IS THERE A LONG RUN NEXUS AMONG MENTAL DISORDER AND SOCIO-ECONOMIC INDICATORS? : EXPERIENCES FROM AN ECONOMETRIC STUDY ACROSS 40 COUNTRIES

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Abstract

Are there evidences of an association between poor mental health and the experience of poverty and socio-economic deprivation? To explore it, we try to relate all sorts of mental disorders with the per-capita GDP (PCGDP), the level of per-capita CO2 emissions as a measure of pollution (PCCO), usage of Internet (IU) as a measure of social behaviour, and Globalization Index (GI), for all the major countries in the world. Applying Vector Autoregression (VAR) model the results reveal that most of the high income countries in the selection have produced the result that mental disorder is cointegrated to the four socio economic indicators. The short run causality tests unambiguously backs up the sustainability of the long run cointegration relations derived for countries like Argentina, Australia, Canada, France, Germany, and UAE. Hence, mental disorder is not a problem to the lower income countries but to the high income countries as well.

Keywords: Mental health; poverty gap; CO2 emissions; terrorism; internet; gender; globalization

JEL classification:

1. Introduction

As is defined by the World Health Organization, mental health is,

"a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community".

As the WHO Commission on Social Determinants of Health reports, there is a growing evidence showing that many common mental health outcomes and disorders are a consequence of social, economic and environmental factors (WHO, 2013). It is important to take actions keeping in mind where people are born, grow, live and work and accordingly target them at improving the conditions of everyday life. As Bell et al. (2013) points out, a basic multilevel framework for understanding these social determinants of mental disorders includes factors like — violence /crime & neighbourhood deprivation, attributes of the natural environment, health care, access to clean water and sanitation, policies targeted at poverty reduction and inequality, gender based discrimination, issues in governance, human rights, etc. that are universal and proportionate to need. There is a building up of a scientific consensus that every child should get the best possible start that will generate the greatest societal and mental health benefits. The prevalence and social distribution of mental disorders has been reasonably well documented in high-income countries but not so in the lower and middle income countries. Furthermore, there is a lack of strategic measurability issue and hence a gap in policy formulation to prevent such mental disorders. Herein, comes the role of the social determinants of health. The objectives of the paper in this context are to make associations among all sorts of mental disorders i.e. Schizophrenia (per cent) plus Bipolar disorder (per cent) plus Eating disorders (per cent) plus Anxiety disorders (per cent) plus

Drug use disorders (per cent) plus Depression cases (per cent) plus Alcohol use disorders (per cent) with per-capita GDP, the level of CO2 emissions, internet usage, and Globalization index (high openness means high globalization and low on socialistic nature) for all the major income levels (i.e. High, Middle, Low). Policy-making at all levels of governance can make a positive difference is what we will be arguing out.

The paper is organized as follows. The following section highlights the variables used in this study followed by the empirical model, the econometric methodology used, information on the dataset used and discussions on the derived results. The paper ends with a conclusion.

There is growing interest in the relation between socio-economic status and mental health, especially in low and middle-income countries. We contribute to the literature by examining how multiple indicators of socio-economic status, as already has been mentioned, along with a focus on anxiety and depression. To begin with a broader perspective, as Allen et al. (2104) points out, systematic differences in mental health occurs on account of variation in factors like gender, age, ethnic identity, income levels, education level and area of residence are inequitable and can be reduced by comprehensive action targeted on these social determinants. Like, the authors point out how depression and anxiety varies disproportionately across the different income groups in UK. This actually motivated us to consider the same in our 40 country set-up to come to more meaningful conclusions. Voicing out almost the same concern, Glymour et al. (2014) argues the importance of community's social hierarchy, money and power in influencing mental disorders. They measure the socio-economic position in terms of income, expenditure, education level and assets. On a similar ground, Ruiz-Perez et al. (2018) performed multinomial logistic regression model to analyze the impacts of socio-demographic (age, socio-professional class, level of education, nationality, employment situation, marital status), psycho-social (social support) and financial (as measured by GDP per capita, risk of poverty, income per capita per household), public welfare services (health spending), labour market (employment and unemployment rates, percentage of temporary workers) on psychic morbidity as a measure of mental health for Spain. The findings in Dolan et al. (2008) support the claims by Ruiz-Perez et al. (2018) in the context of a British household panel data. However, pointed out the difficulty in establishing a causal relation between mental disorders and socio-economic factors. Bringing in the poverty factor, for high income countries, the existing literature has documented a clear improvement in the mental health position, the more an individual moves up the society's hierarchical ladder (Hemingway et al., 1997). Moving on, a discussion of poverty includes indicators like living on less than US$1 or US$2 per day, home overcrowding, extent of food insecurity, not having at least a basic minimum level of education (i.e. primary level are commonly correlated with mental disorders (see Smith, 1776; Murali & Oyebode, 2004 among others). Two of the most famous studies in this context are from UK, and includes the New Haven study (Hollingshead & Redlich, 1964) and the Midtown Manhattan Study conducted in 1963 (Langner & Michael, 1963) indicated that a direct relationship between the experience of poverty and a high rate of emotional disturbance. From poverty to inequality, in a recent study, Yu (2018) investigated — "the association among the ratio of female to male depressive disorder rates, gross domestic product, the GINI Index, and the gender inequality index for 122 countries". Some of the key findings are the existence of a significant correlation between gender inequality and mental health. Second, the significant variation in values of GINI coefficient associated with male but not female depressive disorder rates. Most studies in the literature have shown an association between indicators of poverty and the risk of mental disorders, the most common being with low levels of education and income. People living below the poverty line lack in financial resources to maintain a basic minimum standard of living and have inadequate access to educational opportunities; thereby, leading to lack of employment opportunities, hence, low income and thus, access to poor quality health care which increases the risk of developing a mental disorder under stressful conditions. Thus, the authors here consider per capita income levels and internet usage as a proxy for poverty levels. A high level of per capita income or high levels of internet usage are good indicators signifying non-existence of higher levels of poverty. This study, unlike its predecessors, will not explicitly consider poverty ratios or for that matter inequality levels but rather make use of these proxy variables, namely, level of per capita income or level of internet usage to measure such forms of association between poverty (or inequality) with mental disorders.

Also, from the policy makers' perspective, programmes like investment in education, health and provision of microcredit may have unanticipated benefits in reducing the risk of mental disorders in an unequal society (see for details Reiss, 2013; Patel & Kleinman, 2003). Also, unemployment levels have been found to be significantly correlated in influencing mental disorders but the issue of causality remains unexplored in the literature (see Linn et al, 1985; Dooley et al., 1994; Batic-Mujanovic, 2017). Even internet usage has been found to have a significant impact. As Hokby et al. (2016) puts it,

"Adolescents and young adults are among the most frequent Internet users, and accumulating evidence suggests that their Internet behaviors might affect their mental health.".

