

Reconsidering the tolerable upper levels of zinc intake among infants and young children: A systematic review of the available evidence

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Supplementary Materials

Supplemental Tables

Table S1. Studies and comparisons with reported serum or plasma copper outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose, mg ¹	Actual dose, mg/d ¹	Effect of zinc§
Baqui [1]	2005	Bangladesh	80	Healthy infants	6 m	6	Weekly	Zn + B ₂ supplement	Acetate	20	2.9	±
Baqui [1]	2005	Bangladesh	82	Healthy infants	6 m	6	Weekly	Zn + Fe + B ₂ supplement	Acetate	20	2.9	±
Bertinato [2]	2013	Canada	20	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	5	5	±
Bertinato [2]	2013	Canada	19	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	10	10	±
Bertinato [2]	2013	Canada	18	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	15	15	±
Bhandari [3]	2002	India	930	Healthy infants and children	6-30 m	4	Daily	Zn supplement	Gluconate	10 for < 12 m-old & 20 for ≥12 m-old	10 for < 12 m-old & 20 for ≥12 m-old	↓
Brooks [4]	2005	Bangladesh	636	Healthy infants	1-12 m	10	Weekly	Zn supplement	Acetate	70	10	[±]*

Brown [5]	2007	Peru	144	Healthy infants	6-8 m	6	Daily	Zn + other MN supplement, + Fe fortified food	Sulfate	3	2.3	±
Brown [5]	2007	Peru	147	Healthy infants	6-8 m	6	Daily	Zn + Fe fortified complementary food + MN supplement (no zinc)	Sulfate	3	3.3	↓ [±]*
Caulfield [6]	2013	Peru	159	Healthy infants	4-6 m	18	Daily	Zn + Fe + Cu supplement	Sulfate	10	10	±
Hambidge [7]	1979	USA	58	Healthy children	33-90 m	9	Daily	Zn fortified breakfast cereal (control, no fortificant)	Oxide	3 (difference from control; 9.3) Control: 6.3	»3	↓ [±]*
Heinig [8]	2006	USA	19	Healthy infants	4 m	6	Daily	Zn supplement	Gluconate or Sulfate	5	5	↓
Lind [9]	2003	Indonesia	277	Healthy infants	6 m	6	Daily	Zn supplement	Sulfate	10	10	±
Lind [9]	2003	Indonesia	272	Healthy infants	6 m	6	Daily	Zn + Fe supplement	Sulfate	10	10	±
Radhakrishna [10]	2013	India	68	Healthy infants	4 m	14 (12 with suppl)	Daily	Intervention Zn + B2 supplement	Sulfate	5	5	±
Rosado [11]	2006	Mexico	187	Healthy children with environmental lead exposure	6-7 y	6	5d/wk	Zn supplement	Oxide	30	21.4	±
Rosado [11]	2006	Mexico	198	Healthy children with environmental lead exposure	6-7 y	6	5d/wk	Fe + Zn supplement	Oxide	30	21.4	±
Ruz [12]	1997	Chile	69	Healthy children	27-50 m	6 biochemical	Daily	Zn supplement	Sulfate	10	10	±
Sazawal [13]	2004	India	110	Healthy infants	5-12 m	4	Daily	Zn supplement + multi-vitamins	Gluconate	10	10	±
Tielsch [14]	2007	Nepal	197	Healthy infants and children	1-35 m	12	Daily	Zn supplement	Sulfate	5 for 1-11 m-old, 10 for 12-35 m-old	5 for 1-11 m-old, 10 for 12-35 m-old	±

Walravens [15]	1976	USA	68	Healthy infants	4-6 d	6	Daily	Zn + Fe fortified formula	Sulfate	4 more than (1.8) Control: 1.8	~4	↑
Walravens [16]	1983	USA	40	Zn deficient children	2-6 y	12	Daily	Zn supplement	Sulfate	10 (average 4.2/d based on compliance)	10	±
Wuehler [17]	2008	Ecuador	110	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	10	10	±

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Table S2. Studies and comparisons with reported serum or plasma ceruloplasmin outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year of publication	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose ¹ , mg	Actual dose ¹ , mg/d	Effect of zinc§
Bertinato [2]	2013	Canada	20	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	5	5	±
Bertinato [2]	2013	Canada	19	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	10	10	±
Bertinato [2]	2013	Canada	18	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	15	15	±
De Brito [18]	2014	Brazil	30	Healthy children	8-9 y	3	Daily	Zn added to milk or juice	Sulfate	10	10	↓ [±]*
Wuehler [17]	2008	Ecuador	110	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	10	10	±

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Table S3. Studies and comparisons with reported erythrocyte superoxide dismutase (ESOD) outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose ¹ , mg	Actual dose ¹ , mg/d	Effect of zinc§
Bates [19]	1993	Gambia	106	Healthy infants and children	6-28m	2	Bi-Weekly	Zn supplement	Acetate then gluconate	70	20	±
Bertinato [2]	2013	Canada	18	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	15	15	±
Bertinato [2]	2013	Canada	20	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	5	5	±
Bertinato [2]	2013	Canada	19	Healthy children, male	6-8 y	4	Daily	Zn supplement	Gluconate	10	10	↓ [±]*
Heinig [8]	2006	USA	19	Healthy infants	4 m	6	Daily	Zn supplement	Gluconate or Sulfate	5	5	±
Wuehler [17]	2008	Ecuador	110	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	10	10	±

