PAPER NAME

1.C.1_1.1_8. IOP-Syafruddin_1752_0120 07_2021_SEIR Mathematical Model of Se izure fever in Infants und

WORD COUNT

3922 Words

CHARACTER COUNT

18210 Characters

PAGE COUNT

12 Pages

FILE SIZE

978.4KB

SUBMISSION DATE

Jun 20, 2023 10:01 AM GMT+8

REPORT DATE

Jun 20, 2023 10:02 AM GMT+8

16% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 6% Internet database
- 13% Publications database
- Crossref database
- Crossref Posted Content database
- 6% Submitted Works database

Excluded from Similarity Report

- Bibliographic material
- Manually excluded sources
- Manually excluded text blocks

Journal of Physics: Conference Series

SEIR Mathematical Model of Seizure fever in Infants Under 5 Years Old in Makassar City

To cite this article: S Side *et al* 2021 *J. Phys.: Conf. Ser.* **1752** 012007

SEIR Mathematical Model of Seizure fever in Infants Under 5 Years Old in Makassar City

S Side[1*], I Sari[2] and W Sanusi[1]

[1]Department of Mathematics,Faculty of Mathematics and Natural Science,Universitas Negeri Makassar

*Email: syafruddin@unm.ac.id

Abstract. This study aims to obtain a mathematical model in seizure fever; analyzing the model, simulating a seizure fever model in Makassar City, knowing the prediction of the number of seizure fever in Makassar City. This research is a study of theoretical and applied mathematics; Mathematical models in seizure fever are Suspected, Exposed, Infected and Reovered (SEIR) models; Analysis of the model using the generation matrix, simulation models with Maple software using secondary data on the number of people with seizure fever at the Haji Hospital in Makassar. The results obtained are the SEIR model in seizure fever; The results of the model analysis explain that seizure fever are at a stable stage. Model simulation results show the tendency of seizure fever in Makassar City especially in Tamalate sub-district experiencing a downward trend every year.

Keywords: SEIR mathematical model, seizure fever, infants under five years old

1. Introduction

The incidence of seizure fever in Indonesia is quite varied, around 2-5% per year. Simple seizure fever account for 60 -70% of the total number of seizure cases, while 20-30% are classified as complex seizure fever. In Indonesia, seizure fever can attack children at the age of 6 months to 5 years, this age is the golden age of a child's development, both the development of both cognitive and psychomotor and linguistic development [1].

The incidence of seizure seizure in South Sulawesi, especially in the city of Makassar, according to the Makassar statistical center in 2011 was 4115 cases, in 2012 there were 3467 cases, and an increase in cases in 2013 was as many as 3657 cases spread in various hospitals and puskesmas [2].

Research on mathematical models in the form of SIR, SIRS, SEIR and SEIRS models has been carried out by [3-15], but only discusses mathematical modeling in dengue fever, malaria fever, tuberculosis and cholera. While the seizure fever study has been investigated by [16-19], but only addresses the problem of seizure fever from the health side only. Previous studies have not discussed the problem of seizure fever using mathematical models, so this study examines the mathematical modeling of SEIR in seizure fever. SEIR Mode divides the population into four sub-populations, namely Susceptible (S), Exposed (E), Infected (I), and Recovered (R) populations.

Journal of Physics: Conference Series **1752** (2021) 012007 doi:10.1088/1742-6596/1752/1/012007

2. Research Method

This type of research is theoretical and applied research that is by gathering and reviewing literature relating to epidemic diseases, especially fever and seizure models. The first part of this research is to build a SEIR model of the spread of seizure fever, then conduct an analysis on the model, and make a simulation model. The model uses suspected, exposed, infected and recovered compartments. The stage of determining the basic reproduction numbers is determined using the matrix generation method [15]. Stability analysis stage of fixed point without disease and endemic is obtained by monitoring the exposed and infected populations, so that the jacobi matrix is obtained, then the fixed point is substituted into the jacobi matrix to determine its eigenvalue [9]. Eigenvalues were analyzed using the Routh-Hurwitz criteria to determine stability at each fixed point [7]. The fixed point stability simulation stage uses secondary data on the number of cases of seizure fever at Makassar Haji Hospital [2], the simulation model uses Maple software.

3. Result and Discussion

3.1. SEIR Model Formula for Seizure fever Disease

The formation of the SEIR model in febrile seizures was carried out by taking into account the flow chart in Figure 1 and the definition of the variables and parameters of the SEIR model on the spread of typhus is shown in Table 1.

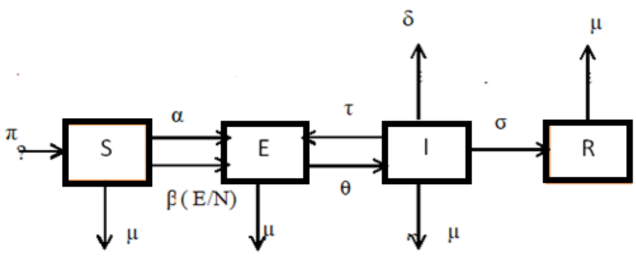

Figure 1. SEIR Model Transfer Diagram for Seizure fever

Table 1 Variables in the SEIR Model for Seizure fever Disease

Variable	Definition
S	The number of Suspected for seizure fever
E	The number of Exposed for seizure fever
I	The number of Infected for seizure fever
R	The number of Recovered for seizure fever
Parameter	
π	Number of births to under-fives populations
α	Genetic factor rate
β	Disease transmission rate from susceptible to exposed
θ	Disease transmission rate from exposed to infected
τ	The rate of decline in disease rates due to drug administration
σ	The cure rate of infected become recovered
μ	Natural death rate
δ	Death rate due to seizure fever

