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Impact of Income on Mental Health during COVID times - findings from SHARE

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TITLE

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ABSTRACT

During COVID-19 stressors of Mental Health problems increased drastically as the majority of population was confined in lockdowns. People with better financial and economic resources could have been more resilient to the challenges on their MH. The purpose of this study is to understand this relation, starting from the SHARE Corona Survey (SCS) population based longitudinal database of Europeans aged 50 and above, through two main research questions: 1. To examine the association between income and mental health using Survey 1 for Axis I mental disorder variables present in the database, for which a negative interaction was found; 2. Given the same income across Surveys, to study whether people with higher income were more likely to increase or maintain their previous level of mental health, which it is not necessarily the case.

KEYWORDS: Mental Health, Health Economics, COVID-19 Pandemic, Older Adults, Income, SHARE

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1. INTRODUCTION

The caducity of humankind has proven to be a central aspect of our modern times. Less affected by armed conflicts at a global scale, our existence has become an uprising of cognitive abilities, which is also reflected on our improved physical skills. The work on the mind has helped people in better specializing in different activities and obligations. Physical excellence is though granted to those who persevere it and exercise the great force of the mind; as the world evolves, it is not anymore a common factor. As much as globalization is taking place, sedentarism is in parallel developing. Everything is easily accessible by our homes and we have less and less the need to go out and physically retrieve our needs.

It is in this context that the Covid-19 pandemic took place; and especially reflected in its safety measures. Globalization was the primary cause of the spread of the SARS-COV-2: people travelling all over the world were often unconsciously carrying the infection and extending it outside their home countries. But it was only thanks to today's abilities to deliver goods to homes and work from there as well, that the lockdown had its effects in slowing down the virus.

On December 31st, 2019 the Country WHO office in the People's Republic of China collected a media statement from the website of the Wuhan Municipal Health Commission on cases of a 'viral pneumonia'. On February 11th, 2020 WHO called the new virus as we know it today: Covid-19; by March 13th, 2020 WHO Director-General mentioned Europe as an active center of the pandemic with more reported death cases than the rest of the world combined, apart from PRC.

Technology advancements were not only among the major drivers of the pandemic recovery, but also one of its major drawbacks. On one side, without existing technologies, the lockdowns implemented all over the world to fight the virus wouldn't have been possible even only ten years ago.

On the other, embracement of digital and/or shift to online communication means have tripled during Covid-19; respondents (businesses) of a survey confirm that they are three times more likely to say that 80% of their customers interactions happen by online means, now compared to before the pandemic (McKinsey, 2020).

However necessary, the explosion in digital adoption was in many cases forced and rushed by the needs of keeping up a business, maintaining a position, and last but not least to maintain contacts with the outside world when locked up in one's home. The expression of social interactions shifted almost completely in an online form, a change to which many age, social and demographic groups were not ready to confront so quickly.

There is evidence on the beneficial support that social interaction can give in times of stress and mental fatigue. Prior researches show how videoconferencing can attenuate the effects of mental disorders like loneliness or depression (Tsai, Tsai, Wang, Chang, & Chu, 2010). Although as mentioned, the context and the speed at which new means of communications and stress relief were spread, made it difficult to adapt for some categories more than others.

Another relevant factor affecting people's lives during the pandemic's lockdown was their ability to sustain their lifestyle. **In the scope of this study is indeed the willing to address how economic resources, could impact on people's MH dimensions**. Using different covariates explored in the Methodology, together with an income explanatory variable we will see if higher income could positively affect people's mental health. Moreover, whether the same level of income could act as a barrier to a worsening of such mood (for which is intended the dependent variables of the different regressions: depression, loneliness and trouble sleeping, further introduced). At EU level, the total employment income decreased by -4.8% in 2020; a change due to absences, laid off workers and reduced hours of work. The effects of such reductions were mitigated of about 2% by a wage compensation scheme, even though not

always efficient at the household level (Eurostat 2020). The severe social distancing measures imposed by the governments led people to collect their properties and close up in their homes. Many businesses were shut off; people with a lower income would be expected to find more difficulties in sustaining themselves during the recession period.

The numerous studies conducted on the pandemic showed evidence on the mentioned disparity of its effects. **The increase of stressors due to the pandemic and quarantines is reconducted to a strong negative impact on the global mental health condition** (Brooks et al., 2020).

These stressors, often associated to financial and economic distress and insecurities were not equally distributed among the population; usually affecting less wealthy and less educated people (Claes, Smeding, Carré, 2021), a finding that will be later confirmed by this research. Previous studies report how people who had less access to outdoors (as well as smaller housing or lower quality indoor) during lockdown were more subject to depressive and anxious symptoms (Amerio et al., 2020). A further study found students with a steady family income or a higher income in general to be more resistant to mental health changes, reporting lower anxiety (Rudestine et al., 2020).

The conditions on mental health, at the global scale, were not only impacted anymore by the previous financial and social challenges, but also by the strong uncertainty about the future. Even though it is still difficult to quantify the impacts that the recession had during its peak, and the ones we are confronting now and will for time to come; emotions at the time were very negative. A World Bank forecast in 2020 was signalling a shrink in the global economy by 5.2 % and a reduction in income per capita of 3.6 % in that year, bringing a lot of people to the face of extreme poverty World Bank, 2020).

This shift and shrink in resources during the pandemic decreased the attentional control (a concept that is more extensively analysed in the next section) of people over their lives. Not

ready to such an impactful shift in their lifestyles, the global population has combated as it could isolation issues and the need for social interactions.

To then better understand the relations and effects of people's characteristic on their state of sanity of minds, a deeper focus is presented on mental health, what it is and its different natures and origins; as well as a more concise view on the particular forms of mental health problems included in this study.

