

Case Report

Stunting, Micronutrient Deficiencies, and Worm Infections Among Primary School Children at Low and Lower-Middle Income Countries in Asia and Africa: A Systematic Review

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Abstract: Most of stunting and children with micronutrient deficiencies lived in Asia and in Africa region. In many developing countries, any nutritional disorders are aggravated by some infectious diseases such as worm infections especially among children aged 5 to 15 years. The aim of this review study was to describe and compare the prevalence of stunting, micronutrient deficiencies, and worm infections prevalence among primary school children at low and lower-middle income countries in Asia and Africa from 2007 to 2017. The methodology of this research was systematic review, with target population is primary school children aged 6-15 years. The resources of this review study came from online and offline databases; included PubMed, Cochrane Library, Google and Google Scholars. Selected studies should be published journals from low and low-middle income countries in Asia and Africa in last 10 years. A total of 450 selected articles from the various resources were exported to Endnote. Then all the references were filtered by reading the titles to exclude duplicate resources and the abstracts to exclude resources with unmatched criteria such as children's age range. Remaining references then were appraised by using appraisal tool and extraction tools from JBI. All these steps were recorded in PRISMA flow diagram (figure 1). Finally, there were 57 of 450 references were selected in this review study. The result of this research showed the prevalence of stunting and micronutrient deficiencies among primary school children in low income countries was higher from Asia. Meanwhile, in lower-middle income countries stunting and micronutrient deficiencies prevalence among primary school children were higher in Africa. Different to stunting and micronutrient deficiencies, prevalence of worm infections in both income country groups was higher in Africa than in Asia. Based on the region, more stunting primary school children were found in Asia than Africa. In contrast, prevalence of micronutrient deficiencies and worm infections were higher among primary school children from Africa. Based on income country group, prevalence of stunting was slightly similar in low and lower-middle income countries. On the other hand, prevalence of micronutrient deficiencies and worm infections were much higher in primary school children from low income countries. In conclusion, this researched stated that primary school children in Asia and Africa have the same nutritional problems and economic level of a country can't be a single variable to describe the burden of stunting, micronutrient deficiencies, and worm infections among primary school children.

Keywords: Stunting, Micronutrient Deficiencies, Worm Infections, Primary School Children, Low Income Countries, Lower-Middle Income Countries, Asia, Africa

1. Introduction

Stunting is the devastating result of poor nutrition in early childhood and the effect can last a lifetime [61]. Most of stunting children lived in Asia Africa region [61]. Not only stunting, micronutrient deficiencies are also affected the children in developing countries in Asia and Africa. In many developing countries, any nutritional disorders are aggravated by some infectious diseases [64]. One of most common infectious diseases in children is worm infections and the highest prevalence was found in 5 to 15 years of age children [65]. In long term, worm infections showed the delayed in growth and physical development in children [62]. This review study is expected to describe and compare the prevalence of stunting, micronutrient deficiencies, and worm infections prevalence among primary school children at low and lower-middle income countries in Asia and Africa from 2007 to 2017.

2. Materials and Methods

This systematic review study collected and analyzed multiple literatures from researches or papers critically. Then, we summarized all evidences from references that matched to criteria in this study to answer research question in this study [15]. In this study, all references with children population in age range of 6 to 15 years will be included. The references should also have the same criteria in determine stunting, micronutrient deficiencies, and worm infections condition in children. This review study defined stunting children as child's physical condition with anthropometry measurement in height-for-age WHO growth charts showed Z-score below -2 SD. Next, micronutrient deficiencies is defined as deficiency in Vitamin A, iron, and zinc among children. Then, worm infections is defined as worm infections that caused by 3 types of worm; nematodes, trematodes, or cestodes. Lastly, all the references should from low and lower-middle income countries in Asia and Africa based on World Bank list.

There are some other criteria for the references to be included in this review study. First, the references should have been published in peer reviewed journal in the last ten years (2007-2017). PUBMED/MEDLINE, Cochrane Library, Google Scholars and Google were online search

engines that had been used in this review study to collect the references. Beside from online resources, journals in both printed and PDF file version which meet the criteria for this study were included. Then, all the references also should be available in full text English version. Then, the resources should show the prevalence of stunting, micronutrient deficiencies, and worm infections among primary school children to give evidence about those conditions, so this review study will be able to answer the research question.

