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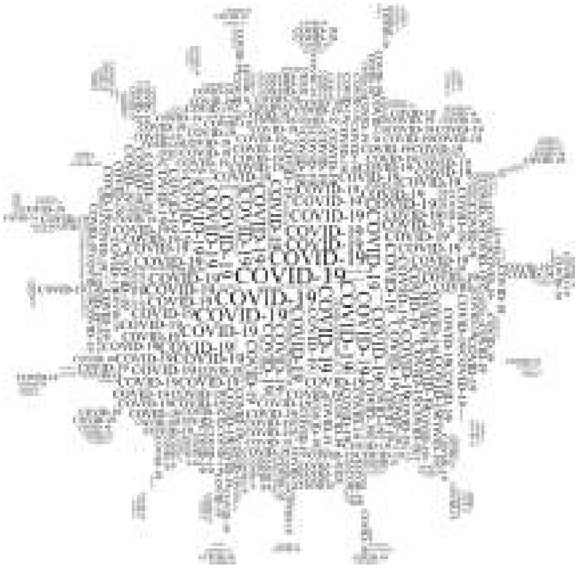

Efficacy of Covid-19 Vaccines, Through Correlating Vaccine Coverage and Death by Covid-19

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ABSTRACT

Aims: In the wake of compulsory vaccination measures against covid-19 and the global effort to tame the Sars-Cov-2 pandemic, the present study examines the correlation between vaccination coverage and the reduction of covid-19 deaths.

Methods: The research sample consists of 27 European countries, which officially declare the data of their vaccination coverage to the ECDC for 18+ years old and 60+ years old. Linear regression and Quadratic regression model were used for statistical analysis of the data.

Results: From the statistical analysis of the vaccination coverage (43% -95%) in the 18+ years and the cumulative deaths (duration of 14 days to 23/11/2021) of the countries, a moderately negative correlation emerged (R_{Linear} = 0,76 / R_{QUADR} = 0,78), p <0,05 => 0,00 <0,05, while a moderately negative correlation was also found on the vaccination coverage (61% -100%) and cumulative deaths(duration of 14 days to 23/11 / 2021) on individuals of 60+ years old (R_{Linear} = 0,78 / R_{QUADR} = 0,81), p <0,05 => 0,00 <0,05.
However, the statistical analysis revealed two different groups in terms of deaths (See Tables 2 and 6), with a marginal point of group's difference at 71% of vaccination coverage at 18+ years old and 85% at 60+ years old. Because this difference in deaths at this point may indicate the existence of a latent variable, which forms a false correlation, two additional correlation analyses are performed, between vaccination coverage and deaths in the two subgroups, as formulated for 18+ with vaccination coverage (43% -71% and 71% -95%), and two analyses of correlation between vaccination coverage and deaths in the two subgroups for 60+ with vaccination coverage (61% -82% and 85% -100%). All 4 sub-analyzes are expected to show correlations, otherwise the initial correlations are judged to be plausible due to the existence of a hidden variable that forms false results. Statistical analyses of the four groups did not show a correlation between increased vaccination coverage and a decrease in covid-19 deaths in all four cases, suggesting that the initial correlations were due to one or more variables underlying the vaccine.

Conclusions: In conclusion, the results of the present study show that the increase in the rate of vaccination coverage at 18+ years old and 60+ years old is not related to the reduction of deaths from covid-19.

INTRODUCTION

In early 2020, the new coronavirus Sars-Cov-2, which causes covid-19 disease, appeared on the world health map. The imprint of the new coronavirus can be seen both from the total deaths so far (5.27 million, *our world in data* 07/12/2021, **See Appendix 7, figure 3**), as well as from the total cases (267 million, *our world in data* 07/12/2021, **See Appendix 7, Figure 3**), but much more than the fact that governments, in an effort to reduce the spread of the virus and its negative consequences, have taken unprecedented mandatory measures (lockdown, mandatory use of masks, bans on gatherings, etc.), raising concerns and reactions in many cases, on issues related to human rights, bioethics, economics, etc. As there seems to be no cohesive policy on tackling the new coronavirus pandemic, the announcement of vaccines against the disease, seems to have intensified the initial separation, as it was perceived by many as a hopeful message, while by several others it was treated with skepticism. The new technology m-rna vaccines, the short study period of the side effects, the limited volume of recording of side effects through the yellow cards, but also the limited studies regarding their effectiveness in the new strains (Delta, Omicron), intensified skepticism, with the result that, under the pressure of the health crisis, an unprecedented social divide was formed between the vaccinated and the unvaccinated. This separation has been sealed by recent government decisions on compulsory horizontal vaccination, either for all or for specific age groups. In Greece, Law 4865/2021 (Government Gazette 238 / AD / 04.12.2021) introduced the mandatory vaccination for those over 60 years, as a solution to the health problem created by Sars-Cov-2.

In the context of this unprecedented separation, the present study aims to examine whether increasing vaccination coverage in adults and especially in 60+ years of age can be a solution or part of the solution to the problem.

The present study draws on vaccination coverage data for 27 of the 30 European countries that provide data to the ECDC, and investigates whether vaccination growth rates can predict a reduction in covid-19 deaths. The investigation hypotheses are therefore summarized as follows:

- H_0 = The increase in vaccination coverage at 18+ years is not related to the reduction in covid-19 deaths.

- H_1 = The increase in the rate of vaccination coverage at 18+ years of age is inversely related to the reduction in deaths from covid-19, which means that the higher the rate of vaccination at 18+ years old, the lower the deaths.

- H_0 = the increase in vaccination coverage at 60+ years is not related to the reduction in covid-19 deaths.

- H_1 = The increase in the rate of vaccination coverage at 60+ years is inversely related to the decrease in deaths from covid-19, which means that the higher the rate of vaccination at 60+ years old, the lower the deaths

The purpose of this study is to enrich the scientific literature regarding the effectiveness of vaccines in the prevention and, ultimately, reduction of deaths from covid-19 in vivo conditions. Although the results of studies conducted to evaluate the efficacy of vaccines show their efficacy for covid-19, the reduction in covid-19 deaths in vivo conditions has not been linked to a cause-and-effect relationship. This, although seemingly contradictory, may be explained by the fact that the studies in all their phases, used for the sample mostly healthy population aged 18-55 years, while the sample excluded people with serious diseases, people, whose treatments may have interacted with the results of the study. Also individuals who had "uncontrolled underlying disease" were excluded (Voysey et al., 2021, appendix 1, pages 23, 24). Therefore, the effectiveness of a vaccine may be true when it has been established in a healthy population, for the most part, but this does not necessarily mean that it will reduce deaths when the vast majority of deaths occur in people over 65 years with severe comorbidities, i.e. people excluded from the studies.

In addition, the lack of sufficient scientific data regarding the association between vaccination coverage and death reduction is evident from the fact that, although in PubMed they were entered as “keywords” (vaccines reduce covid deaths, vaccines related to reduce deaths from covid, correlation analysis vaccines covid deaths) no results related to the request appeared in the first three pages, i.e. in the first 60 results.

The present study therefore aims to add scientific data to the existing scientific literature on the efficacy of vaccines against covid-19 deaths in vivo conditions.

METHOD

DESIGN AND STRUCTURE

Microsoft excel 2010 was used for all the following statistical analyzes.

To investigate a possible correlation between the increase in vaccination coverage from 43%-95% to 18+ (45^{th} week of 2021) and the cumulative deaths per million population for the 14 days until 23/11/2021, the simple Linear regression analysis test and the regression Quadratic model through Microsoft excel 2010, with a sample of 26 countries will be used **(See Table 1**). The independent variable is the percentage of vaccination coverage % (predictor), while the dependent variable is the sum of deaths per million populations (outcome). Due to the fact that the values of both variables do not meet the condition of normal distribution, the values of both variables are converted to rank values **(See Appendix 1, Figure 1**), so that the statistical analysis is performed with the non-parametric Spearman's Rank Correlation Test. Because, from the result of the analysis of the rank values, it appears that the Spearman correlation index is equal to the Pearson correlation index (r), the statistical analysis of the values will be done with the Pearson index (r).

Then, due to the fact that there are two different patterns in the distribution of deaths, according to the vaccination coverage with a focal point of 71% **(See table 2** below, difference of deaths above - below 71% of vaccination coverage), two simple Linear regression analysis tests and two Quadratic regression models will be used.

The first Linear regression and regression Quadratic model will be sampled from the last ten countries with vaccination coverage of 43% -71%, to confirm the moderate strength correlation between vaccination coverage and covid-19 deaths, as determined by the initial analysis of 26 countries, or in case of non-correlation to highlight the factor of a hidden variable that creates a plausible and artificial correlation found in the analysis of 26 countries. The independent and dependent variable is again the vaccination coverage of the 10 countries from 43% -71% and their cumulative deaths, respectively (**See Table 3**). Due to the fact that the values of both variables do not meet the condition of normal distribution, the values of both variables are converted to rank values **(See Appendix 2, Figure 1**), so that the statistical analysis is performed with the non-parametric Spearman's Rank Correlation Test. Because the result of the rank value analysis shows that the Spearman correlation index is equal to the Pearson correlation index (r) (Field, 2009), the statistical analysis of the values will be done with the Pearson index (r).

The second Linear regression and regression Quadratic model will be conducted with a sample of the first 16 countries with vaccination coverage of 71% -95%, to confirm the moderate correlation strength between vaccination coverage and covid-19 deaths, as determined by the initial analysis of 26 countries, or in case of non-correlation to highlight the factor of a hidden variable that creates a plausible and artificial correlation found in the analysis of 26 countries. The independent and dependent variable is again the vaccination coverage of 16 countries from 71% -95% and their cumulative deaths, respectively **(See Table 4)**. Since the values of both variables do not satisfy the condition of normal distribution, the values of both variables are converted to rank values (**See Appendix 3, Figure 1**), so that the statistical analysis can be performed with the non-parametric Spearman's Rank Correlation Test. Because the result of the rank value analysis shows that the Spearman correlation index is equal to the Pearson correlation index (r) (Field, 2009), the statistical analysis of the values will be done with the Pearson index (r).

Exactly the same methodological planning is followed for the examination of a possible correlation, between increasing vaccination coverage from 61% -100% of the countries in 60+ and their cumulative deaths from covid-19, for the 22 countries **(See Table 5)** (Bulgaria and Romania were removed due to outlier, while Germany, Liechtenstein and the Netherlands were removed because they did not provide evidence of vaccination coverage of 60+ at the ECDC). Due to the fact that the values of both variables do not meet the condition of normal distribution, the values of both variables are converted to rank values **(See Appendix 4 Figure 1),** so that the statistical analysis is performed with the non-parametric Spearman's Rank Correlation Test. Since the result of the rank value analysis shows that the Spearman correlation index is equal to the Pearson correlation index (r) (Field, 2009), the statistical analysis of the values will be done with the Pearson index (r).

