Estimation of the R_0 factor of the SIR Model in Italy and some its regions as consequence of the pandemic Sars- Covid -19

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Abstract : We compute the factor $R_0(t)$ by using the SIR model in Italy and its some regional countries. We find that it is descending to a minimum value of 1.11 in Italy and respectively of 1.89, 1.86 and 3.13 for each region respectively..

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INTRODUCTION

We have made a number of estimation of pandemic Sars-Covid-2 using a fractal model [1-4]. In the present paper we utilize the well known SIR model as it has been developed by Yi-Cheng-Chen et al .[5].

We find that the R_0 has changed from the maximum value of 3.21 of the day 4 th of April to the present value of 1.30 in Italy. It has changed from the maximum value of 6.15 of the day 12 of April to the present value of 1.89 for the Lazio, and from the value of 5.70 of the day 1 of April to the present value of 1.70 in Puglia and from the maximum value of 6.80 of the day 2 of April to the present value of 3.13.

Materials and Methods

Let $\beta(t)$ and $\gamma(t)$ be transmission rate and recovering rate at time t. Replacing β and γ by $\beta(t)$ and $\gamma(t)$ in the differential equations of the SIR model, we obtain that

$$dS(t)/dt = -\beta(t)S(t)X(t)/n ,$$

$$dX(t)/dt = \beta(t)S(t)X(t)/n - \gamma(t)X(t),$$

$$dR(t)/dt = \gamma(t)X(t).$$

where

$$S(t) + X(t) + R(t) = n,$$

and S, X,R represents the number of susceptible, of infected and of recovered subjects. For finite difference equations we find

$$S(t+1) - S(t) = -\beta(t)S(t)X(t)/n$$

$$X(t+1) - X(t) = \beta(t)S(t)X(t)/n - \gamma(t)X(t),$$

$$R(t+1) - R(t) = \gamma(t)X(t).$$

From the difference equations above, one can easily derive $\beta(t)$ and $\gamma(t)$ of each day. We have

$$\gamma(t) = R(t+1) - R(t)/X(t)$$

and

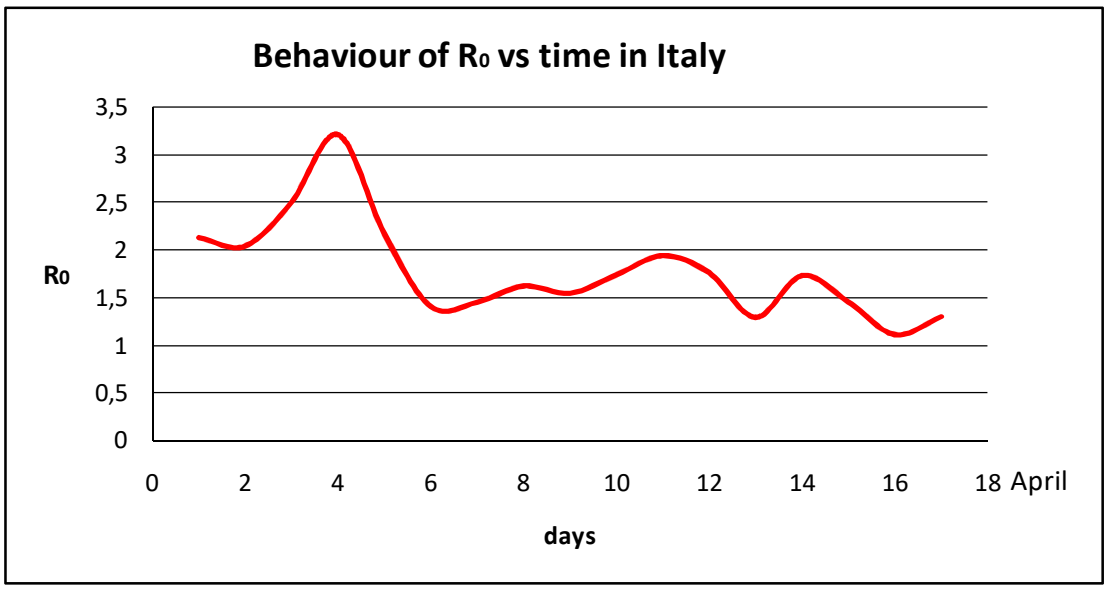
$$\beta(t) = [X(t+1) - X(t)] + [R(t+1) - R(t)]/X(t)$$

