Associations Between Stunting and High-ponderosity Defined through Weight-for-height or Body-mass-index-for-age for Overweight in Under-five Children

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Background

- Co-existence of stunting & overweight; inconsistent in children
- Under 5 children: High ponderosity defined as >1SD & >2SD of WHO for either **Weight-for-height or Body-Mass-Index (BMI)-for-age**
- Unlike BMI-for-age, weight-for-height ignores change in ponderosity with age
- WFH underestimates overweight w.r.t BMI in >6mo children with high stunting prevalence
- Suggests the stunting-overweight association vary with metric to ascertain overweight
- Null Hypothesis: Are Stunting and Overweight defined through WHZ (CSO_WHZ) & BMI-for-age (CSO_BMIZ) associations similar?

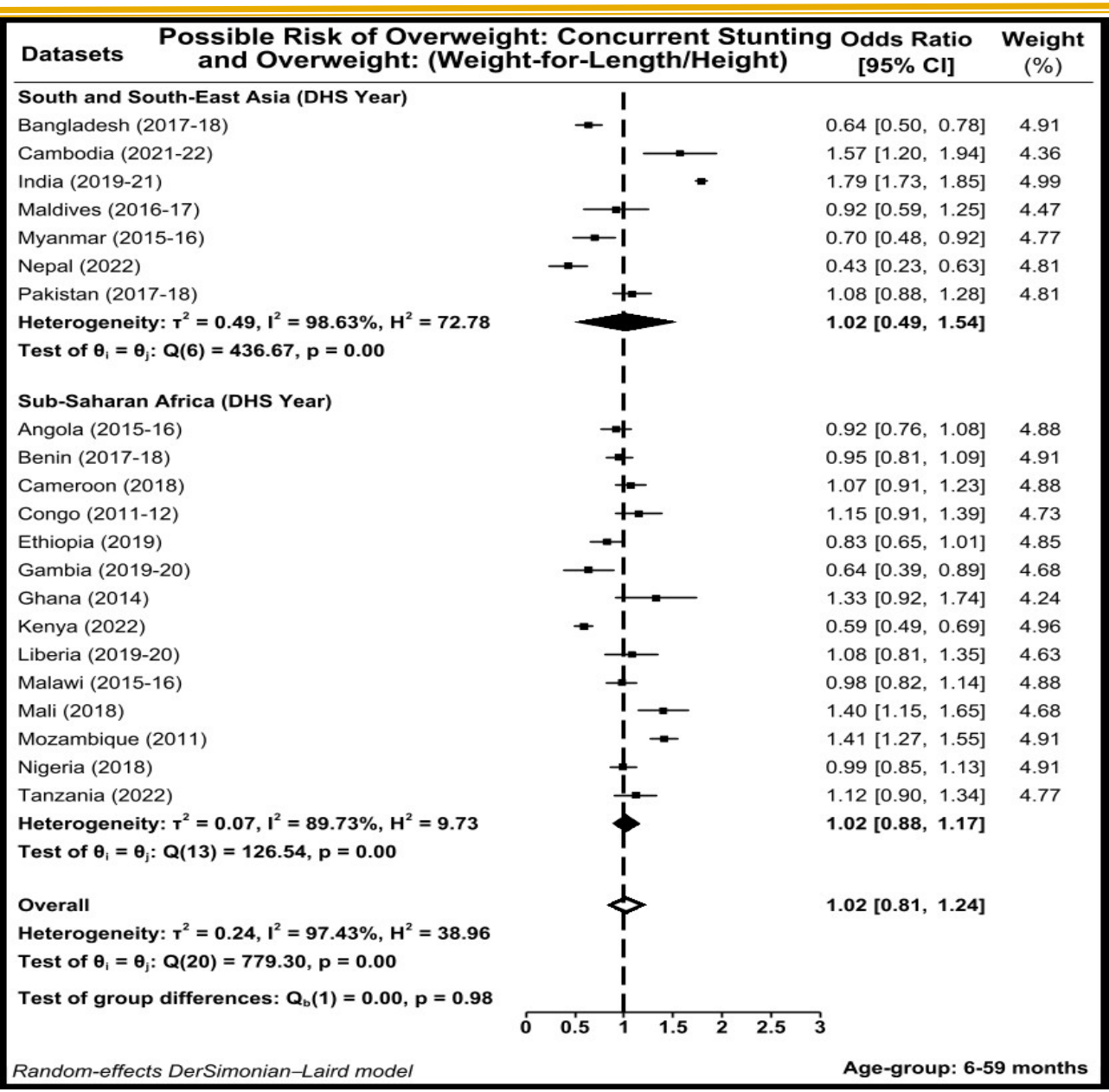
Methods

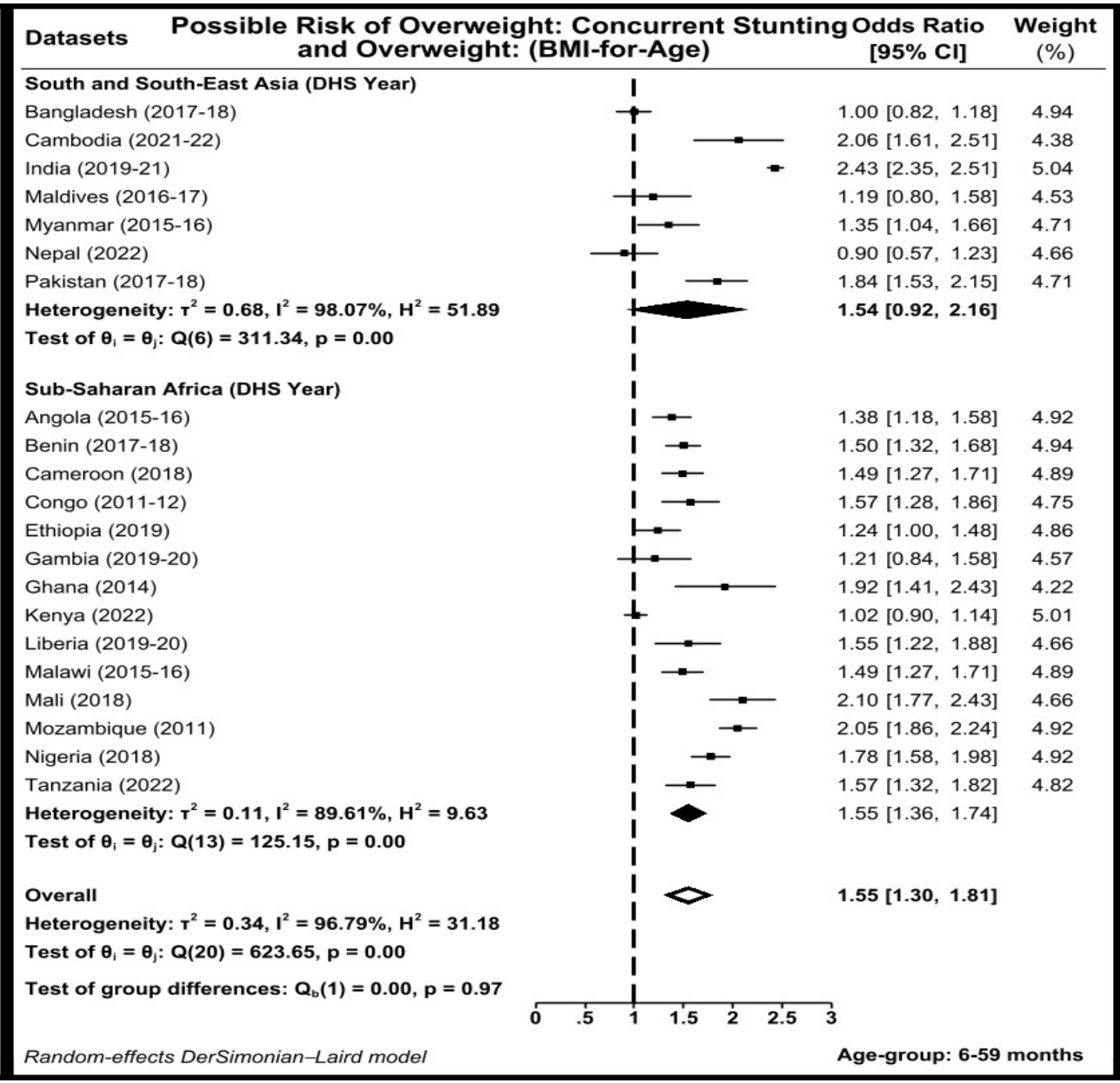
- Contemporary DHS datasets (after 2010) were evaluated from South- and South-East Asia and Sub-Saharan Africa
- Absolute anthropometry converted to WHO Z-scores
- CSO_WHZ & CSO_BMIZ associations: Odds Ratio (OR) in all individual datasets
- Meta analysis: Pooled by using random effects model
- Stratified analyses: sex, age and region
- Software used STATA version 17.0

