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# Determination of Geohelminthiasis and Its Association with Allergic Sensitization among Selected Children in Batangas, Philippines

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**Abstract**

Several studies have explored the cross-reactivity between geohelminthiasis and allergy which share the same immune response in humans by triggering the increase in serum IgE level. Yet, the role of soil-transmitted intestinal parasitism as a protective or contributing factor for allergy remains inconclusive. In this study, the association of geohelminthiasis with allergic sensitization was investigated in a cohort of 50 children aged 5 to 12 years old residing in the areas of Batangas, Philippines where parasitism is prevalent. Stool samples of the subjects were qualitatively examined for the presence of helminth infection through modified Kato-Katz technique. They were also assessed for allergic diseases using the modified International Study of Asthma and Allergies in Childhood Phase I questionnaire. Fecalysis results were correlated with their serum total IgE (tIgE) levels and screening test results for allergic sensitization to common aeroallergens and food allergens determined through ImmunoCAP® system. Of the participants, 78% were under 10 years old while 22% were aged 10 years old and above. Mixed infection of *Ascaris lumbricoides* and *Trichuris trichiura* were found to be the most common (40%) followed by trichuriasis (34%) and ascariasis (26%). Atopic allergy to inhalants is prevalent in children under 10 years old (74.36%) whereas, some of them (5.13%) are fX2 positive which confirms the participants' allergy to seafood. It was revealed that the occurrence of geohelminthic infection and allergy may affect any child regardless of age and serum total IgE level does not considerably vary with age, geohelminthiasis and presence of allergy. Hence, geohelminthiasis does not play contributory nor inhibitory role in allergic sensitization as established by a 0.05 level of significance ($p \leq 0.05$).

**Keywords:** allergens, allergy, children, geohelminthiasis, IgE

## 1. Introduction

Most common infections afflicting developing countries are the neglected tropical diseases (NTDs) which are described as diseases of poverty. These diseases occur mostly in rural areas and in some poor urban settings of low-income countries such as in Asia. They are generally of parasitic etiology, including those brought about by soil-transmitted helminths (STHs) causing helminthiasis (Fenwick et al., 2007). According to Albonico et al. (2006), these STHs, also known as intestinal helminths or geohelminth parasites, include roundworms (*Ascaris lumbricoides)*, whipworms *(Trichuris trichiura)*, and hookworms *(Ancylostoma duodenale* or *Necator americanus)*. They have a worldwide distribution, estimated to infect a quarter of the world's population and are most prevalent among children living in areas of the rural tropics with poor access to sanitation and clean water (Cooper, 2009). Typically, humans become infected by oral contamination with embryonated eggs in cases of roundworms and whipworms and through skin penetration of the hookworms' third-stage larvae (Bradley & Jackson, 2004). Immunity to geohelminthiasis is mediated by the elevated levels of IgE together with tissue eosinophilia and other specific mechanisms (Fallon & Mangan, 2007). Kurpad, Macaden, Nagaraj, and Raghavan (2004) found out that parasitic infections could cause a 10 to 100 fold elevation in total serum IgE. These infections not only stimulate the production of specific anti-parasite IgE but also, non-specifically induce polycolonal IgE synthesis (Jalalian et al., 2004).

Aside from parasitism, increased IgE levels are also seen in patients with atopic diseases (Metcalfe, Prussin, & Stone, 2010). Rogina, Smith, and Tran (2010) revealed that IgE antibodies are secreted by plasma cells in skin and tissues lining the gastrointestinal and respiratory tract and when bound to antigens, these antibodies bind to mast cells and basophils to trigger release of histamine. Barreto, Cooper, and Rodrigues (2006) explained that this phenomenon may lead to allergy which encompasses inflammatory diseases that include asthma, eczema and rhinitis associating with allergic sensitization to environmental allergens. Their research regarded allergic diseases as important causes of morbidity which commonly leads to chronic diseases in childhood.

Research findings for the past few decades indicated either a protective or inhibitory relationship between helminth infections and allergic diseases though they are discretely considered medical conditions (Cauyan, Ramos, & Valmonte, 2012). Although helminth infections can modulate the host inflammatory response directed against the parasite, a causal association between helminths and atopic diseases remains uncertain (Cooper, 2009). Until now, there is a large and growing literature of the interaction between parasite infections and allergy derived from observations in humans and experimental animal models (Fallon & Mangan, 2007). Yet, the nature of the relationship and the mechanisms that lie behind it are still unclear and controversial (Cauyan et al., 2012).

