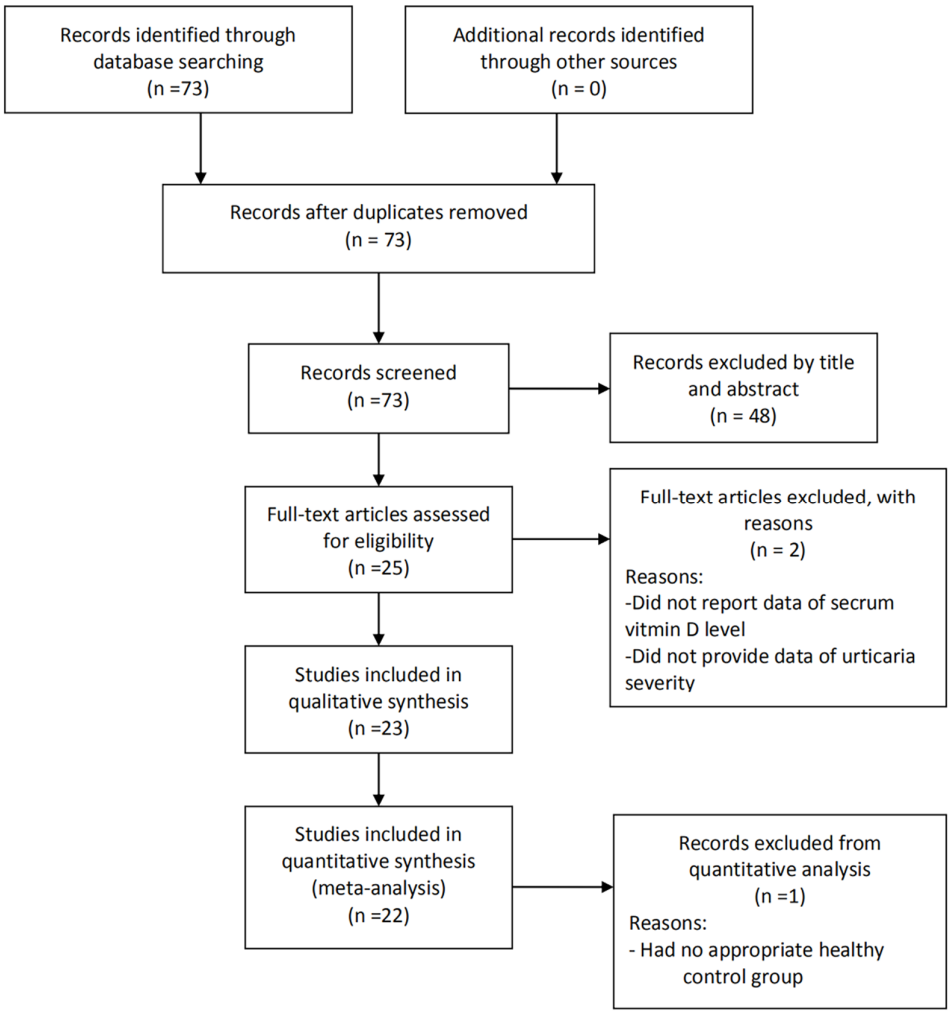
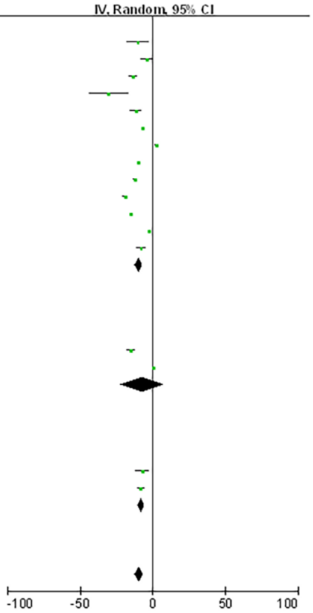
**Supplemental Figure 1. PRISMA flow diagram**



