081	32297	27261	15173	10605	17410	25737	13305
Ealing 013C	28128	31197	30278	32642	27778	22843	14438	6198	30123	30736
Ealing 013D	27738	28389	29439	32732	28224	24428	14907	6358	30983	21360
Ealing 029A	5527	4334	5755	10735	13612	19932	197	15043	8489	1310
Ealing 029B	2523	1546	3582	8020	14356	4281	153	9547	3968	869
Ealing 029C	3919	2510	3959	8418	11978	14437	724	12229	4131	991
Ealing 029D	5627	8454	7034	17574	10810	1763	463	10801	10347	6396
Ealing 029E	9484	11605	9251	18481	13820	16980	705	9790	16937	8687
Ealing 029F	5657	4587	5412	13506	16283	15510	139	14401	5040	5081
Ealing 029G	4859	5984	2802	11544	12033	7130	1016	17307	4397	8015

Figure 6 *Table showing the Index of Deprivation ranks for Ealing 013's four LSOAs and Ealing 029's seven MSOAs*

Ealing 013's population has a mean age of 41 (Office for National Statistics, 2020) and the ward in which it is located, Hanger Hill, is 46 per cent Christian and 19 per cent no religion. Hanger Hill is 32 per cent white British (O'Brien & Cheshire, 2016).

Ealing 029's population has a mean age of 36 (Office for National Statistics, 2020) and is mainly located in the ward of Norwood Green, which is 26 per cent Christian, 26 per cent Sikh and 23 per cent Muslim. The ward is only 15 per cent white British (O'Brien & Cheshire, 2016).

Pitshanger - Ealing 013

Shows the extensive amenities available, which serve to bolster community integration

The abundance of green space in Pitshanger park improves the quality of life of the residents

Figure 7 *Photograph showing Pitshanger Park, located in Ealing 013 © Andy Hill*

Ealing 013 is a majority Christian MSOA, and its two churches act as community centres

St. Barnabas Church has aims including reaching out to and serving the local community

Figure 8 *Photograph showing inside St Barnabas Church, located in Ealing 013 © Lee Bolton*

Roads are lined with trees and gardens are well maintained

No litter or vandalism likely as a result of effective council services

Neighbourhood watch area, implying a strong sense of community and perhaps a wariness of outsiders

Figure 9 *Google Maps Street View showing Pitshanger Lane, located in Ealing 013 © 2020 Google*

Norwood Green North & Windmill Park - Ealing 029

Figure 10 Photograph showing the River Brent, located in Ealing 029 © Uy Hoang

Shows the areas of Ealing 029 suffering from industrial decline, with infrastructure being graffitied

The MSOA also has considerable green space, improving the quality of life of the residents

The gurdwara cost £17.5 million to build and was funded by donations from members of the local Sikh community, demonstrating their commitment to community

In a bid to improve and advance the education of Sikh pupils, the gurdwara set up a new school – the Khalsa School

Figure 11 Photograph showing inside the Gurdwara Sri Guru Singh Sabha, located just outside Ealing 029 © Bhavesh Chauhan Photography

Figure 12 Google Maps Street View showing Bridge Road, located in Ealing 029 © 2020 Google

The cemetery (right, middle ground) will be associated with lower property value

The litter suggests an ineffective council rubbish collection service

Warehouses and vans imply that this part of Ealing 029 is not a desirable residential area

Data Collection

Methodology

The research will be divided into two main sections. The first section involves primarily quantitative data, including the Office for National Statistics COVID-19 death dataset and the Indices of Deprivation. This section will tackle the first research question. The second section will be mostly qualitative primary data collection, involving the differing perceptions of COVID-19 mortality rates, tackling the second and third research questions.

Due to the pivotal importance of the Indices of Deprivation, an outline of the factors it takes into consideration for each of its seven domains, and two supplementary indices (which are referred to as domains throughout this investigation) is provided below:

Figure 13 *Flow diagram summarising the statistical methods used to create the Indices of Deprivation 2019*

The Income Deprivation Affecting Children Index measures the proportion of all children aged 0 to 15 living in income deprived families. Family is used here to indicate a 'benefit unit', that is the claimant, any partner and any dependent children for whom Child Benefit is received (Ministry of Housing, Communities and Local Government, 2019). The Income Deprivation Affecting Older People Index measures the proportion of all those aged 60 or over who experience income deprivation (Ministry of Housing, Communities and Local Government, 2019). As explained above, both of these indices are supplementary to the Income Deprivation Domain.

Research Question	Methodology Overview	Data source	Type of Data	Use	Location	Sampling Strategy	Sampling Strategy Justification
To what extent do COVID-19 mortality rates correlate with relative deprivation in Greater London?	Compare rates of relative deprivation from the Index of Multiple Deprivation to its age-adjusted COVID-19 mortality rates per 100,000 residents between Middle Super Output Areas (MSOAs). Test for correlations using the Pearson product-moment correlation coefficient, having transformed data where necessary. Then use the Pearson product-moment correlation coefficient to investigate the strength of the correlation between an MSOA's nine Indices of Deprivation ranks and its age-adjusted COVID-19 mortality rate per 100,000 residents.	Index of Multiple Deprivation "All ranks, deciles and scores for the indices of deprivation, and population denominators" dataset	Quantitative; secondary	To calculate the Index of Multiple Deprivation rank and the nine Indices of Deprivation ranks of each of the 983 MSOAs in Greater London (the dataset gave the deprivation ranks of each of the 4,642 Lower Super Output Areas (LSOAs) in Greater London, so these were compiled into unweighted MSOA means)	Greater London + Pilot study in The Borough of Reading	Systematic + pragmatic	**Systematic:** Almost every single MSOA in Greater London will be sampled as the data is readily available, and a larger sample size allows more statistically significant results. **Pragmatic:** A few (3%) of the MSOAs do not have COVID-19 mortality data or population estimates available from the ONS so these MSOAs will not be sampled.
		Office for National Statistics "Deaths involving COVID-19 by local area and socioeconomic deprivation: deaths occurring between 1 March and 31 July 2020" dataset	Quantitative; secondary	To calculate the mortality rate of each MSOA in Greater London (To ensure the data for COVID-19 mortalities is available and accurate, only mortality data for the period 1st March 2020 to the 31st July 2020, and registered by 15th August 2020, will be considered)			
		Office for National Statistics "Middle Super Output Area population estimates" dataset + Office for National Statistics "Deaths involving COVID-19, England and Wales" dataset	Quantitative; secondary	To standardise the population and thereby produce an age standardised (against England's COVID-19 death rates between 1st March and 30th June 2020) mortality rate per 100,000 statistic for each MSOA			
To what extent does the perception of COVID-19 mortality rates vary with deprivation?	Use a questionnaire survey of 420 households in a deprived MSOA and a further 420 households in an affluent MSOA to investigate their perception of COVID-19 mortality rates. Although the data collected will be quantitative, the dataset will most likely be too small to give statistically significant results; hence the data will probably have to be analysed qualitatively, without the use of statistical tests.	Blinded questionnaire survey of 420 households in an affluent MSOA and 420 households in a deprived MSOA with a minimum required response of 25 per MSOA (see Data Appendix for an example survey request and survey)	Qualitative + quantitative questions; primary	To compare the perceptions of COVID-19 risk across differing levels of deprivation	Pitshanger (Ealing 013) as the affluent MSOA and Norwood Green North & Windmill Park (Ealing 029) as the deprived MSOA + Pilot questions on friends and teachers	Stratified + random + systematic + convenience	**Stratified:** Both of the MSOAs will be split into their LSOAs, of which Pitshanger had four, and Norwood Green North & Windmill Park had seven. Equal samples from each of these LSOAs will be taken. This is because the Index of Multiple Deprivation for entire MSOAs is an unweighted average of their LSOA's deprivation ranks. Thus, to ensure the results were accurate, the questionnaire survey also needs to take equal sample sizes from these LSOAs. **Random:** Within each LSOA, four streets will be chosen at random (using a random number generator) to sample. This is done to save time whilst also ensuring that the sampling is not subject to bias. **Systematic:** Along each street, an equal number of houses will be sampled (21 per street in Pitshanger and 15 per street in Norwood Green). The houses to be sampled will be chosen systematically (e.g. every third house) to eliminate bias. **Convenience:** If access to a house is difficult, potentially dangerous, or the house appeared unoccupied, the nearest possible house will be sampled instead.
		Index of Multiple Deprivation "All ranks, deciles and scores for the indices of deprivation, and population denominators" dataset	Quantitative; secondary				
		Photographs from Google Maps Street View of the selected MSOAs	Qualitative; secondary				
What other factors do Londoners perceive to influence COVID-19 mortality rates?	Use the above questionnaire survey to ask an open-ended, qualitative question about what other factors the respondents perceive to influence COVID-19 mortality rates. The responses will then be coded, allowing for a more in-depth analysis of the data.	Office for National Statistics "Deaths involving COVID-19 by local area and socioeconomic deprivation: deaths occurring between 1 March and 31 July 2020" dataset	Quantitative; secondary	To ensure the selected MSOAs had similar COVID-19 mortality rates per 100,000			
		Office for National Statistics "Middle Super Output Area population estimates" dataset	Quantitative; secondary				

Figure 14 *Table showing the methodology used to answer each research question*

Pilot Study

Figure 15 *Map showing national level overview of the location of Reading. Reading is identified by a red pushpin symbol*

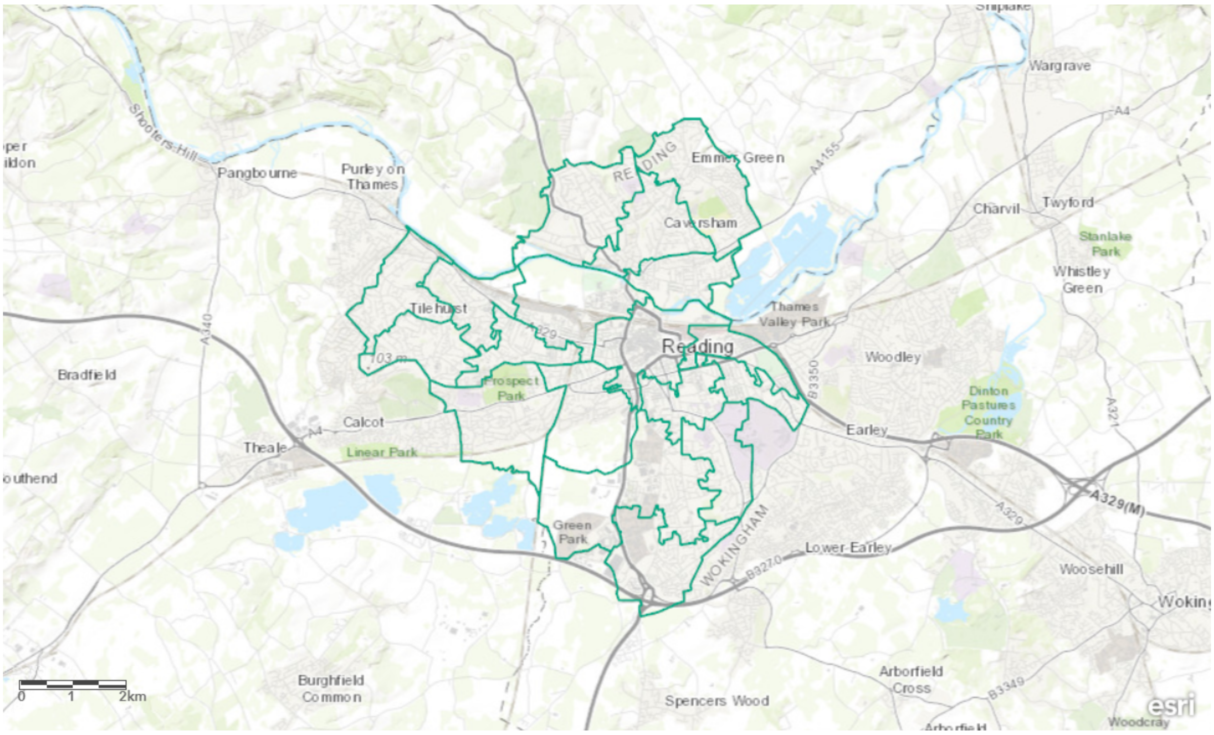

Figure 16 *Map showing regional location of Reading. The blue lines represent the boundaries of the Middle Super Output Areas in Reading*

This pilot study's research area is The Borough of Reading, a large, historic market town in the Royal County of Berkshire. The town saw 806 cases of COVID-19 in the months March through July, resulting in 165 COVID-19 related mortalities. There were also 441 'non-COVID-19' mortalities in the period.