This study determined whether geohelminthiasis can cause or prevent allergic sensitization by correlating positive helminth infection results of the children with serum total IgE levels and screening test results for allergic sensitization to common aeroallergens and food allergens. Outcomes of the research will significantly serve as a theoretical basis regarding the relationship between geohelminthiasis and allergy in Batangas to reduce the incidence of various diseases within the province.

## 2. Method

### *2.1 Study Area and the Study Population*

The study was carried out in each of the four districts in Batangas and includes two municipalities with the highest morbidity rate of parasitism. The statistical data from Batangas Provincial Health Office in 2013 recorded a total of 540 cases of intestinal parasitism mostly infecting children up to 14 years old in the whole province. In District I, Balayan and Lemery had the most infected population while in District II are San Pascual and Mabini. The places, Agoncillo and San Nicolas, garnered the top two spots with the highest cases in District III whereas; Ibaan and San Juan were reported to have the greatest prevalence of parasitism in District IV.

In brief, 68 children aged 5 to 12 who were not yet initially dewormed and suspected to have geohelminthiasis were initially recruited to the study by stratified proportional allocation (Amarasekera, de Silva, Douglass, Gunawardena, O'Hehir, & Weerasinghe, 2012) in the four districts of Batangas.

### *2.2 Study Instruments and Laboratory Methods*

#### 2.2.1 Parasitologic Assessment

Fecal samples were primarily collected from the children suspected of geohelminthiasis. Properly labeled stool containers and instructions on proper stool collection were provided. Each respondent was asked to provide a single stool sample to be submitted immediately to their respective health worker or barangay official for cold preservation (2-8 °C) in an ice chest. They were transported and qualitatively examined through modified Kato-Katz method within 24 hours in designated clinical laboratories (Belizario, Claveria, & Ng, 2014; WHO, 1998). The materials used were improvised in accordance with the protocols provided by Dr. Vicente R. Belizario Jr. of the National Institutes of Health and College of Public Health in University of the Philippines-Manila (Belizario et al., 2014).

#### 2.2.2. Blood Collection

From the 68 children who were initially selected, a total of 50 children, aged 5 to 12, were included in the study. This is regardless of their gender, socio-economic status, lifestyle, nutritional status and genetic predisposition. They were tested positive for geohelminthiasis without any history of being dewormed. Prior to this, ethical approval for the use of human participants was appealed from the Institutional Review Board of the College of Allied Medical Professions of Lyceum of the Philippines University-Batangas. Procedures, benefits, and risks were disclosed to the parents/guardians of the participants to obtain informed consent. They were also notified of their optional participation from the study.

Data regarding the children's demographic profile and allergic diseases were collected from the parent/guardian by employing the International Study of Asthma and Allergies in Childhood Phase I questionnaire as patterned from previous studies of Dubois, Kerkhof, Monchy, Postma, and Schouten (2003), Cauyan et al. (2012), Alcântara-Neves, Badaró, Barreto, dos Santos, and Pontes-de-Carvalho (2010) and Amarasekera et al. (2012). It was slightly modified with the addition of core questionnaire for food allergy, translated to Filipino and subjected to face validation from their advisers and a panel of experts such as pediatrician, immunologist, linguist and psychologist.

Venous blood (5 mL) samples in plain red top tubes were obtained through venipuncture with the assistance of the registered medical technologists (Amarasekera et al., 2012). They were labelled with the name of the participants and transported in an ice chest at 2-4 °C in line with the standards set by the laboratory department of St. Patrick's Hospital Medical Center (SPHMC) in Batangas City. Blood samples were centrifuged and the serum was separated on the same day and stored at 2-4 °C until assayed for total IgE and screened for allergens.

2.2.3 Serum Total IgE Testing

The ImmunoCAP® system, an enzyme immunoassay (Phadia, Sweden) was used to measure the quantitative amount of total IgE (tIgE) in serum of the 50 participants.

2.2.4 Allergy Screening

The children were also screened with the seven most common aeroallergens, namely, housedust mites, cat epithelium, cockroach, pigweed, Bermuda grass, acacia and mixed molds through Phadiatop (Amarasekera et al., 2012) and with FX5E and fX2 for the presence of antibodies in their serum against common food allergens notably, eggwhite, milk, wheat, peanut, soybean, and seafoods such as fish, shrimp, blue mussel, tuna and salmon as evaluated in their questionnaires (Lee, Lee, & Thalayasingam, 2013).