Some studies on different aspects of health and environment and socio-economic factors are addressed here to make an indirect impact upon mental health. Feshari and Hosseinzadeh (2018) investigate the correlation between health care and international tourism over the time period of 1971-2016 and reveal that there is a long-run relationship between health care and tourism for Iranian economy and so the implication policy of the study is that policy makers should adopt policies to improving health care and attract more international tourists. Having indirect link of health expenditure with mental health through poverty reduction, the study of Idaryani et al (2019), during 2006-17, shows that in the short term, health expenditures do not affect poverty in the three autonomous regions, Aceh, Papua, and West Papua, in Indonesia.

It is also possible that excessive use, regardless of the content, be it say, pornographic, computer games, magazines, social networking, surfing, etc. produces negative consequences, such as neglect of protective offline activities." (also see Niemz, 2005; Tripathi, 2017). Hruska-Tvrdy and Foldynova (2011) studied on identifying new social risks for sustainable development in the urban area of Ostrava in Czech Republic. It argued that currently new social risks which were caused by changes in a society appeared more frequently than before and also while previously the groups of underprivileged were counted in endangered groups, now the middle class can be affected as well. This report showed a spatial distribution of these risks. This study has strong implications with respect to the socio-economic determinants of mental health.

The literature with regards to the impact of CO2 emissions on mental health is limited to a few recent studies. Das (2018) attempts to test whether the BRICS nations are converging in terms of per capita CO2 emission over time for the period 1992-2014 and observes no convergence across the members of the group indicating diverging nature of environmental pollution that may lead to mental illness. The study by Obradovich et al. (2018) using meteorological data on a daily basis coupled with collected information from about two million randomly selected US residents highlights that hotter temperatures along with added precipitation each worsen mental health, and also that exposure to tropical cyclones is likely to intensify the worsening of mental health in the future. Studies similar in spirit to Obradovich et al. (2018) but in different contexts voice similar concerns include the works by — Searle and Gow (2010), Simpson et al. (2011), Gifford and Gifford (2016) among others. In their study, Jayanti et al (2019) examines the extent to which the quality of life has contributed towards achieving the SDGs in Indonesian provinces and it documented significant positive effects of the income level, tertiary education level, and formal employment status on the reduction on the poverty and hunger index. Further, both the tertiary level of education and income positively contributed to the increase in clean water access. In this paper, we take a step forward and bring together, as already discussed, all these socio-economic factors simultaneously to see the impact on mental health disorders across a large panel of 40 countries, so far unexplored.

2. Variable Description

The present study works with five endogenous variables, — mental disorder, per capita GDP (PCGDP), extent of globalization, internet use and pollution. Mental disorder is captured by the percentage of total population affected by Schizophrenia, Bipolar disorder, Eating disorders, Anxiety disorders, Drug use disorders, Depression and Alcohol use disorders. Leading factors in this head are Anxiety disorders and Depression. PCGDP is the per head income measured in current US Dollars. Extent of globalization measures the cross

country movements of economic, political and social factors. A value of zero means no exchange of these three factors and a value of 100 means full flow of these three factors of a country to other countries. While, internet use is captured by the percentage of population using internet for personal or business uses, pollution has been confined by the magnitude of CO_2 emission in kilo tones.

3. Material and Empirical Methodology

The study has covered the period of 1996-2016 and 40 countries from six different regions, namely North America (USA, Canada), Western Europe (Germany, France, UK, Italy, Spain, Netherlands, Norway, Portugal & Ireland), Central, South and Eastern Europe (Russia, Greece & Czech Republic), Asia Pacific (China, India, Japan, Australia, S. Korea, Indonesia, Thailand, Malaysia, Philippines & New Zealand), Caribbean and Latin America (Brazil, Mexico, Argentina, Venezuela, Chile, D. Republic, Costa Rica, Trinidad & Tobago) and Middle East and Africa (Turkey, S. Arabia, S. Africa, UAE, Egypt, Nigeria, Algeria & Morocco). The data on the selected variables are borrowed from the World Bank. The primary objective of grouping the countries is to see whether mental disorder is specific to income levels or not. In specific terms it is required to examine whether mental disorder is a disease to the high income, middle income or low income countries.

Since the 21 data points may have stochastic trends we need to test for stationarity or unit roots of the four series for all the selected countries. We have tested for unit roots by Augmented Dickey-Fuller (ADF) (1979). The ADF test is based on the assumptions that the error terms are serially independent and have constant variance. For a data set of variable, y (y_t, t = 1, 2, ...,T), where t denotes time, let us consider the following linear regression set up for unit root test for two versions of the ADF(p) regression for the situations of *without and with time trend*–viz.,

$$\Delta y_t = \alpha + \beta y_{t-1} + \Sigma \gamma_j \Delta y_{t-j} + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\Delta y_t = \alpha + \delta t + \beta y_{t-1} + \Sigma \gamma_j \Delta y_{t-j} + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

If β = 0 is rejected by the ADF statistic then we say that the series is stationary. If this property holds for the series of all the selected variables, then we can run regression without the chances of getting spurious results. If not, we need to test whether the series are integrated of order one (I(1)) or first difference stationary. If we get the result that all the series are I(1) (that is integrated of same order), or non stationary at level values, then we can test for cointegration between the series to establish long run relations. We apply Johansen cointegration test.

Since we have five endogenous variables we can run vector auto regression (VAR) model and if we find cointegration among them then we apply vector error correction model (VECM). If VECM provides usual signs and statistically significant results then there are long run causal relations from any of the four independent variables to any one of the dependent variables. If we do not then there are no long run associations among all the five variables. In that case we test for short run causality in line with Wald test. If we get significant causality results then we test for the fitness of the model. We test for residuals to justify whether there is any serial correlation exists among the error terms (by LM test), whether there is the presence of heteroskedasticity (by Breusche-Pagan test) and whether the residuals are normally distributed (by JB test).

Let us structure a VAR model with five endogenous variables, mental disorder (M), growth of PCGDP (Y), globalization (G), internet use (I) and pollution (P).