Reading was chosen for the pilot study due to its relatively small population of 162,000, making data manipulation and statistical calculation easier. The town is divided into 18 MSOAs that have a median of 90 mortalities from COVID-19 per 100,000 individuals.

Using the Pearson product-moment correlation coefficient to find the correlation between the number of COVID-19 deaths per 100,000 in each MSOA and their average rank on the Index of Multiple deprivation revealed a weak negative correlation between the variables, $r(16) = -0.223$, $p = 0.375$ (complete working can be found in appendix 4). This result is as expected and matches with the evidence presented in the literature review.

The main problem resulting from the data analysis was the low level of statistical significance between the variables. This does not imply there is no significant correlation between the variables, just that there were too few data points to produce the required statistical significance. This is problematic as the investigation requires a comparison of the extent of the correlation of the different Indices of Deprivation, and this can only be done if the data is statistically significant.

Because of this issue, London was chosen as the main study site for the investigation as the high number of data points avaliable means that reliable conclusions can be drawn even from weak correlations.

The questionnaire survey to be conducted for research questions two and three of the investigation was trailed to ensure that the questions were easily understandable, sensitive, and suitable. However, this did not need to be done on a formal representative sample. Instead, the survey was trailed on a group of volunteers, including family members and friends. The trial revealed that some of the questions needed to be worded more clearly and that one of the questions was difficult to answer on a mobile phone. The questions were reworded and reformatted in line with these findings.

Risk Assessment

Risk	Description	Without Mitigations: Likelihood	Without Mitigations: Severity	Without Mitigations: Score	Mitigations	With Mitigations: Likelihood	With Mitigations: Severity	With Mitigations: Score	Managing the Risk
COVID-19	Becoming infected with SARS-CoV-2 and potentially passing it on to others whilst doing fieldwork	4	5	20	Do not visit MSOAs with over 25 cases in the last seven days; wear a facemask for all interactions with the public; do not use public transport; do not mix with anyone outside my household; follow government advice for "Tier 2: high" COVID-19 restrictions (18/10/2020); avoid busy spaces; monitor self for symptoms after completing fieldwork; wash hands regularly	1	3	3	Continue to manage
Driving	Being involved in a traffic collision whilst going to or from the sites	3	4	12	Drive with caution at all time; have a responsible adult in the car; avoid potentially dangerous roads	1	4	4	Continue to manage
Traffic	Being hit by road traffic while posting surveys	3	3	9	Avoid busy roads; be alert of surrounding traffic at all times; cross roads safely; keep a first aid kit in the car	2	3	6	Continue to manage
Crime	Being the victim of a criminal act	3	4	12	Avoid areas with the worst crime ranks on the Indices of Deprivation; be with a responsible adult at all times; be respectful of others; be prepared to seek help	2	3	6	Continue to manage
Access	Dangerous or difficult access to the front door of a property	5	3	15	If access is difficult, use convenience sampling and sample a nearby accessible property; be respectful of peoples property and attitudes; do not post surveys through doors with “No Junk Mail” signs	2	2	4	Continue to manage
Weather	Dangerous weather conditions making driving or walking unsafe	4	2	8	Check the likely weather conditions in advance using BBC Weather; do not go if weather conditions are too poor on the day; plan ahead and bring suitable gear	2	1	2	Continue to manage

Figure 17 *Table showing the risk assessment. The scores given are based of the guidelines set out in appendix 1. The investigation was deemed safe enough to go ahead*

Ethical and Socio-political Considerations

Consideration	Mitigation
The words "death" or "dying" causing adverse reactions, especially given the contemporary nature of the topic	Still use the words "death" and "dying" in the survey as others, such as "mortality", may not be understood; ask survey questions in a sensitive manner; make all the survey questions optional; tell people that if the question makes them feel uncomfortable, they should skip it; in the actual report, use the terms "mortality" or "fatality"
Respondents to the questionnaire, especially from deprived areas, may have challenges in accessing the survey due to lack of technology	Give the option of finding the questionnaire using either a Quick Response (QR) code or a URL; expect fewer responses from deprived areas
Respondents to the questionnaire, especially from deprived areas, may have challenges in accessing the survey due to language difficulties	Always use simple and accessible language; offer a "not sure" option; make all the questions optional
Respondents to the questionnaire may take offence if their area of residence is negatively portrayed	Avoid describing any areas in informal terms; use official UK government terminology to describe areas; avoid discussing the deprivation status of an area with its residents
People may react adversely to me placing something through letterboxes given the danger of COVID-19	Be respectful of their opinions; be respectful of their personal space; avoid being within two meters of them; wear a face covering (mask); do not post surveys through doors with "No Junk Mail" signs
People may react negatively to me posting questionnaire through their letterboxes in the early morning	Do not start before posting surveys before 8 am; try to be quiet when opening and closing letterboxes
Respondents to the questionnaire may be concerned over the use and safety of their data	Ensure the questionnaire clearly states that their data will be completely anonymous and only used in the context of this project; do not ask for personal details such as names or addresses in the survey; do not share the data with anyone else; protect the data behind a password
People may not want to appear in photographs used for the project	Avoid using photographs containing people; blur out any faces to ensure anonymity
Need to properly attribute any material used in the project, including photographs and other literature	Use a bibliography to reference all literature; give suitable copyright credit for photographs; avoid any material that doesn't provide a copyright licence

Figure 18 *Table showing ethical and socio-political considerations*

Data Presentation

To what extent do COVID-19 mortality rates correlate with relative deprivation in Greater London?

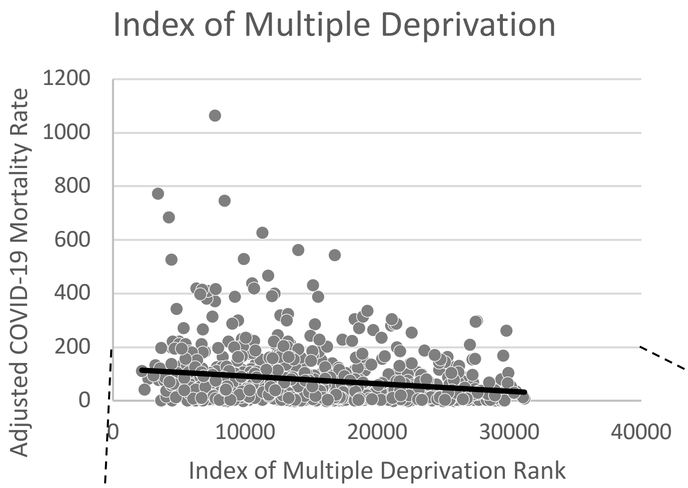

Figure 19 *Scatter graph showing the correlation between the Adjusted COVID-19 Mortality Rate (ACMR) and the Index of Multiple Deprivation (where a low value indicates a higher deprivation) Rank of MSOAs in Greater London. The black line represents the linear regression between the variables*

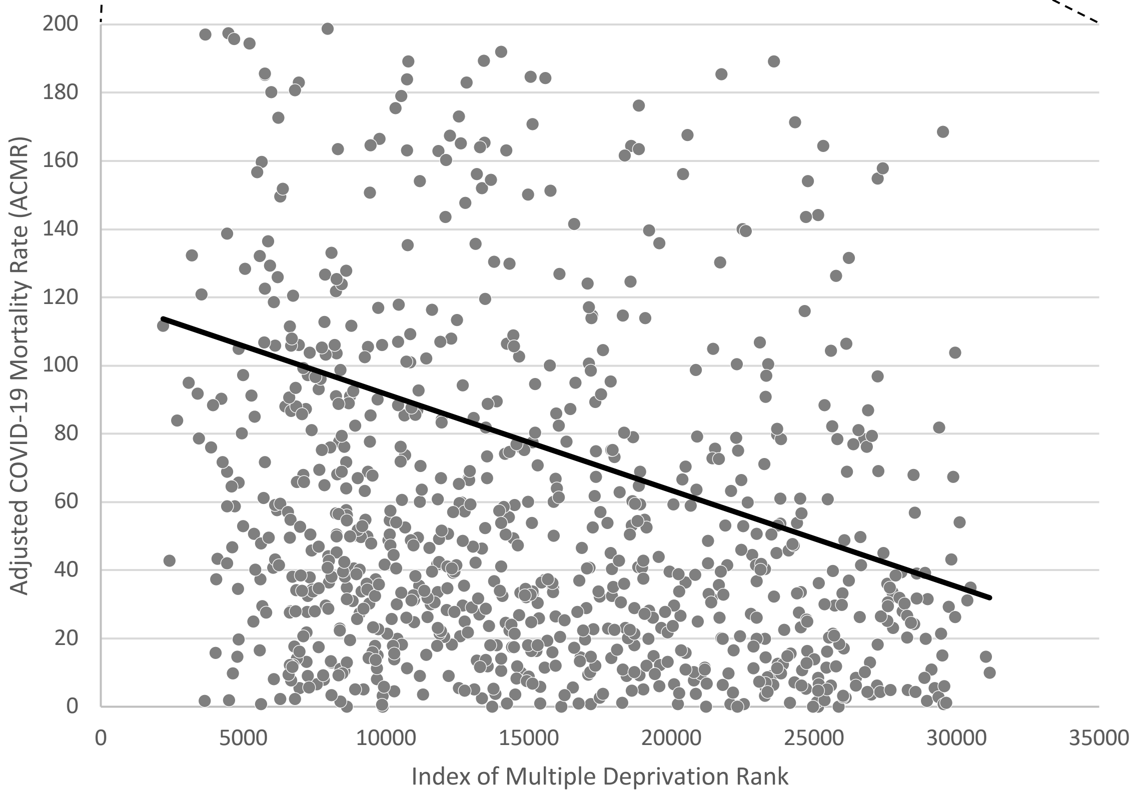

Figure 20 *Scatter graph showing the correlation between the ACMR and the IMD Rank for MSOAs in Greater London. The black line represents the linear regression between the variables. Only MSOAs with a ACMR below 200 per 100,000 (92% of them) are shown*

Figure 21 *Scatter graphs showing the correlation between the ACMR and the nine domains of deprivation (where a low value indicates a higher deprivation) for MSOAs in Greater London. The black lines represent the linear regression between the variables. Only MSOAs with a ACMR below 200 per 100,000 are shown. Green = correlation, yellow = weak correlation, red = no correlation*

To what extent does the perception of COVID-19 mortality rates vary with deprivation?

