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The Relationship between Hookworm Infection and the Level of Serum Iron.

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Abstract

A study on the relationship between hookworm infection and the serum iron level was carried out among the inmates of Chiang Mai provincial prison between November 1970 and January 1971. Quantitative egg counts were done in infected subjects and in normal persons as a control. The level of serum iron and the total iron binding capacity were determined among these subjects. The corelation between the degree of hookworm infection and the serum iron level was established.

Hookworm infection is one of the most commonly found diseases in the world. Evidently, the disease has been present since prehistoric period. It has caused human to suffer and great economic loss in number of times.

During the year 1921 - 1923, the Rockefeller foundation in cooperation with the Thai government made a survey on hookworm infection in Thailand and found 57.3 % of the Thai population sufferred the disease. The data comprised 22.8 % from the Northeast, 26.9 % from the Center, 43 % from the South and 8 % from the North (5). Most of the hookworm infection found in Thailand are caused by the worm **Necator americanus** and only 0.86 % by **Ancyclostoma duodenale.**

Iron (Fe.) is one of the most important component of hemoglobin in blood.

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There is always a constant amount of iron in a normal healthy person. The rate of turnover is about 27 - 35 mg/day. Iron source does not come solely from intestinal absorption but also from hemoglobin catabolism in the reticuloendothelial system. Protein "transferrin" acts as the transportator of which one third is bound to "plasma iron" and the rest remains free. Plasma iron concentration is low in anemic conditions such as rhumatoid, certain kind of cancer. Plasma iron is high during the damage of red blood cells.

The main cause of anemia in tropical areas is due to malaria and hookworm infection. The symptom of hookworm infection is not drastic but long lasting and can be fatal if not treated.

Many records and evidences showed a strong linear relationship between number of hookworms infected persons and hemoglobin concentration (2, 4, 6, 7). The quantity of hookworms is related to the number of eggs in the feces of the infected person. People carrying hookworms in their intestines are divided into four catagories according to the number of eggs/unit of feces as follows.

1) Carrier - persons having less than 800 eggs/1 gm of feces or equivalent to 40 hookworms in the intestine.

2) mild case - persons having between 800-3000 eggs/1 gm of feces or equivalent to 150 worms.

3) moderate case - persons having between 3,000 - 7,500 eggs/1 gm of feces or equivalent to 400 worms.

4) severe case - persons having over 7,500 eggs/1 gm of feces or equivalent to 800 worms.

Investigations were done in patients sufferred severe infection and all of them were found to have low hemoglobin content in blood (3). The anemia is of hypochromic and microcytic type. Plasma iron was reduced greatly. The red cell / white cell ratio is twice as high as in normal. The loss of red blood cell is increased via intestine. A normal healthy persons losses 0.03% of iron per day while 4.79 % of iron per day is lost in severe cases. During the initial infection by hookworm, the hemoglobin content is not changed since iron is replaced by the reserved body iron. Later, when the iron reserve is depleted, the overall iron content begin to decline and hence anemic condition follows.

The purpose of this study is to investigate the relationship between iron content in serum and number of hookworms in the intestine ie. the number of eggs / gm of feces.

Material and Methods The volunteers were the inmates of Chiang Mai provincial prison. Stool examination was performed to detect infection and number of eggs was determined in infected sample by Stool's Technique (7). The multiplication

factor for calculating the number of eggs varies according to the condition of stool as follows.

condition of stool	factor
hard formed	1
mushy, formed	1.5
mushy	2
mushy, diarrheic	3
frankly diarrheic	4
watery	5

Determination of serum iron is achieved by modified technique of Caraway (1). The principle of the method is to reduce Fe and detach it from the heme component with ascorbic acid and hydrochloric acid containing sterox. The Fe is detected in the supernatant by adding 2-4-6-S- tripyridye-S-triazine (TPTZ) and ammoniumacetate. The quantity of Fe is then measured colorimetrically at the wavelength of 590 mu.

