# Palacký University Olomouc
# University of Clermont Auvergne
# University of Pavia


**MASTER THESIS**


**Tasnima Yasmin**

**Supervisor: Professor Cinzia Di Novi**


**GLODEP 2021**

Palacký University Olomouc

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UNIVERSITÀ DI PAVIA

# The Covid-19 Pandemic Impact of the Disruption of Care on Elderly's Psychological Health: Evidence from UK Population.

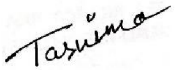
**Tasnima Yasmin**

**Supervisor: Professor Cinzia Di Novi**

GLODEP 2021

## Declaration

I hereby declare that thesis titled “The Covid-19 Pandemic Impact of the Disruption of Care on Elderly ‘s Psychological Health: Evidence from UK Population” focusing the deteriorating mental health and potential negative effects on elderly’s mental/psychological health due to disruption in the provision of informal care at the time of COVID-19 pandemic submitted to GLODEP consortium in 2021 is my original work. The literature review and the dataset used in the study for the analysis have been duly referenced and cited.



Tasnima Yasmin

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# ZADÁNÍ DIPLOMOVÉ PRÁCE

(projektu, uměleckého díla, uměleckého výkonu)

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## Zásady pro vypracování

**Background**

The worldwide crisis due to COVID-19 pandemic is having an impact on almost every aspect of our society. With no medicines or vaccines available at the beginning of pandemic, countries have relied on other type of interventions such as social distancing: isolation, quarantine, travel restriction and closure of schools, workplaces and public spaces. Even though the full effects of COVID-19 and the associated economic crisis are yet to be seen, it is easily to expect that they will not affect all people in a uniform way. Vulnerable and disadvantaged groups will be impacted more severely. Older adults, for instance, have been at higher risk in being infected with COVID-19: they are more likely to already suffer from multiple chronic diseases such as cardiovascular disease, diabetes, or respiratory illness that raise the risk of severe COVID-19 and COVID-19-related death. The balance between age-related disorders and good health during the lockdown has been under high pressure. Social distancing has been often necessary to protect themselves against the risk of coronavirus. However, older adults, especially those with cognitive decline or dementia, need emotional support through informal networks (families) and health professionals and isolation may have created a new set of challenges that can affect other pre-existing health concerns, including mental health consequences. Lockdown might have also led to a paradoxical increase in preventable deaths due to avoidance in seeking necessary medical care, resulting in excess morbidity and mortality from non-COVID conditions.

**Aims**

This study aims to evaluate the negative externality due to deteriorating mental health and potential negative effects on their mental/psychological health from the month of April to September due to disruption in the provision of informal care. The focus age group is the population equal to or over 65 years old who face comparatively higher potential health risk than the other age groups.

**Methodology**

We will use data from the UK Household Longitudinal Study (UKHLS) – Understanding Society. Data were collected through self-administered questionnaires, telephone (computer-assisted) and web-based interviews conducted by University of Essex and the Institute for Social and Economic Research.
The selection of our specific sample will be based on two criteria (1) age group (over 65) and (2) if respondents received informal care before the virus outbreak (yes/no).

In order to test the impact of the informal care disruption on elderly’s psychological health we will take the advantage of the longitudinal dimension of the UKHLS survey. Indeed, we will also control for individuals’ mental health in the pre pandemic year (2019) just to capture the potential onset mental health disorders that may be attributable to the disruption of care due to Covid-19 pandemic. Controlling for pre-existing recent trends in mental health allows to take into account the effect of unobservable that might influence the relationship between care and mental health other than the disruption due to the virus outbreak.

As a measure of current mental health, we will employ the General Health Questionnaire (GHQ) -12 This scale has become one of the most popular and used measure for detecting psychological distress and asks whether respondents have experienced a particular symptom or behaviour recently.

**Policy Implications**

The findings of this study can be utilized as basis for acknowledging the well-being issues associated with social distancing and isolation especially among vulnerable and disadvantaged groups.

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Seznam doporučené literatury:


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2. Benzeval, M., Booker, C., Burton, J., Crossley, T. F., Jäckle, A., Kumari, M., & Read, B. (2020). *Understanding society COVID-19 survey. April briefing note: health and caring* (No. 11, pp. 2020-11). Understanding Society Working Paper.
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Last but not the least, I wish to convey my cordial thanks to the Erasmus Joint Master's Degree GLODEP Consortium for their relentless support throughout the entire program, especially at this universal difficult time due to the ongoing COVID-19 pandemic.

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Tasnima Yasmin

**Abstract**

COVID-19 crisis, initially emerged from China in late 2019, is currently evident to significantly hamper the people's wellbeing on so many levels around the world while badly damaging most of the country's healthcare and financial system. This paper in particular, takes into account the inevitable damage in older adult's psychological health that might have been caused due the global pandemic.

The objective of this study is to evaluate the negative externality due to deteriorating mental health and potential negative effects on elderly's mental/psychological health in April, 2020 due to disruption in the provision of informal care while compared with that of 2019, the previous year. The focus age group is the population equal to or over 65 years old who face comparatively higher potential health risk than the other age groups.

In order to test the impact of the informal care disruption on elderly's psychological health we took advantage of the longitudinal dimension of the UK Household Longitudinal Study (UKHLS) and British Household Panel Survey (BHPS). Indeed, we controlled for individuals' mental health in the pre pandemic year (2019) to capture the potential onset mental health disorders that may be attributable to the disruption of care due to Covid-19 pandemic. Furthermore, we employed the General Health Questionnaire GHQ-12 which has become one of the most popular and used scale for detecting psychological distress and asks whether respondents have developed a particular symptom or behaviour recently.

The findings of this study remain consistent with our initial hypothesis that a substantial level of deterioration in elderly's occurred as a result of interruption in informal care provision due to the COVID-19 crisis. The findings also include an increasing trend in elderly's psychological stress at the time of the pandemic in 2020 compared to that of in 2019. The results can be utilized as a basis for acknowledging the well-being issues associated with the prevention measures as social distancing and shielding especially among vulnerable and disadvantaged groups.

***Keywords****: Covid-19, informal care, psychological distress, older adults, GHQ-12*

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## List of Abbreviations

| | |
|---|---|
| COVID-19 | Coronavirus disease of 2019 |
| NHS | National Health Service |
| DHSC | Department of health and social care |
| LTC | Long-term care |
| ADL | Activities of Daily living |
| UKHLS | UK Household Longitudinal Study |
| BHPS | British Household Panel Survey |
| GHQ-12 | General health questionnaire-12 |
| WHO | World Health Organization |
| GCSE | General Certificate of Secondary Education |
| OLS | Ordinary least squares |
| NCIRD | National Center for Immunization and Respiratory Diseases |
| WB | World Bank |

# Chapter 1: Introduction

## 1.1 Background

The ongoing worldwide crisis that essentially emerged due to COVID-19 pandemic is having devastating impacts on almost every aspect of our society and world economy. While writing this paper dated as 9 May 2021, according to World Health Organization (WHO) dashboard[1], there have been a total of 157,289,118 confirmed cases of COVID-19 that include 3,277,272 deaths in total all around the globe. The emergence and speedy growth of the hideous COVID-19 affliction is caused by a fatal respiratory syndrome termed as coronavirus-2 (SARS-CoV-2) which was initially exposed to the people in the Huanan seafood market in Wuhan City, China in late 2019 (Lekamwasam & Lekamwasam, 2020). The virus primarily spreads via droplets generated from infected person's saliva and nasal discharges mainly through air (WHO,2020) and its most common clinical symptoms include dry cough, fever, fatigue and dyspnea and sputum (Alimohamadi et al., 2020).

The epidemic has led to a range of massive public health awareness activities such as frequent hand washing, minimizing the act of face touching, maintaining social distancing (cocooning), wearing masks in public places and so on to mitigate the spread of the virus (Bavel et al., 2020). With no medicines or vaccines available at the beginning of this pandemic, countries have relied on these types of intervention measures such as social distancing: isolation, quarantine, travel restriction and closure of schools, workplaces and public spaces. Similar to the other countries around the globe, UK had to impose a country-wide lockdown[2] started from 23rd March, 2020 at the eve of the deepening crisis of the pandemic. Even though the full effects of COVID-19 and the associated socio-economic crisis are yet to be seen, it is easily to expect that they will not affect all people in a uniform way.