2. LITERATURE OVERVIEW

One of the most resourceful origins of the Latin's wisdom, was actually their willing to embrace and reproduce the incredibly mindful and studious Greek knowledge and culture.

It is from Greek inspiration that Juvenal, a Roman poet came up with the famous motto: "*Mens sana in corpore sano*" (Juvenal, AD 100-127). The motto can be literally translated in: "**A healthy mind (resides) in a healthy body**".

Body and mind are the two major components of our existence and hence need to cooperate to enable us in maintaining a healthy state. During the pandemic period, the lack of physical movements of any genre had interfered with people's ability to keep the mind in a good state through physical exercise.

There are though other ways we can help our mental health be in shape. WHO defines mental health as not merely the absence of disorders, but rather the state of mental well-being. The first lines of the Constitution of WHO recite: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1948). Furthermore, mental health is determined by an integrative range of biological, environmental and socioeconomic factors.

The American Psychiatric Association publishes a diagnostic and taxonomic tool to identify and classify the different mental disorders called "*Diagnostic and Statistical Manual of Mental Disorders*". In the last publication (DSM-5-TR, 2022) a revision of the previous 2013 version; different Axes of disorders are listed. For the purpose of this study; and to give a general understanding, **we will focus on three Axis I mental disorders: depression, loneliness and sleep disorders**. Although there are many criticisms on the scientific criterion for diving disorders in such Axes, Axis I (hence the abovementioned disorders taken into consideration) refers to clinical disorders. It is the first most comprehensive group, including any conditions other than mental retardation, personality disorders or psychosocial and environmental disorders.

Depression.

The recent pandemic and recession along have significantly stressed the importance of paying attention to people's mental health. According to a recent scientific brief released by the World Health Organization, **the global prevalence of anxiety and depression has increased by 25% in the first year of the Covid-19** (WHO, 2022). If depression before was a burden, it has certainly now gained a spotlight position in the health-related issues. Again, less affected by physical problems, by which I mean the exponential increase in scientific progress we have made in the cure of such issues, humankind is more and more susceptible to mind related complications. Defining a state of depression is not an easy task, indeed less tangible than physical pains.

It is especially difficult to analyze as it can be a temporary mood, with few repercussions on one's lifestyle, identifiable with tiredness, lack of hope, sadness or difficulty to enjoy a certain situation. It becomes dangerous when it falls into being a **clinical condition**, with these 'symptoms' becoming persistent and evolving into more severe states. The most acute form it can take, defined as Major Depressive Disorder (MDD), was actually ranked by WHO as the

third cause of the burden of diseases all over the world in 2008 (Bains, Abdijadid, 2021), predicted to become first by 2030. And Covid-19 did certainly reinforce this prediction.

The severity of depression is externalized through both physical and mental factors; changes in appetite, sleep patterns, as well as energy level bumps, low concentration and self-esteem. As mentioned earlier, attentional control can pay an important role in the management of such mental health problems. Other than regulating the importance we give to all the distractors in our daily life. Lack of control over our moods and emotions is what leads into falling into these disorders, but most importantly is what causes the shifts between them. **Associations between mental disorders are very common**, as one can lead to another without a clear definition of causality (reverse as well) or even simultaneity in many cases.

Attentional Control

From a study on anxiety, and its effects on cognitive performance and attentiveness; it was shown how **mental distress can impede attention** (and *vice-versa*, low attentional control can increase mental distress). The Attentional Control Theory developed by M. W. Eysenck (1992) was an important milestone in defining the increase in effort that anxious people needed to exercise to achieve greater performance. Having control on our attention, and actually shifting our focus and strengths towards what is the task can be a powerful tool against mental health problems.

Attentional control can be defined as "*one's ability to focus and shift attention in a flexible manner*" (Chen, Barnes, 2012), dividing its concept into two main ideas. Our attention can indeed be divided into two main factors: specific focalization when we are facing stressors or distractors; and the ability to shift the attention among competing focuses or tasks (Judah et al., 2014). **These studies show how poor attentional control can lead to negative thinking**, difficulties in focus and hence set the basis for the emotions proper of the studied mental disorders. Especially during Covid-19, having maintained a focused (and positive) attitude, for

how difficult it could have been, would have shown a greater attentional control, resulting in less mental troubles. Rumination about the stressors inevitably links with more worry, less control and ultimately depression, anxiety or associated disorders (Armstrong, Zald et al., 2011). What many trainings and psychological cures try to do to extirpate mental health is indeed to help people achieve a better attentional control over their focus, especially when under the influence of stressors.

Loneliness.

Solitude, isolation and loneliness are difficult concepts and usually (and erroneously) used interchangeably. What we deal with when talking about mental disorders is mainly loneliness, defined as the condition in which one feels alone, no matter the level of social contact and interaction they experience. Solitude is a state of loneliness, which is though often voluntary, as part of a process or proper of very reserved people. Isolation is the physical state of being alone, which can spring from a positive intention of wanting to be in solitude (for growth, challenge, etc.) or can be the result of a loneliness behavior. Yet again, the opposite (and usual) route happens, in which the one who feels lonely closes themselves into isolation.

The pandemic stressed this concept maybe more the all the others: isolation was the strategy choice to fight the virus. People who lived alone were confronted even more with their ability of actually being alone.

Social interactions were limited (if not prohibited) and the attentional control under such stressor is not easy to maintain. Defining the loneliness feeling can be misleading, as it can ensemble different aspects. It is intuitively the feeling of being alone, but it can come from different sources. The effects instead are more concrete and result in a **self-defeating behavior** (Cacioppo et al. 2014), isolation, depression and even here physical repercussions as eating and sleeping disorders. Loneliness is such a common feeling, and proper of the human condition that is not only studied and mentioned in science; but maybe even more in literature. The lonely

condition of men, or at least a certain degree of it is necessary and inevitable during a lifetime. Perceiving loneliness not always as the enemy but sometimes as a friend is one of the first steps in the acceptance and overcoming of this feeling (Wolfe, 1930).