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Table S4. Studies and comparisons with reported serum or plasma ferritin outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose ¹ , mg	Actual dose ¹ , mg/d	Effect of zinc§
Abdollahi [20]	2019	Iran	308	Healthy infants	6-24 m	6	Daily	Zn supplement (program provides Fe)	Sulfate	5	5	±
Alarcon [21]	2004	Peru	213	Anemic infants and children (70-100, moderate anemia)	6-35m	4.1 (18wks)	6d/wk	Fe + Zn supplement	Sulfate	7.6	6.5	↑
Baqui [1]	2005	Bangladesh	77	Healthy infants	6 m	6	Weekly	Zn+ B ₂ supplement	Acetate	20	2.9	±
Baqui [1]	2005	Bangladesh	79	Healthy infants	6 m	6	Weekly	Zn + Fe + B ₂ supplement	Acetate	20	2.9	±
Bates [19]	1993	Gambia	85	Healthy infants and children	6-28m	2	Bi-Weekly	Zn supplement	Acetate then gluconate	70	20	±
Becquey [22] data from authors	2016	Burkina Faso	169	Healthy infants and children	6-27 m	11	IPZS 10 d every 16 wk (IPZS)	Zn supplement	Sulfate	7	0.9	↓ [±]*
Becquey [22] data from authors	2016	Burkina Faso	165	Healthy infants and children	6-27 m	11	DPZS Daily (DPZS)	Zn supplement	Sulfate	7	7	±
Berger [23]	2006	Vietnam	249	Healthy infants	4-7 m	6	Daily	Zn supplement	Sulfate	10	10	±
Berger [23]	2006	Vietnam	327	Healthy infants	4-7 m	6	Daily	Zn + Fe supplement	Sulfate	10	10	±
Brown [5]	2007	Peru	144	Healthy infants	6-8 m	6	Daily	Zn supplement + Fe fortified porridge	Sulfate	3	2.3	±
Brown [5]	2007	Peru	147	Healthy infants	6-8 m	6	Daily	Zn + Fe fortified complementary food	Sulfate	3	3.3	±
Carter [24]	2018	Tanzania	302	Healthy infants	5-7 wk	19-21 wks	Daily	Zn supplement	Sulfate	5 until blood draw at 6 m of age	5 until blood draw at 6 m of age	±

Carter [24]	2018	Tanzania	291	Healthy infants	5-7 wk	19-21wks	Daily	Zn + MV (no Fe) supplement	Sulfate	5 until blood draw at 6 m of age	5 until blood draw at 6 m of age	±
Caulfield [6]	2013	Peru	170	Healthy infants	4-6 m	18	Daily	Zn + Fe + Cu supplement	Sulfate	10	10	±
De Brito [18]	2014	Brazil	30	Healthy children	8-9 y	3	Daily	Zn added to milk or juice	Sulfate	10	10	±
Dijkhuizen [25]	2001	Indonesia	184	Healthy infants	4 m	6	5 d/wk	Zn supplement	Sulfate	10	7.1	±
Dijkhuizen [25]	2001	Indonesia	164	Healthy infants	4 m	6	5 d/wk	Zn + Fe supplement	Sulfate	10	7.1	↓ [±]*
Fahmida [26]	2007	Indonesia	58	Anemic infants (80% anemia)	3-6 m	6	Daily	Zn supplement	Sulfate	10	10	↓ [±]*
Heinig [8]	2006	USA	19	Healthy infants	4 m	6	Daily	Zn supplement	Gluconate or Sulfate	5	5	±
Lind [9]	2003	Indonesia	277	Healthy infants	6 m	6	Daily	Zn supplement	Sulfate	10	10	±
Lind [9]	2003	Indonesia	272	Healthy infants	6 m	6	Daily	Zn + Fe supplement	Sulfate	10	10	↓
Lopez de Romaña [27]	2005	Peru	22	Stunted and anemic children	3-4 y	1.6	5d/wk	Zn + Fe fortified wheat	Sulfate	3	2.1	±
Lopez de Romaña [27]	2005	Peru	24	Stunted and anemic children	3-4 y	1.6	5d/wk	Zn + Fe fortified wheat	Sulfate	9	6.4	±
Rosado [11]	2006	Mexico	187	Healthy children with environmental lead exposure	6-7 y	6	5d/wk	Zn supplement	Oxide	30	21.4	±
Rosado [11]	2006	Mexico	198	Healthy children with environmental lead exposure	6-7 y	6	5d/wk	Fe + Zn supplement	Oxide	30	21.4	±
Rosado [28]	1997	Mexico	95	Healthy children	18-36 m	12	5d/wk	Zn supplement	Methionine	20	14.3	±
Rosado [28]	1997	Mexico	99	Healthy children	18-36 m	12	5d/wk	Fe + Zn supplement	Methionine	20	14.3	±

Ruz [12]	1997	Chile	68	Healthy children	27-50 m	6	Daily	Intervention; Zn supplement	Sulfate	10	10	±
Soofi [29]	2013	Pakistan	317	Healthy infants	6 m	12	Daily	Zn + Fe + MNP supplement	Gluconate	10	10	±
Tielsch [30]	2006	Nepal	310	Healthy infants and children	1-35 m	12	Daily	Zn + Fe + FA supplement	Sulfate	5 for 1-11 m-old, 10 for 12-35 m-old	5 for 1-11 m-old, 10 for 12-35 m-old	↓
Veenemans [31]	2011	Tanzania	299	Healthy infants and children	6-60 m	8.3	Daily	Zn supplement	Gluconate	10	10	↓
Veenemans [31]	2011	Tanzania	299	Healthy infants and children	6-60 m	8.3	Daily	Zn + Fe + MMN supplement	Gluconate	10	10	↓
Wasantwisut [32]	2006	Thailand	256	Healthy infants, Hb 80+ g/L	4-6 m	6	Daily	Zn + VitC supplement	Sulfate	10	10	±
Wasantwisut [32]	2006	Thailand	256	Healthy infants, Hb 80+ g/L	4-6 m	6	Daily	Zn + Fe + VitC supplement	Sulfate	10	10	↓
Wieringa [33]	2003	Indonesia	91	Healthy infants	4 m	6	5d/wk	Zn supplement	Sulfate	10	7.1	↓ [±]*
Wieringa [33]	2003	Indonesia	77	Healthy infants	4 m	6	5d/wk	Zn + β-carotene supplement	Sulfate	10	7.1	±
Wieringa [33]	2003	Indonesia	88	Healthy infants	4 m	6	5d/wk	Zn + Fe supplement	Sulfate	10	7.1	±
Wuehler [17]	2008	Ecuador	110	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	10	10	±
Zlotkin [34]	2003	Ghana	202	Infants and children with mild-moderate anemia	6-18 m	2	Daily	Zn + Fe + VitC supplement	Gluconate	10	10	±