Results

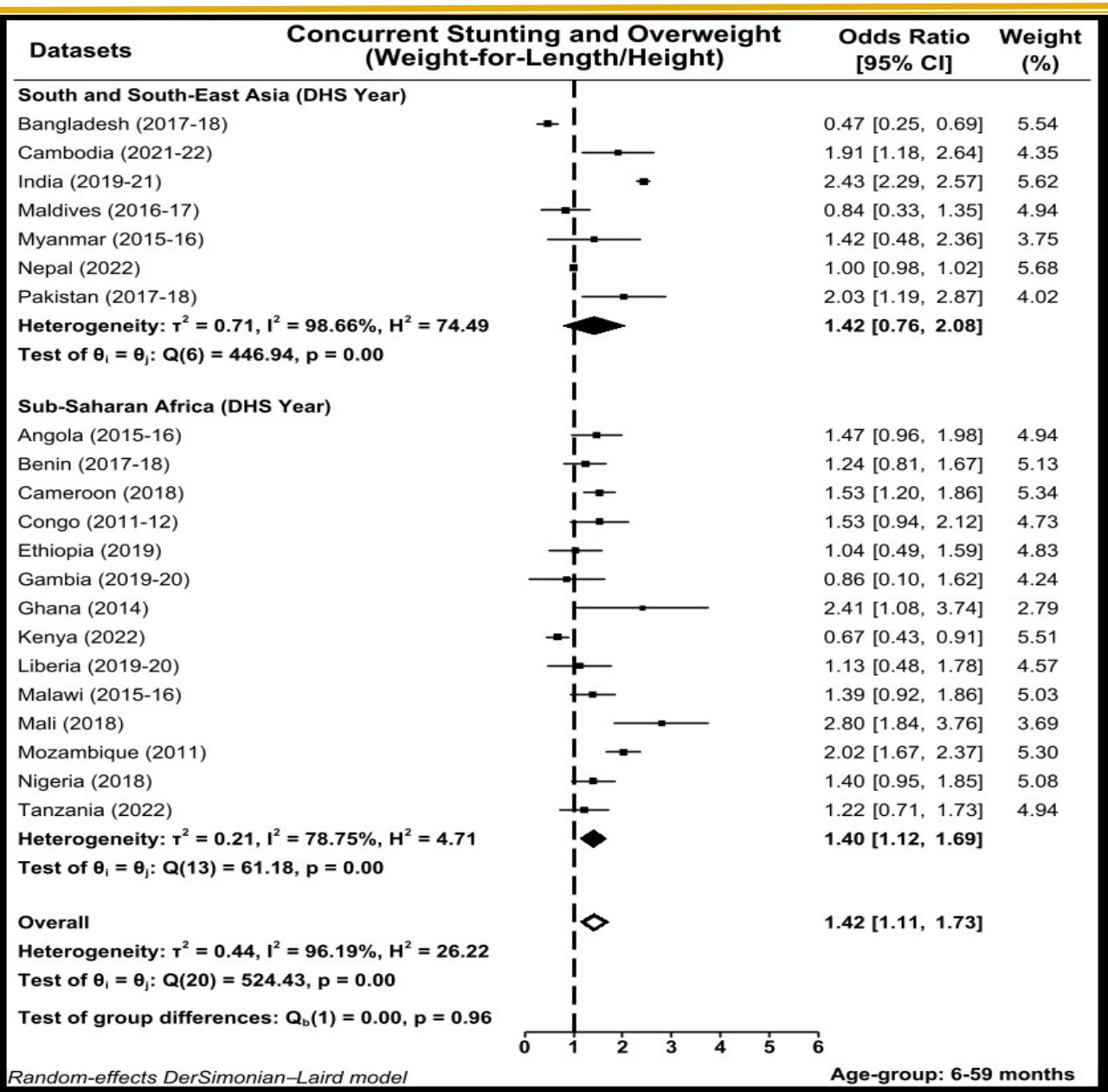
- 21 DHS datasets: 7 South- and South-East Asia & 14 Sub-Saharan Africa
- Total sample = 314,187; Except India (197,651), in other DHS surveys: 2342 (Maldives) to 17,280 (Kenya)
- Young infants (<6 mo) comprised 8%-14% of under 5 children; boys = girls
- Participants, especially Asians, were mostly shorter with lower ponderosity than WHO standards (HAZ: -1.6 to -0.9; Asia: WHZ: -0.9 to -0.2; BMIZ: -0.8 to -0.1; Africa: WHZ: -0.5 to +0.4; BMIZ: -0.5 to +0.5)
- CSO_WHZ prevalence (1.5%) < CSO_BMIZ (2.3%) in 6-59 months; reverse <6 mo (5.2% vs 2.0%)