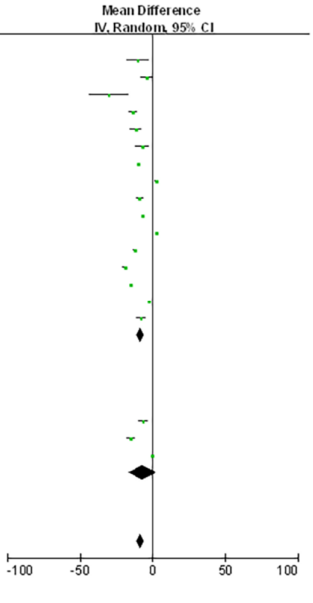
**Supplemental Figure 2. Forest Plot for sub-analysis of serum vitamin D level comparison.**

| Study or Subgroup | Urticaria Serum VitD Mean | SD | Total | Control Serum VitD Mean | SD | Total | Weight | Mean Difference IV, Random, 95% CI | Year |
|---|---|---|---|---|---|---|---|---|---|
| **1.1.1 Adult** | | | | | | | | | |
| Thorp et al., 2010 | 29.4 | 13.4 | 25 | 39.6 | 14.7 | 25 | 4.4% | -10.20 [-18.00, -2.40] | 2010 |
| Grzanka et al., 2014 | 27.2 | 11.07 | 35 | 31.1 | 6.41 | 33 | 5.7% | -3.90 [-8.17, 0.37] | 2014 |
| Boonpiyathad et al., 2014 | 17.27 | 9.73 | 60 | 31.11 | 4.87 | 40 | 6.1% | -13.84 [-16.73, -10.95] | 2014 |
| Abdel-Rehim et al., 2014 | 11.36 | 3.63 | 22 | 41.8 | 30.72 | 20 | 2.7% | -30.44 [-43.99, -16.89] | 2014 |
| Chandrashekar et.al, 2014 | 12.7 | 2.7 | 45 | 24.3 | 13.5 | 45 | 5.8% | -11.60 [-15.62, -7.58] | 2014 |
| Movahedi et al., 2015 | 15.8 | 1.5 | 114 | 22.6 | 1.6 | 187 | 6.5% | -6.80 [-7.16, -6.44] | 2015 |
| Wu et al., 2015 | 20.56 | 10.81 | 225 | 18.16 | 9.94 | 1321 | 6.4% | 2.40 [0.89, 3.91] | 2015 |
| Rasool et al., 2015 | 17.87 | 1.22 | 192 | 27.65 | 1.65 | 210 | 6.5% | -9.78 [-10.06, -9.50] | 2015 |
| Nasiri-Kalmarzi et al., 2017 | 19.26 | 1.26 | 110 | 31.72 | 7.14 | 110 | 6.4% | -12.46 [-13.81, -11.11] | 2017 |
| Rather et al., 2018 | 19.6 | 6.9 | 110 | 38.5 | 6.7 | 110 | 6.3% | -18.90 [-20.70, -17.10] | 2018 |
| Mohamed et al., 2020 | 25 | 1.01 | 77 | 40.2 | 1.1 | 67 | 6.5% | -15.20 [-15.55, -14.85] | 2020 |
| Ma et al. 2020 | 18.08 | 5.97 | 90 | 20.31 | 3.43 | 90 | 6.4% | -2.23 [-3.65, -0.81] | 2020 |
| Vurgun et al., 2020 | 9.1 | 5.1 | 30 | 17.2 | 8.8 | 30 | 5.9% | -8.10 [-11.74, -4.46] | 2020 |
| **Subtotal (95% CI)** | | | **1135** | | | **2288** | **75.7%** | **-9.78 [-12.41, -7.14]** | |
| Heterogeneity: Tau² = 20.08; Chi² = 1663.72, df = 12 (P < 0.00001); I² = 99% | | | | | | | | | |
| Test for overall effect: Z = 7.28 (P < 0.00001) | | | | | | | | | |
| **1.1.2 Children** | | | | | | | | | |
| Ozdemir et al., 2016 | 13.17 | 4.36 | 30 | 28.27 | 7.4 | 30 | 6.1% | -15.10 [-18.17, -12.03] | 2016 |
| Lee et al., 2017 | 20.26 | 5.06 | 624 | 20 | 5.1 | 3159 | 6.5% | 0.26 [-0.18, 0.70] | 2017 |
| **Subtotal (95% CI)** | | | **654** | | | **3189** | **12.6%** | **-7.34 [-22.39, 7.71]** | |
| Heterogeneity: Tau² = 116.71; Chi² = 94.06, df = 1 (P < 0.00001); I² = 99% | | | | | | | | | |
| Test for overall effect: Z = 0.96 (P = 0.34) | | | | | | | | | |
| **1.1.3 Mixed** | | | | | | | | | |
| Oguz Topal et al., 2015 | 11.38 | 11.17 | 58 | 18.43 | 13.14 | 45 | 5.5% | -7.05 [-11.85, -2.25] | 2015 |
| Woo et al., 2015 | 12.46 | 6.85 | 98 | 20.77 | 9.74 | 72 | 6.2% | -8.31 [-10.94, -5.68] | 2015 |
| **Subtotal (95% CI)** | | | **156** | | | **117** | **11.7%** | **-8.02 [-10.32, -5.72]** | |
| Heterogeneity: Tau² = 0.00; Chi² = 0.20, df = 1 (P = 0.65); I² = 0% | | | | | | | | | |
| Test for overall effect: Z = 6.82 (P < 0.00001) | | | | | | | | | |
| **Total (95% CI)** | | | **1945** | | | **5594** | **100.0%** | **-9.35 [-12.27, -6.44]** | |
| Heterogeneity: Tau² = 33.99; Chi² = 3628.37, df = 16 (P < 0.00001); I² = 100% | | | | | | | | | |
| Test for overall effect: Z = 6.29 (P < 0.00001) | | | | | | | | | |
| Test for subgroup differences: Chi² = 1.00, df = 2 (P = 0.61), I² = 0% | | | | | | | | | |