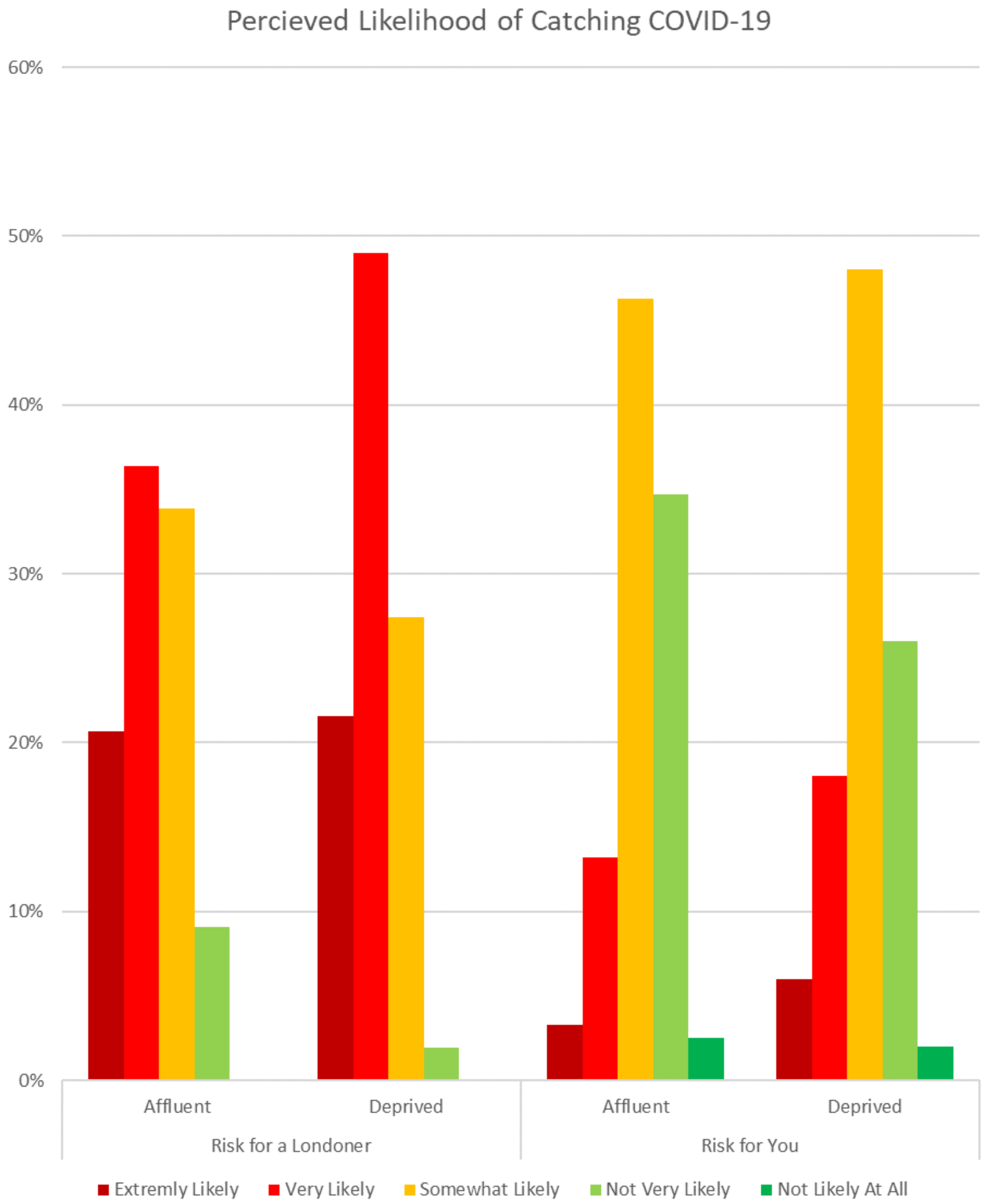

Figure 22 *Clustered bar chart showing the perceived risk of catching COVID-19 for a resident of Greater London and the respondent themselves. The chart is based on the 343 responses to questions 5 and 7 of the questionnaire survey (see appendix 3). The data for the affluent area is from Ealing 013 (least deprived quintile of England) and the data for the deprived area is from Ealing 029 (most deprived quintile of England)*

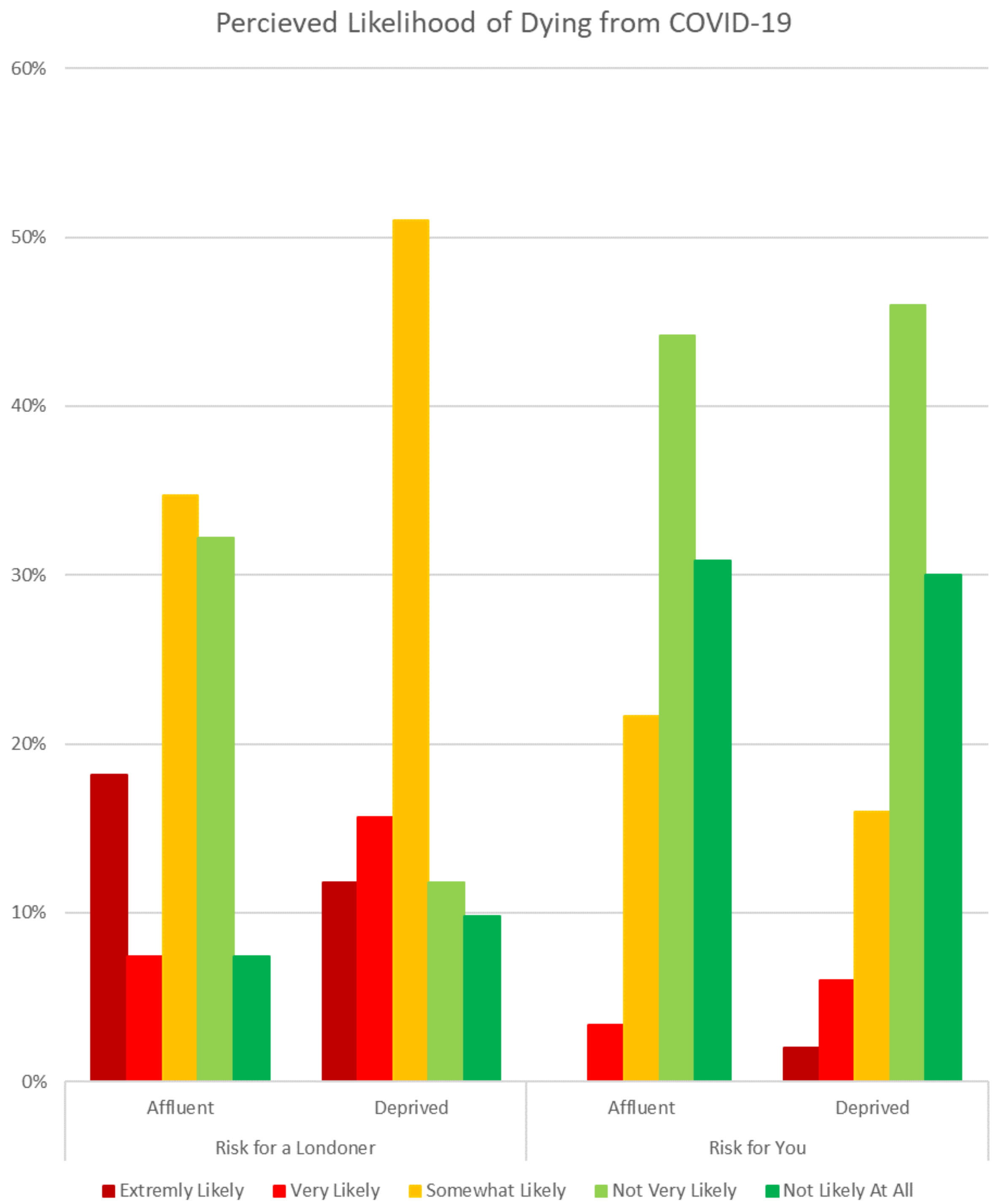

Figure 23 *Clustered bar chart showing the perceived COVID-19 mortality risk for a resident of Greater London and the respondent themselves. The chart is based on the 342 responses to questions 6 and 8 of the questionnaire survey (see appendix 3). The data for the affluent area is from Ealing 013 (least deprived quintile of England) and the data for the deprived area is from Ealing 029 (most deprived quintile of England)*

