



Hemoglobin Level and Risk of Anemia in Soil-Transmitted Helminths Infections among Children: A Systematic Review and Meta-analysis

Ahmad Razi Maulana Alnaz¹, Dewi Masyithah Darlan²*, Yunilda Andriyani², Rodiah Rahmawaty Lubis³

¹Department of Undergraduate Program, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia; ²Department of Parasitology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia; ³Department of Ophtalmology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia

Abstract

Edited by: Eli Djulejic Citation: Alnaz ARM, Darlan DM, Andriyani Y, Lubis RR. Hemoglobin Level and Risk of Anemia in Soil-Transmitted Helminths Infections among Children: A Systematic Review and Meta-analysis. Open Access Maced J Med Sci. 2022 Apr 28: 10(F):355-363. https://doi.org/10.3889/damjms.2022.8974 Keywords: Anemia; Children; Hemoglobin; Infection; Soiltransmitted helminthes *Correspondence: Dewi Masyithah Darlan, Department of Parasitology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia. E-mail: dewi2@usu.acid Received: 12-Feb-2022 Revised: 14-Apr-2022 Accepted: 18-Apr-2022 Copyright: © 2022 Ahmad Razi Maulana Alnaz, Dewi Masyithah Darlan, Yunida Andriyani, Rodiah Rahmawały Lubis Funding: This research did not receive any financial support Competing Interests: The authors have declared that no competing Interests exist

Open Access: This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0) **BACKGROUND:** Soil-transmitted helminthiasis (STH) is a Neglected Tropical Disease with almost 25% world population infected. Children were vulnerable to infection with morbidities affecting growth. STH infection alters children nutritional status which potentially causing anemia. Meta-analysis relating STH infections to hemoglobin (Hb) level and risk of anemia in children are limited.

AIM: The aim of this was to compare Hb levels and risk of anemia in children infected and uninfected with STH.

METHODS: Meta-analysis conducted from journals obtained from PubMed, ScienceDirect, WileyLibrary, Cochrane, EBSCO, ProQuest, DOAJ, and GoogleScholar from 2011 to 2021. Full-text cross-sectional studies on children with relevant topic are included, while unclear, inaccessible, or post interventional studies were excluded from the study. Articles were analyzed in Review Manager 5.4 in mean difference (MD) and odds ratio (OR) with confidence interval of 95%.

RESULTS: Out of 25,683 articles in the literature search, 29 were eligible for systematic review and metaanalysis. STH infection significantly decreases Hb level (MD –0.2 g/dL; p = 0.02) and increases risk of anemia (OR 1.83; p < 0.00001). Species analysis presented parallel result on *Trichuris trichiura* (MD –0.31 g/dL; p = 0.001and OR 1.66; p = 0.009), Hookworm (MD –0.56 g/dL; p = 0.02 and OR 3.3; p < 0.00001), and multiple infection (MD –0.25g/dL; p = 0.03 and OR 4.49; p = 0.005). *Ascaris lumbricoides* did not show significance on Hb level but comparable for risk of anemia (MD –0.16 g/dL; p = 0.17 and OR 1.57; p = 0.001).

DISCUSSION: All STH infections exhibit lower Hb level and higher risk of anemia caused by lower nutrition absorption and occult bleeding in gastrointestinal tract. Hookworm and multiple infections have the highest risk of anemia. Proportion of anemia may vary in studies and influenced by sociodemographic characteristics, but higher proportions occur in STH infected.

CONCLUSION: Children infected with STH have lower Hb level and in risk of anemia compared to uninfected children; hence, further study is still needed to be conducted.

Introduction

Soil-transmitted helminthiasis (STH) is a parasitic infection which includes *Ascaris lumbricoides*, *Trichuris trichiura*, and Hookworm (*Ancylostoma duodenale* and *Necator americanus*) manifestation in human intestines with soil related in the transmission [1]. The WHO includes STH as one of the Neglected Tropical Disease (NTD) with barely one-fourth population in the world (1.5 billion) infected, with specifically estimated of 0.8–1.1 billion infected with *Ascaris lumbricoides*, 0.6–0.8 billion infected with *Trichuris trichiura*, and 0.5–0.7 billion with hookworms [2].

STH infections were common in tropical countries with low income and poor hygiene and sanitation. Countries in Subsahara, Latin America, Asia Pasific, and South East Asia were reported with the highest STH transmission and highest disability related to STH infections [3]. Children specifically in pre-schoolaged children (PSAC) and school-aged children (SAC) have the highest risk of infection. More than 267 million PSAC and 568 SAC recorded to be infected with STH by 2020 [4].

STH is commonly asymptomatic and not lifethreatening, but chronic infections affects long-term morbidities on children's growth and development. The pathophysiology of the infection relates to nutrition deficiency and anemia which may alter the rapid growth in childhood [5], [6]. Anemia itself stated as one of public health problem in the world by the WHO. PSAC and SAC were major groups in anemia prevalence with 47.3% (293 million) and 25.4% (305 million) each [7]. Children have a greater risk of anemia among other age, and since 1990–2013, there were more reports regarding anemia related to STH infection [8]. At present, there were plenty of local studies relating anemia and hemoglobin (Hb) levels in STH infections, but the results were vary and lots of bias may occur. At present, there were lack of broad systematic review and meta-analysis on Hb level and risk of anemia in children, except local meta-analysis or coinfections.

Aim

The aim of this study was to compare the Hb level and risk of anemia in infected with uninfected children with STH.

Methods

Study design and duration

This research was conducted as a systematic review and meta-analysis from the previous researches regarding STH infections relation to Hb level and risk of having anemia. This study was conducted in June up to November 2021 and was analyzing related journals published up to the literature search date.

Literature search

The literatures searching in this research was conducted in evidence of PRISMA Guideline in selecting eligible articles for systematic review and meta-analysis. We conducted a systematic search in certain search engines such as PubMed, Science Direct, Cochrane Library, Wiley Library, ProQuest, EBSCO, DOAJ, and Google Scholar. Search strategies applied were adapting Boolean logic association among keywords of PICO analysis of (Children OR Child OR Pediatric) AND (Soil-Transmitted Helminths OR Ascaris OR Trichuris OR Hookworm) AND (Anemia OR Hemoglobin OR Hemoglobin). Keywords were inserted in search entries every database, screened by filters available. Search results were, then, screened for title and abstract and relevant articles were, then, included for full-text read with careful selection based on inclusion and exclusion criteria of the articles. Selected articles were then presented as systematic review tables and further statistical calculation for meta-analysis.

Eligible study criteria

This systematic review and meta-analysis includes articles from observational or pre-clinical trial cross-sectional surveys providing data presenting Hb levels and case proportion of anemia among STH infected and uninfected children which were not mixed with other infection data. Studies included should presented researches conducted in human, written in English, and are accessible for full text. Articles published previous that 10 years before the literature search and duplicates would be excluded. Unclear, biased data, or data presented in inaccessible supplements would also be excluded. Post-interventional and irrelevant data would not be considered for analysis.

Selected studies were assessed for analyzed for eligible methods of diagnosis with STH infections were confirmed by any presented STH infections of Kato-Katz, lugol, or iodine fecal microscopic examinations. Hb level was assessed with blood test from peripheral of vena puncture with automated spectrometry-based hemoglobinometer and anemia status which were grouped by the WHO Hb cut off value of anemia based on age and altitude.

Quality assessment and data extraction

Selected articles were then analysis for methodological quality using the Newcastle Ottawa Scale (NOS) assessment for sample selection, comparability, and outcome. Studies with very good and good quality assessment (NOS > 7) would be continued to data extraction for further review and analysis.

Data were extracted from the journals by two independent reviewer. Extracted data were mainly collected for authors' name, year of publication, country, number of sample, age, infection status (any type of STH, *Ascaris lumbricoides* only, *Trichuris trichiura* only, hookworm only, or multiple infections), Hb level (in mean and standard deviations), and number and proportion of anemia.

Data synthesis and analysis

Qualitative systematic review analysis was conducted with presentations of data in mean Hb level with standard deviation and number and percentage of anemia in every infection status groups. Quantitative meta-analysis were calculated and analyzed using Review Manger Version 5.4® (The Cochrane Collaboration, Oxford, UK). Numerical variables such as the Hb level were measured in mean differences (MD) and categorical variables such as proportion of anemia were measured in odds ratio (OR). Confidence interval of the statistic equation was 95% with α 5% and was considered as statistically significant with p < 0.05. Test of heterogeneity was used to assess data variability with I² < 50% analyzed with Fixed Effect Model and >50% analyzed in Random Effect Model.

Results

Figure 1 presented the literature search and selection process of the study. Twenty-five



Figure 1: PRISMA flowchart of the study selection

thousand and six hundred eighty-three articles were identified in initial identification trough keyword search entry in search engines and were filtered in the database by selected criteria of publication year, language, human sample, study design, and type of article. Twelve thousand and four hundred ninety-four articles filtered articles were screened for title and abstract, but 9100 were inaccessible due to search engine limitations. Remaining 3394 articles were screened and only 134 included due to topic irrelevance. Articles were downloaded and checked for duplication using Mendeley® and 53 were duplicated.

From 81 articles read for full text, 16 excluded due to low NOS Score, 14 contained mixed data with other infections, ten were mixed with adult data, nine were not presenting either hb level or anemia, and nine other were irrelevant. Thirty-eight articles were available for systematic review, but only 29 has available raw data to be analyzed in Review Manager.

Hemoglobin level in infected and uninfected children

Fourteen reports were identified presenting data of mean Hb level in STH infected children and uninfected children. All reviewed articles compared Hb levels to non-infected children as control group. Any STH infection presented most records recorded for nine studies, while Ascaris lumbricoides had the most articles mentioning for seven articles. Trichuris trichiura and hookworm presented five and four journals mentioning, while multiple infection only three. Table 1 presented Hb level in any group presented in Mean and standard deviation. Overall STH infected individuals presented lower mean Hb level than control group, but individual reports of statistical significancies in each articles may vary or lacking. Lowest Hb level was reported in Any STH group with 10.3 g/dL (1.8) in Sumbele et al., 2020. Highest Hb level was recorded from non-infected group for 13.6 g/dL (3.02) by Verhagen et al., 213.

Figure 2 presented forest plot of Hb levels of subgroup comparison between STH infected and uninfected group. All five subgroups presented lower mean Hb level with negative MD to uninfected children. Only *Ascaris lumbricoides* infection failed to exert significance (p = 0.17) with MD -0.16 g/dL (-0.4, 0.07). Hookworm had the lowest Hb level with MD -0.56 g/dL (-1.04, -0.08, p < 0.05). Any STH, *Trichuris trichiura*, and multiple also had significance compared to uninfected with MD -0.2g/dL (-0.38, -0.03, p < 0.05), -0.3g/dL (-0.48, -0.14, p < 0.05), and -0.25 g/dL (-0.48, -0.02, p < 0.05), respectively. All mean Hb levels data were positive heterogenicity and analyzed in random effects.

Risk of anemia in STH infected children

Table 2 presented compilations of proportion of anemia between STH infected and uninfected children. Almost all presented more proportions of anemia in infected groups, whether single or multiple infections occur. Non-specific any type of STH infection presented the most number of studies included with 20 articles analyzed, followed by *Ascaris* and hookworm with 12 articles and *Trichuris* with nine articles. Only

Tahlo	1. Hemoglobin	loval in soil-	transmitted	holminthiasis	infected	and w	ninfected	childron
lable	I. Remoground	level III Soll-	lansinilleu	nemmunasis	mecleu	anu ui	innecteu	cilliuren

Author, year	Number of Age (year)		Any STH		Ascaris lumbricoides		Trichuris trichiura		Hookworm		Multiple infection		Not infected	
	sample		n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
Abanyie et al., 2013 [9]	690	1–5			72	10.1 (1.5)							77	10.1 (1.4)
Cho et al., 2021 [10]	2018	8.3 (2.5)	369	12.4 (2.2)	304	12.37 (2.18)	17	12.45 (1.76)	41	12.01 (2.54)			1649	13.2 (2.0)
De Gier et al., 2016 [11]	510	7.5±0.9			118	12.11 (0.732)	67	11.69 (0.75)	9	11.74 (0.84)	215	11.81 (0.77)	101	12.2 (0.587)
Liu et al., 2015 [12]	2179	10.58 (0.87)	912	12.54 (1.31)									1267	12.68 (1.19)
Matangila et al., 2014 [13]	616	8 (7.5–9.5)			92	11.45 (1.13)	120	11.5 (1.22)					365	11.6 (1.26)
Müller et al., 2016 [14]	934	9–12			248	12.4 (0.964)	207	11.95 (0.844)			156	11.95 (0.83)	635	12.31 (0.964)
Muñoz-Antoli et al., 2018 [15]	341	8.53 (2.68)	185	11.41 (1.31)	11	11.7 (1.13)	95	11.7 (1.25)	7	12.1 (1.14)			156	11.72 (1.26)
Sanchez et al., 2013 [16]	320	7–12	232	12.95 (0.77)							103	12.93 (0.71)	88	12.91 (0.74)
Staudacher et al., 2015[17]	301	4.9-17.10	115	13.3 (1)									186	13.4 (1.2)
Staudacher et al., 2016[17]	321	4.9-17.11	43	12.8 (1.3)									278	13.2 (1.1)
Sumbele et al., 2020 [18]	401	4–14	3	10.3 (1.8)									195	10.8 (1.3)
Suraweera et al., 2018 [19]	233	1–12	64	12.3 (0.8)									169	12.1 (0.8)
Verhagen et al., 2013 [20]	390	4–16			104	13.5 (2.08)			111	12.8 (1.88)			286	13.6 (3.02)
Wijaya <i>et al</i> ., 2021 [21]	384	5–14	138	12.27 (0.99)									246	12.59 (0.73)
STH: Soil-transmitted helminthiasis,	SD: Standard	The Sol-Transmitted helimithiasis. SD: Standard deviation.												