*2.3 Statistical Analysis*

Data derived from the questionnaires and laboratory results were analysed through descriptive and inferential measures using Statistical Package for the Social Sciences (SPSS) version 18 program. Interaction of age, geohelminth infections, allergic sensitization and total IgE were investigated using Pearson Chi-Square test to correlate the variables.

## 3. Results and Discussion

The baseline data used in the study such as age and presence of geohelminthic infections are presented in Table 1. All (100%) of the chosen participants were 5 to 12 years old and majority of them were below 10 years (78%) while the rest were 10 years old and above (22%). This denotes a decreased prevalence rate with increasing age group which is possibly due to change in attitude, habits and more awareness regarding personal hygiene among the older schoolchildren (Adedokun et al., 2011). Similar findings were shown by Baldo, Belizario, Chung, De Leon, and Kong (2004) and Belizario et al. (2014) indicating a greater predisposition of children who are under 10 years old to be infected by intestinal parasites thereby putting them at greater risk of morbidity.

Table 1. Percentage distribution of the respondents by age and geohelminthic infection (n=50)

| **Age Group (years)** | **Geohelminth Detected** | | | **No. Examined n (%)** |
|---|---|---|---|---|
| | *A. l.* | *T. t.* | M. I. | |
| <10 | 10 | 14 | 15 | 39(78) |
| ≥10 | 3 | 3 | 5 | 11(22) |
| **No. Infected n (%)** | 13(26) | 17(34) | 20(40) | 50(100) |

*Note.* Legend: A. l.=Ascaris lumbricoides; T. t.=Trichuris trichiura; M. I.=mixed infection of Ascaris lumbricoides & Trichuris trichiura.

(A) (B) (C)

Figure 1. Photomicrographs of (A) *Ascaris lumbricoides* eggs, (B) *Trichuris trichiura* egg and (C) *Ascaris lumbricoides* and *Trichuris trichiura* mixed infection from some selected geohelminth-positive patients' stool samples

In addition, based on Table 1, mixed infection of *Ascaris lumbricoides* and *Trichuris trichiura* was the most common (40%) followed by trichuriasis (34%) and ascariasis (26%) which is comparable with the recent findings of Belizario et al. (2014) and the past study of Baldo et al. (2004). The predominant cases of co-infection with *Ascaris lumbricoides* and *Trichuris trichiura* can be explained by their similar fecal-oral route transmission pattern (Belizario et al., 2014). On the other hand, the greater prevalence of *Trichuris trichiura* infection may be due to the occurrence of superinfection, a phenomenon where the host harbouring the parasite is reinfected with the same parasite species. Contrariwise, there were no hookworms infections identified which may be due to the intrinsic characteristic of hookworm eggs to disintegrate after smear preparation (Belizario et al., 2014).

To assess what specific allergy test to perform, allergy history of the respondents were determined, as enumerated in Table 2, respective to age group. It was found out that most of the children who were infected with geohelminths did not have history of asthma (72%), rhinitis (84%), eczema (92%) and food allergy (90%). In spite of this, it was reported that those children under 10 years old were the ones who commonly experienced symptoms attributed to asthma (26%), rhinitis (16%), and eczema (6%), and food allergy (8%) while they are atypical (6%) to those 10 years old and above.

Table 2. Percentage distribution of the respondents' allergy history by age group

| Allergy History | | | Age Group n (%) | |
|---|---|---|---|---|
| | | | <10 years old | ≥10 years old |
| Asthma | Yes | | 13(26) | 1(2) |
| | No | | 26(52) | 10(20) |
| Rhinitis | Yes | | 8(16) | 0 |
| | No | | 31(62) | 11(22) |
| Eczema | Yes | | 3(6) | 1(2) |
| | *No* | | 36(72) | 10(20) |
| Food Allergy | Yes | Seafood (unspecified) | 1(2) | 0 |
| | | shrimp | 1(2) | 0 |
| | | fish | 1(2) | 1(2) |
| | | hen's egg | 1(2) | 0 |
| | No | | 35(70) | 10(20) |

This point out that infected children may or may not exhibit allergy at all and those who are below 10 years old are possibly more susceptible to allergic sensitization compared with the other age group. It was investigated that allergic diseases are caused by complex interaction between host genetics and environmental factors which may give a good reason for the observation. Important environmental exposures that have been associated with the risk of allergy include high-level exposure to allergens, exposure to pets and farm animals, socio-economic level, nutritional status and lifestyle factors such as diet (Barreto et al., 2006). Furthermore, timing and intensity of infection may influence the effect of helminths on allergy. Children who are early, chronically and heavily infected by geohelminths have induced immunomodulatory effects that suppress allergy (Cooper, 2009).