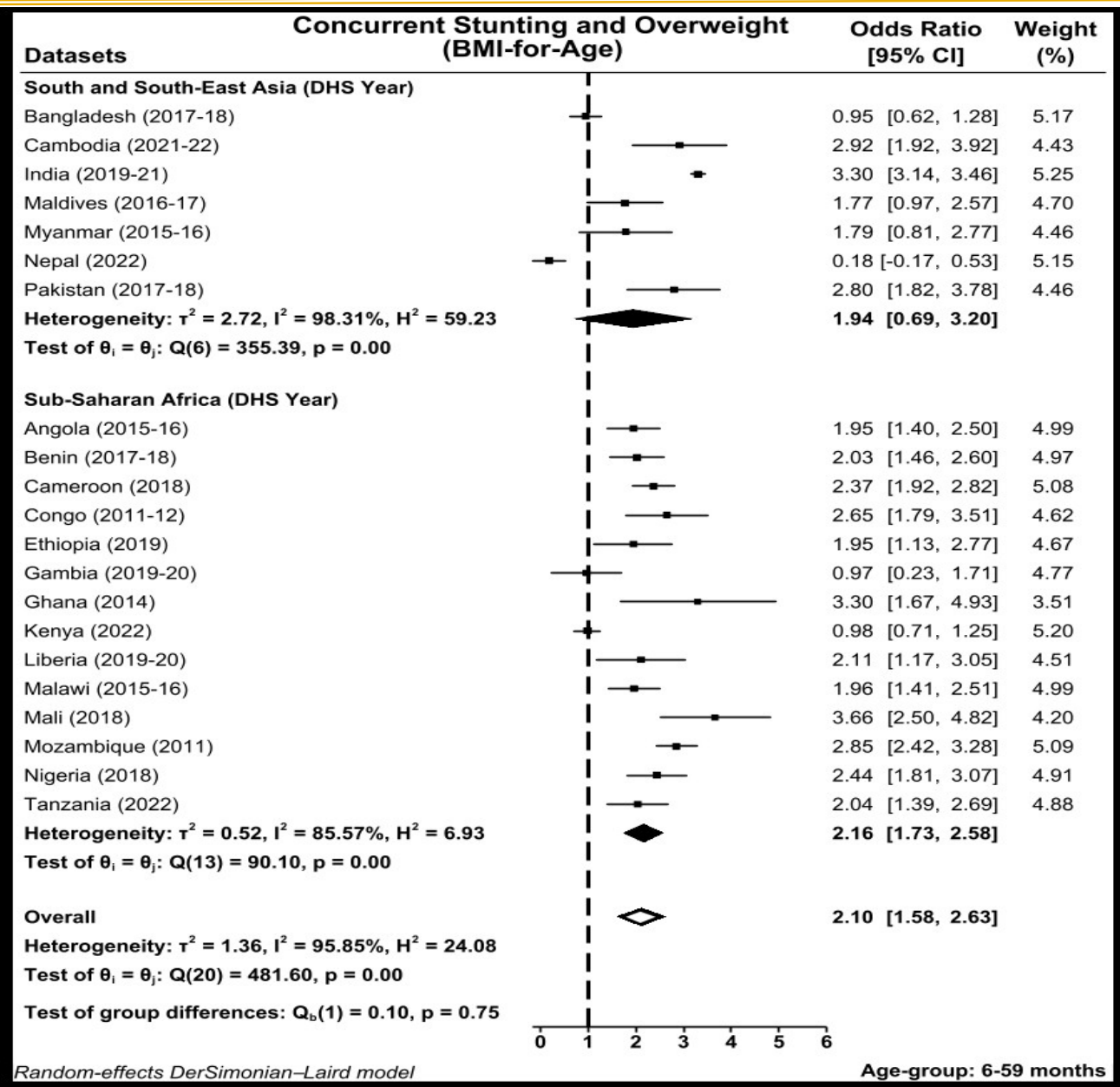
Results


Datasets
Possible Risk of Overweight: Concurrent Stunting and Overweight: (Weight-for-Length/Height)
Odds Ratio [95% CI]
Weight (%)
South and South-East Asia (DHS Year)
Bangladesh (2017-18) 0.64 [0.50, 0.78] 4.91
Cambodia (2021-22) 1.57 [1.20, 1.94] 4.36
India (2019-21) 1.79 [1.73, 1.85] 4.99
Maldives (2016-17) 0.92 [0.59, 1.25] 4.47
Myanmar (2015-16) 0.70 [0.48, 0.92] 4.77
Nepal (2022) 0.43 [0.23, 0.63] 4.81
Pakistan (2017-18) 1.08 [0.88, 1.28] 4.81
Heterogeneity: τ² = 0.49, I² = 98.63%, H² = 72.78 1.02 [0.49, 1.54]
Test of θi = θj: Q(6) = 436.67, p = 0.00
Sub-Saharan Africa (DHS Year)
Angola (2015-16) 0.92 [0.76, 1.08] 4.88
Benin (2017-18) 0.95 [0.81, 1.09] 4.91
Cameroon (2018) 1.07 [0.91, 1.23] 4.88