Open Access Maced J Med Sci. 2022 Apr 28; 10(F):355-363.

seven studies presented proportion of anemia and was measurable to uninfected groups. Most prevalence of anemia was found in the STH infected groups in Tandoh *et al.* with barely 70% of infected children that were also anemia. Only some of the included studies exert contradictive result with lower proportions of anemia in infected group in contrast to uninfected group such as Djuardi *et al.* and Suraweera *et al.*, but most did not show statistical significance.

Forest plot analysis on Figure 3 of the anemia proportion also provided significance and relation that infected by STH was a risk factor of having anemia in childhood. All subgroup analysis whether non-specific test, specific to single species of STH, or multiple infection were all exerts OR > 1. Children with multiple infection were at the greatest risk for anemia with OR 4.49 (1.58, 12.75, p < 0.05). Greatest risk of anemia in single infection was possible in hookworm infected children with OR 3.3 (1.98, 5.49, p < 0.05), while *Ascaris lumbricoides* had OR 1.57 (1.2, 2.07, p < 0.05) and *Trichuris trichiura* with OR 1.66 (1.13, 2.43, p < 0.05). Overall any type of STH infection would risk children to be anemic for 2.05 (1.52, 2.76, p < 0.05) more likely than uninfected children.

	Infected Uninfected						Mean Difference	Mean Difference				
Study or Subgroup	Mean St) Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI				
Cho et al, 2021	12.4 2.2	2 369	13.1	2	1649	12.2%	-0.70 [-0.94, -0.46]					
Liu et al, 2015	12.54 1.31	912	12.68	1.19	1267	15.3%	-0.14 [-0.25, -0.03]					
Munoz-Antoli et al, 2018	11.41 1.31	185	11.72	1.26	156	11.5%	-0.31 [-0.58, -0.04]					
Sanchez et al, 2013	12.95 0.77	232	12.91	0.74	88	13.7%	0.04 [-0.14, 0.22]					
Staudacher et al, 2014	12.8 1.3	3 43	13.2	1.1	278	8.4%	-0.40 [-0.81, 0.01]					
Staudacher et al, 2014	13.3 1	115	13.4	1.2	186	12.0%	-0.10 [-0.35, 0.15]					
Sumbele et al, 2020	10.3 1.8	3 3	10.8	1.3	195	0.7%	-0.50 [-2.55, 1.55]	,				
Suraweera et al, 2018	12.3 0.8	3 64	12.1	0.8	169	12.6%	0.20 [-0.03, 0.43]					
Wijaya et al, 2021	12.27 0.99	3 138	12.59	0.73	246	13.6%	-0.32 [-0.51, -0.13]					
Total (95% CI)		2061			4234	100.0%	-0.20 [-0.38, -0.03]	◆				
Heterogeneity: Tau ² = 0.05; Chi ² = 38.37, df = 8 (P < 0.00001); I ² = 79%												
Test for overall effect: Z = 2.34 (P = 0.02) -1 -0.5 U 0.5 1 Favors Infected Favors Uninfected												
	Accaric	•)	Uni	nfooto	d		Moon Difference	Magn Difference				
Study or Subgroup	Ascaris(Total	Moan	en en	u Total	Woight	Wear Difference	Wean Difference				
Abamia at al. 2012	10.1 1.4	70101	10.1	30	77	44 AO	1V, Kalluolli, 95% Cl					
Abanyle et al, 2013	10.1 1.5	204	10.1	1.4	1640	16.6%	0.00[-0.47, 0.47]					
Do Gior et al. 2021	12.37 2.10	110	13.1	0 6 0 7	1049	10.3%	-0.73 [-0.99, -0.47]					
Matangila at al. 2014	11.45 1.13	02	11.6	1 26	265	16.6%	-0.09 [-0.20, 0.00]					
Muller et al. 2014	124 0.96/	249	12 31	0.064	635	10.3%	0.09 [0.41, 0.11]					
Munoz-Antoli et al. 2010	11 7 1 13	240	11.31	1 26	156	7 2 %	-0.10[-0.00] 0.20]					
Verhagen et al. 2013	13.5 2.08	104	13.6	3.02	286	10.1%	-0.10[-0.63_0.43]					
verhägen et al, 2015	15.5 2.00	104	15.0	5.02	200	10.1%	-0.10 [-0.03, 0.43]					
Total (95% CI)		949			3269	100.0%	-0.16 [-0.40, 0.07]					
Heterogeneity: Tau ² = 0.07	; Chi ² = 29.23	df = 6 (F	° < 0.00	01); I² =	: 79%			-1 -0.5 0 0.5 1				
Test for overall effect: $Z = 1$	1.36 (P = 0.17)							Favors Ascaris (+) Favors Uninfected				
	Trichuris	(+)	Unii	nfected	1		Mean Difference	Mean Difference				
Study or Subgroup	Mean SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI	IV, Random, 95% Cl				
Cho et al, 2021	12.45 1.76	17	13.1	2	1649	3.7%	-0.65 [-1.49, 0.19]	· · · · · · · · · · · · · · · · · · ·				
De Gier et al, 2016	11.69 0.75	67	12.2	0.587	101	25.2%	-0.51 [-0.72, -0.30]					
Matangila et al, 2014	11.5 1.22	120	11.6	1.25	337	21.5%	-0.10 [-0.36, 0.16]					
Muller et al, 2016	11.95 0.844	207	12.31	0.964	635	32.8%	-0.36 [-0.50, -0.22]					
Munoz-Antoli et al, 2018	11.7 1.25	95	11.8	1.26	156	16.9%	-0.10 [-0.42, 0.22]					
Total (95% CI)		506			2878	100.0%	-0.31 [-0.48, -0.14]	•				
Heterogeneity: Tau ² = 0.02	; Chi² = 8.57, o	lf = 4 (P =	= 0.07);1	² = 539	Хо		-	-1 -0.5 0 0.5 1				
Test for overall effect: $Z = 3$	3.56 (P = 0.000	4)						Favors Trichuris (+) Favors Uninfected				
	Hookworm	(+)	Uninf	ected			lean Difference	Mean Difference				
Study or Subgroup	Mean SD	Total M	Nean	SD 1	Fotal V	Neight I	/, Random, 95% Cl	IV, Random, 95% CI				
Cho et al, 2021	12.01 2.54	41	13.1	2 1	649	21.0%	-1.09 [-1.87, -0.31]					
De Gier et al, 2016	11.74 0.84	9	12.2 0	.587	101	28.8%	-0.46 [-1.02, 0.10]					
Munoz-Antoli et al, 2018	12.1 1.14	7	11.8	1.26	156	18.6%	0.30 [-0.57, 1.17]					
Verhagen et al, 2013	12.8 1.88	111	13.6	3.02	286	31.5%	-0.80 [-1.29, -0.31]					
Total (95% CI)		168		2	2192 1	100.0%	-0.56 [-1.04, -0.08]					
Heterogeneity: Tau ² = 0.13	; Chi² = 6.51, d	f= 3 (P =	: 0.09); F	² = 54%	6							
Test for overall effect: Z = 2	2.27 (P = 0.02)							Favors Hookworm (+) Favors Uninfected				
M	ultiple Infectio	n	Uninfed	cted		Me	an Difference	Mean Difference				
Study or Subgroup Me	an SD T	otal Me	an s	SD To	tal We	eight IV,	Random, 95% CI	IV, Random, 95% CI				
De Gier et al, 2016 11.	.81 0.77	215 12	2.2 0.5	87 1	01 34	4.5% -0	.39 [-0.54, -0.24]					
Muller et al, 2016 11.	.95 0.83	156 12.	31 0.9	64 6	35 34	4.8% -0	.36 [-0.51, -0.21]					
Sanchez et al, 2013 12.	.93 0.71	103 12.	.91 0.1	74	88 30	0.7% (0.02 [-0.19, 0.23]	_				
Total (05% CI)		474		0	24 40	0.0%	26 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0					
Hotorogonoity Tou2 - 0.02	- Chi2 - 11 10	414 df = 2 /D	- 0.004	8 0 - 51 - 0	24 10	0.0% -0.	25 [-0.46, -0.02]					
Test for overall effect: Z = 2	17 (P = 0.03)	ui = 2 (P	- 0.004	, = 8	2 70		-1	-0.5 0 0.5 1				
							1	ravors multiple intection ravors Unintected				

Figure 2: Subgroup forest plot of hemoglobin mean differences of soil-transmitted helminthiasis infected and uninfected children