[1] https://covid19.who.int/
[2] https://fullfact.org/health/coronavirus-lockdown-hancock-claim/

## 1.2 Informal care scheme in UK

The conventional social care system for primarily elder part of population includes formal and informal care scheme where care can be essentially derived from formal and informal sources. The informal care is identified as the paid care provided by the trained, licensed and qualified professionals[3] and according to the DHSC (Powell et al., 2020), informal carers are defined as the people who look after and provide long-term care (LTC) with family members, friends, neighbours or perhaps some other relatives or individuals due to their adverse long-term physical or mental condition or disability as well as the older adult population. However, any activities with paid employment are not included to informal care scheme and the people receiving informal care are known as care receiver group of people. Moreover, according to Triantafillou et al. (2010), being more specific, informal care is typically acknowledged as the unpaid support or care generally given to older and dependent people by a person with whom they have a social relationship and the social relation can include being their child, parent, spouse, friends, relative, neighbour or other non-kin. During 2018 to 2019, around 7% of the UK population were providing with unpaid informal care which was estimated by the Family Resources Survey[4]. In addition, according to ageUK[5](2019), approximately 15% of the total population aged between 65 and 69 struggles with at least one Activity of Daily Living (ADL) while specifically for those aged 85 and over, this takes place for 1 in 3 old people who constitutes the major group in need of assistance. According to the future prediction by ageUK[6], within the year of 2040, the total number of disabled older adults is estimated to raise by approximately 67% to 5.9 million. Therefore, an ageing population determines the need for increasing level of care provision in society and informal care scheme in UK contributes largely to the society as well as helps make the country's NHS (National Health Service) sustainable in the long run. Furthermore, in terms of social isolation, according to Zavaleta et al. (2016), this is considered to be a situation with an absence of adequate social interaction resulting in meagre quality and quantity of social relationships among people at different levels which plausibly include individual group level, community level and even larger

[3] https://link.springer.com/referenceworkentry/10.1007%2F978-3-319-69892-2_847-1#:~:text=Definition,relatives%2C%20friends%2C%20and%20neighbors.
[4] https://www.gov.uk/government/statistics/family-resources-survey-financial-year-201819
[5] https://www.ageuk.org.uk/
[6] https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/health--wellbeing/age_uk_briefing_state_of_health_and_care_of_older_people_july2019.pdf

society. Being consistent with this definition, at the time COVID-19 outbreak, this informal care system was largely disrupted due to implementation of lockdown and other prevention measures and the next sections of this paper will establish its potential impact on older adult's psychological wellbeing.

### 1.3 Literature review

Tamin et al. (2021) suggests that older population and people with chronic underlying health conditions and disabilities are the most clinically vulnerable and disadvantaged groups that is predicted to be impacted more severely in the worst way of all. Older adults, for instance, have been at higher risk in being infected with COVID-19 as they are more likely to already been suffering from multiple potential chronic diseases such as cardiovascular disease, diabetes, or respiratory illness that reportedly raise the risk of severe COVID-19 affliction and COVID-19-related deaths. Moreover, the pandemic is witnessed to disproportionately affect elderly people aged 65 years or older who are more exposed to the COVID-19 infection and therefore, this tendency indicates 80% of hospitalization of this age-group who happens to carry a 23-fold greater risk than those under 65 in terms of mortality (Mueller et al., 2020). The ability to control viral loads is one of the key factors that determines whether a patient will show mild or severe symptoms of Covid-19. While aging, the immunity system of a human body changes drastically in two ways. The first is termed as immunosenescence that is a slow yet continuous decline in patient's immunity resulting in endangering pathogen recognition, alert signaling and clearance. The next one arises from an overactive, yet ineffective alert system that leads to a systemic inflammation known as inflammaging. In addition, a particular cytokine type might release syndrome of disseminated intravascular coagulation which further leads to damage of liver, cardiovascular infection, some other complications and even death (Mueller et al., 2020). All of these reasons altogether put elder people at a greater risk during this covid-19 pandemic.

According to WHO[7], people of all age groups and from all walks share different levels of risk of infecting with COVID-19, yet however, older adults of 65 years old and above are

[7] https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/4/supporting-older-people-during-the-covid-19-pandemic-is-everyones-business

threatened with a significantly higher risk of suffering from acute and lethal sickness if they are diagnosed with COVID-19 due to aging and other pre-existing underlying physiological conditions (D'Cruz & Banerjee, 2020.) Hence, maintaining the balance between age-related disorders and good health (both physical and psychological) during the lockdown period has been under immense pressure. Therefore, essentially social distancing has been often considered necessary to protect the older adults against the threat of coronavirus. However, older adults, especially those with neurocognitive disorders or dementia seem to have reduced compliance to the precautionary and therapeutic measures (D'Cruz & Banerjee, 2020) and eventually, these people with psychological disorders, in specific dementia, mostly require high levels of care and emotional support through informal networks as own family caregivers (Brodaty, 2009).

Furthermore, the act of isolation may have created a new set of challenges for the old population that can highly affect and worsen their other pre-existing health concerns, including mental health consequences. In addition, results have shown that lockdown measures have substantially minimized the access to mental health care schemes such as face-to-face visits and talking therapies (Mansfield et al., 2021) and for the people already with a history of previous psychological heath treatment are proven to struggle with the most negative capability wellbeing and emotional wellbeing as a result of imposed lockdown measures (Simon et al., 2021). The implementation of lockdown might have also led to a paradoxical increase in preventable deaths due to avoidance in seeking necessary medical care, resulting in excess morbidity and mortality from non-COVID conditions.

However, individual's demographic, socio-economic and health status are considered as significant as the sort and level of need required by the older people in terms of determining the magnitude of their difficulties in daily living. (Vlachantoni et al., 2011). Furthermore, marital status and living arrangements being two dynamic criteria rather than static over the life course are seen to unfavorably affect individual's physiological and mental wellbeing along with the accessible informal care available in later lifetime (Blomgren et al. 2010; Glaser et al. 2008).

Moreover, in a study conducted by Taquet et al. (2020) based on the USA population showed that, patients who did not have any past diagnosis records of any mental disorder, dementia, insomnia or other psychological illness, a diagnosis of COVID-19 was found to be interrelated with increasing event of first patient's diagnosis with mental disorder in the following

two weeks to 3 months of period while comparing with further similar health incidents. For the people aged above 65 years, this first diagnosis of dementia in next 2 weeks to 3 months after coronavirus diagnosis was found to be 1·6%. However, observing the previous year's diagnosis of psychological illness, it was found to be correlated with an increasing incident of COVID-19 diagnosis. Although this probability was not known to be dependent on any physical fitness risk factors for coronavirus, yet the possibility of a residual confounding through socioeconomic elements cannot be excluded (Taquet et al.,2020). Socioeconomic factors may include income level, level of education, employment status which we will try to incorporate in this study.

However, this to be noted that, the COVID-19 being an ongoing pandemic, there is still a large of data being collected to be analyzed later which will plausibly help produce profound and in-depth literatures. Therefore, this paper was only able to utilize a few numbers of recent works as its literature review regarding the current pandemic.

### 1.4 Purpose of the study

This study aims to evaluate the negative externality due to deteriorating mental health and potential negative effects on their mental/psychological health in the month of April, 2020 due to the disruption in the provision of informal care at the time of the lockdown. The paper further seeks to determine the change in mental being of the respondents in 2020 in comparison with that of 2019 while controlling for 2019's settings. The focus age group is derived from the UK population equal to or over 65 years old who face substantially higher potential health risk in comparison with the other age groups. For the construction of variables, we utilized the knowledge from the paper "Older and 'staying at home' during lockdown: informal care receipt during the COVID-19 pandemic amongst people aged 70 and over in the UK" (Evandrou et al, 2020) which is established on the similar dataset (UKHLS[8] survey) that we will be employing in our paper.

The remainder of the paper is organized as follows. Chapter 2 describes the data and the empirical model, while the results are presented in Chapter 3. Discussion and concluding remarks are made in Chapter 4 and Chapter 5 respectively.

[8] https://www.understandingsociety.ac.uk/topic/covid-19

## Chapter 2: Empirical strategy

### 2.1 Source of data and sample design

We utilized the data derived from the UK Household Longitudinal Study (UKHLS) - Understanding Society and British Household Panel Survey (BHPS). Data were collected through self-administered questionnaires, telephone (computer-assisted) and web-based interviews conducted by University of Essex and the Institute for Social and Economic Research. The selection of our specific sample was based on two criteria (1) age group (equal to 65 years or above) and (2) if respondents received informal care before the virus outbreak. After correcting for the missing value, the sample size includes 3202 observations.

### 2.2 Dependent Variable

As a measure of current mental health, we employed the General Health Questionnaire (GHQ)-12: This measurement has gained profound popularity and has been utilized in determining mental distress while inquiring on if respondents have developed any certain symptom or behaviour in recent days. Furthermore, its concise nature makes it more worthy to utilize in clinical settings and also in the settings where patients require assistance to fill in the questionnaire (Goldberg et al., 1997). This scale was designed by Goldberg in 1970's. In its original form, it had 60 components (GHQ-60), which were reduced to 30 components (GHQ-30), 28 components (GHQ-28) and finally reduced to 12 components (GHQ-12) (Goldberg & Williams, 1988). According to (Werneke, Goldberg, Yalcin, & Üstün, (2000), its psychological measurements have been implemented in different counties while taking different population types into account, for instance, senior population of the country (Costa, Barreto, Uchoa, Firma, Lima-Costa, & Prince, 2006), and urological patients in some cases (Quek, Low, Razack, & Loh, 2001).

In order to test the impact of the informal care disruption on elderly's psychological health we will take the advantage of the longitudinal dimension of the UKHLS survey. Indeed, we will also control for individuals' mental health in the pre pandemic year (2019) just to capture the potential onset mental health disorders that may be attributable to the disruption of care due to Covid-19 pandemic. Controlling for pre-existing recent trends in mental health allows to take into

account the effect of unobservable that might influence the relationship between care and mental health other than the disruption due to the virus outbreak.

We applied 'subjective wellbeing GHQ: Likert scale' as our dependant variable in the model. This variable 'subjective wellbeing GHQ: Likert scale' is derived from General Health Questionnaire (GHQ-12) that was originated by British scholar Goldberg in 1972 and is acknowledged to be one of the most recognized and vastly used screening scale for identifying and quantifying psychological wellbeing (Montazeri et al., 2003). The concerned Questionnaire (GHQ-12) essentially includes 12 items whereas the severity of a psychological distress over the previous four weeks is assessed by each item through implementing a 4-point index (from 0 to 3 and the two mostly used scoring kinds are bi-modal (0-0-1-1) and Likert scoring methods (0-1-2-3). The derived score gets to be used in producing a total mark ranging from 0 to 36 whereas the higher scores happen to imply most distressed conditions of mental wellbeing. Therefore, our dependant variable (subjective wellbeing GHQ: Likert) determines the value from 0 to 36 scale and the higher value basically depicts the worse health condition.