The formulation for the model in Figure 1 is written in the form of a differential equation as in Equation 1:

$$\begin{aligned}
\frac{dS}{dt} &= \pi - \left(\mu + \frac{\beta E}{N} + \alpha\right) S \\
\frac{dE}{dt} &= \left(\alpha + \frac{\beta E}{N}\right) S - (\mu + \theta)E + \tau I \\
\frac{dI}{dt} &= \theta E - (\tau + \mu + \delta + \sigma) I \\
\frac{dR}{dt} &= \sigma I - \mu R \\
N &= S + E + I + R
\end{aligned} \tag{1}$$

To simplify the analysis of equation (1), a model transformation or simplification is performed by making a comparison of each population to the total population with an example in Equation (2).

$$s = \frac{S}{N}; \qquad e = \frac{E}{N}; \qquad i = \frac{I}{N}; \qquad r = \frac{R}{N} \tag{2}$$

We found,

$$\begin{aligned}
\frac{ds}{dt} &= \frac{1}{N}\frac{dS}{dt} - \frac{s}{N}\frac{dN}{dt} \\
\frac{de}{dt} &= \frac{1}{N}\frac{dE}{dt} - \frac{e}{N}\frac{dN}{dt} \\
\frac{di}{dt} &= \frac{1}{N}\frac{dI}{dt} - \frac{i}{N}\frac{dN}{dt} \\
\frac{dR}{dt} &= \frac{1}{N}\frac{dR}{dt} - \frac{r}{N}\frac{dN}{dt}
\end{aligned} \tag{3}$$

with

$$\frac{dN}{dt} = \frac{dS}{dt} + \frac{dE}{dt} + \frac{dI}{dt} + \frac{dR}{dt} \tag{4}$$

Equation (1) is substituted into Equation (4) so that Equation 5 is obtained.

$$\frac{dN}{dt} = \pi - \mu N - \delta I \tag{5}$$

From Equations (1) and (5), equation (3) is obtained by Equation (6).

$$\begin{aligned}
\frac{ds}{dt} &= \frac{\pi}{N}(1 - s) - (\alpha + \beta e - \delta i)s \\
\frac{de}{dt} &= (\alpha + \beta e)s + \tau i - \left(\theta + \frac{\pi}{N} - \delta i\right) e \\
\frac{di}{dt} &= \theta e - \left(\tau + \sigma + \delta + \frac{\pi}{N}\right) i + \delta i^2 \\
\frac{dr}{dt} &= (\sigma + \delta r)i - \frac{\pi}{N} r \\
s + e + i + r &= 1
\end{aligned} \tag{6}$$

3.2. Analysis of the SEIR Model in Seizure Fever

To determine the fixed point equation (6) is used. Determining the fixed point of the system of differential equations of a SEIR type mathematical model is done by assuming that the derivative of system 1 is zero, namely:

$$\frac{ds}{dt} = 0; \qquad \frac{de}{dt} = 0; \qquad \frac{di}{dt} = 0; \qquad \frac{dr}{dt} = 0 \tag{7}$$

There are two fixed points obtained, namely the disease-free equilibrium and the endemic equilibrium. A fixed point without disease contains i = 0 and e = 0, while a fixed point contains i ≠ 0 and e ≠ 0, i.e.

The fixed point for disease free are $T_0(s,e,i,r) = T_0(\frac{\pi}{\pi+\alpha N},0,0,0)$ and The fixed point for endemic are $T_1(s^*,e^*,i^*,r^*)$ with $s^* = \frac{\pi}{\pi+N(\beta e-\delta i+\alpha)}$; $e^* = \frac{N(\alpha s+\tau i)}{N(\theta-\beta s-\delta i)+\pi}$; $i^* = \frac{\pi+(\delta+\tau+\sigma)N-\sqrt{(\pi+(\delta+\tau+\sigma)N)\ \ ^2-4\theta\delta e N^2}}{2\delta N}$ and $r^* = -\frac{\sigma i N}{\delta i N-\pi}$

3.3. The Basic Reproduction Number

Basic reproduction numbers are the expected value of many vulnerable populations becoming infected during the infection. Basic reproduction numbers can be determined using equations that contain only infection. The approach used to determine basic reproduction numbers uses the next generation matrix G which is defined:

$$G = FV^{-1} \tag{8}$$

The equation used is Equation (9):

$$\frac{de}{dt} = (\alpha+\beta e)s + \tau i - \left(\theta + \frac{\pi}{N} - \delta i\right)e$$
$$\frac{di}{dt} = \theta e - \left(\tau+\sigma+\delta+\frac{\pi}{N}\right)i + \delta i \tag{9}$$

Then, define Equation (10)

$$F_i = \begin{pmatrix} (\alpha+\beta e)s + \delta i e \\ \delta i^2 \end{pmatrix}$$
$$V_i = \begin{pmatrix} \left(\frac{\pi}{N}\right)e \\ \left(\sigma+\delta+\frac{\pi}{N}\right)i \end{pmatrix} \tag{10}$$

Then, the linearization of the equation F_i and V_i around the fixed point is carried out without disease (T_0). The results of the alignment F_i and V_i around a fixed point. Linearization result F_i and V_i around the fixed point $T_0(\frac{\pi}{\pi+\alpha N},0,0,0)$ is presented in Equation (11).

