The Impact of Early Childhood Development Interventions on Children's Growth outcomes in Developing Countries: A Systematic Review

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FAIR Breakfast
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Motivation

- **SDG goals** for child health targeted globally by 2030 (United Nations, 2021)
  - SDG 2: Food security (stunting and wasting for children under 5 years of age)
  - SDG 3: Promote healthy lives
  - SDG 6: Sustainable water and sanitation
- **Statistics**: 22% of children below 5 are stunted and 7% wasted
- **COVID-19**: +9.3 million wasted children, 2.6 million stunted children, 168,000 additional child deaths, $29.7 billion USD in future productivity losses
- **Causes**: Poverty, food insecurity, unhygienic conditions, inadequate parental care etc.

Motivation

- **Treatments**: Nutritional supplementation, awareness and education, asset/cash, sanitation, deworming etc.
- **Existing evidence** on LMICs: evaluation of sole intervention types- daycare, nutritional supplements etc. (Aboud and Yousafzai, 2015),(Miller et al., 2015))

Research Questions

1. Which ECD interventions have an impact improving child growth outcomes?
2. What are the gaps in the literature?
3. What are the policy implications that can be made to achieve the SDG goals by 2030?

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Search Strategy

- Follow a standard PRISMA systematic review and meta-analysis method (Page and Moher, 2017)
- Board search of both published manuscripts and grey literature
- Pulled articles from 20 search engines

Search Strategy

- **Search Terms:** "early childhood development", "early development", "early child care", "ecd", "health", "nutr*", and "food".
- **Primary Outcomes:** Anthropometric Measures (Upper Arm Circumference, Underweight, Stunting, Wasting), Worms Infection, Anemia
- **Secondary Outcomes:** Height (cms), Height for Age, Weight(kgs), Weight for Age, Worms Infection, Head Circumference
- **Exclusion Criteria:** (1) not a developing country as of 1999 (United Nations, 2020), (2) subjects older than 8 years old, (3) publication or intervention prior to the year 2000, (4) another literature review or meta-analysis, (5) not written in English, (6) not an ECD intervention, (7) doesn't measure selected outcome measures, and (8) does not use the RCT method.

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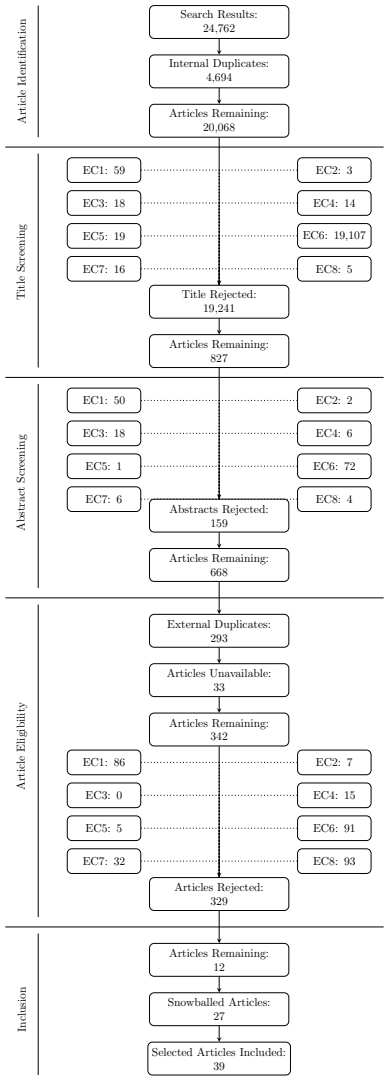
Search Process



Article Selection

- 41 articles included
- 22 countries represented
- **Interventions identified:** (1) childcare, caregiver or parental education, (2) cash transfers, (3) nutritional supplements, (4) deworming, (5) psycho-social stimulation programs, and (6) water and improved sanitation.