Study of Subserve							
Chudu an Cubanaun	Infect	ed	Uninfe	cted		Odds Ratio	Odds Ratio
Study of Subgroup	Events	Total	Events	Total	Weight	IV, Random, 95% CI	IV, Random, 95% CI
Alaribi et al. 2020	31	55	25	93	5.5%	3 51 [1 74 7 10]	
Alelian et al 2015	20	211	20	173	3 5%	12 45 [2 77 41 00]	
Religinet al, 2015	50	100	50	105	0.070	12.40 [3.77, 41.09]	
Belizario et al, 2021	03	100	52	105	0.0%	1.33 [0.84, 2.09]	
Belizario et al, 2021	76	271	50	385	6.9%	2.61 [1.75, 3.89]	
Cho et al, 2021	126	369	341	1649	7.5%	1.99 [1.56, 2.54]	
Darlan et al, 2016	14	29	10	43	4.1%	3.08 [1.12, 8.50]	
Djuardi et al, 2021	24	51	46	61	5.0%	0.29 [0.13, 0.65]	
Getaneh et al. 2017	11	18	70	505	4 2%	9 77 13 66 26 041	
Liuetal 2015	173	912	190	1267	7 5%	1 33 [1 06 1 66]	-
Mollo et al. 2019	66	220	100	204	5 70	4 00 12 54 0 421	
Molia et al, 2016	50	239	12	204	0.7 %	4.90 [2.04, 9.40]	
Munoz-Antoli et al, 2018	79	185	44	156	6.6%	1.90 [1.20, 2.99]	
Osazuwa et al, 2011	68	139	44	177	6.5%	2.90 [1.80, 4.66]	
Sanchez et al, 2013	6	262	1	88	1.6%	2.04 [0.24, 17.17]	
Staudacher et al, 2014	32	153	80	461	6.6%	1.26 [0.80, 1.99]	
Suchdeviet al. 2014	31	82	41	123	6.0%	1 22 10 68 2 181	
Sumbele et al. 2020	2	3	140	195	1 3%	0 79 10 07 8 841	
Current and a 2020	2		140	400	4.000	0.75 [0.07, 0.04]	
Suraweera et al, 2018	5	64	32	109	4.2%	0.36 [0.13, 0.98]	
Tandoh et al, 2020	25	36	62	128	5.1%	2.42 [1.10, 5.33]	
Wijaya et al, 2021	31	138	15	246	5.7%	4.46 [2.31, 8.61]	
Total (95% CI)		3383		6288	100.0%	2.05 [1.52, 2.76]	•
Total events	891		1258				
Heterogeneity Tau ² = 0.2	Q. Chiz - Q	2.95 d	f - 19 /P	< 0.000	101) 12-	91%	L
Test for everall effect: 7 -	4 74 /D - 1	0.000,0	1 100	~ 0.000	,01),1 =	01.0	0.01 0.1 1 10 100
Test for overall effect: $Z =$	4.14 (P <)	0.0000	0				Favors Uninfected Favors Infected
		1.3	Halada			Odda Datia	Odda Datia
	Ascans	(+)	Unintec	tea		Odds Rado	Odds Rauo
Study or Subgroup	Events	lotal	Events	Total	weight	IV, Random, 95% CI	IV, Random, 95% CI
Abanyie et al, 2013	50	72	55	77	8.0%	0.91 [0.45, 1.84]	
Alaribi et al, 2020	15	31	41	117	6.9%	1.74 [0.78, 3.87]	
Amare et al, 2020	64	159	88	382	12.5%	2.25 [1.51, 3.35]	
Cho et al. 2021	105	304	341	1649	14.7%	2 02 [1 55 2 64]	
De Gier et al 2016	14	118	12	101	6 7%	1 00 0 44 2 271	
Motongilo et al. 2014	47	00	150	265	11 50	1.00 [0.44, 2.27]	
Malangha et al, 2014	47	32	100	303	7.4.00	1.37 [0.07, 2.10]	
Molla et al, 2018	17	92	12	204	7.1%	3.63 [1.65, 7.96]	
Munoz-Antoli et al, 2018	4	11	44	156	3.6%	1.45 [0.41, 5.22]	
Oliveira et al, 2015	7	53	64	275	6.5%	0.50 [0.22, 1.17]	
Osazuwa et al, 2011	40	85	44	177	10.1%	2.69 [1.56, 4.64]	
Subahar et al, 2020	4	14	37	178	3.9%	1.52 [0.45, 5.14]	
Suchdev et al. 2014	18	50	54	155	8.5%	1.05 (0.54, 2.05)	
Total (95% CI)		1081		3836	100.0%	1.57 [1.20, 2.07]	•
Total quanta	205		050			nor [neo; eior]	-
Total events	300	10.10	900	0.000	12 570		r r r
Heterogeneity: Tau* = 0.1	1; Uni*= 2:	5.42, ar	= 11 (P =	0.008)	; h = 57%		0.2 0.5 1 2 5
Test for overall effect: Z =	3.25 (P = 0	.001)					Favors Uninfected Favors Ascaris (+)
	Trichuric	(4)	Uninfor	tod		Odde Patio	Odde Patio
Study of Subgroup	Fuente	Tetel	Cuento	Tatal	Mainht	Uus Rauo	Duds Rado
Study of Subgroup	Events	Total	Evenus	Total	weight	IV, Rahuom, 95% Ci	IV, Rahuom, 95% Ci
	~ ~	~~			10 101		
Alaribi et al, 2020	20	32	36	116	10.4%	3.70 [1.64, 8.38]	
Alaribi et al, 2020 Amare et al, 2020	20 115	32 360	36 88	116 382	10.4% 17.3%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021	20 115 3	32 360 17	36 88 341	116 382 1649	10.4% 17.3% 6.3%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016	20 115 3 30	32 360 17 67	36 88 341 12	116 382 1649 101	10.4% 17.3% 6.3% 10.9%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014	20 115 3 30 54	32 360 17 67 120	36 88 341 12 151	116 382 1649 101 337	10.4% 17.3% 6.3% 10.9% 16.0%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66 1.53]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018	20 115 3 30 54 3	32 360 17 67 120 30	36 88 341 12 151 12	116 382 1649 101 337 204	10.4% 17.3% 6.3% 10.9% 16.0% 5.8%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Mulpac Antoli et al, 2018	20 115 3 30 54 3	32 360 17 67 120 30	36 88 341 12 151 12 44	116 382 1649 101 337 204	10.4% 17.3% 6.3% 10.9% 16.0% 5.8%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.40, 2.87]	
Alambi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018	20 115 30 54 3 36	32 360 17 67 120 30 95	36 88 341 12 151 12 44	116 382 1649 101 337 204 156	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2014 Molla et al, 2014 Munoz-Antoli et al, 2018 Osazuwa et al, 2011	20 115 3 30 54 3 36 4	32 360 17 67 120 30 95 18	36 88 341 12 151 12 44 44	116 382 1649 101 337 204 156 177	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014	20 115 3 30 54 3 36 4 18	32 360 17 67 120 30 95 18 47	36 88 341 12 151 12 44 44 54	116 382 1649 101 337 204 156 177 158	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.88 [0.27, 2.76] 1.20 [0.61, 2.34]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2016 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2014	20 115 3 30 54 3 36 4 18	32 360 17 67 120 30 95 18 47	36 88 341 12 151 12 44 44 54	116 382 1649 101 337 204 156 177 158	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2011 Molla et al, 2014 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI)	20 115 3 30 54 3 36 4 18	32 360 17 67 120 30 95 18 47 786	36 88 341 12 151 12 44 44 54	116 382 1649 101 337 204 156 177 158 3280	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matanglia et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events	20 115 3 30 54 3 36 4 18 283	32 360 17 67 120 30 95 18 47 786	36 88 341 12 151 12 44 44 54 782	116 382 1649 101 337 204 156 177 158 3280	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2016 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events	20 115 3 30 54 3 36 4 18 283 3; Chi ² = 22	32 360 17 67 120 30 95 18 47 786 .87, df=	36 88 341 12 151 12 44 44 54 54 782 = 8 (P = 0	116 382 1649 101 337 204 156 177 158 3280	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% *= 65%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ^a = 0.15 Test for overall effect: Z = 2	20 115 3 30 54 3 36 4 18 283 283 283 260 (P = 0.	32 360 17 67 120 30 95 18 47 786 .87, df= 009)	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0	116 382 1649 101 337 204 156 177 158 3280	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2 = 65%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43]	
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2	20 115 3 30 54 3 36 4 18 283 2; Chi² = 22 2.60 (P = 0.	32 360 17 67 120 30 95 18 47 786 .87, df= 009)	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0	116 382 1649 101 337 204 156 177 158 3280	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% ² = 65%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 (0.66, 1.53] 1.78 (0.47, 6.71] 1.55 (0.90, 2.67] 0.86 (0.27, 2.76] 1.20 (0.61, 2.34] 1.66 [1.13, 2.43]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+)
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matanglia et al, 2016 Munoz-Antoli et al, 2018 Osazuwa et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2	20 115 3 30 54 3 36 4 18 283 3; Chiř = 22 2.60 (P = 0.	32 360 17 67 120 30 95 18 47 786 .87, df= 009)	36 88 341 12 151 12 44 44 54 782 8 (P = 0	116 382 1649 101 337 204 156 177 158 3280 0.004); P	10.4% 17.3% 6.3% 10.9% 5.8% 14.1% 7.0% 12.2% 100.0% 2= 65%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+)
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matanglia et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2	20 115 3 30 54 3 36 4 18 283 3; Chi ^p = 22 2.60 (P = 0. Hookworr Events	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) Total	36 88 341 12 151 12 44 44 54 782 8 (P = 0 Uninfect Events	116 382 1649 101 337 204 156 177 158 3280 0.004); P	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% *= 65%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] - Odds Ratio V. Random, 95% Cl	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al 2020	20 115 3 30 54 3 36 4 18 283 283 20 Chi ² = 22 2.60 (P = 0. Hookworr Events	32 360 17 67 120 95 18 47 786 .87, df= 009) m (+) Total	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events	116 382 1649 101 337 204 156 177 158 3280 .004); P	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% ² = 65% Weight	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 (0.66, 1.53] 1.78 (0.47, 6.71] 1.55 [0.90, 2.67] 0.86 (0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] - Odds Ratio V, Random, 95% CI 3.46 [0.61, 1.0.65]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% C1
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2016 Munoz-Antoli et al, 2018 Osazuwa et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2 <u>Study or Subgroup</u> Alaribi et al, 2020	20 115 3 30 54 3 36 4 18 283 283 20 Chi ² = 22 20 0 (P = 0. Hookworr <u>Events</u> 4 20 20 20 20 20 20 20 20 20 20	32 360 17 67 120 95 18 47 786 .87, df= 009) m (+) Total	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events 52 2	116 382 1649 101 337 204 156 177 158 3280 .004); F .ted Total 142 142	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% *= 65% Weight 5.4% 7.0%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio <u>V, Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [2.4, 26.55] 10.68 [2.4, 26.55]	0.1 0.2 0.5 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleijon et al, 2020	20 115 3 30 54 3 36 4 18 283 3(Chi ² = 22 2.60 (P = 0.) Hookworr <u>Events</u> 4 23 13	32 360 17 120 30 95 18 47 786 .87, df= 009) m (+) Total 6 145 27	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events 52 3 00	116 382 1649 101 337 204 156 177 158 3280 .004); F .ted Total 142 173 202	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% E 65% Weight 5.4% 7.9%	3.70 [1.64, 8.38] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio IV, Random, 95% C1 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 20.014 0.5 551	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2016 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleign et al, 2015 Amare et al, 2020	20 115 3 30 54 3 36 4 18 283 2; ChiP = 22 2:60 (P = 0. Hookworr <u>Events</u> 4 23 17	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 145 37	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events 52 3 88 88	116 382 1649 101 307 204 156 177 158 3280 0.004); P 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% *= 65% ************************************	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] - Odds Ratio V, Random, 95% C1 3.46 [0.61, 19.55] 10.68 [3.14, 3.63.8] 2.84 [1.43, 5.66] 2.84 [1.43, 5.66]	0.1 0.2 0.5 1 2 5 10 Favors Uninflected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.15 Test for overall effect: Z = 2 <u>Study or Subgroup</u> Alaribi et al, 2020 Aleiign et al, 2015 Amare et al, 2020 Cho et al, 2021	20 115 3 30 54 3 36 4 18 283 283 20 Chi ² = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17	32 360 17 67 120 95 18 47 786 .87, df= 009) m (+) <u>Total</u> 6 145 37 41	36 88 341 12 151 12 44 44 54 782 8 (P = 0 Uninfec Events 52 3 88 341	116 382 1649 101 337 204 156 177 158 3280 0.004); F ted Total 142 173 382 1649	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% *= 65% Weight 5.4% 7.9% 11.5% 11.5%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0dds Ratio <u>V, Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.56] 2.24 [1.43, 5.66] 2.72 [1.44, 5.11] 0.72 [1.44, 5.11]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 <u>Study or Subgroup</u> Alaribi et al, 2020 Alelign et al, 2021 Cho et al, 2021 De Gier et al, 2016	20 115 3 30 54 3 36 4 18 283 36 4 18 283 (Chi ² = 22 2.60 (P = 0.) Hookworr <u>Events</u> 4 23 17 17 3	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 145 37 41 9 	36 88 341 12 151 12 44 54 782 58 (P = 0 Uninfec Events 52 3 88 8 341 12	116 382 1649 101 337 204 156 177 158 3280 .004); F cted Total 142 173 382 1649 101	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 5.4% 7.9% 11.5% 6.4%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio V. Random, 95% Cl 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2 <u>Study or Subgroup</u> Alaribi et al, 2015 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2017	20 115 3 30 54 3 36 4 18 283 3(Chi ^P = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 17 3 195	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 145 37 41 9 679	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events 52 3 88 341 12 2655	116 382 1649 101 337 204 156 177 158 3280 .004); P	10.4% 17.3% 6.3% 10.9% 18.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2= 65% Weight 5.4% 7.9% 11.5% 11.5% 11.5% 11.9% 6.4%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 (2.78, 13.01) 1.01 (0.66, 1.53) 1.78 (0.47, 6.71) 1.55 (0.90, 2.67] 0.86 (0.27, 2.76) 1.20 (0.61, 2.34) 1.66 [1.13, 2.43] 0dds Ratio <u>V, Random, 95% Cl</u> 3.46 (0.61, 19.55) 10.68 [3.14, 36.38] 2.84 (1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 (1.19, 1.73]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleign et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2017 Kebede et al, 2016	20 115 3 30 54 3 36 4 4 18 283 283 283 283 283 283 283 28	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 145 37 41 9 9 18 47 786 .87, df= 009) 145 37 41 9 145 145 145 145 145 145 145 145	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events 52 3 88 341 12 52 3 341 12 52 3	116 382 1649 101 337 204 156 177 158 3280 .004); P	10.4% 17.3% 6.3% 18.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 5.4% 7.9% 11.9% 6.4% 14.3% 8.9%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio <u>IV, Random, 95% CI</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.15 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleiign et al, 2020 Aleign et al, 2015 Amare et al, 2016 Grimes et al, 2016 Ketema et al, 2016	20 115 3 30 54 4 3 36 4 18 283 3; Chi ^a = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 3 195 122 2	32 360 17 67 120 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 145 37 41 9 679 18 44 44	36 88 341 12 151 44 44 54 782 54 782 58 (P = 0 Uninfec Events 3 88 341 12 55 311 12 655 311 14	116 382 1649 101 337 204 156 3280 .004); F 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2=65% Weight 5.4% 7.9% 11.5% 11.5% 11.9% 6.4% 8.9% 6.4%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 (0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 (0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] - Odds Ratio <u>V. Random, 95% C1</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alaribi et al, 2020 Alaribi et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Ketema et al, 2015 Molla et al, 2018	20 115 3 30 54 3 36 4 18 283 3; Chi ^p = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 17 3 195 12 2 2 12 2 2	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 145 37 41 9 679 18 45 37 41 9 679 18 47 7 145 7 15 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 47 7 86 18 18 18 18 18 18 18 18 18 18	36 88 341 12 151 12 44 44 54 782 = 8 (P = 0 Uninfec Events 52 3 88 341 12 555 53 31 12	116 382 1649 101 337 204 156 3280 .004); P .ted 142 173 382 1649 101 2993 112 2993 204	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2= 65% Weight 5.4% 7.9% 11.5% 6.4% 7.9% 11.5% 6.4% 8.9% 6.4% 14.3%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0dds Ratio <u>V, Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.9], 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 565] 6.72 [3.10, 14.58]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2021 De Gier et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018	20 115 3 30 54 4 4 18 283 36 4 4 18 283 283 (Chi ² = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 3 195 12 2 2 2 2 2 2 2 2 2 2 2 2 2	32 360 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 145 37 41 9 9 18 44 7 17 120 18 44 7 17 18 18 18 18 18 18 18 18 18 18	36 88 81 12 151 12 12 44 44 54 54 52 8 (P = 0 Uninfect Events 52 3 3 8 8 341 12 12 52 52 3 3 8 341 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 15 15 15 15 15 15 15 15 15 15 15	116 382 1649 101 337 204 156 177 158 3280 .004); P	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% *= 65% ************************************	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio <u>V. Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 (1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ^a = 0.19 Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleiign et al, 2015 Amare et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018	20 115 3 30 54 4 3 36 4 18 283 1; Chi ^a = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 17 195 12 2 21 2 24	32 360 17 67 120 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 6 1455 37 41 9 679 8 78 44 71 786 120 009) 14 786 14 787 14 787 14 787 786 14 787 14 787 14 787 14 787 14 787 14 787 15 787 18 787 18 787 19 787 19 787 19 787 19 787 19 787 19 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 10 787 787 10 787 10 787 10 77 787 10 77 787 10 77 787 10 77 787 10 77 77 77 787 77 787 77 787 77 7	36 88 341 12 151 12 44 44 44 54 782 28 (P = 0 Uninfec Events 52 23 38 88 341 12 23 331 12 23 31 12 44 44 44 44 44 44 44 44 44 44 44 44 44	116 382 1649 101 337 204 156 177 158 3280 .004); F 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2= 65% Weight 5.4% 7.9% 11.5% 11.5% 11.9% 6.4% 10.9% 5.6%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] . Odds Ratio <u>V. Random, 95% C1</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.7, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09]	0.1 0.2 0.5 1 2 5 10 Favors Uninflected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleign et al, 2020 Cho et al, 2021 De Gier et al, 2016 Ketema et al, 2016 Ketema et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011	20 115 3 30 54 4 18 283 283 283 283 283 283 283 28	32 360 17 67 120 30 95 18 47 786 .87, df= 009) Total 6 145 37 41 9 679 18 44 9 679 18 47 786 195 18 47 786 18 18 47 786 18 18 47 786 18 18 18 47 786 18 18 18 18 18 18 18 18 18 18	366 88 341 12 151 12 12 44 44 44 44 44 54 Uninfece Events 52 3 8 82 341 12 2 3 8 83 41 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 15 15 15 15 15 15 15 15 15 15 15	116 382 1649 101 337 204 156 177 158 3280 .004); P ted Total 142 283 112 293 112 293 112 293 112 204 156 177	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% ² = 65% Weight 5.4% 7.9% 11.5% 11.9% 6.4% 10.9% 6.4% 10.9%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] . 66 [1.13, 2.43] . 68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.91, 7.3] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matanglia et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2021 De Gier et al, 2016 Ketema et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Total (95% CI)	20 115 3 30 54 4 3 36 4 18 283 36 4 18 283 36 4 18 283 36 4 18 283 36 4 18 283 36 4 18 283 17 17 17 17 22 20 0 (P = 0. Hookworr Events 12 2 2 2 2 2 2 2 2 2 2 2 2 2	322 3600 17 67 1200 95 18 47 786 6 6 6 145 37 786 6 147 9 6 79 19 18 44 7 30 9 18 47 786 18 47 786 18 47 786 19 18 47 786 18 47 786 18 47 786 19 18 47 786 18 47 786 19 19 18 47 786 19 19 18 18 47 786 19 19 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 12 44 44 54 782 28 (P = C Events 52 8 88 341 12 23 88 341 12 12 55 51 14 12 24 44 44 44 44 44 44	116 382 1649 101 337 204 156 177 158 3280 .004); P ted Total 142 173 32 1649 101 2993 204 101 29379 204 156 177 6468	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65% ¹ = 65%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ^a = 0.19 Total events Heterogeneity: Tau ^a = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleign et al, 2015 Amare et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2011 Total (95% Cl) Total events	20 115 3 30 54 4 18 283 36 4 18 283 36 4 18 283 36 Chi ² = 22 2.60 (P = 0. Hookworr Events 4 23 17 17 3 195 12 2 24 320 320 330 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 36 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5	322 3600 17 67 120 30 95 18 47 786 .87, df= 009) 01 (+) <u>Total</u> 6 145 37 41 9 679 18 44 71 10 10 10 10 10 10 10 10 10 1	36 88 341 12 151 12 44 44 54 54 52 52 52 52 38 88 341 12 655 31 11 12 44 44 44	116 382 1649 101 337 204 156 177 158 3280 .004); F 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2= 65% Weight 5.4% 7.9% 11.5% 11.5% 11.5% 11.5% 11.5% 11.5% 11.5% 11.5% 11.5% 10.9% 5.6% 10.9% 11.5% 11.5% 11.9% 10.0% 10.0% 10.0% 10.0% 10.9% 10.0%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] . 66 [1.13, 2.43] . 64 [1.43, 5.43] . 74 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Suchdev et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 3 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Ketema et al, 2016 Ketema et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2011 Total (95% CI) Total events	20 115 3 30 54 4 4 18 283 36 4 18 283 283 2060 (P = 0. Hookworr Events 4 23 17 17 3 195 12 2 2 2 2 4 2 2 2 4 2 2 2 4 2 2 2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2	322 3600 17 67 1200 95 18 47 786 6 1455 37 41 9 6 679 18 44 7 41 9 679 18 44 7 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 12 44 44 44 44 44 44 44 44 12 88 (P = C 52 3 88 81 11 12 12 13 14 14 12 12 14 14 14 14 14 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 15 15 15 15 15 15 15 15 15 15 15	116 382 1649 101 337 204 156 177 158 3280 .004); F ted Total 142 173 382 1649 101 142 173 382 1649 101 156 177 6468	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 5.4% 7.9% 11.5% 6.4% 10.9% 5.6% 10.9% 10.9% 5.8% 10.9% 10.9% 5.8% 10.9% 10.9% 5.8% 11.9% 11.	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.47 [0.62, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.15 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleiign et al, 2010 Cho et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46	20 115 3 30 54 4 3 36 4 18 283 3; Chi [#] = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 17 195 12 2 24 21 2 24 3 (Chi [#] = 22 24 3 195 12 2 24 3 195 12 2 24 3 195 12 2 24 3 195 12 2 2 24 3 195 12 2 2 24 3 195 12 2 2 2 2 4 3 195 195 195 195 195 195 195 195	322 3600 17 67 120 30 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 145 37 41 145 37 145 37 145 37 145 37 145 37 145 145 37 145 145 145 145 145 145 145 145	36 88 341 12 151 12 44 44 54 782 Events 52 52 3 88 8341 12 23 88 341 12 12 655 31 14 12 44 44 44 1296 10 (P < 0	116 382 1649 101 337 204 156 177 158 3280 .004); F 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% 2=65% Weight 5.4% 7.9% 11.5% 11.9% 6.4% 10.9% 5.6% 5.6% 10.9% 5.6% 5.	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] .068 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.46 [0.61, 19.55] 10.68, 13.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Total events Heterogeneity: Tau ² = 0.19 Alaribi et al, 2020 Aleign et al, 2020 Aleign et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2017 Kebede et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4	20 115 3 30 54 4 18 283 260 (P = 0. Hookworr Events 4 23 17 3 195 12 2 24 320 (Chi ² = 43. .60 (P < 0.0	322 360 17 67 120 30 95 18 47 786 6 145 37 786 145 37 41 9 679 18 44 47 17 36 1093 1003 10, 10 10,	366 88 341 12 151 12 44 44 44 44 44 44 54 Uninfect Events 52 3 8(P = 0 Uninfect 12 2 3 8 341 12 12 4 4 4 4 4 4 4 12 10 10 10 10 10 10 10 10 10 10 10 10 10	116 382 1649 101 337 204 156 177 158 3280 .004); F 	10.4% 17.3% 6.3% 18.0% 5.8% 14.1% 7.0% 12.2% 100.0% *= 65% Weight 5.4% 7.9% 11.9% 6.4% 14.3% 8.9% 6.4% 10.9% 10.9% 10.9% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 6.	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 1.66 [1.13, 2.43] 0.045 Ratio <u>IV, Random, 95% CI</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.9, 1.73] 5.23 [1.80, 15.14] 1.42 [0.27, 5.65] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49]	0.1 0.2 0.5 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2021 De Gier et al, 2016 Ketema et al, 2016 Ketema et al, 2016 Ketema et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4	20 115 3 30 54 3 36 4 18 283 36 4 18 283 36 4 18 283 36 4 18 283 17 17 17 17 17 17 17 17 22 21 2 21 2 2 24 320 (Chi² = 43). 60 (P = 0.) 105 105 105 105 105 105 105 105	322 3600 17 67 1200 95 18 47 786 .87, df= 009) Total 6 145 37 45 37 44 71 9 679 18 44 47 19 5 18 44 7 36 19 5 18 18 18 18 18 18 18 18 18 18	366 88 341 12 151 12 44 44 54 782 28 (P = C Uninfec Events 52 23 88 341 12 655 51 14 12 24 44 44 1296 (P < 0 Uninfec (P < 0 Uninfec (P < 0) 0 (P < 0) 0 (P < 0) Uninfec (P < 0) 0 (P < 0) Uninfec (P < 0) (P < 0) Uninfec (P < 0) (P < 0) Uninfec (P < 0) (P < 0) Uninfec (P < 0) (P < 0) (P < 0) Uninfec (P < 0) (P < 0) (P < 0) Uninfec (P < 0) (P <	116 362 1649 101 337 204 156 3280 .004); P .ted Total 142 173 382 101 129 337 204 101 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 3280 .004); P .ted 177 158 177 158 3280 .004); P .ted 177 164 177 177 158 177 177 178 177 178 177 178 177 178 177 168 177 177 177 178 177 178 177 177	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 5.4% 7.9% 11.5% 6.4% 14.3% 6.4% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.0% 10.9%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio <u>V. Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 1.44 [1.19, 1.73] 5.23 (1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] Odds Ratio	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Total events Heterogeneity: Tau ² = 0.19 Alaribi et al, 2020 Alaribi et al, 2020 Alaribi et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4	20 115 3 30 54 4 3 36 4 18 283 36 4 18 283 36 Chi ^a = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 17 3 195 12 2 24 320 (Chi ^a = 43) .60 (P < 0. Wuttple Inffe Events	322 3600 17 67 1200 95 18 47 786 87, df= 0009) n (+) <u>Total</u> 145 37 41 145 37 41 9 679 18 44 71 78 6 100 9 100 100 100 100 100 100	36 88 341 12 151 12 44 44 44 54 54 52 52 23 88 8341 12 23 88 341 12 23 38 83 31 12 26 55 31 12 26 55 31 12 29 67 90 90 90 90 90 90 90 90 90 90 90 90 90	116 362 1649 101 337 1649 204 156 177 158 3280 .0004); F .tted Total 142 2993 112 2993 112 2993 1177 6468 .00001) .cted Total	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% 2= 65% Weight 5.4% 7.9% 11.5% 11.9% 6.4% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 11.5% 5.6% 11.5% 5.6% 11.5% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 11.5% 5.6% 10.9% 5.6% 5.6% 10.9% 5.6	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] . Odds Ratio <u>V. Random, 95% C1</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] — Odds Ratio <u>V. Random, 95% C1</u>	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Suchdev et al, 2011 Suchdev et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleiton et al, 2015 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Ketema et al, 2017 Kebede et al, 2016 Ketema et al, 2017 Ketema et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4	20 115 3 30 54 4 3 36 4 18 283 283 283 283 283 283 283 28	322 360 17 67 120 30 95 18 47 786 .87, df= 0009) n (+) Total 6 145 37 41 9 6 786 145 37 41 9 167 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 44 44 44 44 44 44 44 44 44 1226 655 52 33 8 (P = 0 52 33 41 12 12 44 44 1226 (P < 0 P <	116 362 1649 101 337 204 158 3280 .0004); F 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 14.3% 6.4% 10.9% 10.9% 10.9% 10.9% 10.0% 5.6% 10.9%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.47 [0.62, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.22 [10.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] Odds Ratio IV, Random, 95% CI	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% Cl) Total events Heterogeneity: Tau ² = 0.15 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2016 Grimes et al, 2016 Ketema et al, 2016 Ketema et al, 2016 Ketema et al, 2016 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alelign et al, 2015 De Gier et 2015	20 115 3 30 54 4 3 36 4 18 283 3(Chi ² = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 3 195 12 2 24 320 (Chi ² = 43. .60 (P < 0.0 Wultiple Infe <u>Events</u> 15 25 26 24 320 320 320 320 320 320 320 320	322 3600 17 67 1200 95 18 47 786 187, df= 009) n (+) Total 9 679 18 44 71 6 1093 01, df= 10003 333 345 10003 10000 100	366 88 341 12 151 12 44 44 44 54 782 Events 52 8 (P = 0 Uninfec Events 52 3 3 88 341 12 655 31 14 12 655 31 14 12 26 655 31 14 12 2 9 8 9 9 0 9 9 0 9 9 0 9 10 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 12 15 11 12 12 15 11 12 12 12 12 12 12 12 12 12 12 12 12	116 362 1649 101 337 1649 204 158 3280 .004); F .ted Total 142 2993 204 158 .0004); F .ted Total 117 6468 .00001) .cted Total 1177 .cted .004; F .cted .004; F .cted .c	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 5.4% 7.9% 11.5% 6.4% 10.9% 5.4% 10.9% 5.4% 10.9% 5.4% 10.9% 10	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 (0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Total events Heterogeneity: Tau ² = 0.19 Alaribi et al, 2020 Aleign et al, 2020 Aleign et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Ketema et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alaribi et al, 2016 Ketema et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Aleign et al, 2015 De Gier et al, 2016 Diversit et al, 2016	20 115 3 30 54 4 18 283 283 283 283 283 283 283 28	322 3600 17 67 120 30 95 18 47 786 6 18 47 786 6 145 37 41 9 6 786 145 37 41 9 6 786 145 37 41 9 6 786 19 5 18 18 47 786 18 18 18 18 18 18 18 18 18 18	366 88 341 12 151 12 44 44 44 44 44 44 44 44 45 8 52 3 3 8 (P = 0 Uninfect Events 3 3 41 12 44 44 44 44 44 44 44 12 9 655 52 3 11 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 15 11 12 12 15 11 12 12 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 12 11 12 12 12 11 12 12 12 11 12 12	116 362 1649 101 337 1649 204 156 177 158 3280 .004); F .tted Total 142 2993 112 2993 112 2993 112 204 156 177 6468 .00001) .tted Total 177 158 177 158 177 158 177 158 177 101 177 101 177 101 177 101 177 105 177 105 177 105 177 105 105 107 107 105 107 107 105 107 105 107 107 105 107 107 107 107 107 107 107 107	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% ¹² = 65% ¹³ - 5% 11.9% 6.4% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 11.9% 6.4% 10.9% 11.9% 11.9% 6.4% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 10.9% 11.9% 10.0% 10.9% 10.0% 10.0% 11.9% 10.0% 10.0% 11.9% 10.0% 11.9% 10.0% 11.9% 10.0% 11.9% 10.0% 10.0% 11.9% 10.0%	3.70 [1.64, 8.36] 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] . 66 [1.13, 2.43] . 64 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] . Odds Ratio IV, Random, 95% CI IV,	0.1 0.2 0.5 2 5 10 Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2016 Grimes et al, 2016 Grimes et al, 2011 Total events Heterogeneity: Tau ² = 0.46 Grimes et al, 2011 De Gier et al, 2016 Ketema et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alelign et al, 2015 De Gier et al, 2015 De Gier et al, 2015 De Gier et al, 2016	20 115 3 30 54 4 4 18 283 36 4 4 18 283 36 4 4 18 283 200 (P = 0. Hookworr Events 4 23 17 17 3 195 12 2 24 3200 (Chi ² = 43) .60 (P < 0.) Wutiple Infe Events 15 60 (P < 0.) Wutiple Infe Events 15 60 (P < 0.) 15 15 15 15 15 15 15 15 15 15	322 360 17 67 120 30 95 18 47 786 .87, df= 0009) 786 145 37 41 9 67 9 18 44 71 9 18 44 7 36 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 44 44 44 44 44 54 52 28 (P = 0 52 23 88 80 341 12 12 655 31 14 12 26 55 22 3 38 11 12 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 15 15 11 12 11 11	116 362 1649 101 337 1649 204 156 3280 .004); F .ted Total 142 173 382 203 .004); F .ted 142 173 382 203 .004); F .ted 177 .ted 177 .ted 177 .ted 177 .ted 177 .ted 177 .ted 177 .ted .004); F .ted .004); F .ted .004); F .ted .ted .004); F .ted .004); F .ted .ted .004); F .ted	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 15.4% 7.9% 11.5% 6.4% 10.9% 5.4% 10.9%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 (0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] Odds Ratio <u>V. Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 (1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] Odds Ratio <u>IV, Random, 95% Cl</u> .47, 178, 6.68] 0.349 [1.76, 6.68] 0.349 [1.76, 6.68] 0.39 [0.17, 0.88] 1.92 [0.17, 0.88] 1.92 [0.17, 0.88] 1.92 [0.17, 0.88] 1.92 [0.17, 0.88] .92 [0.17, 0.88] .93 [0.17, 0.84] .93 [0.17, 0.85] .93 [0.17, 0.84] .93 [0.17, 0.85] .93 [0.17, 0.85] .93 [0.17,	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% Cl Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Total events Heterogeneity: Tau ² = 0.19 Alaribi et al, 2020 Alaribi et al, 2020 Alaribi et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Grimes et al, 2017 Kebend et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 I Study or Subgroup Alaribi et al, 2015 Mola et al, 2016 Cho et al, 2017 Keberna et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 I Study or Subgroup Alelign et al, 2015 De Gier et al, 2016 Diyardi et al, 2021 Mula et al, 2018	20 115 3 30 54 4 3 36 4 18 283 3(Chi [#] = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 3 195 12 2 24 21 2 24 320 (Chi [#] = 43) .60 (P < 0.0 Wultiple Infe <u>Events</u> 15 68 25 15 68 25 15 15 15 15 15 15 15 15 15 1	320 360 17 67 120 95 18 47 786 6 6 6 6 786 6 6 786 145 37 41 145 37 41 145 37 44 74 145 37 44 74 6 6 79 6 79 140 78 6 78 78 6 78 78 6 78 78 6 78 78 6 79 145 37 78 6 79 145 37 7 8 7 145 37 7 145 37 7 145 37 7 145 37 7 167 100 9 100 100 100 100 100 100	366 88 341 12 151 12 44 44 44 54 782 28 (P = 0 Uninfec Events 52 3 88 8341 12 23 88 341 12 23 88 341 12 12 655 31 14 12 20 65 53 11 2 26 65 53 11 2 26 65 53 11 2 2 3 3 88 83 41 12 2 4 6 4 4 4 4 4 4 4 5 4 5 4 5 4 5 4 5 4 5	116 362 1649 101 337 1649 204 156 177 158 3280 .0004); F .ted Total 142 2993 112 2993 112 204 156 .00001) .cted Total 177 6468 .00001) .cted Total 177 177 	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 5.4% 7.9% 11.5% 11.9% 6.4% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.8% 1.5%	3.70 (1.64, 8.36) 1.57 [1.13, 2.17] 0.82 (0.23, 2.88] 6.01 [2.78, 13.01] 1.01 (0.66, 1.53] 1.78 (0.47, 6.71] 1.55 (0.90, 2.67] 0.86 (0.27, 2.76] 1.20 (0.61, 2.34] 1.66 [1.13, 2.43] 1.66 [1.13, 2.43] 	0.1 0.2 0.5 1 2 5 10 Favors Uninflected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninflected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleign et al, 2015 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Ketema et al, 2017 Kebede et al, 2016 Grimes et al, 2017 Kebede et al, 2017 Kebede et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 I Study or Subgroup Aleign et al, 2018 De Gier et al, 2018 Dia events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 I Study or Subgroup Aleign et al, 2018 Duardi et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018	20 115 3 30 54 4 4 18 283 36 4 18 283 283 283 280 (P = 0. Hookworr Events 4 23 17 3 195 12 2 24 320 (Chi ² = 22 2,60 (P = 0. Hookworr Events 4 23 17 3 195 12 2 24 3 10 5 12 2 24 3 20 (Chi ² = 43) .60 (P < 0.0 Wultiple Infe Events 16 8 26 27 27 27 27 27 27 27 27 27 27	322 360 17 67 120 30 95 18 47 786 .87, df= 0009) 6 145 37 786 145 37 41 9 9 6 145 37 41 9 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 44 44 44 44 44 44 44 454 Uninfec <u>Events</u> 33 8 (P = 0 52 38 8 (P = 0 52 33 8 (2) 10 (P = 0 10 (P < 0 10 (P < 0 10 (P < 0)) 12 (P < 0 12 (P < 0)) 12 (P < 0) 12 (P < 0)) 12 (P < 0) 12 (P < 0)) 12 (P < 0))	116 362 1649 101 337 204 158 3280 .0004); F ted Total 142 173 382 1649 101 2993 204 1649 101 142 173 382 203 1649 1649 158 3280 .0004); F Control Control	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 14.3% 6.4% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 11.5% 15.3	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] 0.34 [1.7, 3.68] 0.34 [1.7, 3.68] 0.39 [0.17, 0.88] 1.23 [1.7, 30.87] 3.77 [2.04, 6.87] 3.77 [2.04, 6.87] 3.77 [2.04, 6.87] 3.77 [2.04, 6.87]	0.1 0.2 0.5 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI Cl Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI Cl Cl Cl Cl Cl Cl Cl Cl Cl Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matanglia et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2017 Kebede et al, 2016 Grimes et al, 2017 Kebede et al, 2016 Ketema et al, 2017 Kebede et al, 2016 Ketema et al, 2017 Kebede et al, 2016 Ketema et al, 2017 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alelign et al, 2017 Do Gier et al, 2016 De Gier et al, 2016 Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Sanchez et al, 2018	20 115 3 30 54 4 3 36 4 4 18 283 36 4 18 283 36 4 18 283 36 4 18 283 36 4 18 283 36 (Chi ² = 22 20.00 (P = 0.1 Hookworr Events 12 2 24 320 (Chi ² = 43.1 60 (P < 0.0 Withiple Info Events 15 68 25 15 60 7 2 2 2 2 15 60 7 2 2 2 2 4 3 19 5 12 2 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 2 4 3 19 5 12 2 2 4 3 10 5 12 2 2 2 4 3 10 5 12 2 2 4 3 10 5 12 2 2 4 3 10 5 12 2 2 4 3 10 5 12 2 2 4 3 10 5 12 2 2 4 3 10 5 12 2 2 4 3 15 5 15 12 2 2 2 4 3 15 5 15 15 15 15 15 15 15 15	322 3600 17 67 120 30 95 18 47 786 145 37 41 19 679 145 37 41 9 679 145 37 41 9 679 1000 100001) 100001) 100001 1000001 1000001 1000001 1000001 1000001 1000001 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 1000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 10000000 100000000	366 88 341 12 151 12 44 44 44 54 782 28 (P = 0 Uninfec Events 52 3 3 88 341 12 55 3 3 31 12 655 531 11 4 4 4 4 4 4 4 4 12 15 12 12 12 12 12 15 11 12 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 12 15 11 12 12 15 11 12 12 15 11 12 12 15 11 12 12 12 12 12 12 12 12 12 12 12 12	116 362 1649 101 337 1649 204 1649 204 156 3280 .004); F .ted Total 173 382 101 2993 312 2993 204 177 6468 .00001) .ted Total 177 6468 .00001) .ted 205 .00001) .ted .00001) .ted .00001 .ted .00001) .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .00001 .ted .ted .00001 .ted .ted .00001 .ted .ted .ced .ted .ced .ted .ted .ted .ced .ted	10.4% 17.3% 6.3% 14.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 5.4% 7.9% 11.5% 11.5% 11.5% 11.5% 10.9% 10.0% ; P= 77% Weight 13.5% 16.3% 9.0% 16.3% 9.0% 10.0%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 (0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] . Odds Ratio <u>V, Random, 95% C1</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.74 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] . Odds Ratio <u>IV, Random, 95% C1</u> . Odds Ratio <u>IV, Random, 95% C1</u> . Odds Ratio <u>IV, Random, 95% C1</u>	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.19 Total events Heterogeneity: Tau ² = 0.19 Alaribi et al, 2020 Aleign et al, 2020 Aleign et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2017 Kebede et al, 2017 Kebede et al, 2016 Grimes et al, 2017 Molla et al, 2018 Deszuwa et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Aleign et al, 2015 De Gier et al, 2017 Molla et al, 2018 Sanchez et al, 2013 Wijaya et al, 2013 Wijaya et al, 2013	20 115 3 30 54 4 3 36 4 18 283 283 283 283 283 283 283 28	322 3600 17 67 120 30 95 18 47 786 6 18 47 786 6 145 37 786 6 145 37 41 9 6 787 41 9 6 786 1009) 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 44 44 44 44 44 44 44 45 4 Uninfect Events 52 3 3 8(P = 0 Uninfect Events 3 41 12 44 44 44 44 44 44 44 44 44 44 44 44 44	116 362 1649 101 337 1649 204 156 177 158 3280 .0004); F .tted Total 142 2993 112 2993 112 2993 112 204 156 107 157 101 105 101 101 101 101 104 105 107 105 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 107 108 108 107 108 108 107 108 108 107 108 108 108 108 108 108 109 108 108 108 108 108 108 108 108	10.4% 17.3% 6.3% 14.1% 7.0% 12.2% 100.0% = 65% Weight 5.4% 7.9% 11.9% 6.4% 7.9% 11.9% 6.4% 10.9% 10.9% 10.9% 10.9% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 10.9% 11.9% 6.4% 11.9% 6.4% 11.9% 6.4% 10.9% 11.5% 12.2% 12.2% 12.2% 13.5% 12.2% 12.2% 13.5% 12.2% 13.5% 14.2% 12.2% 13.5% 14.2%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 (2.78, 13.01) 1.01 (0.66, 1.53) 1.78 (0.47, 6.71) 1.55 (0.90, 2.67] 0.86 (0.27, 2.76] 1.20 (0.61, 2.34) 1.66 (1.13, 2.43] 1.66 (1.13, 2.43) 1.66 (1.14, 3.6.38) 2.84 (1.43, 5.66] 2.72 (1.44, 5.11] 3.71 (0.82, 16.81] 1.44 (1.19, 1.73] 5.23 (1.80, 15.14] 1.24 (1.27, 5.65] 6.72 (3.10, 14.58] 1.02 (0.19, 5.44] 6.05 (2.79, 13.09] 3.30 (1.98, 5.49] Odds Ratio IV, Random, 95% C1 IV, Random, 85% C1 IV	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 3 Study or Subgroup Alaribi et al, 2020 Alelign et al, 2015 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2017 Kebede et al, 2016 Grimes et al, 2017 Kebede et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alelign et al, 2017 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alelign et al, 2018 Munoz-Antoli et al, 2018 De Gier et al, 2016 Duardi et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Sanchez et al, 2018 Sanchez et al, 2011 Total (95% CI)	20 115 3 30 54 4 4 18 283 36 4 4 18 283 20 20 10 10 10 10 10 10 10 10 10 1	322 3600 17 67 120 30 95 18 47 786 .87, df= 0009) n (+) Total 6 145 37 41 9 67 9 8 78 44 7 36 109 10 10 10 10 10 10 10 10 10 10	366 88 341 12 151 12 44 44 44 44 44 44 44 45 4 52 28 8 (P = C Events 52 23 88 80 341 12 12 655 51 14 41 12 90 (P < 0 90 (P < 0)) (P < 0 90 (P < 0)) (P < 0) (P < 0)) (P < 0) (P < 0)) (P < 0) (P < 0)) (P < 0)) (P < 0)) (P < 0)) (P < 0	116 362 1649 101 337 1649 104 204 156 3280 .0004); F .ted Total 142 173 382 204 142 177 168 173 382 204 142 177 164 177 158 3280 .0001); F .ted 177 6468 .00001) .ted 177 6468 .00001) .ted 1649 1648 1648 101 156 1648 101 156 1648 101 156 1648 101 156 101 156 101 156 101 156 101 156 101 156 101 156 101 156 101 156 101 101 156 101 101 156 101 104 104 105 104 105 104 105 105 105 105 105 105 105 105	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 5.4% 7.9% 11.5% 6.4% 10.9% 5.4% 7.9% 11.5% 6.4% 10.9% 5.6% 10.9% 10.0% (P=77% Weight 15.6% 15.6% 15.3% 9.0% 9.0% 14.2% 16.3% 9.0% 14.2% 16.3% 16.3% 16.3% 9.0% 14.2% 16.3%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0 Odds Ratio <u>V. Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.47 [0.62, 16.81] 1.44 [1.19, 1.73] 5.23 (1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] Odds Ratio <u>IV, Random, 95% Cl</u> 7.20 [1.47, 178.80] 3.43 [1.76, 6.69] 0.39 [0.17, 0.88] 12.63 [5.17, 30.87] 3.77 [2.04, 6.87] 1.72 [0.15, 19.33] 7.00 [2.15, 22.76]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% Cl Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% Cl Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% Cl
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2018 Munoz-Antoli et al, 2018 Osazuwa et al, 2011 Suchdev et al, 2014 Total (95% CI) Total events Heterogeneity: Tau ² = 0.15 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Alaribi et al, 2020 Alaribi et al, 2020 Cho et al, 2021 De Gier et al, 2016 Grimes et al, 2016 Ketema et al, 2015 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2018 Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alaribi et al, 2016 Ketema et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alelign et al, 2018 Munoz-Antoli et al, 2018	20 115 3 30 54 4 3 36 4 18 283 3(Chi ² = 22 2.60 (P = 0. Hookworr <u>Events</u> 4 23 17 17 3 195 12 2 24 320 (Chi ² = 43). 60 (P < 0.0 Wultiple Infe <u>Events</u> 15 68 25 15 37 2 5	322 360 17 67 120 95 18 47 786 .87, df= 009) n (+) <u>Total</u> 145 37 41 145 37 41 9 679 18 44 71 10 00, 145 37 41 145 36 100 31 32 15 44 7 1000 1000 100 100 100 100 100	366 88 341 12 151 12 44 44 44 54 782 28 (P = 0 Uninfec Events 52 3 3 88 341 12 655 3 3 11 2 655 3 11 4 4 4 4 4 4 4 1296 10 (P < 0 Uninfec Events 5 2 3 3 8 8 11 2 2 3 3 8 11 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 11 2 3 3 8 11 2 3 3 8 11 2 3 3 3 8 11 2 3 3 8 11 2 3 3 3 11 2 3 3 8 11 2 2 3 3 8 11 2 3 3 8 11 2 2 3 3 8 11 2 2 3 3 8 8 11 2 2 3 3 8 11 2 2 3 3 8 8 11 2 2 3 3 8 112 2 3 3 8 8 11 2 2 6 5 5 5 3 3 11 12 2 6 5 5 5 3 3 11 12 2 6 5 5 5 3 11 11 2 2 6 6 5 5 5 3 11 11 2 2 6 6 5 5 5 3 11 11 12 2 6 5 5 5 3 11 11 12 2 6 6 5 5 3 11 11 12 2 6 6 5 5 5 3 11 11 12 2 6 5 5 5 3 11 11 12 2 6 5 5 5 3 11 11 12 2 6 5 5 5 3 11 11 12 2 6 5 5 5 3 11 11 12 2 6 5 5 5 3 11 11 1 2 6 5 5 5 3 11 11 12 2 6 5 5 5 5 5 3 11 11 12 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	116 362 1649 101 337 1649 204 156 3280 .0004); F .ted Total 142 2993 117 6468 .00001) .cted 177 6468 .00001) .cted 177 6468 .00001) .cted 177 6468 .00001) .cted 177 .01 .01 .01 .01 .01 .01 .01 .01	10.4% 17.3% 6.3% 18.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 5.4% 7.9% 11.5% 14.3% 8.9% 5.6% 10.9% 5.6% 10.9% 5.6% Weight 13.5% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 5.6% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.9% 10.0% 10.9% 10.0% 10.9% 10.0% 10.0% 10.0% 10.0% 10.0% 10.0% 10.0% 10.0% 10.0% 11.5% 10.0%	3.70 (1.64, 8.36) 1.57 [1.13, 2.17] 0.82 [0.23, 2.88] 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 1.66 [1.13, 2.43] 1.66 [1.13, 2.43] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] 0.33 [1.78, 6.69] 0.33 [1.7, 0.87] 3.77 [2.04, 6.97] 1.72 [0.15, 19.33] 7.00 [2.15, 22.76] 4.49 [1.58, 12.75]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI Cl Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Suchdev et al, 2011 Suchdev et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.15 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleign et al, 2015 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Ketema et al, 2017 Kebede et al, 2016 Grimes et al, 2017 Kebede et al, 2017 Kebede et al, 2018 Osazuwa et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Aleign et al, 2018 De Gier et al, 2018 Di Sazuwa et al, 2018 De Gier et al, 2018 Di Sazuwa et al, 2018 Di Sazuwa et al, 2018 De Gier et al, 2018 Munoz-Antoli et a	20 115 3 30 54 4 3 36 4 18 283 36 4 18 283 36 4 283 36 4 283 36 4 23 17 3 195 12 2 24 320 (Chi ² = 22 24 320 (Chi ² = 43 .60 (P < 0.0 Wultiple Infe Events 16 8 26 17 2 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 19 5 12 2 2 4 3 10 5 12 2 2 4 3 10 5 12 2 2 4 3 15 5 12 2 2 4 3 16 5 12 2 2 4 3 16 5 12 2 2 4 3 16 5 12 2 2 4 3 16 5 12 2 2 4 3 16 5 18 18 5 18 18 5 18 18 18 18 18 18 18 18 18 18	322 360 17 67 120 30 95 18 47 786 6 141 9 6 145 37 786 145 37 41 9 6 145 37 41 9 6 109 30 18 44 7 100 18 44 7 100 18 18 47 100 18 18 47 100 18 18 47 100 18 18 18 18 18 18 18 18 18 18	366 88 341 12 151 12 44 44 44 44 44 44 44 44 12 26 55 23 38 8 (P = 0 Uninfece Events 33 11 12 44 44 44 44 12 20 60 55 31 11 12 2 46 6 52 33 12 12 12 12 12 12 12 12 12 12 12 12 12	116 362 1649 101 337 204 158 3280 .000); F ted Total 142 173 382 204 158 3280 .000); F ted 142 173 382 293 204 164 177 158 3280 .000); F ted 142 177 158 3280 .000); F ted 142 177 158 3280 .000); F ted 142 177 158 3280 .000); F 158 3280 .000); F 158 3280 .000); F 158 3280 .000); F 158 3280 .000); F 158 .000); F 158 .000); F 158 .000); F 164 .000); F 164 .000); F .000); F .00	10.4% 17.3% 6.3% 10.9% 16.0% 5.8% 14.1% 7.0% 12.2% 100.0% = 65% Weight 15.3% 11.5% 11.5% 11.5% 11.5% 15.6% 10.9% 100.0% Weight 13.5% 16.3% 9.0% 14.2% 100.0% 14.2% 100.0% 14.2% 100.0% 14.2% 100.0% 14.2% 100.0% 14.2% 100.0% 15.3% 15.	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 1.44 [1.19, 1.73] 5.23 [1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] 0.045 Ratio IV, Random, 95% CI IV, Random, 95% CI IV, Random, 95% CI IV, Random, 95% CI IV, 20, 17, 0.88] 1.23 [1.70, 8.69] 0.39 [0.17, 0.88] 1.23 [1.70, 8.67] 1.72 [0.15, 19.33] 7.00 [2.15, 22.76] 4.49 [1.58, 12.75]	0.1 0.2 0.5 2 5 10 Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI Favors Uninfected Favors Hookworm (+) Odds Ratio IV, Random, 95% CI
Alaribi et al, 2020 Amare et al, 2020 Cho et al, 2021 De Gier et al, 2016 Matangila et al, 2014 Molla et al, 2018 Munoz-Antoli et al, 2018 Suchdev et al, 2011 Suchdev et al, 2011 Total events Heterogeneity: Tau ² = 0.19 Test for overall effect: Z = 2 Study or Subgroup Alaribi et al, 2020 Aleiign et al, 2015 Amare et al, 2016 Grimes et al, 2016 Grimes et al, 2016 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2011 Total events Heterogeneity: Tau ² = 0.46 Test for overall effect: Z = 4 Study or Subgroup Alaribi et al, 2020 Aleiign et al, 2017 Kebede et al, 2016 Ketema et al, 2018 Munoz-Antoli et al, 2018 Munoz-Antoli et al, 2011 Total (95% CI) Total events Heterogeneity: Tau ² = 0.46 Diagradia et al, 2018 Munoz-Antoli et al, 2017 Total (95% CI) Total events Heterogeneity: Tau ² = 1.65; CI)	20 115 3 30 54 4 4 18 283 36 4 4 18 283 36 4 4 18 283 200 (P = 0. Hookworr Events 4 23 17 3 195 12 2 24 3200 (Chi ² = 43) 60 (P = 0.) Hookworr Events 4 23 17 17 3 195 12 2 24 320 (Chi ² = 43) 60 (P = 0.) 4 25 17 17 3 195 12 2 24 320 (Chi ² = 51,75 15 15 15 15 15 15 15 15 15 1	322 360 17 67 120 95 18 47 786 1009) 786 18 47 786 145 37 145 36 18 18 145 36 18 18 18 18 18 18 18 18 18 18	366 88 341 12 151 12 44 44 44 44 44 44 54 52 28 87 80 88 80 81 341 12 12 655 31 14 42 44 44 44 12960 10 (P < 0 Uninfece Events 33 2 46 6 12 12 15 15 15 12 12 15 15 15 12 12 15 15 15 12 12 15 15 15 15 12 12 15 15 15 15 12 12 15 15 15 15 15 15 15 15 15 15 15 15 15	116 362 1649 101 337 1649 204 158 3280 .004); F .ted Total 173 382 101 129 337 204 101 177 158 3280 .0001); F .ted Total 156 88 246 .00001) .ted 101 158 3280 .0001; F .ted 102 .0001; F .ted 101 .0001; F .ted 102 .0001; F .ted 102 .0001; F .ted .0001; F .ted .0001; F .ted .00001; F .ted .000001; F .ted .000001; F .ted .000001; F .ted .000001; F .ted .ted .000001; F .ted	10.4% 17.3% 6.3% 14.0% 5.8% 14.1% 7.0% 100.0% = 65% Weight 15.4% 7.9% 11.5% 6.4% 10.9% 5.4% 7.9% 11.5% 6.4% 10.9% 5.6% 10.9% 100.0% (P= 77% Weight 15.6% 15.3% 16.3% 9.0% 14.2% 100.0% 88%	3.70 (1.64, 8.36) 1.57 (1.13, 2.17) 0.82 (0.23, 2.88) 6.01 [2.78, 13.01] 1.01 [0.66, 1.53] 1.78 [0.47, 6.71] 1.55 [0.90, 2.67] 0.86 [0.27, 2.76] 1.20 [0.61, 2.34] 1.66 [1.13, 2.43] 0 Odds Ratio <u>V. Random, 95% Cl</u> 3.46 [0.61, 19.55] 10.68 [3.14, 36.38] 2.84 [1.43, 5.66] 2.72 [1.44, 5.11] 3.71 [0.82, 16.81] 1.44 [1.19, 1.73] 5.23 (1.80, 15.14] 1.24 [0.27, 5.65] 6.72 [3.10, 14.58] 1.02 [0.19, 5.44] 6.05 [2.79, 13.09] 3.30 [1.98, 5.49] Odds Ratio <u>IV. Random, 95% Cl</u> V. Random, 95% Cl 12.63 [5.17, 30.87] 3.77 [2.04, 6.87] 1.72 [0.15, 19.33] 7.00 [2.15, 22.76] 4.49 [1.58, 12.75]	0.1 0.2 0.5 1 2 5 10 Favors Uninfected Favors Trichuris (+) Odds Ratio IV, Random, 95% CI