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Table S5. Studies and comparisons with reported hemoglobin outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose ¹ , mg	Actual dose ¹ , mg/d	Effect of zinc§
Alarcon [21]	2004	Peru	213	Anemic infants and children (70-100, moderate anaemia)	6-35m	4.1 (18wks)	6d/wk	Fe + Zn supplement	Sulfate	0.7mg/kg/d	6.5	↑
Baqui [1]	2005	Bangladesh	124	Healthy infants	6 m	6	Weekly	Zn+ B ₂ supplement	Acetate	20	2.9	±
Baqui [1]	2005	Bangladesh	125	Healthy infants	6 m	6	Weekly	Zn + Fe + B ₂ supplement	Acetate	20	2.9	±
Becquey [22] data from authors	2016	Burkina Faso	169	Healthy infants and children	6-27 m	11	10 d every 16 wk	Zn supplement	Sulfate	7	0.9	±
Becquey [22] data from authors	2016	Burkina Faso	165	Healthy infants and children	6-27 m	11	Daily	Zn supplement	Sulfate	7	7	±
Berger [23]	2006	Vietnam	381	Healthy infants	4-7 m	6	Daily	Zn supplement	Sulfate	10	10	±
Berger [23]	2006	Vietnam	379	Healthy infants	4-7 m	6	Daily	Zn + Fe supplement	Sulfate	10	10	±
Brooks [4]	2005	Bangladesh	636	Healthy infants	1-12 m	10	Weekly	Zn supplement	Acetate	70	10	±
Brown [5]	2007	Peru	144	Healthy infants	6-8 m	6	Daily	Zn supplement + Fe fortified porridge	Sulfate	3	2.3	±
Brown [5]	2007	Peru	147	Healthy infants	6-8 m	6	Daily	Zn + Fe fortified complementary food	Sulfate	3	»3.3	±
Carter [24]	2018	Tanzania	302	Healthy infants	5-7 wk	18	Daily	Zn supplement	Sulfate	5 until 6 m of age then 10	5 until 6 m of age then 10	±
Carter [24]	2018	Tanzania	291	Healthy infants	5-7 wk	18	Daily	Zn + MV (no Fe) supplement	Sulfate	5 until 6 m of age then 10	5 until 6 m of age then 10	±
Caulfield [6]	2013	Peru	209	Healthy infants	4-6 m	18	Daily	Zn + Fe + Cu supplement	Sulfate	10	10	± [↑]*
De Brito [18]	2014	Brazil	30	Healthy children	8-9 y	3	Daily	Zn added to milk or juice	Sulfate	10	10	±
Dijkhuizen [25]	2001	Indonesia	184	Healthy infants	4 m	6	5 d/wk	Zn supplement	Sulfate	10	7.1	±
Dijkhuizen [25]	2001	Indonesia	164	Healthy infants	4 m	6	5 d/wk	Zn + Fe supplement	Sulfate	10	7.1	↓

Fahmida [26]	2007	Indonesia	303	Anemic infants (80% anemia)	3-6 m	6	Daily	Zn supplement	Sulfate	10	10	±
Heinig [8]	2006	USA	19	Healthy infants	4 m	6	Daily	Zn supplement	Gluconate or Sulfate	5	5	±
Hess [35]	2015	Burkina Faso	970	Healthy infants	9 m	9	Daily	Zn supplement	Not specified, but likely sulfate	5	5	±
Hess [35]	2015	Burkina Faso	987	Healthy infants	9 m	9	Daily	Zn + Fe SQ-LNS + placebo supplement	Not specified, but likely sulfate	5	5	±
Hess [35]	2015	Burkina Faso	978	Healthy infants	9 m	9	Daily	Zn + Fe SQ-LNS + placebo supplement	Not specified, but likely sulfate	10	10	±
Lind [9]	2003	Indonesia	277	Healthy infants	6 m	6	Daily	Zn supplement	Sulfate	10	10	±
Lind [9]	2003	Indonesia	272	Healthy infants	6 m	6	Daily	Zn + Fe supplement	Sulfate	10	10	↓
Lopez de Romaña [27]	2005	Peru	22	Stunted and anemic children	3-4 y	1.6	5d/wk	Zn + Fe fortified wheat	Sulfate	3	2.1	±
Lopez de Romaña [27]	2005	Peru	24	Stunted and anemic children	3-4 y	1.6	5d/wk	Zn + Fe fortified wheat	Sulfate	9	6.4	↓ [±]*
Olney [36]	2006	Zanzibar	102	Nutritionally at-risk infants	9.0 m	12	Daily	Zn supplement	Not specified, but likely sulfate	10	10	↑
Olney [36]	2006	Zanzibar	110	Nutritionally at-risk infants	8.6-8.7 m	12	Daily	Zn + Fe + FA supplement	Not specified, but likely sulfate	10	10	±
Owusu-Agyei [37]	2013	Ghana	182	Healthy infants and children	6-24 m	6	Daily	Zn supplement (+ 1 dose VitA)	Gluconate	10	10	[±]
Penny [38]	2004	Peru	134	Infants and children recovering from persistent diarrhea	6-36 m	6	Daily	Zn supplement	Gluconate	10	10	±