Selected Articles

(1) ID	(2) Article	(3) Search Source	(4) Country	(5) Age Range	(6) Program	(7) Interventions	(8) Outcomes	(9) Sample Size	(10) GRADE	(11) Risk of Bias
1	(Behrman and Hoddinott, 2001)*	AgEcon Search	Mexico	1 – 3	PROGRESA	CT	H	693	Moderate	Low
2	(Attanasio et al., 2018)*	EconLit	Colombia	0 – 1	FAMI	CC	HA, S	1,456	Moderate	Low
3	(Levere et al., 2016)*	EconPapers	Nepal	0 – 2	Attencion a Crisis	NS, CT	HA, WA, UW, S, WT	1,953	High	Unclear
4	(Pickering et al., 2019)	IPA	Kenya	2 – 2	Integrated WASH and Child Parasite Infections Study	NS, WS	WI	9,077	High	Low
5	(Null et al., 2018)	IPA	Kenya	0 – 2	Kenya WASH Benefits Study	NS, WS	HC, WA, UW, S, WT	6,583	Moderate	Low
6	(Fink et al., 2017)	IPA	Zambia	0 – 2	National Food and Nutrition Strategic Plan for Zambia	CC, NS	HA, WA, UW, S	497	Moderate	Low
7	(Ozier, 2018)	IPA	Kenya	8 – 8	Primary School Deworming Project	DW	H, HA, S	15,158	Moderate	Low
8	(Berry et al., 2017)*	J-PAL	India	3 – 5	The Mid-day Meal Program & Weekly Iron Folic Acid Program	NS	H, W, WA, UC	1,947	High	Medium
9	(Attanasio et al., 2014)	ProQuest	Colombia	1 – 2	Independent RCT	NS, PS	H, W	1,231	High	Low
10	(Martinez et al., 2018)	Scopus	Bolivia	1 – 1	Community Child Nutrition Project	CC	A, HC, HA, WA, S	1,513	Moderate	Low
11	(Muhoozi et al., 2017)	Web of Science	Uganda	0.5 – 2	Independent RCT	CC	HC, UC, HA, WA	511	High	Low
12	(Rockers et al., 2016)	Web of Science	Zambia	0.5 – 1	Independent RCT	NS	HA, WA	540	Moderate	Low
13	(Yousafzai et al., 2014)	Snowball	Pakistan	1 – 2	Lady Health Worker Programme	NS, PS	HA, WA	1,489	High	Low
14	(Fernald et al., 2009)	Snowball	Mexico	8 – 8	Oportunidades	CT	HA	1,710	Moderate	Low
15	(Attanasio et al., 2015)	Snowball	Colombia	1 – 7	Familias en Accion	CT	UW, S, WT	3,591	High	Low
16	(Powell et al., 2004)	Snowball	Jamaica	0.75 – 2.5	Independent RCT	CC	H, W	139	High	Low
17	(Clasen et al., 2014)	Snowball	India	0 – 4	Total Sanitation Campaign Offshoot	WS	HA, WA	2,952	High	Low
18	(Lin et al., 2018)	Snowball	Bangladesh	2 – 3	WASH Benefits Bangladesh	NS, WS	WI	5,551	High	Low
19	(Patil et al., 2014)	Snowball	India	1.75 – 5	Total Sanitation Campaign	WS	UC, H, HA, W, WA, S	5,209	Moderate	Low
20	(Pickering et al., 2015)	Snowball	India	0 – 5	Community-led Total Sanitation	WS	HA, WA, UW, S	2,365	Moderate	Low
21	(Christian et al., 2015)	Snowball	Bangladesh	0.5 – 1.5	JiVitA Project	NS	H, HA, W, WA	5,319	High	Low
22	(Iannotti et al., 2013)	Snowball	Haiti	0.5 – 1	Lipid-based Nutrient Supplements Program	NS	HA, WA	589	Moderate	Low
23	(Maleta et al., 2015)	Snowball	Malawi	0.5 – 0.5	Independent RCT	NS	H, HA, W, WA, UW, S, WT	1,932	Moderate	Low
24	(Hess et al., 2015)	Snowball	Burkina Faso	0.75 – 1.5	iLiNS Project	NS	A, H, HA, W, WA, UW, S, WT	3,220	High	Low
25	(Hammer and Spears, 2013)*	Snowball	India	0 – 5	Total Sanitation Campaign	WS	HA	3,432	High	Low
26	(Kirwan et al., 2010)	Snowball	Nigeria	1 – 5	Independent RCT	NS	WI	1,228	High	Low
27	(Kandpal et al., 2016)	Snowball	The Philippines	0.5 – 5	Pantawid Program	CT	HA, WA, UW, S	485	High	Low
28	(Gertler, 2004)	Snowball	Mexico	2 – 4	PROGRESA	CT	A, H, S	2,010	High	Low
29	(Vermeersch and Kremer, 2004)*	Snowball	Kenya	4 – 6	The Meals Program	NS	HA, WA	1,184	High	Low
30	(Bhandari et al., 2004)	Snowball	India	0 – 2	The Integrated Child Development Services Scheme	NS	H, W, UW, S	1,025	High	Low
31	(Vazir et al., 2013)	Snowball	India	0.75 – 1.25	The Integrated Child Development Services Programme	CC, NS	W, H	511	High	Low
32	(Penny et al., 2005)	Snowball	Peru	0.5 – 1.5	Growth and Development Monitoring Programme	NS	H, W, S	187	Moderate	Low
33	(Olney et al., 2006)	Snowball	Tanzania	0 – 1	International Nutritio	NS	HA, WA	354	High	Low
34	(Faber et al., 2005)	Snowball	South Africa	0.5 – 1	The Valley Trust	NS	H, HA, W, WA	361	High	Low
35	(Gardner et al., 2005)	Snowball	Jamaica	0.75 – 2.5	Independent RCT	NS	H, HA, W, WA	114	High	Low
36	(Hamadani et al., 2002)	Snowball	Bangladesh	0.5 – 1	Independent RCT	NS	HA, WA	168	High	Medium
37	(Blimpo et al., 2018)*	Snowball	The Gambia	1 – 2	Baby Friendly Community Initiative	NS	HA, WA	1,228	High	Low
38	(Rahman et al., 2008)	Snowball	Pakistan	0.5 – 1	Thinking Healthy Program	PS	HA, WA	903	High	Low
39	(Bouguen et al., 2013)*	Snowball	Cambodia	3 – 5	Education Fast Track Initiative Catalytic Fund	CC	HA, WA	1,541	High	Medium

