

## Epidemiological Studies on *Enterobius vermicularis* in Korea.

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Enterobiasis is one of the commonest helminthic infections found in man, particularly in children. Many surveys have been made to determine the prevalence of infection with *Enterobius vermicularis* at the various areas of the world. In the United States an incidence of 35 to 41 per cent has been reported in the general population.<sup>1)</sup> Stoll (1947)<sup>2)</sup> has calculated the world incidence of this infection to be over 200 millions.

Various local surveys show an incidence in school children, ranging from one per cent in Guam to 100 per cent in Amsterdam during the war years.<sup>3)</sup>

However only a few investigations on the incidence of enterobiasis have been made in this country. According to the previous surveys, Hunter et al. (1949)<sup>4)</sup> reported an incidence of 20.2 per cent in 84 persons, and Chyu (1957)<sup>5)</sup> reported 19.7 per cent in 1,529 school children aged 6 to 15 years by Tulane scotch tape method.

The purpose of the present studies is to determine the incidence of enterobiasis among children and to make a comparison with the rate of infection in different population groups. Brief surveys were also undertaken for the detection of *E. vermicularis* ova in the dirt beneath the finger-nails of children and in the dust collected from the floor of various rooms.

### Materials and Methods

From April to August 1958, a total 2,689 children and adults, from infants to 67 years of age, was examined for *Enterobius* infection in eight different orphanages, two kindergartens, two primary schools and inhabitants who live in Kangwha Island.

The dirt beneath the finger-nails of each of 139 children, know to be infested with *E. vermicularis*, was examined on one occasion. The dust samples collected from the floor of 135 rooms in various places.

A modification of the Graham's scotch tape swab technique was used to establish the diagnosis of enterobiasis. The scotch tape used was 1/2 inch wide and 2 1/2 inches long, this was looped adhesive-side-out on the end of a small wooden tongue blade. The end of the tape was held by the smooth-faced forceps to keep it against the tongue blade. The adhesive surface of the tape was then pressed to the side of the anal orifice. After swabbing the piece of scotch tape was placed adhesive-side-down, in a drop of toluene, on a slide which is then examined under the microscope for eggs of *E. vermicularis*.

The dirt beneath the finger-nails is obtained by cutting the nails with scissors, these dirt and debris of nails are vigorously shaken in centrifuge tube containing 1/10 N. sodium hydroxide solution and applied zinc sulfate floatation technique. For the recovery of the ova from the dust in rooms, 0.5 to one gram of dust samples were treated by the zinc sulfate floatation technique. These floats were examined microscopically.

### Results and Discussion

A total of 2,689 children and adults in all ages of males and females was investigated for *E. vermicularis* by modified Graham's scotch tape swab technique, the results are shown in Table 1. The highest percentage of infection is found in children of orphanages(44.9%), next in the primary school children (33.3%) and lowest in the inhabitants of Kangwha Island in all ages(7.9%).

The percentage of infestation by *E. vermicularis* on the total population examined is 31.7 per cent. The incidences in two sexes are different, 27.5 per cent in males and 38.3 per cent in females. On the whole, the rate in females is higher than that in males. Similar results have been obtained by Chyu (1957).<sup>5)</sup> According to him, they were 21.1 per cent in females and 18.7 per cent in males. However, by

**Table 1.** Incidence of *Enterobius vermicularis* infestation in male and female at various groups.

Name of groups.	Number examined.	Number positive.	Per cent positive.
Orphanages	671	301	44.9%
Male	282	113	40.1%
Female	389	188	48.3%
Kindergartens	196	50	25.5%
Male	102	23	22.6%
Female	94	27	28.7%
Primary schools	1,406	468	33.3%
Male(Urban)	573	118	20.6%
// (Rural)*	449	182	40.5%
Female(//)	384	168	43.8%
Inhabitants in Kangwha Island.	416	33	7.9%
Male	244	18	7.4%
Female	172	15	8.7%
Total	2,689	852	31.7%
Male	1,650	454	27.5%
Female	1,039	398	38.3%

\* Chyu-duk Myon, Chung-chong Buk Do(Province).