$$M_t = \alpha_1 + \sum_{j=1}^{n} \beta_{1j} M_{t-j} + \sum_{j=1}^{n} \gamma_{1j} Y_{t-j} + \sum_{j=1}^{n} \delta_{1j} G_{t-j} + \sum_{j=1}^{n} \theta_{1j} I_{t-j} + \sum_{j=1}^{n} \phi_{1j} P_{t-j} + u_{1t} \quad (3)$$

$$Y_t = \alpha_2 + \sum_{j=1}^{n}\beta_{2j}M_{t-j} + \sum_{j=1}^{n}\gamma_{2j}Y_{t-j} + \sum_{j=1}^{n}\delta_{2j}G_{t-j} + \sum_{j=1}^{n}\theta_{2j}I_{t-j} + \sum_{j=1}^{n}\phi_{2j}P_{t-j} + u_{2t} \quad (4)$$

$$G_t = \alpha_3 + \sum_{j=1}^{n}\beta_{3j}M_{t-j} + \sum_{j=1}^{n}\gamma_{3j}Y_{t-j} + \sum_{j=1}^{n}\delta_{3j}G_{t-j} + \sum_{j=1}^{n}\theta_{3j}I_{t-j} + \sum_{j=1}^{n}\phi_{3j}P_{t-j} + u_{3t} \quad (5)$$

$$I_t = \alpha_4 + \sum_{j=1}^{n}\beta_{4j}M_{t-j} + \sum_{j=1}^{n}\gamma_{4j}Y_{t-j} + \sum_{j=1}^{n}\delta_{4j}G_{t-j} + \sum_{j=1}^{n}\theta_{4j}I_{t-j} + \sum_{j=1}^{n}\phi_{4j}P_{t-j} + u_{4t} \quad (6)$$

$$P_t = \alpha_5 + \sum_{j=1}^{n}\beta_{5j}M_{t-j} + \sum_{j=1}^{n}\gamma_{5j}Y_{t-j} + \sum_{j=1}^{n}\delta_{5j}G_{t-j} + \sum_{j=1}^{n}\theta_{5j}I_{t-j} + \sum_{j=1}^{n}\phi_{5j}P_{t-j} + u_{5t} \quad (7)$$

where α_1, β_{1j}, γ_{1j}, δ_{1j}, θ_{1j} *and* φ_{1j} stand for the intercept and slope coefficients when M is the dependent variable. The notations with numbers will change accordingly from 2 to 5 for Y, G, I and P as the dependent variables. Once the optimum lag is selected then the VAR model will have to be modified.

Once it is tested that the series are cointegrated, we will go for modeling the VECM. VECM is a restricted VAR model and it has cointegrating relation built into the specification so that it restricts the long run behaviours of the endogenous variables to converge to their long run equilibrium relations while allowing for the short run dynamics. The cointegrating term is known as the error correction (EC) term since the deviation from the long run equilibrium is corrected gradually through a series of short run dynamic adjustments. Here an additional explanatory variable, $\hat{\eta e}_{t-i}$, is added which is the estimated error terms with lagged values as the error correction terms. The equations are not shown here.

A negative and significant 'η' means errors are corrected and the series are back to the equilibrium relation and also justifies long run causality from any of the four endogenous variables to the rest of the endogenous variable.

Short run causality, say in equation (3), from Y, G, I and P to M can be examined on the basis of null hypothesis, H_0: $\gamma_{1j} = \delta_{1j} = \theta_{1j} = \varphi_{1j} = 0$. If the null hypothesis is accepted with probability values less than 0.05 then there is no causality running from Y, G, I and P to M. Wald test ensures the results.

4. Results

To begin with, in Table 1 the authors present the results of augmented Dickey–Fuller test (ADF) (see Cheung & Lai, 1995 for details). The results indicate that the variables under consideration have attained stationarity either at level or first difference or second difference values. Carrying out the tests separately for the countries, we see that first difference level of stationarity happens — for Argentina, it is the globalization index and mental disorder; for Australia, Egypt, Italy and Brazil, it is mental disorder, PCGDP and pollution; for Philippines it is mental disorder and globalization; for Canada it is mental disorder, globalization and internet use; for France it is only mental disorder. Only in case of Czech Republic, mental disorder is represented through trends and intercepts format of the ADF unit root test. All the endogenous variables have attained stationarity at their levels of second difference in majority of the countries like — Chile, China, Greece, India, Ireland, Malaysia, Mexico, Morocco, Netherlands, Nigeria, Norway, UK, New Zealand, Portugal, Russia, South Africa, South Korea, Spain, Thailand, Trinidad & Tobago, and Turkey. Apart from these countries, the endogenous variables in the remaining countries are stationary at their level values. Accordingly, we have applied the procedure of Johansen and Juselius (1990) in every individual country, separately. The basis is to look into the possibility of cointegration between the focus variables. In this study, given the AIC criteria, an optimum lag of 1 to 4 has been considered.

Table 1. Unit root test results of first differences unless otherwise specified

Country	Mental Disorder	PCGDP	Globalization	Internet Use	Pollution

	ADF	***Prob***	***ADF***	***Prob***	***ADF***	***Prob***	***ADF***	***Prob***	***ADF***	***Prob***
Algeria	-3.14	0.04	-3.85	0.00	-4.94	0.00	-2.76	0.08	-3.04	0.05
Argentina	-1.82*	0.06	-3.69	0.01	-2.23*	0.05	-4.34	0.00	-2.81	0.07
Australia	-2.14*	0.03	-2.70*	0.00	-3.92	0.00	-4.32	0.00	-3.01	0.05
Brazil	-1.81*	0.06	-3.18*	0.00	-4.08	0.00	-2.95	0.07	-1.99*	0.05
Canada	-1.77*	0.07	-3.13	0.04	-2.23*	0.04	-1.84*	0.07	-3.60	0.03
Ch. Repub.	-4.78**	0.00	-3.73	0.01	-2.82	0.07	-2.92	0.06	-4.37	0.00
Chile#	-3.82	0.01	-4.39	0.00	-3.30	0.04	-4.21	0.00	-4.64	0.00
China#	-4.44	0.00	-4.02	0.00	-5.39	0.00	-2.86	0.06	-2.98	0.06
Costa Rica	-3.45	0.02	-3.23	0.03	-3.42	0.03	-2.98	0.06	-3.85	0.01
D. Repub.	-2.92	0.06	-4.22	0.00	-5.05	0.00	-4.14	0.00	-4.30	0.00
Egypt	-1.74*	0.08	-1.88*	0.05	-4.29	0.00	-3.65	0.04	-3.42	0.03
France	-1.80*	0.06	-3.67	0.01	-2.99	0.06	-3.73	0.04	-3.61	0.02
Germany	-4.31	0.00	-3.37	0.02	-5.62	0.00	-3.59	0.04	-3.90	0.00
Greece#	-5.00	0.00	-4.51	0.00	-2.85	0.07	-4.85	0.00	-5.71	0.00
India#	-4.17	0.00	-5.89	0.00	-4.13	0.00	-4.80	0.00	-4.74	0.00
Indonesia	-3.98	0.00	-3.07	0.04	-3.12	0.04	-3.19	0.04	-5.88	0.00
Ireland#	-6.68	0.00	-4.56	0.00	-3.05	0.05	-5.55	0.00	-5.67	0.00
Italy	-1.79*	0.06	-3.46*	0.00	-3.03	0.00	-2.99	0.06	-2.98	0.06
Japan	-6.86	0.00	-3.40	0.02	-4.27	0.00	-3.66	0.01	-4.06	0.00
Malaysia#	-4.27	0.00	-5.44	0.00	-6.19	0.00	-4.53	0.00	-6.86	0.00
Mexico#	-4.24	0.00	-3.48	0.02	-6.29	0.00	-3.10	0.05	-5.39	0.00
Morocco#	-5.56	0.00	-5.75	0.00	-3.79	0.03	-3.97	0.01	-5.84	0.00
Netherlands#	-4.47	0.00	-6.45	0.00	-5.07	0.00	-13.4	0.00	-5.61	0.00
Nigeria#	-3.44	0.02	-7.93	0.00	-5.83	0.00	-2.93	0.06	-4.70	0.00
Norway#	-5.25	0.00	-5.20	0.00	-7.81	0.00	-5.50	0.00	-6.09	0.00
N. Zealand#	-4.38	0.00	-5.53	0.00	-4.02	0.00	-5.14	0.00	-3.92	0.01
Philippines	-1.82*	0.07	-3.11	0.04	-2.28*	0.03	-3.05	0.05	-3.47	0.03
Portugal#	-5.52	0.00	-6.60	0.00	-5.79	0.00	-5.15	0.00	-6.93	0.00
Russia#	-6.10	0.00	-4.65	0.00	-4.88	0.00	-3.77	0.02	-4.23	0.00
S. Africa#	-4.30	0.00	-3.40	0.02	-2.99	0.06	-3.19	0.05	-5.45	0.00
S. Arabia	-3.81	0.01	-3.84	0.00	-4.13	0.00	-2.97	0.06	-4.19	0.00
S. Korea#	-5.31	0.00	-6.56	0.00	-4.79	0.00	-5.35	0.00	-6.39	0.00
Spain#	-4.46	0.00	-5.87	0.00	-4.88	0.00	-4.86	0.00	-5.34	0.00
Thailand#	-4.38	0.00	-6.11	0.00	-5.15	0.00	-3.11	0.05	-3.81	0.01
Tri &Tob#	-4.72	0.00	-5.81	0.00	-3.80	0.00	-2.97	0.06	-4.09	0.00
Turkey#	-4.12	0.00	-4.83	0.00	-4.64	0.00	-4.45	0.00	-5.46	0.00
UAE	-3.05	0.04	-4.44	0.00	-3.11	0.05	-2.77	0.08	-4.06	0.00
UK#	-3.36	0.05	-5.63	0.00	-5.07	0.00	-4.51	0.00	-6.86	0.00
USA	-4.37	0.00	-2.94	0.06	-3.92	0.00	-2.83	0.07	-3.05	0.05
Venezuela#	-3.05	0.05	-11.3	0.00	-2.97	0.06	-3.84	0.01	-5.72	0.00