Again, because there are two different patterns in the distribution of deaths according to vaccination coverage with a focal point of 85% (**See Table 6** below, death difference above - below 85% of vaccination coverage), two simple Linear regression analysis tests will be performed and two regression Quadratic models, according to the reasoning and methodological design described above.

The first Linear regression and regression Quadratic model will be conducted with a sample of the last 9 countries with vaccine coverage of 61% -82%, to confirm the moderate correlation strength between vaccination coverage and covid-19 deaths, found in the analysis of 22 countries for 60+, or in case of non-correlation to highlight the factor of a hidden variable that creates a plausible and artificial correlation found in the analysis of 22 countries for 60+. The independent and dependent variable is again the vaccination coverage of the 9 countries from 61% - 82% and their cumulative deaths, respectively (**See Table 7**). Due to the fact that the values of both variables do not meet the condition of normal distribution, the values of both variables are converted to rank values (**See Appendix 5, Figure 1**), so that the statistical analysis is performed with the non-parametric Spearman's Rank Correlation Test. Since the result of the rank analysis shows that the Spearman correlation index is equal to the Pearson correlation index (r), the statistical analysis of the values will be done with the Pearson index (r).

The second Linear regression and regression Quadratic model will be conducted with a sample of the first 13 countries with vaccination coverage of 85% -100%, to confirm the moderate correlation strength between vaccination coverage and covid-19 deaths, found in the analysis of 22 countries, or in case of non-correlation to highlight the factor of a hidden variable that creates a plausible and artificial correlation found in the analysis of 22 countries. Due to the fact that the values of both variables do not meet the condition of normal distribution, the values of both variables are converted to rank values (**See Appendix 6, Figure 1**), so that the statistical analysis is performed with the non-parametric Spearman's Rank Correlation Test. Furthermore the result of the rank analysis shows that the Spearman correlation index is equal to the Pearson correlation index (r) and as a result the statistical analysis of the values will be done with the Pearson index (r).

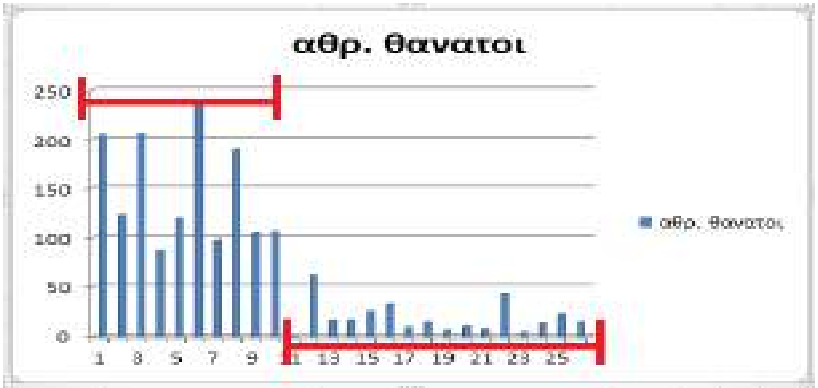
TABLE 1

COUNTRY	VACCINATION COVERAGE 18+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
DENMARK	95%	14
IRELAND	93%	23
PORTUGAL	92%	13
MALTA	92%	4
BELGIUM	87%	43
SPAIN	84%	7
FINLAND	83%	10
SWEDEN	83%	6
ITALY	82%	14
FRANCE	82%	9
GERMANY	81%	33
HOLLAND	80%	26
CYPRUS	80%	16
LUXEMBOURG	76%	16
AUSTRIA	74%	62
LIECHTENSTEIN	71%	0

GREECE	**71%**	**106**
CZECHIA	**68%**	**105**
HUNGARY	**68%**	**189**
ESTONIA	**67%**	**98**
LATVIA	**66%**	**239**
SLOVENIA	**64%**	**119**
POLAND	**62%**	**86**
CROATIAN	**55%**	**205**
SLOVAKIA	**54%**	**123**
ROMANIA	**43%**	**204**

The table shows the countries that make up the final sample of 26 countries in terms of vaccination coverage and cumulative deaths for 18+

TABLE 2



The two different patterns formed by the difference of the cumulative deaths at the point of 71% of the vaccination coverage for 18+.

TABLE 3

COUNTRY	VACCINATION COVERAGE 18+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
GREECE	**71%**	**106**
CZECHIA	**68%**	**105**
HUNGARY	**68%**	**189**
ESTONIA	**67%**	**98**
LATVIA	**66%**	**239**
SLOVENIA	**64%**	**119**
POLAND	**62%**	**86**
CROATIAN	**55%**	**205**
SLOVAKIA	**54%**	**123**
ROMANIA	**43%**	**204**

The table shows the 10 countries with vaccination coverage of 43% -71% with cumulative deaths, which are the sample of the first sub-analysis for 18+.

TABLE 4

COUNTRY	VACCINATION COVERAGE 18+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
DENMARK	95%	14
IRELAND	93%	23
PORTUGAL	92%	13
MALTA	92%	4
BELGIUM	87%	43
SPAIN	84%	7
FINLAND	83%	10
SWEDEN	83%	6
ITALY	82%	14
FRANCE	82%	9
GERMANY	81%	33
HOLLAND	80%	26
CYPRUS	80%	16
LUXEMBOURG	76%	16
AUSTRIA	74%	62
LIECHTENSTEIN	71%	0

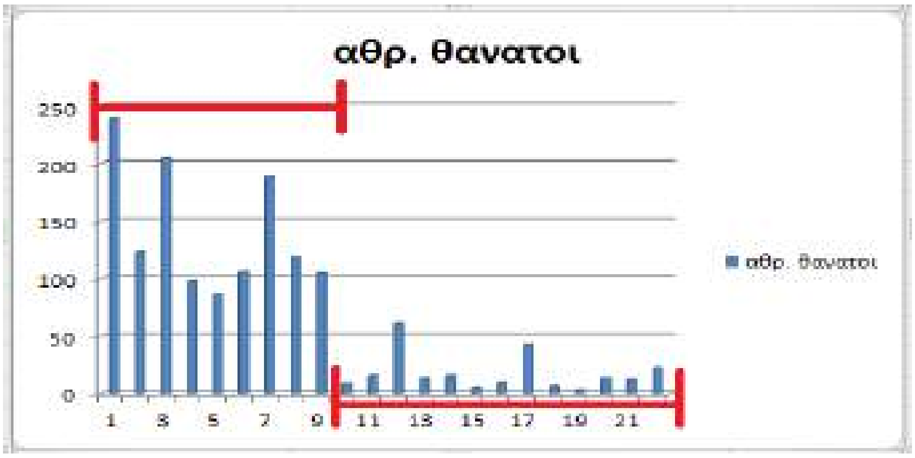
The table shows the 16 countries with vaccination coverage of 71% -95% with cumulative deaths, which are the sample of the second sub-analysis for 18+.

TABLE 5

COUNTRY	VACCINATION COVERAGE 60+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
IRELAND	100	23
PORTUGAL	100	13
DENMARK	99	14
MALTA	99	4
SPAIN	98	7
BELGIUM	94	43
FINLAND	93	10
SWEDEN	93	6
CYPRUS	93	16
ITALY	89	14
AUSTRIA	88	62
LUXEMBOURG	87	16
FRANCE	85	9
CZECHIA	82	105
SLOVENIA	80	119
HUNGARY	80	189
GREECE	79	106
POLAND	75	86
ESTONIA	72	98
CROATIAN	70	205
SLOVAKIA	67	123
LATVIA	61	239

The table shows the countries that make up the final sample of 22 countries in terms of vaccination coverage and cumulative deaths for 60+

TABLE 6



The two different patterns formed by the difference of the cumulative deaths at the point of 85% of the vaccination coverage for the 60+.

TABLE 7

COUNTRY	VACCINATION COVERAGE 60+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
CZECHIA	82	105
SLOVENIA	80	119
HUNGARY	80	189
GREECE	80	106
POLAND	75	86
ESTONIA	73	98
CROATIAN	71	205
SLOVAKIA	68	123
LATVIA	61	239

The table shows the 9 countries with vaccination coverage of 61% -82% with cumulative deaths, which are the sample of the first sub-analysis for 60+.

TABLE 8

COUNTRY	VACCINATION COVERAGE 60+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
IRELAND	100	23
PORTUGAL	100	13
DENMARK	99	14
MALTA	99	4
SPAIN	98	7
BELGIUM	94	43
FINLAND	93	10
SWEDEN	93	6
CYPRUS	93	16

ITALY	**89**	**14**
AUSTRIA	**88**	**62**
LUXEMBOURG	**87**	**16**
FRANCE	**85**	**9**

The table shows the 13 countries with vaccination coverage of 85% -100% with cumulative deaths, which are the sample of the second sub-analysis for 60+.

SAMPLE

The research sample consists of 27 European countries (**See Table 9**). The 27 countries were selected because they belong to the 30 European countries that have officially declared their vaccination coverage to the ECDC and because these countries were used in a publication (**See references)** that correlated their vaccination coverage with the reduction of deaths per million populations. Therefore, this survey uses as a sample 90% of the European countries, which have officially declared their vaccination coverage to the ECDC.

The age limits of 18+ and 60+ vaccination coverage used in the research were chosen for the following reasons:

- those under 18 years of age do not constitute a significant percentage of deaths from covid-19[1*] https://www.statista.com/statistics/1191568/reported-deaths-from-covid-by-age-us/ ; https://eody.gov.gr/wp-content/uploads/2021/12/covid-gr-daily-report-20211207.pdf PAGE 3[2*]
- due to the fact that 60+ belong to the vulnerable age group that makes up a significant percentage of deaths by covid-19[3*] https://www.statista.com/statistics/1191568/reported-deaths-from-covid-by-age-us/ ; https://eody.gov.gr/wp-content/uploads/2021/12/covid-gr-daily-report-20211207.pdf PAGE 3[4*]
- c) due to the decision of the Greek government on compulsory vaccination of 60+ years https: //www.youtube.com/watch?v=kJKROeKNn9U&ab_channel=newsittv.
- Because the ECDC uses exactly the same age limits in the vaccination coverage data, as mentioned on its official website.

The period, during which the cumulative deaths per million will be investigated, was chosen to be 14 days until 23/11/2021. This date was chosen because this research started on 23/11/2021 and 14/11/2021 (week 45) was chosen as the median date of vaccination coverage of the countries. In addition, on this date, virtually all sample countries have moved away from the summer months, which may have affected the results of the study, as fewer cases are reported in the summer, hence fewer hospitalizations and deaths from covid-19, as the spread of covid-19 appears to be positively related to a country's latitude and inversely related to climate. This means that in warmer climates the spread of covid-19 decreases, while in countries with

greater latitude more intense epidemic waves are observed (Zoran et al., 2021; Liu et al., 2021).
The 14-day period was chosen over the 7-day period, as it is the longest period for which there are data [https://ourworldindata.org/covid-deaths] and on the basis of which the ECDC draws information.