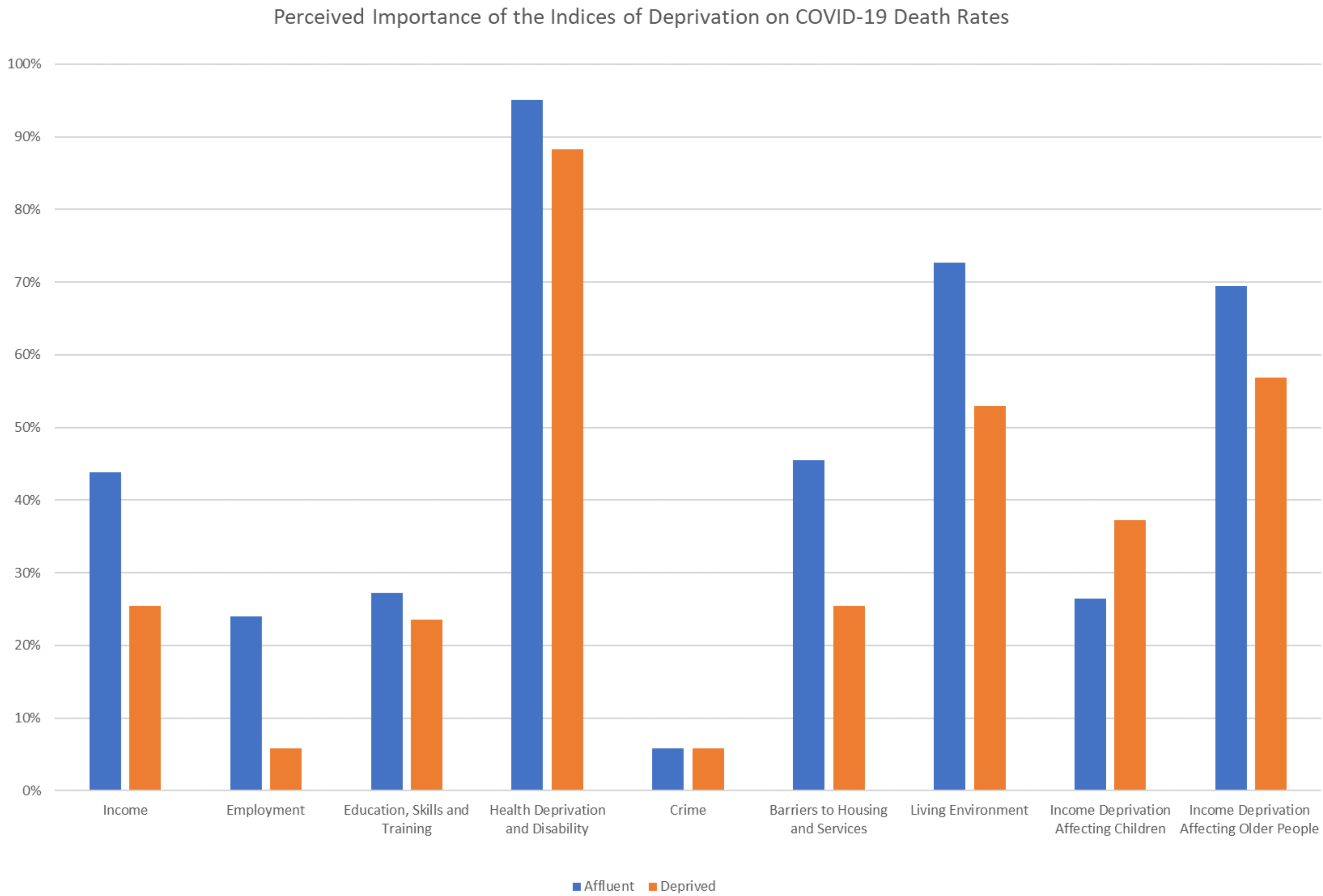

Figure 24 *Clustered bar chart showing the perceived importance of the Indices of Deprivation on COVID-19 mortality risk by deprivation level. The chart is based on the 172 responses to question 9 of the questionnaire survey (see appendix 3). The category names were reworded in the questionnaire survey in order to ensure they conveyed the actual meaning of the index. The rewordings can be found in question nine of appendix 3. The data for the affluent area is from Ealing 013 (least deprived quintile of England) and the data for the deprived area is from Ealing 029 (most deprived quintile of England)*

Actual Ranking of Correlations	Affluent Ranking of Influence	Deprived Ranking of Influence	Affluent Accuracy	Deprived Accuracy
Barriers to Housing and Services	Health Deprivation and Disability	Health Deprivation and Disability	5	5
Income	Living Environment	Income Deprivation Affecting Older People	7	2
Employment	Income Deprivation Affecting Older People	Living Environment	1	6
Income Deprivation Affecting Older People	Barriers to Housing and Services	Income Deprivation Affecting Children	3	3
Education, Skills and Training	Income	Barriers to Housing and Services	3	4
Health Deprivation and Disability	Education, Skills and Training	Income	1	4
Income Deprivation Affecting Children	Income Deprivation Affecting Children	Education, Skills and Training	0	2
Crime	Employment	Employment	5	5
Living Environment	Crime	Crime	1	1
		Mean Accuracy:	2.9	3.6

Figure 25 *Table showing the accuracy of the perceived importance of the Indices of Deprivation on COVID-19 mortality risk by deprivation level, compared to the indices' actual correlation with ACMRs across Greater London's 951 MSOAs. Accuracy is defined as the number of positions between the perceived ranking and the actual ranking, where a lower value indicates higher accuracy. The category names were reworded in the questionnaire survey in order to ensure they conveyed the actual meaning of the index. The rewordings can be found in question nine of appendix 3. The chart is based on the 172 responses to question 9 of the questionnaire survey (see appendix 3) and the levels of correlation calculated in appendix 4. The data for the affluent area is from Ealing 013 (least deprived quintile of England) and the data for the deprived area is from Ealing 029 (most deprived quintile of England)*

What other factors do Londoners perceive to influence COVID-19 mortality rates?

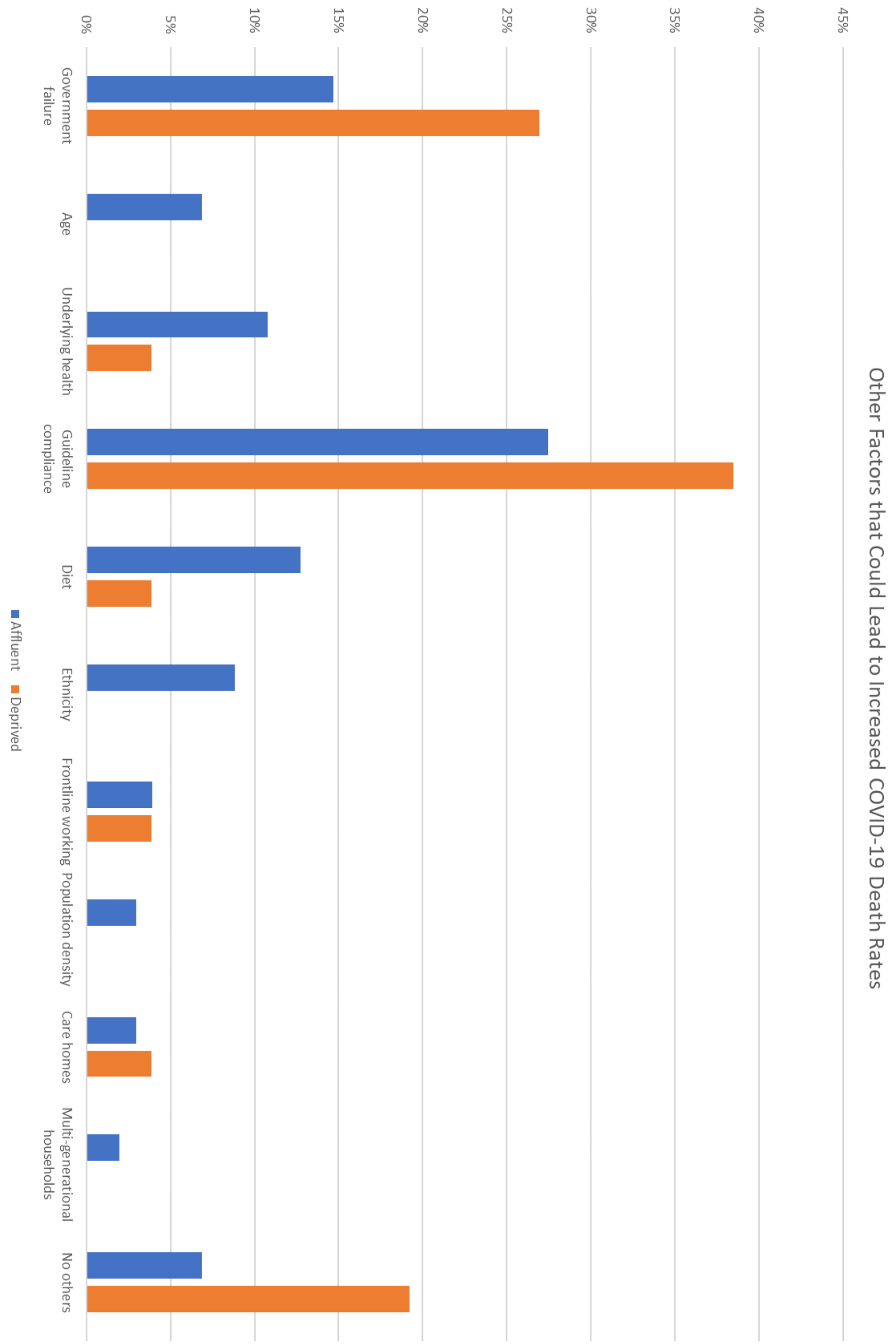

Figure 26 *Clustered bar chart showing the perceived importance of other factors on COVID-19 mortality risk by deprivation level. The chart is based on the 128 responses given to question 10 of the questionnaire survey (see appendix 3). The survey question was open ended and the responses have been coded. Only responses which were given by more than one respondent are shown. The data for the affluent area is from Ealing 013 (least deprived quintile of England) and the data for the deprived area is from Ealing 029 (most deprived quintile of England)*

Data Analysis

Statistical Tests

X Variable	Y Variable	PMCC	P value	Significance	Conclusion
Index of Multiple Deprivation	ACMR	-0.205	<0.001	Significant	Sufficient evidence to say that The Index of Multiple Deprivation and the ACMR are negatively correlated
Income	ACMR	-0.204	<0.001	Significant	Sufficient evidence to say that the Income Rank and the ACMR are negatively correlated
Employment	ACMR	-0.204	<0.001	Significant	Sufficient evidence to say that the Employment Rank and the ACMR are negatively correlated
Education, Skills and Training	ACMR	-0.164	<0.001	Significant	Sufficient evidence to say that the Education, Skills and Training Rank and the ACMR are weakly negatively correlated
Health Deprivation and Disability	ACMR	-0.159	<0.001	Significant	Sufficient evidence to say that the Health Deprivation and Disability Rank and the ACMR are weakly negatively correlated
Crime	ACMR	-0.125	<0.001	Significant	Sufficient evidence to say that the Crime Rank and the ACMR are weakly negatively correlated
Barriers to Housing and Services	ACMR	-0.234	<0.001	Significant	Sufficient evidence to say that the Barriers to Housing and Services Rank and the ACMR are negatively correlated
Living Environment	ACMR	-0.027	0.408	Insignificant	Insufficient evidence to say that the Living Environment Rank and the ACMR are correlated
Income Deprivation Affecting Children	ACMR	-0.157	<0.001	Significant	Sufficient evidence to say that the Income Deprivation Affecting Children Index Rank and the ACMR are weakly negatively correlated
Income Deprivation Affecting Older People	ACMR	-0.179	<0.001	Significant	Sufficient evidence to say that the Income Deprivation Affecting Older People Rank and the ACMR are weakly negatively correlated

***Figure 27** Table showing statistical tests for data answering the first research question. The full workings are shown in appendix 4*

The use of Pearson's product-moment correlation coefficient in the above statistical tests is justified by the manipulation of the Indices of Deprivation ranks that occurred before the tests were done. This transformation meant that the data was considered to be interval, instead of being ordinal. Thus, the data satisfied the parametric test assumptions, and hence the PMCC statistical test was appropriate. Furthermore, the practical difficulties of ranking the 951 Middle Super Output Areas (MSOAs) over the ten required indices meant that using Spearman's rank correlation coefficient was deemed to be impractical.

To what extent do COVID-19 mortality rates correlate with relative deprivation in Greater London?

Index of Multiple Deprivation Rank

As the results presented in figures 19 and 20 show, the Index of Multiple Deprivation ranks of London's 951 Middle Super Output Areas have a significant negative correlation with their Adjusted Covid-19 Mortality Rates between March and July 2020, $r(949) = -0.205$, $p < 0.001$. This level of this correlation means that we can reliably conclude that COVID-19 mortality rates correlate with relative deprivation to a significant extent.

This finding is in agreement with the existing literature, as explored in the literature review. Most notably, the Office for National Statistics analysis of the data for the entirety of England (figure 1) concluded that the mortality rate in the most deprived areas in England was 2.2 times the mortality rate in the least deprived areas (Office for National Statistics, 2020).

However, the correlation's potential reasons cannot reliably be concluded upon by merely analysing this composite, though revealing, IMD statistic. Instead, we must examine the data for the individual Indices of Deprivation (figures 21 and 27), which will be done below.