This study used some techniques to find suitable resources from online databases. Boolean Logic technique was used in PUBMED/MEDLINE search engine. Then, MeSH (Medical Sub Heading) was used for Cochrane library, and typing suitable keywords is used for Google. Keywords and their synonyms for stunting, micronutrient deficiencies and/or worm infections among primary school children in low and lower-middle income countries in Asia and Africa were used for any search techniques in online search engines. In the filter sections, last ten years full text published journals and available in English version were chosen. Then, all studies from online databases were imported to Endnote to make it easier in calculating the total documents were chosen and to make doing citation easier later.

Next, critical appraisal framework and data extraction form from the Joanna Briggs Institute (JBI) was used as a guide to assess the quality of studies reviewed [30, 31]. Then, the data extraction result was discussed with independent reviewer. Finally, based on the discussion with independent viewer, a table list of included final selected resources and the data from those references were developed. Total of 450 selected articles from the various resources were exported to Endnote and recorded in PRISMA flow diagram. From those 450 resources, 393 articles were removed due to several factors such as duplication, inappropriate study setting, published year, sample's age range and study result. Total 57 articles were selected in this study. The step of selected the references for this study was recorded and recorded in a PRISMA flow diagram, as can be seen in figure 1 below.

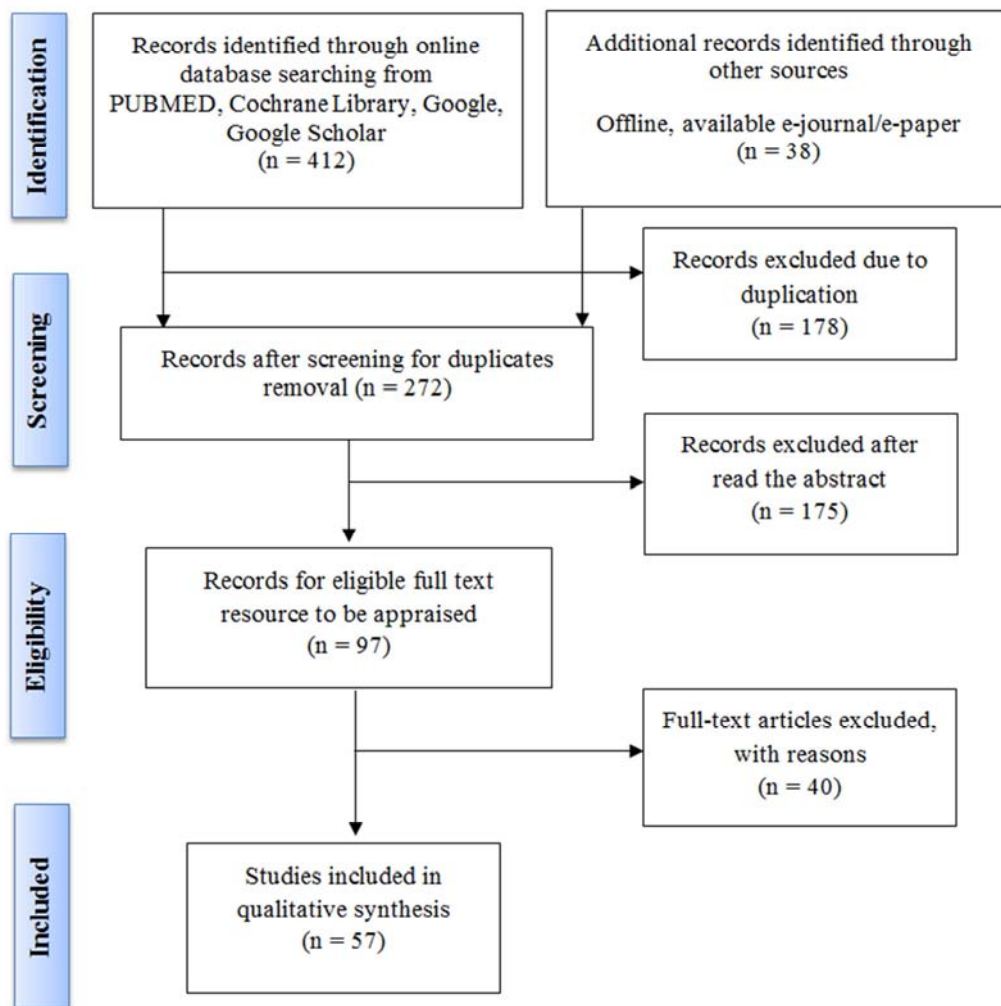


Figure 1. PRISMA 2009 Flow Diagram.