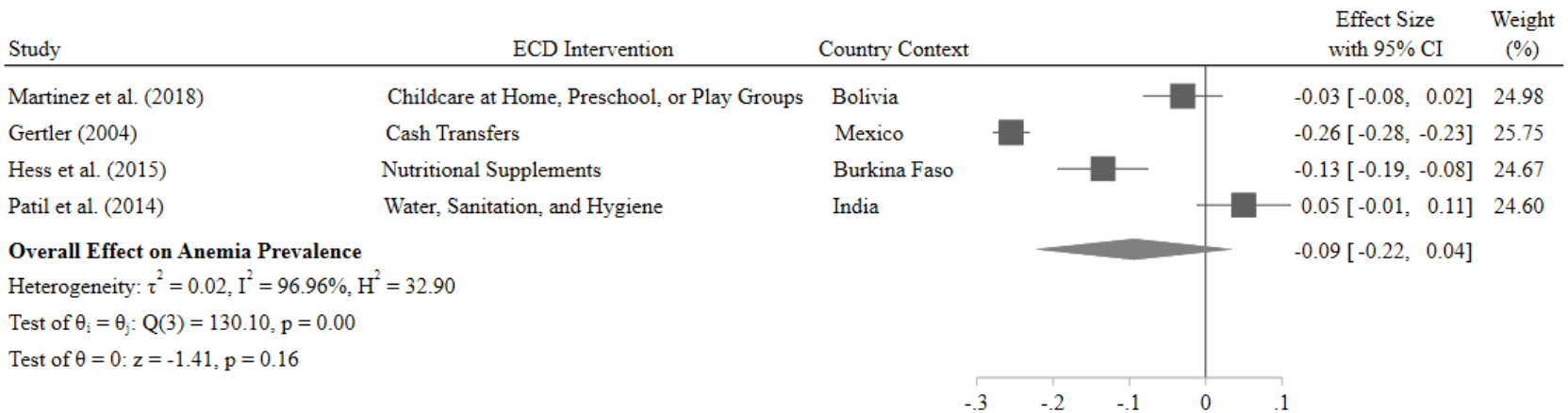
Meta Analysis

$$\hat{\theta}_k = \theta_k + \beta D_k + \varepsilon_k + \zeta_k \tag{1}$$

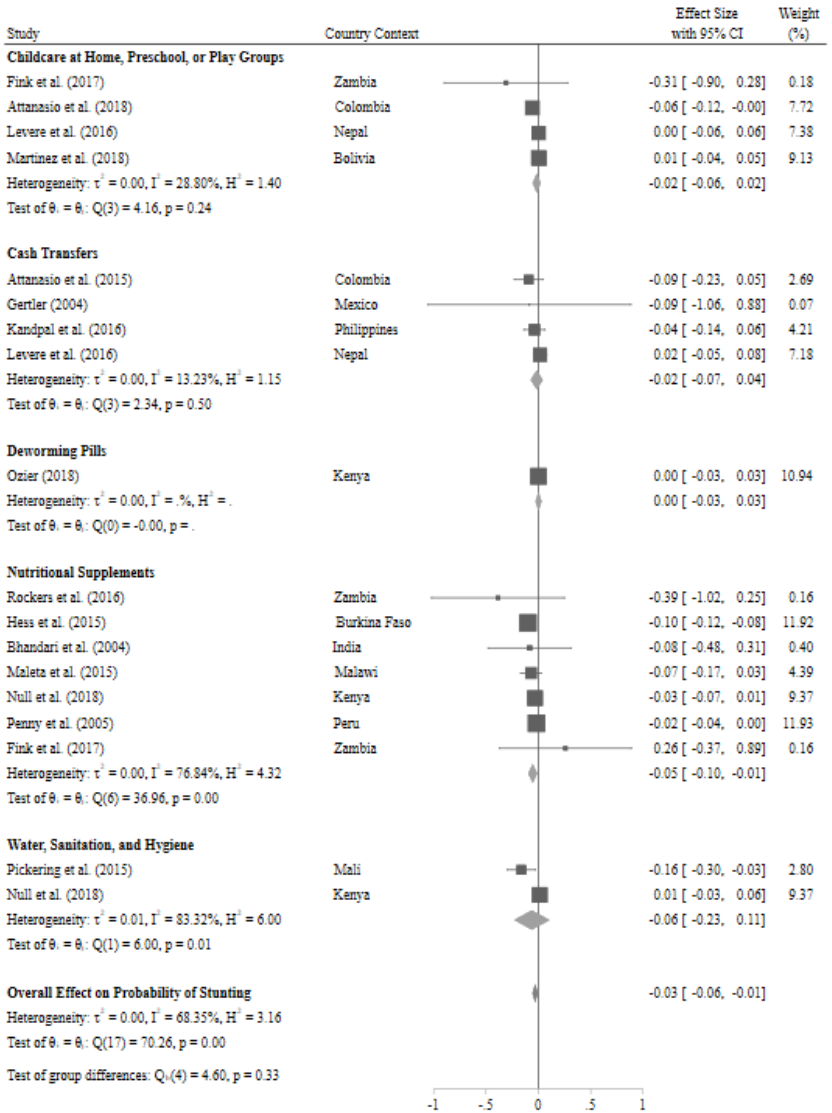
- Random Effects Model
- k = Study (Unit of Obs.)
- θ_k = True effect size of study k
- $\hat{\theta}_k$ = Observed effect size of study k
- D = ECD Intervention
- ε_k = Sampling error (study effect size vs true effect size)
- ζ_k = Covariate heterogeneity