Isolation, especially when coerced by greater authorities such as in the pandemic case, stressed to the limits our abilities to live without social interactions. The elders are often the most effected by feelings of loneliness, however it is surprising how those of young people between 18-25 can be even higher, with levels of perceived loneliness of 61% in a survey from the US (Weissbourd, 2021).

Sleep disorder.

If loneliness can be a "brutal experience" to mention a renowned psychologist, having trouble sleeping can be as much as bad, given the consequences. Sleep disorders are changes in one's sleeping patterns, quality and duration usually caused by stress, overthinking or changes in habits. The consequences of not sleeping well are carried out throughout all day and can become a **serious issue** if not immediately resolved. As the other mental disorders, the intensity of issues in sleeping, can vary from mild to more severe. They can manifest in very different ways as more than 80 different sleeping issues can be identified.

Sleep itself is a fundamental and very complex biological process. Previous studies found how our brains not only stay remarkably active during sleep, but they 'clean' many toxins that creates when we are in the awake state (Iliff, Nedergaard, 2012). **Interfering with sleep or disrupting our sleeping patterns can compromise the next day and the days to come**: the more we modify and shift our sleeping schedule, the less our body can create a unique circadian cycle that regulates our life. Common sleep disorders can be insomnia, narcolepsy, sleep apnea or Restless Leg Syndrome (RLS). Association with sleep problems to mental health issues are most common, they manifest particularly in people with **anxiety, bipolar disorders, depression and also ADHD** (attention deficit hyperactivity disorder). Sleep can be severely

affected by physical activity as well. **Aerobic exercise** can result in a better quality of life and self-reported sleep (Baron et al. 2010). The lack or difficulty in exercising during the pandemic has caused shifts in people sleeping schedules; Covid-19 itself, for people affected by it was reported to have negative impact on people's sleep.

The main hypotheses of the conducted study try to prove what was often evaluated in other researches introduced in the literature overview. **Mental health disorders can be fought by achieving a better economic stability**, especially (not exclusively, as the surveys were conducted during a pandemic) in recessions periods. Better focus (more often than not) derived from higher level of education is expected to act as barrier for mental health issues, while age, again in such cases as in the conducted study, can be a burden. **However, these factors might lose significance if we test them over time**, especially because as the world evolves, more new stressors are added to the equation, and people might better cope with the already existing factors; shifting attentional control on the new ones.

3. DATA COLLECTION

3.1 Data

The data used in this study is from the Wave 8 SHARE Corona Survey (SCS) 1 and Wave 9 SHARE Corona Survey (SCS) 2, both from the release 8.0.0. As the names suggest this data comes from two different waves of the pandemic hit, the first one between June and August 2020 and the second one a year later between June and August 2021. **SHARE** is the Survey of Health, Age and Retirement in Europe, which data collected in question refer to individuals aged 50 and older. Although, as will be further explained other ages were included as results of imputations.

The Surveys are part of a longitudinal study of adults in 24 European countries during the pandemic period, with interviews conducted first in person for about 70 % of the sample and then in the CATI form (Computer Assisted Telephone Interview). Several topics are covered: health, mental health, economic and financial status, demographics, social networks, changes in work and economic situation and more.

For the purpose of this study the SHARE database constitutes a good basis, with as objective the calculation of **relationship between income and MH dimensions**.

To achieve this, the model was adjusted for different covariates as it will be further explained. No particular subsample was selected in the covariates as in the studied context they were deemed important, having income as main explanatory variable. In the Appendix we can see regressions for 'depressed' and 'trouble sleeping' using age categories rather than the continuous variable, to just compare the incidence level for age categories. Yet again the purpose of this study was to find more meaningful relationships and relative movements between the selected MH dimensions and covariates.

4. METHODOLOGY AND ANALYSIS

Explanatory variables and covariates.

Recalling what has been said, mental health is rarely an independent manifestation, rather caused by internal and external factors that influence one's mind. Something that in health in general is usually the case. What is interesting in mental health rather than physical is the difficulty in addressing the sources of mental disorders, the circumstances that may induce one to fall into states of depression, loneliness as well as anxiety and many other disturbs. In this analysis, with a final sample of *N=33634*, the main explanatory variable for which we are trying to test significance is monthly **Income**.

Especially during recession periods, economic and financial stabilities might be expected to play a central, if not at least important role in the sustenance of one's life. Being able to retrieve good food, good shelter and also a good perspective of the future is not an easy task when the stressors are at the peak and our attentional control is overloaded, as it was during the pandemic.

Age. (continuous) In the database, the sample of people is aged 50+ for the SHARE Corona Survey. However, Survey 1 (SCS 1) was essentially a spin-off of the more general SHARE 'normal' survey, meaning that SCS 1 (and 2 along) was restricted to people aged 50+ due to the shift in data collection, from CAPI (personal interviews) to CATI (telephone interviews). In the age covariate there is a small portion of imputed data, as well as in other variables like gender which were hot-deck imputed. This small fraction (in our age sample is <1%, about 250 units) was kept as it did not affect at all the outcome would give slightly more stretch to the covariate, we will see this better in the limitations of the conducted study.

