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A fundamental study on the so-called nine worms  
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— a new interpretation of them as the mixture  
of the real and imaginary parasites(note)

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## RESEARCH NOTE

A fundamental study on the so-called nine worms  
traditionally believed to inhabit the human body  
— a new interpretation of them as the mixture  
of the real and imaginary parasites (note)

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## SUMMARY

The present fundamental study has been pursued to interpret rationally the “nine worms (presumably parasites)” described in “Ishimpou”, which was compiled in Heian Period of Japan. It is supposedly one of the most authentic medical books in

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those days. Among these worms, three kinds are generally thought to be the roundworm, tapeworm(s) and pinworm whereas the other ones (6 worms) are enigmatic as reported earlier by researchers including the present authors. However, it is presumed that one of the latter 6 worms is a real one because of the description of its length. The other 5 worms without the description of their length are thought, by the present authors, to be imaginary parasites. We have to remember that it was hard for the ancient people to identify the parasites in the human body. In addition to this, we have to attach much more importance to the fact that there have been various kinds of expressions including the Japanese word, “musi” or worms in the human body. These two facts will lend support to the clarification of the enigmatic worms. This is the conclusion of this paper.

## INTRODUCTION

The historical studies on the infections and treatment of parasites in Japan are the field of interest to all the present authors. This paper pays attention to the nine worms explained in a famous medical text which was compiled in the 10th century. This is called “Ishimpou”, being considered as one of the oldest medical books in Japan.<sup>1)</sup>

What they mean has intrigued historians and parasitologists so far on the assumption that the direct translation, “nine worms” described in “Ishimpou”<sup>2,3)</sup> are the 9 kinds of parasitic helminthes. The interpretation of the “nine worms” in human bodies described on the text still remains a question to be made clear.

The 3 out of the 9 parasites are generally presumed to be the roundworm, tapeworm(s) and pinworm if we believe in the literal expression.<sup>2,3)</sup> The other worms still remain to be enigmatic. Whether the 6 worms are real ones should be clarified by a rational method. Although it does not seem to be readily answered,

this is an important question, to begin with. In a book,<sup>3)</sup> some of the parasites are presumed to be genuine ones, for instance anisakis and *Schistosoma mansoni*. Whether or not this view is true in a scientific sense is worthy of discussion.

An idea of “the imaginary worms” in addition to the real ones has hit the present authors in their interpretation of the so-called “worms inhabiting the human body” traditionally believed in. It may be that we should not always adhere to the idea of worms in a scientific sense because the Japanese word, “musi” (or “worm” in English) does not always mean the worm present in the real world or in a biological sense. It is sometimes no more than a comparison or a metaphor.

This paper describes the possibility of the imaginary worms in addition to the real ones.

## MATERIALS AND METHODS

The information and publications<sup>1-9)</sup> that are thought to have something to do with “Ishimpou” have been collected through libraries and Internet, and cited. Parts of them that are considered to be directly related are indicated in the text. Information on a Japanese word, “mushi (or the worm in English)” has also been collected. Some of them are cited in the text for discussion.

## RESULTS AND DISCUSSION

### The introduction of the worms described in the traditional text

The following 9 worms have been mentioned in the traditional text.<sup>3)</sup> The direct translation is shown below. This has already been presented in the congress<sup>9)</sup> held in Mito, Ibaraki Prefecture, 2010. The Japanese suffixes, -mushi and -chu mean “worm”.

The 3 worms (the serial number 1, 2 and 3) out of the 9 have different sizes in length (described in centimeters in this present paper after conversion).

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| (1) Fushi-mushi (the hiding worm) | 伏虫 : 4 <i>bu</i> (about 1.2 cm)   |
| (2) Kai-chu (the roundworm)       | 蛔虫 : 1 <i>shaku</i> (about 30 cm) |
| (3) Haku-chu (the white worm)     | 白虫 : 1 <i>sun</i> (about 3 cm)    |
| (4) Niku-mushi (the flesh worm)   | 肉虫 : no description on the length |
| (5) Hai-chu (the lung worm)       | 肺虫 : no description on the length |
| (6) I-chu (the stomach worm)      | 胃虫 : no description on the length |
| (7) Jyaku-chu (the weak worm)     | 弱虫 : no description on the length |
| (8) Aka-mushi (the red worm)      | 赤虫 : no description on the length |
| (9) Gyo-chu (the pinworm)         | 蟯虫 : no description on the length |

### The 3 presumably genuine worms out of the so-called “9 worms”

When we believe in the literal meaning of the 9 worms numbered as (1)~(9) above mentioned, (2) Kaichu, (3) Hakuchu and (9) Gyochu are thought to be authentic worms. This is consistent with the idea of Yoshida.<sup>2)</sup> It is probable that they were naturally expelled and/or observed to be recognized with the naked eye even in those days. The 3 worms<sup>9)</sup> in question (worms 2, 3 and 9) are confirmed to be the roundworm, tapeworm(s) and the pinworm based on the following discussion. They are present both in China and Japan now (They are the well-known parasites distributed ubiquitously at global level).