Table 1 - Description of dependent variables (i)

| **Variable type** | **Module** | **Variable name** | **Questionnaire (12)** | **Sample responses (4)** | **Construction method** |
|---|---|---|---|---|---|
| Dependent variable | GHQ Module: Likert | 2020 subjective wellbeing: Likert scale | (a) Concentration<br>(b) Loss of sleep<br>(c) Playing a useful role<br>(d) Capable of making decision<br>(e) Constantly under strain<br>(f) Problem overcoming difficulties<br>(g) Enjoy day-to-day activities | (i) More so than usual<br>(ii)Same as usual<br>(iii) Less so than usual<br>(iv) Much less capable | Score from 0 to 36 (the higher the score, the most distressed) - subjective wellbeing GHQ: Likert – April. |

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| | | | (h) Ability to face problems<br>(i) Unhappy or depressed<br>(j) Losing confidence<br>(k) Believe worthless<br>(l) General happiness | | |

We developed another dependent variable for our probit regression model analysis that is '2020 dummy GHQ: Caseness' which is constructed from the April, 2020's GHQ module: Caseness scale with cut-off value of >=4 where dummy 1 if GHQ Caseness of April, 2020 >= 4, 0 otherwise.

Table 2 - Description of dependent variables (ii)

| **Unit** | **Variable description** | **Variable name** | **Construction method** |
|---|---|---|---|
| (1) | April, 2020 GHQ Module: Caseness | 2020 dummy GHQ: Caseness | Dummy 1 if GHQ Caseness of April, 2020 >= 4, 0 otherwise, with a cut-off >=4. |

### 2.3 Independent Variables

The independent variables can be grouped in the following categories: demographic variables (age, female, race, born inside UK, urban area, region, married couple) socio-economic variables (education, being up-to-date with bill payments, worse future financial subjective wellbeing), health variables (2 or more long-standing underlying illness, tested for coronavirus,

2019 Subjective wellbeing: Likert, 2019 GHQ dummy) and care variables (less informal care received).

*Demographic variables:*

(a) We started with age as the continuous variable where we classified the 'age' group into four different subgroups. However, our sole focus is limited on the age group equal to 65 years or above since our study tend to investigate the effect of the change in informal care on psychological wellbeing of this elderly population group in UK during the lockdown period imposed due to the pandemic. The classified groups are ranged as: age group 1 when age is from 65 to 69(36.82% of total sample), age group 2 when age is 70-74(35.26% of sample), age group 3 when age is 75-79 (18.05% of sample) and age group 4 when age equals to 80 or above (9.87 of sample).

(b) For the next explanatory variable, we categorized 'sex' into Female and Male as a dummy variable for our model where Female dummy variable: 1 if female, 0 otherwise and Male dummy variable: 1 if male, 0 otherwise.

(c) We categorized race and generated a 'race' variable to predict if someone is British/ English/ Scottish/ Welsh/ Northern Irish and generated the dummy variable BSWEN equals to 1 if race happens to be English/Scottish/welsh/ northern Irish, 0 otherwise.

(d) Then another dummy variable named as 'not born inside UK' was originated on the basis of the questionnaire about the nationality of the respondent of the questionnaire that being born whether inside or outside UK where the value of dummy is determined as 1 if not born inside UK and 0 if born inside UK.

(e) for defining the respondent's locality or region, we determined the next independent variable named 'region' with values associated with 12 regions such as North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland and Northern Ireland.

(f) For developing the next explanatory variable named as 'Urban area' which tends to explain the region the respondent lives in, we take the value dummy 1 if the respondent is living in an urban area and 0 if otherwise. Generally, dummy 0 here includes the respondents living in a rural area.

(g) ‘Married couple’ is an independent variable and married couple dummy variable: 1 if married/same-sex partners/living as a couple/former civil partner and 0 otherwise.

Table 3 - Description of demographic variables

| **Unit** | **Variable description** | **Variable name** | **Construction method** |
|---|---|---|---|
| (1) | Age of the respondent | Age | Continuous variable |
| | | Age group 1 | dummy 1 if age 65-69, 0 otherwise |
| | | Age group 2 | dummy 1 if age 70-74, 0 otherwise |
| | | Age group 3 | dummy 1 if age 75-79, 0 otherwise |
| | | Age group 4 | dummy 1 if age 80+, 0 otherwise |
| (2) | Gender of the respondent | Female | dummy 1 if female, 0 otherwise (if male) |
| (3) | Race of the participant | Race | dummy 1 if English/Scottish/Welsh/Northern Irish, 0 otherwise |
| (4) | Nationality of the participant | Born inside UK | dummy 1 born in UK 0 not born in UK |
| (5) | Locality: Urban or Rural area where the respondent lives in | Urban area | dummy 1 if living in urban area, 0 if living in rural area |
| (6) | Locality: Government office regions where the participant dwells | Regions | Categorical variable with values split among 12 regions such as North East, North West, Yorkshire and The Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland and Northern Ireland. |

| | | | |
|---|---|---|---|
| (7) | Marital status of the respondent | Married couple | dummy 1 if married/same-sex partners/living as a couple/former civil partner, 0 otherwise |

*Socio-economic variables:*

Concerning the socio-economic variables, we essentially took advantage of the variables of the respondent's level of education, working status, subjective financial wellbeing and capability of being up to date with bills payment of the respondent.

(a) We considered including two different levels of education from British Household Panel dataset as an important socio-economic variable in our model, the first one termed as 'Secondary level education' which include those respondents with a secondary (GCSE) level of education interpreting that the dummy equals 1 if the respondent has a secondary level education and 0, otherwise. Then again, the next one that is 'Tertiary level education' determines if the respondent has a tertiary level of education qualification level and carries the value dummy 1 if respondent has this tertiary level of education and 0 otherwise. Here, dummy 0 takes the reference category such as 'no education', 'college education' and 'other unspecified education' into account.

(b) In accordance with April dataset, 'Up to date with payment bills' is another independent variable utilized in this study to predict if the respondent is up to date with payment bills where dummy 1 depicts if the respondent is up to date with all payment bills and 0 if the respondent answers otherwise for example: respondents behind with paying some or behind with paying all bills.

(c) The future subjective financial wellbeing is determined by the independent variable 'Worse future subjective financial wellbeing' where dummy 1 explains if the subjective financial situation of the respondent is worse off in the future and 0 if the future financial situation of the that respondent is otherwise. Dummy 0 include two groups into accounts, such as: those with a view of better future subjective financial wellbeing and those with the same/stable future subjective financial status. The concerning variable had responses on the following question (UKHLS COVID-19, April Questionnaire, page 43), 'Looking ahead, how do you think you

think you will be financially a month from now, will you be? The answers included options of: (1) better off; (2) worse off than you are now; (3) about the same. The variable used in this model is based on the second responses (worse off than you are now) which takes value 1, 0 otherwise.

Table 4 - Description of socio-economic variables

| **Unit** | **Variable description** | **Variable name** | **Reference category** | **Construction method** |
|---|---|---|---|---|
| (1) | Different levels of education achieved by the respondent | | No education | dummy 1 no education, 0 otherwise |
| | | Secondary level education | | dummy 1 if education level 1 & 2 (GCSE), 0 otherwise |
| | | | College education | dummy 1 education level 3 (A level), 0 otherwise |
| | | Tertiary level education | | Dummy 1 if educational level 4 5 6 7 (tertiary education), 0 otherwise |
| | | | Other unspecified education | other qualification (not specified) |
| (2) | Being the respondent's up to date with payment bills | Up to date with payment bills | | dummy 1 if up to date with all payment bills, 0 otherwise (we consider the value 0 if the respondent is behind with some or behind with all bills) |
| (3) | Subjective financial situation in | Worse future subjective financial wellbeing | | dummy 1 if subjective financial situation in the future is worse off, 0 otherwise |

| | | | | |
|---|---|---|---|---|
| | upcoming future | | Better future subjective financial wellbeing | dummy 1 if subjective financial situation in the future is better off, 0 otherwise |
| | | | Same/unchanged future subjective financial wellbeing | dummy 1 if subjective financial situation in the future is unchanged or same, 0 otherwise |

*Health variables:*

(a) The '2 or more long-standing underlying illness' is an independent health variable performed in the model as an independent variable developed from the answers on whether the respondent was suffering from 2 or more long standing illness or disability and this dummy takes value 1 if the respondent was suffering from the 2 or more long-standing illness or disability, 0 if represents the condition to be otherwise. The value 0 takes the reference groups into account that are if respondents are suffering from 1 long-standing underlying illness, 2 long-standing underlying illness, 2 long-standing underlying illness or no long-standing underlying illness at all.

(b) The independent health variable 'Tested for coronavirus' is formed on the basis of the responses gathered from the respondent that if the respondent was tested for coronavirus or not. The dummy variable carries a value of 1 if the respondent tested for the coronavirus, and 0 if otherwise. The concerning question is seen in the UKHLS COVID-19 questionnaire (coronavirus illness module, page 6) which was: "Have you been tested for coronavirus? The answers took: (1) Yes; (2) No responses and based on the responses those who answered yes were included to the dummy value 1 and those who did not take the coronavirus test were considered to take value 0.