Notes : * mark is for 1st difference with no intercepts and trends. ** indicates tests for trends and intercepts. # represents stationary at 2nd differences. Mainly the series for Mental disorders and Internet use are stationary at second differences in most of the cases.
Source : Authors' own estimates

As from the results in Table 2, there is a strong evidence of a cointegrating relation in countries like Algeria, Argentina, Australia, Brazil, Canada, Czech Republic, Costa Rica, Italy, Dominican Republic, Egypt, France, Indonesia, Japan, Philippines, Saudi Arabia, UAE, USA and Germany where the test statistic values lie in the critical region (be it the right-hand tail or left-hand tail) and the null hypothesis of 'no cointegration' gets resoundingly rejected.

Table 2. Johansen Cointegration test results

Country	Whether Cointegration present*	No. of CEs*

Algeria	Yes	2
Argentina	Yes	4
Australia	Yes	5
Brazil	Yes	4
Canada	Yes	3
Ch. Repub.	Yes	3
Chile#	-	-
China#	-	-
Costa Rica	Yes	4
D. Repub.	Yes	1
Egypt	Yes	5
France	Yes	3
Germany	Yes	1
Greece#	-	-
India#	-	-
Indonesia	Yes	2
Ireland#	-	-
Italy	Yes	2
Japan	Yes	2
Malaysia#	-	-
Mexico#	-	-
Morocco#	-	-
Netherlands#	-	-
Nigeria#	-	-
Norway#	-	-
N. Zealand#	-	-
Philippines	Yes	2
Portugal#	-	-
Russia#	-	-
S. Africa#	-	-
S. Arabia	Yes	2
S. Korea#	-	-
Spain#	-	-
Thailand#	-	-
Tri &Tob#	-	-
Turkey#	-	-
UAE	Yes	2
UK#	-	-
USA	Yes	4
Venezuela#	-	-

Note: * mark indicates that the results are based on Trace statistics and Maximum-Eigen values.
Source: Authors' own estimates

It is an alarming result that most of the high income countries in the selection have produced the result that mental disorder is cointegrated to the four socio economic indicators.

Moving on to Table 3, using the VECM modelings one can clearly check for the significance of the long-run cointegrating relation that exists for the concerned countries. The model developed in this paper where mental disorder has been expressed as a function of PCGDP, Globalization, Internet use, CO2 emissions sustains in the long run going by the long run causality significance for 11 countries like Argentina, Australia, Canada, Costa Rica, Dominican Republic, France, Germany, Italy, Japan, Saudi Arabia and UAE (see Table 3 for the summary results and the coefficients of the error correction term in column 4).

Table 3. Results of error correction and long run causality test through VECM

Country	Dependent Variables	Independent Variables	EC term(η)	Prob.	Remarks
Algeria	Ment	PCGDP, Glob, Inter, Co2	0.025	0.94	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	-0.297	0.37	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-1.372	0.01	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.432	0.01	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-1.00	0.09	Ment, PCGDP, Glob, Inter→CO2
Argentina	Ment	PCGDP, Glob, Inter, Co2	-0.31	0.04	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-1.26	0.00	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-0.58	0.09	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.32	0.06	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.42	0.27	No LR causality
Australia	Ment	PCGDP, Glob, Inter, Co2	-0.41	0.00	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-0.39	0.06	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-1.05	0.01	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.33	0.06	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.54	0.14	No LR causality
Brazil	Ment	PCGDP, Glob, Inter, Co2	-0.19	0.23	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	-0.14	0.56	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-2.17	0.00	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.06	0.74	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	-0.78	0.01	Ment, PCGDP, Glob, Inter→CO2
Canada	Ment	PCGDP, Glob, Inter, Co2	-0.28	0.02	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-0.13	0.59	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-0.14	0.59	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	-0.27	0.09	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-1.33	0.00	Ment, PCGDP, Glob, Inter→CO2
Ch. Repub.	Ment	PCGDP, Glob, Inter, Co2	-0.05	0.83	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	-0.22	0.26	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	0.06	0.68	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	-0.47	0.08	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.33	0.42	No LR causality
Chile#	-	-	-	-	-
China#	-	-	-	-	-
Costa Rica	Ment	PCGDP, Glob, Inter, Co2	-0.46	0.04	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	0.36	0.04	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-0.68	0.15	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	-0.97	0.03	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.47	0.17	No LR causality
D. Repub	Ment	PCGDP, Glob, Inter, Co2	-0.06	0.01	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-0.005	0.91	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-0.05	0.73	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	-0.07	0.00	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.16	0.02	Ment, PCGDP, Glob, Inter→CO2
Egypt	Ment	PCGDP, Glob, Inter, Co2	-0.10	0.30	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	-0.54	0.00	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-1.09	0.00	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.13	0.57	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	-1.71	0.00	Ment, PCGDP, Glob, Inter→CO2
France	Ment	PCGDP, Glob, Inter, Co2	-0.17	0.02	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-1.03	0.04	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-0.80	0.43	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	0.18	0.73	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	-0.61	0.31	No LR causality
Germany	Ment	PCGDP, Glob, Inter, Co2	-0.02	0.08	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-0.06	0.89	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-0.13	0.47	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	0.16	0.03	No LR causality