Education. (continuous) The education variable is usually associated with a better state of mental health. As we have discussed, knowledge and discipline can have an impactful effect on our ability to shift focus to what is good for us. Going back to the theory of attentional control, an educated mind that is prone and used to shift concentration to its needs, it's more likely to resist the 'brains chemical temptations' to fall under the need of depression comfort. The more we train our mind to negative thinking, the more comfort it will find in it; because of its tendency spirits of adaptation. Which is yes, the most powerful tool of humankind, but as we can see it can become its doom as well. We would then expect a negative correlation between this covariate and mental health status.

Gender. (binary) In the sample we have a higher percentage of women, who also account for the majority being affected by mental disorders as will be further explained and possibly

addressed. Many studies show the disparity and difference in mental health problems among genders.

Men have usually higher rates of antisocial behavior or substance abuse which are referred to as externalizing disorders, while women may more often be subject of internalizing disorders as depression and anxiety (Rosenfield, 2012). These results are also confirmed in the sample for what concerns externalizing disorders.

Health. (ordered/self-reported) During COVID, health related issues were coming from all the sides. People in hospitals, would be even more isolated than people at home. Thus meaning, that already having health problems before a recession, and a pandemic even worse, could significantly impact your MH. It becomes a challenge to maintain a positive attitude when having problems. Poor health conditions might then be associated with worse states of mental health rather than being in a better physical condition.

Couple. (binary) Going back again on the isolation matter, when having a family, or at least someone to share with the period of lockdown, it can become easier to maintain a better mental health. Although it is also true that during the pandemic man couples or families had problems, as being locked at home with someone can be a challenge, especially for such a long time. We would expect that having someone to share your thoughts to can act as defendant to mental health problems, but not necessarily all the time.

Analysis 1.

Univariate analyses were performed to explore the data separately and measure association with the dependent variables. As well as statistical tests to asses significance between the dependent

variables and income[1]. From a first exploration we can identify the distribution of the independent variables for each associated dependent one:

Table. Description of variables for the whole sample, then studied means grouped by dependent (gender 2 = Female)

	age	yedu	gender	income	couple
count	33634.00	33634.00	33634.00	33634.00	33634.0
mean	68.58	11.35	1.51	2086.57	1.0
std	8.44	4.10	0.50	1599.95	0.0
min	32.00	0.00	1.00	74.37	1.0
25%	62.00	8.80	1.00	950.00	1.0
50%	68.00	12.00	2.00	1504.28	1.0
75%	74.00	14.00	2.00	2861.28	1.0
max	101.00	35.00	2.00	18179.37	1.0

sad_depressed	age	yedu	gender	income	couple
1. Yes	69.21	10.84	1.64	1886.31	1.0
5. No	68.40	11.50	1.48	2143.50	1.0

lonely	age	yedu	gender	income	couple
1. Often	70.00	10.28	1.65	1723.58	1.0
2. Some of the time	69.17	10.81	1.60	1797.08	1.0
3. Hardly ever or never	68.41	11.50	1.49	2155.13	1.0

trouble_sleep	age	yedu	gender	income	couple
1. Trouble with sleep or recent change in pattern	69.25	11.11	1.61	1854.53	1.0
2. No trouble sleeping	68.36	11.43	1.48	2163.41	1.0

By studying the mean of the independent variables, we can first explore some features.

Although numerically greater roughly by one year, age of people more affected by the presented mental health problems is in fact slightly higher, which can be deemed as expected. Especially for loneliness, older people tend to feel lonelier, which during the pandemic was even more prominent as physical isolation was also obligatory. People with a higher education seem to suffer less from mental disorders, which can be due to indeed more consciousness on the matter.

[1] Python language was used for all computations

Among respondents, female tend to be the more affected. Finally, when looking at income among the surveyed population, we notice how higher income was associated with having less troubles sleeping, less loneliness feelings and lower depression as well.

Taking a deeper look at the t-tests between the depression and trouble sleeping against the log of income we see how we fail to reject the hypothesis that there is actual association between the two, as the p-value results significantly small.

T-test: means of log_income for sad_depressed==Yes and sad_depressed==No

	T	dof	alternative	p-val	CI95%	cohen-d	BF10	power
T-test	-12.779	33632	two-sided	0.0	[-0.14, -0.11]	0.168	3.321e+33	1.0

T-test: means of log_income for trouble_sleeping==Yes and trouble_sleeping==No

	T	dof	alternative	p-val	CI95%	cohen-d	BF10	power
T-test	-16.459	33632	two-sided	0.0	[-0.17, -0.14]	0.208	5.071e+56	1.0

Looking now at the regression models we can have a deeper understanding of the behavior of the covariates with our dependents. The dependent variables ‘depression’ and ‘trouble sleeping’ were modeled using logistic regressions, while for ‘loneliness’ an ordered logistic model was conducted. To maximize for power and hence the significance level of the explanatory, interactions were controlled for sex and age, income and age, income and income and education.

With depression as dependent variable the interaction between income and education revealed to be significant and was introduced to the model, which was also adjusted for age, education and sex. For trouble sleeping no significant interactions were found and the model was adjusted for age, education and sex.