(c) We also employed the '2019 Subjective wellbeing: Likert scale' as a control variable which is constructed with a score from 0 to 36 (the higher the score, the most distressed) that was employed in our second multilinear regression model. The questionnaire included the responses if the respondent had trouble with (1) concentrating; (2) sleeping; (3) playing useful

role; (4) making depression; (5) overcoming difficulties; (6) under strain; (7) enjoying daily activities; (8) facing problem; (9) depression; (10) losing confidence; (11) worthless feeling; (12) happiness level (UKHLS COVID-19 dataset, page 62-65)where the responses usually were ranged among 4 levels of answers such as (1) Not at all; (2) No more than usual (3) Rather more than usual; (4) Much more than usual. As mentioned, if the respondent shows a high score, his psychological health is acknowledged to be more threatening and vice versa.

(d) In our model, we constructed another binary dummy variable named 2019 dummy GHQ: Caseness from 2019 GHQ module: Caseness and for its construction, we considered a value of cutoff >=4 that the dummy takes 1 when GHQ Caseness equals >=4, 0 otherwise (if less than 4). This dictates that when the respondent has a score equal to 4 or more out of 12 in the GHQ-12 caseness scale, his psychological wellbeing is considered to be worsening.

Table 5 - Description of health variables

| **Unit** | **Variable description** | **Variable name** | **Reference category** | **Construction method** |
|---|---|---|---|---|
| (1) | Long standing illness/ disability | | 1 long-standing underlying illness | dummy 1 if the respondent has 1 long-standing illness, 0 otherwise |
| | | | 2 long-standing underlying illness | dummy 1 if the respondent has 2 long-standing illnesses, 0 otherwise |
| | | 2 or more long-standing underlying illness | | dummy 1 if the respondent has 2 or more long-standing illnesses, 0 otherwise |
| | | | No long-standing underlying illness | dummy 1 if the respondent does not have any long-standing illness, 0 otherwise |
| (2) | Tested for COVID-19 | Tested for coronavirus | | dummy 1 if the respondent tested for coronavirus, 0 |

| | | | | |
|---|---|---|---|---|
| | | | | otherwise (if not tested for coronavirus) |
| (3) | GHQ Module: Likert scale | 2019 Subjective wellbeing: Likert scale | | score from 0 to 36 (the higher the score, the most distressed) - subjective wellbeing GHQ: Likert – 2019. |
| (4) | 2019 GHQ Module: Caseness | 2019 dummy GHQ: Caseness | | Dummy 1 if GHQ Caseness equals >=4, 0 otherwise (if the score is less than 4) |

*Care variables:*

(a) Based on the responses of the question that if the respondent has received any help in the previous 4 weeks from family, friends or neighbours out the same house, we developed this dummy variable where dummy 1 explain explains if the respondent received care during past 4 weeks from family, friends or neighbours and dummy 0 explains otherwise. Concerning the informal care received, respondents were inquired on the following question: Thinking about the last 4 weeks, did you receive support from family, neighbours or friends who do not currently live in the same house/flat as you? (see Understanding Society COVID-19 Study: April 2020 questionnaire, page 25). The answers were based on: 1. Yes; 2. No. For our variable construction, we took yes as dummy 1 and no as 0, as we seek to differentiate the group of older adults who managed to receive informal care at the time of the pandemic.

(b) The independent variable 'Less informal care received' is created on the responses of the respondents about the change in informal care received during the lockdown that was imposed upon them as a preventive measure against Covid19 pandemic. We constructed this dummy variable where dummy 1 explains less informal care received by the respondents during the lockdown and 0 if represents otherwise. Concerning the informal care received, respondents were asked to answer the following question: "Thinking back to earlier this year, before the outbreak of the coronavirus pandemic. How has the help and

support you receive from family, friends or neighbours who do not live in the same house/flat as you changed?" (see Understanding Society COVID-19 Study: April 2020 questionnaire, page 26). The answers ranged from one to five, specifically: "1. There has been no change; 2. I receive more help from some people who previously helped me 3; I receive less help from some people who previously helped me 4; I currently receive help from family, friends or neighbours who did not previously help me; 5. Other". Since we are interested in testing the effect of the disruption of care and its potential effect on elderly mental health, we excluded from the sample those who reported to have received more care compared to the period before the Covid outbreak (13.67% of the initial sample) and those who reported "other". Then we constructed a binary variable for the disruption in the informal care received that takes value 1 and 0 if otherwise.

Table 6 - Description of care variables

| **Unit** | **Variable description** | **Variable name** | **Reference category** | **Construction method** |
|---|---|---|---|---|
| (1) | If received informal care in past 4 weeks during lockdown | Care received | | Dummy 1 if the respondent received care from outside household during last 4 weeks in April, 2020, 0 otherwise. |
| (2) | Disruption in informal care received during lockdown | Less informal care received | | dummy 1 if less care is received by the respondent during lockdown period, 0 otherwise |
| | | | More informal care received | dummy 1 if more care is received by the respondent during lockdown period, 0 otherwise |

| | | | | |
|---|---|---|---|---|
| | | | No change in care received | dummy 1 if there was no change in care received by the respondent during lockdown period, 0 otherwise |

**2.4 Methodology**

For our methodology, we utilized STATA 14 which is known as a widely used statistical software for data management and data analysis. With STATA, in order to design the dataset, we merged the two dataset that were from British Household Panel Survey (Wave 10) and the Understanding society dataset (April,2020) on the basis of the participant's unique identifier to originate a new dataset to proceed with. From the Covid dataset (Understanding society dataset, April, 2020), we had access to the informal care module that explains if the participant had received informal care and if the level of the previously received care increased, decreased and consistent with the informal care received during the lockdown due to COVID-19. We also utilized some of the demographic and socio-economic variables found on the dataset (British panel household survey, wave 10, 2019) collected before the pandemic. We created our model through employing demographic, socio-economic, health and care variables that were found and generated on the basis of these two datasets.

In order to estimate the potential effect that the disruption of informal care might have had on elderly's mental health, we employed two multiple linear regression models. The first model and the second model are estimated with an Ordinary Least Square Estimation (OLS) method. The first model tests the effect of the disruption of informal care on the "onset" elderly subject mental wellbeing in the time of the pandemic and the second model includes as control variable for pre-pandemic subjective wellbeing, shows and analyses the status of mental wellbeing for our sample before the virus outbreak in 2019. We worked OLS regression model as it generally has the ability to capture the relative influence of one or more independent variables on the dependent variable of the model as well as to determine the outliers. However, we had to check for multicollinearity among the predictor variables so that we could avoid the problems with redundancy and collinearity. For instance, considering marital status of the respondents in our model, we had two

variables, the first one as “married couple” explaining if the respondent was married/same-sex partners/living as a couple/former civil partner and next variable “with partner” explaining if the respondent was living with a partner. These two variables were 92% correlated with one another and therefore, for our model we picked the former one only.

We also worked with two probit models which is a familiar method to perform regression analysis for binary outcome dependent variables as ‘2019 dummy GHQ: Caseness’ and ‘2020 dummy GHQ: Caseness’ in our paper. We employ probit regressions for the robustness checks of our original regression models where the probit model 1 takes the pre-pandemic condition of respondent’s subjective wellbeing into account and probit 2 considers the same attribute of the identical respondents at the time of the COVID-19 crisis. Concerning GHQ-12 as our binary dependent variable, the participants with a score of 3 or more (on a scale 12 as the total possible outcome) are likely to be suffering from psychiatric disorders, for instance, anxiety, insomnia, fatigue, depression etc (Aalto *et al.*, 2012; Holi *et al.*, 2003). Psychological deterioration is computed as the difference in the GHQ-12 score between 2020 and 2019, where a positive value (greater or equal than 3) suggests worsening of mental health after the outbreak of the pandemic. Specifically, we constructed a dummy variable that takes value 1 if the variation in GHQ-12 score is greater or equal than 4, 0 otherwise.

# Chapter 3: Results

## 3.1 Descriptive summary statistics

Table 10 shows the descriptive statistics (mean and standard deviations) of the dependent and independent variables utilized in our models. First of all, considering '2020 Subjective wellbeing: Likert scale' as our dependent variable, we find a mean of 10.94 which is clearly greater than 9.77 which is '2019 subjective wellbeing: Likert scale'. As we already emphasized, the greater score for GHQ (subjective wellbeing: Likert) predicts the more deteriorating psychological health for the respondents and comparing the two mean values of these consecutive years, we can comment that in 2020, the higher value of GHQ scale predicts a worsening subjective wellbeing status of the respondents. Similarly, the variable '2019 dummy GHQ: Caseness' used in our probit model has a mean, $\mu = 0.104$ which is comparatively lower than that of 2020 which is, $\mu = 0.189$, we can interpret that the higher value of mean in 2020 shows a declining trend in respondent's mental wellbeing when compared with the lower mean value in 2019.

We witness the independent variable respondent age which we already mentioned to consider as equal to 65 years or above and the mean age falls within the range of minimum age (65) and maximum age (96) which is 72.02 for the total respondent sample where the sample size is, $n = 3202$ in total.

Looking at variable expressing gender (female) of the respondent, the 'female' dummy variable in our study shows to have the value of mean, $\mu = 0.5209$

To explain the dummy variable race, as mentioned in the table above the value of mean is,0.9409.