$$F = \begin{pmatrix} \frac{\pi\beta}{\pi+\alpha N} & 0 \\ 0 & 0 \end{pmatrix}$$
$$V^{-1} = \begin{pmatrix} 1/(\frac{\pi}{N}) & O \\ 0 & 1/(\sigma+\delta+\frac{\pi}{N}) \end{pmatrix} \tag{11}$$

Futhermore, the fixed point T_0 is substituted on the matrices **F** and **V**, so that the matrix **G,**

$$G = \begin{pmatrix} \frac{N\pi\beta}{(\pi+\alpha N)\pi} & 0 \\ 0 & 0 \end{pmatrix} \tag{12}$$

Then, determined the eigenvalue of the **G** matrix and based on the analysis conducted obtained the dominant eigenvalue of the **G** matrix.

$$R_0 = \frac{\pi\beta N}{(\pi)(\pi+\alpha N)} \tag{13}$$

3.4. Disease Free Stability Analysis

Suppose the system of Equations (6) is written in Equation (14).

$$
\begin{aligned}
f_1(s,e,i,r) &= \frac{\pi}{N}(1-s) - (\alpha + \beta e - \delta i)s \\
f_2(s,e,i,r) &= (\alpha + \beta e)s + \tau i - \left(\theta + \tfrac{\pi}{N} - \delta i\right) e \\
f_3(s,e,i,r) &= \theta e - \left(\tau + \sigma + \delta + \tfrac{\pi}{N}\right) i + \delta i^2 \\
f_4(s,e,i,r) &= (\sigma + \delta r)i - \tfrac{\pi}{N} r
\end{aligned}
\tag{14}
$$

To determine the stability around a fixed point without disease (T_0), the linearization of equation (14) as

$$
JT_0 = \begin{bmatrix}
\frac{\partial f_1}{\partial s} & \frac{\partial f_1}{\partial e} & \frac{\partial f_1}{\partial i} & \frac{\partial f_1}{\partial r} \\
\frac{\partial f_2}{\partial s} & \frac{\partial f_2}{\partial e} & \frac{\partial f_2}{\partial i} & \frac{\partial f_2}{\partial r} \\
\frac{\partial f_3}{\partial s} & \frac{\partial f_3}{\partial e} & \frac{\partial f_3}{\partial i} & \frac{\partial f_3}{\partial r} \\
\frac{\partial f_4}{\partial s} & \frac{\partial f_4}{\partial e} & \frac{\partial f_4}{\partial i} & \frac{\partial f_4}{\partial r}
\end{bmatrix}
\tag{15}
$$

Let $\frac{ds}{dt} = f_1, \frac{de}{dt} = f_2, \frac{di}{dt} = f_3, \frac{dr}{dt}, f_4 = \frac{di}{dt}$, then, we obtained Jacobian matrix is

$$
JE_0 = \begin{bmatrix}
-\frac{\pi+\alpha N}{N} & -\frac{\pi\beta}{\pi+\alpha N} & \frac{\pi\delta}{\pi+\alpha N} & 0 \\
\alpha & -\theta - \frac{\pi}{N} + \frac{\pi\beta}{\pi+\alpha N} & \tau & 0 \\
0 & \theta & -\frac{\pi+N(\delta+\tau+\sigma)}{N} & 0 \\
0 & 0 & \sigma & -\frac{\pi}{N}
\end{bmatrix}
$$

To find out the stability of T_0, the eigenvalue is found, if λI is eigen values of JT_0, then $\det(\lambda I - JT_0) = 0$

$$
det\left(\begin{bmatrix}
\lambda & 0 & 0 & 0 \\
0 & \lambda & 0 & 0 \\
0 & 0 & \lambda & 0 \\
0 & 0 & 0 & \lambda
\end{bmatrix} - \begin{bmatrix}
-\frac{\pi+\alpha N}{N} & -\frac{\pi\beta}{\pi+\alpha N} & \frac{\pi\delta}{\pi+\alpha N} & 0 \\
\alpha & -\theta - \frac{\pi}{N} + \frac{\pi\beta}{\pi+\alpha N} & \tau & 0 \\
0 & \theta & -\frac{\pi+N(\delta+\tau+\sigma)}{N} & 0 \\
0 & 0 & \sigma & -\frac{\pi}{N}
\end{bmatrix}\right) = 0
$$

The Jacobian equation can be written into the characteristic equation in Equation (16).

$$
\lambda^4 + a_1\lambda^3 + a_2\lambda^2 + a_3\lambda + a_4 = 0 \tag{16}
$$

Where,

$\boldsymbol{a_1 = N^5\alpha^2 + 3N^3\pi^2 + N^5\alpha\theta + 4N^4\alpha\pi + N^4\pi\theta + N^4N(\delta+\tau+\sigma)\alpha + N^3N(\delta+\tau+\sigma)\pi + N^4\alpha\pi + N^3\pi^2 - N^4\beta\pi}$