1* The deaths of people under the age of 18 in the USA as of 01/12/21, constitute 0,08% of the total deaths of covid-19, ie in 10,000 deaths from covid-19 only 8 occur in persons under 18 years of age.

2* The deaths of people under 18 years of age in Greece until 07/12/21, constitute 0,01% of the total deaths of covid-19, ie in the 10,000 deaths of covid-19 only 1 will occur in persons under the age of 18 years old.

3* The deaths of people over 65 in the USA until 01/12/21, constitute 79,95% of the total deaths of covid-19, ie in 100 deaths from covid-19 ~ 80 are people over 65 years of age. (STATISTA divides the age group at the age of 65 and not at 60).

4* The deaths of people over 65 years in Greece until 07/12/21, constitute 83,14% of the total deaths covid-19, ie in the 100 deaths from covid-19, 83 concern people over 65 years old . (EODY divides the age group at the age of 65 and not at 60).

PROCEDURE

Initially, the vaccination coverage% for 18+ **(See Table 9)** and for 60+ respectively **(See Table 10)** was recorded and tabulated on the official ECDC website https://qap.ecdc.europa.eu/public/extensions/COVID19/vaccinetracker.html#national-ref-tab for WEEK 45.
The cumulative deaths per million population of covid-19 over a 14-day period up to 23/11/2021 **(See Table 9,10)** from https://ourworldindata.org/covid-deaths were then recorded and tabulated. (**See Appendix 7, Figure 1-2)**.

TABLE 9

COUNTRY	VACCINATION COVERAGE 18+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
DENMARK	95%	14
IRELAND	93%	23
PORTUGAL	92%	13
MALTA	92%	4
BELGIUM	87%	43
SPAIN	84%	7
FINLAND	83%	10
SWEDEN	83%	6
ITALY	82%	14
FRANCE	82%	9
GERMANY	81%	33
HOLLAND	80%	26
CYPRUS	80%	16
LUXEMBOURG	76%	16
AUSTRIA	74%	62
LIECHTENSTEIN	71%	0
GREECE	71%	106

CZECHIA	68%	105
HUNGARY	68%	189
ESTONIA	67%	98
LATVIA	66%	239
SLOVENIA	64%	119
POLAND	62%	86
CROATIAN	55%	205
SLOVAKIA	54%	123
ROMANIA	43%	204
BULGARIA	28%	305

All countries, with vaccination coverage for 18+ and cumulative deaths, initially selected. Bulgaria was then removed because the value of its cumulative deaths was an outlier.

TABLE 10

COUNTRY	VACCINATION COVERAGE 60+ YEARS OLD UNTIL WEEK 45	CUMUL. DEATHS PER 1M. (14 DAYS PERIOD) UNTIL 23/11/21
IRELAND	100	23
PORTUGAL	100	13
DENMARK	99	14
MALTA	99	4
SPAIN	98	7
BELGIUM	94	43
FINLAND	93	10
SWEDEN	93	6
CYPRUS	93	16
ITALY	89	14
AUSTRIA	88	62
LUXEMBOURG	87	16
FRANCE	85	9
CZECHIA	82	105
SLOVENIA	80	119
HUNGARY	80	189
GREECE	79	106
POLAND	75	86
ESTONIA	72	98
CROATIAN	70	205
SLOVAKIA	67	123
LATVIA	61	239
ROMANIA	41	204
BULGARIA	32	305

All countries, with vaccination coverage in the 60+ and cumulative deaths, selected. Bulgaria and Romania were then removed because they had outliers.

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RESULTS (18+)

Results from the initial linear regression and Quadratic model analysis test, for the 26 countries with vaccination coverage from 43% -95% for 18+ years old

H_0: The increase in vaccination coverage from 43% - 95% in 18+ years is not related to the reduction in covid-19 deaths.

H_1: Vaccination coverage of 43% - 95% in 18+ years is inversely related to covid-19 deaths. As vaccination coverage increases at 18+, covid-19 deaths decrease.

An outlier check for variable prices resulted in an outlier, the value 305 (Bulgarian deaths), therefore deducted together with the value of the Bulgarian vaccination coverage, i.e. the value 28. The new check did not reveal any new outliers **(See Appendix 1, Figure 2)**. Checking the histograms of the variables shows that their values are not distributed normally **(See Appendix 1, Figure 3)**. The values of the variables are therefore converted to rank values **(See Appendix 1, Figure 1)**, so that a non-parametric test can be performed through the rank values, calculating the Pearson index.

From the descriptive statistics, the average of the rank values of the vaccination coverage of the 26 countries (N=26) for the 18+ is: $M_{vac.cov}$=13,5 with standard deviation $St.Deviation_{vac.cov}$=7,64 and $range_{vac.cov}$=1-26, while the average of the rank values of the cumulative deaths per million for the 14-day period is $M_{cum.deaths}$=13,5, with a standard deviation of $St.Deviation_{cum.deaths}$=7,64 and $range_{cum.deaths}$=1-26.

TABLE 11

$M_{vac.cov}$/$St.Deviation_{vac.cov}$/$range_{vac.cov}$			$M_{cum.deaths}$/$St.Deviation_{cum.deaths}$/$range_{cum.deaths}$		
13,5	7,64	1-26	13,5	7,64	1-26

FOR VACCINATION COVERAGE FROM 43% - 95% AT 18+ YEARS OLD: (H_0 REJECTED)

Statistical analysis using Linear regression and Quadratic model revealed moderate negative correlations between vaccination and death (R_{Linear}=0,76 / R_{QUADR}=0,78), which can be generalized to the general population, as the statistical significance index is p <0,05 => 0,00 <0,05 in both cases **(See Appendix 1, Figure 4)**. This means that vaccination is inversely related to covid-19 deaths, i.e. as vaccination rates increase, covid-19 deaths decrease. The effect size R^2 informs us, about the percentage of deaths from covid-19 which is explained by the increase of vaccination.

The statistical analysis showed moderate effect sizes (R^2_{Linear}=0,57 / R^2_{Quadr}=0,62) which means that the increase in vaccination to 18+ years explains by 62% the change in deaths (at best) without meaning that the change in deaths is due, in causation, to increased vaccination. This means that 38% of the change in deaths is explained by other factors.
However, behind the 62% that explains the change in deaths, there may be factors behind the vaccination, which are the cause of the reduction in deaths, such as the health system, demographic factors (how old is the population of a country), economy, population density per sq. km., intensity of the epidemic wave and so on. Consequently the reduction of deaths can not be attributed to the increase of vaccination.
On the other hand, since the vaccine, regardless of the above factors, must prevent disease and consequently death, it must, if it is indeed responsible for reducing deaths, give this picture (of the inversely proportional correlation with the change in deaths) always regardless of study periods and countries.
Because there are two different patterns in the distribution of deaths according to vaccination coverage with a focal point of 71% (difference in deaths above - below 71% of vaccination coverage) as mentioned above **(See Design, See Table 2)**, two simple linear regression analyses tests and two Quadratic regression models will be performed. If the correlation found is true, correlations between vaccination increase and death are expected to be found in the individual samples as well, otherwise the correlation between vaccination increase and death is likely to be plausible.

Results from the regression linear analysis test, regression Quadratic model for the last 10 countries with vaccination coverage from 43% - 71% for 18+ years old.

H_0: The increase in vaccination coverage from 43% - 71% in 18+ years is not related to the reduction in covid-19 deaths.

H_1: Vaccination coverage of 43% - 71% in 18+ years is related to the covid-19 deaths inversely. As vaccination coverage increases at 18+, covid-19 deaths decrease.

Checking the histograms of the variables shows that their values are not distributed normally **(See Appendix 2, Figure 2)**. Therefore the values of the variables are converted to rank values **(See Appendix 2, figure 1)**, so that through the rank values a non-parametric test is performed, calculating the Pearson index.
From the descriptive statistics, the average of the rank values of the vaccination coverage of the 10 countries (N=10) for 18+ is: $M_{vac.cov.}$=5,5 with standard deviation $St.Deviation_{vac.cov}$=3,01 and $range_{vac.cov}$=1-10, while the average of the rank values of

the cumulative deaths per million for the 14-day period is $M_{cum.deaths}$=5,5 with a standard deviation of $St.Deviation_{cum.deaths}$=3,02 and $range_{cum.deaths}$=1-10.

TABLE 12

$M_{vac.cov}$/$St.Deviation_{vac.cov}$/$range_{vac.cov}$			$M_{cum.deaths}$/$St.Deviation_{cum.deaths}$/$range_{cum.deaths}$		
5,5	3,01	1-10	5,5	3,02	1-10

FOR VACCINATION COVERAGE OF 10 COUNTRIES FROM 43% - 71% 18+ YEARS OLD: (H_0 FAILED TO REJECT)

Statistical analysis using Linear regression and Quadratic model showed no correlation between vaccination and covid-19 deaths (p_{Linear}>0,05=>0,34>0,05/ $p_{Quadr.}$>0,05 =>0,63>0,05) **(See Appendix 2, Figure 3)**.

In other words, it seems that the fluctuation of deaths is not related to the increase of vaccination coverage. Even in the sample of these 10 countries there is a small size effect in the correlation between vaccination and deaths from covid-19 (R^2_{Linear}=0,11/ $R^2_{Quadr.}$=0,12), which means that the percentage increase of vaccination from 43% in 71% explains only 12% of the change (reduction) in covid-19 deaths of this sample (at best), while 82% of the change in deaths is explained by other factors. However, because the statistical significance index is above 0,05, even this weak correlation can not be generalized, resulting in H_0 failing to be rejected, meaning that the increase in vaccination from 43% - 71% to 18+ does not seems to be a predictor of fluctuations in covid-19 deaths.

Results from the regression linear analysis test, regression Quadratic model for the first 16 countries in vaccination coverage from 71% -95% for 18+ years old.

H_0: The increase in vaccination coverage from 71% - 95% at 18 + years is not related to the reduction in covid-19 deaths.

H_1: Vaccination coverage of 71% - 95% in 18+ years is inversely related to covid-19 deaths. As vaccination coverage increases at 18+, covid-19 deaths decrease.

Checking the histograms of the variables shows that their values are not distributed normally **(See Appendix 3, Figure 2)**. Therefore, the values of the variables are converted to rank values **(See Appendix 3, Figure 1)**, so that through the rank values a non-parametric test is performed, calculating the Pearson index.

From the descriptive statistics, the average of the rank values of the vaccination coverage of the 16 countries (N=16) for 18+ is: $M_{vac.cov.}$=8,5 with standard deviation $St.Deviation_{vac.cov}$=4,74 and $range_{vac.cov}$=1-16, while the average of the rank values of cumulative deaths/million for the 14-day period is $M_{cum.deaths}$=8,5 with a standard deviation of $St.Deviation_{cum.deaths}$=4,75 and $range_{cum.deaths}$=1-16.