Figure 3: Subgroup forest plot for risk of anemia in soil-transmitted helminthiasis infected and uninfected children

Table 2: Number and proportion of soil-transmitted helminthiasis infected and uninfected children with anemia

Author, year	Number	Age (year)	Any STH		Ascaris lumbricoides		Trichuris trichiura		Hookworm		Multiple Infection		Not Infected	
	of sample	0 0 /	n (total)	Percentage	n (total)	Percentage	n (total)	Percentage	n (total)	Percentage	n (total)	Percentage	n (total)	Percentage
Abanyie	690	1–5	50 (72)	69.4									55 (77)	71.4
<i>et al.</i> , 2013 [9] Alaribi <i>et al</i> .,	148	< 12	31 (55)	56.36	15 (31)	48.4	20 (32)	62.5	4 (6)	66.7			25 (93)	26.88
2020 [22] Alelign <i>et al</i> .,	384	5–14	38 (211)	18.01					23 (145)	15.86	15 (33)	45.45	3 (173)	1.73
2015 [23] Hailu Amare	861	11 4 (1 9)	. ,		64 (159)	40 25	115 (360)	31 94	17 (37)	45 94			88 (382)	23.04
and Lindtjørn, 2020 [24]		(01 (100)	10.20		01101	(0.)	10101			00 (002)	20.01
Belizario et al., 2021/251	331	3–6	63 (166)	38									52 (165)	31.5
Belizario et al.,	656	6–12	76 (271)	28									50 (385)	13
2021[25] Cho <i>et al</i> ., 2021 [10]	2018	8.3 (2.5)	126 (369)	34.1	105 (304)	34.54	3 (17)	17.65	17 (41)	41.46			341 (1649)	20.7
Darlan <i>et al.</i> ,	72	7–10	14 (29)	48.28									10 (43)	23.26
2018 [26] De Gier <i>et al.</i> , 2016	510	7.5 (0.9)			14 (118)	11.9	30 (67)	44.8	3 (9)	33.3	68 (215)	31.6	12 (101)	11.9
Djuardi <i>et al.</i> ,	393	1–5	24 (51)	47.1							25 (46)	54.3	46 (61)	75.4
Getaneh <i>et al.</i> , 2017	542	6–14	11 (18)	61									70 (505)	13.9
[28] Grimes <i>et al</i> .,	3672	11.8 (2.1)							195 (679)	29			655 (2993)	22
2017 [29] Kebede	130	0–19							12 (18)	66.7			31 (112)	27.7
<i>et al</i> ., 2016 [30]														
Ketema <i>et al</i> ., 2015 [31]	423	5–14							2 (44)	4.55			14 (379)	4.48
Liu et al.,	2179	10.58	173 (912)	19									190 (1267)	15
2015 [12] Matangila <i>et al.</i> , 2014	616	(0.87) 8 (7.5–9.5)			47 (92)	51.1	54 (120)	45					158 (365)	43.2
Molla and Mamo, 2018	443	6–15	56 (239)	23.4	17 (92)	18.48	3 (30)	10	21 (71)	29.58	15 (34)	44.12	12 (204)	5.9
[32] Muñoz-Antoli et al., 2018	341	8.53 (2.68)	79 (185)	42.7	4 (11)	36.3	36 (95)	37.9	2 (7)	28.5	37 (62)	59.68	44 (156)	28.2
[15] Oliveira	328	5–12			7 (53)	13.2							64 (275)	23.3
[33] Osazuwa	316	1–15	68 (139)	48.92	40 (85)	47.06	4 (18)	22.22	24 (36)	66.67			44 (177)	24.86
[34] Sanchez	320	7–12	6 (262)	1.9							2 (103)	1.7	1 (88)	1.1
<i>et al.</i> , 2013 [16] Staudachar	622	40.170	22 (152)	20.02									90 (461)	17.25
et al., 2014 [17]	022	4.9-17.9	32 (153)	20.92									80 (461)	17.35
Subahar <i>et al</i> ., 2020	188	6–18			4 (14)	28.57							37 (178)	20.79
Suchdev et al., 2014	205	3.2 (0.08)	31 (82)	37.9	18 (50)	35.6	18 (47)	38					41 (123)	33.6
[0] Sumbele <i>et al.</i> , 2020	401	4–14	2 (3)	66.7									140 (195)	71.8
[36] Suraweera <i>et al</i> ., 2018	233	1–12	5 (64)	7.8									32 (169)	18.9
[19] Tandoh <i>et al.</i> ,	86	9–12	25 (36)	69.4									61 (128)	48.4
2020 [37] Wijaya <i>et al.</i> , 2021 [21]	384	5–14	38 (211)	18.01					23 (145)	15.86	15 (33)	45.45	15 (246)	6.1
STH: Soil transm	itted helminthi	iasis.												