Anemia

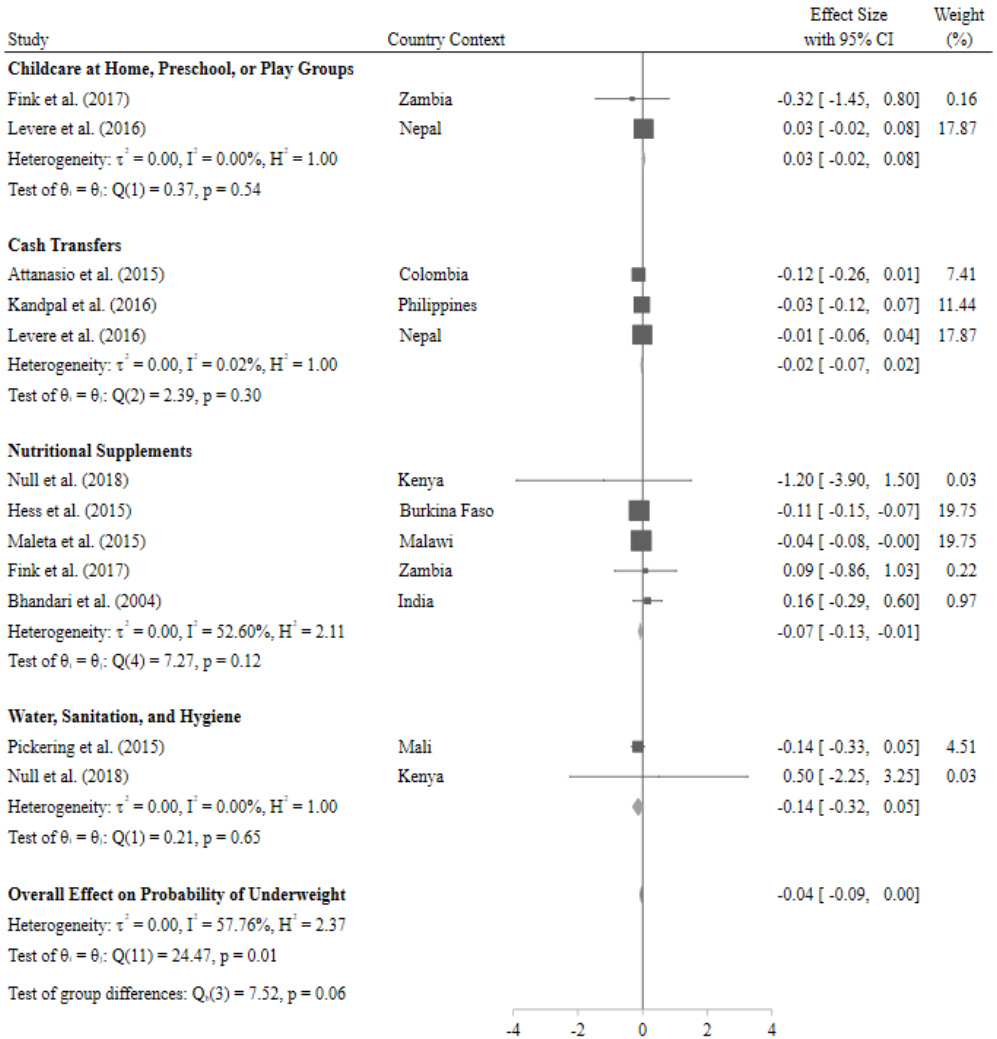
- (Gertler, 2004): PROGRESA- Immunization, nutrition intake, cash, health monitoring
- (Hess et al., 2015): Small quantity Lipid Based Nutrition supplementation