Considering the country of birth in the next variable, from the descriptive summary table, we see the dummy variable 'not born in UK' explaining if the respondent is born in UK or not and its mean value is, $\mu = 0.9434$

For the next dummy variable which is the 'region' where the respondent lives in urban, as a binary dummy variable as well and the mean value of the variable is, $\mu = 0.6742$for the total respondent sample.

In terms of the specific government office region (North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland and Northern Ireland) where the respondent lives, we have this variable with the value of mean, $\mu = 6.596$

For education as we have already mentioned that we took two different levels of education into account that is secondary level of education of the respondent and the tertiary level of education of the respondent for which initially, the respondents with a secondary level of education (GCSE) shows the mean value of 0.1867 and the standard deviation value of 0.389. In addition, the respondent with a tertiary level of education variable shows a mean value of 0.4506.

Furthermore, considering the dummy variable explaining if the respondents are capable of keeping themselves up to date with the bill payments, the value of the mean as 0.9906

In terms of another significant demographic variable that is marital status of the respondent that when the respondent is living as a married couple, the mean of the variable is 0.7592

For another indicator of determining respondent's future subjective wellbeing situation, we find the value for is 0.0790 from the table established.

The dummy variable that explains if a respondent had two or more pre-existing long-term illness or underlying health condition has the mean value for this variable as, $\mu = 0.3963$

If the respondent was tested for Coronavirus is emphasized through another variable termed as 'tested for coronavirus' has the mean score of 1.997 while the score of the standard deviation is calculated to be 0.046.

For the number of individuals who received less informal care during last four weeks during the pandemic compared with the amount of informal care they used to receive in the absence of the pandemic is explained by a dummy variable and its mean value, $\mu = 0.0371$.

Table 7 - Descriptive Summary Statistics

| Variables | Mean | Standard deviation |
|---|---|---|
| 2019 subjective wellbeing: Likert scale | 9.776 | 4.216 |

| | | |
|---|---|---|
| 2020 Subjective wellbeing: Likert scale | 10.94 | 5.009 |
| 2019 dummy GHQ: Caseness | 0.104 | 0.305 |
| 2020 dummy GHQ: Caseness | 0.189 | 0.391 |
| Age | 72.02 | 5.30 |
| Female | 0.5209 | 0.499 |
| Race | 0.9409 | 0.235 |
| Not born inside UK | 0.9434 | 0.230 |
| Urban area | 0.6742 | 0.468 |
| Regions | 6.596 | 3.03 |
| Secondary level of education | 0.1867 | 0.389 |
| Tertiary level of education | 0.4506 | 0.497 |
| Up to date with payment bills | 0.9906 | 0.096 |
| Married couple | 0.7592 | 0.427 |
| Worse future financial wellbeing | 0.0790 | 0.269 |
| 2 or more long-standing underlying illness | 0.3963 | 0.489 |
| Tested for coronavirus | 1.997 | 0.046 |
| Less informal care received | 0.0371 | 0.189 |
| Care received | 0.555 | 0.496 |

### 3.2 Empirical results

To begin with the analysis of the findings, this study tends to address the noteworthy differences in UK population mental health from before the COVID-19 pandemic and during the subsequent lockdown period imposed as a prevention measure against COVID-19. While being

consistent with our hypothesis, we found an overall increase in mental distress for the people in United Kingdoms aged equal to 65 or above in comparison with the previous year (2019) in the absence of the pandemic. As expected, this high rise in psychological distress did not affect all groups equally, with people in some demographic subgroups showing little (or no) additional mental distress after lockdown, while other subgroups showed remarkable increases such as the older adult group. The factors that we hypothesized would be most strongly correlated with mental health deterioration include age, gender, education, race, ethnic groups, location of living, living arrangement, marital status, economic situation, future subjective financial well-being, pre-existing health conditions, long-term illness, status of being tested and less level of informal care received due to physical and societal distancing if compared with the previous level of informal care received by the respondent. To begin with the analysis of the findings, this study tends to address the noteworthy differences in UK population mental health from before the COVID-19 pandemic and during the subsequent lockdown period imposed as a prevention measure against COVID-19. While being consistent with our hypothesis, we found an overall increase in mental distress for the people in United Kingdoms aged equal to 65 or above in comparison with the previous year (2019) in the absence of the pandemic. As expected, this high rise in psychological distress did not affect all groups equally, with people in some demographic subgroups showing little (or no) additional mental distress after lockdown, while other subgroups showed remarkable increases such as the older adult group. The factors that we hypothesized would be most strongly correlated with mental health deterioration include age, gender, education, race, ethnic groups, location of living, living arrangement, marital status, economic situation, future subjective financial well-being, pre-existing health conditions, long-term illness, status of being tested and less level of informal care received due to physical and societal distancing if compared with the previous level of informal care received by the respondent.

Table 8 - Results from multiple linear regressions and probit regressions

| Attributes | (1) Multilinear regression model (i) (2020 subjective wellbeing: Likert scale as dependent variable) | (2) Multilinear regression Model (ii) (2020 subjective wellbeing: Likert scale as dependent variable) | (3) Probit model (i) (2020 dummy GHQ: Caseness as dependent variable) | (4) Probit model (ii) (2020 dummy GHQ: Caseness as dependent variable) |
|---|---|---|---|---|
| Explanatory Variables | coef. | coef. | coef. | coef. |
| 2019 Subjective wellbeing: Likert scale (control variable for 2019) | | 0.52515<br>(0.0183) | | |
| 2019 dummy GHQ: Caseness | | | | 0.91983<br>(0.0775) |
| Age | -0.01210<br>(0.0160) | -0.01064<br>(0.0142) | -0.00585<br>(0.0051) | -0.00614<br>(0.0052) |
| Female | 1.84424***<br>(0.1729) | 1.29481***<br>(0.1554) | 0.45089***<br>(0.0561) | 0.42157***<br>(0.0573) |
| Race | -0.44910<br>(0.4512) | -0.32723<br>(0.4024) | -0.20113<br>(0.1361) | -0.16673<br>(0.1415) |
| Not born inside UK | -0.09493<br>(0.4585) | -0.05218<br>(0.4089) | 0.22586<br>(0.1439) | 0.22138<br>(0.1489) |
| Urban area | 0.09496<br>(0.1806) | 0.15477<br>(0.1610) | -0.01217<br>(0.0573) | -0.00315<br>(0.0586) |
| Regions | -0.02317<br>(0.0278) | -0.01774<br>(0.0248) | -0.00348<br>(0.0088) | -0.00432<br>(0.0090) |

| | | | | |
|---|---|---|---|---|
| Secondary level of education | 0.07881<br>(0.2392) | 0.06701<br>(0.2134) | 0.09178<br>(0.0761) | 0.09554<br>(0.0778) |
| Tertiary level of education | 0.40261**<br>(0.1879) | 0.46640***<br>(0.1675) | 0.16192***<br>(0.0602) | 0.17286***<br>(0.0617) |
| Up to date with payment bills | -5.06925***<br>(0.8872) | -3.53226***<br>(0.7930) | -1.13218***<br>(0.2543) | -0.98658***<br>(0.2618) |
| Married couple | -0.80436***<br>(0.2030) | -0.50381***<br>(0.1813) | -0.19961***<br>(0.0615) | -0.17054***<br>(0.0631) |
| Worse future subjective financial wellbeing | 3.16852***<br>(0.3171) | 2.26379***<br>(0.2845) | 0.64737***<br>(0.0890) | 0.57938***<br>(0.0912) |
| 2 or more long-standing underlying illness | 1.05195***<br>(0.1732) | 0.33683**<br>(0.1565) | 0.23112***<br>(0.0544) | 0.14200**<br>(0.0563) |
| Tested for coronavirus | -4.42945**<br>(1.7930) | -3.44898**<br>(1.5994) | -1.32797***<br>(0.4961) | -1.33174***<br>(0.5064) |
| Less informal care received | 2.29581***<br>(0.4426) | 1.84145***<br>(0.3950) | 0.49162***<br>(0.1243) | 0.44002***<br>(0.1268) |
| Constant | 24.9896***<br>(3.8920) | 16.4403***<br>(3.4839) | 2.93001***<br>(1.0950) | 2.69377**<br>(1.1211) |
| Number of observations | 3202 | 3202 | 3202 | 3202 |
| Log likelihood | | | -1435.9142 | -1366.1713 |
| Prob > F | 0.0000 | 0.0000 | | |
| Prob> $chi^2$ | | | 0.0000 | 0.0000 |
| R-squared | 0.1168 | 0.2956 | | |

| | | | | |
|---|---|---|---|---|
| Pseudo $R^2$ | | | 0.0756 | 0.1205 |

Standard errors in parenthesis

***p<0.01, **p<0.05, *p<0.1

***Sex (Female):***

From regression model 1 in table 9, our findings suggest that being a female old adult have a particularly strong influence on the extent to which mental distress increased under the lockdown period. For the female respondent, the findings indicate an increase of 1.84 (95% confidence interval from 1.50 to 2.18) in their subjective wellbeing GHQ: Likert which depict a worsened condition in mental being during the lockdown period than their male counterpart and the p-value is significant at the 0.01 level. While in the regression model 02, where we control for the subjective well-being of 2019 as the pre-pandemic period, we found this result as high as 1.29 (at 95% confidence intervals from .990 to 1.59), yet comparatively lower than that of April,2020 at the time of the pandemic. Hence, we can elaborate that the mental stress caused by the pandemic during lockdown time illustrates a highly negative impact on women's psychological wellbeing than the previous period.