#### 1. Which is the roundworm, *Ascaris lumbricoides*?

The note on the color of the worm, (8) Akamushi is reminiscent of the possibility that the roundworm may be one of the candidates. However, there are some other parasites looking reddish in color such as schistosomes and hookworms,

both of which suck the host blood and look reddish as a result. These worms, unlike the roundworm, are not readily found in the feces without very close observations that are presumed to be impossible in those days. No length of the “red worm” is described. Judging from the length and the shape, it is highly probable that the worm, (2) Kaichu is thought to be the roundworm. It is hard to define what “the red worm” is.

## 2. Which is the tapeworm ?

The worm (3) Hakuchu is thought to be one of the tapeworms. The worms called “sunnpaku or suhaku”(寸白) are thought to be some kinds of the tapeworms. One of the well-known tapeworms is *Diphyllobothrium latum* in Japan. This one is rather readily found to be out of the anus of patients when it is not cut short there but often lingers.<sup>2)</sup> Other tapeworms recognizable, even if they were very roughly observed with the naked eye, are *Taenia solium* and *Taenia saginata*. The long body of the tapeworms is often split at the anus. The description of the length of about 3 cm in “Ishimpou” is not incorrect. It varies, depending on where they are split. However, in cases infected with *T. saginata*, the split segment (usually one segment) is about 2 cm long.<sup>2)</sup> The likelihood is that the worm readily recognized by Chinese and Japanese people is *T. saginata*. They actively move on the excreted feces after they are split at the excretion.<sup>2)</sup>

## 3. Which is the pinworm, *Enterobius vermicularis* ?

The worm (9) Gyochu is thought to be the pinworm. The worm called “gyochu” is literally thought to be *Enterobius vermicularis*. The text describes it as a minute worm. In fact, it is small (female worms : about 1 cm, males : about 3~4 mm). They are readily found on the peri-anal parts. Ancient people probably saw and noticed them in those days.

### The agreement and disagreement with the previous interpretation<sup>3)</sup> on the nine worms

In a book, the translated version of the original “Ishimpou” into modern Japanese,<sup>3)</sup> most of the worms were thought to be the genuine worms as follows. However, to the present authors’ view, some of them (3 or 4 worms) are presumed to be correct while others (6 or 5 worms) are based on meager evidences.

(1) Fushimushi (the hiding worm) is presumed to belong to the group of hookworms according to the translation.<sup>3)</sup> The original description on the length (about 1.2 cm) is reasonable. However, no other evidence is indicated. If ancient people observed hookworms, how the worms were recovered still remains a question.

(2) Kaichu (the roundworm) : There is almost no problem on the interpretation of this worm. The description of the length (about 30 cm) is in accordance with that in modern texts on parasitology.<sup>3)</sup>

(3) Hakuchu (the white worm) : In the thought of the length (about 3 cm), the color and other characteristics, this is the split tapeworm as researchers, historians and writers think.

(4) Nikumushi (the flesh worm) : Without the description on the length or any decisive evidences, it is hard to ascertain that this is the Chinese liver fluke (*Clonorchis sinensis*) as the footnote of the book<sup>3)</sup> suggests. We have to bear it in mind that the fluke is parasitic in the bile duct.

(5) Haichu (the lung worm) : It is hard to recover parasites in the lungs. The suggested *Paragonimus* spp. is questionable due to the scanty information.

(6) Ichu (the stomach worm) : With no description on the length, the footnote of the book describes this one as anisakis. Is this recognition true ?

Anisakis became well-known after the World War II. No parasites called anisakis are found in the feces. In man, anisakis parasites at their larval stage can best be found mostly in the stomach and the intestine. Did they eat raw fish from the sea ? People did eat raw fish in Japan while they rarely ate them in China. Did they dissect the parasitized organs ? Dissection or operation of patients' bodies like the stomach is hard to think of. It is rather difficult to support the possibility of anisakis as one of the unidentified worms.

The possibility of the infection with this parasite cannot be denied right now because Japanese people eating sea fish raw sometimes suffer from it. However, we have to consider the fact that anatomical studies on human body were generally impossible in those days.

(7) Jyakuchu (the weak worm) : This worm without the description on the length is mysterious. The book<sup>3)</sup> describes this as an unknown worm.

(8) Akamushi (the red worm) : Although no description on the length is read, the red color is reminiscent of some kinds of parasites. However, this is by no means *S. mansoni*. Infection with this parasite has been out of a question because *S. mansoni* has mainly been found in the endemic areas of African and Latin American countries and has never been distributed in China and Japan. The parasite of the same genus which is endemic in China is *S. japonicum*. This parasitizes in the portal vein similar to the case of *S. mansoni*. This kind of the worm *S. japonicum* has been recovered from a mummy.<sup>2)</sup> However, it is hard to find the adult worms in the feces in those days when excellent anthelmintics and the magnifying glass were not available.