Income Rank & Employment Rank

The income rank and the employment rank for an MSOA measure the number of residents relying on various forms of the United Kingdom's benefits systems. Hence, it is perhaps unsurprising that the two ranks show a similar significant negative correlation with an MSOA's ACMR, $r(949) = -0.204$, $p < 0.001$. These are the joint (to three decimal places) second-highest correlations of all the Indices of Deprivation, with only the barriers to housing and services index seeing a higher correlation level.

This pattern is potentially because those with little to no income will be unable to choose to safely work from home, instead often taking up any employment opportunities available. This inequity means that these individuals will more often end up working in public-facing professions, where their risk of being exposed to COVID-19 is higher, intrinsically increasing their mortality risk (Public Health England, 2020).

Income and employment are also likely to be the primary determining factors in an MSOA's rank on the other Indices of Deprivation, influencing factors including overcrowding, disability prevalence and health status (Chaturvedi, 2020). This effect could mean that the income and employment rank only correlate with the other ranks and do not necessarily directly impact mortality rates.

Education, Skills and Training Rank

The education, skills and training rank shows a medium strength of significant correlation with MSOAs' ACMRs across Greater London $r(949) = -0.164$, $p < 0.001$.

This correlation could be due to those receiving a higher quality education having increased awareness of government restrictions because of their increased interaction with reliable media. It is also likely that those with higher education levels will follow the government guidelines more closely, resulting in lower transmission rates. Moreover, those with little to no knowledge of the English language (English language proficiency is part of the index's measurement) may have difficulty understanding some of the nuanced and constantly adapting restrictions, potentially increasing their exposure, and subsequent mortality, risk.

Health Deprivation and Disability Rank

The correlation between this index of deprivation, and the ACMR across Greater London's MSOAs, was unexpectedly low, $r(949) = -0.159$, $p < 0.001$, though still highly significant.

The literature review concluded that the health deprivation and disability rank would likely have the highest correlation with the ACMRs as individuals with underlying health conditions were frequently cited as most at risk of dying from COVID-19. It was found that of the 33,841 deaths that occurred in March and June 2020 involving COVID-19 in England and Wales, 30,577 (90.4%) had at least one pre-existing condition, while only 3,264 (9.6%) had none (Office for National Statistics, 2020).

The unexpectedly low correlation is difficult to explain; however, one potential reason could be that the rank is not as closely correlated with the prevalence of underlying health conditions as the name initially suggests.

The rank takes into account four indicators: years of potential life lost; the comparative illness and disability ratio; acute morbidity (rate of emergency admission to hospital); mood and anxiety disorders (rate of adults suffering from mood and anxiety disorders, hospital episodes data, suicide mortality data and health benefits data) (Ministry of Housing, Communities and Local Government, 2019). Although the comparative illness and disability ratio would be expected to correlate closely to the incidence rate of underlying health conditions, the other three ranks would not necessarily align so closely. The acute morbidity indicator would most likely only reflect shorter-term health conditions. The years of potential life lost indicator only measures actual premature mortality and does so across all causes, including likely unrelated causes such as road traffic incidents. Furthermore, there is no known link between mood and anxiety disorders and COVID-19 mortality rates.

The misnomer of the health deprivation and disability rank in this context is one plausible reason for the lower correlation than might be expected. However, further research would need to be done to test the validity of this claim.

Crime Rank

Figures 21 and 27 show that the crime rank has the lowest correlation out of the eight Index of Deprivation ranks significantly correlated with the ACMRs, $r(949) = -0.125$, $p < 0.001$.

This evidence implies that the index is probably only correlated with ACMRs due to its correlation with the other Indices of Deprivation, as hypothesised in the literature review. This was hypothesised as no evidence has ever suggested that increased crime rates could have anything other than a negligible impact on SARS-CoV-2 transmission rates or COVID-19 mortality rates.

Barriers to Housing and Services Rank

Barriers to housing and services showed the highest correlation, $r(949) = -0.234$, $p < 0.001$, with ACMRs across Greater London's MSOAs. This result was somewhat unexpected, with the health deprivation and disability rank initially hypothesised to see the highest correlation level.

Factors measured by the barriers to housing and service rank fall into two categories, geographical barriers and wider barriers.

Geographical barriers describe the road distance to essential services, including GP surgeries, supermarkets, primary schools and post offices. Instinctively, one might suggest that road distance to a GP surgery would be the most influential of these factors. However, the National Health Service's advice to people with suspected symptoms of SARS-CoV-2 to call NHS 111 and not to go to their GP surgery, pharmacy or hospital (United Kingdom National Health Service, 2020) means that this should be inconsequential over COVID-19 mortality rates (though it probably will increase mortality rates from other causes). The road distance to other services may have some impact, as individuals that have to travel further to access these essential services will be exposed to more potential carriers of the virus, especially if they rely on public transport. This could lead to an increased chance of mortality, though this increased risk's presumable effect would not account for the high level of correlation seen.

On the other hand, the second stratum of barriers to housing and services, wider barriers, can provide a credible explanation for the high correlation level. The most notable factor in this category is household overcrowding. This is because, as outlined in the contextualisation of the investigation, airborne transmission of SARS-CoV-2 can occur in poorly ventilated indoor spaces, particularly if individuals are in the same room together for an extended time (Public Health England, 2020). This evidence means that household overcrowding will be highly influential over the transmission rate of SARS-CoV-2 and therefore increase the mortality rate in the MSOA. Furthermore, the stratum also measures housing affordability. If houses are less affordable and overcrowded, there is an increased chance that a household will be multigenerational, thus substantially increasing the likelihood of transmission to older and more vulnerable individuals who have a naturally higher mortality rate (Public Health England, 2020) (Haroon, et al., 2020). The final factor measured in the wider barriers stratum is homelessness, which could also lead to increased exposure to the virus and provide insurmountable difficulties if an individual must self-isolate, likely increasing the mortality risk.

Living Environment Rank

The only index not to see a significant negative correlation with ACMRs across Greater London's MSOAs was the living environment rank, $r(949) = -0.027$, $p = 0.408$. This is a significant result as the living environment rank has a significant positive correlation with all of the other indices of deprivation (except for the education skills and training rank, with which shows no significant correlation, $r(949) = -0.049$, $p = 0.129$) and the Index of Multiple Deprivation, $r(949) = 0.422$, $p < 0.001$. Hence the lack of negative correlation between the living environment rank and the ACMRs could imply that the correlation is positive, that a 'more deprived' living environment may result in higher COVID-19 mortality rates, though there are other plausible explanations.

The lack of a clear correlation is a surprising and unexpected result especially given that some of the indicators measured by the index, such as road traffic pollution, would be expected to result in higher COVID-19 mortality rates (Pozzer, et al., 2020).

Income Deprivation Affecting Children Index Rank & Income Deprivation Affecting Older People Rank

Income Deprivation Affecting Older People shows a significantly stronger negative correlation, $r(949) = -0.179$, $p < 0.001$, than Income Deprivation Affecting Children, $r(949) = -0.157$, $p < 0.001$. This is in line with the existing literature on the topic which, as outlined in the literature review, suggests that older individuals are more likely to be at risk of dying from COVID-19 due to a higher prevalence of underlying health conditions and a weaker immune system (Public Health England, 2020).

The correlations themselves can be explained by the same reasoning applied to the income rank and employment rank.

To what extent does the perception of COVID-19 mortality rates vary with deprivation?

The results of the survey questions five through nine displayed revealing trends in Londoners' perception of COVID-19 mortality rates, and how these perceptions varied with deprivation, as shown in figures 22, 23 and 24.

The deprived sample respondents believed a Londoner was both slightly more likely to catch SAS-CoV-2, and slightly more likely to die from COVID-19 than the respondents from the affluent sample believed. This trend held for the respondents perceived risk to themselves, though it was less significant. This trend was despite the affluent population having a marginally higher mortality rate than the deprived population (225 and 208 per 100,000, respectively (Office for National Statistics, 2020)). The affluent sample also had an estimated age of 50, 18 years older than the deprived sample. It is challenging to hypothesise what may have influenced this trend. However, it is possible that the respondents from the more deprived sample area correctly identified that more deprived individuals do have a higher mortality rate, while the individuals living in the more affluent sampling area correctly identified that they were at less risk (see the first research question for analysis of the correlation between deprivation and age-adjusted COVID-19 mortality rates).

Figures 22 and 23 also show that both affluent and deprived respondents believed the risk of dying from COVID-19 for other Londoners to be much greater than the risk to themselves. This result held for their perceived likelihood of catching SARS-CoV-2. While this finding may be due to the respondent's responses not being age-adjusted, it could also be caused by a psychological contrast between the news of tens of thousands of COVID-19 deaths juxtaposing with their own experience of the epidemic, since they perhaps do not personally know anybody that has died from the disease. Over 70% of the respondents stated that they did not personally know anybody who had died from the disease.

The notable anomaly to the otherwise bell-shaped distribution curves of the responses shown in figures 22 and 23 is the affluent sample's perceived likelihood of a Londoner dying from COVID-19. Here, the respondents more frequently identified the risk of a Londoner dying from COVID-19 as being "extremely likely" than they reported it to be "very likely". The high number of responses received (121 for this question) rule out the possibility of this anomaly being due to insignificant data, instead suggesting that another factor has influenced their perception. The other factor could be the affluent sample's likely increased media interaction over the deprived sample, as set out in the literature review. Their increased interaction with the news and other forms of media could lead to them having an unexpectedly high perception of the risk of COVID-19 mortality, as they are more exposed to the images and stories of those that have died from COVID-19, even if they do not personally know anybody who has died.

Figure 24 shows Londoner's perceived importance of the individual Indices of Deprivation on COVID-19 mortality risk. The figure shows that respondents from the affluent sample identified more of the Indices of Deprivation as influential over COVID-19 mortality rates than respondents from the deprived sample. In the affluent sample, the mean number of factors identified was 4.1 (out of a maximum of nine), the median was 4.0, and the mode was also 4.0. In the deprived sample, the mean number of factors identified was 3.2, the median was 3.0, and the mode was 1.0. This trend is in line with the evidence presented in the literature review, which hypothesised that the respondents from the affluent area would suggest more reasons that could be influencing COVID-19 mortality rates than those from the deprived sampling area due to their increased media interaction.

The only exception to the general trend of the affluent sample more frequently identifying each index was the Income Deprivation Affecting Children Index. Only 26 per cent of the affluent sample perceived the factor as influential on COVID-19 mortality rates, compared to 37 per cent of the deprived sample. This notable exception could be due to the affluent sample perceiving age to be a more influential factor than the individual's socioeconomic status. This theory is supported by the fact that 69 per cent of the affluent sample, compared to only 57 per cent of the deprived sample, believed the Income Deprivation Affecting Older People to be influential on an MSOA's ACMR.

The data presented in figure 25 suggests that the respondents from the affluent area, Ealing 013, were slightly more accurate in their perception of the importance of each of the Indices of Deprivation over COVID-19 mortality rates than the respondents from the deprived area, Ealing 029. Again, this supports the hypothesis that more affluent individuals will identify factors influencing COVID-19 mortality rates more accurately due to increased interaction with reliable sources of media (Helsper, 2017).

Living environment was the index least accurately placed by both the affluent and deprived samples, closely followed by the health deprivation and disability index and the employment index. On the other hand, the crime index was the most accurately placed index, with both the samples placing it as the second least influential factor over COVID-19 mortality rates.