Congo (2011-12) 1.15 [0.91, 1.39] 4.73
Ethiopia (2019) 0.83 [0.65, 1.01] 4.85
Gambia (2019-20) 0.64 [0.39, 0.89] 4.68
Ghana (2014) 1.33 [0.92, 1.74] 4.24
Kenya (2022) 0.59 [0.49, 0.69] 4.96
Liberia (2019-20) 1.08 [0.81, 1.35] 4.63
Malawi (2015-16) 0.98 [0.82, 1.14] 4.88
Mali (2018) 1.40 [1.15, 1.65] 4.68
Mozambique (2011) 1.41 [1.27, 1.55] 4.91
Nigeria (2018) 0.99 [0.85, 1.13] 4.91
Tanzania (2022) 1.12 [0.90, 1.34] 4.77
Heterogeneity: τ² = 0.07, I² = 89.73%, H² = 9.73 1.02 [0.88, 1.17]
Test of θi = θj: Q(13) = 126.54, p = 0.00
Overall 1.02 [0.81, 1.24]
Heterogeneity: τ² = 0.24, I² = 97.43%, H² = 38.96
Test of θi = θj: Q(20) = 779.30, p = 0.00
Test of group differences: Qb(1) = 0.00, p = 0.98
0 0.5 1 1.5 2 2.5 3
Random-effects DerSimonian–Laird model
Age-group: 6-59 months