$a_2 = 3N^2\pi^3 + 3N^4\alpha\pi\theta + N^4N(\delta+\tau+\sigma)\alpha\theta + 3N^3N(\delta+\tau+\sigma)\alpha\pi + N^3N(\delta+\tau+\sigma)\pi\theta + 2N^2N(\delta+\tau+\sigma)\pi^2 + N^5\alpha^2\theta + 2N^4\alpha^2\pi + 5N^3\alpha\pi^2 + 2N^3\pi^2\theta + N^4N(\delta+\tau+\sigma)\alpha^2 + N^4\alpha^2\pi + 3N^2\pi^3 + N^4\alpha\theta\pi + 4N^3\alpha\pi^2 + N^3\pi^2\theta + N^3N(\delta+\tau+\sigma)\alpha\pi + N^2N(\delta+\tau+\sigma)\pi^2 - (N^5\alpha\tau\theta + N^4\pi\tau\theta + N^3N(\delta+\tau+\sigma)\beta\pi + 2N^3\beta\pi^2 + N^3\beta\pi^2)$

$a_3 = N\lambda\pi^4 + NN(\delta+\tau+\sigma)\pi^3 + N^3\alpha^2\pi^2 + 2N^2\alpha\pi^3 + 2N^3N(\delta+\tau+\sigma)\alpha\pi\theta + 2N^2N(\delta+\tau+\sigma)\alpha\pi^2 + N^2N(\delta+\tau+\sigma)\pi^2\theta + N^4\alpha^2\theta\pi + 2N^3\alpha\theta\pi^2 + N^2\pi^3\theta + N^4N(\delta+\tau+\sigma)\alpha^2\theta + N^3N(\delta+\tau+\sigma)\alpha^2\pi + 3N\pi^4 + 3N^3\alpha\pi^2\theta + N^3N(\delta+\tau+\sigma)\alpha\theta\pi + 3N^2N(\delta+\tau+\sigma)\alpha\pi^2 + 2NN(\delta+\tau+\sigma)\pi^3 + N^4\alpha^2\theta\pi + 2N^3\alpha^2\pi^2 + 5N^2\alpha\pi^3 + 2N^2\pi^3\theta + N^3N(\delta+\tau+\sigma)\alpha^2\pi) - (N^2\beta\pi^3 + N^4\alpha\delta\pi\theta + 2N^4\alpha\pi\tau\theta + N^5\alpha^2\theta\tau + \pi^2\tau\theta + N^4\alpha\tau\theta\pi + \pi^2\tau\theta + 2N^2\beta\pi^3 + N^2N(\delta+\tau+\sigma)\beta\pi^2)$

$a_4 = \pi^5 + N(\delta+\tau+\sigma)\pi^4 + 2N\alpha\pi^4 + N\pi^4\theta + 2N^2N(\delta+\tau+\sigma)\alpha\pi^2\theta + 2NN(\delta+\tau+\sigma)\alpha\pi^3 + NN(\delta+\tau+\sigma)\pi^3\theta + N^3\alpha^2\theta\pi^2 + 2N^2\alpha\theta\pi^3 + N^3N(\delta+\tau+\sigma)\alpha^2\theta\pi + +N^2N(\delta+\tau+\sigma)\alpha^2\pi^2) \quad -(N^2\pi^3\tau\theta + N^4\alpha^2\theta\tau\pi + N^3\pi^2\alpha\delta\theta + 2N^3\alpha\pi^2\tau\theta + N\beta\pi^4 + NN(\delta+\tau+\sigma)\beta\pi^3)$

Simplyfy as

$a_1 = b_1 - b_2$
$a_2 = b_3 - b_4$
$a_3 = b_5 - b_6$
$a_4 = b_7 - b_8$

According to the Routh-Hurwitz criteria for characteristic equations of degree 4, the equilibrium point T_0 is said to be stable if

$a_1 > 0, a_3 > 0, a_4 > 0$ and $a_1a_2a_3 > (a_3)^2 + (a_1)^2a_4$

$\boldsymbol{a_1 > 0}$ **with** $\boldsymbol{b_1 > b_2}$
$\boldsymbol{a_3 > 0}$ **with** $\boldsymbol{b_5 > b_6}$
$\boldsymbol{a_4 > 0}$ **with** $\boldsymbol{b_7 > b_8}$

$a_1a_2a_3 > (a_3)^2 + (a_1)^2a_4$ with condition

$$b_1b_3b_5 + b_2b_4b_5 + b_1b_4b_6 + b_2b_3b_6 + {b_5}^3b_8 + {b_6}^3b_7 + 3b_5{b_6}^2b_8 + 3{b_5}^2b_6b_7 > {b_5}^3b_7 + {b_6}^3b_8 + 3b_5{b_6}^2b_8 + 3{b_5}^2b_6b_8 + b_1b_3b_6 + b_2b_4b_6 + b_1b_4b_5 + b_2b_3b_5$$

3.5. Analysis of Endemic Stability in Seizure fever

The stability of the fixed point endemic analysis is then performed. Determine the stability around the fixed point endemic T_1 the same as using stability at a fixed point without disease, by conducting a linearity to obtain the Jacobi matrix. Then the fixed point T_1 substituted into the Jacobi matrix is obtained.

$$T_1 = \left(A = \frac{\pi}{\pi+N(\beta e-\delta i+\alpha)};, B = \frac{N(\alpha s+\tau i)}{N(\theta-\beta s-\delta i)+\pi}, C = \frac{\pi+(\delta+\tau+\sigma)N-\sqrt{(\pi+(\delta+\tau+\sigma)N)^2-4\theta\delta e N^2}}{2\delta N}, D = -\frac{\sigma i N}{\delta i N-\pi}\right)$$

As in the case of disease-free, we obtain the eigenvalue equation in endemic cases that have roots of the characteristic equation.