Cram and Reardon(1939),<sup>6)</sup> it was *vice versa*; 44 per cent in males and 36 per cent in females.

In the eight different orphanages surveyed by us, the results obtained by two or three times examinations in successive days are 83.8%, 62.8%, 61.9%, 61.7%, 51.7%, 50.0%, 21.4% and 19.0% in each orphanage.

On the basis of a single examination, the incidence in the 196 kindergarten's children is 50 or 25.5 per cent and in the 573 urban primary school boys, 118 or 20.6 per cent. On the other hand the incidences in the rural primary school boys and girls are 40.5 per cent and 43.8 per cent respectively. According to these results, the percentages of *Enterobius* infestation of the rural primary school children are much higher than those of urban children. These result seemingly from the different sanitary conditions in two areas.

Age distribution of *Enterobius* infestation in all

ages of males and females is shown in Table 2. The age group of 4 to 5 years shows highest percentage of 50.7 per cent and the incidences in the age groups of 6 to 13 years are 32.0 to 36.9 per cent. The incidences in the age groups of over 14 years tend to decrease gradually. One out of six infants examined was also found infected. According to Cram et al. (1937)<sup>7)</sup> the percentage in the children of school age is shown higher than that in the preschool age. However it was contrary to our result, because a large number of orphans examined by repeated swabs in the early morning were included in this survey.

An important practical consideration in the diagnosis of enterobiasis is the number of repeated anal swabbing. Of the 315 orphanage's children examined, 127 or 40.3 per cent were determined positive by the first swab series. Of 188 children, negative on

**Table 2.** Age distribution of *Enterobius* infestation in all ages of males and females.

Age groups.	Males		Females		Total		
	No. of exam.	No. of posit.	No. of exam.	No. of posit.	No. of exam.	No. of posit.	Per cent positive.
Infants	3	1	3	0	6	1	16.7%
2—3	9	1	33	11	42	12	28.6%
4—5	69	24	75	49	144	73	50.7%
6—7	192	58	197	82	389	140	36.0%
8—9	326	92	139	57	465	149	32.0%
10—11	590	161	233	110	823	271	32.9%
12—13	241	89	185	68	426	157	36.9%
14—15	67	17	59	17	126	34	27.0%
16—17	24	4	10	0	34	4	11.8%
18—19	17	2	4	1	21	3	14.3%
20—29	31	2	41	1	72	3	4.2%
30—67	81	3	60	2	141	5	3.6%

**Table 3.** Various ova of helminths found in 2,689 anal swab specimens.

Name of helminths	No. of positive	Per cent positive
<i>Enterobius vermicularis</i>	852	31.7%
<i>Ascaris lumbricoides</i>	1,046	38.9%
<i>Trichocephalus trichiurus</i>	376	14.0%
<i>Taenia saginata</i>	23	0.9%
Hookworms	2	—
<i>Hymenolepis nana</i>	2	—

**Table 4.** Ova of *Enterobius* and other helminths in comparison with anal swab technique and fecal examination among the 121 children.

Name of helminths.	Anal swabs		Stool examination.	
	No of posit.	Per cent positive.	No. of posit.	Per cent positive.
<i>E. vermicularis</i>	76	62.8%	2	1.7%
<i>A. lumbricoides</i>	71	58.7%	112	92.6%
<i>T. trichiurus</i>	20	16.5%	91	75.2%
Hookworms	0	—	12	19.9%
<i>T. orientalis</i>	0	—	3	2.5%

the first swab, 40 were found positive on the second swab. Of the 148 children, negative on the first and the second swabs, 21 were added to the positives on the third swab. Thus, 188 or 59.7 per cent of the 315 children examined were found infected after the third swab series. Similar results have been also obtained by Cram et al.<sup>7)</sup> In their survey of 49 individuals by the four-time-swabs of NIH technique, the rate of detection increased from 31 per cent on the first to 59 per cent on the fourth swab.

In order to obtain the best result, specimens are preferably made in the morning before bathing or defecation. Out of the 388 children examined in an orphanage, 165 or 42.5 per cent were found positive in the early morning, immediately after the children have risen. However in the same orphanage, 99 or 28.4 per cent of the 349 children examined were found positive in the examination at the evening of a consecutive day.