Country	Dependent Variables	Independent Variables	EC term(η)	Prob.	Remarks
	Co2	Ment, PCGDP, Glob, Inter	-0.41	0.07	Ment, PCGDP, Glob, Inter→CO2
Greece#	-	-	-	-	-
India#	-	-	-	-	-
Indonesia	Ment	PCGDP, Glob, Inter, Co2	-0.006	0.93	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	-0.51	0.20	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	0.03	0.70	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	0.09	0.32	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	-1.67	0.00	Ment, PCGDP, Glob, Inter→CO2
Ireland#	-	-	-	-	-
Italy	Ment	PCGDP, Glob, Inter, Co2	-0.26	0.00	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-0.36	0.20	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-0.22	0.03	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.13	0.33	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	0.05	0.61	No LR causality
Japan	Ment	PCGDP, Glob, Inter, Co2	-0.20	0.00	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	-0.93	0.00	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-0.81	0.18	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	-0.16	0.15	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	-0.12	0.72	No LR causality
Malaysia#	-	-	-	-	-
Mexico#	-	-	-	-	-
Morocco#	-	-	-	-	-
Netherlands#	-	-	-	-	-
Nigeria#	-	-	-	-	-
Norway#	-	-	-	-	-
N. Zealand#	-	-	-	-	-
Philippines	Ment	PCGDP, Glob, Inter, Co2	-0.01	0.73	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	0.15	0.47	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-0.16	0.41	No LR causality
	Inter	Ment, PCGDP, Glob,Co2	0.009	0.96	No LR causality
	Co2	Ment, PCGDP, Glob, Inter	-2.96	0.00	Ment, PCGDP, Glob, Inter→CO2
Portugal#	-	-	-	-	-
Russia#	-	-	-	-	-
S. Africa#	-	-	-	-	-
S. Arabia	Ment	PCGDP, Glob, Inter, Co2	-0.14	0.01	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	0.16	0.74	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-1.05	0.03	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.19	0.03	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.88	0.00	Ment, PCGDP, Glob, Inter→CO2
S. Korea#	-	-	-	-	-
Spain#	-	-	-	-	-
Thailand#	-	-	-	-	-
Tri &Tob#	-	-	-	-	-
Turkey#	-	-	-	-	-
UAE	Ment	PCGDP, Glob, Inter, Co2	-0.43	0.07	**PCGDP, Glob, Inter, Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	0.04	0.21	No LR causality
	Glob	Ment, PCGDP, Inter, Co2	-0.69	0.02	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.10	0.09	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-0.26	0.45	No LR causality
UK#	-	-	-	-	-
USA	Ment	PCGDP, Glob, Inter, Co2	-0.12	0.17	No LR causality
	PCGDP	Ment, Glob, Inter, Co2	-0.36	0.02	Ment, Glob, Inter, CO2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	-1.11	0.01	Ment, PCGDP, Inter, CO2→Glob
	Inter	Ment, PCGDP, Glob,Co2	-0.84	0.00	Ment, PCGDP, Glob, CO2→Inter
	Co2	Ment, PCGDP, Glob, Inter	-1.11	0.00	Ment, PCGDP, Glob, Inter→CO2
Venezuela#	-	-	-	-	-

Source: Authors' own estimates

It is further noted that out of these 11 countries, where long run causal relations are observed from all the four socio-economic indicators to mental disorder, eight are from the high income earning group. Hence, mental disorder is a real problem for the developed countries.

It should be noted here that the results in Table 4 relates to the significance of the causal relations in the short run. In other words, to draw a parallel, Granger causality is more about short run (i.e. results in Table 4) while long run causality depends upon significance of the long run relations and has been tested through the lagged error correction term (see column 4 of Table 3) derived from the long run equilibrium relationships in Table 3. The results of the short run causality tests in Table 4 unambiguously backs up the sustainability of the long run cointegration relations derived for countries like Argentina, Australia, Canada, Costa Rica, Dominican Republic, France, Germany, Italy, Japan, Saudi Arabia and UAE, as already mentioned above along with Egypt.

Table 4. Short run causality test results (Wald test)

Country	Dependent Variables	Independent Variables	Chi Square Value	Prob.	Remarks
Algeria	Ment	PCGDP, Glob, Inter, Co2	3.56	0.46	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	2.32	0.61	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	2.25	0.68	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	6.36	0.17	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	3.92	0.41	No SR causality
Argentina	Ment	PCGDP, Glob, Inter, Co2	11.96	0.01	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	18.28	0.00	Ment, Glob, Inter, Co2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	9.23	0.05	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	3.43	0.48	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	13.49	0.00	Ment, PCGDP, Glob, Inter→ Co2
Australia	Ment	PCGDP, Glob, Inter, Co2	6.68	0.15	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	4.69	0.32	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	7.24	0.12	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	5.50	0.22	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	4.93	0.29	No SR causality
Brazil	Ment	PCGDP, Glob, Inter, Co2	8.67	0.06	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	3.29	0.50	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	1.25	0.86	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	11.85	0.01	Ment, PCGDP, Glob, Co2→ Inter
	Co2	Ment, PCGDP, Glob, Inter	6.81	0.14	No SR causality
Canada	Ment	PCGDP, Glob, Inter, Co2	19.88	0.00	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	3.09	0.54	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	10.20	0.03	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	8.20	0.08	Ment, PCGDP, Glob, Co2→ Inter
	Co2	Ment, PCGDP, Glob, Inter	13.12	0.01	Ment, PCGDP, Glob, Inter→ Co2
Ch. Repub.	Ment	PCGDP, Glob, Inter, Co2	2.08	0.72	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	0.38	0.98	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	19.22	0.00	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	3.83	0.42	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	10.36	0.03	Ment, PCGDP, Glob, Inter→ Co2
Chile#	Ment	Co2	2.75	0.09	d(d(Co2)) →d(d(Ment))
	PCGDP	None & All	0.24	0.99	No SR causality
	Glob	None & All	2.91	0.57	No SR causality
	Inter	Glob	2.95	0.08	d(d(Glob)) →d(d(Inter))
	Co2	None & All	5.46	0.24	No SR causality
China#	Ment	None & All	2.96	0.56	No SR causality
	PCGDP	None & All	2.17	0.70	No SR causality
	Glob	Ment	2.80	0.09	d(d(Ment))→d(d(Glob))
	Inter	None & All	0.67	0.95	No SR causality
	Co2	PCGDP	2.97	0.08	d(d(PCGDP))→d(d(Co2))
Costa Rica	Ment	PCGDP, Glob, Inter, Co2	6.32	0.17	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	16.64	0.00	Ment, Glob, Inter, Co2→PCGDP