$$p_1 = -\left(-\beta B + \delta C - \frac{\pi+\alpha N}{N} - \theta + \beta A + \delta C - \frac{\pi}{N} - \frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N}\right)\frac{\pi}{N} - \delta C - \frac{\pi}{\pi+N(\beta e-\delta i+\alpha)}$$

$$p2 = \left(\left(-\theta+\beta A+\delta C-\frac{\pi}{N}\right)\left(-\frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N}\right) - \theta(\delta\beta+\tau) + \left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}\right)\left(-\frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N}\right) + (\beta B)^2 + \alpha\beta B - \left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}\right)\left(-\theta+\beta A+\delta C-\frac{\pi}{N}\right)\right) + ((\delta C-\frac{\pi}{N})(\left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}-\theta+\beta A+\delta C-\frac{\pi}{N}-\frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N}\right))$$

$$p_3 = ((\beta B)^2+\alpha\beta B)\left(\frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N} - \theta\delta A(\beta B+\alpha) + \theta(\delta\beta+\tau)\left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}\right) + \left(\frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N}\right)\left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}\right)\left(-\theta+\beta A+\delta C-\frac{\pi}{N}\right)\right) - ((\delta F-\frac{\pi}{N})(\left(-\theta+\beta A+\delta F-\frac{\pi}{N}\right)\left(-\frac{\pi+(\delta-2\delta F+\tau+\sigma)N}{N}\right) + (\beta B)^2 + \pi\beta B\left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}\right)\left(-\theta+\beta A+\delta C-\frac{\pi}{N}\right))$$

$$p_4 = -((\beta B)^2+\alpha\beta B)\left(\frac{\pi+(\delta-\delta C+\tau+\sigma)N}{N}\right) - \theta\delta A(\beta B+\alpha) + \theta(\delta B+\tau)\left(-\beta B+\delta C-\frac{\pi+\alpha N}{N}\right) + (\frac{\pi+(\delta-2\delta C+\tau+\sigma)N}{N})(-\beta B+\delta C-\frac{\pi+\alpha N}{N})(-\theta+\beta A+\delta C-\frac{\pi}{N}))(\delta C-\frac{\pi}{N})$$

According to the Routh-Hurwitz criteria for characteristic equations of degree 4, the equilibrium point T_0 is said to be stable if $p_1 > 0, p_3 > 0, p_4 > 0$ and $p_1p_2p_3 > p_3^2 + p_1^2p_4$

$\mathbf{p_1 > 0}$ **with** $\mathbf{q_1 > q_2}$
$\mathbf{p_3 > 0}$ **with** $\mathbf{q_5 > q_6}$
$\mathbf{p_4 > 0}$ **with** $\mathbf{q_7 > q_8}$

$p_1p_2p_3 > p_3^2 + p_1^2p_4$ with condition

$$q_1q_3q_5 + q_2q_4q_5 + q_1q_4q_6 + q_2q_3q_6 + {q_5}^3q_8 + {q_6}^3q_7 + 3q_5{q_6}^2q_8 + 3{q_5}^2q_6q_7 > {q_5}^3q_7 + {q_6}^3q_8 + 3q_5{q_6}^2q_8 + 3{q_5}^2q_6q_8 + q_1q_3q_6 + q_2q_4q_6 + q_1q_4q_5 + q_2q_3q_5$$

3.6. SEIR Model Simulation for Seizure fevers in Makassar

After an analysis of the SEIR model for seizure fevers, a simulation is then performed to predict the number of cases of seizure fevers in Makassar City with the SEIR model. The initial values of the variables and parameters used are presented in Table 2.

Table 2. Initial values of variables and parameters of model

Variable	**Values**	**Source**	**Parameter**	**Values**	**Source**
$S(0)$	$\frac{1482}{2080}$	Hospital Haji, Makassar	π	0.17	Assumption
$E(0)$	$\frac{1045}{2080}$	Hospital Haji, Makassar	α	0.0000554	Assumption
$I(0)$	$\frac{485}{2080}$	Hospital Haji, Makassar	β	0.005	Assumption
$R(0)$	$\frac{517}{2080}$	Hospital Haji, Makassar	δ	0.000013	Assumption
		Hospital Haji, Makassar	τ	0.00002	Assumption
		Hospital Haji, Makassar	θ	0.00244	Assumption
		Hospital Haji, Makassar	σ	0.00260	Assumption

Based on the parameter values and initial requirements used in the simulation model obtained from the Central Statistics Agency and Makassar Haji Hospital. The simulation in this study uses a time interval $0 \le t \le 100$ where the x-axis value is time (years) and the y-axis value is the fractional variable used. Graph interpretation based on parameter values can be seen in the following Figure 2:

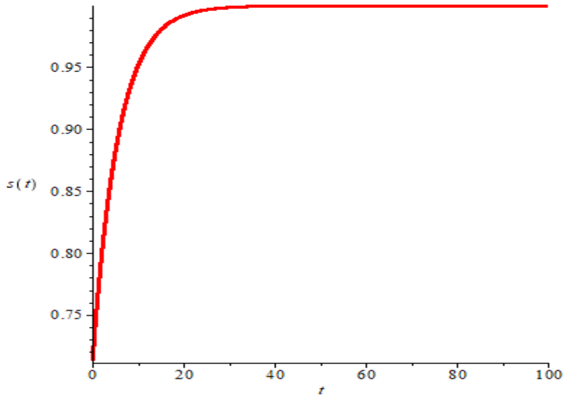

Figure 2. The number prediction of Suspected for seizure fever in Makassar

Based on Figure 2 it can be seen that the number of individuals in the Suspected (S) for seizure fever increased dramatically until the 40th year, and was in a convergent after the 40th year, with the number of individuals in the equilibrium state was 0.99995.