Radhakrishna [10]	2013	India	68	Healthy infants	4 m	14 (12 with suppl)	Daily	Zn+B2 supplement	Sulfate	5	5	±
Richard [39]	2006	Peru	418	Healthy infants and children	6 m to 15 y	7	6d/wk	Zn supplement	Sulfate	20	17.1	±
Richard [39]	2006	Peru	418	Healthy infants and children	6 m to 15 y	7	6d/wk	Fe + Zn supplement	Sulfate	20	17.1	±
Rosado [11]	2006	Mexico	187	Healthy children with environmental lead exposure	6-7 y	6	5d/wk	Zn supplement	Oxide	30	21.4	±
Rosado [11]	2006	Mexico	198	Healthy children with environmental lead exposure	6-7 y	6	5d/wk	Fe + Zn supplement	Oxide	30	21.4	±
Rosado [28]	1997	Mexico	95	Healthy children	18-36 m	12	5d/wk	Zn supplement	Methionine	20	14.3	±
Rosado [28]	1997	Mexico	99	Healthy children	18-36 m	12	5d/wk	Fe + Zn supplement	Methionine	20	14.3	±
Ruz [12]	1997	Chile	74	Healthy children	27-50 m	6 biochem	Daily	Intervention; Zn supplement	Sulfate	10	10	±
Sazawal [13]	2004	India	115	Healthy infants	5-12 m	4	Daily	Zn supplement + multi-vitamins (no zinc)	Gluconate	10	10	±
Sazawal [40]	2018	India	6005	Healthy children	4-6 y	6	Daily	High Zn biofortified wheat (control is low zinc biofortified wheat)	Not specified	1.2 diff from lo zinc control	»1.2	±
Shankar [41]	2000	Papua New Guinea	212	Infants and children in malaria endemic area	6-60 m	10.6	6d/wk	Zn supplement	Gluconate	10	8.6	±
Smith [42]	1999	El Salvador	37	Children with low serum Zn and low VitA	28-70 m	6	Weekly	Zn supplement	Gluconate	Intervention:70	10	±
Smith [42]	1999	El Salvador	37	Children with low serum Zn and low VitA	28-70 m	6	Weekly	Zn + VitA supplement	Gluconate	Intervention:70	10	±
Soofi [29]	2013	Pakistan	411	Healthy infants	6 m	12	Daily	Zn + Fe + MNP supplement	Gluconate	10	10	±

Taneja [43]	2009	India	319	Healthy infants	0.5 m	9	Daily	Zn + Fe + MN supplement	Sulfate	5 for 3-5 m-old, 10 for 6-12 m-old	5 for 3-5 m-old, 10 for 6-12 m-old	±
Tielsch [30]	2006	Nepal	335	Healthy infants and children	1-35 m	12	Daily	Zn + Fe + FA supplement	Sulfate	5 for 1-11 m-old, 10 for 12-35 m-old	5 for 1-11 m-old, 10 for 12-35 m-old	±
Veenemans [31]	2011	Tanzania	299	Healthy infants and children	6-60 m	8.3	Daily	Zn supplement	Gluconate	10	10	±
Veenemans [31]	2011	Tanzania	299	Healthy infants and children	6-60 m	8.3	Daily	Zn + MMN with Fe supplement	Gluconate	10	10	±
Wasantwisut [32]	2006	Thailand	124	Healthy infants, Hb 80+ g/L	4-6 m	6	Daily	Zn + VitC supplement	Sulfate	10	10	↓ [±]
Wasantwisut [32]	2006	Thailand	132	Healthy infants, Hb 80+ g/L	4-6 m	6	Daily	Zn + Fe + VitC supplement	Sulfate	10	10	↓ [±]
Wieringa [33]	2003	Indonesia	91	Healthy infants	4 m	6	5d/wk	Zn supplement	Sulfate	10	7.1	±
Wieringa [33]	2003	Indonesia	77	Healthy infants	4 m	6	5d/wk	Zn + β-carotene supplement	Sulfate	10	7.1	±
Wieringa [33]	2003	Indonesia	88	Healthy infants	4 m	6	5d/wk	Zn + Fe supplement	Sulfate	10	7.1	±
Wuehler [17]	2008	Ecuador	106	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	3	3	±
Wuehler [17]	2008	Ecuador	108	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	7	7	±
Wuehler [17]	2008	Ecuador	110	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	10	10	±
Zlotkin [34]	2003	Ghana	239	Infants and children with mild-moderate anemia	6-18 m	2	Daily	Zn + Fe + VitC supplement	Gluconate	10	10	↓

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Table S6. Studies and comparisons with reported serum transferrin receptor outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose ¹ , mg	Actual dose ¹ , mg/d	Effect of zinc§
Baqui [1]	2005	Bangladesh	80	Healthy infants	6 m	6	Weekly	Zn + B ₂ supplement	Acetate	20	2.9	±
Baqui [1]	2005	Bangladesh	83	Healthy infants	6 m	6	Weekly	Zn + Fe + B ₂ supplement	Acetate	20	2.9	±
Becquey [22] data from authors	2016	Burkina Faso	165	Healthy infants and children	6-27 m	11	Daily	Zn supplement	Sulfate	7	7	±
Becquey [22] data from authors	2016	Burkina Faso	169	Healthy infants and children	6-27 m	11	10 d every 16 wk	Zn supplement	Sulfate	1.4	0.9	±
Carter [24]	2018	Tanzania	302	Healthy infants	5-7 wk	6 (18)	Daily	Zn supplement	Sulfate	5 until 6 m of age then 10	5 until 6 m of age then 10	±
Carter [24]	2018	Tanzania	291	Healthy infants	5-7 wk	18	Daily	Zn + MV (no Fe) supplement	Sulfate	5 until 6 m of age then 10	5 until 6 m of age then 10	±
Lind [9]	2003	Indonesia	257	Healthy infants	6 m	6	Daily	Zn supplement	Sulfate	10	10	±
Lind [9]	2003	Indonesia	250	Healthy infants	6 m	6	Daily	Zn + Fe supplement	Sulfate	10	10	±

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Table S7. Studies and comparisons with reported lipid outcomes in response to additional zinc supplementation or fortification, by author.