Table 1. Logistic regression for depression

Generalized Linear Model Regression Results

Dep. Variable:	sad_depressed	No. Observations:	33634
Model:	GLM	Df Residuals:	33624
Model Family:	Binomial	Df Model:	9
Link Function:	Logit	Scale:	1.0000
Method:	IRLS	Log-Likelihood:	-16498.
Date:	Wed, 18 May 2022	Deviance:	32996.
Time:	19:10:17	Pearson chi2:	3.35e+04
No. Iterations:	5	Pseudo R-squ. (CS):	0.07337
Covariance Type:	nonrobust		

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-0.4604	0.210	-2.189	0.029	-0.873	-0.048
gender_name[T.2. Female]	0.7253	0.029	25.376	0.000	0.669	0.781
health[T.2. Very good]	0.2919	0.077	3.777	0.000	0.140	0.443
health[T.3. Good]	0.7660	0.071	10.778	0.000	0.627	0.905
health[T.4. Fair]	1.4323	0.073	19.488	0.000	1.288	1.576
health[T.5. Poor]	2.4181	0.086	27.956	0.000	2.249	2.588
log_income	-0.2195	0.053	-4.104	0.000	-0.324	-0.115
yedu:log_income	0.0192	0.005	4.258	0.000	0.010	0.028
yedu	-0.1556	0.034	-4.581	0.000	-0.222	-0.089
couple	-0.4604	0.210	-2.189	0.029	-0.873	-0.048
age	0.0011	0.002	0.653	0.514	-0.002	0.004

Log_income: the relation between the odds of feeling depressed and income is **negative and significant**. As we might have expected, an increase in income would reduce the odds of falling into depression. Especially during a pandemic or a recession period, we would assume that having a better financial stability could improve the mood, and hence prevent our behavior from assuming a more negative approach. Economic/financial stability can also improve our attentional control during recessions, by letting us focus on improvements in other fields and not struggle in the sustaining of our lifestyle. By using the log, and the interaction effect explained below we also understand how income effects might be smaller in magnitude over time, given increasing years of education.

Yedu:Log_income (interaction): what said before, can be though interpreted differently as we set an interaction term between education and income. Mentioned before and added to the table above, this interaction has proved to be **significant**.

It is hence more difficult to isolate the effect of income on mental health, as it now also depends on the levels of education. Interestingly, the interaction effect has a positive coefficient, which

can be interpreted as increased odds of mental disturbs feelings for each additional year of education and higher incomes, as there was edge of decrease in return for each more year spent in education even though earning more income. **This result indeed indicates that the effect of *log_income* is smaller for higher education levels**. For *yedu* about 20 the effect of *log_income* on the latent variable becomes essentially zero. So, high education with high income has a smaller protective effect than having low education and high income: **income protects more those who are lower educated**.

Yedu: If we were not to plug the interaction term in the equation the effect of education for a zero level of income wouldn't change significantly, without the interaction term the coefficient was estimated at -0.0232 (and also significant), with the interaction it is still significant but with a greater impact on the model in terms of magnitude of effects, for certain levels of income. The relation is however **negative**, suggesting as it was with income people with a higher level of education might better cope with feelings associated with mental disorders.

Gender: as shown before the role of gender can have an impact on mental health, which is also significant, as females are reported to be more subject to mental distress, which is in the database self-reported. One could indeed argue on the degree of openness of the two genders on the topic of mental health, for which women may have a more open-minded view. Although the classes seem to be quite balanced per se. Below we can see an example for the depressed dependent, but the same applies for the other two studied. P-value of the chi-squared is also very significant.