TABLE 13

$M_{vac.cov}$/St.Deviation $_{vac.cov.}$/$range_{vac.cov.}$			$M_{cum.deaths}$/$St.Deviation_{cum.deaths}$/$range_{cum.deaths}$		
8,5	4,74	1-16	8,5	4,75	1-16

FOR VACCINATION COVERAGE OF 16 COUNTRIES FROM 71% - 95% 18+ YEARS OLD: (H0 FAILED TO REJECT)

Statistical analysis using Linear regression and Quadratic model showed no correlation between vaccination and covid-19 deaths (p_{Linear}>0,05=>0,55>0,05/ $p_{Quadr.}$>0,05=>0,87>0,05) **(See Appendix 3, Figure 3)**.

In other words, it seems that the fluctuation of deaths is not related to the increase of vaccination coverage. Even in the sample of these 16 countries there is a small size effect in the correlation between vaccination and deaths from covid-19 (R^2_{Linear}=0,02/$R^2_{Quadr.}$=0,02), which means that the percentage increase of vaccination from 71% to 95% explains only 2% of the change (reduction) in deaths from covid-19, while 98% of the change in deaths is explained by others variables. However, because the statistical significance index is above 0,05 even this weak correlation can not be generalized, resulting in H_0 failing to be rejected, meaning that the increase in vaccination from 71% to 95% in 18+ years does not play a role in the fluctuation of covid-19 deaths.

DISCUSSION

From the first statistical analysis of 26 countries, regarding the investigation of whether the increase in vaccination coverage at 18+ years is associated with the reduction of deaths, a moderate correlation was found. Because the distribution of deaths **(See Table 2)** reveals two different patterns that may incorrectly correlate or influence the correlation rate, two more correlation tests between vaccine coverage and covid-19 deaths were developed. Since the initial correlation was true (without suggesting a causal relationship), it was expected that a statistically significant correlation would be found in the two individual samples. In both samples (16 countries with vaccination coverage of 71% - 95%, 10 countries with vaccination coverage of 43% - 71%) no correlation was found. The hypothesis that an external factor affects the results, giving a plausible non correlation is excluded due to the nature of the variable (ie vaccination). That is to say, it is excluded because the vaccine is manufactured, disregarding other parameters, with the aim of providing, if not 100%, protection against death, at least to provide high protection rates. That is, a third factor may not actually affect in such a way, as to give non correlation results between vaccination and covid-19 deaths. The opposite, however, can be understood, as third variables can affect in such a way as to reveal a false correlation.

In view of all the above, the conclusions tend not to correlate covid-19 deaths with increased vaccination (18+). The initial, moderate correlation strength is probably revealed due to a third variable inherent in 16 and 10 countries, respectively, as a common factor, which here works in reverse, resulting in the difference between the 2 groups, noting a false correlation.

Particular attention should be paid to the fact that this is a point correlation, i.e. there is no continuous linear or exponential correlation, but the correlation appears falsely at a specific point (71% of vaccination coverage) due to the difference created by the third latent variable. One reason that may affect the outcome of non-correlation is the distribution of the percentage of vaccination coverage by age. For example, Greece has almost the same vaccination coverage rate as Austria (71% - 74%) 18+, but has more than 50% covid-19 deaths than Austria does, studying the same 14-day period. Therefore, this difference in deaths may be due to the variation in vaccination coverage in the 60+ age group, where most deaths occur. Therefore, bearing in mind that the vast majority of covid-19 deaths occur in people over 60+ years of age, it is advisable to re-establish from the beginning correlations between vaccination coverage and covid-19 deaths with a more targeted sample (60+ years old). Since covid-19 deaths regard the 60+ age group, it is expected that if there is a strong inverse correlation between increased vaccination coverage and covid-19 deaths, it will be visible in the statistical correlation analysis, that has a sample of all countries, while also in the two sub-correlations that will follow in a similar way, as elaborated above, so that a continuous and not a point correlation is revealed. So the new hypothesis will be whether the increase in vaccination coverage to 60+ years is related, not causally, to the reduction in covid-19 deaths.

RESULTS (60+)

Results from the regression Linear analysis and the Quadratic model test, for the 22 countries with vaccination coverage from 61% -100% for the 60+ years old.

H_0: The increase in vaccination coverage to 60+ from 61% - 100% is not related to the reduction in covid-19 deaths.

H_1: Vaccination coverage in 60+ from 61% - 100% is inversely related to covid-19 deaths. As vaccination coverage increases at age 60+, covid-19 deaths decrease.

The check for outliers in the prices of the variables revealed three outliers, the vaccination coverage values 32 (Bulgaria), 41 (Romania) and the value 305 which refers to the deaths of Bulgaria. These values were therefore deducted together with the Romanian death rate (204) which is the pair of value 41 **(See Appendix 4, Figure 2)**. No new outlier was found from the new audit. Checking the histograms of the variables shows that their values are not distributed normally **(See Appendix 4, Figure 3)**. Therefore, the values of the variables are converted to rank values **(See Appendix 4, Figure 1)**, so that through the rank values a non-parametric test is performed, calculating the Pearson index.

From the descriptive statistics, the average of the rank values of the vaccination coverage of the 22 countries (N=22) for the 60+ is: $M_{vac.cov.}$=11,5 with standard deviation $St.Deviation_{vac.cov}$=6,48 and $range_{vac.cov}$=1-22, while the average of the rank values of the cumulative deaths per million for the 14-day period is $M_{cumul.deaths}$=11,5, with a standard deviation of $St.Deviation_{cumul.deaths}$=6,48 and $range_{cumul.deaths}$=1-22.

TABLE 14

$M_{vac.cov}$/$St.Deviation_{vac.cov}$/$range_{vac.cov}$			$M_{cumul.deaths}$/$St.Deviation_{cumul.deaths}$/$range_{cumul.deaths}$		
11,5	6,48	1-22	11,5	6,48	1-22

FOR VACCINATION COVERAGE FROM 61% - 100% 60+ YEARS OLD: (H0 REJECTED)

Statistical analysis using Linear regression and Quadratic model showed a negative correlation of moderate strength between vaccination and death (R_{Linear}=0,78/R_{QUADR}=0,81), which can be generalized to the general population, as the statistical significance index is p<0,05=>0,00<0,05 in both cases **(See Appendix 4, Figure 4)**. This means that vaccination is inversely related to covid-19 deaths, i.e. as vaccination rates increase to 60+ from 61% -100%, covid-19 deaths decrease. The effect size R^2 informs us about how it is related, i.e. how much the reduction of deaths from covid-19 is explained due to the increase in vaccination. The statistical analysis showed a moderate effect size (R^2_{Linear}=0,61/$R^2_{Quadr.}$=0,66) which means that the increase in vaccination 60 + years explains by 66% the change in deaths (at best) without meaning that this change in deaths is due to a causal increase in vaccination, while it appears that the change in deaths is explained by other factors by 34%.

However, because behind the 66% explaining the change in deaths, factors may play a role as mentioned above and due to the fact that two different patterns and groups appear at 85% vaccination coverage regarding the deaths, statistical analyses

of correlations between deaths and the increase in vaccine coverage will be performed, as they appear to have formed in these two groups **(See Table 6)**.
The first will be conducted to confirm the correlation of the increase in vaccination coverage of 60+ years with deaths from covid-19 for the 9 countries with vaccination coverage from 61% to 82% **(see Table 7)**, while the second will be conducted to confirm the correlation of vaccination coverage with covid-19 deaths, for the 13 countries with vaccination coverage of 85% to 100% **(See Table 8)**.
If the inverse correlation of vaccination coverage with death is true, a negative correlation is expected in the two subgroups to be found, otherwise the point correlation found above will be confirmed and will mean that a third concealed variant gives a contrived picture of an inversely related correlation

Results from the regression Linear analysis and the Quadratic model test, for the 9 countries with vaccination coverage from 61% -82% for the 60+ years old.

H_0: The increase in vaccination coverage from 61% - 82% in 60+ years is not related to the reduction in covid-19 deaths.

H_1: Vaccination coverage of 61% - 82% in 60+ years is reversely related to covid-19 deaths. As vaccination coverage increases at age 60+, covid-19 deaths are reduced.

Checking the histograms of the variables shows that their values are not distributed normally **(See Appendix 5, Figure 2)**. Therefore, the values of the variables are converted into rank values **(See Appendix 5, Figure 1)**, so that through the rank values a non-parametric test is performed, calculating the Pearson index.
From the descriptive statistics, the average of the rank values of the vaccination coverage of 9 countries (N=9) for 60+ is: $M_{vac.cov.}$=5 with standard deviation $St.Deviation_{vac.cov.}$=2,72 and a $range_{vac.cov.}$=1-9, while the average of the rank values of the cumulative deaths per million for the 14-day period is $M_{cumul.deaths}$=5 with a standard deviation of $St.Deviation_{cumul.deaths}$=2,72 and $range_{cumul.deaths}$=1-9.

TABLE 15

$M_{vac.cov.}$/$St.Deviation_{vac.cov}$/$range_{vac.cov}$			$M_{cumul.deaths}$/$St.Deviation_{cumul.deaths}$/$range_{cumul.deaths}$		
5	2,72	1-9	5	2,72	1-9

FOR VACCINATION COVERAGE OF 9 COUNTRIES FROM 61% - 82% 60+ YEARS OLD: (H0 FAILED TO REJECT)

Statistical analysis using Linear regression and Quadratic model showed no correlation between vaccination and covid-19 deaths (p_{Linear}>0,05=>0,24>0,05/$p_{Quadr.}$>0,05=>0,22>0,05) **(See Appendix 5, Figure 3)**.
It seems that the fluctuation of deaths is not related to the increase of vaccination coverage from 61%-82% to 60+. This means that a country with vaccination coverage of 61% at the age of 60+ will not achieve a reduction in deaths even if the vaccination coverage for the 60+ age group reaches 82%.

Results from the regression Linear analysis and the Quadratic model test, for the 13 countries with vaccination coverage from 85% -100% for the 60+.

H_0: The increase in vaccination coverage from 85% - 100% in 60+ years is not related to the reduction in covid-19 deaths.

H_1: Vaccination coverage of 85% - 100% in 60+ years is inversely related to covid-19 deaths. As vaccination coverage increases at age 60+, covid-19 deaths decrease.

Checking the histograms of the variables shows that their values are not distributed normally **(See Appendix 6, Figure 2)**. The values of the variables are therefore converted to rank values **(See Appendix 6, Figure 1)**, so that through the rank values a non-parametric test is performed, calculating the Pearson index.

From the descriptive statistics, the average of the rank values of the vaccination coverage of the 13 countries (N=13) for the 60+ is: $M_{vac.cov.}$=7 with standard deviation $St.Deviation_{vac.cov}$=3,86 and $range_{vac.cov}$=1-13, while the average of the rank values of cumulative deaths/million for the 14-day period is $M_{cumul.deaths}$=7 with a standard deviation of $St.Deviation_{cumul.deaths}$=3,88 and $range_{cumul.deaths}$=1-13.

