THE METHOD OF USING THE FUNCTIONAL-DIFFERENTIAL EQUATION IN DETECTING PARASITES IN CHILDREN

Rustam Bakhramov
Assistant of the chair of Informatics, Information Technologies
Samarkand State Medical Institute (Uzbekistan, Samarkand)
E-mail: baxrustam@mail.ru

Murod Malikov
Associate Professor of the chair of Informatics, Information Technologies
Samarkand State Medical Institute (Uzbekistan, Samarkand)
E-mail: malikovmurod55@mail.ru

ABSTARCT
In the article we will consider the types of helminths found in the body of young children, their distribution, reproduction and harm to the human body. And also effective methods of treating these helminths in children. An attempt has been made to describe the dynamics of the development of helminthic invasion - parasites in the human body. With the help of differential equations using a mathematical model of the development of parasites, the dynamics of their change in time is described using the initial conditions.

Keywords: helminthic disease, mathematical model, functional differential equations with delay, hospital treatment.

INTRODUCTION
The article discusses the use of functional differential equations in the diagnosis of helminths in children - the analysis of the stability of stationary solutions, their harmful effects on the human body, that is, methods of mathematical argumentation of ways to get rid of these pests.
In Uzbekistan, an active fight is underway against various diseases caused by helminths, protozoa, as well as bacteria and viruses that occur in adults, especially in young children. While most parents know briefly about the parasites that inhabit the bodies of their children, they do not know what type they are.
It is known that helminthic diseases occur in humans, animals and plants. To date, it is known that more than 270 species of helminths live in the human body. However, 40 of these types of parasites are constant companions of humans and cause significant outbreaks in the body.
The most common type of helminths in young children is pinworms. Pinworms are small helminths belonging to the class of nematodes, the average size of which does not exceed 10-12 mm. Torso circular, elongated shape and has an angular view of the ends. Males and females of this species are different from each other. During the breeding season, the female lays eggs, so they are larger than the males. As for the spread of these parasites, their development will be much better if the air is moderate and the temperature is from 30^0 to 40^0 degrees, as their seeds sink to the ground. When the air is humid and the temperature is between 10^0 and 15^0 degrees, their development slows down.
Treatment of helminths is very important, because their effect on the human body leads to negative consequences. It is well known that this disease, if not treated in time, can cause many other diseases and shorten a person's life by 10-15 years.
Each parasite, including helminths has favorable conditions for life in a living organism. Pinworms and other helminths live in the intestines in the digestive system of children. If you have observed young children, they put any objects in their mouths that fall into their hands. These items may contain invisible microinfections. They begin to develop after they enter the body of children from the oral cavity.

METHODS

Worms are parasites that are found not only in the gastrointestinal tract, they live in the respiratory organs, liver, spleen, muscles, blood, brain, eyes and other organs. They feed on outer shells of proteins, fats and carbohydrates. During digestion, most of the nutrients are absorbed by the helminths. The development of such symptoms of the disease, in turn, leads to weakness and chronic fatigue. First of all, it requires parents to pay attention to their child in order to prevent the growth of helminths in young children. Complications of the disease negatively affect the growth of children, the ideal development of the body.

Currently, the dynamics of the development of helminths is being carefully studied. In this process, approaches using the method of mathematical analysis in order to increase the body's immunity give positive results. The term mathematical immunology is widely used in science. In turn, the analysis of systems proposed in the field of biomedicine is called "systems biology".

At the same time, medicine uses the largest sections of modern mathematics, such as mathematical modeling, theory of differential equations. For example, differential equations were used in the process of creating an artificial kidney, since the process of hemodialysis (blood purification using an artificial kidney) is described by a system of differential equations.

Today, the elaboration of mathematical models and computational algorithms for a system of functional differential equations in the treatment of helminths, as well as the development of information technology programs for the prevention and treatment of helminths in children is an important task.