Different allergy screening tests were performed, as shown in Table 3, to verify the allergic sensitization of the children as stated in their questionnaires. Atopic allergy to inhalants was found to be the most common in geohelminth-infected children aged below (74.36%) and above 10 years old (45.54%) as depicted by positive Phadiatop test, whereas, some of them (14.22%) are fX2-positive which confirms the participants' allergy to seafood. It clearly indicates that many of the children with geohelminthiasis were more prone to be allergic to inhalants than seafood. According to Barreto et al. (2006), Fallon and Mangan (2007) and Lee et al. (2013), this may suggest that intestinal parasitic infection may play a role in the development of atopy notably, respiratory allergies (Acevedo & Caraballo, 2011; Alcântara-Neves et al., 2010; Cauyan et al., 2012; Beyers et al., 2006).

On the other hand, the rest of the children (85.31%) were negative in their particular screening test which indicates that the infected children may not as well demonstrate atopy to inhalants and certain food. This could be accounted for the protective ability of helminth antigens against allergy (Amarasekera et al., 2012) especially during chronic infections (Cooper, 2009; Fallon & Mangan, 2007) or misdiagnosis particularly for those negative (25.64%) in Phadiatop test since allergic rhinitis and asthma may be confused with respiratory viral infections

(Cooper, 2004). However, the context is different in children aged 10 years old and above since there are more negative Phadiatop results (54.55%) than positive ones (45.45%). It was explained by Barreto et al., (2006) that this inconsistency may be brought about by geohelminths enhancing allergic reactivity in populations with low prevalence of infection and suppressing allergy in populations where infections are highly prevalent.

Table 3. Summary statistics on allergy screening test results by age and geohelminthic infection

| Allergy Screening Test | | Age Group n (%) | | Geohelminthic Infection n (%) | | |
|---|---|---|---|---|---|---|
| | | <10 years old (n=39) | ≥10 years old (n=11) | *A. lumbricoides* (n=13) | *T. trichiura* (n=17) | Mixed Infection *(A. lumbricoides & T. trichiura)* (n=20) |
| Phadiatop | Positive | 29(74.36) | 5(45.45) | 9(69.23) | 12(70.59) | 13(65) |
| | Negative | 10(25.64) | 6(54.55) | 4(30.77) | 5(29.41) | 7(35) |
| FX5E | Positive | 0 | 0 | 0 | 0 | 0 |
| | Negative | 1(2.56) | 0 | 1(7.69) | 0 | 0 |
| fX2 | Positive | 2(5.13) | 1(9.09) | 1(7.69) | 2 (11.76) | 0 |
| | Negative | 1(2.56) | 0 | 0 | 0 | 1(5) |

Allergy screening test results with respect to geohelminthic infection are also presented in Table 3. Based on the data, *Trichuris trichiura* infection demonstrates the most number of positive results (70.59%) with Phadiatop test, compared with *Ascaris lumbricoides* (69.23%) and mixed infection of the two geohelminths (65%). Others with trichuriasis (11.76%) and ascariasis (7.69%) were also sensitized to seafood as confirmed with fX2 test. This implies that children with trichuriasis are more likely to exhibit allergic reaction with aeroallergens than with other geohelminthic infection which may support the earlier hypotheses in Cooper (2004) and the study of Alcântara-Neves et al. (2010) proposing that certain atopies brought about by inhalants may be attributed to *Trichuris trichiura* infection.

Yet, in spite of these positive findings, few of *Ascaris* and *Trichuris* infected children were tested negative with Phadiatop (30.77% and 29.41%, respectively) and FX5E as well, in case of trichuriasis (7.69%). Similar results with Phadiatop (35%) and fX2 tests (5%) were also demonstrated by those with mixed infection. These imply an ambiguity on the possible role of geohelminths in allergic sensitization. Nonetheless, previous research groups have provided evidence for a protective effect of helminth infection against allergic disease (Everts, Hartgers, Smits, & Yazdanbakhsh, 2010; Burney & Calvert, 2010; Amarasekera et al., 2012). It was suggested that heavy infection with soil-transmitted parasites may be the reason for this effect (Amarasekera et al., 2012).