***Level of education:***

In terms of education, our model takes three levels of education into account that the respondent who have education until secondary level (GCSE) and those who have tertiary level education. We found from our first multilinear regression model that people with secondary level of education tend to have a subjective GHQ wellbeing score of .078 (at 95% confidence interval from -.390 to .547) that is comparatively higher than the result found from the second regression model that is .067 (at 95% confidence interval from -.351 to .485) where we control for 2019 subjective wellbeing (GHQ). However, as the explanatory variable's p-value scores much less than its t-statistics value which is 0.782, the variable turns out to be insignificant. On the other hand, the respondent with a tertiary level of education shows a decrease in subjective wellbeing GHQ scale that is noted be .402 (at 95% confidence interval from .034 to .771) which is significant at 95% confidence interval and we found the score of the same variable to be .466 (at 95% confidence interval from .137 to .795) from the model where we control for 2019's subject wellbeing GHQ and the variable happens to be significant at the 0.01 level.

The interpretation of our findings for this education variable is that, the more the respondent is educated or knowledgeable with tertiary level of education, the more he is capable of understanding the intensity and the adverse effect of the pandemic in every aspect of his life, and apparently this understanding makes him more alarmed to abide by the pandemic measures and lead a comparatively healthier lifestyle than the ones with less education which results in his decreasing level of GHQ score as a comparatively lower of unfavorable impact on the status of psychological wellbeing while comparing with the group of respondent with secondary level of education. Therefore, when the participant is more aware of the socio-economic downturn caused by the pandemic due to their higher level of education, their mental wellbeing is seen to have a better outcome during the pandemic due to their higher level of education. On the contrary, the group of respondents with comparatively lower level of education, specifically with secondary level of education tend to experience more turmoil in their mental health wellbeing during lockdown which is shown by an increased level of coefficient than the previous year of pandemic.

***Subjective financial wellbeing in future:***

For evaluating the subjective financial or economic condition, we utilized two variables. The first one is to capture the capability to stay up to date with bill payments which shows if they are economically sound enough to afford their bill expenses and the second one is to speculate the future financial wellbeing status. Our findings suggest the first value (the variable explaining the respondent's affordability to stay up to date with bill payment) to be -5.06 (at 95% confidence interval from value -6.80 to -3.32) which represents a negative relationship with the subjective wellbeing GHQ: Likert on a scale of 36 and a negative value reflects that the respondent's mental health is subject to improve if he is capable to stay up to date with paying bills that is measured decrease in GHQ score and finally, this variable is proved significant at the 0.01 level. The same variable represented a value of -3.53 (at 95% confidence interval from -5.08 to -1.97) in the regression model where we control for 2019 subjective wellbeing. The next variable is employed to understand the respondent's future subjective wellbeing if worse and we found that for a worse prediction of future financial status, the mental wellbeing decreases by 3.16 (at 95% confidence interval from value 2.54 to 3.79) that is proved to be significant at the 0.01 level where in the pre-pandemic time in the previous year, the psychological wellbeing was seen to decrease by 2.26 (at 95% confidence interval from value 1.70 to 2.82).

***Pre-existing underlying medical condition:***

In addition, our findings address that being an old adult and living with pre-existing underlying health conditions have had a particularly strong influence on the extent to which mental distress is proved to get increased to 1.05(at 95% confidence interval ranged between 7.12 and 1.39) in the regression model 1 under the lockdown period from 0.336 (at 95% confidence interval ranged between .029 and .643) in the regression model 2 here we control for 2019 subjective wellbeing in GHQ scale. This result interprets the greater psychological distress in older adult's mental wellbeing who were already dealing with pre-existing heath complications such as cardiovascular disease, diabetes, chronic respiratory disease and many more and therefore, the variable is proved to be significant at a 0.01 confidence level.

***Marital status:***

One of our important demographic variables includes whether the respondent is living as a married couple or not. Statistics show that, for the elderly person who are seen to live as a married couple represents a value of -.804 in the first regression model that is significant at 0.01 level. This interprets that the elderly people who are living as a married couple tend to suffer from less mental health injury during lockdown period.

***Tested for coronavirus:***

In our model, another important dimension was about older adult's being tested for COVID-19 and from our findings we witness a substantial increase in GHQ score of the respondent who essentially took the COVID test even if the result of the test was unknown so far. Compared to the model where we control for 2019 GHQ and the concerned variable shows a value of -3.44 (at 95% confidence interval from -6.58 to -.312), the 2020 model shows an increased result of -4.42 (at 95% confidence intervals from 1.42 to 3.16) which shows a negative correlation with the subjective wellbeing GHQ: Likert and emphasizes that respondents who took the test for coronavirus tend to have a comparatively better mental health situation that is represent by a lower level of GHQ score in the multiple linear regression model 1 and the variable shows to be significant at a 0.05 confidence level.

***Informal care received:***

Speaking of informal care, mean population GHQ-12 score increased from 1.84 (at 95% Confidence intervals 1.06-2.61) in 2019 to 2.29 (at 95% confidence intervals 1.42-3.16) April, 2020 on the basis of receiving less informal care by the respondents. This finding portrays a substantial increase in psychological traumas represented by a greater score of GHQ level. Therefore, we witness that during the lockdown period, older adult's mental health wellbeing tends to get worse as they afford to receive less informal care from family and friends due the prevalence of the pandemic. Furthermore, for the variable of care received, explain if the respondent received any support from outside household during last 4 weeks at the time of the ongoing COVID-19 crisis, the mean for this variable is 0.555

***Probit regressions:***

We conducted two probit regression model for the robustness check and the numeric result we found is presented in the table above. From the output table, we see that we employed 3202 observations in total for which all of the response and predictor variables are non-missing. From the table we see the coefficients, their standard errors, the z-statistic, associated p-values at the 95% confidence interval. Probit regressions provide coefficients in the form of Z-scores.

In the first probit model, the value -1435.9142 expresses the log likelihood of the fitted model which is utilized in the Likelihood Ratio Chi-Square test of whether all predictors' regression coefficients in the model are simultaneously zero. In a similar way, the value of log likelihood is -1366.1713 in our second probit model where we control for the dummy GHQ from 2019.

Now, looking at the Prob > chi2, our first probit model portrays the chi-square of 235.03 with 14 degrees of freedom where its associated p-value has a value of 0.000 which is less than 0.001 and this formulation of values tell us that our model as a whole fits significantly or has a better goodness of fit than an empty model. This is sometimes called a likelihood ratio test (the deviance residual is -2*log likelihood). From our second probit model where we control for 2019 GHQ dummy, we acquire a value of 374.52 for our chi2 with 15 degrees of freedom and the associated p-value is less than 0.001 that also represents this as a significant model.

Unlike ordinary least square-$R^2$, log-likelihood-based pseudo-$R^2$s do not represent the proportion of explained variance but rather the improvement in model likelihood over a null model. However, our first probit regression model shows a value of 0.0756 for pseudo-$R^2$ and in the second probit regression where we include the GHQ dummy variable for 2019, we find a value of 0.1205 of the pseudo-$R^2$.

For interpreting the finding from our probit regressions, we analyze the change in the z-score or probit index for an additional unit change in any of the predictor variable which is provided by the probit regression coefficients. For instance, in terms of female dummy variable, from Probit model 1 we can say that compared with their male counterpart, women are more likely to suffer from worsen mental condition as the coefficient of this variable increases from 0.421 (at 95% confidence interval from approximately 0.309 to 0.533, derived from the second probit regression including the 2019 dummy GHQ) to 0.450 (at 95% confidence interval from 0.340 to 0.560). The change in coefficient of female dummy variable is therefore, can be analyzed by its z-score. For female, the variable shows to be significant at 0.01 level according to its p-value (0.000).

In a similar way, the respondents with tertiary level of education are more likely to have a deteriorated mental health wellbeing as the coefficient for this variable represents a value of 0.161 (at 95% confidence interval from 0.043 to 0.280) which is significant at 0.01 level, yet this coefficient value is comparatively less than the coefficient value from the second probit model where we control for 2019 GHQ and the coefficient is .172 (at 95% confidence interval from .051 to .293)

For the respondents, who are up to date with payment of bills, we can say that they are less likely to have a deteriorated mental health condition during this pandemic as the coefficient for this variable is -1.13 (at 95% confidence interval from -1.63 to -0.63) in 2020 and -0.986 in 2019 (at 95% confidence level from -1.49 to -0.47) which is significant at 0.01 level. For the next explanatory variable, a person who is married is less likely to have a deteriorated mental health condition as the coefficient for married couple in probit model 1 is -0.199 (at 95% confidence level from -0.32 to -0.07) and in probit model 2 which is -0.170 (at 95% confidence level from -0.29 to -0.04) and both these values are significant as the z value is 0.001 in model 1 and 0.007 in model 2 respectively.

Moreover, for the respondents who are at a risk of having a worse future financial wellbeing, are more likely to have a deteriorated mental condition as in our probit model 1, the coefficient of the associated variable is 0.647 (at 95% confidence level 0.47 to 0.82) and in probit model 2 which we are considering as a control for 2019 is 0.579 (at 95% confidence interval from 0.40 to 0.75). Both of these values have significance at 95% confidence level as the z value for them is 0.000.

People who are suffering from 2 or more underlying illness are more likely to have a deteriorated mental health condition during covid-19, as the coefficient of the variables associated with this condition are 0.231 (at 95% confidence interval from 0.12 to 0.33) in model 1 and 0.142 (at 95% confidence interval from 0.03 to 0.25) in model 2 with a z value of 0.000 for model 1 and 0.012 for model 2 respectively. Hence, it can be said that at 95% confidence level, this variable has significance in both of the models.