TABLE 16

$M_{vac,cov}$/$St.Deviation_{vac.cov}$/$range_{vac.cov}$			$M_{cumul.deaths}$/$St.Deviation_{cumul.deaths}$/$range_{cumul.deaths}$		
7	3,86	1-13	7	3,88	1-13

FOR VACCINATION COVERAGE OF 13 COUNTRIES FROM 85% - 100% 60+ YEARS OLD: (H0 FAILED TO REJECT)

Statistical analysis using Linear regression and Quadratic model showed no correlation between vaccination and covid-19 deaths (p_{Linear}>0,05=>0,74>0,05/$p_{Quadr.}$>0,05=>0,89>0,05). Even in this sample it appears that the correlation between vaccination of 60+ and deaths is marginal (R_{Linear}=0,09/R_{QUADR}=0,14) **(See Appendix 6, Figure 3)**. This shows that, even in this sample, the change in deaths is explained by the change in vaccination coverage from 85% -100% at a rate of only 2% (at best), 98% of the change in deaths is explained by other factors (R^2_{Linear}=0,01/$R^2_{Quadr.}$=0,02). However, as mentioned above, due to the fact that the statistical significance index is p>0,05 even this marginally low correlation can not be generalized. As a result, H_0 failed to be rejected. Therefore, it seems that the fluctuation of deaths is not related to the increase of vaccination coverage from 85% -100% to 60+. This means that a country with 85% vaccination coverage for 60+ year olds will not be able to reduce deaths, even if vaccination coverage for 60+ year olds reaches 100%.

CONCLUSIONS

The present study, based on a final sample of 26 European countries with vaccination coverage rates from 43% to 95% for 18+ age groups and vaccination coverage rates from 61% to 100% for 60+ age groups, revealed the following conclusions:

- It appears that the increase in vaccination rate in both age groups is not related to the change in covid-19 deaths. This means that even if the vaccination rate increases from 43% to 95% in the 18+ age group and from 64% to 100% in the 60+ age group, covid-19 deaths will not decrease.

- In addition, the present study suggests that finding a moderate correlation between an increase in vaccination rate and covid-19 deaths should be viewed with skepticism, as the correlation may be caused by one or more external factors, which creating a point difference , form the image of a fictitious, plausible correlation.

- The results of the research show that it is not possible to achieve "building" a wall of immunity, which has the effect of reducing deaths from covid-19, as it seems that even if the vaccination percentage coverage increases to 100% in the vulnerable age group 60+, covid-19 deaths do not appear to be reducing. More specifically, a typical example is Greece, which with a vaccination coverage rate of 79% in those over 60+, counts an average of 106 deaths from covid-19 per million in the 14-day period up to 11/23/21, compared to France which for the same period counts 9 deaths, having almost the same rate of vaccination coverage (85%) in those over 60+ years.

- The difference found in covid-19 deaths between the countries sampled in the present study paints a picture of countries with two different paces (See Table 17), on the matter of dealing with covid-19. The cause of the difference should be sought in a third latent variable, either quantitative, e.g. economy, available ICU beds, either qualitative, e.g. geographical location (See map below), and which is responsible for the observed difference in deaths.

The methodological set up and conduct of further research is proposed, in order to identify the factors related to the reduction of deaths from covid-19, as well as to clarify the mechanism that works and leads to the reduction of deaths. Variables that can be used in the investigation of the above are: the GDP of the countries, the per capita income, the health system based on ICU beds, the medical staff in the key positions related to covid-19 hospitalizations, the climate based on some of its characteristics (such as temperature), using regression analysis tests (Linear, Quadratic).

A further investigation is proposed, regarding the correlation of the number of deaths from covid-19 with the geographical location of the countries, comparing the death rates of the central-eastern countries of Europe, as outlined to the right of the red line of the map below, when their vaccination coverage will have exceeded the 71% threshold for 18+ and 85% for 60+, using the Chi Squared Goodness of Fit Test.

In conclusion, since all the above establish that vaccination coverage does not help reduce covid-19 deaths, a proposal is made for the governments of individual countries to introduce a different mix of policy measures to counter the new pandemic wave.

TABLE 17

ΧΩΡΕΣ-ΘΑΝΑΤΟΙ (GROUP 1)	**ΧΩΡΕΣ-ΘΑΝΑΤΟΙ (GROUP 2)**
IRELAND - 23	**GREECE - 106**
PORTUGAL - 13	**CZECHIA - 105**
MALTA - 4	**HUNGARY - 189**
DENMARK - 14	**ESTONIA - 98**
BELGIUM - 43	**LATVIA - 239**
SPAIN - 7	**SLOVENIA - 119**
FINLAND - 10	**POLAND - 86**
SWEDEN - 6	**CROATIA - 205**
ITALY - 14	**SLOVAKIA - 123**
FRANCE - 9	**ROMANIA - 204**
GERMANY - 33	**BULGARIA - 305**
NETHERLANDS - 26	
CYPRUS - 16	
LUXEMBOURG - 16	
AUSTRIA - 62	
LIECHTENSTEIN - 0	

Countries with two different paces, on the matter of dealing with covid-19 deaths.

MAP OF EUROPE

- On the map the black line depicts the borders of Europe, within which the countries of the sample are present.
- The red line is the geographical boundary, which separates the two different paces of the countries. Thus the countries of group 1 of table 10 are all left of the red line (Cyprus is excluded because it geographically belongs to Asia), while on the right are all the countries of group 2.

APPENDICES

APPENDIX 1

FIGURE 1

1	εμβ. Κάλυψη +18 week 45	αθρ. Θανατοι	rank εμβ. Κάλυψης	rank αθρ. Θανάτων	rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
2	43	204	1	24	1	1
3	54	123	2	22	2	4
4	55	205	3	25	3	9
5	62	86	4	17	4	16
6	64	119	5	21	5	25
7	66	239	6	26	6	36
8	67	98	7	18	7	49
9	68	189	8,5	23	8,5	72,25
10	68	105	8,5	19	8,5	72,25
11	71	106	10,5	20	10,5	110,25
12	71	0	10,5	1	10,5	110,25
13	74	62	12	16	12	144
14	76	16	13	10,5	13	169
15	80	16	14,5	10,5	14,5	210,25
16	80	26	14,5	13	14,5	210,25
17	81	33	16	14	16	256
18	82	9	17,5	5	17,5	306,25
19	82	14	17,5	8,5	17,5	306,25
20	83	6	19,5	3	19,5	380,25
21	83	10	19,5	6	19,5	380,25
22	84	7	21	4	21	441
23	87	43	22	15	22	484
24	92	4	23,5	2	23,5	552,25
25	92	13	23,5	7	23,5	552,25
26	93	23	25	12	25	625
27	95	14	26	8,5	26	676

FIGURE 2

CHECK FOR OUTLIERS IN VARIABLES (VACC. COVERAGE 18+, CUMUL. DEATHS/ 27 COUNTRIES)

28 43 54 55 62 64 66 67 68 68 71 71 74 76 80 80 81 82 82 83 83 84 87 92 92 93 95

0 4 6 7 9 10 13 14 14 16 16 23 26 33 43 62 86 98 105 106 119 123 189 204 205 239 305

(0-305) minimum 0, median 33, maximum 305, q1 13, q3 119

Upper limit = (q3-q1) x 1,5 + q3 => (119-13) x 1,5 + 119 = 278 **305>278 outlier**

Lower limit = q1 - (q3-q1) x 1,5 => 13- (119-13) x 1,5 = -146 **no outliers**

(28-95) minimum 28, median 76, maximum 95, q1 66, q3 83

Upper limit = (q3-q1) x 1,5 + q3 => (83-66) x 1,5 + 83 = 108 **no outliers**

Lower limit = q1 - (q3-q1) x 1,5 => 66- (83-66) x 1,5 = 40,5 **28<40,5 outlier**

FIGURE 3

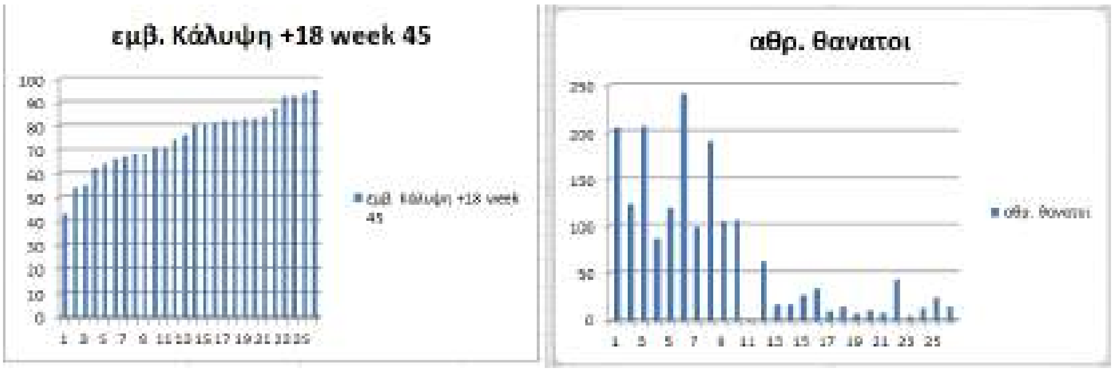


FIGURE 4

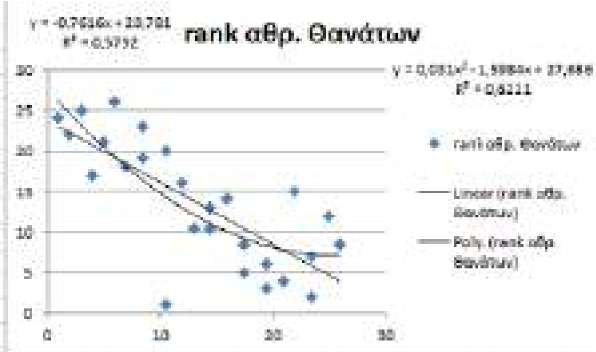
SUMMARY OUTPUT

Regression Statistics	
Multiple I	0,761041
R Square	0,579183
Adjusted I	0,561649
Standard I	5,062111
Observati	26

ANOVA

	df	SS	MS	F	gnificance F
Regressio	1	846,5	846,4764	33,03396	6,36E-06
Residual	24	615	25,62398		
Total	25	1462			

	Coefficients	Standard E	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	23,78109	2,046	11,62397	2,41E-11	19,55863	28,00355	19,55863	28,00355
rank εμβ.	-0,76156	0,133	-5,74734	6,36E-06	-1,03504	-0,48808	-1,03504	-0,48808



SUMMARY OUTPUT

Regression Statistics	
Multiple I	0,788735
R Square	0,622102
Adjusted I	0,589242
Standard I	4,9003
Observati	26