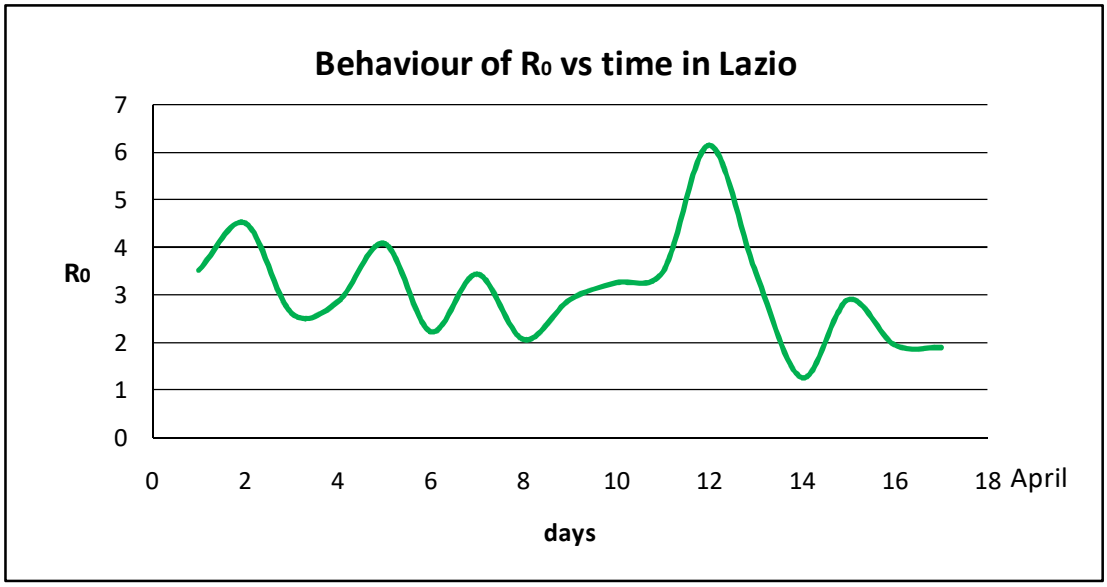
Given the experimental data furnished every day from the Ministry of the Health, we estimate the factor $R_0(t) = \beta(t)/\gamma(t)$