Study	Year	Country	Sample size analyzed	Characteristics of subjects	Initial age	Duration, m	Schedule	Intervention (All controls are same without the added zinc)	Form of zinc	Dose ¹ , mg	Actual dose ¹ , mg/d	Effect of zinc§
Chimhashu [44]	2018	Benin	162	Healthy children	6-10 y	4.6	5 d/wk	Zn fortified water	Zinc ions	4.3	2.8	nervonic acid
Hambidge [7]	1979	USA	58	Healthy children	33-90 m	9	Daily	Zn fortified breakfast cereal (control, no fortificant)	Oxide	9.3	3	± serum cholesterol
Walravens [15]	1976	USA	68	Healthy infants	4-6 d	6	Daily	Zn + Fe fortified formula	Sulfate	5.8	4	± serum cholesterol
Wuehler [17]	2008	Ecuador	110	Healthy children	12-30 m	6	Daily	Zn supplement	Sulfate	10	10	± serum cholesterol

*In brackets is the effect as reported by the original study. ↑ or ↓ indicates the final concentration is higher or lower, respectively, in the zinc intervention group compared to the non-zinc comparison; ± indicates no reported difference between zinc and no-zinc interventions.

¹ All control groups received the same as the intervention except the dose of zinc listed

Supplementary Figures

Figure S1: Effect of additional zinc intervention on plasma or serum ceruloplasmin concentrations.

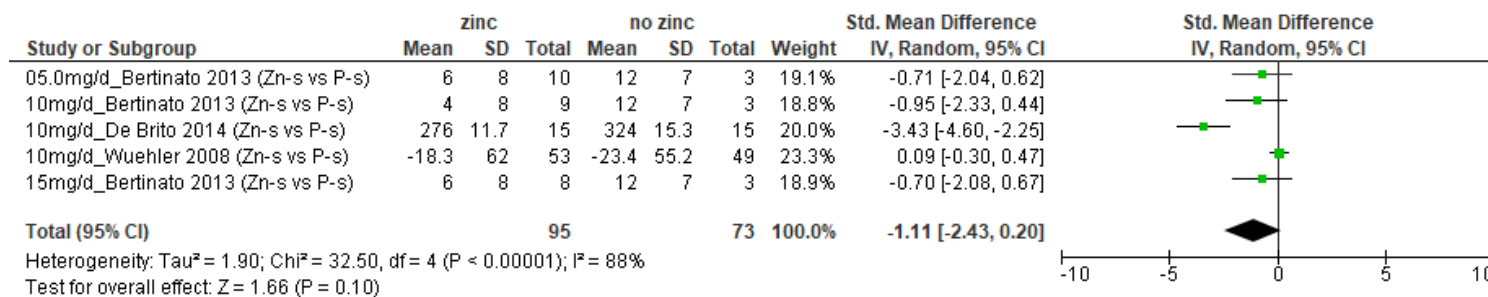


Figure S1 legends: Zn-s: Zinc supplement; P-s: Placebo supplement

Figure S2: Effect of additional zinc intervention on erythrocyte super-oxide dismutase concentrations.

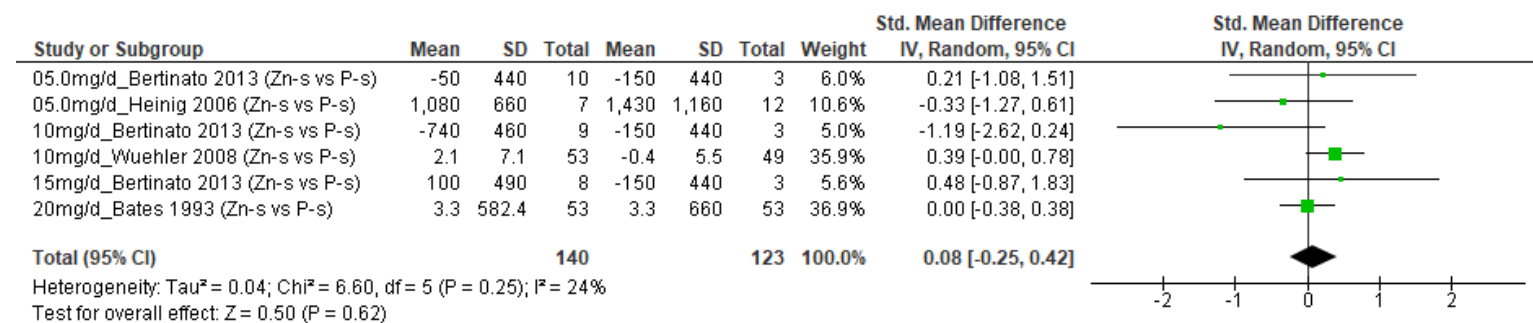


Figure S2 legends: Zn-s: Zinc supplement; P-s: Placebo supplement

Figure S3: Effect of additional zinc intervention (no iron was provided either in the intervention or control group) on serum ferritin concentrations (a) < 12 months, (b) 12 months or more.