3. Result

3.1. Stunting

The description of stunting among primary school children in some low and lower-middle income countries in Asia and Africa is assessed by the prevalence of 6 to 15 years of age children with Z-score below -2 SD in WHO Growth Charts based on anthropometry measurements. The summary table has been developed to show description of stunting among primary children in low and lower-middle income countries in Asia and Africa (Table 1).

Table 1. Description of stunting among primary school children.

Income Country Group/ Region	Country	Population Group (Aged years)	Sample (Aged 6-15 years)	Stunting Prevalence (%)
Low Income Country/ Asia	Nepal [43]	6-12	125	34.4
	Nepal [47]	9-13	287	56.1
	Nepal [10]	10-13	381	55.1
	Nepal [58]	6-8	3356	45.4
	Ethiopia [24]	5-18	1368	10.0
Low Income Country/ Africa	Ethiopia [19]	6-14	523	46.1
	Ethiopia [38]	5-18	284	10.6
	Ethiopia [37]	6-15	587	34.6

Income Country Group/ Region	Country	Population Group (Aged years)	Sample (Aged 6-15 years)	Stunting Prevalence (%)
Lower-middle Income Country/ Asia	Ethiopia [26]	7-17	7431	22.2
	Ethiopia [1]	6-14	356	13.5
	Uganda [36]	6-14	432	22.5
	Burkina Faso [17]	8-14	385	29.4
	Tanzania [52]	7-14	845	30.0
	Sri Lanka [42]	5-10	4021	15.0
	Sri Lanka [18]	1-15	341	26.4
	Bangladesh [55]	6-9	571	22.0
	Vietnam [45]	6-8	510	25.5
	Philippines [48]	6-14	693	49.2
	Myanmar [49]	5-19	513	57.5
	Nigeria [8]	12-18	169	50.3
Lower-middle Income Country/ Africa	Nigeria [56]	5-19	245	19.6
	Nigeria [22]	9-12	2015	52.7
	Nigeria [16]	6 months to 15 years	202	33.2
	Ghana [7]	6-13	404	22.3
	Ghana [21]	6-12	142	24.0
	Ghana [5]	14-15	188	15.0

3.2. Micronutrient Deficiencies

The description of micronutrient deficiencies among primary school children in some low and lower-middle income countries in Asia and Africa is assessed by the prevalence of 6 to 15 years children with deficiencies in Vitamin A, zinc, and/or iron. The resources summary of micronutrient deficiencies among primary school children has been drawn in table 2 below.

Table 2. Description of micronutrient deficiencies among primary school children.

Income Country Group/ Region	Country	Population Group (Aged years)	Total Sample (Aged 6-15 years)	Prevalence of Micronutrient Deficiency (%)		
				Vitamin A	Iron	Zinc
Low Income Country/ Asia	Nepal [43]	6-12	125	-	-	85.6
Low Income Country/ Africa	Tanzania [52]	7-14	798	31.9	32.7	-
	Ethiopia [14]	6-12	586	-	37.5	-
	Bangladesh [2]	6-11	368	-	-	39.1
Lower-middle Income Country/Asia	Bangladesh [50]	6-15	352	29	43.9	-
	Sri Lanka [6]	6-19	2281	-	14.7	-
	India [25]	6-16	1247	2.0	-	-
	Vietnam [44]	6-8	510	11.2	5.1	55.8
	Vietnam [12]	6-9	510	10.2	0.8	70.6
	Nigeria [8]	12-18	13	46.2	76.9	-
Lower-middle Income Country/ Africa	Kenya [11]	9-12	206	-	-	21.0
	Ghana [21]	6-12	142	93.6	-	-
	Ghana [5]	14-15	188	36.0	4	-

3.3. Worm Infections

The description of worm infections among primary school children in some low and lower-middle income countries in Asia and Africa is assessed by the prevalence of 6 to 15 years children with worm infections caused by nematodes, cestodes, and/or trematodes. Total 34 resources have been collected to

describe the prevalence of worm infection among primary school children in low and lower-middle income countries from Asia and Africa. Table 3 has been built to give summary of included resources of worm infections among primary school children in low and lower-middle income countries in Asia and Africa.

Table 3. Description of worm infections among primary school children.