ANOVA

	df	SS	MS	F	gnificance F
Regressio	2	909,2	454,6012	18,93151	1,38E-05
Residual	23	552,3	24,01294		
Total	25	1462			

	Coefficients	Standard E	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	27,68128	3,122	8,867193	7,02E-09	21,22342	34,13914	21,22342	34,13914
rank εμβ.	-1,5969	0,533	-2,99874	0,006409	-2,6985	-0,49529	-2,6985	-0,49529
rank εμβ.	0,03093	0,019	1,616223	0,119681	-0,00866	0,070518	-0,00866	0,070518

APPENDIX 2

FIGURE 1

1	εμβ. Κάλυψη +18 week 45	αθρ. θανατοι	rank εμβ. Κάλυψης	rank αθρ. Θανάτων	rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
2	43	204	1	8	1	1
3	54	123	2	6	2	4
4	55	205	3	9	3	9
5	62	86	4	1	4	16
6	64	119	5	5	5	25
7	66	239	6	10	6	36
8	67	98	7	2	7	49
9	68	189	8,5	7	8,5	72,25
10	68	105	8,5	3	8,5	72,25
11	71	106	10	4	10	100

FIGURE 2

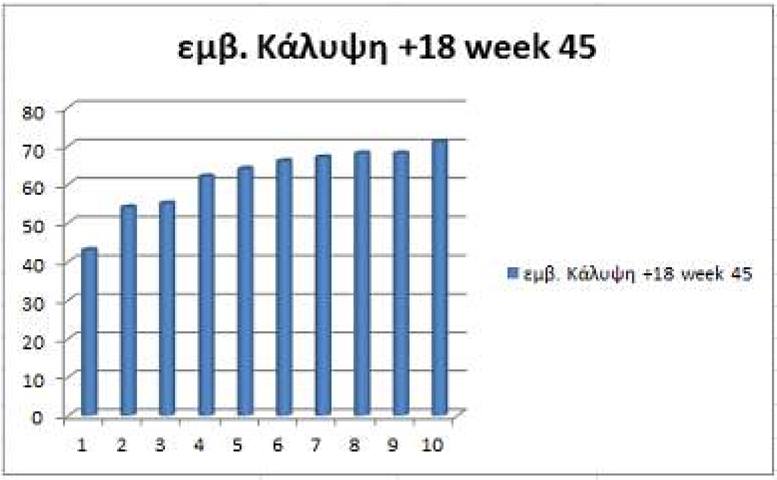
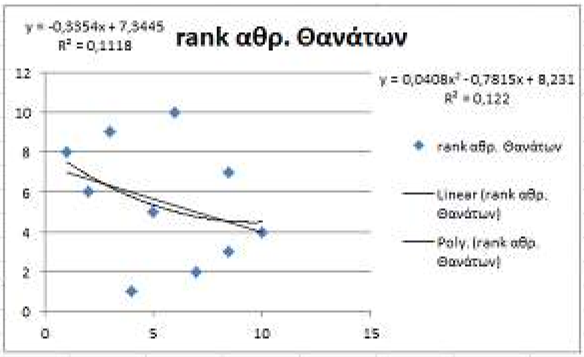


FIGURE 3

rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8,5	72,25
8,5	72,25
10	100



Regression Statistics	
Multiple R	0,334348049
R Square	0,111788618
Adjusted R Square	0,000762195
Standard Error	3,026496304
Observations	10

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	1	9,222561	9,222561	1,006865	0,345036
Residual	8	73,27744	9,15968		
Total	9	82,5			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	7,344512195	2,072437	3,543901	0,007577	2,565463	12,12356	2,565463	12,12356
rank εμβ. Κάλυψης	-0,335365854	0,334221	-1,00343	0,345036	-1,10608	0,435348	-1,10608	0,435348

Regression Statistics	
Multiple R	0,349336311
R Square	0,122035858
Adjusted R Square	-0,128811039
Standard Error	3,216742844
Observations	10

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	2	10,06796	5,033979	0,486495	0,634116
Residual	7	72,43204	10,34743		
Total	9	82,5			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	8,230967779	3,80394	2,163801	0,06723	-0,76392	17,22586	-0,76392	17,22586
rank εμβ. Κάλυψης	-0,781489097	1,600691	-0,48822	0,640315	-4,56652	3,003544	-4,56652	3,003544
rank εμβ. Κάλυψης	0,040760007	0,1426	0,285834	0,783279	-0,29644	0,377956	-0,29644	0,377956

APPENDIX 3

FIGURE 1

1	εμβ. Κάλυψη +18 week 45	αθρ. θανατοι	rank εμβ. Κάλυψης	rank αθρ. Θανάτων	rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
2	71	0	1	1	10,5	110,25
3	74	62	2	16	12	144
4	76	16	3	10,5	13	169
5	80	16	4,5	10,5	14,5	210,25
6	80	26	4,5	13	14,5	210,25
7	81	33	6	14	16	256
8	82	9	7,5	5	17,5	306,25
9	82	14	7,5	8,5	17,5	306,25
10	83	6	9,5	3	19,5	380,25
11	83	10	9,5	6	19,5	380,25
12	84	7	11	4	21	441
13	87	43	12	15	22	484
14	92	4	13,5	2	23,5	552,25
15	92	13	13,5	7	23,5	555,25
16	93	23	15	12	25	625
17	95	14	16	8,5	26	676

FIGURE 2

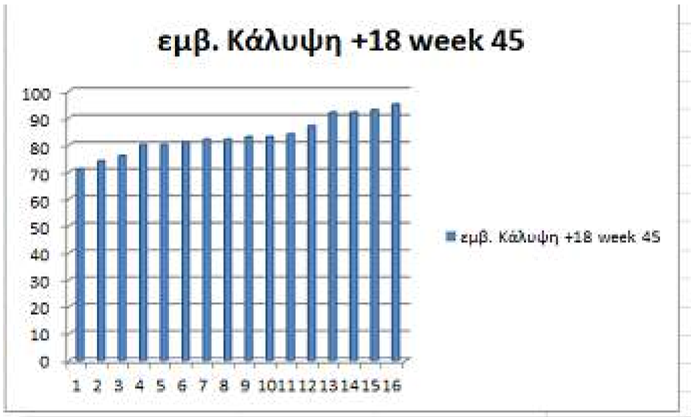


FIGURE 3

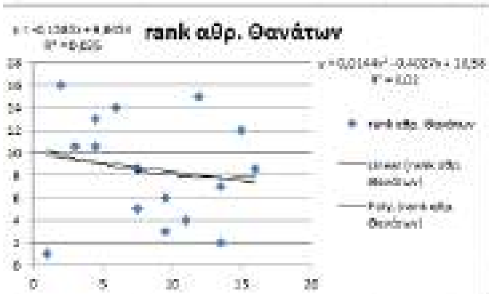
αν	rank εμβ. κάλυψης	rank εμβ. κάλυψης square
1	10,5	110,25
[illegible]	12	144
[illegible]	13	169
[illegible]	14,5	210,25
[illegible]	14,5	210,25
[illegible]	16	256
5	17,5	306,25
[illegible]	17,5	306,25
3	19,5	380,25
8	19,5	380,25
4	21	441
[illegible]	22	484
2	23,5	552,25
7	23,5	552,25
12	25	625
[illegible]	26	676

Regression Statistics	
Multiple R	0,15803
R Square	0,02496
Adjusted R	-0,04466
Standard E	4,856853
Observati	16

ANOVA

	df	SS	MS	F	Significance F
Regressio	1	8,468195	8,468195	0,358679	0,558880
Residual	14	330,5318	23,60941		
Total	15	339			

	Coefficients	Standard Err	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	9,865484	2,553675	3,863389	0,00175	4,367888	15,32308	4,367888	15,32308
rank εμβ.	-0,15828	0,264150	-0,5989	0,558808	-0,72513	0,408506	-0,72513	0,408506



Regression Statistics	
Multiple R	0,14847
R Square	0,021361
Adjusted R	-0,12843
Standard E	5,052227
Observati	16

ANOVA

	df	SS	MS	F	Significance F
Regressio	2	7,173727	3,586863	0,140523	0,870286
Residual	13	331,8263	25,5251		
Total	15	339			

	Coefficients	Standard Err	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	11,64515	20,65158	0,563870	0,582300	-32,402	56,69228	-32,402	56,69228
rank εμβ.	-0,20852	2,361642	-0,08491	0,933628	-5,30254	4,903485	-5,30254	4,903485
rank εμβ.	0,001568	0,048782	0,026167	0,98111	-0,11603	0,109322	-0,10603	0,109322

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APPENDIX 4

FIGURE 1

1	εμβ. Κάλυψη 60+ week 45	αθρ. θανατοι	rank εμβ. Κάλυψης	rank αθρ. Θανάτων	rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
2	61	239	1	22	1	1
3	67	123	2	19	2	4
4	70	205	3	21	3	9
5	72	98	4	15	4	16
6	75	86	5	14	5	25
7	79	106	6	17	6	36
8	80	189	7,5	20	7,5	56,25
9	80	119	7,5	18	7,5	56,25
10	82	105	9	16	9	81
11	85	9	10	4	10	100
12	87	16	11	9,5	11	121
13	88	62	12	13	12	144
14	89	14	13	7,5	13	169
15	93	16	15	9,5	15	225
16	93	6	15	2	15	225
17	93	10	15	5	15	225
18	94	43	17	12	17	289
19	98	7	18	3	18	324
20	99	4	19,5	1	19,5	380,25
21	99	14	19,5	7,5	19,5	380,25
22	100	13	21,5	6	21,5	462,25
23	100	23	21,5	11	21,5	462,25

FIGURE 2

4 6 7 9 10 13 14 14 16 16 23 43 62 86 98 105 106 119 123 189 204 205 239 305

32 41 61 67 70 72 75 79 80 80 82 85 87 88 89 93 93 93 94 98 99 99 100 100

(4-305) minimum 4, median 52,5, maximum 305, q1 13,5, q3 121,5

Upper limit = (q3-q1) x 1,5 + q3 => (121,5-13,5) x 1,5 + 121,5 = 283,5 **305>283,5 outlier**

Lower limit = q1 - (q3-q1) x 1,5 => 13,5- (121,5-13,5) x 1,5 = -148,5 **no outliers**

(32-100) minimum 32, median 86, maximum 100, q1 73,5, q3 93,5

Upper limit = (q3-q1) x 1,5 + q3 => (93,5-73,5) x 1,5 + 93,5 = 123,5 **no outliers**

Lower limit = q1 - (q3-q1) x 1,5 => 73,5 - (93,5-73,5) x 1,5 = 43,5 **32, 41<43,5 outliers. The value 204 is removed due to the fact that this value is the pair of value 41.**