The respondents overwhelmingly believed that the health deprivation and disability index (or "Personal Health" as it was phased in the questionnaire survey) was an influential factor over COVID-19 mortality rates. Ninety-five per cent of the affluent sample and 88 per cent of the deprived sample believed this to be so. This means that the respondents' perceptions fell in line with the hypothesis set out in the literature review, that the health deprivation and disability index would be the most influential factor. However, as explored in the first research question analysis, the health deprivation and disability index showed a lower correlation with an MSOA's ACMR than expected.

In contrast, only 5.8 per cent of the affluent sample and 5.9 per cent of the deprived sample perceived crime to influence COVID-19 mortality rates. Again, this supports the evidence presented in the literature review, which states that although it expects a correlation to exist between crime and ACMRs, it does not expect any form of causality link.

What other factors do Londoners perceive to influence COVID-19 mortality rates?

The questionnaire survey results (figure 26) show that Londoners believe that there is a multitude of other factors that also influence COVID-19 mortality rates. The respondents collectively identified thirteen categories of factors, with individual respondents linking as many as six factors to increased COVID-19 mortality rates.

A significant number, 19 per cent of the deprived sample and 6.9 per cent of the affluent sample, believed that no other factors influenced COVID-19 mortality rates beyond the ones covered by the Indices of Deprivation. Moreover, this figure is likely understated as only 41 per cent of the survey's respondents answered this open-ended question. This suggests that the respondents believed that the Indices of Deprivation provided reasonably comprehensive coverage of the factors that may correlate with, or influence, COVID-19 mortality rates.

A plurality of the sample that gave a response perceived the government's inadequate response to the epidemic and the public's failure to follow public health measures as causing higher COVID-19 mortality. Interestingly, individuals from the deprived sample area were far more likely to perceive this than those from the affluent sample area. One potential theory that could explain this stark difference is the link between deprivation and social trust.

In the National Centre for Social Research's 35th annual British Social Attitudes Survey, it was found that social trust, the confidence in the moral orientation or trustworthiness of our fellow citizens, in Britain was heavily influenced by education and socioeconomic status, as shown in figure 21 (Phillips, et al., 2018). This means that those in the deprived sample are hypothetically more likely to have a lower social trust level and, therefore, cite government incompetence or public negligence more often.

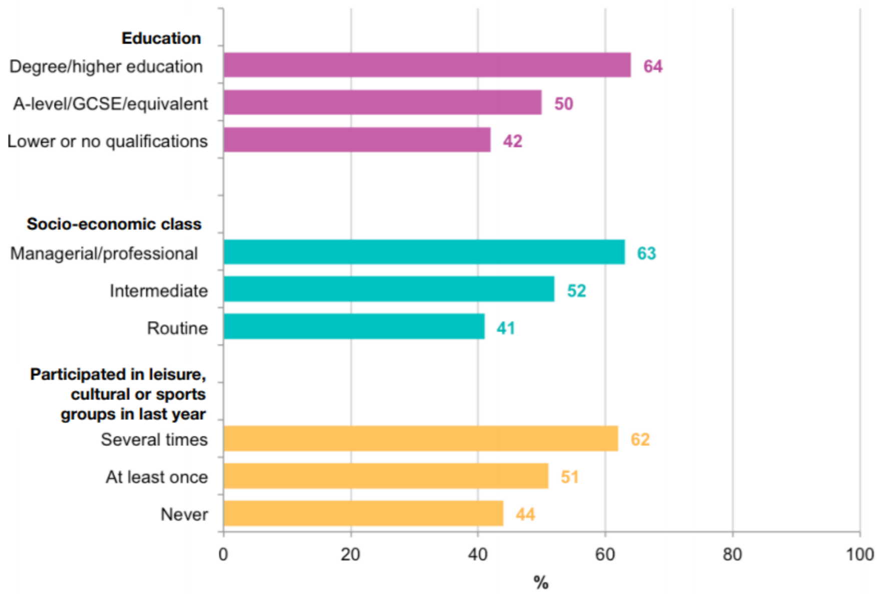

***Figure 28** Graph showing social trust, by education, socioeconomic class, and participation in leisure, cultural and sports groups (Phillips, et al., 2018)*

Interestingly, 8.8 per cent of respondents (or nine individuals) from the affluent sample perceived ethnicity as influencing COVID-19 mortality rates, while nobody from the deprived sample identified this potential factor. This result is surprising as the deprived population had a lower proportion of white British individuals than the affluent sample (15 per cent compared to 32 per cent) and being of non-white ethnic groups is correlated with increased COVID-19 mortality rates, as shown in figure 29.

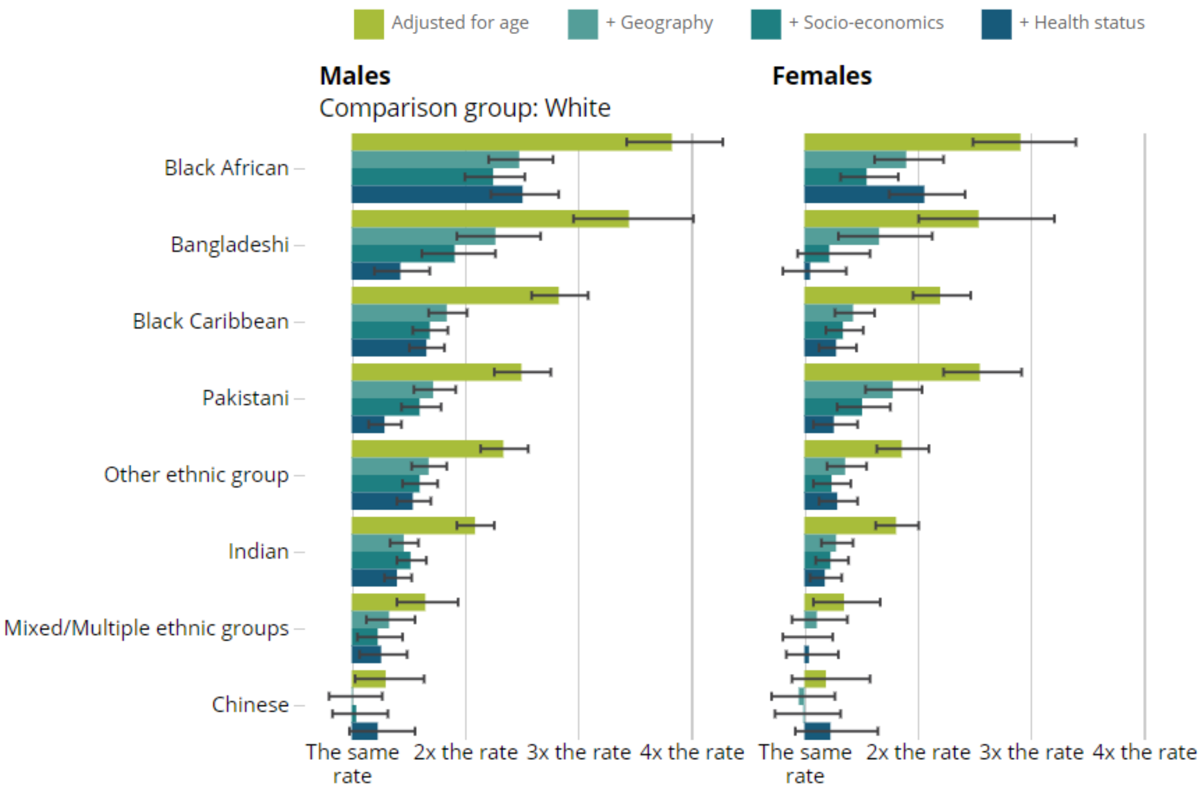

Figure 29 *Graph showing rate of death involving the coronavirus (COVID-19) by ethnic group and sex relative to the White population, England, 2 March to 28 July 2020. Non-overlapping error bars denote a statistically significant (p < 0.05) difference in prevalence (Office for National Statistics, 2020)*

A similar trend was observed for the number perceiving age as influential over COVID-19 mortality rates. 6.9 per cent of respondents (or seven individuals) from the affluent sampling area believed this to be true compared to nobody from the deprived area. This effect could be due to the affluent population had a higher mean age of 41 and the sample having an estimated mean age of 50, while the deprived population had a lower mean age of 31, and the deprived sample had a significantly lower estimated mean age of 32. However, it is perhaps more likely that the higher levels of education among affluent populations could result in them being able to link more factors, including age and ethnicity, to increased COVID-19 mortality rates.

Another factor respondents often cited as being influential over COVID-19 mortality rates was diet. Some of the respondents linked obesity with increased COVID-19 mortality rates, while others focused on low vitamin D levels' potential impact. Regarding obesity, numerous studies have shown it to influence COVID-19 outcomes negatively (World Obesity Federation, 2020). However, despite some misleading headlines from Britain's most highly circulated newspapers stating that a lack of vitamin D does lead to increased COVID-19 mortality rates (Metro, 2020) (The Sun, 2020) (Daily Mail, 2020), this theory has since been discredited by the British Medical Journal citing a lack of peer-reviewed evidence (BMJ, 2020).

The other factors commonly perceived to influence COVID-19 mortality rates included population density, multigenerational households, underlying health conditions (though the health deprivation and disability index somewhat covered this factor), occupation type and spread in care homes.

Conclusion

Summary

This investigation has explored the extent to which COVID-19 mortality rates and their perception correlate with relative deprivation in Greater London.

The investigation started by showing that COVID-19 mortality rates correlate with relative deprivation in Greater London. This was done by comparing the age-Adjusted COVID-19 Mortality Rates (ACMRs) of 951 of Greater London's Middle Super Output Areas (MSOAs) against their transformed Index of Multiple Deprivation rank and nine Indices of Deprivation ranks. This produced statistically significant negative correlations across all but one of these ranks, the living environment index, allowing us to conclude that relative deprivation and COVID-19 mortality rates correlate.

The ACMRs strongest correlation was with the barriers to housing and services rank, $r(949) = -0.234$, $p < 0.001$. This result was somewhat unexpected, with the health deprivation and disability rank initially hypothesised to see the highest correlation level. However, potential explanations for this trend included the index's dimensions of household overcrowding, housing affordability and the road distance to essential services. It was suggested that the reason for the health deprivation and disability rank's lower correlation, $r(949) = -0.159$, $p < 0.001$, could be that it was heavily weighted on shorter-term health-conditions and mental health issues which have not been shown to correlate with COVID-19 mortality rates, instead of longer-term underlying health conditions which do cause increased COVID-19 mortality rates (Public Health England, 2020). However, further research will be required to test the validity of this theoretical postulation.

Other hypotheses set out in the literature review regarding the correlation of the indices with the ACMRs saw considerable success. With results, such as the crime rank and the income deprivation affecting children rank, seeing the expected lower correlations and others, such as the income deprivation affecting older people rank and the income and employment ranks, seeing the anticipated higher correlations.

Next, the investigation explored the extent to which the perception of COVID-19 mortality rates varied with relative deprivation. This was done using a blinded questionnaire survey posted through the letterboxes of 420 households in Ealing 013, an MSOA in the most affluent quintile of England, and a further 420 households in Ealing 029, an MSOA in the most deprived quintile of England.