For the participants who could get tested for coronavirus are more likely to have a comparatively better psychological health condition in comparison with the group of participant who did not take the test during the pandemic and this is why, we observe the coefficient of the variables to be -1.32 (at 95% confidence interval from -2.30 to -0.35) in probit model 1 and -1.33 (at 95% confidence interval from -2.32 to -0.33) in probit model 2 with a z value of 0.007 for model 1 and 0.009 for model 2 respectively. Hence, it can be said that at 95% confidence level, this variable has significance at 0.01 level in both of the models.

Last but not the least, correspondents who received less informal care are more likely to suffer from worse mental condition as the coefficient of this variables are 0.491 (at 95% confidence interval from 0.24 to 0.73) in model 1 and 0.440 (at 95% confidence interval from 0.19 to 0.68) in model 2 with a z value of 0.000 for model 1 and 0.001 for model 2. Therefore, it can be said that at 95% confidence level, this variable has significance in both of the models.

Finally, from the analysis and interpretation of the co-efficient and p-values of the variables mentioned in the table above derived from both the regression analysis, we can conclude which variables are proved to be statistically significant at what amount of significance level and which are not. From our models, for the total observation (n = 3202), the findings that we have established are also consistent with our initial hypothesis and evident that during the lockdown period in April 2020, due to the pandemic measures taken by government authority to restrict face-to-face

interaction, the informal care received by the elderly people substantially decreased as the older population we were shielding as being categorized as clinically extremely vulnerable group. Due to this reason, the older adults were largely deprived of the informal care that they used to receive previously in the absence of the pandemic and therefore, the psychological wellbeing of these elderly population was adversely affected and throughout our regression model analysis, we can see this immense negative impact. To summarize, the results derived from probit models show the robustness of the multiple regression models employed in the study.

# Chapter 4: Discussion

## 4.1 Discussion of the findings

The findings of this study can be utilized as a basis for acknowledging the well-being issues associated with social distancing and isolation especially among vulnerable and disadvantaged groups. So far, we have witnessed mixed outcomes of different measures imposed by the government such as lockdown, social distancing, wearing mask in outdoor places, shielding and so on to minimize the infection rate and the deaths due to the global pandemic. As we already discussed that the Covid-19 pandemic has hit the older group of population (aged equal to 65 or above) hardest due to their increased vulnerability such as weaker immune system and pre-existing underlying health complications which unfortunately makes it significantly harder to fight infections while compared with the other age cohorts. This is why, they were more exposed to the pandemic and was explicitly advised to minimize contact with outside people and stay at home to reduce the risk of the virus infection. Due to this social distancing, the amount of informal care they used to receive in the previous period in the absence of pandemic got reduced and apparently, this interruption in their informal care resulted in a worse outcome of their mental health wellbeing. As our sample was constructed with the older adults, a large number of them were already dealing with a lot of pre-existing health conditions such as high blood pressure, diabetes, cardiovascular disease, chronic respiratory disease and many more.

From the findings of a relevant paper by Evandrou et al. (2020), we can observe that one in five people who are aged 70 and above and living alone could not manage to receive any support or care from informal sources outside their own household. We can interpret from the studies that

due to the lacking of informal care in the time of lockdown, the older people faced increased level of difficulties to deal with their daily chores that could be easily managed in absence of social distancing. Moreover, loneliness during the lockdown period can also have an adverse impact on the psychological wellbeing of the elderly. A significant number of researches suggests that loneliness can be largely associated with a higher risk of mental disorders including anxiety, depression, low self-esteem, sleep apnea, insomnia and increased level of stress. The elderly people living alone when any non-co-resident informal carers are not allowed to visit them to provide with informal care during lockdown, their needs for daily living are not being met and, in some cases, this unmet need for informal care might overweigh the benefits of their shielding or staying at home during lockdown period. To summarize, the insight of our paper as well as our findings on the stressors affecting the quarantined older adult's mental wellbeing can be further utilized by concerned parties in order to realize to address the psychological issues among elderly and other clinically vulnerable groups.

***Sex (Female):***

If assuming that some our female respondents are living as a married couple with their spouses who also in need of informal care (especially during stay-at-home order) and in this scenario, if the women traditionally tend to play role in providing their partners with informal care at any extent, a large number of previous studies addresses the diminishing mental wellbeing under this circumstance. As we can assume, at the time the pandemic, it is quite impossible to get assistance or care from the friends and relatives who are not living under the same roof, let alone the formal caregivers. Therefore, this is easily to expect that in the elderly households where both the husband and wife are living together during the pandemic, they tend to help each other and according to a large number of existing literature, historically there has been an ideology established that of men's and women's work sphere are considered to be different which promotes the idea that women are easily expected to provide uncompensated cared to the members of family who require informal care at home (Hooyman, 1990). However, this tendency of women caring for other household members often proved to be burdening and seen to result in severe level of stress, depression, emotional disorder and diminishing mental health wellbeing for the caregiver group of women (Murray & Livingstone, 1998).

Taking the above probable circumstances into account, during the pandemic it is not actually feasible for the female caregivers to have some leisure time with friends or neighbors which opens up the way to gain emotion support through social networking. To reduce the stress level, however, another appropriate and quite effective approach may include being familiar and utilize the extra coping tools on some websites targeted to this group of informal caregivers in order help them on the process (Tuithof et al., 2015).

***Level of education:***

For education, different previous studies have identified the correlation between education level and mental health wellbeing as higher levels of education generally comes as an advantage through enhancing people's skills and enabling better coping mechanisms and overall resulting in a better mental health condition. Elaborating on our findings for the respondents with tertiary level of education, we witness a tendency of this group of people to have their mental health less deteriorated during the turmoil of the pandemic while compared with the mental wellbeing of the respondent group who acquired secondary level of education. For explaining this outcome, we consider the higher level of education that might have played a strong role in the perception of pandemic for the former group of people and the opposite trend happened for the latter group of people with combatively lower lever of education. According to a study conducted with a German representative sample ($N = 7937$), a respondent's educational level was investigated through a cross-sectional approach that if it shows any correlation with depressive symptoms as mental disorder and the research found significant research evidence showed that education and psychological health are closely intertwined that low education is associated with less metal health wellbeing (Neimeyer et al., 2019). Therefore, we can interpret the result from the previous studies while applying into the current situation that, this is highly probable that the people with higher level of education could utilize their knowledge at the time of the pandemic through practicing the lockdown or other necessary measures properly. On the other end of the spectrum, people with less education level are seen to be more likely to believe, miscommunicate and spread false news while misinterpreting and sharing misinformation as well without verifying the source creditability which might result in a more panicked situation while making their subjective mental health wellbeing substantially fall which is explicitly shown in a study[9]. This situation again proves the

[9] https://news.ku.edu/2020/04/28/study-shows-vulnerable-populations-less-education-more-likely-believe-share

necessity of proper education in the society, especially for those who are vulnerable to these risk factors and also the necessity of health and awareness campaigns as prevention measures against covid-19 for those having a somewhat lower level of education (The World Bank, 2020).

***Current financial wellbeing:***

As a predictor for respondent's economic situation and financial wellbeing we examined through the variable about the status of respondent's staying up to date with payment bills to analyze the economic wellbeing of the participant. We also tried to investigate the interrelation between mental health status changes with the economic wellbeing of people. For our study, as we narrowed down and only focused on the people aged equal to 65 or above, we necessarily did not take the employment status into account as according to UK retirement policy, 65 is the default retirement age as determined by the government of United Kingdom and hence, most of the respondents might show the employment status as retired, if not all. This is why, instead of considering employment status, we tried to understand the economic situation of the sample population by the variable that defines the status of respondent's staying up to date with the payment bills. As a matter of fact, numerous previously executed studies have found the intimate relation between people's financial wellbeing and mental health status. One of the studies conducted with a sample of 34 653 noninstitutionalized adults from United States showed that these participants with an annual household income of $20 000 were revealing higher risk of mental disorders while compared with those participants with an annual income of $70 000 or more which further implies that lower levels of respondent income are associated with a number of mental disorders including suicidal tendencies (Sareen et al., 2011). In addition, Sareen et al. (2020) also emphasized that it seems to be necessary for policymakers and concerned authority to seek for optimal and effective measures of intervention for mental disorders among low-income citizen.

***Subjective financial wellbeing in future:***

We inspect the relationship between future financial wellbeing and mental health which also showed a decreasing trend in our model and the interpretation is same as the previous one. Existing data found that financial and psychological wellbeing are intrinsically linked and from a prior research conducted on the basis of the great economic recession (2006-2010) with a total of 5,366 respondents seeks to examine if the economic setback contributed to respondent's worsening

depression and other mental disorders over these 4 years of period. Later, the study found that for worsening wellbeing of psychological health between 2006 and 2010, financial strain was proved to be a highly significant and robust reasoning behind this (Wilkinson, 2016). Therefore, relating this with the ongoing pandemic, we can comment that the current crisis has taken a toll on people's mental health due to an increasing uncertainty in their future financial wellbeing as well as the country's economic growth in the long run.