Discussion

Meta-analysis result of all parameters in this study presented trends of Hb level decrease and increase risk of anemia than that uninfected children groups. Most of analysis was comparable in statistic. This result was also in line to another meta-analysis which was limited in India by Salam and Fareed, in 2019, which pooled that mean Hb was lower than anemia cut off value and risk of anemia at OR 2.8 (2.4–3.4) and still limited at not specific at each species analysis [38]. Lower Hb level and risk of anemia were also synergy to a meta-analysis in Africa which analyzed an increased

risk of anemia in malaria patients coinfected with STH than without STH coinfection for 2.2 times. Children were also at higher risk in comparison to other age groups, in which OR was 2.72 (1.11, 6.7) and Hb level reduction was -1.1 g/dL [39].

Hb level reduction in STH infection was explained from certain mechanism of nutrition absorption deficiency and blood lost [38]. Nutrition absorption alteration was common in *Ascaris lumbricoides* infection affection iron (Fe) absorption followed with other nutrients such as zinc (Zn), protein, folate, vitamin B6, and B12 [40]. One of the symptoms in STH infection causing abdominal discomfort caused lost in appetite which leads to less food and nutrient intake [41]. Blood lost was common due to occult bleeding in *Trichuris trichiura* and hookworm infection, in which biological activity of the parasite caused penetration and disruption in intestinal mucosal epithelium. This was also related to hyaluronidase enzyme responsible in degrading mucosal layer [42].

Almost all included articles in this study presented similar results in Hb level reduction and risk of anemia. Some of those failed to show significance in comparison to uninfected groups such as Sanchez et al. All included studies were cross-sectional that direct causative relation was not clear enough. Endemic area might also interfere due to malnutrition, sociodemographic factors, and climate in study area which may be related to nutritional status and Hb level among subjects [16]. Population with high number or stunting and underweight could also be contrast to other studies as subjects may be at high risk even without any other risk factors such as infections. Daily food intake problems might vary the results as some groups with food intake problem may be a greater risk specific to certain nutrients essential in blood formation which may cause anemia even without any STH infections [25], [43]. Poverty and living in rural communities were the most common factors related to less differences between infected and uninfected groups [42], [44].

As far as, the literature searches were done that the authors could not find other similar meta-analysis to this research specially with species subgroup analysis with broad inclusion in children populations. Some limitation were recorded in this study due to inability to access all publication from all countries and some parameter and subgroup analysis were consisted of small number of references.

Conclusion

STH infection whether single of multiple infection, *Ascaris lumbricoides, Trichuris trichiura*, or hookworm infection were all causes decrease in

Hb level and increase risk to be anemia in children compared to uninfected children. Multiple infection and hookworm infection had the highest risk among other STH species. Other further meta-analysis with broader population and preventive programs to avoid further cases of STH infection and anemia related to STH infections will still needed to be conducted.