gender_name	1. Male	2. Female	Total
sad_depressed			
0	13674	12515	26189
1	2710	4735	7445
Total	16384	17250	33634

```
Chi2_score: 580.1679866403854, Degrees of freedom: 1, p-value: 3.447785392654046e-128
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Age: the age variable seems to have a **positive and but not significant** effect, very small in terms of increasing odds of falling into depression. The range age of the population studied is not large wide enough to allow for a greater impact, although as mentioned it seems that with age the risk of mental problems increases.

Couple. The couple effect is significant at the 0.05 level, with a negative interaction. This suggests how people who were physically lonelier during the pandemic might have indeed felt higher levels of mental discomfort.

Health. When the general health condition, so considering mostly the physical part, was 'poor', a significant and very positive interaction was found. People with low levels of health were more subject to challenges: accessing medicines, aid, company… If we also take into consideration the fact that in the self-reported health, mental conditions apply, there would need to be more care in assessing interactions. The significance of each state of self-reported health with the latent can indicate a certain level of simultaneity between the two: if I am in bad general condition my MH can be low; if I have mental disturbs my health state can worsen.

Table 2. Logistic Regression for trouble sleeping

Generalized Linear Model Regression Results

Dep. Variable:	trouble_sleeping	No. Observations:	33634
Model:	GLM	Df Residuals:	33625
Model Family:	Binomial	Df Model:	8
Link Function:	Logit	Scale:	1.0000
Method:	IRLS	Log-Likelihood:	-17632.
Date:	Thu, 19 May 2022	Deviance:	35263.
Time:	19:35:43	Pearson chi2:	3.36e+04
No. Iterations:	5	Pseudo R-squ. (CS):	0.07087
Covariance Type:	nonrobust		

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-0.9992	0.096	-10.418	0.000	-1.187	-0.811
gender_name[T.2. Female]	0.5864	0.027	21.634	0.000	0.533	0.640
health[T.2. Very good]	0.2190	0.073	3.013	0.003	0.077	0.361
health[T.3. Good]	0.7143	0.066	10.748	0.000	0.584	0.845
health[T.4. Fair]	1.4815	0.069	21.536	0.000	1.347	1.616
health[T.5. Poor]	2.1573	0.083	26.140	0.000	1.996	2.319
log_income	-0.0951	0.019	-5.017	0.000	-0.132	-0.058
yedu	0.0137	0.003	4.017	0.000	0.007	0.020
age	0.0032	0.002	1.959	0.050	-1.71e-06	0.006
couple	-0.9992	0.096	-10.418	0.000	-1.187	-0.811

Similar results apply when we regress with trouble sleeping as the dependent variable. Although here no interactions were used as they did not prove to be very statistically significant. The sources of sleeping issues can be of different ones. Income in this case still seems to play a role with a negative impact, less strong than the one with depression but still significant.

Education is also significant. With a positive interaction, the opposite of the one found in the previous regression, it seems that with increase years of education, the risk of incurring in trouble sleeping problems decrease. Gender and age both have a positive and significant coefficient as also found in the previous regression.

As for gender we can confirm that the female population seem to be more subject to mental distresses, as well as more aged people. Age in this model is more significant, but barely at the 0.05 level.

Table 3. Order Logit Regression for loneliness

OrderedModel Results

Dep. Variable:	lonely	Log-Likelihood:	-18511.
Model:	OrderedModel	AIC:	3.703e+04
Method:	Maximum Likelihood	BIC:	3.709e+04
Date:	Sun, 08 May 2022		
Time:	19:20:52		
No. Observations:	33634		
Df Residuals:	33628		
Df Model:	6		

	coef	std err	z	P>|z|	[0.025	0.975]
log_income	0.2957	0.019	15.177	0.000	0.257	0.334
yedu	0.0278	0.004	7.571	0.000	0.021	0.035
age	-0.0147	0.002	-8.540	0.000	-0.018	-0.011
gender	-0.4982	0.029	-17.055	0.000	-0.555	-0.441
1. Often/2. Some of the time	-2.8156	0.199	-14.165	0.000	-3.205	-2.426
2. Some of the time/3. Hardly ever or never	0.7031	0.015	47.379	0.000	0.674	0.732

In the ordered logit above we confirm again the findings for the previous two regressions. Although this time, we have opposite interactions: the income and education interactions are positive and significant, which means how the more income or education the more we shift toward the highest category of loneliness (3. Hardly ever or never); gender interaction is

negative and significant, as well as the interaction with age, for which older people tend to be lonelier, shifting towards the first category (1. Often).

Analysis 2.

The second analysis aimed at analyzing whether people with higher income were more likely to increase or maintain their previous level of mental health, given the same level of income over the year period. In order to conduct this part Survey 2 was considered, in which it was asked to assess the variation in mental health compared to the previous year, collected in a delta variable and coded (for the three dependent variables) as (numbering is as coded in data):

1. More so: if the person felt an increase in the feeling of that dependent variable

3. About the same: if there wasn't a relative change in that mental health state.

2. Less so: if there was an improvement in the health state of that variable

For the three analyses it was used an Ordered Logit Model, to study the significance of the explanatory (income) and the previously used covariates in the change in the mental health state

sad_depressed_2	age	yedu	gender	income
1. More so	67.0	12.0	2.0	1500.000000
2. Less so	69.0	11.0	2.0	1200.000000
3. About the same	70.0	11.0	2.0	1274.312865

lonely_2	age	yedu	gender	income
1. More so	69.0	11.0	2.0	1424.460968
2. Less so	69.0	11.0	2.0	1300.000000
3. About the same	70.0	11.0	2.0	1100.000000

trouble_sleep_2	age	yedu	gender	income
1. More so	68.0	12.0	2.0	1273.62573
2. Less so	69.0	11.0	2.0	1300.00000
3. About the same	69.0	11.0	2.0	1200.00000

From a first exploration we might see how the median level of income affecting people with an increase mental health problem state is slightly lower than before.

Table 4. Variation in depression

OrderedModel Results

Dep. Variable:	sad_depressed_2	Log-Likelihood:	-4112.0
Model:	OrderedModel	AIC:	8236.
Method:	Maximum Likelihood	BIC:	8275.
Date:	Wed, 18 May 2022		
Time:	19:29:59		
No. Observations:	4597		
Df Residuals:	4591		
Df Model:	6		

	coef	std err	z	P>|z|	[0.025	0.975]
log_income	-0.0943	0.039	-2.398	0.016	-0.171	-0.017
yedu	-0.0111	0.007	-1.509	0.131	-0.025	0.003
age	0.0006	0.003	0.188	0.851	-0.006	0.007
gender	-0.1318	0.061	-2.152	0.031	-0.252	-0.012
1. More so/3. About the same	-3.5795	0.400	-8.957	0.000	-4.363	-2.796
3. About the same/2. Less so	1.0200	0.021	48.423	0.000	0.979	1.061

For the second analysis I explored and compared the different regression outcomes given the Covid-19 situation. The sample used was the same, given the longitudinal nature of SHARE data, with self-assessed responses for the variation in mental health state. Explanatory and covariance significance in the depression model is not very powerful.

Given the same level of income throughout the year, it is not safe to say that those who have a higher income can be considered more resilient to depression. The fact the income is not statistically so (it is at the 0.02 level) significant can actually be reassuring on some levels. The model itself does not behave like before suggesting how other external factors did in fact influence the change. While the state of the depression during the first wave was associated with the most ‘primitive’, if we want, factors for humans (age, income, gender...), as the

uncertainty of that period was stressed mainly of these points; after one year of coexistence with the recession things changed.

By living through the pandemic people have realized many things and have adapted to the harsh conditions of living, both those with high and low levels of income, high and low level of education, younger and older and so on. Hence, the transition from a state of mental health to another is most likely affected by the covariates presented as well as many other external factors, which especially during the ups and downs of Covid waves were affecting our lives. Similar results are found in the following tables for sleep issues and loneliness.

Table 5. Variation in trouble sleeping

OrderedModel Results

Dep. Variable:	trouble_sleep_2	Log-Likelihood:	-3640.0
Model:	OrderedModel	AIC:	7292.
Method:	Maximum Likelihood	BIC:	7331.
Date:	Wed, 18 May 2022		
Time:	19:22:42		
No. Observations:	4597		
Df Residuals:	4591		
Df Model:	6		

	coef	std err	z	P>|z|	[0.025	0.975]
log_income	0.0792	0.041	1.944	0.052	-0.001	0.159
yedu	0.0097	0.008	1.274	0.203	-0.005	0.025
age	0.0067	0.004	1.911	0.056	-0.000	0.014
gender	0.0152	0.063	0.239	0.811	-0.109	0.140
1. More so/3. About the same	-2.2276	0.416	-5.360	0.000	-3.042	-1.413
3. About the same/2. Less so	1.1147	0.027	41.483	0.000	1.062	1.167

As presented above the change in sleeping patterns was not significantly affected by income. Although barely significant at the 0.05 level the considerations above and the results together with the other covariates p-values do not suggest a strong model, also tested for interactions.

Table 6. Variation in loneliness

OrderedModel Results

Dep. Variable:	lonely_2	Log-Likelihood:	-3224.1
Model:	OrderedModel	AIC:	6460.
Method:	Maximum Likelihood	BIC:	6499.
Date:	Wed, 18 May 2022		
Time:	19:23:06		
No. Observations:	4597		
Df Residuals:	4591		
Df Model:	6		

	coef	std err	z	P>|z|	[0.025	0.975]
log_income	0.1153	0.046	2.513	0.012	0.025	0.205
yedu	0.0062	0.009	0.723	0.470	-0.011	0.023
age	-0.0109	0.004	-2.761	0.006	-0.019	-0.003
gender	-0.2215	0.072	-3.060	0.002	-0.363	-0.080
1. More so/3. About the same	-3.1919	0.464	-6.873	0.000	-4.102	-2.282
3. About the same/2. Less so	0.6578	0.033	20.050	0.000	0.594	0.722

The loneliness model has slightly different performance. In Table 6 we can see that income is slightly significant and with a positive coefficient; for which higher level of income lead to a shift to 'better' states of loneliness. The age covariate is also negative and significant, this is an interesting result because as mentioned the sample was collected in a very particular period. The older the person in the sample, the more likely they were to feel lonelier, an effect we could notice also in the first two models, although not significant. Having more financial support could finally help in general, especially during recessions, to be more flexible and resist difficult situations. However, we know that mental health is a very particular matter to which many of such reasonings do not always apply.

5. FURTHER RESEARCH – STRENGHTS/LIMITATIONS

Many of the studies and researches conducted during (and about) the Covid-19 period have contrasting results. The high degree of uncertainty which characterizes this period, together with some incompleteness of the data make it a very delicate topic, and context of study. The focus on older adults in the study of MH dimensions can be a powerful tool when using income as explanatory variable. Mature people usually have more stable incomes, especially across the

years for which we can better study longitudinal effects. However, in this case we saw a limitation in Analysis 2 as the income variable was not yet imputed by SHARE and was only available for Survey 1. This brought us to analyze only the change in MH health overtime given a stable income.

Another limitation can be the reporting bias on the state of mental health: given the aforementioned peculiarity of mental health states, although also clinically diagnosable, the one present in the sample is a self-reported state. Self-reported states can be subject to some bias as people can tend to either exaggerate but even underestimate their health problems. This one can be mixed with a certain level of recall bias: in the Survey 2 in particular people need to recall their mental health state from the prior year, which is indeed not easy to do. Income is also a variable that is often subject to reporting bias, as people are very much reserved on the level of their economic status.

A further research question or analysis that could belong to the same study is the verification of causality. The main assumption of this paper was that the direction of causality between income and MH dimensions would come from the former to the latter. To complement such analysis, one could study the opposite effect, or reverse causality: so, to assess whether changes or persistent states of mental distress have effects on income.

A final limitation was the software used: Python programming language is very broad in use and scopes, with also many statistical applications. More effort is though needed to identify, select and manipulate data for the sole statistical purpose, as it is not in Python's main abilities.

6. CONCLUSION

The aim of this paper was to analyze and asses the relation direction between income and mental health, with the assumption that lower levels of income could positively impact an increase in self-reported mental disorders. Mental health is an incredibly delicate issue. Through the paper

it was mentioned how people do not usually share openly their moods or mental health problems as there are still seen as a big defection, sometimes even more than physical disparities. This happens because, going back to the introduction of the paper, humans are fragile; even more so when it comes to mind issues rather again than physical. When compared to income, mental health assumes also different perspectives. In the proposed research income does play an important role in protecting people from incurring or falling into negative moods or mental disorders. From this, one could argue that money could buy happiness, as it's usually cited. It is not in the scope of this analysis to assess this question, but we can indeed observe how higher level of income act as barrier for mental disorders; in a recession period, where people are locked in their homes, and there is a small (if none) possibility to find company outside one's home. Hence yes, money can be a powerful tool against not only mental health but as we know all health in general. Income is naturally not the major source of MH problems, which was not what is presented, these findings want to the contrary suggest that too much focus can go on money. More awareness needs to be created around the possibility of finding stability through recession by other means, one is education.

Education has a similar effect: people should be encouraged more to get educated not only to build a successful lifestyle (which can though assume different interpretations from person to person), but to be resilient against challenges in life that affect our main engine (after literally our heart), the brains. And education does not necessarily mean school. Today, resources can be found anywhere, and we must never stop improving ourselves.

More sensitivity should finally be given to more aged people. This study already includes as a sample an older population. With increasing age, many elders tend to be left alone, by family, by the state and by others who do not want to take the burden to take care of them. Growing up should be a transition to a state in which one is conscious of the difficulties of life and has come to embrace them. This is way we should never stop learning.

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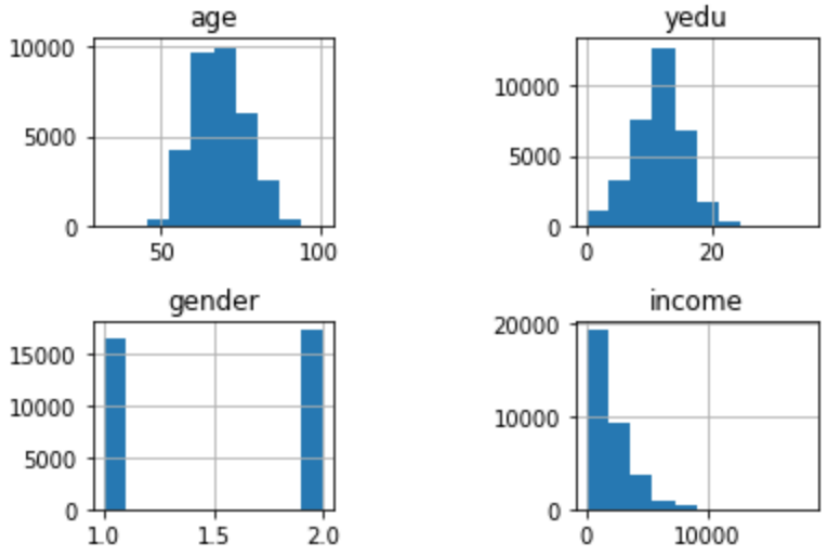
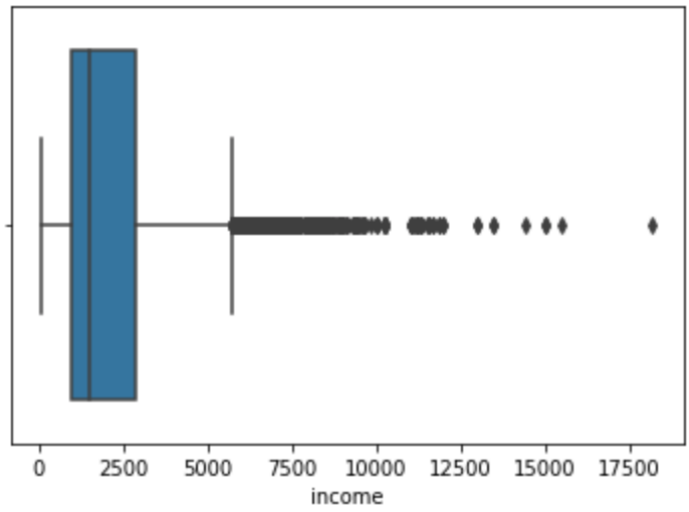
APPENDIX 1.

1. *Covariates distributions.*



2. *Income box-plot (highly skewed). Adjusted to log(income) for regression.*



3. Trouble sleeping logistic regression with age variable binned.