Table 4 reveals the association between age and geohelminthiasis and with allergy screening test results particularly, Phadiatop and fX2. The obtained p-values of 0.860, 0.312 and 0.513, respectively, are greater than 0.05 level of significance; thus, there is no significant relationship among the three variables. It proves that regardless of age, the two clinical conditions may affect any child.

Table 4. Relationship between age and geohelminthiasis and with allergy screening test results

| Variable | | p-value | Interpretation |
|---|---|---|---|
| Geohelminthic infection | | 0.860 | Not Significant |
| Allergy Screening Test Results | Phadiatop | 0.312 | Not Significant |
| | fX2 | 0.513 | Not Significant |

*Note.* Legend: Significant at p-value <0.05; FX5E result is constant.

This supports the idea that intestinal parasitism and allergic sensitization tend to be prevalent in school-aged children (Bethony et al., 2008; Lee et al., 2013; Cooper, 2004; Hansell, Helms, Hollowell, Osman, & Simpson, 2006; Ariawan et al., 2011) which could be attributed to their lower immune response compared to adults, poor hygiene, poor sanitary and environmental conditions (Ayo, Imade, & Osazuwa, 2011; Bradley et al., 2006), lifestyle (Ariawan et al., 2011) and frequent outdoor exposures (Belizario et al., 2014).

The measured mean serum total IgE levels of the geohelminth-infected children which were used to gauge their immune response is reported in Table 5 in accordance with age. Apparently, a remarkable increase in serum total IgE level was exhibited by the children as compared with the respective normal levels. This attests the concept that serum IgE levels typically increases in response to parasitic infestation. Similarly, Agbonlahor et al., (2013) stated that parasitism can cause a 10 to 100 fold elevation in total serum IgE which comprises specific anti-parasite and non-specific polyclonal IgE.

Table 5. Summary statistics on serum total IgE test results by age group

| **Age Group (years)** | **No. Examined n (%)** | **IgE Level (KU/L)** | |
|---|---|---|---|
| | | Mean Value | Normal Value |
| <10 | 39(78) | 1820±264 | 0-25 |
| ≥10 | 11(22) | 956±263 | 0-100 |

Previous studies have explained that the phenomenon is brought about by helminths' ability to strongly induce IgE production (Bradley et al., 2006; Ayre et al., 2008) which seems to be a result of polyclonal B-cell stimulation by parasite products (Acevedo & Caraballo, 2011). This may serve as an adaptive defense mechanism by the immune system to get rid of the intestinal parasites through releasing mediator which stimulates eosinophil differentiation and cytotoxity thereby conferring protective immunity against geohelminths (Ayre et al., 2008; Agbonlahor et al., 2013).

On Table 6, the measured mean serum total IgE levels of the children in accordance with geohelminthic infection and Phadiatop test result are presented. Children with ascariasis and Phadiatop-positive had higher serum total IgE levels (1876.3±495.87KU/L) than those who were Phadiatop-negative (1805.5±744.5KU/L). The same was also true with *T. trichiura* infection (1961.2±672.82KU/L and 1227.6±469.27KU/L, respectively) and those with mixed infection (1964.3±517.83KU/L and 575.89±179.21KU/L).

Table 6. Summary statistics on serum total IgE test results by geohelminthic infection and phadiatop test result

| **Geohelminthic Infection** | **IgE Level (KU/L)*** | |
|---|---|---|
| | **Phadiatop (+)** | **Phadiatop (-)** |
| *Ascaris lumbricoides* | 1876.3±495.87 | 1805.5±744.5 |
| *Trichuris trichiura* | 1961.2±672.82 | 1227.6±469.27 |
| Mixed Infection *(Ascaris lumbricoides & Trichuris trichiura)* | 1964.3±517.83 | 575.89±179.21 |

*Note.* Legend: *expressed in mean±SEM; Serum Total IgE Normal Value: 0-100 KU/L.

It clearly shows very high serum total IgE levels compared with the normal value. It could also be observed that those who were tested positive with Phadiatop had higher serum total IgE levels in contrast with those negative. According to Barreto et al. (2006), these findings indicate an additional burden of infection since clinical conditions, geohelminthiasis and allergy, are associated with significant levels of IgE. It may also be deduced that those with trichuriasis may indeed, possibly mediate allergy especially with aeroallergens as exhibited by its highest total IgE level among the three types of parasitic infections. This is parallel with the sutdy of Cooper (2004) and Alcântara-Neves et al. (2010) which proposed the idea that *Trichuris trichiura* infection may mediate allergy with inhalants.