It is known that for research, helminths were previously determined primarily on an expert model, that is, using laboratory testing methods. This formula, which we recommend, allows you to determine the dynamics of the growth of helminths, the occurrence of undesirable phenomena in the human body through the latent course of the disease, using mathematical formulas (theory of differential equations).

By reviewing and analyzing the characteristics of the susceptibility of the mathematical model of helminthic disease, one can find similarities corresponding to the parameters or conditions of the system, which allow the development of effective parasitological methods. The main goal is to study the possibility of determining a compensatory effect on the immune system in the late stages of helminthic disease using mathematical modeling methods. Immediate optimal conditions in the theory of aerodynamic stability can be used as a violation of the steady state of the disease in the framework of models.

The mathematical model of the disease will allow studying the characteristics of susceptibility, taking into account the spread, speed and time of spread of parasites. Previously, the expert model was mainly used to study diseases. Using this formula, it is possible to reveal the latent manifestations of this disease in the linear differential of the dynamics of a simple mathematical model of worms.

Here V - time spread of worms, E_p – active worms, E_e – effectiveness of worms, W - reproductive worms.

$$\frac{d}{dt}V(t) = \beta V(t)\left(1 - \frac{V(t)}{V_{m\upsilon c}}\right) -_{YVE} E_e(t)V(t),$$

$$\frac{d}{dt}E_p(t) = \alpha E_p\left(E_p^0 - E_p(t)\right) + \beta_p g_p(W)V(t-\tau)E_p(t-\tau) - \alpha_{AP}V(t-\tau_A)V(t)E_p(t),$$

$$\frac{d}{dt}E_e(t) = b_d g_e(W)V(t-\tau)E_p(t-\tau) - \alpha_{AE}V(t-\tau_A)V(t)E_e(t) - \alpha_{Ee}E_e(t),$$

$$\frac{d}{dt}W(t) = b_w V(t) - \alpha_w W(t), \qquad (1)$$

Herein $g_p(W) = 1/(1 + W/\theta_p)^2$, $g_e(W) = 1/(1 + W/\theta_e)^2$

The biological meaning of the size of the system is given in the above formula. To calculate this t > 0 да $-\tau_A \leq t \leq 0$ in this interval it is enough to calculate the meaning V(t), $-\tau \leq t \leq 0$ in this interval, the meaning $E_p(t)$, when $t \leq 0$ the meaning $E_e(0)$ и $W(0)$.

However, for consistency, the initial value of all variables in the range $-\tau_A \leq t \leq 0$. The biological meaning of this formula is as follows: β - The speed of worms in this range; YVE- Loss of constant speed of worms due to cellular results; $V_{m\upsilon c}$- the number of the most common worms in the interstitial space; τ - classification of the duration of recurrence of cytotoxic lymphocytes; β_p - constant cytotoxic lymphocyte rate; b_d - differentiation of cytotoxic lymphocytes; θ_p - state of the border of treatment of worms; θ_e - limit of worms for converting results into energy state; αE_p - a constant rate of natural death during treatment for worms; α_{Ee} - the result of permanent natural death when treated for worms; E_p^0 - non-helminthic concentration of spleen muscles; τ_A - persistent transition of cytotoxic lymphocytes to apoptosis; α_{AP} - constant rate of precursors of apoptosis; α_{AE} - constant rate of performer apoptosis; b_w - growth rate of cumulative worm load; α_w - constant rate of recovery of the body under the influence of a worm load.

(1) determination of the vector of system variables by the formula

$$U(t) = (V(t), E_p(t), E_e(t), W(t))^T, \qquad (2)$$

This formula can also be written in the following form

$$\frac{d}{dt}U(t) = F(U(t), U(t-\tau), U(t-\tau_A)). \quad (3)$$

Based on the above, we consider the variable as a vector in $U(t)$ given $-\tau_A \leq t \leq 0$

(3) the formula was calculated by Newton's method to a nonlinear equation in stationary cases.