Low Income Country / Region	Country	Population Group (Aged years)	Total Sample (Aged 6-15 years)	Worm Infections Prevalence by Worm Type (%)		
				Nematodes	Cestodes	Trematodes
Low Income Country/ Asia	Afghanistan [34]	8-18	1169	25.3	10.0	1
	Nepal [54]	5-15	928	2.3	1.7	-
	Nepal [51]	9-12	495	32.5	1.8	-
	Nepal [35]	6-16	114	13.1	3.5	-
	Nepal [53]	12-15	200	6.5	6.5	-
Low Income Country/ Africa	Ethiopia [24]	5-18	138	17.0	-	-
	Ethiopia [19]	6-14	523	3.4	-	-
	Ethiopia [37]	6-15	583	26.0	14.0	22.0
	Ethiopia [60]	5-15	201	52.7	-	36.3
	Ethiopia [4]	5-19	370	39.2	-	59.7

Low Income Country / Region	Country	Population Group (Aged years)	Total Sample (Aged 6-15 years)	Worm Infections Prevalence by Worm Type (%)		
				Nematodes	Cestodes	Trematodes
Lower-middle Income Country/ Asia	Ethiopia [66]	5-15	257	50.6	0.8	26.5
	Ethiopia [13]	5-15	170	51.8	-	-
	Uganda [36]	6-14	432	13.5	-	1.8
	Tanzania [39]	4-15	490	-	-	67.1
	Tanzania [52]	7-14	845	68.0	-	54.0
	Sierra Leone [27]	9-14	1760	35.2	-	40.2
	Burkina Faso [17]	6-14	385	0.8	6.5	4.2
	India [59]	9-10	646	59.6	-	-
	India [23]	4-17	590	42.5	-	-
	India [32]	6-14	3706	7.8	-	-
	Philippines [28]	8-11	70	63.0	-	-
	Philippines [48]	6-14	667	25.6	-	2.0
	Vietnam [45]	6-8	510	65.4	-	-
	Vietnam [12]	6-9	510	80.2	-	-
	Palestine [29]	7-13	735	5.4	-	-
	Ghana [7]	6-13	404	-	-	2.5
	Kenya [33]	5-18	2824	16.4	-	-
Lower-middle Income Country/ Africa	Kenya [11]	9-12	206	-	-	51.5
	Zambia [41]	9-15	214	-	-	93.0
	Nigeria [3]	4-15	572	25.5	9.6	47.2
	Nigeria [46]	6-14	316	82.3	-	-
	Cote d'Ivoire [40]	7-15	156	-	-	9.6
	Cote d'Ivoire [20]	6-15	112	55.4	-	83.0
	Angola [57]	6-15	1142	38.1	7.5	-

3.4. Comparison

The comparison of stunting, micronutrient deficiencies, and worm infections among primary school children is assessed by comparing the prevalence of stunting, micronutrient deficiencies, and worm infections among primary school children between low and lower-middle income countries in Asia and Africa.

3.4.1. Stunting, Micronutrient Deficiencies, and Worm Infections in Low and Lower-Middle Income Countries in Asia and Africa

Figure 2 showed the comparison of stunting, micronutrient deficiencies, and worm infections prevalence between primary school children in low and lower-middle income

countries from Asia and Africa. From the figure, it can be seen that stunting is higher among primary school children in low income countries from Asia than children from Africa. But, in lower-middle income countries, more primary school children from Africa suffered from stunting than children in Asia region. Similar to stunting prevalence, micronutrient deficiencies prevalence also showed the same trend. Higher prevalence of micronutrient deficiencies is higher among children from low income countries in Asia than children in Africa. Then, primary school children in low income countries from Africa have higher prevalence of micronutrient deficiencies than children from Asia region. For worm infections, the data showed that the prevalence of worm infections among primary school children is higher in Africa than Asia, in both income country groups.

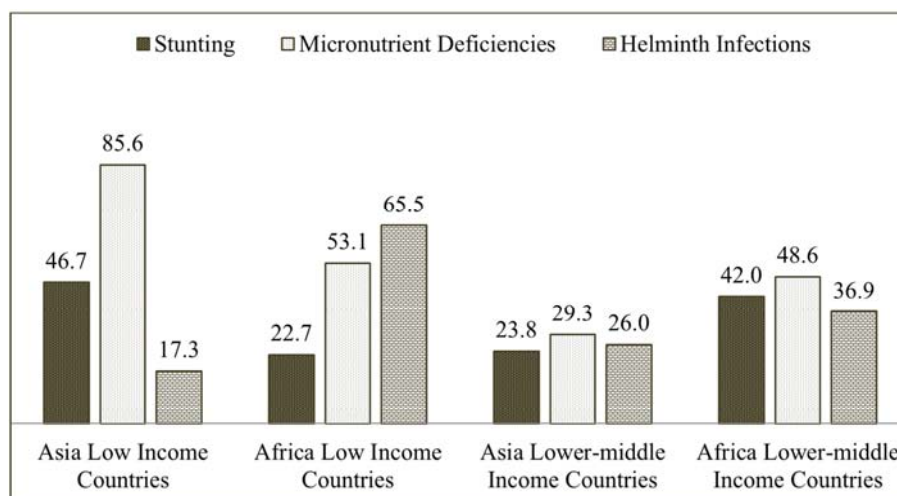


Figure 2. Comparison of stunting, micronutrient deficiencies, and worm infections prevalence between primary school children in low and lower-middle income countries from Asia and Africa.