Country	Dependent Variables	Independent Variables	Chi Square Value	Prob.	Remarks
	Glob	Ment, PCGDP, Inter, Co2	6.90	0.14	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	3.74	0.44	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	0.72	0.94	No SR causality
D. Repub	Ment	PCGDP, Glob, Inter, Co2	3.24	0.66	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	13.61	0.01	Ment, Glob, Inter, Co2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	9.97	0.09	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	22.83	0.00	Ment, PCGDP, Glob, Co2→ Inter
	Co2	Ment, PCGDP, Glob, Inter	13.67	0.01	Ment, PCGDP, Glob, Inter→ Co2
Egypt	Ment	PCGDP, Glob, Inter, Co2	8.35	0.07	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	8.05	0.08	Ment, Glob, Inter, Co2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	13.38	0.00	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	0.93	0.91	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	13.25	0.01	Ment, PCGDP, Glob, Co2→ Inter
France	Ment	PCGDP, Glob, Inter, Co2	22.53	0.00	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	4.75	0.31	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	4.55	0.33	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	2.33	0.67	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	4.98	0.29	No SR causality
Germany	Ment	PCGDP, Glob, Inter, Co2	14.98	0.01	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	4.67	0.45	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	6.61	0.25	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	17.11	0.00	Ment, PCGDP, Glob, Co2→ Inter
	Co2	Ment, PCGDP, Glob, Inter	12.66	0.02	Ment, PCGDP, Glob, Inter→ Co2
Greece#	Ment	None & All	4.72	0.31	No SR causality
	PCGDP	None & All	0.61	0.96	No SR causality
	Glob	Ment, Co2	2.92, 4.13	0.08, 0.04	d(d(Ment& Co2))→d(d(Glob))
	Inter	Ment, Glob	2.82, 4.58	0.09, 0.03	d(d(Ment& Glob))→d(d(Inter))
	Co2	PCGDP	3.05	0.08	d(d(PCGDP))→d(d(Co2))
India#	Ment	None & All	2.47	0.64	No SR causality
	PCGDP	None & All	4.57	0.33	No SR causality
	Glob	All	64.35	0.00	d(d(All))→d(d(Glob))
	Inter	Glob	3.93	0.04	d(d(Glob))→d(d(Inter)) Bilateral between Glob and Inter
	Co2	Inter	4.00	0.04	d(d(Inter))→d(d(Co2))
Indonesia	Ment	PCGDP, Glob, Inter, Co2	4.09	0.39	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	2.21	0.69	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	3.51	0.47	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	3.01	0.55	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	13.18	0.01	Ment, PCGDP, Glob, Inter→ Co2
Ireland#	Ment	PCGDP	3.69	0.05	d(d(PCGDP))→d(d(Ment))
	PCGDP	None & All	5.94	0.20	No SR causality
	Glob	None & All	1.92	0.74	No SR causality
	Inter	Ment& All	5.74, 8.36	0.01, 0.07	d(d(Ment))→d(d(Inter)) d(d(All))→d(d(Inter))
	Co2	Ment, Inter & All	10.04, 10.25, 22.23	0.00, 0.00, 0.00	d(d(Ment& Inter))→d(d(Co2)) d(d(All))→d(d(Co2))
Italy	Ment	PCGDP, Glob, Inter, Co2	17.59	0.00	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	6.52	0.16	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	2.72	0.60	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	1.05	0.90	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	5.27	0.25	No SR causality
Japan	Ment	PCGDP, Glob, Inter, Co2	11.34	0.02	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	6.24	0.18	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	2.40	0.66	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	1.81	0.77	No SR causality

Country	Dependent Variables	Independent Variables	Chi Square Value	Prob.	Remarks
	Co2	Ment, PCGDP, Glob, Inter	0.60	0.96	No SR causality
Malaysia#	Ment	Glob & All	5.97, 10.96	0.01, 0.02	d(d(Glob))→d(d(Ment)) d(d(Jointly))→d(d(Ment))
	PCGDP	None & All	2.80	0.59	No SR causality
	Glob	Ment, Inter & All	3.10, 3.21 & 12.36	0.07, 0.07, 0.01	d(d(Ment& Inter))→d(d(Glob)) d(d(Jointly))→d(d(Glob))
	Inter	None & All	1.19	0.87	No SR causality
	Co2	Glob	2.79	0.09	d(d(Glob))→d(d(Co2))
Mexico#	Ment	None & All	0.95	0.91	No SR causality
	PCGDP	None & All	3.86	0.42	No SR causality
	Glob	Inter & All	6.56, 10.0	0.01, 0.04	d(d(Inter))→d(d(Glob)) d(d(Jointly))→d(d(Glob))
	Inter	None & All	0.87	0.92	No SR causality
	Co2	PCGDP	4.07	0.04	d(d(PCGDP))→d(d(Co2))
Morocco#	Ment	Glob	5.14	0.02	d(d(Glob))→d(d(Ment))
	PCGDP	None & All	0.72	0.94	No SR causality
	Glob	None & All	2.01	0.73	No SR causality
	Inter	None & All	0.57	0.96	No SR causality
	Co2	Glob, Inter & All	2.89, 9.57 & 10.69	0.08, 0.00& 0.03	d(d(Glob, Inter))→d(d(Co2)) d(d(Jointly))→d(d(Co2))
Netherlands#	Ment	Co2 & All	5.41 & 9.35	0.02 &0.05	d(d(Co2))→d(d(Ment)) d(d(Jointly))→d(d(Ment))
	PCGDP	Co2	3.00	0.08	d(d(Co2))→d(d(PCGDP))
	Glob	PCGDP & All	9.03 & 13.2	0.00 &0.01	d(d(PCGDP))→d(d(Glob)) d(d(Jointly))→d(d(Glob))
	Inter	None & All	3.39	0.49	No SR causality
	Co2	PCGDP & All	10.24 &14.3	0.00 &0.00	d(d(PCGDP))→d(d(Co2)) Bilateral Causality d(d(Jointly))→d(d(Co2))
Nigeria#	Ment	PCGDP, Co2, Inter & All	6.02, 8.82, 4.12 & 26.4	0.01, 0.00, 0.04 & 0.00	d(d(PCGDP, Co2, Inter))→d(d(Ment)) d(d(Jointly))→d(d(Ment))
	PCGDP	Co2	3.62	0.05	d(d(Co2))→d(d(PCGDP))
	Glob	PCGDP	5.13	0.02	d(d(PCGDP))→d(d(Glob))
	Inter	PCGDP	2.74	0.09	d(d(PCGDP))→d(d(Inter))
	Co2	Ment	2.94	0.08	d(d(Co2))→d(d(Ment)) Bilateral Causality
Norway#	Ment	PCGDP & All	14.98 & 18.41	0.00, 0.00	d(d(PCGDP))→d(d(Ment)) d(d(Jointly))→d(d(Ment))
	PCGDP	None & All	1.37	0.84	No SR causality
	Glob	Co2	3.08	0.07	d(d(Co2))→d(d(Glob))
	Inter	None & All	1.79	0.77	No SR causality
	Co2	Ment	3.12	0.07	d(d(Ment))→d(d(Co2))
N. Zealand#	Ment	None & All	2.10	0.71	No SR causality
	PCGDP	None & All	4.81	0.30	No SR causality
	Glob	None & All	0.67	0.95	No SR causality
	Inter	None & All	2.31	0.67	No SR causality
	Co2	PCGDP	2.87	0.09	d(d(PCGDP))→d(d(Co2))
Philippines	Ment	PCGDP, Glob, Inter, Co2	1.47	0.83	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	2.26	0.68	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	3.00	0.55	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	37.46	0.00	Ment, PCGDP, Glob, Co2→ Inter
	Co2	Ment, PCGDP, Glob, Inter	19.50	0.00	Ment, PCGDP, Glob, Inter→ Co2
Portugal#	Ment	None & All	2.31	0.68	No SR causality
	PCGDP	None & All	2.39	0.66	No SR causality