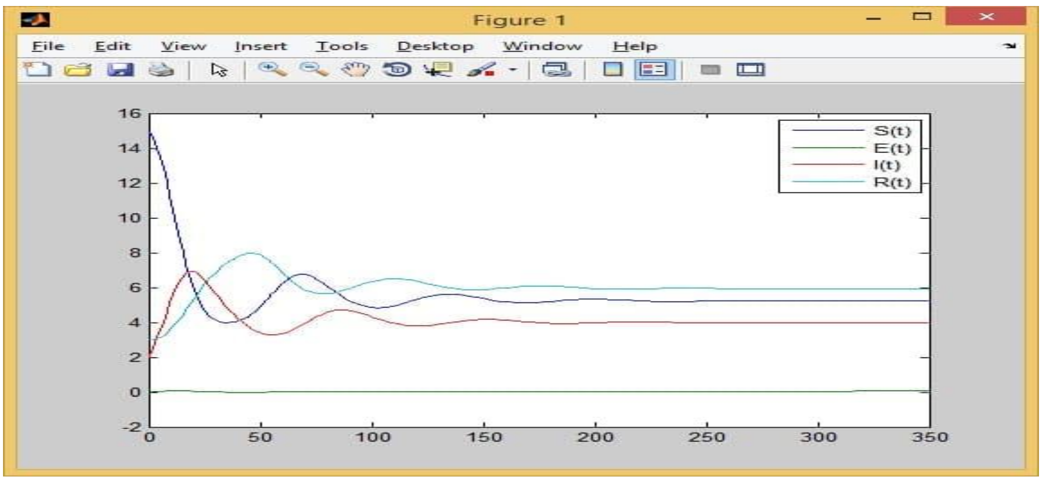
For different sets of parameters, formula (3) has constant states. In this study, we used two sets of parameters, for each of which a steady state was found. Stationary states were calculated using Newton's method to the nonlinear equation: F(U)=0, F(U)= F(U,U,U)

Result

The stationary states of the model (3) are based on the search for sets of parameters with the required properties and the results of the analysis of numerical bifurcations ("bifurcus" comes from the Latin word for division) at initial values corresponding to the Newtonian method.

The above formula was developed in Matlab program.

Picture 1: The value $-\boldsymbol{\tau}_{\mathbf{A}} \leq \mathbf{t} \leq \mathbf{0}$ is taken in this range



Picture 2: Transition of the model to a stationary solution

We can see the results of the values in this graph.

In addition to the above, the only way to prevent the development of symptoms is to see a doctor, who will prescribe tests and medications for the treatment of enterobiasis in childhood and follow the doctor's instructions:

- ✓ Store baby clothes separately, do not put on each other's clothes;
- ✓ Toys children play should be washed with soap from time to time;
- ✓ Disinfection of children's toilets, toilet floors, doors and gutters, window sills, tables and chairs with boiling water, 5% lysol solution, creolin, bleach, etc.;
- ✓ Regularly decontamination (disinfection), cleanliness and replacement of sand in the play sandbox;
- ✓ Wash fruits and vegetables thoroughly in clean water and then consume;
- ✓ Strict adherence to sanitary standards in the kitchens of schools and kindergartens and the elimination of parasites, cover the dishes as much as possible;
- ✓ Do not eat meat that has not been fully cooked or fried;
- ✓ Regularly talk about the prevention of helminthic diseases with parents;
- ✓ Boil children's bedding and underwear before washing, iron and change every day, in the morning wash the anal area with soap and warm water.

Also use natural ways to treat worms, eat pumpkin seeds and garlic in food. Of course, with these natural methods, we cannot completely get rid of parasites, but we can get rid of some.

CONCLUSION

In this article, we reviewed the results obtained using a mathematical model and differential equations based on experiments with helminthic diseases, as well as the results in Matlab. The main objective of the study was to uncover the hidden arguments underlying this disease. Differential equations were used to calculate the prevalence, reproduction and adverse effects of ascaris on the human body.

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