The sample populations had similar COVID-19 mortality rates, yet the samples showed substantial differences in their responses. Notably, the deprived sample identified that it had a higher average mortality risk than the affluent sample identified for itself, despite the blinded nature of the survey. This was a significant result as the affluent sample had a far higher mean age than the deprived sample, which would be expected to result in it perceiving its mortality risk to be higher. That this was not the case suggested that the responses were more influenced by the deprivation differential between the two samples than was hypothesised in the literature review.

The samples were also asked to select which of the Indices of Deprivation they believed may influence COVID-19 mortality rates. The more affluent sample identified a mean of 4.1 of the indices as influential, whereas the deprived sample identified a mean of 3.2 of the indices. Furthermore, the affluent sample was marginally more accurate in its ranking of the factors, as shown in figure 25. These results were in line with the literature cited in the literature review, hypothesising that the more affluent sample would identify more indices and do so more accurately due to their increased interaction with reliable news and other forms of media (Helsper, 2017).

Both of the samples overwhelmingly believed that the health deprivation and disability index was an influential factor over COVID-19 mortality rates, while neither of the samples believed crime to be an influential factor. This means that the respondents' perceptions largely matched the hypothesis set out in the literature review.

Finally, using the same questionnaire survey detailed above, this investigation explored other factors Londoners perceived to influence COVID-19 mortality rates. The respondents identified a total of 13 categories of factors that were not covered by the Indices of Deprivation. However, a significant number, 19 per cent of the deprived sample and 6.9 per cent of the affluent sample believed that no other factors influenced COVID-19 mortality rates, implying that the believed the Indices of Deprivation covered all potentially influential factors.

The deprived sample respondents most frequently cited the failure of Her Majesty's Government to manage the pandemic and the failure of the public to follow public health guidelines as reasons for increased COVID-19 mortality rates. The affluent sample also commonly identified these factors as influential, albeit less frequently, but also suggested other factors, including diet, ethnicity, and age, could be influential. The differences between these perceptions were theorised to be caused by higher levels of social trust among affluent populations and factors such as the respondents' age and education level.

Overall, this investigation has shown that relative deprivation does correlate with COVID-19 mortality rates in Greater London to a highly significant extent. The investigation has also demonstrated that there are meaningful differences across differing levels of deprivation in the perception of what influences COVID-19 mortality rates. Finally, the investigation uncovered some of the other critical factors that Londoners perceive to influence COVID-19 mortality rates.

In the wider geographical context, this investigation has shown that, at a microscopic level, diseases do discriminate by socioeconomic status, confirming the link between development and disease set out in the OCR specification. However, a broader analysis of national-level data would be required to investigate this finding in a global, macroscopic context.

Investigation Evaluation

The investigation evaluation will examine four critical areas of the project; the reliability of the data used, the strengths and weaknesses of the data collection methods, the validity of the conclusions drawn, and the investigation's ethical and socio-political dimensions.

First, most of the secondary datasets used throughout this investigation originated from the Office for National Statistics, including the absolute number of COVID-19 deaths by MSOA, the estimated population of each MSOA, and the Index of Deprivation (IoD) ranks by Lower Super Output Area (LSOA). The Office for National Statistics is considered a highly reliable and accurate source and is the United Kingdom's largest independent producer of official statistics and its recognised national statistical institute (legislation.gov.uk, 2018). Other secondary data used in this investigation included demographic data from the 2011 census and mapping data sourced from ArcGIS and Google Maps; all of these sources were evaluated on a case-by-case basis and found to be reliable.

The data collection methods used in the investigation were, on the whole, successful. Despite this, to further improve the investigation, multiple adjustments could be made. The first research question was answered entirely using ONS datasets, allowing for almost the entire population of Greater London's MSOAs to be sampled. However, due to what initially appeared to be issues with the COVID-19 mortality dataset, 32 (3.3 per cent) of Greater London's 983 MSOAs could not be sampled. This was described as pragmatic sampling in the methodology (figure 14). Nevertheless, the effect of this would have been relatively insignificant, as the MSOAs had varying levels of deprivation and were distributed evenly across Greater London, meaning the 951 MSOAs sampled were most likely representative of the population. Another potential issue with the population's representation for the first research question occurred when compiling the IoD ranks from the 4,642 LSOAs to the 983 MSOAs. This was done as an unweighted mean of all the ranks of the LSOAs in an MSOA. However, to reduce potential biases, the compilation should have been weighted by LSOA population size, which typically ranges from 1,000 to 3,000 people.

The second and third research questions used a primary questionnaire survey of 420 households in Ealing 013, an MSOA ranked in the least deprived quintile of England according to the Index of Multiple Deprivation, and a further 420 households in Ealing 029, an MSOA ranked in the most deprived quintile of England. The sampling method used was detailed in the methodology in figure 14 but involved stratified, random, systematic, and convenience sampling. This was highly successful in ensuring that the LSOAs, which had been weighted equally in the IoD ranks' compilation, were also equally represented in the sampled population. The chosen sampling methods also ensured that the fieldwork could be conducted within one morning, minimising the risks set out in the risk assessment while still reaching a representative sample of the population (figure 17).

Assessing the validity of the conclusions drawn requires a more in-depth evaluation, though it is worth noting that, where possible, all conclusions were drawn based on statistical significance.

The first research question used a large enough dataset that concluding with statistical significance was almost always possible. However, several statistical improvements could further add to the validity of the conclusions. Most importantly, the investigation should have utilised the raw IoD scores instead of the ranks. This amendment would have allowed for a comparison of absolute deprivation levels rather than relative deprivation levels, improving the validity of applying Pearson's product-moment correlation coefficient for the statistical tests. Secondly, the investigation could have correlated both COVID-19 mortality rates and mortality rates form all other causes with the IoD to uncover if the results for COVID-19 are more strongly correlated. The reasoning for not doing this was the Office for National Statistics had already carried out a similar analysis which, as presented in figure 1, suggested that the results for COVID-19 would be statistically significantly higher regardless. Finally, to further improve the validity of the conclusions drawn in research question one, it would have been useful to examine the extent to which the IoD ranks correlated to each other, potentially allowing for an increased distinction between correlation and causality.

Identifying statistically significant results was not an objective when conducting the questionnaire survey for questions two and three as it was initially assumed that there would be too few respondents to draw statistical significance from the results. However, due to the survey's success in attracting respondents, it would have been effective to include more quantitative questions that would better apply themselves to statistical tests. Such questions could have included asking respondents to estimate the COVID-19 mortality rates for an unspecified deprived and affluent area. When conducting the survey questionnaire, one challenge was conveying to the respondents in question nine (appendix 3) what the IoD domains measured. This challenge could be partly responsible for factors such as living environment and employment, being ranked inaccurately by the respondents (figure 25). This challenge was partially overcome by the rewording of some of the official IoD domain names. For example, the health deprivation and disability index was amended to "personal health". However, it is unlikely this solution entirely resolved the challenge. The validity of the conclusions drawn could also be improved by making statistical adjustments based on the background data collected in the questionnaire survey. This could include adjusting for gender, whether the respondent had contracted SARS-CoV-2 and did they personally know anybody who died from COVID-19. Although the investigation did allude to the samples' average age in a limited way during the analysis of research question three, further adjustments could improve the conclusions' quality and validity.

The final focus of the investigation evaluation is the analysis of the investigation's ethical and socio-political dimensions. Throughout the investigation, the ethical and socio-political considerations outlined in figure 18 have been fully and effectively implemented. The questionnaire survey, which most of the considerations pertained to, was successfully conducted, and all interactions with members of the public were positive. The number and quality of responses received also imply that the implemented ethical and socio-political considerations were thorough and extensive.

Overall, the investigation has successfully utilised reliable data sources and data collection methods allowing for valid conclusions to be drawn; this has meant that few weaknesses in the investigation have been identified, though some improvements have been suggested. Furthermore, the investigation's ethical and socio-political dimensions were found to have been successful and comprehensive.

Bibliography

Andersen, K. G. et al., 2020. The proximal origin of SARS-CoV-2. *Nature Medicine,* 26(4), pp. 450-452.

BMJ, 2020. Covid-19: Evidence is lacking to support vitamin D's role in treatment and prevention. *BMJ,* Volume 371.

Chaturvedi, P. N., 2020. *Poorest areas of England and Wales hit hardest by Covid-19 – ONS* [Interview] (12 June 2020).

Coronaviridae Study Group of the International Committee on Taxonomy of Viruses, 2020. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nature Microbiology,* Issue 5, p. 536–544.

Daily Mail, 2020. *Another study finds having a vitamin D deficiency could make you more likely to catch Covid-19.* [Online]
Available at: https://www.dailymail.co.uk/news/article-8814521/Having-vitamin-D-deficiency-make-likely-catch-Covid-19-study-claims.html
[Accessed December 2020].

Daszak, P. et al., 2020. *IPBES (2020) Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services,* Bonn: IPBES secretariat.

Elgot, J., 2020. Minister blames public for second English lockdown. *TheGuardian.com*, 5 November.

Haroon, S., Chandan, J. S., Middleton, J. & Cheng, K. K., 2020. Covid-19: breaking the chain of household transmission. *The BMJ,* 370(8258).

Helsper, E. J., 2017. The Social Relativity of Digital Exclusion: Applying Relative Deprivation Theory to Digital Inequalities. *Communication Theory,* 27(3), p. 223–242.

House of Commons Library, 2020. *House of Commons Library MSOA Names.* [Online]
Available at: https://visual.parliament.uk/msoanames
[Accessed October 2020].

Jones, K. E. et al., 2008. Global trends in emerging infectious diseases. *Nature,* 451(7181), p. 990–993.

legislation.gov.uk, 2018. *Statistics and Registration Service Act 2007.* [Online]
Available at: https://www.legislation.gov.uk/ukpga/2007/18/contents
[Accessed December 2020].

Metro, 2020. *Vitamin D reduces risk of catching coronavirus, studies find.* [Online]
Available at: https://metro.co.uk/2020/09/26/vitamin-d-reduces-risk-of-catching-coronavirus-studies-find-13329339/
[Accessed December 2020].

Ministry of Housing, Communities and Local Government, 2019. *English indices of deprivation.* [Online]
Available at: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019
[Accessed September 2020].

National Health Service, 2020. *www.nhs.uk.* [Online]
Available at: https://www.nhs.uk/conditions/coronavirus-covid-19/people-at-higher-risk/whos-at-higher-risk-from-coronavirus/
[Accessed October 2020].

O'Brien, O. & Cheshire, J., 2016. Interactive mapping for large, open demographic data sets using familiar geographical features. *Journal of Maps,* 12(4), pp. 676-683.

OCR, 2020. *A Level Geography Specification,* Cambridge: Oxford Cambridge and RSA Examinations.

Office for National Statistics, 2019. *Socioeconomic inequalities in avoidable mortality, England and Wales: 2001 to 2017.* [Online]
Available at:
https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/articles/measuringsocioeconomicinequalitiesinavoidablemortalityinenglandandwales/2001to2017
[Accessed October 2020].

Office for National Statistics, 2020. *Deaths involving COVID-19 by local area and socioeconomic deprivation: deaths occurring between 1 March and 31 July 2020.* [Online]
Available at:
https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsinvolvingcovid19bylocalareasanddeprivation/deathsoccurringbetween1marchand31july2020
[Accessed October 2020].

Office for National Statistics, 2020. *Deaths involving COVID-19, England and Wales.* [Online]
Available at:
https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/deathsinvolvingcovid19englandandwales
[Accessed October 2020].