```
                 Generalized Linear Model Regression Results
==============================================================================
Dep. Variable:       trouble_sleeping   No. Observations:                33634
Model:                            GLM   Df Residuals:                    33627
Model Family:                Binomial   Df Model:                            6
Link Function:                  Logit   Scale:                          1.0000
Method:                          IRLS   Log-Likelihood:                -18488.
Date:                Sat, 14 May 2022   Deviance:                       36977.
Time:                        12:14:29   Pearson chi2:                 3.37e+04
No. Iterations:                     5   Pseudo R-squ. (CS):            0.02232
Covariance Type:            nonrobust
================================================================================================================
===
                                                   coef    std err          z      P>|z|      [0.025      0.9
75]
----------------------------------------------------------------------------------------------------------------
---
Intercept                                        0.4698      0.130      3.612      0.000       0.215       0.
725
gender_name[T.2. Female]                         0.5431      0.026     20.713      0.000       0.492       0.
594
age_bins[T.Interval(62.0, 68.0, closed='right')]     0.0333      0.036      0.911      0.362      -0.038       0.
105
age_bins[T.Interval(68.0, 74.0, closed='right')]     0.1785      0.037      4.869      0.000       0.107       0.
250
age_bins[T.Interval(74.0, 101.0, closed='right')]    0.3248      0.037      8.784      0.000       0.252       0.
397
log_income                                      -0.2734      0.018    -15.478      0.000      -0.308      -0.
239
yedu                                         8.102e-05      0.003      0.025      0.980      -0.006       0.
007
================================================================================================================
===
```

4. Depression logistic regression with age variable binned.