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FIGURE 3

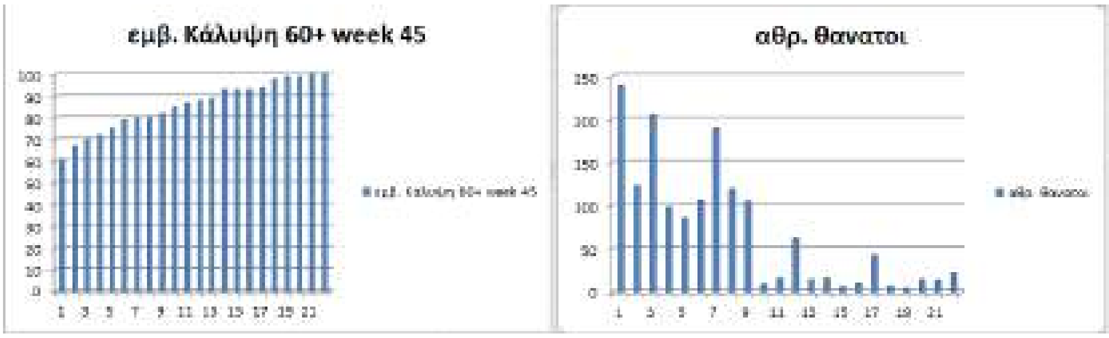


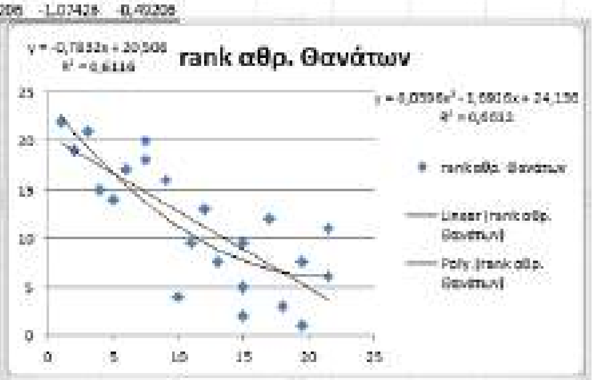
FIGURE 4

Regression Statistics	
Multiple R	0,782066
R Square	0,611611
Adjusted R	0,592192
Standard E	4,144454
Observati	22

ANOVA

	df	SS	MS	F	gnificance F
Regressio	1	540,97	540,97	31,49478	1,71E-05
Residual	20	343,53	17,1765		
Total	21	884,5			

	Coefficients	Standard Err	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	20,50618	1,832007	11,19335	4,8E-10	16,68488	24,32788	16,68488	24,32788
rank εμβ.	-0,78216	0,139551	-5,61202	1,71E-05	-1,07426	-0,49208	-1,07426	-0,49208



Regression Statistics	
Multiple R	0,813118
R Square	0,661177
Adjusted R	0,625512
Standard E	3,971515
Observati	22

ANOVA

	df	SS	MS	F	gnificance F
Regressio	2	584,8115	292,4058	18,53828	3,48E-05
Residual	19	299,6887	15,77309		
Total	21	884,5			

	Coefficients	Standard Err	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	24,13612	2,798852	8,623783	5,34E-08	18,28235	29,9901	18,28235	29,9901
rank εμβ.	-1,69259	0,561638	-3,01368	0,007142	-2,86811	-0,51706	-2,86811	-0,51706
rank εμβ.	0,039612	0,023766	1,667182	0,111877	-0,01012	0,089365	-0,01012	0,089365

APPENDIX 5

FIGURE 1

1	εμβ. Κάλυψη 60+ week 45	αθρ. θανατοι	rank εμβ. Κάλυψης	rank αθρ. Θανάτων	rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
2	61	239	1	9	1	1
3	67	123	2	6	2	4
4	70	205	3	8	3	9
5	72	98	4	2	4	16
6	75	86	5	1	5	25
7	79	106	6	4	6	36
8	80	189	7,5	7	7,5	56,25
9	80	119	7,5	5	7,5	56,25
10	82	105	9	3	9	81

FIGURE 2

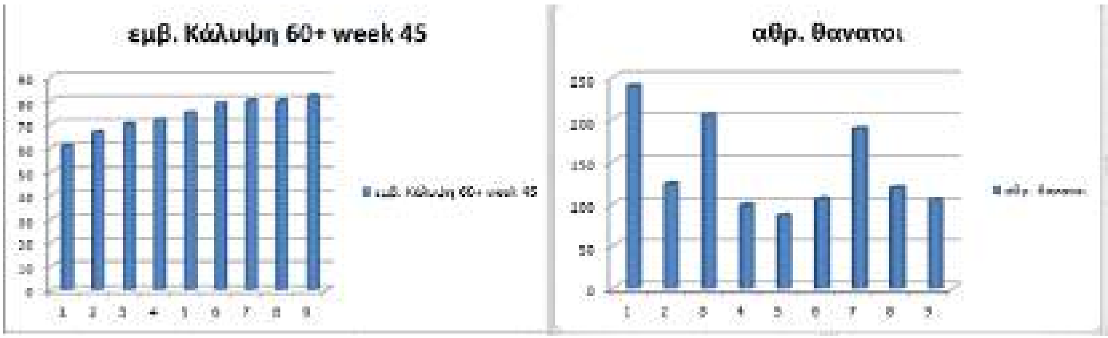
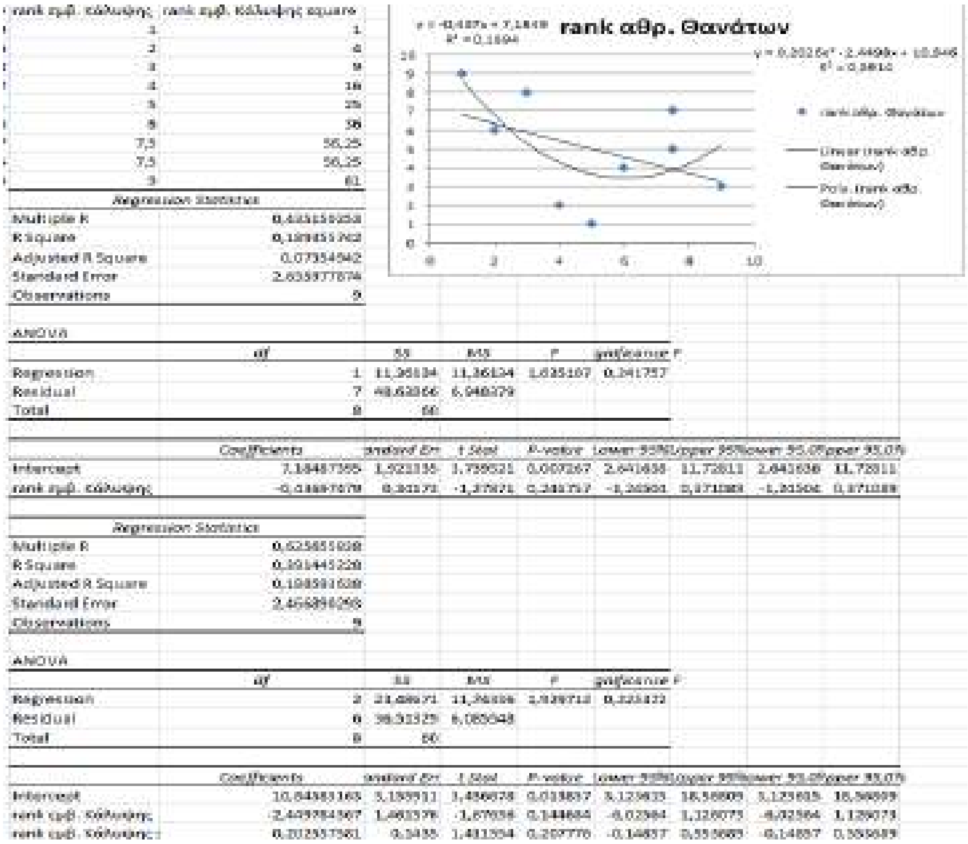


FIGURE 3



rank εμβ. κάλυψης	rank εμβ. κάλυψης square
1	1
2	4
3	9
4	16
5	25
6	36
7,5	56,25
7,5	56,25
9	81

Regression Statistics	
Multiple R	0,435155058
R Square	0,189455702
Adjusted R Square	0,07354542
Standard Error	2,635977874
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	11,36134	11,36134	1,635107	0,241757
Residual	7	48,63866	6,948379		
Total	8	60			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	7,18487395	1,921335	3,739521	0,007267	2,641638	11,72811	2,641638	11,72811
rank εμβ. κάλυψης	-0,41137079	0,32171	-1,27871	0,241757	-1,17201	0,371088	-1,17201	0,371088

Regression Statistics	
Multiple R	0,625655938
R Square	0,391445228
Adjusted R Square	0,188593638
Standard Error	2,466896258
Observations	9

ANOVA

	df	SS	MS	F	Significance F
Regression	2	23,48671	11,74336	1,929712	0,225422
Residual	6	36,51329	6,085548		
Total	8	60			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	10,84583163	3,135911	3,458678	0,013837	3,123633	18,56809	3,123633	18,56809
rank εμβ. κάλυψης	-2,449784567	1,463578	-1,67036	0,144684	-6,02584	1,126075	-6,02584	1,126075
rank εμβ. κάλυψης	0,202557561	0,1435	1,411554	0,207776	-0,14857	0,553685	-0,14857	0,553685

APPENDIX 6

FIGURE 1

1	εμβ. Κάλυψη 60+ week 45	αθρ. θανατοι	rank εμβ. Κάλυψης	rank αθρ. Θανάτων	rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
2	85	9	1	4	1	1
3	87	16	2	9,5	2	4
4	88	62	3	13	3	9
5	89	14	4	7	4	16
6	93	16	6	9,5	6	36
7	93	6	6	2	6	36
8	93	10	6	5	6	36
9	94	43	8	12	8	64
10	98	7	9	3	9	81
11	99	4	10,5	1	10,5	110,25
12	99	14	10,5	8	10,5	110,25
13	100	13	12,5	6	12,5	156,25
14	100	23	12,5	11	12,5	156,25