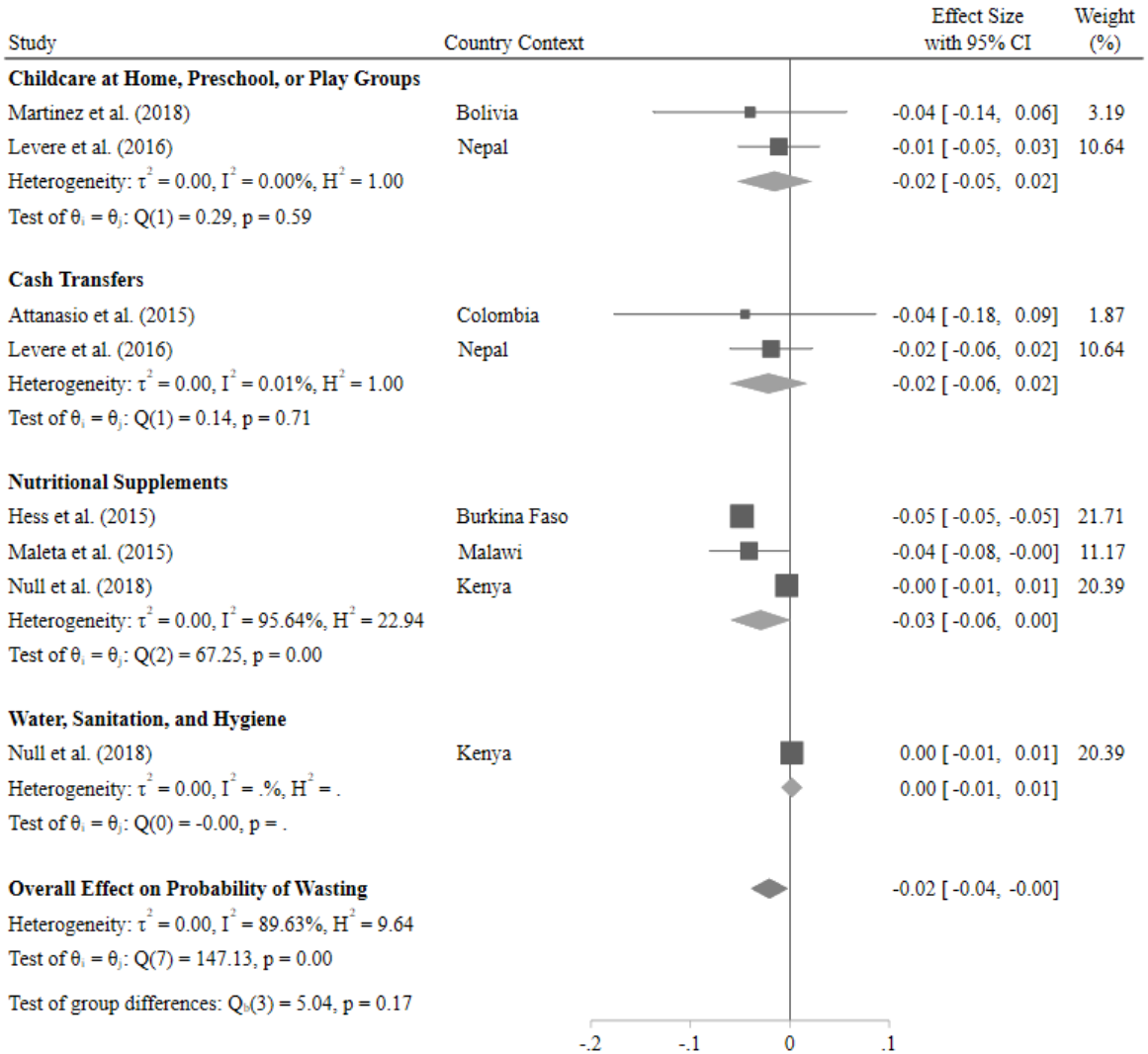
STUNTING


Study
Country Context
Effect Size with 95% CI
Weight (%)
Childcare at Home, Preschool, or Play Groups
Fink et al. (2017) Zambia -0.31 [-0.90, 0.28] 0.18
Attanasio et al. (2018) Colombia -0.06 [-0.12, -0.00] 7.72
Levere et al. (2016) Nepal 0.00 [-0.06, 0.06] 7.38
Martinez et al. (2018) Bolivia 0.01 [-0.04, 0.05] 9.13
Heterogeneity: τ² = 0.00, I² = 28.80%, H² = 1.40 -0.02 [-0.06, 0.02]
Test of θi = θj: Q(3) = 4.16, p = 0.24
Cash Transfers
Attanasio et al. (2015) Colombia -0.09 [-0.23, 0.05] 2.69
Gertler (2004) Mexico -0.09 [-1.06, 0.88] 0.07
Kandpal et al. (2016) Philippines -0.04 [-0.14, 0.06] 4.21
Levere et al. (2016) Nepal 0.02 [-0.05, 0.08] 7.18
Heterogeneity: τ² = 0.00, I² = 13.23%, H² = 1.15 -0.02 [-0.07, 0.04]
Test of θi = θj: Q(3) = 2.34, p = 0.50
Deworming Pills
Ozier (2018) Kenya 0.00 [-0.03, 0.03] 10.94
Heterogeneity: τ² = 0.00, I² = .%, H² = . 0.00 [-0.03, 0.03]
Test of θi = θj: Q(0) = -0.00, p = .
Nutritional Supplements
Rockers et al. (2016) Zambia -0.39 [-1.02, 0.25] 0.16
Hess et al. (2015) Burkina Faso -0.10 [-0.12, -0.08] 11.92
Bhandari et al. (2004) India -0.08 [-0.48, 0.31] 0.40
Maleta et al. (2015) Malawi -0.07 [-0.17, 0.03] 4.39
Null et al. (2018) Kenya -0.03 [-0.07, 0.01] 9.37
Penny et al. (2005) Peru -0.02 [-0.04, 0.00] 11.93
Fink et al. (2017) Zambia 0.26 [-0.37, 0.89] 0.16
Heterogeneity: τ² = 0.00, I² = 76.84%, H² = 4.32 -0.05 [-0.10, -0.01]
Test of θi = θj: Q(6) = 36.96, p = 0.00
Water, Sanitation, and Hygiene
Pickering et al. (2015) Mali -0.16 [-0.30, -0.03] 2.80
Null et al. (2018) Kenya 0.01 [-0.03, 0.06] 9.37
Heterogeneity: τ² = 0.01, I² = 83.32%, H² = 6.00 -0.06 [-0.23, 0.11]
Test of θi = θj: Q(1) = 6.00, p = 0.01
Overall Effect on Probability of Stunting -0.03 [-0.06, -0.01]
Heterogeneity: τ² = 0.00, I² = 68.35%, H² = 3.16
Test of θi = θj: Q(17) = 70.26, p = 0.00
Test of group differences: Qb(4) = 4.60, p = 0.33
-1
-.5
0
.5
1