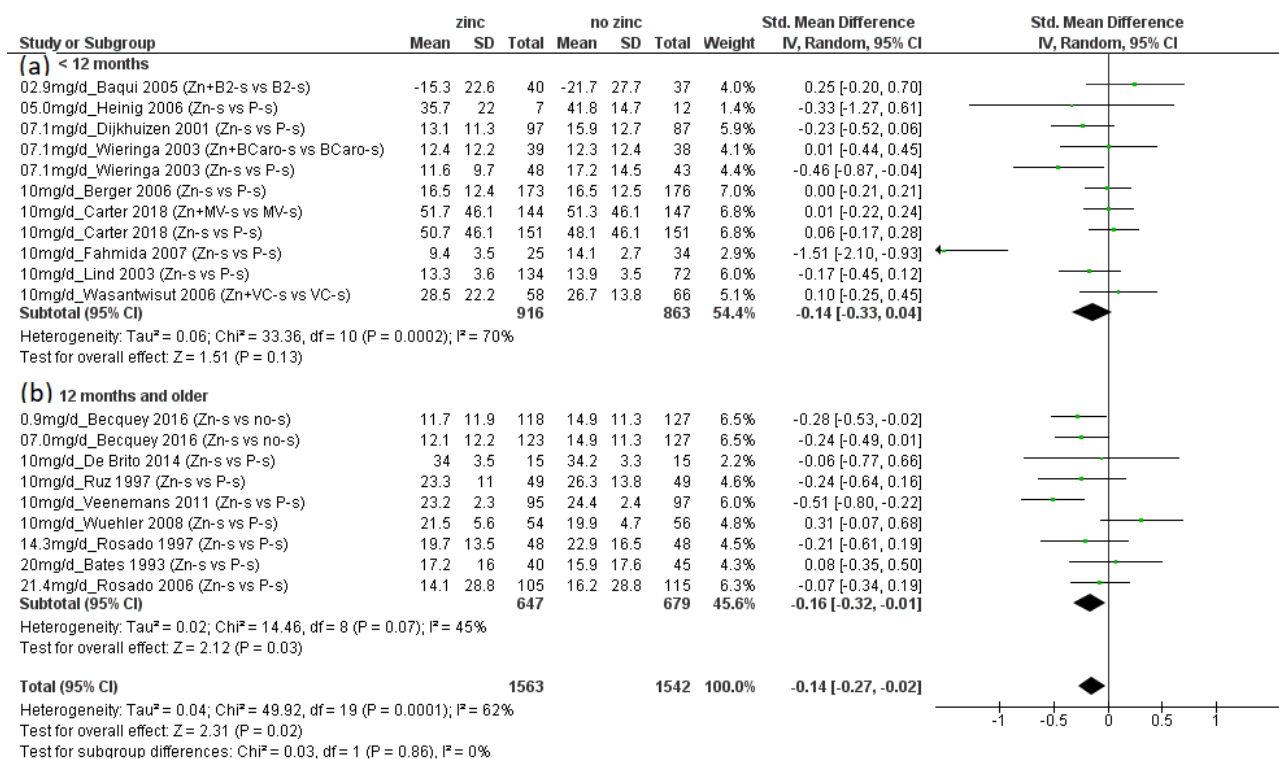


Figure S3 legends: Zn-s: Zinc supplement; Zn + B2-s: Zinc plus vitamin B12 supplement; B2-s: Vitamin B2 supplement; P-s: Placebo supplement; no-s: No supplement; Zn + BCaro-s: zinc plus beta carotene supplement; BCaro-s: Beta carotene supplement; Zn + MV-s: Zinc plus multivitamin supplement; MV-s: Multivitamin supplement; Zn + VC-s: Zinc plus vitamin C supplement; VC-s: Vitamin C supplement. NOTE: Placebo value (P) from Lind et al 2003 updated by Dr. Lind through personal communication.

Figure S4: Effect of additional zinc intervention (iron was provided in both the intervention and control group) on serum ferritin concentrations (a) < 12 months, (b) 12 months or more.