The helminths ova, chiefly of *Ascaris lumbricoides*, *Trichocephalus trichiurus* and *Taenia sp.* can be recovered frequently in fecal fragments collected by the scotch tape swabs (Table 3). Of the 2,689 specimens examined, *A. lumbricoides* ova are found in 1,046 specimens(38.9%) and *T. trichiurus* ova are detected in 376(14.0%). The ova of *Taenia sp.* are detected in 0.9 per cent by this technique, however in the adults who live in Kangwha Island, the ova of *Taenia sp.* possibly *T. saginata* are found

in 6.2 per cent of the 211 specimens. This confirms that the scotch tape anal swab technique is also applicable to the recovery of the ova of *Taenia sp.*

Fecal specimens were also examined by zinc sulfate floatation technique. These results were compared with those of this anal swab technique (Table 4). Among 121 children aged 3 to 7 years, examinations by scotch tape swabs showed *Enterobius* in 76 children(62.8%), *Ascaris* in 71(58.7%) and *Trichocephalus* in 20(16.5%), otherwise the results by the fecal examinations in the same children were; *Enterobius* in 2 children(1.7%), *Ascaris* in 112(92.6%) and *Trichocephalus* in 91(75.2%). According to these results, stool examinations are useless for the detection of *Enterobius* ova.

The dirt beneath the finger-nails of each of 139 children, aged 3 to 15 years, known to be infested with *E. vermicularis*, was examined on one occasion. In only nine of these infected children, ova were obtained from the dirt. Ova of *A. lumbricoides* were also found in these dirt in nine instances. Goters(1952)<sup>8)</sup> examined on twelve occasions the dirt beneath the finger-nails of each of 86 children, known to be infested with *E. vermicularis*. Fortyfive of these children were found infected. If the examinations had been made on several occasions in this survey, it seems likely that more instances would have been found.

Examinations were made from a total of 135 dust

**Table 5.** Ova of *Enterobius* and other helminths found in the dust samples.

Places of collection.	No. of collect.	No. of positive (per cent)			
		<i>E. ver.</i>	<i>A. lum.</i>	<i>T. tri.</i>	<i>T. sp.</i>
Orphanages	42	19(45.2%)	16	5	1
Primary schools	16	5(31.3%)	4	2	2
Rural households*	57	7(12.3%)	5	1	—
Public bathhouses	20	4(20.0%)	3	1	—
Total	135	35(25.9%)	28(20.7%)	9(6.7%)	3

\* Chyu-duk Myon, Chung-chong Buk Do (Province).

samples collected from the floor of various rooms. Ova of *Enterobius* were found in 19 or 45.2 per cent of the 42 dust samples from the rooms of orphanages, 5(31.3%) of the 16 samples from the rooms of primary schools, 7(12.3%) of the 57 samples from the rooms of rural households and 4(20.0%) of the 20 samples from each floor of public bathhouses in Seoul (Table 5). Nolan and Reardon(1939)<sup>9)</sup> collected and examined a total 241 dust samples at all levels in all of the rooms of seven houses occupied by one or more persons heavily infected with *E. vermicularis*. Ova were found in 221 or 91.7 per cent of the 241 dust samples examined. In comparison with this, our lower data result from the examination of the random dust samples which collected in one or several rooms of the each place occupied by persons infected or not infected. Ova of *A. lumbricoides* were found in 28 or 20.7 per cent of the 135 dust samples, and ova of *T. trichiurus* and *Taenia sp.* were also found in the dust samples.

These results may indicate the importance of the inhalation of egg-containing dust in the spread of the helminthiases, particularly, enterobiasis.

#### Summary

A total of 2,689 children and adults in the all age group was investigated for *Enterobius vermicularis* by modified Graham's scotch tape anal swab technique. The percentage of infestation examined is 31.7 per cent (females 38.3% and males 27.5%).

The highest incidence was found in the children of orphanages (44.9%), next in the primary school children (33.3%) and lowest in the inhabitants of Kangwha Island in all ages (7.9%). The percentage of the rural primary school children is much higher than that of the urban children. The highest percentage of 50.7 per cent was shown in the age group ranging from 4 to 5 years.