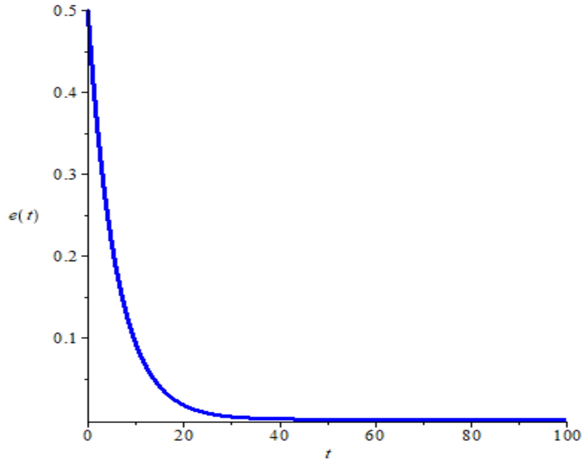

Figure 3. The number prediction of Exposed for seizure fever in Makassar

Based on Figure 3, it is known that the number of individuals in the Exposed (E) group dropped dramatically until the 40th year, and was in a balanced state after the 40th year, with the number of individuals in the equilibrium state is 0. It can be said that after the 40th year there is no more individuals who have symptoms of fever seizure.

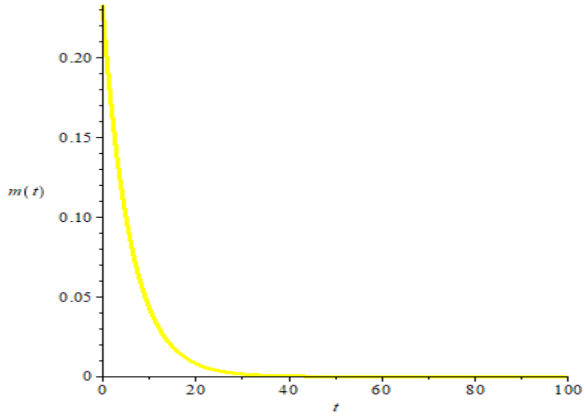

Figure 4. The number prediction of Infected for seizure fever in Makassar

Based on Figure 4, it can be seen that the number of individuals in the Infected (I) group dropped dramatically until the 30th year, and was in a balanced state after the 30th year, with the number of individuals in the equilibrium state is or can be said that after the 30th year there is no more individuals infected with Fever Seizures.

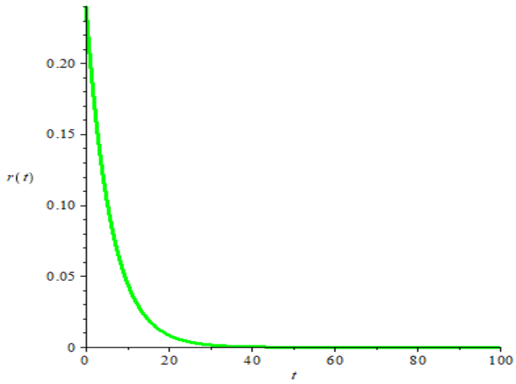

Figure 5. The number prediction of Recovered for seizure fever in Makassar

Based on Figure 5 it can be seen that the total population of Recovered (R) groups decreased dramatically until the 30th year, and was in a balanced state after the 30th year, with the number of individuals in the equilibrium state is or it can be said that after the 30th year all individuals who are infected with fever seizures will recovered.

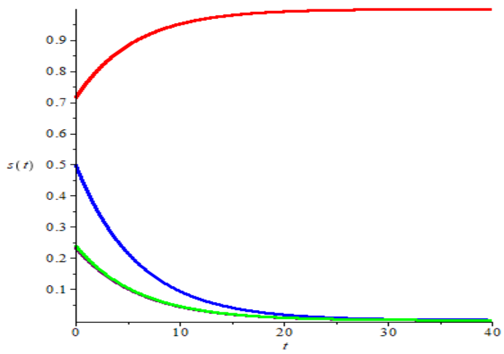

Figure 6. The number prediction of Suspected, Exposed, Infected and Recovered for seizure fever in Makassar

Based on Figure 6, obtained relationships of vulnerable, infected and cured individuals. Individual population S, increase from initial value then stable around s = 0.99995, individual population E decreases from initial value, then stable around e = 0, individual population I, decreases from initial value, then stable around i = 0, while population individual R decreases from the initial value, then stable around r = 0. Based on the simulations carried out it can be concluded that each population goes to a fixed point without disease or in other words the population goes to stable around a fixed point (0.99995, 0, 0, 0).

Based on Figure 6 it can be seen that most of the compartment graphs show a significant decline since the 30th year except for the graph of the number of vulnerable human populations. Therefore, it can be concluded that the condition of febrile seizures in Makassar City especially in Tamalate sub-district experiences a decline trend every year.

4. Conclusion

Based on the analysis and discussion of SEIR type mathematical modeling it can be concluded that the results obtained are the SEIR model in febrile seizures; the results of the model analysis explain that febrile convulsions are at a stable stage. Model simulation results show the tendency of febrile seizures in Makassar City especially in Tamalate sub-district to experience a declining trend every year.