UNDERWEIGHT



WASTING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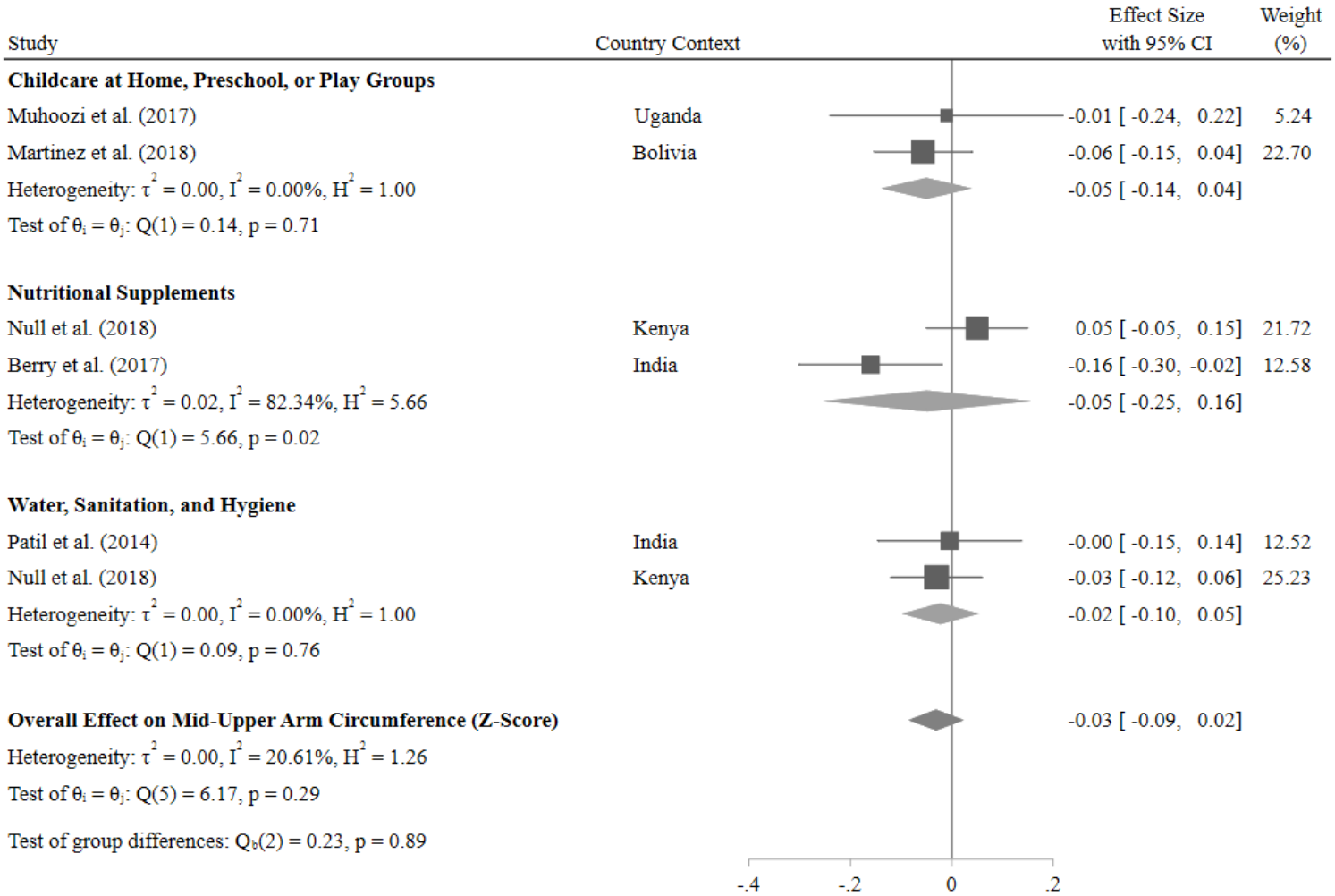
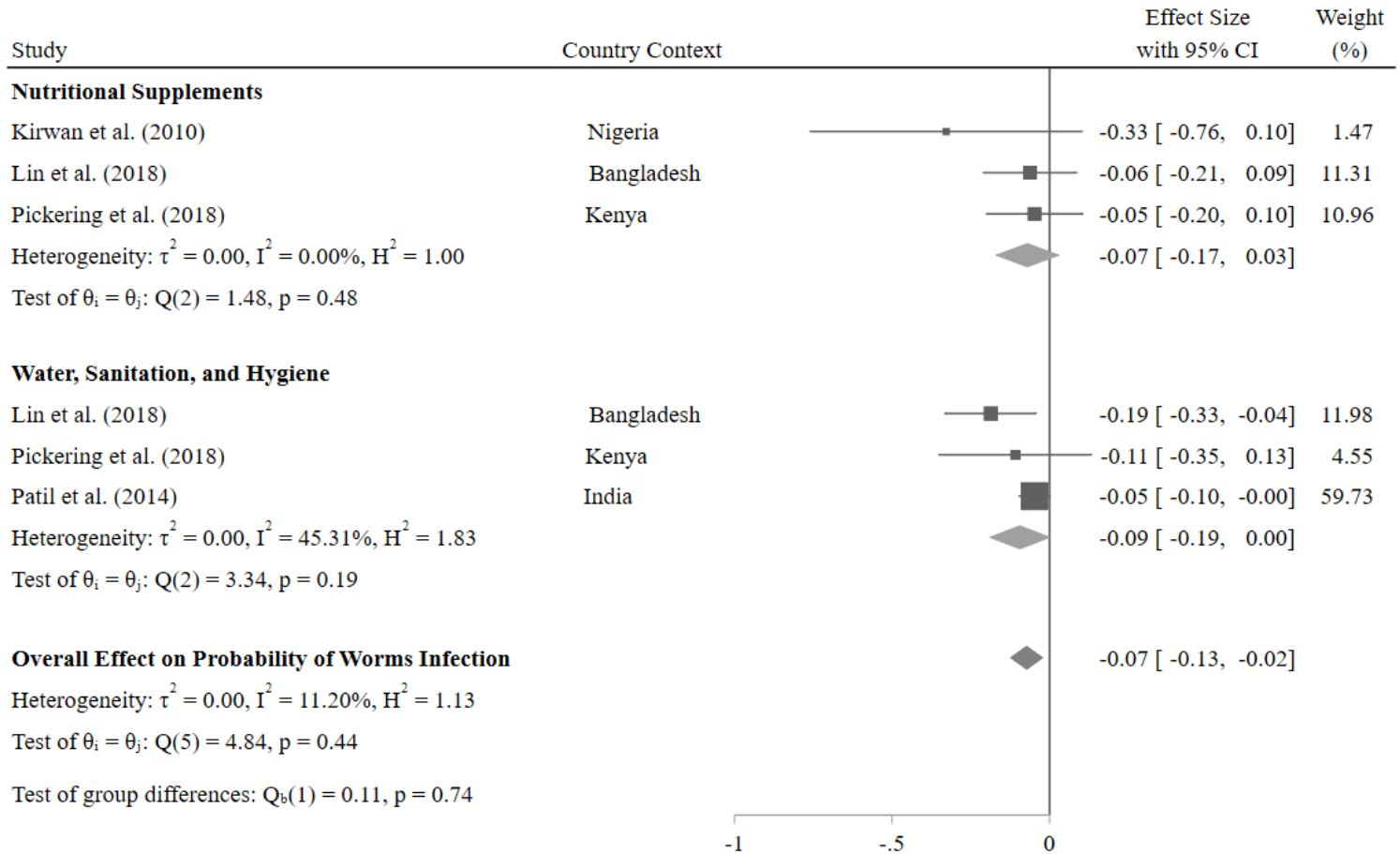
Weight (%)
Childcare at Home, Preschool, or Play Groups
Martinez et al. (2018) Bolivia -0.04 [-0.14, 0.06] 3.19
Levere et al. (2016) Nepal -0.01 [-0.05, 0.03] 10.64
Heterogeneity: τ² = 0.00, I² = 0.00%, H² = 1.00 -0.02 [-0.05, 0.02]
Test of θi = θj: Q(1) = 0.29, p = 0.59
Cash Transfers
Attanasio et al. (2015) Colombia -0.04 [-0.18, 0.09] 1.87
Levere et al. (2016) Nepal -0.02 [-0.06, 0.02] 10.64
Heterogeneity: τ² = 0.00, I² = 0.01%, H² = 1.00 -0.02 [-0.06, 0.02]
Test of θi = θj: Q(1) = 0.14, p = 0.71
Nutritional Supplements
Hess et al. (2015) Burkina Faso -0.05 [-0.05, -0.05] 21.71
Maleta et al. (2015) Malawi -0.04 [-0.08, -0.00] 11.17
Null et al. (2018) Kenya -0.00 [-0.01, 0.01] 20.39
Heterogeneity: τ² = 0.00, I² = 95.64%, H² = 22.94 -0.03 [-0.06, 0.00]
Test of θi = θj: Q(2) = 67.25, p = 0.00
Water, Sanitation, and Hygiene
Null et al. (2018) Kenya 0.00 [-0.01, 0.01] 20.39
Heterogeneity: τ² = 0.00, I² = .%, H² = . 0.00 [-0.01, 0.01]
Test of θi = θj: Q(0) = -0.00, p = .
Overall Effect on Probability of Wasting -0.02 [-0.04, -0.00]
Heterogeneity: τ² = 0.00, I² = 89.63%, H² = 9.64
Test of θi = θj: Q(7) = 147.13, p = 0.00
Test of group differences: QB(3) = 5.04, p = 0.17
-.2
-.1
0
.1