```
                 Generalized Linear Model Regression Results
==============================================================================
Dep. Variable:          sad_depressed   No. Observations:                33634
Model:                            GLM   Df Residuals:                    33626
Model Family:                Binomial   Df Model:                            7
Link Function:                  Logit   Scale:                          1.0000
Method:                          IRLS   Log-Likelihood:                -17316.
Date:                Sat, 14 May 2022   Deviance:                       34633.
Time:                        12:06:54   Pearson chi2:                 3.36e+04
No. Iterations:                     5   Pseudo R-squ. (CS):            0.02715
Covariance Type:            nonrobust
================================================================================================================
===
                                                   coef    std err          z      P>|z|      [0.025      0.9
75]
----------------------------------------------------------------------------------------------------------------
---
Intercept                                        1.5786      0.379      4.166      0.000       0.836       2.
321
gender_name[T.2. Female]                         0.6735      0.028     24.380      0.000       0.619       0.
728
age_bins[T.Interval(62.0, 68.0, closed='right')]    -0.0109      0.038     -0.288      0.774      -0.085       0.
063
age_bins[T.Interval(68.0, 74.0, closed='right')]     0.0774      0.038      2.018      0.044       0.002       0.
153
age_bins[T.Interval(74.0, 101.0, closed='right')]    0.2823      0.038      7.359      0.000       0.207       0.
357
log_income                                      -0.4098      0.051     -8.022      0.000      -0.510      -0.
310
yedu:log_income                                  0.0201      0.004      4.621      0.000       0.012       0.
029
yedu                                            -0.1747      0.033     -5.342      0.000      -0.239      -0.
111
================================================================================================================
===
```