Acknowledgements

We would like thank to Universitas Negeri Makassar and Hospital Haji, Makassar for supporting research data.

References

[1] Amalia, M & Bulan. 2013. Faktor Resiko Kejadian Kejang Demam Pada Anak Balita Di Ruang Perawatan Anak RSUD Daya Kota Makassar. Vol. 1-3.

[2] Depkes RI. 2000. Perawatan Bayi dan Anak. Ed.1. Jakarta : Pusat Pendidikan Tenaga Kesehatan.

[3] Wahyudin Nur, Hirman Rachman, Nurul Mukhlisah Abdal, Muhammad Abdy, Syafruddin Side., 2018. SIR Model Analysis for Transmission of Dengue Fever Disease with Climate Factors Using Lyapunov Function. Journal of Physics: Conf. Series 1028 (1), 012117.

[4] Syafruddin Side, Sukarna, Gita Tri Asfarina, Muh Isbar Pratama, Usman Mulbar., 2018. Analysis of SEIRS Model for Cholera Spreading with Vaccination and Treatment Factors. Journal of Physics: Conf. Series 1114 (2018), 012120

[5] Rangkuti YM, Side S, Noorani MSM. 2014. Numerical analytic solution of SIR model of dengue fever disease in south Sulawesi using homotopy perturbation method and variational iteration method. ITBC J Sci (J Math Fundam Sci);46A(1):91–105.

[6] Dontwi IK, Obeng WD, Andam EA, Obiri LA. 2014. A mathematical model to predict the prevalence and transmission dynamics of tuberculosis in amansie west district, Ghana. Br J Math Comp Sci;4(3):402–4025.

[7] Wahidah Sanusi, Syafruddin Side, Nasiah Badwi, Muh. Isbar Pratama, Sahlan Sidjara., 2019. A SEIRS Model Analysis and Simulation for Dengue Fever Transmission. International Journal of Scientific & Technology Research 8 (10), 1048-1053

[8] Syafruddin Side, Muh Isbar Pratama, Nur Rezky Ramadhan, and Wahidah Sanusi., 2020. Numerical Solution for Spread of Tuberculosis Model With Perturbation Homotopy Method (MPH). International Journal of Scientific & Technology Research 9(1), 816-820.

[9] Syafruddin Side, Usman Mulbar, Sahlan Sidjara, Wahidah Sanusi., 2017. A SEIR model for transmission of tuberculosis. AIP Conference Proceedings 1830 (1), 020004.

[10] Nur Rezky Ramadhan, Syafruddin Side, Sahlan Sidjara, Irwan, Wahidah Sanusi., 2019 Numerical solution of SIRS model for transmission of dengue fever using Homotopy Perturbation

Method in Makassar. AIP Conference Proceedings 2192 (1), 060015
[11] Syafruddin Side., 2015. A susceptible-infected-recovered model and simulation for transmission of tuberculosis. Advanced Science Letters 21 (2), 137-139.
[12] Yulita M Rangkuti., Marlina S Sinaga, Faridawaty Marpaung, Syafruddin Side., 2014. A VSEIR model for transmission of Tuberculosis (TB) disease in North Sumatera, Indonesia. AIP Conference proceedings 1635 (1), 201-208.
[13] Awaluddin, M. 2018. Model Epidemiologi SIR dengan Vaksinasi dan Pengobatan. Jurnal Matriks. Vol. 1, No.1, 61-70.
[14] Elif D, Arzu U, Nuri O. 2011. A fractional order SEIR model with density dependent death rate. Hacet J Math Stat;40(2):287–95
[15] Diekmann O, Heesterbeek JAP, Roberts MG. 2010. The construction of next-generation matrices for compartmental epidemic models. J R Soc Interface Vol 2010;7:873–85.
[16] Tri Anggini Yulia. 2015. Angka Kejadian Dan Karakteristik Kejang Demam. Prosiding Pendidikan Dokter.Vol. 2 No. 2.
[17] Ngastiyah. 2014. Perawatan Anak Sakit.Ed. 2. Jakarta : Penerbit Buku Kedokteran EGC
[18] Wibisono & Bahtera T. 2015. Faktor Risiko Kejang Demam Berulang sebagai Prediktor Bangkitan Kejang Demam Berulang. Kajian Mutasi Gen Pintu Voltase Kanan Ion Natrium.Disertasi.Semarang : Fakultas Kedokteran Universitas Diponegorode,S.
[19] Rohaiza. 2017. Identifikasi Faktor Risiko Kejang Demam Pada Anak . Skripsi Universitas Negeri Hasanuddin

16% Overall Similarity

Top sources found in the following databases:

- 6% Internet database
- 13% Publications database
- Crossref database
- Crossref Posted Content database
- 6% Submitted Works database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	M Asri, S Sidjara, W Sanusi, S Side, M I Pratama. "Analysis and Solution... Crossref	5%
2	Nurhaeda, S Anas, S Side. "Analysis and simulation of mathematical m... Crossref	2%
3	Universitas Pendidikan Indonesia on 2022-01-21 Submitted works	<1%
4	moam.info Internet	<1%
5	W Sanusi, M I Pratama, M Rifandi, S Sidjara, Irwan, S Side. "Numerical ... Crossref	<1%
6	Suwardi Annas, Syafruddin Side, Andi Muhammad Ridho Yusuf Sainon ... Crossref	<1%
7	S Side, N Badwi, M Abdy, W Sanusi. "SEIR Model and Simulation for Ty... Crossref	<1%
8	arxiv-vanity.com Internet	<1%

