Effects of school-based deworming on hemoglobin level, growth development and school performance of primary school children in North Sumatera

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Abstract. Worm infestation is mainly caused by soil-transmitted helminths (STH) infecting one-third of the world’s population, where the most affected are primary school children. This chronic, long-lasting infection can affect the growth aspects in children. A school-based deworming is one of the treatments recommended by WHO to counteract worm infection in primary school children. To evaluate the effect of school-based deworming on the hemoglobin level, growth and school performance of primary school children, an open randomized clinical trial was conducted on 165 targeted populations in SukaKaro village, North Sumatra; 156 of which were then chosen based on inclusion and exclusion criteria. The samples’ feces-sampling, hemoglobin level, and growth chart data were recorded on the first day of study before any treatment was given. They were then divided into two groups; the first group of 80 samples did not receive any treatment, while the second group of 76 samples received 400mg of albendazole as part of a school-based deworming program. The samples were being followed up after sixth months of study. In conclusion, albendazole is able to improve the hemoglobin level, growth development, and school performance of the samples, although there were no significant differences between the two groups.

1. Introduction
Worm infestation is mainly caused by soil-transmitted helminths (STH) such as Ascaris, hookworms, and Trichuris, infecting one-third of the world’s population, where the most affected are primary school children and the poor.[1,2] Since this chronic, long-lasting infection is rarely fatal, over the years, worm infections are considered as “less important.”[3] In fact, the worm is the most common pathogen found in developing country such as Indonesia and may cause a global health problem exceeding malaria and tuberculosis. In North Sumatra alone, the incidence of worm infection in primary school children reaches 50%. The highest prevalence rate of worm infection can be found in places with poor hygiene, unavailability of clean water and inadequate sanitation facilities.[4-6]

Worm infections rarely cause death, but it may greatly affect the growth aspects of children: health, nutrition, development of school performance and learning processes.[3,5,6] The World Health Organization (WHO) predicts that STH can infect nearly 2 million people and cause 12,000 deaths
annually.

In 2005, the result of this infection had been termed Disability-Adjusted Life Years (DALYs).

Currently, there are only a few tools available to control this infection, with the discovery of antihelminthic (Albendazole and Mebendazole) since 1975. Mass drug administration (MDA) is a great approach to control worm infection in developing countries. WHO recommends periodic antihelminthic treatment (deworming) without the needs of individual examination of all children living in endemic areas. Individual screening is not recommended as the required cost can be 4 to 10 times greater than the treatment itself.

Treatment is recommended once a year if the prevalence of this infection is more than 20% and twice a year if it exceeds 50%. Most of the deworming programs are aimed at school-aged children as they have the highest risk of exposure to worms. The school-based deworming program is now widely known as one of the important strategies to control worm infection and improve the children’s learning abilities. This program is considered to have benefits in improving growth, school performance and also preventing anemia.

The aim of this study is to evaluate the effects of school-based deworming in improving the hemoglobin level, growth and school performance in primary school children. The result can be implemented as a guide to lower the incidence rate of worm infection and to improve the quality of life in primary school children.

2. Methods
In this study, an open randomized clinical trial was conducted to compare the effects of school-based deworming by giving a single dose of 400mg albendazole to a group, and without any treatment to the other. The samples were primary school children living in SukaKaro village, North Sumatra, who meet the inclusion and exclusion criteria. The primary data were collected from interview and questionnaire. Samples’ feces-sampling, hemoglobin level, and growth curve were recorded before any treatment was given. They were after sixth months of study. Data analysis was performed using STATA software version 10.1 with a significance level of p<0.05.

3. Results
During the study period, 165 primary school children in SukaKaro village were screened. As many as 156 children were then chosen based on inclusion and exclusion criteria, 104 of which were proven to be infected by soil-transmitted helminths. The samples were divided into two groups. The first group (n=80) did not receive any treatment, while the second group (n=76) received 400mg of albendazole as part of a school-based deworming program. Most of the samples were above 8 years old (group I=76.25% and group II=72.63%) with a good nutritional status (group I=81.25% and group II=67.11%) and infected by a single type of worm (group I=71.15% and group II=67.31%).

![Table 1. Characteristics of samples in two groups.](image-url)

| Characteristics | Group I (n=80) | Group II (n=76) |
|-----------------|---------------|-----------------|
| Age (n, %)      |               |                 |
| < 8 years       | 19 (28.75)    | 17 (22.37)      |
| >8 years        | 61 (76.25)    | 59 (72.63)      |
| Gender (n, %)   |               |                 |
| Female          | 40 (50%)      | 35 (46.05)      |
| Male            | 40 (50%)      | 41 (53.93)      |
| Weight, kg (mean, SD) | 24.67 ± 5.80 | 25.94 ± 6.10 |
| Height, cm (mean, SD) | 123.59 (9.43) | 124.23 (9.92) |
| Nutritional status |               |                 |
After performing a chi-square test, it was found that the mean hemoglobin level on the first day of the examination was significantly different between two groups (p=0.05). However, reexamination on the first (p=0.58) and sixth (p=0.62) month of the study showed that there were no significant differences between the two groups, although the group which received albendazole had a slightly higher hemoglobin level.