Datasets
Possible Risk of Overweight: Concurrent Stunting and Overweight: (BMI-for-Age)
Odds Ratio [95% CI]
Weight (%)
South and South-East Asia (DHS Year)
Bangladesh (2017-18) 1.00 [0.82, 1.18] 4.94
Cambodia (2021-22) 2.06 [1.61, 2.51] 4.38
India (2019-21) 2.43 [2.35, 2.51] 5.04
Maldives (2016-17) 1.19 [0.80, 1.58] 4.53
Myanmar (2015-16) 1.35 [1.04, 1.66] 4.71
Nepal (2022) 0.90 [0.57, 1.23] 4.66
Pakistan (2017-18) 1.84 [1.53, 2.15] 4.71
Heterogeneity: τ² = 0.68, I² = 98.07%, H² = 51.89 1.54 [0.92, 2.16]
Test of θi = θj: Q(6) = 311.34, p = 0.00
Sub-Saharan Africa (DHS Year)
Angola (2015-16) 1.38 [1.18, 1.58] 4.92
Benin (2017-18) 1.50 [1.32, 1.68] 4.94
Cameroon (2018) 1.49 [1.27, 1.71] 4.89
Congo (2011-12) 1.57 [1.28, 1.86] 4.75
Ethiopia (2019) 1.24 [1.00, 1.48] 4.86
Gambia (2019-20) 1.21 [0.84, 1.58] 4.57
Ghana (2014) 1.92 [1.41, 2.43] 4.22
Kenya (2022) 1.02 [0.90, 1.14] 5.01
Liberia (2019-20) 1.55 [1.22, 1.88] 4.66
Malawi (2015-16) 1.49 [1.27, 1.71] 4.89
Mali (2018) 2.10 [1.77, 2.43] 4.66
Mozambique (2011) 2.05 [1.86, 2.24] 4.92
Nigeria (2018) 1.78 [1.58, 1.98] 4.92
Tanzania (2022) 1.57 [1.32, 1.82] 4.82
Heterogeneity: τ² = 0.11, I² = 89.61%, H² = 9.63 1.55 [1.36, 1.74]
Test of θi = θj: Q(13) = 125.15, p = 0.00
Overall 1.55 [1.30, 1.81]
Heterogeneity: τ² = 0.34, I² = 96.79%, H² = 31.18
Test of θi = θj: Q(20) = 623.65, p = 0.00
Test of group differences: Qb(1) = 0.00, p = 0.97
0 .5 1 1.5 2 2.5 3
Random-effects DerSimonian–Laird model
Age-group: 6-59 months