9	ijstr.org Internet	<1%
10	Syafruddin Side, Sukarna, Gita Tri Asfarina, Muh. Isbar Pratama, Usma... Crossref	<1%
11	University of Stirling on 2023-04-03 Submitted works	<1%
12	researchportal.bath.ac.uk Internet	<1%
13	Universiti Kebangsaan Malaysia on 2014-08-22 Submitted works	<1%
14	Syafruddin Side, Usman Mulbar, Sahlan Sidjara, Wahidah Sanusi. "A SE... Crossref	<1%
15	researchonline.ljmu.ac.uk Internet	<1%
16	annalsofrscb.ro Internet	<1%
17	hdl.handle.net Internet	<1%
18	journal.universitasbumigora.ac.id Internet	<1%
19	nlistsp.inflibnet.ac.in Internet	<1%
20	pt.scribd.com Internet	<1%

21	Andrzej Mizera. "Methods for Biochemical Model Decomposition and ...	Crossref	<1%
22	Higher Education Commission Pakistan on 2023-06-12	Submitted works	<1%
23	Kiyohiro Ikeda. "Bifurcation Behavior of D n -Equivariant Systems", App...	Crossref	<1%
24	M Rifandy, Rahmawati, S Side. "Mathematical Modelling for Event Occ...	Crossref	<1%
25	University of Nicosia on 2022-01-22	Submitted works	<1%
26	e-prints.unm.ac.id	Internet	<1%
27	Syafruddin Side. "Analysis and Simulation of SIRI Model for Dengue Fe...	Crossref	<1%
28	S Side, A Saman, M I Pratama, N R Ramadhan, W Sanusi. "Numerical S...	Crossref	<1%
29	Syafruddin Side, Putri Kharina Mahathir Hulinggi, Husnul Khatimah Sya...	Crossref	<1%

Excluded from Similarity Report

- Bibliographic material
- Manually excluded text blocks
- Manually excluded sources

EXCLUDED SOURCES

S Side, I Sari, W Sanusi. "SEIR Mathematical Model of Seizure fever in Infants ... Crossref	75%
researchgate.net Internet	10%
eprints.unm.ac.id Internet	5%
assets.researchsquare.com Internet	<1%
S. P. Levashkin, O. I. Zakharova, S. V. Kuleshov, A. A. Zaytseva. "Adaptive-co... Crossref	<1%
nlist.inflibnet.ac.in Internet	<1%

EXCLUDED TEXT BLOCKS

Journal of Physics: Conference SeriesPAPER • OPEN ACCESSYou may also like
Universitas Diponegoro on 2022-01-30

Risk of seizures induced by intracranialresearch stimulation: analysis of 770stimul...
Joseph West, Zahra Dasht Bozorgi, Jeffrey Herron, Howard J Chizeck, Jordan D Chambers, Lyra Li. "Machin...

Non-invasive wearable seizure detectionusing long-short-term memory networksw...
Takehiro Hasegawa, Satoru Matsumoto. "Deep Level Induced by Thermal Oxidation in CZ n-Type Silicon", Ja...

A Smart Integrated Brain-ComputerInteraction for Epileptic Seizure DetectionA. M....

V Sangeetha, E Shanthini, T Aravindhan, S Dineshkumar, D Ashwin Shivaa. "Early Detection of Seizure Using ...

To cite this article: S Side et al 2021 J. Phys.: Conf. Ser. 1752

S Side, N Badwi, M Abdy, W Sanusi. "SEIR Model and Simulation for Typus Disease", Journal of Physics: Con...

View

sipeg.unj.ac.id

SEIR Mathematical Model of Seizure fever inInfants Under 5 Years Old in Makassa...

nlistsp.inflibnet.ac.in

ICSMTR 2019Journal of Physics: Conference SeriesIOP Publishing1752 (2021

School of Business and Management ITB on 2023-05-05

SEIR Mathematical Model of Seizure fever in Infants Under 5Years Old in Makassa...

nlistsp.inflibnet.ac.in

of Mathematics,Faculty of Mathematics and Natural Science,UniversitasNegeri Ma...

Syafruddin Side, Gustman Putra Astari, Muh Isbar Pratama, Irwan, Wahidah Sanusi. "Numerical Solution of ...

Content from this work may be used under the terms of the Creative Commons Att...

eprints2.undip.ac.id

transmission rate from susceptible to exposed

Higher Education Commission Pakistan on 2019-07-18

DefinitionS

Syafruddin Side, Putri Kharina Mahathir Hulinggi, Husnul Khatimah Syam, Muhammad Irfan et al. "The Effect...

in Table 1.Figure 1

Universitas Pendidikan Indonesia on 2022-01-21

differential equation

S Side, A Saman, M I Pratama, N R Ramadhan, W Sanusi. "Numerical Solution of the SEIR Model for Online G...

□□ □ □□ □ □□

Kuppusami GOVINDARAJU. "Report (1967?1981) on Four ANRT Rock Reference Samples: Diorite DR-N, Ser...

□□ □ □□ □ □□

Kuppusami GOVINDARAJU. "Report (1967?1981) on Four ANRT Rock Reference Samples: Diorite DR-N, Ser...

to Universitas Negeri Makassar and

Suwardi Annas, Syafruddin Side, Andi Muhammad Ridho Yusuf Sainon Andi Pandjajangi, Nurul Fadhilah Sya...