FIGURE 2

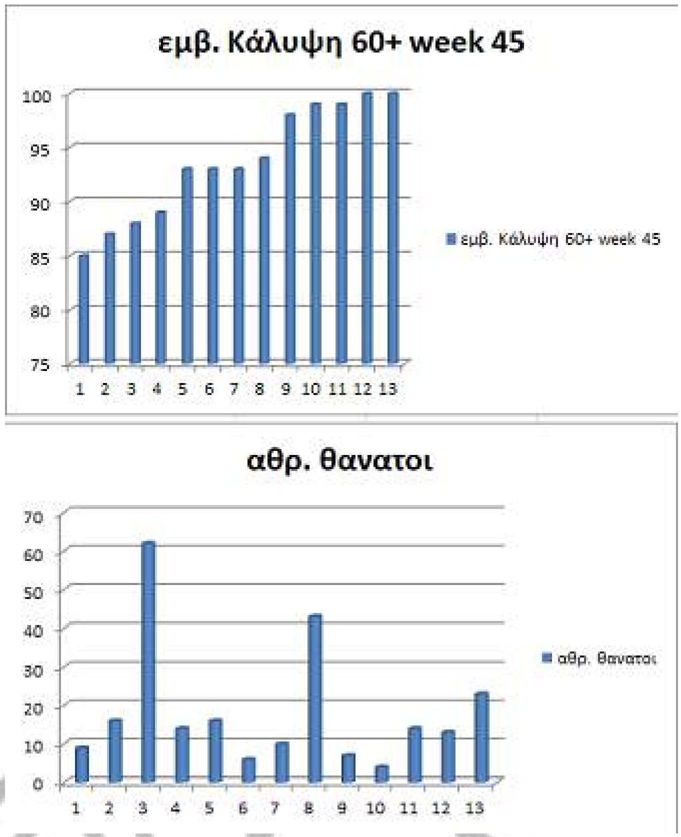
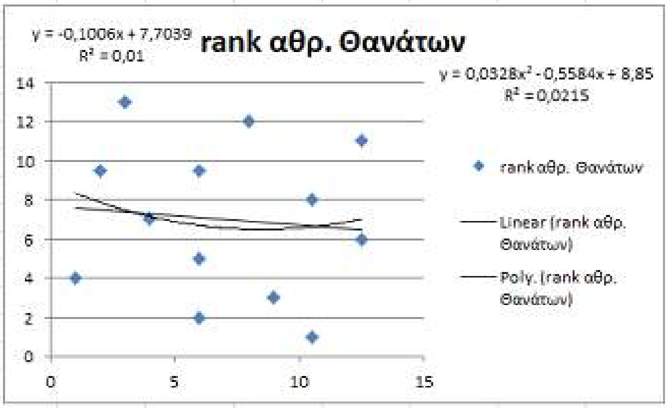

εμβ. Κάλυψη 60+ week 45
100
95
90
85
80
75
1 2 3 4 5 6 7 8 9 10 11 12 13
εμβ. Κάλυψη 60+ week 45
αθρ. θανατοι
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13
αθρ. θανατοι

FIGURE 3



rank εμβ. Κάλυψης	rank εμβ. Κάλυψης square
1	1
2	4
3	9
4	16
6	36
6	36
6	36
8	64
9	81
10,5	110,25
10,5	110,25
12,5	156,25
12,5	156,25

Regression Statistics	
Multiple R	0,099863705
R Square	0,00997276
Adjusted R Square	-0,080029717
Standard Error	4,041713679
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	1	1,810056	1,810056	0,110805	0,745487
Residual	11	179,6899	16,33545		
Total	12	181,5			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	7,703910615	2,393384	3,218836	0,008176	2,436107	12,97171	2,436107	12,97171
rank εμβ. Κάλυψης	-0,100558659	0,302092	-0,33287	0,745487	-0,76546	0,564341	-0,76546	0,564341

Regression Statistics	
Multiple R	0,146608341
R Square	0,021494006
Adjusted R Square	-0,174207193
Standard Error	4,214247715
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	2	3,901162	1,950581	0,109831	0,897052
Residual	10	177,5988	17,75988		
Total	12	181,5			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	8,849993227	4,169348	2,122632	0,059758	-0,43989	18,13988	-0,43989	18,13988
rank εμβ. Κάλυψης	-0,558437691	1,371063	-0,4073	0,692368	-3,61336	2,496481	-3,61336	2,496481
rank εμβ. Κάλυψης s	0,032803821	0,0956	0,343137	0,738599	-0,18021	0,245813	-0,18021	0,245813

APPENDIX 7

FIGURE 1

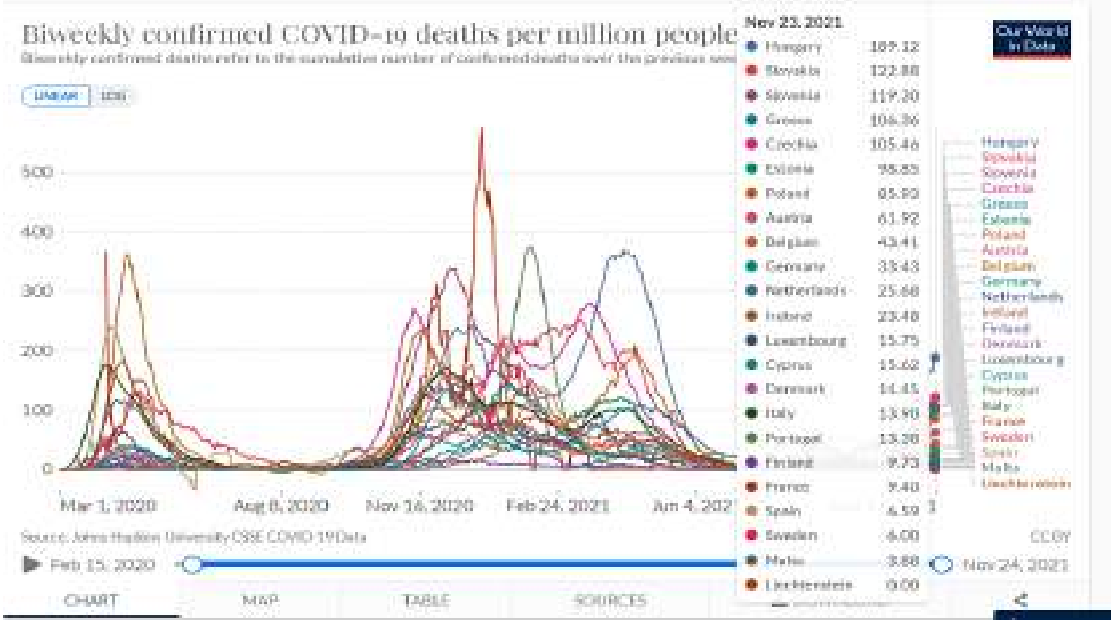


FIGURE 2

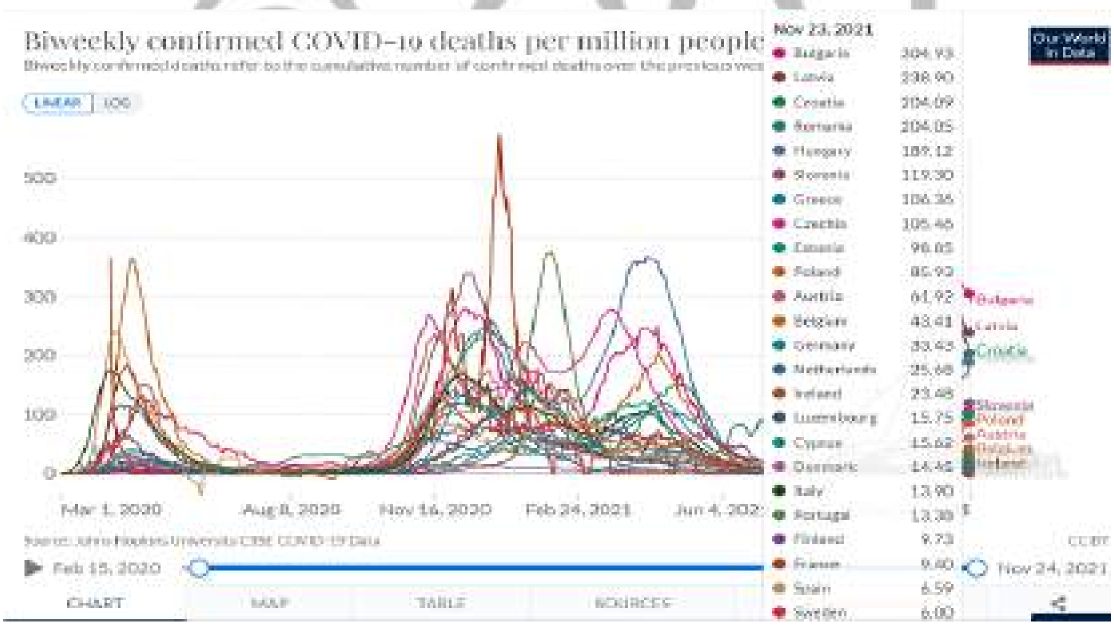
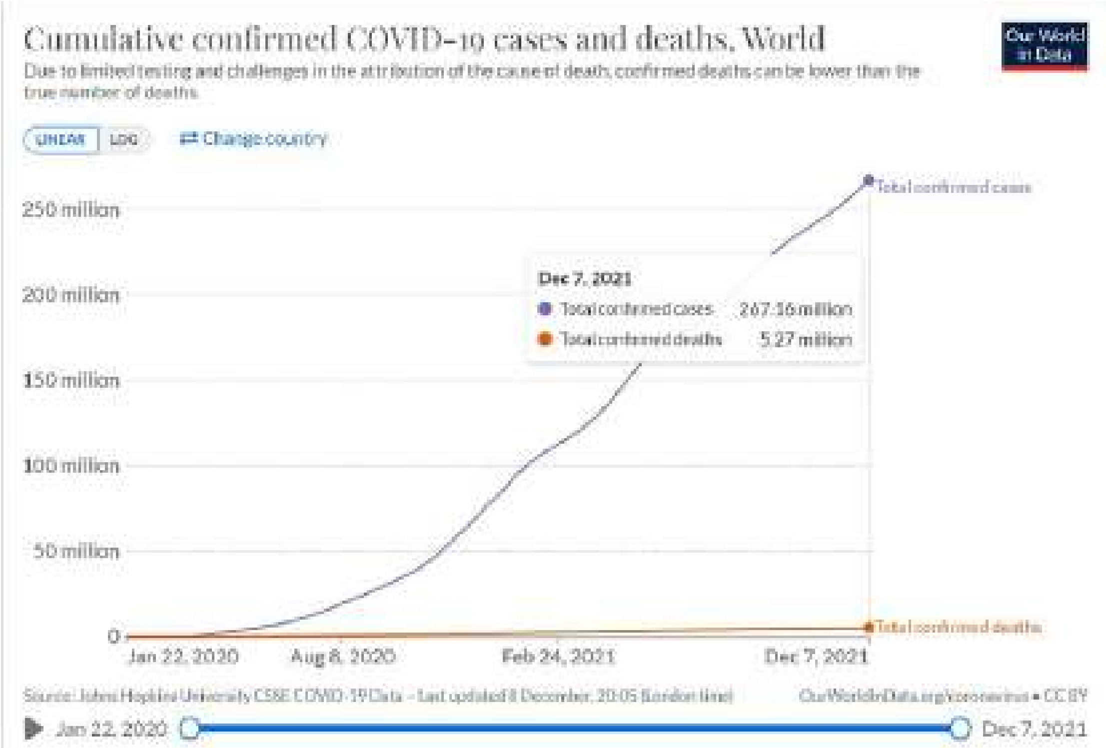


FIGURE 3



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