***Marital status:***

In our study, the respondent whose marital status was married tend to show a negative correlation with the General Health Questionnaire score which translates into a better subjective psychological wellbeing at the time of the pandemic. Prior studies show that there remains some distinguishable differences in stress level given the groups where the participant belong to such as married, separated/divorced, widowed and never married groups and in addition, one study conducted on a sample size of 3,617 American individuals found that found that among the married group of people, psychosocial resources (include capacities, skills, beliefs, coping strategies, optimism, talents and other individual personality traits in handling stress) were seen to be highest and depression was lowest compared to other groups with different marital statuses (Cotton, 1999). Considering the current time of the global pandemic, according to a study by Hamermesh (2020), for the married couples, their mental satisfaction was found to be hit hard was reduced to high extent mostly due to the uncertainty involving future economic condition and overall life as an adverse consequence of the pandemic (Wilcox, 2020). However, this effect was seen to be partly reduced and indicated a positive trend in their subjective wellbeing primarily as a result of them spending more time with their spouse while the opposite trend was found in terms of the individual spending their additional time on their own (Hamermesh 2020). In the light of the discussion above, we see that living alone has increasingly been difficult in the time of the pandemic when visiting outside people has been restricted, therefore the informal care received by them has mitigated as well and furthermore, cause to a substantial reduction in subjective psychological wellbeing of the respondent as found in our study.

***Pre-existing underlying medical condition:***

We examined in our study if the respondents suffering from two or more chronic pre-existing health issues are prone to a decreasing trend of their subjective mental wellbeing and we found the

variable statistically significant. Therefore, our study shows evidence that psychological health does follow a deceasing trend for people with two or more underlying diseases or health condition. The elderly people feel increasingly threatened by the risk of being affected with coronavirus due to primarily their weak immune system as strong immunity is a key to fight against the infection of COVID-19 (Hangargekar et al., 2020). According to the previous literature, Italy is one of worst hit European country during the current pandemic where in 2020, the amount of population aged 65 years or older apparently constituted 23.2 percent of the total population (Varrella, 2021) and it is acknowledged that a higher percentage of older person are severely exposed to the infection of the concerned virus that leads to increasing deaths (Stewart, 2021) ) due to their pre-existing two or more medical conditions such as cancer, chronic kidney issues, chronic lung diseases, asthma (moderate-to-severe), interstitial lung disease, cystic fibrosis, and pulmonary hypertension, dementia, diabetics, obesity down syndrome, heart conditions (NCIRD, 2020)[10].

***Tested for coronavirus:***

Due to the limited resources available for testing COVID infection at the initial phase of the pandemic outbreak, it created huge hue and cry as testing is inevitable to identify the infected people and isolate them, especially those who are asymptomatic (Odubanjo, 2020). Because of older adult's increasing vulnerability, their test sample could be collected from their homes instead of bringing them out to hospital which is also a risky place considering their sensitivity of immune system. As a matter of fact, when the people were deprived of necessary testing due to short supply of testing equipment, they are easily expected to more stress out when they show any symptom that matches with COVID-19 symptoms (even can be a mere flue) that might lead to an overall decreased mental health wellbeing.

***Provision of informal care:***

In terms of the elderly population who are in a constant need of care primarily due to disabilities and health complications, informal care sector indicates a significant proportion of care providers including the older adult's immediate family members, friends, neighbors and close relatives in some case. From a prior study conducted with 55 elderly respondents including 21 men and 23 women (mean age = 67.6) who were receiving informal support from informal sources

[10] https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html

were observed in order to examine and identify the type of support they were receiving and the quality of care they were receiving as well as their feeling and perceptions about the care that they were receiving from these informal sources of care. It was found from this same study that these elderly people required help from their carers with managing household chores such as cleaning, preparing meals and shopping and other assistances they demanded included keeping the participant safe from household accidents, helping with dressing up and other different kinds of personal care (McCann, 2001). As we have already discussed earlier in the paper, due to the ongoing COVID-19 outbreak, receiving informal care has increasingly been challenging, if not totally impossible for the elderly people. The outbreak of this current pandemic has led to monumental disruption of healthcare where both the parties who provide care and those who receive face significant risk which might even lead to higher health inequalities for particularly the high-risk groups (Egan, 2020). All these risk and uncertainties revolving the pandemic while added with the disruption in informal care apparently result in the older adult's lower level of subjective psychological wellbeing, being consistent with our findings. However, in an era of technological advancement, innovations on digital healthcare could possibly make path for noteworthy outcome with wise planning and execution (Egan, 2020).

### 4.2 Limitations of the study

As pointing out the limitations of this study, our study inspected which characteristics were associated with a subsequent decline in mental health wellbeing under initial pandemic measures such as societal distancing, lockdown, shielding and so on. However, the COVID-19 questionnaire is seen to acquire a response rate which is less than 50%, and moreover, the responses were significantly differed among age, gender, education, ethnic group, economic situation, health status, and other attributes despite of the UKHLS being considered as a high-quality probability sample cohort study. Another potentially important source of bias is attrition even though the non-responses were adjusted through applying survey weights. In addition, we cannot comment on GHQ-12 being a clinically approved assessment for the respondents although it indeed is a screening mechanism that is capable of making a strong reliable correlation with the existence of psychological illness where a threshold with notably high score was applied (threshold value to be four or more) for the analysis of prevalence of the mental illness symptoms. Furthermore, the GHQ-12 method is seen to underestimate both socioeconomic and ethnic disparities.

Another limitation to be noted is that, even though the sample size was quite large enough, but still it was somewhat underpowered to identify the recurring changes for some groups. Being specific, measuring significant differences by various ethnic groups as well as for men and women separately within particular ethnic groups was proved to be a major limitation and another prime setback of the study. In addition, The UKHLS takes only the people into account who reside in private household settings only and we can assume that these individuals are typically at lower level of risk if compared with the ones living at nursing homes, psychiatric facilities and prisons. However, the latter group was not sampled in UKHLS data which we can consider as one of the significant shortcomings in our study. Moreover, we were clearly able to examine a notably few number of Black, Asian and minority ethnic respondents in our sample. However, these dimensions can be considered to evaluate the mental health burden associated with the ongoing global pandemic in these groups in further studies of this research field. Then again, between Wave 10 survey and the COVID-19 survey, there were notable differences in the approach of the questionnaire administration due to which the reporting of the responses might have been potentially affected by a biased procedure. For instance, in Wave 10 questionnaire, the GHQ-12 was usually self-completed by the respondent and in some cases with the interviewer present as a part of a in person interview, whereas the COVID-19 questionnaire was entirely completed through online questionnaire and this differences in the interview process is subject to produce a biased response sheet on different response levels. Moreover, for the respondents who are unable or unwilling to get part in the survey online, the total time to get their data in future would take periods of time and if yet not available during analysis, could potentially result in introducing bias as well. Furthermore, for conducting the comparative analysis, no contemporaneous control group was available to consider and this is why we are unable to eliminate the secular changes except from those predicted ones from earlier dataset. Therefore, we are unable to be optimistic to terminate other ecological drivers of change in terms of psychological wellbeing that might have influenced our findings.

## Chapter 5: Conclusions

Based on the discussion above, to summarize, this paper clearly pointed out the negative consequences on older adult's psychological wellbeing due to the disruption in informal care provision which was caused by the lockdown imposed as a prevention measure against the COVID-19 pandemic during April, 2020. Moreover, the findings of the paper were consistent with our initial hypothesis that elderly's mental health tend to decline when they receive lower level of care from the informal sources. In addition, with empirical evidence, we were able to show this fact and its magnitude that at what level the mental health was deteriorating for the respondents compared with the previously received care as a consequence of limited care received at the time of the global pandemic outbreak.

About the prospect on the future researches in this field, the massive amounts of data collection that is being carried out right now are expected to discover numerous significant new insights on different dimensions of both COVID-19 effects and stressors of mental wellbeing transition. Furthermore, the different recent experiences of countries involving the pandemic generally offer a huge fertile ground for researchers to continue their in-depth studies on the drivers of the psychological health change in a way that is highly likely to influence future policy implementations. Considering the interesting prospects for longitudinal studies on the basis of different mental disorders as depression, anxiety and many more, different significant implications will be generated indicating numerous mental and socio-economic consequence of the coronavirus around the globe. Therefore, increased opportunities for international comparative study can be originated utilizing these internationally comparable datasets. Overall, this whole process will initiate a way of improved global understanding of psychological health effects which might lead the researchers to analyze the different impact of the pandemic on its international settings and government's responses to it to investigate causal processes.

Finally, at the time of writing this paper, we can witness a plethora of uncertainties on how the total psychological consequences may turn out to be at the end as many countries are still going through lockdowns and various socio-economic restrictions due the second and third waves of the COVID-19 and its newly developed more contagious variants. Writing about the recent improvements of the pandemic situation, in order to minimize the devasting impact of the pandemic, some vaccinations have already been developed and made available to the people. The

people in UK have started to take vaccinations and as a clinically vulnerable group the elderly population in UK was considered as a priority group to get vaccinated. As a matter of fact, according to BBC (2020), the first person to get vaccinated (Pfizer Covid-19 vaccine) across the world was 90 years old grandma, Margaret Keenan from UK. However, as we have already discussed earlier, people with long-term illness or underlying medical condition are yet to show the consequence of vaccination which is why it might be time-consuming to understand and realize the total effect of vaccination on the population health. To be noted, perhaps the findings on the effectiveness of vaccination will also produce difference in results due to the different type of vaccinations[11] taken by the people such as, OXFORD, Pfizer, Moderna, Valneva, Johnson & Johnson and available other ones.

[11] https://www.sciencefocus.com/news/covid-vaccine-uk/

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