Ova of *Ascaris lumbricoides*, *Trichocephalus tric-*

*hiurus* and *Taenia sp.* also were detected frequently in fecal fragments collected by the scotch tape swabs. This technique seems to be a reliable diagnostic method for the detection of the ova of *Taenia sp.*

The dirt beneath the finger-nails of each of 139 children was examined on one occasion. The ova of *E. vermicularis* were found in nine of these children. Examinations were made in a total of 135 dust samples collected from the floor of the various rooms, ova of *E. vermicularis* were found in 35 or 25.9 per cent.

#### 國文抄錄

#### 韓國에 있어서 蟯蟲(*Enterobius vermicularis*)에 關한 疫學的 調査

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蟯蟲은 人類固有의 寄生蟲으로서 特히 小兒에 많으며 全世界의 으로 널리 分布되어 있다. 우리나라에 있어서는 蟯蟲의 感染率에 對하여 몇 사람의 報告가 있을 뿐 疫學的 調査報告는 아직 없었다.

本 調査에서는 서로 다른 環境에서 生活하는 集團群에 대하여 蟯蟲感染率을 全年齡의 男女에서 調査하여 比較 하였고 또한 蟯蟲의 感染源으로 作用할 수 있는 兒童의 爪垢 및 各處의 室內塵埃內에 있는 蟯蟲卵을 調査하였다.

調査對象으로서 서울市內 8個所의 孤兒院院兒 671名, 2個所의 市內幼稚園園兒 196名, 市內 1個所의 國民學校兒童 573名, 地方國民學校兒童 833名, (忠淸北道 周德面所在) 및 江華島住民 416名 以上 總人員 2,689名의 幼兒로부터 67歲까지의 全年齡에 對하여 1958年 4월부터 8월까지 調査를 實施하였다.

蟯蟲의 感染源에 對한 簡單한 調査로서 蟯蟲에 感染되어 있는 孤兒院院兒 139名의 爪垢를 1回 檢査하였으며 또한 兒童이 居住하고 있는 室內, 國民學校教室, 各家庭의 內室 및 市內沐浴場의 脫衣場에서 135個의 塵埃를 採取 檢査하였다.

蟯蟲感染率 檢査方法으로서는 Graham氏 變法을 使用

하였으며 可能的限 早朝에 檢査하였으며 1~3回 反復檢査를 實施하였다. 爪垢 및 室內塵埃에서 蟯虫卵을 檢出하기 위하여 硫酸亞鉛遠沈 浮遊法을 適用하여 얻은 成績을 要約하던 다음과 같다.

總被檢者 2,689名에서 蟯虫感染率이 31.7%이며 그中 女子가 38.3%이고 男子에 있어서 27.5%이어서 女子에 있어서 男子 보다 若干 높은 感染率을 보였다. 集團別 蟯虫感染狀況을 보면 孤兒院院兒의 44.9%가 最高이고 다음이 國民學校兒童의 33.3%이었고 江華島住民에 있어서 7.9%로 最下의 感染率을 나타내었다. 國民學校兒童中 地方兒童이 市內兒童에 비해 그 感染率이 훨씬 더 높았다. 年齡別感染率을 보면 4~5歲에 있어서 50.7%로 最高의 感染率을 보였고 6~13歲에 있어서 32.0~36.9%이었고, 14歲以上에 있어서 그 年齡에 따라 漸次 減少하여 成人에 있어서는 極히 低率이었다.

蟯虫卵 以外에 蛔虫卵, 鞭虫卵 및 條虫卵도 本法인 scotch tape swab 에서 얻은 標本에서 發見되었으며 特히 無鈎條虫卵 發見에 診斷的 價値가 있다고 본다.

孤兒院院兒 139名의 爪垢에서 9例에 있어서 蟯虫卵이 發見되었고 135個所의 塵埃 檢査에서 35個所(25.9%)에서 蟯虫卵을 發見하였다. 이와같은 檢査成績은 兒童에 있어서 蟯虫卵에 汚染된 爪垢 및 室內塵埃가 感染源으로서 그 疫學的 意義가 크다는 것을 能히 推定할 수 있다.

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