3.4.2. Stunting, Micronutrient Deficiencies, and Worm Infections in Asia and Africa

This review study also compares the prevalence of stunting, micronutrient deficiencies, and worm infections among primary school children between Asia and Africa region without considered their income group. All the resources from Asian countries are compared to all resources from African

countries to describe the comparison of stunting, micronutrient deficiencies, and worm infections prevalence among primary school children. Based on the region, prevalence of micronutrient deficiencies and worm infections among primary school children are higher in Africa than Asia. In contrast, the prevalence of stunting among primary school children is higher in Asia than in Africa.

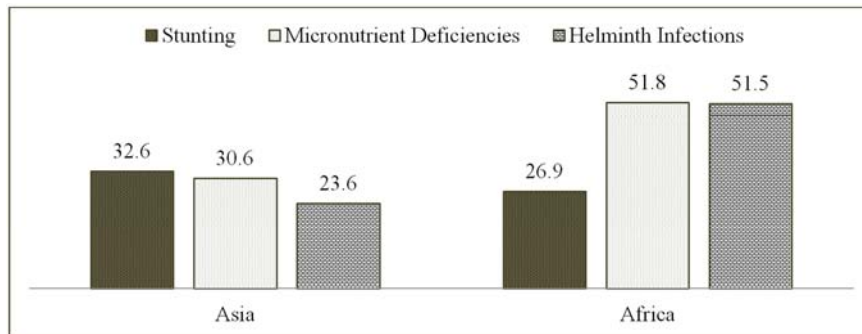


Figure 3. Comparison of stunting, micronutrient deficiencies, and worm infections prevalence between primary school children in Asia and Africa.

3.4.3. Stunting, Micronutrient Deficiencies, and Worm Infections in Low and Lower-Middle Income Countries

Based on income country group, this study divided it into two groups which are low and lower-middle income countries. The references for each group were taken from selected

references from any countries in Asia and Africa. The result showed the prevalence of micronutrient deficiencies and worm infections among primary school children were higher in low income country group, while slight higher prevalence of stunting was higher in lower-middle income country group than low income country group.

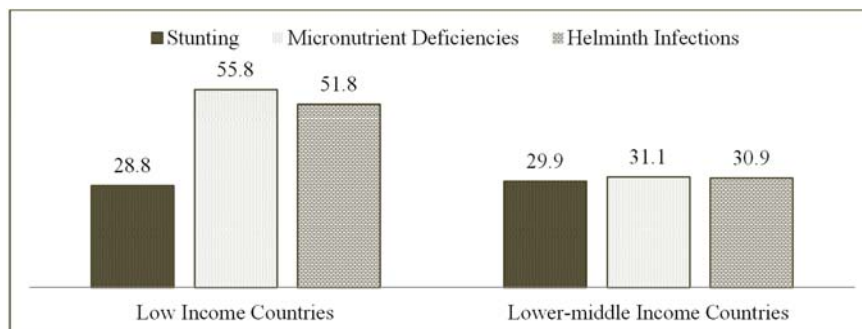


Figure 4. Comparison of stunting, micronutrient deficiencies, and worm infections prevalence between primary school children in low and lower-middle income countries.

Based on the type of micronutrient deficiencies, prevalence of iron deficiency was the highest in primary school children from low income countries, while zinc deficiency prevalence was the highest among primary school children in lower-middle income countries.