Country	Dependent Variables	Independent Variables	Chi Square Value	Prob.	Remarks
	Glob	Ment& Inter	2.99 & 2.85	0.08, 0.09	d(d(Ment&Inter))→d(d(Glob))
	Inter	None & All	1.78	0.77	No SR causality
	Co2	Ment	2.72	0.09	d(d(Ment))→d(d(Co2))
Russia#	Ment	None & All	1.26	0.86	No SR causality
	PCGDP	None & All	4.58	0.33	No SR causality
	Glob	PCGDP	6.20	0.01	d(d(PCGDP))→d(d(Glob))
	Inter	None & All	1.84	0.76	No SR causality
	Co2	PCGDP & Glob	2.91 & 3.69	0.08 &0.05	d(d(PCGDP & Glob))→d(d(Co2))
S. Africa#	Ment	Co2	2.84	0.09	d(d(Co2))→d(d(Ment))
	PCGDP	Glob	4.56	0.03	d(d(Glob))→ d(d(PCGDP))
	Glob	Ment	2.96	0.08	d(d(Ment))→d(d(Glob))
	Inter	None & All	2.46	0.65	No SR causality
	Co2	None & All	1.34	0.84	No SR causality
S. Arabia	Ment	PCGDP, Glob, Inter, Co2	18.13	0.00	**PCGDP,Glob,Inter,Co2→Ment**
	PCGDP	Ment, Glob, Inter, Co2	1.91	0.75	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	3.62	0.45	No SR causality
	Inter	Ment, PCGDP, Glob,Co2	5.22	0.26	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	26.29	0.00	Ment, PCGDP, Glob, Inter→ Co2
S. Korea#	Ment	PCGDP & Co2	2.98 &2.78	0.08 &0.09	d(d(PCGDP&Co2))→d(d(Ment))
	PCGDP	Co2	3.64	0.05	d(d(Co2))→d(d(PCGDP))
	Glob	Co2 & Inter	2.97 &2.70	0.08 &0.10	d(d(Co2 & Inter))→d(d(Glob))
	Inter	Co2	3.31	0.06	d(d(Co2))→d(d(Inter))
	Co2	PCGDP & All	4.32 &8.14	0.03 &0.08	d(d(PCGDP))→d(d(Co2)) Bilateral Causality d(d(Jointly))→d(d(Co2))
Spain#	Ment	PCGDP & Co2	3.18 &2.62	0.07, 0.10	d(d(PCGDP & Co2))→d(d(Ment))
	PCGDP	Ment, Co2 & All	11.13, 2.79 & 13.53	0.00, 0.09, 0.00	d(d(Ment,Co2))→d(d(PCGDP)) Bilateral Causality d(d(Jointly))→d(d(PCGDP))
	Glob	Co2	5.08	0.02	d(d(Co2))→d(d(Glob))
	Inter	None & All	0.66	0.95	No SR causality
	Co2	None & All	3.54	0.47	No SR causality
Thailand#	Ment	None & All	2.37	0.66	No SR causality
	PCGDP	Ment, Inter & All	6.35, 8.76 & 13.95	0.01, 0.00, 0.00	d(d(Ment, Inter))→d(d(PCGDP)) d(d(Jointly))→d(d(PCGDP))
	Glob	None & All	0.91	0.92	No SR causality
	Inter	Co2	2.87	0.09	d(d(Co2))→d(d(Inter))
	Co2	None & All	3.40	0.49	No SR causality
Tri &Tob#	Ment	None & All	2.29	0.68	No SR causality
	PCGDP	None & All	3.76	0.43	No SR causality
	Glob	Co2	3.02	0.08	d(d(Co2))→d(d(Glob))
	Inter	None & All	3.76	0.43	No SR causality
	Co2	Ment, PCGDP, Inter & All	3.73, 8.85, 4.72 & 14.89	0.05, 0.00, 0.02 & 0.00	d(d(Ment, PCGDP& Inter))→d(d(Co2)) d(d(Jointly))→d(d(Co2))
Turkey#	Ment	None & All	1.09	0.89	No SR causality
	PCGDP	None & All	2.32	0.67	No SR causality
	Glob	Inter & All	10.13 &16.63	0.00 &0.00	d(d(Inter))→d(d(Glob)) d(d(Jointly))→d(d(Glob))
	Inter	Ment, Glob & All	14.20, 3.35 &	0.00,	d(d(Ment, Glob))→d(d(Inter))