(9) Gyochu (the pinworm) : Despite no description on the length (much less than “1 sunn”), this must be *Enterobius vermicularis*. This female worm is readily found on the peri-anal parts of patients.

In conclusion, the three worms (2), (3) and (9) are thought to be real ones, again. It is no exaggeration to say that these are the identified worms.

### The possibility of the description in the text as imaginary worms

The present study was partly shown in the 111<sup>th</sup> General Meeting of the Japan Society of Medical History.<sup>9)</sup> The lecturer (J. Maki), who is here in this communication as one of the present authors, was given an advice from the audience (Dr. Sakai, S) saying that the research should not attach importance just to the real worms. Namely we have to take the possibility of the imaginary worms into consideration.

Again, the basic idea is whether or not the number “nine” is a real figure, meaning the 9 kinds in a scientific classification. We have to remember that an old story (山海經) tells us about the fox with 9 tails (九尾狐) on the imagination. The number “9” seems to be the one with which people in those days would be familiar. In other words, the number “9” did not necessarily mean that counting the numbers correctly resulted in “9”.

Although the 3 out of the 9 parasites are authentic, as above mentioned, probably seen by ancient people expelled from the anus of patients or recognized around the anus of patients, there is the possibility that Fushimushi<sup>(1)</sup> would also be a real one because of its length described. However, it is difficult to identify it now. This should be worthy of identification based on scientific and rational works. However, it is possible that the other worms (5 worms), at least, are probably just the imaginary “products” without being confirmed for their presence in the feces and the host bodies.

It seems that “counting up to nine” was the result via an imaginary force. This possibility should not be excluded at least for the time being because there were possibly imaginary numbers in China in those days. Such a number itself may be ornamental one of no scientific significance and may not reflect the exact number.

### **The present authors’ idea on the 6 unidentified worms**

Most of the 9 worms have been enigmatic apart from the 3 worms, the roundworm (the serial number (2)), the tapeworm(s) (number (3)) and the pinworm (9). Were the parasites, namely the lung worm and the stomach worm recovered from the organs? This question remains to be clarified. We have to search for the old documents possibly related with this.

It is hard to recognize parasites in the feces from infected patients with the naked eye, although a few exceptional examples were mentioned in the historical description on human parasites.<sup>7)</sup> Thinking over the meaning of the number “9” repeatedly, we have to examine as to whether or not this is a good figure. In case that just the 3 or 4 kinds of the worms were recognized based on observation with the other worms named just after imagination, the total number “9” was probably favored by Chinese people in those days. It is sure that the 3 or 4 worms are real parasites whose names have been identified except for the one of the four.

It is possible that the 6 unidentified worms were accompanied with such a kind of mixtures of syndromes and signs that patients felt as if imaginary “parasites” were involved with them despite no symptomatological evidences. The ancient people combined or mixed these 2 groups to believe in the 9 kinds of worms. This number is probably a favored one which ancient people were ready to accept. It is of close resemblance to the number of 9 in the 9 tails of the fox in the old story above mentioned. Even today, we understand “mushi” in such a line of feeling, thought or sense mentioned below.

We hear still nowadays many Japanese words and expressions containing the “-worm” or “-mushi” in Japanese language as a suffix. Their examples are as follows.

Tentori-mushi(点取り虫) : very earnest pupils and students who are always learning just for the purpose of raising their scores as highly as possible in their school examinations

Hara-no-mushi(腹の虫) : the direct translation is worm(s) in the abdomen. When a person gets too angry to control himself(herself), the person’s unhappy situation is expressed with a comparison (metaphor) that “the worms (perhaps moving violently ones) in the abdomen cannot be controlled”.

These are just a few examples. The suffix “～-mushi” can be seen among many Japanese words. We Japanese sometimes feel as if such kinds of worms, or subconscious worms move actively in the body. This is exemplified with the daily-life expressions, for instance “Hara no “mushi” ga osamaranai”(腹の虫がおさまらない). We mean, by this customary expression, that it is impossible to control the “worms” in a person’s belly or that the person cannot prevent the “parasites” in the body from violently moving when he (or she) gets angry. There is an analogous expression. “Mushi no idokoro ga warui”(虫の居所が悪い) means that the person is unsatisfied by chance. These are just a few examples.

In the traditional society of Japan there used to be a special superstition(庚申信仰) in which 3 kinds of parasitic worms called “sanshichu”(三尸虫 (サンシチュウ), the second Chinese character means “shikabane” or the dead body) inhabiting the human body will leave the body during the sleeping hours of the host at a special night to tell the heaven that the person in question is a bad person with the result that he (or she) is destined to the immediate death. To avoid this misfortune, the person has to sit up all the night through. By so doing, the worms cannot leave the body. The person can keep the worms within the body and never loses his (or

her) life very soon. This traditional idea suggests that people believed in the 3 kinds of parasites present in their body.

Our interest is how many kinds of parasites within the body were imagined in total in the age of the text<sup>8)</sup> compiled. They presumably believed in “9” kinds of parasites including the real ones with their length described. This is our hypothesis raised through the present work.

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