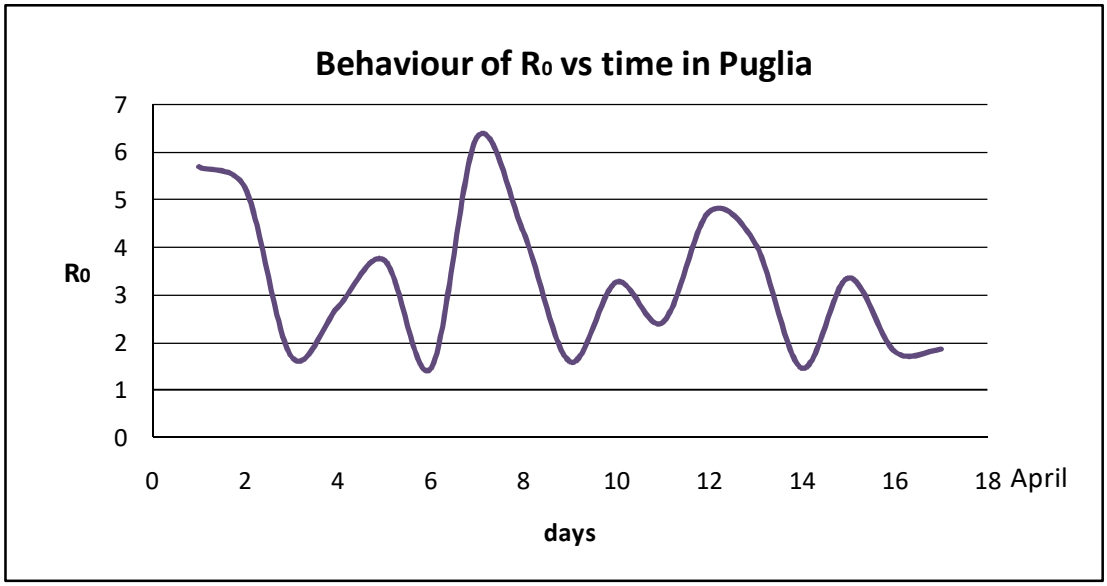
Results and Conclusions

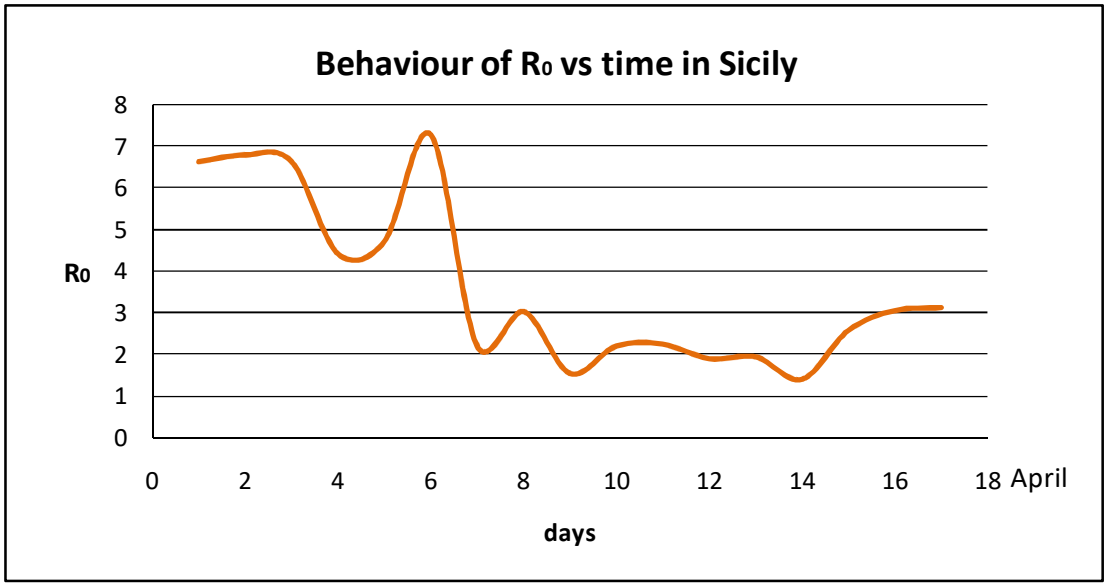
The results are reported in Table 1 and Figure 1.

$R_0=\beta(t)/\gamma(t)$				
April's days	**Italy**	**Lazio**	**Puglia**	**Sicily**
1	2,13	3,52	5,70	6,64
2	2,04	4,51	5,25	6,80
3	2,50	2,62	1,71	6,64
4	3,21	2,86	2,75	4,43
5	2,17	4,08	3,74	4,73
6	1,41	2,23	1,46	7,29
7	1,45	3,44	6,32	2,21
8	1,62	2,06	4,32	3,04
9	1,55	2,91	1,60	1,56
10	1,74	3,26	3,28	2,21
11	1,94	3,49	2,43	2,26
12	1,76	6,15	4,75	1,91
13	1,29	3,49	4,08	1,95
14	1,73	1,26	1,47	1,42
15	1,46	2,90	3,36	2,59
16	1,11	1,95	1,82	3,07
17	1,30	1,89	1,86	3,13




Behaviour of R0 vs time in Lazio
R0
7
6
5
4
3
2
1
0
0
2
4
6
8
10
12
14
16
18
April
days


Behaviour of R0 vs time in Puglia
R0
7
6
5
4
3
2
1
0
0
2
4
6
8
10
12
14
16
18
April
days



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