Country	Dependent Variables	Independent Variables	Chi Square Value	Prob.	Remarks
			17.45	0.06 & 0.00	d(d(Jointly))→d(d(Inter))
	Co2	None & All	1.97	0.73	No SR causality
UAE	Ment	PCGDP, Glob, Inter, Co2	4.75	0.31	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	8.92	0.06	Ment, Glob, Inter, Co2→PCGDP
	Glob	Ment, PCGDP, Inter, Co2	8.41	0.07	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	3.54	0.47	No SR causality
	Co2	Ment, PCGDP, Glob, Inter	1.21	0.87	No SR causality
UK#	Ment	PCGDP & All	3.74 & 8.62	0.05 & 0.07	d(d(PCGDP))→d(d(Ment)) d(d(Jointly))→d(d(Ment))
	PCGDP	None & All	0.23	0.99	No SR causality
	Glob	None & All	1.20	0.87	No SR causality
	Inter	Ment	5.09	0.02	d(d(Ment))→d(d(Inter))
	Co2	None & All	0.52	0.97	No SR causality
USA	Ment	PCGDP, Glob, Inter, Co2	7.19	0.12	No SR causality
	PCGDP	Ment, Glob, Inter, Co2	5.88	0.20	No SR causality
	Glob	Ment, PCGDP, Inter, Co2	7.91	0.09	Ment, PCGDP, Inter, Co2→ Glob
	Inter	Ment, PCGDP, Glob,Co2	9.34	0.05	Ment, PCGDP, Glob, Co2→ Inter
	Co2	Ment, PCGDP, Glob, Inter	14.40	0.00	Ment, PCGDP, Glob, Inter→ Co2
Venezuela#	Ment	None & All	0.71	0.94	No SR causality
	PCGDP	Co2, Inter & All	5.29, 4.06 & 11.41	0.02, 0.04, 0.02	d(d(Co2,Inter))→d(d(PCGDP)) d(d(Jointly))→d(d(PCGDP))
	Glob	None & All	1.96	0.74	No SR causality
	Inter	None & All	2.30	0.68	No SR causality
	Co2	Glob & Inter	3.03 & 2.76	0.08 &0.09	d(d(Glob &Inter))→d(d(Co2))

Source: Authors' own estimates

Combining the long run and short run results of the study it is inferred that mental disorder is not a problem specific to the lower income countries as the existing literatures claim but also to the high income countries as well. But the interpretations and the factorial roles are very different. In the lower income countries low income levels, pollution, poverty and inequality lead to mental disorder, whereas, for the higher income countries, it is more of affluence that lead to mental disorder through a move towards globalization, internet use and exposure to pollution.

To justify the feasibility and applicability of the model developed in this paper, we test for the normality of the residuals and to what extent the models can be a good fit. The derived results have been also scanned for diagnostic checking on whether thee errors are normally distributed and are heteroscedastic. We observed that the countries for which the significant long run and short run results are observed satisfied the diagnostic checking. We did not place the table in the text as it is very large in size. The different models specified against the criteria of serial autocorrelation, heteroskedasticity and normality checks of the residuals for the countries were tested for validating the existence of a cointegrating relationship for countries like, Algeria, Argentina, Australia, Brazil, USA, UAE, Canada, Costa Rica, Italy, Dominican Republic, Egypt, France, Indonesia, Czech Republic, Japan, Philippines, Saudi Arabia, and Germany.

Going back to the basic model where mental disorder has been expressed as a function of per capita GDP (PCGDP), extent of globalization, internet use and pollution, we see that the relationship is somewhat stable and significant, mostly for the developing countries as reported in Table 3. In this rapidly changing world, one of the most alarming issues is mental ill health increasingly occupying a larger proportion of the world disease burden. Starting off with per-capita GDP, it is clear that the myth of mental disorder being prevalent only in low income countries gets broken (see Allen et al., 2014; Ruiz-Perez et al., 2018; Dolan et al.,

2008). Since high income countries like Italy, France, Germany and Japan very much suffer from mental disorders (see Table 2 - 4) as per the predictions of the model. One of the reasons why globalization has an impact on mental health is the change in social and psychological dimensions of work accompanying patterns of globalization bringing about a growth of an informal sector of employment (Zulfiqar, 2016), defined by "low earnings, the absence of contracts, unstable working conditions, poor access to social services, low rates of union affiliation and growing levels of irregular and quasilegal labour" (Bhavsar & Bhugra, 2008). It is how individuals, societies, and governments respond to such consequences in terms of self-esteem, resilience, anxiety, etc. seems to have an impact on level of mental health (Sharma, 2016). But, surprisingly, this reason is not true for the cross-section of middle and low income countries that we have considered here in this paper. For the developed countries the experience of mental disorder actually stems from the market deregulation mechanism creating huge inequalities in the income distribution leading to worsening the problem of "poverty, inequality and social injustice" (Bhavsar & Bhugra, 2008) further. Coming to internet use and pollution, our results support the claims existing in the literature, as already discussed and are found to be significant determinants of mental disorders. What needs to be mentioned here is that for both excessive internet use and pollution, there can be observed behavioural changes like spending less time outside and not socializing, or leading a more deskbound daily life can be a cause psychological distress or social isolation.

5. Conclusion

In a nutshell, not only has this study highlighted mental disorder as a problem specific to the lower-middle income countries, but also for the countries under consideration in the high income bracket. There is a rich literature on the subject of mental health being a cause of concern in the developing world consistent to what we have pointed out. However, there is no proper reference in the literature of a possibility that developed countries also face the stigma of mental health disorder and its consequential impacts. Herein, lies our major contribution. As emphasized, out of the eleven countries where long run causal relations have been observed from all the four socio-economic indicators to mental disorder, eight come from the high income earning group. We expect that this paper will be a benchmark to initiate further cross-country research at the micro level and necessitate urgent action across the globe to curb the menace of mental disorder. Irrespective of the income classification the country belongs to, policy making is essential at all the levels of governance to make a positive difference to mental health outcomes.

For the purpose of future research, given the availability of data, it would be worth investigating the role played by other indicators like gender, caste or race, ethnicity, social security schemes available etc., besides, the ones considered here, that affect the relationship between a stressful life situation and mental health across both developed and developing countries. Also, the whys and hows of childrens' mental health given socio-economic considerations like per-capita GDP, the level of per-capita CO2 emissions, usage of Internet, etc., again across both developed and developing countries is an unexplored area of research. In terms of opportunities for intervention and prevention, the aspect of parental education needs to be thoroughly examined in this regard. Even on the basis of the age distribution, the proportion of mental health cases is something that remains to be comprehended but getting sufficient data on the decile or percentile classification of mental health disorders among children, middle-aged and older people is the real challenge. Another exercise at the macro level can be exploring the public health infrastructure provisions like, number of public healthcare centers, public hospitals, doctors available, etc. and to what extent these influence mental health conditions. Last, but not the least, carrying out a micro level study by collecting data on smoking habits, alcohol use, jogging, cycling, gymming or any other intense physical activity, etc. at all age levels using a primary survey and trying to relate it with the mental health conditions will add in another dimension to the mental health literature as a part of our future course of action.

List of Abbreviations

ADF: Augmented Dickey-Fuller

GI: Globalization Index
GINI: A measure of inequality
Glob: Globalization
Inter: Internet
IU: Internet Use
LR: Long run
Ment: Mental Disorder
PCCO: Per capita CO2
PCGDP: Per capita Gross Domestic Product
Prob.: Probability
SR: Short run
UAE: United Arab Emirates
UK: United Kingdom
USA: United States of America
VAR: Vector auto regression
VECM: Vector error correction model
WHO: World Health Organization

Declarations

Ethical Approval and Consent to participate: We as authors of the submitted title hereby disclose that we have no funding source behind the research, have no conflict of interests and the manuscript has been developed originally and has not been submitted elsewhere.

Consent for publication: We put our consent to publish the article if accepted.

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