### Table 2. Difference of hemoglobin level between two groups on the first day of examination, followed by reexamination on the first and sixth month of study.

| Follow up       | Group I (mean gr/dL, SD) | Group II (mean gr/dL, SD) | p     |
|-----------------|--------------------------|---------------------------|-------|
| Day 0 (n=156)   | 13.3 (0.14)              | 12.72 (0.16)              | 0.05  |
| 1\textsuperscript{st} month (n=128) | 12.8 (0.14)              | 12.9 (0.2)               | 0.58  |
| 6\textsuperscript{th} month (n=78) | 14.7 (1.92)              | 16.6 (3.8)               | 0.62  |

There were no significant differences in height by age between the two groups in the examination conducted on the first day and sixth month of study.

### Table 3. The difference in height by age between two groups on the first day and sixth months of study.

| Follow up       | Group I (mean %, SD)  | Group II (mean %, SD)  | p |
|-----------------|------------------------|------------------------|---|
| Day 0 (n=156)   | 91.48 (3.89)           | 92.14 (4.4)            | 0.32  |
| 6\textsuperscript{th} month (n=135) | 92.16 (4.67)          | 92.9 (4.27)            | 0.28  |

After 6 months of study, the children’s school achievements were being evaluated. It was shown that there was an improvement in the group which received albendazole as a treatment. The samples who scored <70 had decreased more than those who did not receive any treatment, although there were no significant differences between the two groups statistically (p=0.44 and p=0.54).

### Table 4. Difference in school achievement between two groups on the first day and sixth month of study.

| Follow up       | Group I (n, %)  | Group II (n, %)  | p |
|-----------------|----------------|----------------|---|
| Mathematics     |                |                |   |
| Day 0 (n=156)   |                |                |   |
| >70             | 69 (86.25)     | 58 (76.32)     | 0.25  |
| <70             | 11 (13.75)     | 18 (23.68)     |       |
| 6\textsuperscript{th} month (n=133) | 57 (81.43)     | 54 (85.71)     | 0.44  |
| <70             | 13 (18.57)     | 9 (14.29)      |       |

**Bahasa**
Based on the type of infection, *Ascaris lumbricoides* was the most common parasite found at the beginning of the study, and there was 1 sample which was still infected during the first month of follow up. Unfortunately, there was an increasing number of re-infection during the sixth month of follow up. For *Trichuris trichiura* infection, there was an increase in number from the first day of study to the first and sixth month of follow up.

**Table 5.** Total of soil-transmitted helminth infections by the type of worm during the study.

| Type of worm          | Day 0 (n) | 1st month (n) | 6th month (n) |
|-----------------------|-----------|---------------|---------------|
| *Ascaris lumbricoides* | 84        | 1             | 28            |
| *Trichuris trichiura* | 50        | 52            | 60            |
| Hookworm              | 2         | 0             | 0             |

In the study, there were 71 children (45.81%) who had stunted growth in both groups; 42 (52.51%) of which were from the group I and the other 29 (38.16%) were from group II. After 6 months of study, there was a decreasing number of stunted children in both groups (p=0.02), where group II had a significantly greater decrease in the number of stunted growth.

**Table 6.** The difference in growth development between two groups during the study.

| Follow up     | Group I (n, %) | Group II (n, %) | p   |
|---------------|----------------|-----------------|-----|
| Day 0 (n=156) |                |                 |     |
| Stunting +    | 42 (52.51)     | 29 (38.16)      | 0.07|
| Stunting -    | 38 (47.50)     | 47 (61.84)      |     |
| 6th month (n=135) |            |                 |     |
| Stunting +    | 28 (39.4)      | 14 (21.80)      | 0.02|
| Stunting -    | 43 (60.6)      | 50 (78.13)      |     |

4. **Discussion**
Worm infestation is mainly caused by soil-transmitted helminths (STH), infecting one-third of the world’s population, where the most affected are primary school children.[1,2] The infection rarely causes death, but it may greatly affect the growth aspects in children, such as health, nutrition, development of school performance and learning processes.[3,5,6]

In this study, the mean hemoglobin level on the first day of the examination was significantly different between two groups (p=0.05). However, reexamination on the first (p=0.58) and sixth (p=0.62) month of the study showed that there were no significant differences between the two groups, although the group which received albendazole had a slightly higher hemoglobin level.

There were 71 children (45.81%) who had stunted growth in both groups; 42 (52.51%) of which were from the group I and the other 29 (38.16%) were from group II. After 6 months of study, there was a decreasing number of stunted children in both groups (p=0.02). Group II which received albendazole as part of the school-based deworming program had a significantly greater decrease in the number of stunted growth.

After 6 months of study, the children’s school achievements were being evaluated. It was shown that there was an improvement in the group which received albendazole as a treatment. The samples who scored <70 had decreased more than those who did not receive any treatment, although there were no significant differences between the two groups statistically (p=0.44 and p=0.54).
Based on the type of infection, _Ascaris lumbricoides_ was the most common parasite found at the beginning of the study, and there was 1 sample which was still infected during the first month of follow up. Unfortunately, there was an increasing number of re-infection during the sixth month of follow up. This might be caused by a poor way of hand-washing and unsuitable toilet used in daily routines. For _Trichuris trichiura_ infection, there was an increase in number from the first day of study to the first and sixth month of follow up. In addition to personal hygiene, surrounding and daily routines, a single dose of albendazole not enough to counterattack _Trichuris trichiura_ since two-thirds of the worm’s body was indented in the intestinal lumen. Therefore, it requires more than a single dose to eradicate the parasite.

5. Conclusion

Albendazole is able to improve the hemoglobin level, growth development and school performance of the primary school children in Suka Karo village, North Sumatra; although there were no significant differences between the two groups.

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