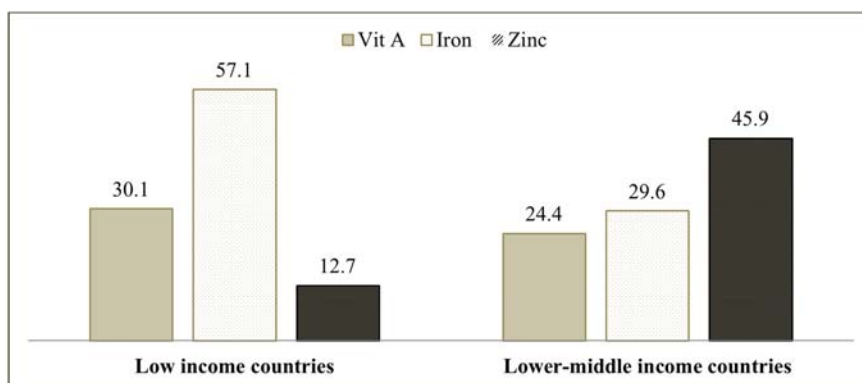


Figure 5. Comparison the type of micronutrient deficiencies prevalence between primary school children in low and lower-middle income countries.

Lastly, based on the type of worm that infected the children, prevalence of nematodes infection was the highest in primary school children from low and lower-middle income country group, and followed by trematodes and cestodes infections.

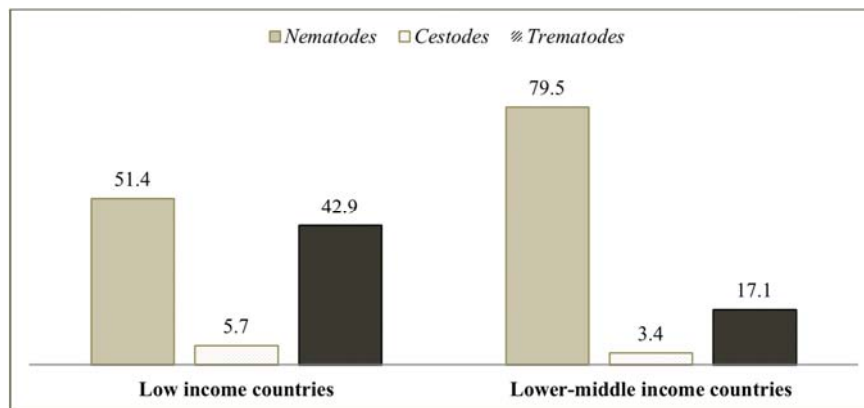


Figure 6. Comparison the type of worm infections prevalence between primary school children in low and lower-middle income countries.

4. Discussion

The prevalence of stunting among children aged below 5 years was higher in Asia than Africa [61]. This review study showed that among primary school-age children aged 6-15 years, stunting prevalence also was higher in Asia than in Africa.

In Asia, the highest prevalence of stunting children was found in Southern and Southeast region [2]. This report was relevant to this review study result, where all the references that contributed to the result of this review study were from both part of Asia. The countries such as Nepal, Afghanistan, Sri Lanka, and Bangladesh were located at South part of Asia, while Myanmar, Philippines, and Vietnam which also contributed in this review study result were located at Southeast part of Asia. There were no references in this review study came from the countries at other part of Asia.

It was reported that only Northern Africa which has low prevalence of stunting children [61]. This report was also relevant to the result of this review study. In this study, there were no references from North part of Africa showed stunting prevalence among primary school children.

Some references showed that the prevalence of micronutrient deficiencies such as iron deficiency, Vitamin A deficiency, and zinc deficiency was high in Africa and Asia specifically low income countries [9]. The result of this review study showed the same trend to the references. This review study showed the higher prevalence of micronutrient deficiencies was found in Africa than in Asia. Moreover, micronutrient deficiencies prevalence was also higher in low income country group than lower-middle income country group. Then, the prevalence of zinc deficiency was always high in any references which compared it with iron and vitamin A deficiency directly.

Many references showed that Worm infections were affected the poorest and most deprived communities mostly [63]. This review study showed that children who lived in the low income country group in Asia and Africa had higher prevalence of worm infections than children who lived at

lower-middle income country group. Nematode is the most common type of worm that infected primary school children in low and lower-middle income country from Asia and Africa region. This high prevalence comes from all species which are categorized as nematodes worm, but mostly infections were caused by *Schistosoma* sp.

5. Conclusion

The prevalence of stunting, micronutrient deficiencies, and worm infections among primary school children (aged 6-15 years) has the identical trend as pre-school children (below 5 years of age). We concluded that children aged primary school children and pre-school children from low and lower-middle income countries in Asia and Africa have the same burden of stunting, micronutrient deficiencies, and worm infections.

Limitation

The result of this review study was highly influenced by the data resources which dominated by some particular countries in each country group and each region. Limitation also caused by age range of the population target in this review study. Most of studies were excluded due to variety of age range didn't meet the age range requirement for this review study.

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