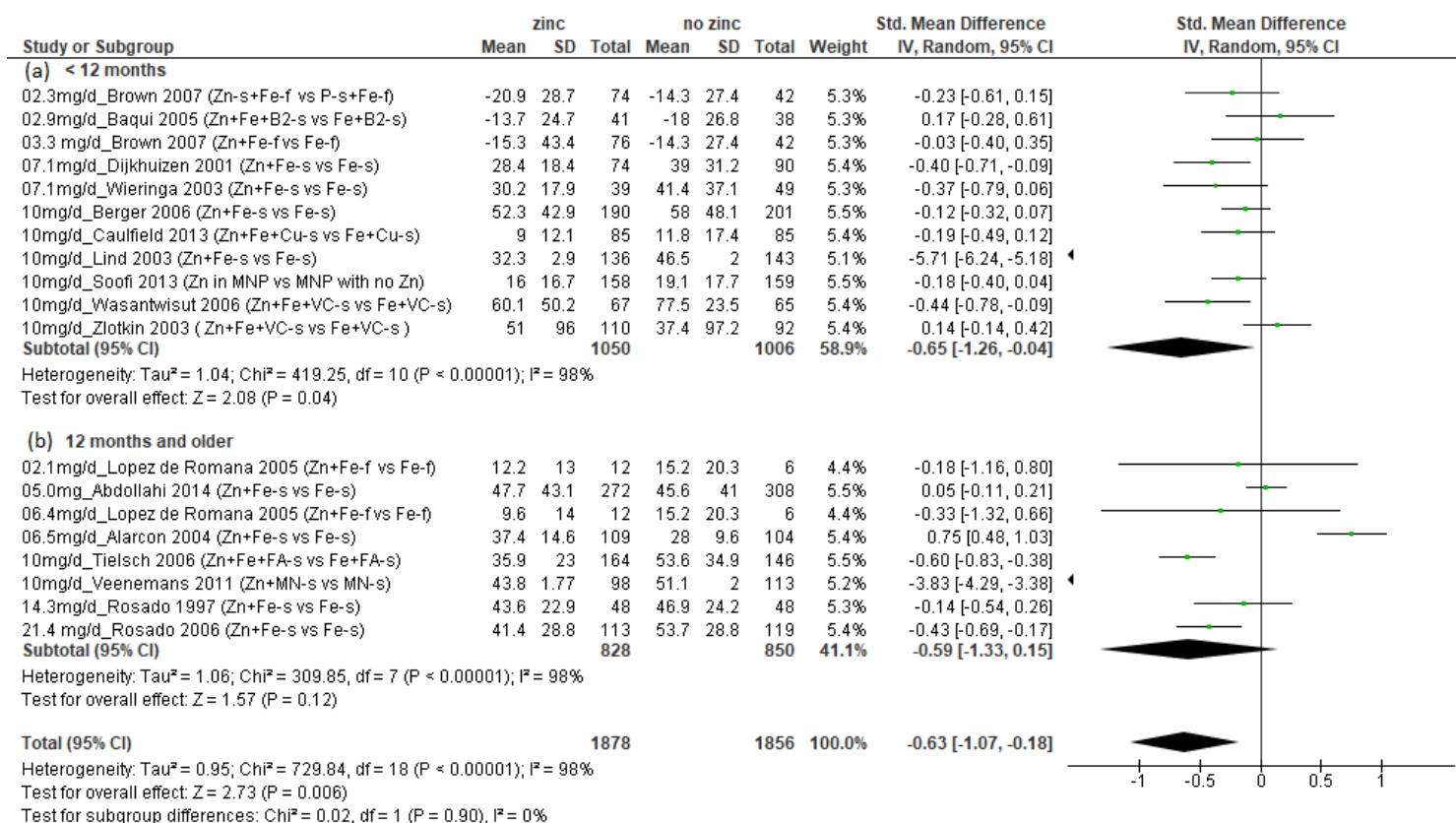


Figure S4 legends: Zn+Fe-s: Zinc plus iron supplement; Zn + Fe + Cu-s: Zinc plus iron plus copper supplement; Fe + Cu-s: Iron plus copper supplement; Zn+Fe+B2-s: Zinc plus iron plus vitamin B2 supplement; Fe-f: Iron fortified; Fe-s: Iron supplement; Zn + Fe-f: Zinc plus iron fortified; Fe-f: Iron fortified; Zn-s+Fe-f: Zinc supplement plus iron fortified; P-s+Fe-f: Placebo supplement plus iron fortified; Zn+Fe+FA-s: Zinc plus iron plus folic acid supplement; Fe+FA-s: Iron plus folic acid supplement; Zn in MNP: Micronutrient powder with zinc plus iron; MNP with no Zn: Micronutrient powder with no zinc plus iron; Zn + MN: Zinc plus micronutrient supplement; Zn + Fe + VC-s: Zinc plus iron plus vitamin C supplement.

Figure S5: Effect of additional zinc intervention on whole blood hemoglobin concentrations, by mean age at baseline: (a) <12 months, (b) 12 months or older.