References

- Farrar J, Hotez PJ, Junghanss T, Kang G, Lalloo D, White NJ. Manson's Tropical Diseases. 23rd ed. Philadelphia, PA: Elsevier Ltd.; 2014. p. 1337. https://doi.org/10.1016/ b978-0-7020-5101-2.00094-7
- Centers for Disease Control and Prevention. Parasites-soiltransmitted Helminths. CDC; 2020. Available from: https://www. cdc.gov/parasites/sth/index.html [Last accessed on 2021 Apr 03].
- Gordon CA, Kurscheid J, Jones MK, Gray DJ, McManus DP. Soil-transmitted helminths in tropical Australia and Asia. Trop Med Infect Dis. 2017;2(4):56. https://doi.org/10.3390/ tropicalmed2040056
- World Health Organization. Soil-transmitted Helminthiases. Geneva: World Health Organization; 2020. Available from: https://www.who.int/health-topics/soil-transmittedhelminthiases#tab=tab_1 https://doi.org/10.1007/978-3-642-70841-1_5 [Last accessed on 2021 Apr 03].
- Al Amin AS, Wadhwa R. Helminthiasis. Treasure Island, FL: StatPearls; 2021. Available from: https://www.pubmed.ncbi.nlm. nih.gov/32809360 [Last accessed on 2021 Apr 03].
- Suchdev PS, Davis SM, Bartoces M, Ruth LJ, Worrell CM, Kanyi H, et al. Soil-transmitted helminth infection and nutritional status among urban slum children in Kenya. Am J Trop Med Hyg. 2014;90(2):299-305. https://doi.org/10.4269/ajtmh.13-0560 PMid:24343884
- World Health Organization. Global Anemia Prevalence and Number of Individuals. Geneva: World Health Organization; 2008. Available from: https://www.who.int/vmnis/anaemia/ prevalence/summary/anaemia_data_status_t2/en [Last accessed on 2021 Oct 25].
- Kassebaum NJ, Fleming TD, Flaxman A, Phillips DE, Steiner C, Barber RM, *et al.* The global burden of anemia. Hematol Oncol Clin North Am. 2016;30(2):247-308. http://doi.org/10.1016/j. hoc.2015.11.002
 - PMid:27040955
- Abanyie FA, McCracken C, Kirwan P, Molloy SF, Asaolu SO, Holland CV, *et al*. Ascaris co-infection does not alter malariainduced anaemia in a cohort of Nigerian preschool children. Malar J. 2013;12(1):1-9. https://doi.org/10.1186/1475-2875-12-1 PMid:23282136
- Cho FN, Ngala HN, Bongazi RT, Kinsam RS, Tata BT, Aji D, et al. Effects of soil-transmitted helminths and intestinal protozoan infections on haemoglobin levels among schoolaged children in belo and Bui, North West Cameroon: A crosssectional study. J Parasitol Res. 2021;2021:8873555. https:// doi.org/10.1155/2021/8873555
- De Gier B, Nga TT, Winichagoon P, Dijkhuizen MA, Khan NC, Van De Bor M, *et al.* Species-specific associations between soil-transmitted helminths and micronutrients in Vietnamese schoolchildren. Am J Trop Med Hyg. 2016;95(1):77-82. https:// doi.org/10.4269/ajtmh.15-0533 PMid:27246448

 Liu C, Luo R, Yi H, Zhang L, Li S, Bai Y, *et al.* Soil-transmitted helminths in Southwestern China: A cross-sectional study of links to cognitive ability, nutrition, and school performance among children. PLoS Negl Trop Dis. 2015;9(6):1-17. https:// doi.org/10.1371/journal.pntd.0003877

PMid:26110518

- Matangila JR, Doua JY, Linsuke S, Madinga J, Inocêncio Da Luz R, Van Geertruyden JP, *et al.* Malaria, schistosomiasis and soil transmitted helminth burden and their correlation with anemia in children attending primary schools in kinshasa, democratic republic of congo. PLoS One. 2014;9(11):e110789. https://doi.org/10.1371/journal.pone.0110789
 PMid:25372029
- Müller I, Yap P, Steinmann P, Damons BP, Schindler C, Seelig H, *et al.* Intestinal parasites, growth and physical fitness of schoolchildren in poor neighbourhoods of Port Elizabeth, South Africa: A cross-sectional survey. Parasites Vectors. 2016;9(1):1-14. http://doi.org/10.1186/s13071-016-1761-5 PMid:27595566
- Muñoz-Antoli C, Pérez P, Pavón A, Toledo R, Esteban JG. Soiltransmitted helminth infections and anemia in schoolchildren from Corn Island archipelago (RAAS, Nicaragua). Am J Trop Med Hyg. 2018;99(6):1591-7. https://doi.org/10.4269/ ajtmh.18-0195

PMid:30298802

 Sanchez AL, Gabrie JA, Usuanlele MT, Rueda MM, Canales M, Gyorkos TW. Soil-transmitted helminth infections and nutritional status in school-age children from rural communities in honduras. PLoS Negl Trop Dis. 2013;7(8):e2378. https://doi. org/10.1371/journal.pntd.0002378

PMid:23951385

- Staudacher O, Heimer J, Steiner F, Kayonga Y, Havugimana JM, Ignatius R, *et al.* Soil-transmitted helminths in southern highland Rwanda: Associated factors and effectiveness of school-based preventive chemotherapy. Trop Med Int Health. 2014;19(7):812-24. https://doi.org/10.1111/tmi.12321 PMid:24750543
- Sumbele IU, Nkain AJ, Ning TR, Anchang-Kimbi JK, Kimbi HK. Influence of malaria, soil-transmitted helminths and malnutrition on haemoglobin level among school-aged children in Muyuka, Southwest Cameroon: A cross-sectional study on outcomes. PLoS One. 2020;15(3):1-19. https://doi.org/10.1371/journal. pone.0230882

PMid:32226023

- Suraweera O, Galgamuwa L, Wickramasinghe S, Iddawela D, Nandasiri N. Soil-transmitted helminth infections, associated factors and nutritional status in an estate community in Sri Lanka. Sri Lankan J Infect Dis. 2018;8(2):100. https://doi. org/10.4038/sljid.v8i2.8226
- Verhagen LM, Incani RN, Franco CR, Ugarte A, Cadenas Y, Sierra Ruiz CI, *et al.* High malnutrition rate in venezuelan yanomami compared to warao amerindians and creoles: Significant associations WITH intestinal parasites and anemia. PLoS One. 2013;8(10):1-13. https://doi.org/10.1371/journal. pone.0077581

PMid:24143243

- Wijaya W, Pasaribu AP, Yanni GN, Suteno E, Husin N, Pasaribu S. Correlation between soil-transmitted helminths and anemia incidence in primary school children in talawi, batubara regency. Open Access Maced J Med Sci. 2021;9(T3):325-9. https://doi.org/10.3889/oamjms.2021.6357
- Alaribi FI, Unyah NZ, Misni N, Masri SN, Osman M. The prevalence of soil-transmitted helminths infection and its association with anaemia among refugee school children in the Klang Valley, Malaysia. Malaysian J Med Heal Sci. 2020;16(4):46-53.

- Alelign T, Degarege A, Erko B. Prevalence and factors associated with undernutrition and anaemia among school children in Durbete Town, northwest Ethiopia. Arch Public Health. 2015;73(1):34. https://doi.org/10.1186/s13690-015-0084-x PMid:26261719
- 24. Hailu Amare H, Lindtjørn B. Helminth infections among rural schoolchildren in Southern Ethiopia: A cross-sectional multilevel and zero-inflated regression model. PLoS Negl Trop Dis. 2020;14(12):1-24. https://doi.org/10.1371/journal.pntd.0008002
- Belizario VY, Totañes FI, de Leon WU, Lumampao YF, Ciro RN. Soil-transmitted helminth and other intestinal parasitic infections among school children in indigenous people communities in Davao del Norte, Philippines. Acta Trop. 2011;120(1):12-8. https://doi.org/10.1016/j.actatropica.2011.02.010 PMid:21396344
- Darlan DM, Ananda FR, Sari MI, Arrasyid NK, Sari DI. Correlation between iron deficiency anemia and intestinal parasitic infection in school-age children in Medan. IOP Conf Ser Earth Environ. 2018;125(1):1-7. https://doi. org/10.1088/1755-1315/125/1/012059
- Djuardi Y, Lazarus G, Stefanie D, Fahmida U, Ariawan I, Supali T. Soil-transmitted helminth infection, anemia, and malnutrition among preschool-age children in nangapanda subdistrict, indonesia. PLoS Negl Trop Dis. 2021;15(6):1-17. https://doi.org/10.1371/journal.pntd.0009506
 PMid:34138863
- Getaneh Z, Enawgaw B, Engidaye G, Seyoum M, Berhane M, Abebe Z, et al. Prevalence of anemia and associated factors among school children in Gondar town public primary schools, northwest Ethiopia: A school-based cross-sectional study. PLoS One. 2017;12(12):1-14. https://doi.org/10.1371/journal. pone.0190151

PMid:29284032

- Grimes JE, Tadesse G, Gardiner IA, Yard E, Wuletaw Y, Templeton MR, *et al.* Sanitation, hookworm, anemia, stunting, and wasting in primary school children in southern Ethiopia: Baseline results from a study in 30 schools. PLoS Negl Trop Dis. 2017;11(10):1-18. https://doi.org/10.1371/journal.pntd.0005948 PMid:28991894
- Kebede SW, Beyene DA, Meshesha AG, Sinishaw MA. Two thirds of hookworm infected children were anemic at the outpatient department in Jimma Health Center, Jimma, Southwest Ethiopia. Asian Pac J Trop Dis. 2016;6(9):691-4. https://doi.org/10.1016/s2222-1808(16)61111-8
- Ketema H, Biruksew A, Mekonnen Z. Prevalence of Necator americanus infection and risk factors among school-age children in Mirab Abaya District, South Ethiopia. Asian Pacific J Trop Dis. 2015;5(5):363-8. https://doi.org/10.1016/ s2222-1808(14)60798-2
- Molla E, Mamo H. Soil-transmitted helminth infections, anemia and undernutrition among schoolchildren in Yirgacheffee, South Ethiopia. BMC Res Notes. 2018;11(1):1-7. https://doi. org/10.1186/s13104-018-3679-9 PMid:30103797
- Oliveira D, Ferreira FS, Atouguia J, Fortes F, Guerra A, Centeno-Lima S. Infection by intestinal parasites, stunting and anemia in school-aged children from Southern Angola. PLoS One. 2015;10(9):1-10. https://doi.org/10.1371/journal.pone.0137327 PMid:26371758
- Osazuwa F, Ayo OM, Imade P. A significant association between intestinal helminth infection and anaemia burden in children in rural communities of Edo state, Nigeria. NAm J Med Sci. 2011;3(1):30-4. PMid:22540060
- Subahar R, Susanto L, Astuty H, Winita R, Sari IP. Intestinal parasitic infections and hemoglobin levels among schoolchildren participating in a deworming program in Jakarta, Indonesia:

A cross-sectional study. Open Access Maced J Med Sci. 2020;8(E):589-94. https://doi.org/10.3889/oamjms.2020.5153

- Sumbele IU, Nkemnji GB, Kimbi HK. Soil-transmitted helminths and plasmodium falciparum malaria among individuals living in different agroecosystems in two rural communities in the mount Cameroon area: A cross-sectional study. Infect Dis Poverty. 2017;6(1):1-16. https://doi.org/10.1186/s40249-017-0266-6 PMid:28302147
- Tandoh MA, Mills-Robertson FC, Wilson MD, Anderson AK. Nutritional and cognitive deficits of school-age children: A study in helminth-endemic fishing and farming communities in Ghana. Nutr Food Sci. 2020;50(3):443-62. https://doi.org/10.1108/ nfs-01-2019-0035
- Salam N, Fareed M. Soil transmitted helminth infections and its association with haemoglobin levels in India: A meta-analysis. J Clin Diagnostic Res. 2019;13(6):12. https://doi.org/10.7860/ jcdr/2019/40681.12950
- Naing C, Whittaker MA, Nyunt-Wai V, Reid SA, Wong SF, Mak JW, et al. Malaria and soil-transmitted intestinal helminth co-infection and its effect on anemia: A meta-analysis. Trans R Soc Trop Med Hyg. 2013;107(11):672-83. https://doi. org/10.1093/trstmh/trt086
 - PMid:24123127
- Righetti AA, Koua AY, Adiossan LG, Glinz D, Hurrell RF, N'Goran EK, *et al.* Etiology of anemia among infants, schoolaged children, and young non-pregnant women in different

settings of South-Central Côte d'Ivoire. Am J Trop Med Hyg. 2012;87(3):425-34. https://doi.org/10.4269/ajtmh.2012.11-0788 PMid:22848097

- Ahmed A, Al-Mekhlafi HM, Al-Adhroey AH, Ithoi I, Abdulsalam AM, Surin J. The nutritional impacts of soil-transmitted helminths infections among Orang Asli schoolchildren in rural Malaysia. Parasites Vectors. 2012;5(1):1-9. https://doi. org/10.1186/1756-3305-5-119 PMid:22704549
- Sungkar S, Tambunan FB, Gozali MN, Kusumowidagdo G, Wahdini S. The effect of albendazole toward anemia in children with soil-transmitted helminths infection in a remote and endemic area. Med J Indones. 2018;27(4):293-8. https://doi. org/10.13181/mji.v27i4.2857
- Ness TE, Agrawal V, Bedard K, Ouellette L, Erickson TA, Hotez P, et al. Maternal hookworm infection and its effects on maternal health: A systematic review and meta-analysis. Am J Trop Med Hyg. 2020;103(5):1958-68. https://doi.org/10.4269/ ajtmh.20-0503

PMid:32840198

 Ngui R, Lim YA, Kin LC, Chuen CS, Jaffar S. Association between anaemia, iron deficiency anaemia, neglected parasitic infections and socioeconomic factors in rural children of West Malaysia. PLoS Negl Trop Dis. 2012;6(3):1-9. https://doi. org/10.1371/journal.pntd.0001550 PMid:22413027