Office for National Statistics, 2020. *Mid-2019 Middle Super Output Area population estimates.* [Online]
Available at:
https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/middlesuperoutputareamidyearpopulationestimates
[Accessed October 2020].

Office for National Statistics, 2020. *Updating ethnic contrasts in deaths involving the coronavirus (COVID-19), England and Wales: deaths occurring 2 March to 28 July 2020.* [Online]
Available at:
https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/updatingethniccontrastsindeathsinvolvingthecoronaviruscovid19englandandwales/deathsoccurring2marchto28july2020
[Accessed December 2020].

Our World in Data, 2020. *Mortality Risk of COVID-19.* [Online]
Available at: https://ourworldindata.org/mortality-risk-covid
[Accessed October 2020].

Phillips, D., Curtice, J., Phillips, M. & Perry, J., 2018. *British Social Attitudes: The 35th Report,* London: The National Centre for Social Research.

Pozzer, A. et al., 2020. Regional and global contributions of air pollution to risk of death from COVID-19. *Cardiovascular Research,* 116(14), p. 2247–2253.

Public Health England & NHSX, 2020. *Coronavirus (COVID-19) in the UK.* [Online]
Available at: https://coronavirus.data.gov.uk/
[Accessed 4 October 2020].

Public Health England, 2020. *COVID-19: epidemiology, virology and clinical features.* [Online]
Available at: https://www.gov.uk/government/publications/wuhan-novel-coronavirus-background-information/wuhan-novel-coronavirus-epidemiology-virology-and-clinical-features
[Accessed 18 December 2020].

Public Health England, 2020. *Disparities in the risk and outcomes of COVID-19,* London: PHE Publications.

Public Health England, 2020. *Guidance for households with grandparents, parents and children living together where someone is at increased risk or has possible or confirmed coronavirus (COVID-19) infection.* [Online]

Available at: https://www.gov.uk/government/publications/covid-19-stay-at-home-guidance/guidance-for-households-with-grandparents-parents-and-children-living-together-where-someone-is-at-increased-risk-or-has-symptoms-of-coronavirus-cov
[Accessed December 2020].

Shannon, L., 2009. Correlation of Poverty and Crime Testing the Anomie Theory. *Concord McNair Scholars Research Journal,* Volume 12, pp. 234-244.

Singh, A. R. & Singh, S. A., 2008. Diseases of Poverty and Lifestyle, Well-Being and Human Development. *Mens sana monographs,* 6(1), pp. 187-225.

Steffen, W. et al., 2004. *Global Change and the Earth System: A Planet Under Pressure.* 1st ed. New York: Springer-Verlag.

The Sun, 2020. *SUN DOWNER Terrifying graph shows how Covid-19 patients with low vitamin D levels 'almost certainly die if they end up in hospital'.* [Online]
Available at: https://www.thesun.co.uk/news/11891485/health-chiefs-review-vitamin-d-coronavirus-save-lives/#comments
[Accessed December 2020].

United Kingdom National Health Service, 2020. *Briefing: Primary care providers and the coronavirus (COVID-19).* [Online]
Available at: https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/coronavirus-primary-care-briefing.pdf
[Accessed December 2020].

Vaughan, A., 2020. Why have there been so many coronavirus deaths in the UK?. *New Scientist*, 3 June.

Williamson, E. J. et al., 2020. Factors associated with COVID-19-related death using OpenSAFELY. *Nature,* Issue 584, p. 430–436.

World Obesity Federation, 2020. *Data and case studies.* [Online]
Available at: https://www.worldobesity.org/resources/policy-dossiers/obesity-covid-19/data-and-case-studies
[Accessed December 2020].

Appendix

Risk Assessment Guide

Scoring Table

LEVEL OF RISK	OVERALL RATING	HOW THE RISK SHOULD BE TACKLED/MANAGED
HIGH RISK	15-25	Immediate Management Action
MEDIUM RISK	9-12	Plan for Change
LOW RISK	1-8	Continue to Manage

Likelihood (A)					
5 Almost Certain	5	10	15	20	25
4 Probable /Likely	4	8	12	16	20
3 Possible	3	6	9	12	15
2 Unlikely	2	4	6	8	10
1 Very Unlikely / Rare	1	2	3	4	5
	1 Insignificant / Negligible	2 Minor	3 Moderate	4 Major	5 Critical / Catastrophic
	Impact (B)				

Risk Score

To calculate the Risk Score in the Risk Assessment Register above, simply multiply the Impact by the Likelihood to identify the level of risk as per the table above.

Risk Scoring Guide

Consider the potential harm or injury that could result from the identified hazard if an accident or incident were to occur, based on the table below.

Impact Criteria (B)

IMPACT	SCORE	HEALTH & SAFETY EFFECT
Critical/ Catastrophic	5	Multiple deaths of employees, service users, members of the public, etc.
Major	4	Death of an employee, service user, member of the public, etc.
Moderate	3	Serious injury (acute, chronic of life -changing) to employee, service user or member of the public requiring medical intervention.
Minor	2	Minor injury such as a bump or bruise that may require First Aid treatment and the person returns to work.
Insignificant / Negligible	1	A day to day issue/problem but negligible harm would result.

Now consider the likelihood of that harm or injury being realised based on the expected frequencies in the table below.

Likelihood Criteria (A)

LIKELIHOOD	SCORE	EXPECTED FREQUENCY
Almost Certain	5	Reasonable to expect that the event **WILL** undoubtedly happen/recur, possibly frequently and is probable in the current year
Probable / Likely	4	Event is **MORE THAN LIKELY** to occur, will probably happen/recur, but is not a persisting issue. Will possibly happen in the current year and be likely in the longer term
Possible	3	**LITTLE LIKELIHOOD** of event occurring. Not likely in the current year, but reasonably likely in the medium/long term.
Unlikely	2	Event **NOT EXPECTED** Do not expect it to happen/recur. Extremely unlikely to happen in the current year, but possible in the longer term.
Very Unlikely /Rare	1	**EXCEPTIONAL** event. This will probably never happen/recur. A barely feasible event.

Appendix 1 Table showing the risk assessment guide used to give scores in the investigation's risk assessment

Exemplar Questionnaire Survey Request

Hello,

My name is Euan Baldwin and I'm hoping you can give me three minutes of your time to help me with my A-level geography.

I'm doing a project on how people feel about coronavirus. Please could you answer a few questions using the link:

https://forms.gle/jQxWkrLmQqrzynay5

Thank you so much,

Euan

Appendix 2 Image showing the questionnaire survey request that was posted through the front-doors of 420 houses in Ealing 013 and a further 420 houses in Ealing 029

Exemplar Questionnaire Survey

A-Level Geography Project

Thank you very much for your help answering the questions below about COVID-19.
If you feel uncomfortable answering any of the questions, please skip them.
Your answers are completely anonymous and will only be used for my A-level project.
The form will only take a few minutes to complete.

1. Are you in a high-risk category (e.g. asked to shield by the government during the national lockdown)?

   Mark only one oval.

   - Yes
   - No
   - Not sure

2. Have you had COVID-19 (coronavirus)?

   Mark only one oval.

   - Yes
   - No
   - Not sure

3. Do you personally know anyone (other than yourself) who has caught COVID-19?

   Mark only one oval.

   - Nobody
   - One person
   - Multiple people

4. Do you personally know anyone who has died as a result of COVID-19?

   Mark only one oval.

   - Nobody
   - One person
   - Multiple people

5. How likely do you think it is that someone living in London will catch COVID-19?

   Mark only one oval.

   - Extremely likely
   - Very likely
   - Somewhat likely
   - Not very likely
   - Not likely at all

6. How likely do you think it is that someone living in London will die from COVID-19?

   Mark only one oval.

   - Extremely likely
   - Very likely
   - Somewhat likely
   - Not very likely
   - Not likely at all

7. Do you think you are likely to catch COVID-19

   Mark only one oval.

   - Extremely likely
   - Very likely
   - Somewhat likely
   - Not very likely
   - Not likely at all

8. Do you think you are at risk of dying from COVID-19?

   Mark only one oval.

   - Extremely likely
   - Very likely
   - Somewhat likely
   - Not very likely
   - Not likely at all

9. Which of these things do you think influence the risk of dying from COVID-19 (please select all that apply)?

   Tick all that apply.

   - Education level
   - Personal health
   - Crime Rate
   - Access to housing and services
   - Living conditions
   - Child poverty
   - Elderly poverty
   - Job opportunities
   - Income level

10. Do you think there any other factors that could lead to increased COVID-19 death rates? (please give as much detail as possible)

11. Please select your age category

    Mark only one oval.

    - 18 - 24
    - 25 - 34
    - 35 - 44
    - 45 - 54
    - 55 - 64
    - 65 +

12. Please select your gender

    Mark only one oval.

    - Male
    - Female
    - Other
    - Prefer not to say

Appendix 3 Images showing a printout the questionnaire survey that 420 households in Ealing 013 and a further 420 households in Ealing 029 were asked to complete. The respondents filled out the questionnaire by scanning a QR code that took them to a Google Form

Workings for Statistical Tests

x variable	Index of Multiple Deprivation Rank	Income Rank	Employment Rank	Education, Skills and Training Rank	Health Deprivation and Disability Rank	Crime Rank	Barriers to Housing and Services Rank	Living Environment Rank	Income Deprivation Affecting Children Index Rank	Income Deprivation Affecting Older People Rank	Pilot Study IMD Rank
y variable	ACMR	ACMR	ACMR	ACMR	ACMR	ACMR	ACMR	ACMR	ACMR	ACMR	ACMR
Size of x population	951	951	951	951	951	951	951	951	951	951	18
Size of y population	951	951	951	951	951	951	951	951	951	951	18
Mean of x	15124	14335	17087	20556	20415	13009	7907	10418	14397	11179	16916
Mean of y	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	76.70	106.74
Standard Deviation of x	7112	7140	6877	6834	6679	5706	5570	4917	7282	7530	7531
Standard Deviation of y	97.45	97.45	97.45	97.45	97.45	97.45	97.45	97.45	97.45	97.45	78.12
Covariance of xy	-142202	-142094	-136416	-109330	-103383	-69728	-126897	-12863	-111085	-131564	-130924
rho	-0.2052	-0.2042	-0.2036	-0.1642	-0.1588	-0.1254	-0.2338	-0.0268	-0.1565	-0.1793	-0.2225
t statistic	6.4585	6.4261	6.4048	5.1267	4.9561	3.8934	7.4077	0.8272	4.8824	5.6143	0.9130
p value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.4083	0.0000	0.0000	0.3748

Appendix 4 Table showing the workings for the statistical tests used in the project

Data Tables

This investigation used a large volume of data (circa 200,000 cells). As a result, the data is only available online at the following link:

https://1drv.ms/x/s!AmgmaOAIoZgvmTQQJxOeoRbCrzpg

The above link shows the "Euan Baldwin NEA Data" Excel workbook, which contains the following worksheets:

- "Primary Dataset"
- "LSOA IoD Values"
- "Standard Mortality Rates"
- "Ealing 013 Survey Responses"
- "Ealing 029 Survey Responses"
- "Pilot Study Dataset"

If you experience any issues with the above link, please contact euan.baldwin@abingdon.org.uk