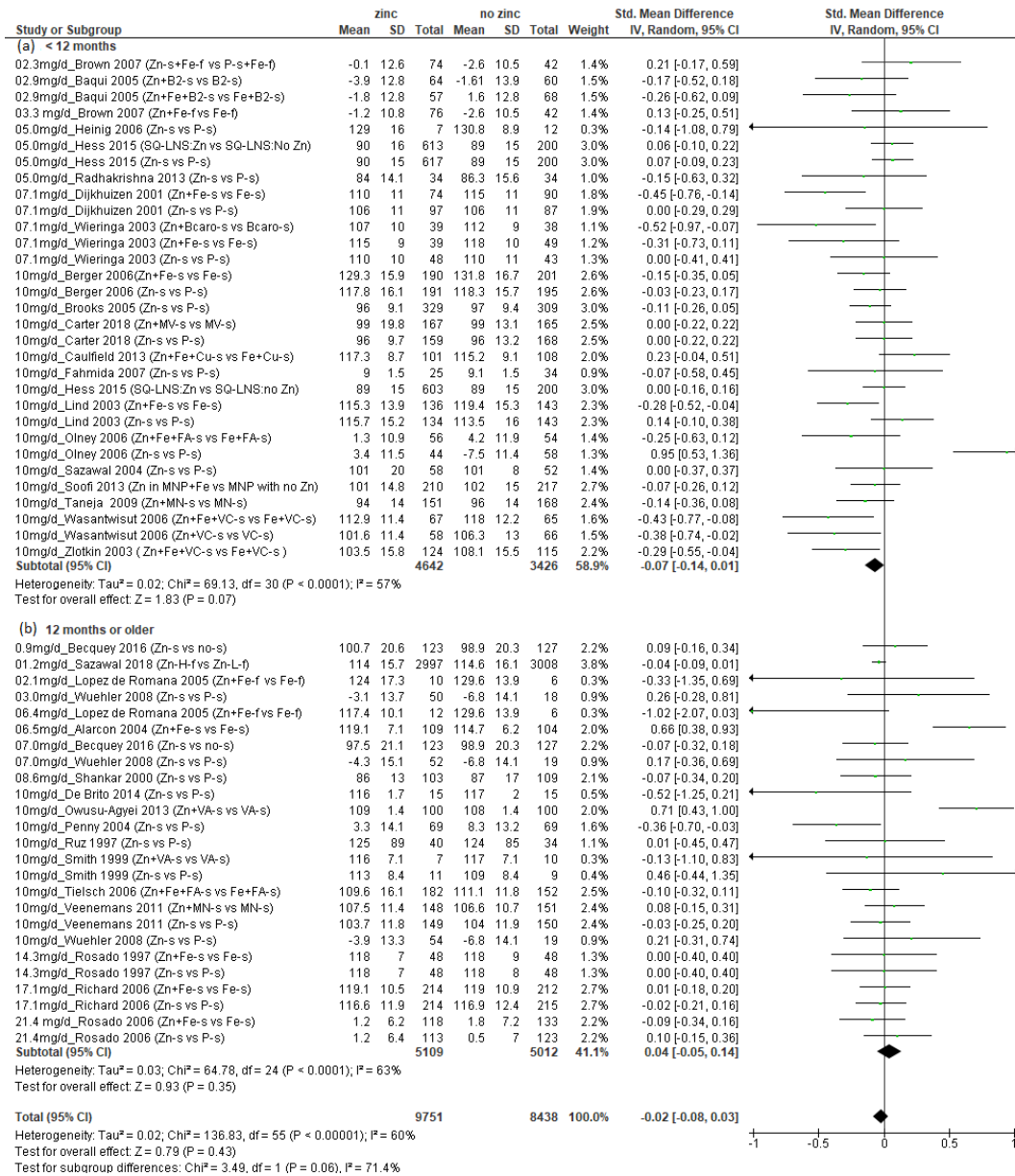


Figure S5 legends: Zn-s: Zinc supplement; Zn+ Fe-s: Zinc plus iron supplement; Zn + Fe + Cu-s: Zinc plus iron plus copper supplement; Fe + Cu-s: Iron plus copper supplement; Zn + B2-s: Zinc plus vitamin B12 supplement; B2-s: Vitamin B2 supplement; Zn+Fe+B2-s: Zinc plus iron plus vitamin B2 supplement; Zn-f: Zinc fortified; P-s: Placebo supplement; P-f: Placebo fortified; Fe-f: Iron fortified; Fe-s: Iron supplement; Zn-H-Dose-f: Zinc high dose fortified; Zn-L-Dose-f: Zinc low dose fortified; Zn-H-f: Zinc high fortified; Zn-L-f: Zinc low fortified; no-s: No supplement; Zn + BCaro-s: zinc plus beta carotene supplement ;BCaro-s: Beta carotene supplement; Zn + MV-s: Zinc plus multivitamin supplement; MV-s: Multivitamin supplement; Zn+VA-s: Zinc plus vitamin A supplement; VA-s: Vitamin A supplement; Zn + VC-s: Zinc plus vitamin C supplement ; VC-s: Vitamin C supplement; Zn + Fe-f: Zinc plus iron fortified; Fe-f: Iron fortified; Zn-s+Fe-f: Zinc supplement plus iron fortified; P-s+Fe-f: Placebo supplement plus iron fortified; SQ-LNS:Zn: Small quantity Lipid Nutrient supplement with zinc; SQ-LNS:No Zn: Small quantity Lipid Nutrient supplement with no zinc; Zn+Fe+FA-s: Zinc plus iron plus folic acid supplement; Fe+FA-s: Iron plus folic acid supplement; Zn in MNP: Micronutrient powder with zinc plus iron; MNP with no Zn: Micronutrient powder with no zinc plus iron; Zn + MN: Zinc plus micronutrient supplement; Zn + Fe + VC-s: Zinc plus iron plus vitamin C supplement.

Figure S6: Effect of additional zinc intervention on serum transferrin receptor concentrations.

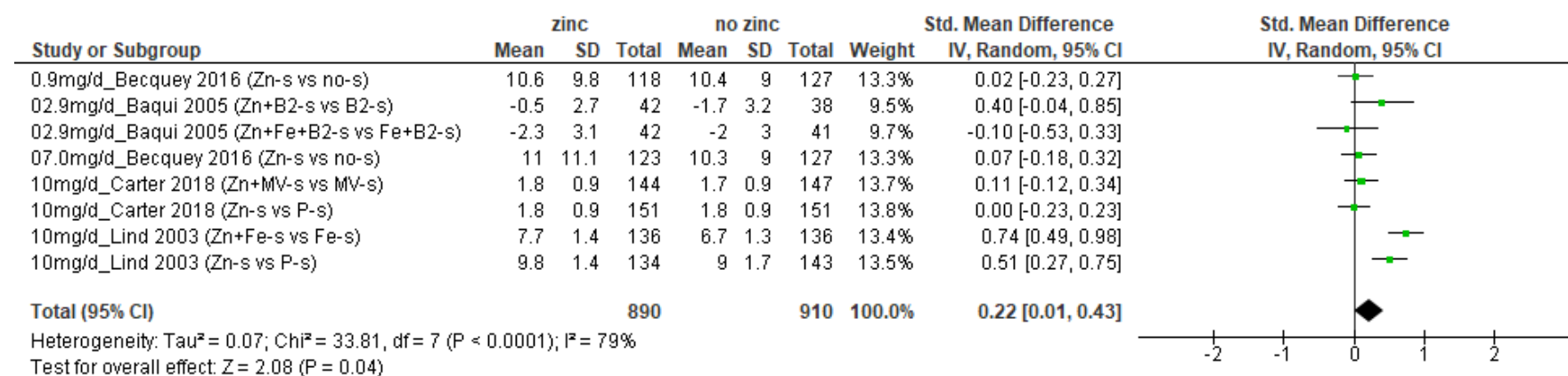


Figure S6 legends: Zn-s: Zinc supplement; P-s: Placebo supplement; Zn + B2-s: Zinc plus vitamin B12 supplement; B2-s: Vitamin B2 supplement; no-s: No supplement

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