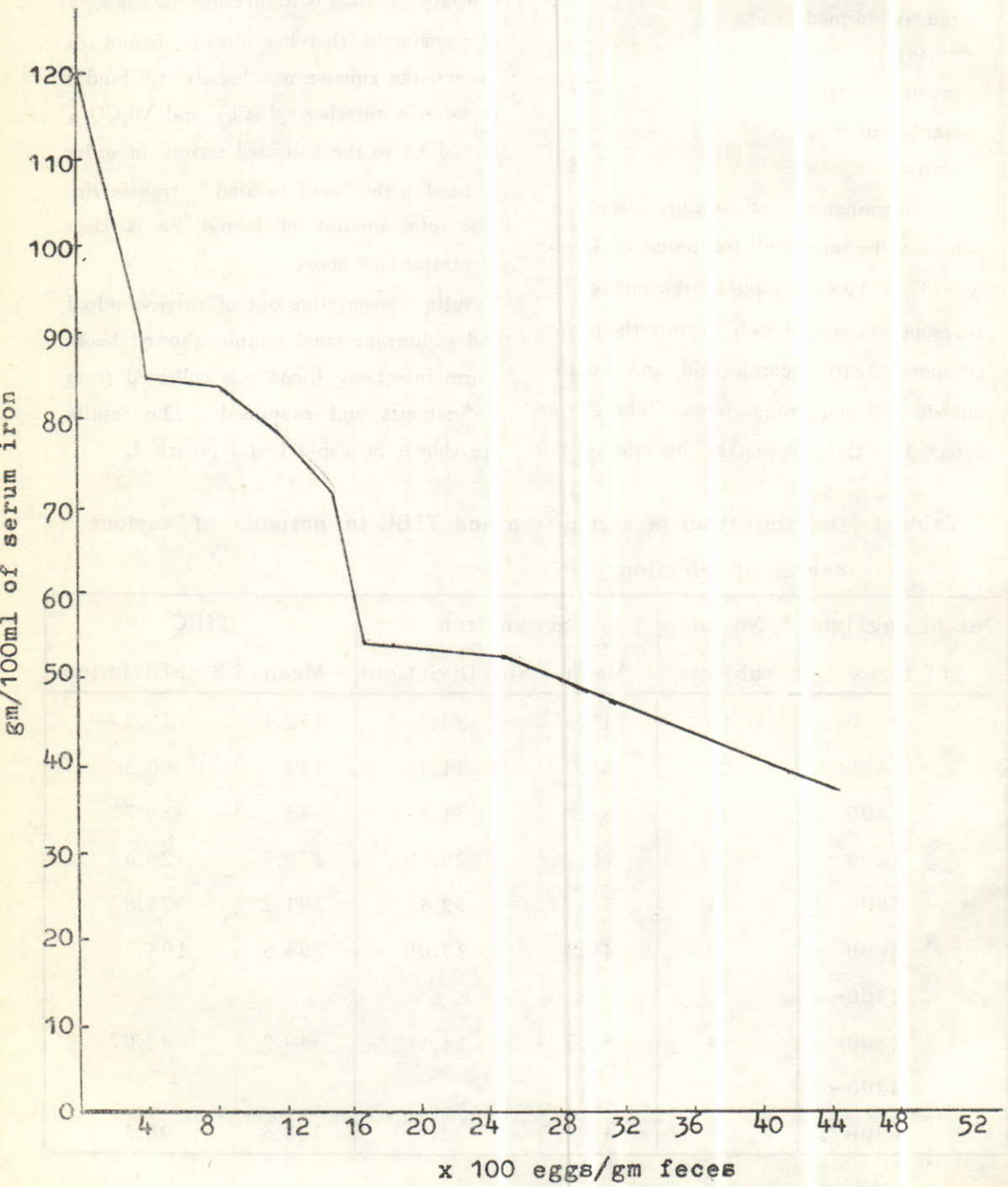
Determination of total iron binding capacity (TIBC) is to measure the capacity of transferrin that has already bound to Fe and the amount of "ready to bind" transferrin together. $FeCl_3$ and $MgCO_3$ are added to the collected serum in order to bind with "read to bind" transferrin. The total amount of bound Fe is then determined as above.

Results Seventyfive out of three hundred and eightynine stool samples showed hookworm infection. Blood was collected from 45 patients and examined. The results are shown in Table 1 and Figure 1.

Table 1 Determination of serum iron and TIBC in patients of various degree of infection.

No. of egg/lgm of faces	No. of subjects	Serum iron		TIBC	
		Mean	Std. Diviation	Mean	Std. Diviation
0	15	119.5	23.7	352.4	39.2
400	23	85	31.5	341	60.3
800	8	84.8	31.5	345	59.7
1200	7	78.14	29.09	339.5	25.6
1600	4	73	32.3	391.2	71.8
2000	3	49.3	23.09	364.3	104.7
2400–2800	4	52.5	14.1	349.2	82.07
3200–6800	5	45.2	22.9	354.6	99.3

Figure 1 Relationship between level of serum iron and the degrees of infection of hookworm in the subjects.



Discussion There is a gradual reduction of level of serum iron in the persons infected with hookworm. Although the initial drop of the iron level in very mild cases seems to be too great, it is still in the limit. The reduction of serum iron may not indicates the anemic condition since there may be enough iron from the body reservior to bind with hemoglobin. The data indicates the loss of overall Fe and the degree of Fe loss corelates with the degree of hookworm infection. In this experiment, the TIBC is rather constant in both normal and infected subjects. The power of binding of transferrin to Fe may be influenced by many factors such as diet, individual Fe reserve, daily turnover of Fe.

Conclusion The level of iron serum in hookworm infected persons is lower than normal. The degree of hookworm infection directly relates with the degree of reduction of iron serum.

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