Results


Datasets
Concurrent Stunting and Overweight (Weight-for-Length/Height)
Odds Ratio [95% CI]
Weight (%)
South and South-East Asia (DHS Year)
Bangladesh (2017-18) 0.47 [0.25, 0.69] 5.54
Cambodia (2021-22) 1.91 [1.18, 2.64] 4.35
India (2019-21) 2.43 [2.29, 2.57] 5.62
Maldives (2016-17) 0.84 [0.33, 1.35] 4.94
Myanmar (2015-16) 1.42 [0.48, 2.36] 3.75
Nepal (2022) 1.00 [0.98, 1.02] 5.68
Pakistan (2017-18) 2.03 [1.19, 2.87] 4.02
Heterogeneity: τ² = 0.71, I² = 98.66%, H² = 74.49 1.42 [0.76, 2.08]
Test of θi = θj: Q(6) = 446.94, p = 0.00
Sub-Saharan Africa (DHS Year)
Angola (2015-16) 1.47 [0.96, 1.98] 4.94
Benin (2017-18) 1.24 [0.81, 1.67] 5.13
Cameroon (2018) 1.53 [1.20, 1.86] 5.34
Congo (2011-12) 1.53 [0.94, 2.12] 4.73
Ethiopia (2019) 1.04 [0.49, 1.59] 4.83
Gambia (2019-20) 0.86 [0.10, 1.62] 4.24
Ghana (2014) 2.41 [1.08, 3.74] 2.79
Kenya (2022) 0.67 [0.43, 0.91] 5.51
Liberia (2019-20) 1.13 [0.48, 1.78] 4.57
Malawi (2015-16) 1.39 [0.92, 1.86] 5.03
Mali (2018) 2.80 [1.84, 3.76] 3.69
Mozambique (2011) 2.02 [1.67, 2.37] 5.30
Nigeria (2018) 1.40 [0.95, 1.85] 5.08
Tanzania (2022) 1.22 [0.71, 1.73] 4.94
Heterogeneity: τ² = 0.21, I² = 78.75%, H² = 4.71 1.40 [1.12, 1.69]
Test of θi = θj: Q(13) = 61.18, p = 0.00
Overall 1.42 [1.11, 1.73]
Heterogeneity: τ² = 0.44, I² = 96.19%, H² = 26.22
Test of θi = θj: Q(20) = 524.43, p = 0.00
Test of group differences: Qb(1) = 0.00, p = 0.96
0 1 2 3 4 5 6
Random-effects DerSimonian–Laird model
Age-group: 6-59 months


Datasets
Concurrent Stunting and Overweight (BMI-for-Age)
Odds Ratio [95% CI]
Weight (%)
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Bangladesh (2017-18) 0.95 [0.62, 1.28] 5.17
Cambodia (2021-22) 2.92 [1.92, 3.92] 4.43
India (2019-21) 3.30 [3.14, 3.46] 5.25
Maldives (2016-17) 1.77 [0.97, 2.57] 4.70
Myanmar (2015-16) 1.79 [0.81, 2.77] 4.46
Nepal (2022) 0.18 [-0.17, 0.53] 5.15
Pakistan (2017-18) 2.80 [1.82, 3.78] 4.46
Heterogeneity: τ² = 2.72, I² = 98.31%, H² = 59.23 1.94 [0.69, 3.20]
Test of θi = θj: Q(6) = 355.39, p = 0.00
Sub-Saharan Africa (DHS Year)
Angola (2015-16) 1.95 [1.40, 2.50] 4.99
Benin (2017-18) 2.03 [1.46, 2.60] 4.97
Cameroon (2018) 2.37 [1.92, 2.82] 5.08
Congo (2011-12) 2.65 [1.79, 3.51] 4.62
Ethiopia (2019) 1.95 [1.13, 2.77] 4.67
Gambia (2019-20) 0.97 [0.23, 1.71] 4.77
Ghana (2014) 3.30 [1.67, 4.93] 3.51
Kenya (2022) 0.98 [0.71, 1.25] 5.20
Liberia (2019-20) 2.11 [1.17, 3.05] 4.51
Malawi (2015-16) 1.96 [1.41, 2.51] 4.99
Mali (2018) 3.66 [2.50, 4.82] 4.20
Mozambique (2011) 2.85 [2.42, 3.28] 5.09
Nigeria (2018) 2.44 [1.81, 3.07] 4.91
Tanzania (2022) 2.04 [1.39, 2.69] 4.88
Heterogeneity: τ² = 0.52, I² = 85.57%, H² = 6.93 2.16 [1.73, 2.58]
Test of θi = θj: Q(13) = 90.10, p = 0.00
Overall 2.10 [1.58, 2.63]
Heterogeneity: τ² = 1.36, I² = 95.85%, H² = 24.08
Test of θi = θj: Q(20) = 481.60, p = 0.00
Test of group differences: Qb(1) = 0.10, p = 0.75
0 1 2 3 4 5 6
Random-effects DerSimonian–Laird model
Age-group: 6-59 months

Conclusions

- CSO_WHZ and CSO_BMIZ associations are dissimilar
- Originates from ignoring physiological changes with age in Weight-for-height metric


thank
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