Upper Arm Circumference



Worms Infections



Summary of Findings

Outcomes	Interventions						
	CC	CT	VX	NS	PS	WS	Overall
	Primary Outcomes						
Anemia	Ineffective (1)	Effective (1)	Untested (0)	Effective (1)	Untested (0)	Ineffective (1)	Inconclusive (4)
Stunting	Ineffective (4)	Ineffective (4)	Ineffective (1)	Effective (7)	Untested (0)	Ineffective (2)	Effective (18)
Underweight	Ineffective (2)	Ineffective (3)	Untested (0)	Effective (5)	Untested (0)	Ineffective (2)	Effective (12)
Wasting	Ineffective (2)	Ineffective (2)	Untested (0)	Effective (3)	Untested (0)	Ineffective (1)	Effective (8)
Mid-Upper Arm Circumference	Ineffective (2)	Untested (0)	Untested (0)	Ineffective (2)	Untested (0)	Ineffective (2)	Ineffective (6)
Worms Infections	Untested (0)	Untested (0)	Untested (0)	Ineffective (3)	Untested (0)	Effective (3)	Effective (6)
	Secondary Outcomes						
Height	Ineffective (2)	Effective (2)	Effective (1)	Ineffective (10)	Ineffective (1)	Ineffective (1)	Ineffective (17)
Height for Age	Ineffective (6)	Ineffective (3)	Ineffective (1)	Ineffective (14)	Effective (2)	Ineffective (4)	Effective (30)
Weight	Ineffective (2)	Untested (0)	Untested (0)	Ineffective (9)	Ineffective (1)	Ineffective (1)	Ineffective (13)
Weight for Age	Ineffective (5)	Ineffective (2)	Untested (0)	Ineffective (15)	Ineffective (2)	Ineffective (4)	Ineffective (28)
Head Circumference	Ineffective (1)	Untested (0)	Untested (0)	Untested (0)	Untested (0)	Untested (0)	Untested (1)
Overall	Ineffective (27)	Inconclusive (17)	Inconclusive (3)	Effective (69)	Inconclusive (6)	Ineffective (21)	Inconclusive (143)