Table 7 presents the relationship between serum total IgE level and age, geohelminthiasis and with Phadiatop results. It was found out that the corresponding obtained p-values of 0.510, 0.444 and 0.143 are greater than 0.05 level of significance which indicates an insignificant association among the three variables. This shows that serum total IgE level does not considerably vary with age, geohelminthiasis and presence of allergy specifically to inhalants.

Table 7. Relationship between serum total IgE level and age, geohelminthiasis and with phadiatop results

| Variable | p-value | Interpretation |
|---|---|---|
| Age | 0.510 | Not Significant |
| Geohelminthiasis | 0.444 | Not Significant |
| Phadiatop Results | 0.143 | Not Significant |

*Note.* Legend: Significant at p-value <0.05; FX5E and fX2 results are constant.

The data corroborate with prior investigations showing considerable increased serum IgE levels with children irrespective of age (Arbes et al., 2011) and type of allergy (Erwin et al., 2010; Levin, Le Souëf, & Motala, 2008). In contrast, Agbonlahor et al. (2013) postulated a link between parasitic infestation type and high serum total IgE levels in his study in Nigeria. It was demonstrated that the serum IgE level of intestinal parasite infested children increased with the infestation type from single to multiple infestation as compared with the control subjects.

The relationship between Phadiatop results and geohelminthiases, trichiuriasis and mixed infection, is confirmed in Table 8. The obtained p- values of 0.506 and 0.657, respectively are greater than 0.05 level of significance; thus, there is no significant relationship among the three variables. This proves that geohelminthiasis does not have any effect with allergic sensitization whatever the infection may be.

Table 8. Relationship between phadiatop and geohelminthiasis

| Variable | p-value | Interpretation |
|---|---|---|
| *T. trichiura* | 0.506 | Not Significant |
| Mixed Infection *(A. lumbricoides* & *T. trichiura)* | 0.657 | Not Significant |

*Note.* Legend: Significant at p-value<0.05; Results of those with A. lumbricoides are constant.

The findings are contradictory as those established by the study of Cooper (2009) concluding that helminth infections had been associatedwith both reduced and increased prevalence of atopy in different populations. On the other hand, there were indications that these infections can only either enhance or suppress the allergic immune response (Acevedo & Caraballo, 2011). Earlier studies have suggested that parasitic infection might cause wheeze by stimulating production of specific IgE against nonparasitic allergens (Burney & Calvert, 2010). The cross-reactivity between parasites and aeroallergens has also been expounded by Acevedo & Caraballo (2011), owing to their cross-reacting antibodies, which contributes to the pathogenesis of allergy. However, evidence suggested that helminthic infection and high total IgE levels might protect against the effects of allergens, possibly by blocking the mast cell response or through a mechanism mediated by certain cytokines (Burney & Calvert, 2010) consequently lowering the risk of allergic disease (Bradley et al., 2006). Nevertheless, previous studies have shown parallel results providing no evidence of association among geohelminthic infection, asthma, atopic dermatitis and allergic rhinitis (Barreto et al., 2006; Burney & Calvert, 2010).

## 4. Conclusion

This study revealed that mixed infection of *Asacris lumbricoides* and *Trichuris trichiura* tend to be the most common parasitism affecting children in Batangas. Those who are below 10 years old have great predisposition to geohelminthiasis and allergy to the most common aeroallergens such as housedust mites, cat epithelium, cockroach, pigweed, Bermuda grass, acacia and mixed molds. From the three types of parasitic infections, it was suggested that trichuriasis is more likely to cause allergy especially with aeroallergens and seafood. A remarkable increase in serum total IgE level was also observed among the children whether positive or negative to Phadiatop. The occurrence of geohelminthic infection and allergy may affect any child regardless of age and serum total IgE level does not considerably vary with age, geohelminthiasis, and presence of allergy. It was proven that there was no significant association demonstrated between geohelminthiasis and allergic screening results hence, it does not play any contributory nor inhibitory role to allergic sensitization.

### Recommendation

For further study, a more specific allergy testing regarding allergens notably, inhalants and a quantitative fecalysis must be performed. Other possible contributory factors to geohelminthiasis and allergy must also be considered such as gender, socio-economic status, lifestyle, nutritional status and genetic predisposition. The

Batangas Provincial Health Office must formulate health projects and programs on parasitic and allergic status of the people to reduce the prevalence and morbidity rates of these diseases within the province.

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**Competing Interests Statement**

The authors declare that there is no conflict of interests regarding the publication of this paper.

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