Conclusion

1. What works for improving child growth outcomes?
   - +Direct Nutrition based supplementation
   - +Cash- Unconditional/conditional
2. Gaps in the literature:
   - Long term impacts
   - Concentration in evidence within developing countries - SSA, SA
   - Growth outcomes between children of 3-8 years of age
   - 50% studies report insignifcant impacts
   - Longer intervention exposure periods
   - Heterogeneity (gender, socio-economic status, religion etc.)
   - Mechanisms
   - Only 5% studies conducted a Cost-effectiveness analysis

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1. Future research work:
   - Determinants of malnutrition which are unrelated to diets in population
   - Long term impacts of interventions showing significant effects in the short run
   - Cost-effective and more diverse evidence
2. Policymaker Takeaways:
   - Multifaceted interventions: Direct Nutrition/Cash + Information
   - Targeting to the most needy

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Other evidence

- Nurturing/stimulation: No effect on linear growth (Prado et al., 2019; Zhang et al., 2021; Jeong et al., 2021)
- No effect of daycare intervention on child growth ouctomes (Leroy et al., 2012)
- Nutrition works in child development (Grantham-McGregor et al., 2014)

Limitation

- Focus on Clustered RCTs only
- Pre-natal stage interventions
- Inconclusive pooled meta effects across all interventions
- Limited scope for subgroups based on gender, socio-economic status
- Sample size and number of studies

Thank you!

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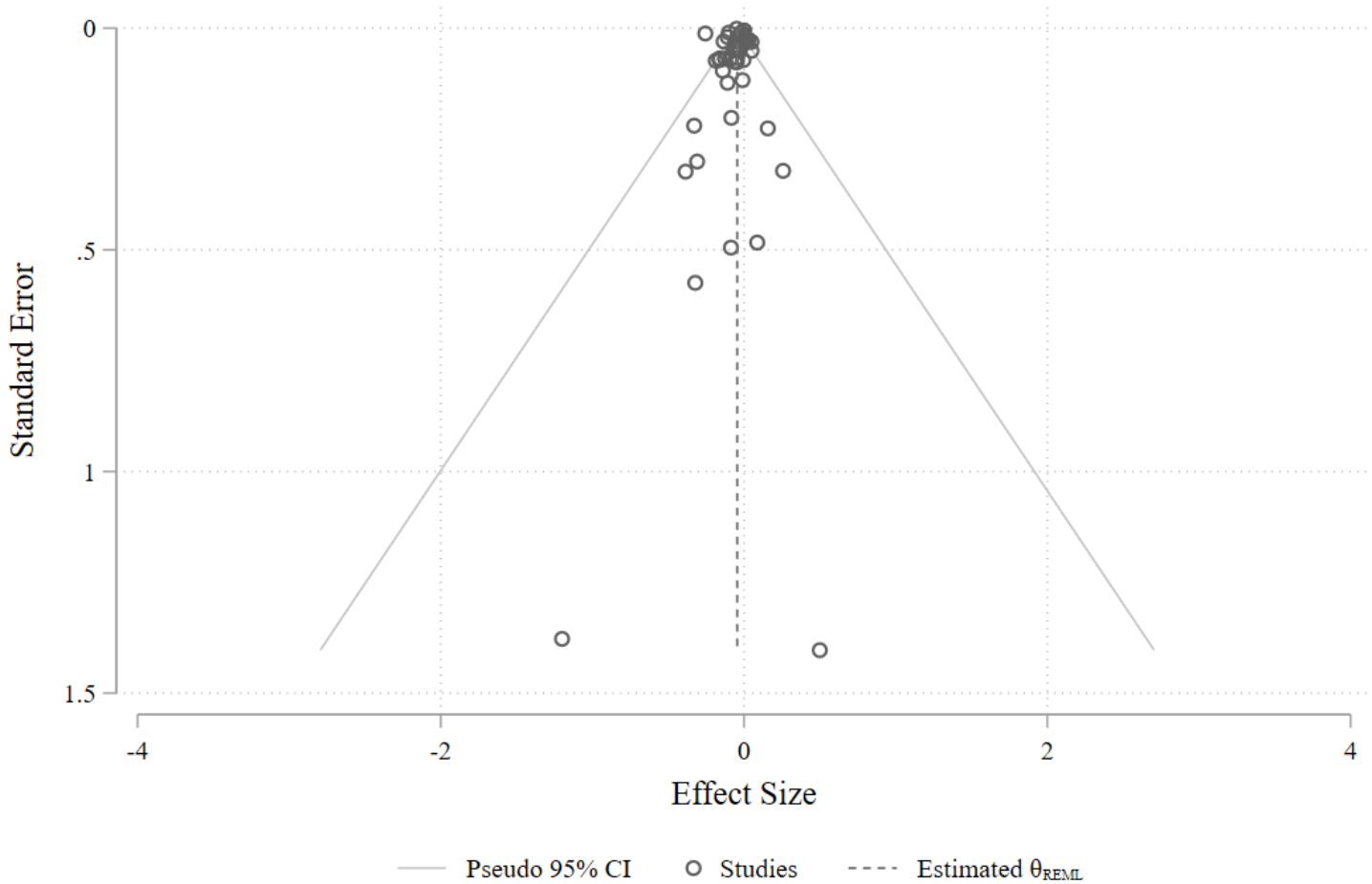
Publication Bias: Primary Outcomes



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