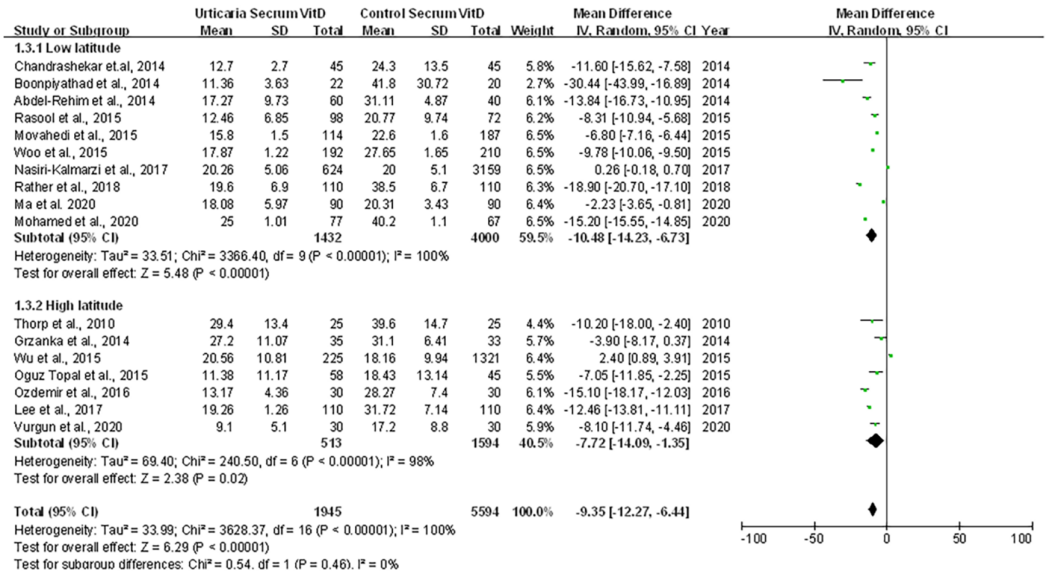



(a)

| Study or Subgroup | Urticaria Serum VitD Mean | SD | Total | Control Serum VitD Mean | SD | Total | Weight | Mean Difference IV, Random, 95% CI | Year |
|---|---|---|---|---|---|---|---|---|---|
| **1.2.1 Chronic urticaria** | | | | | | | | | |
| Thorp et al., 2010 | 29.4 | 13.4 | 25 | 39.6 | 14.7 | 25 | 4.0% | -10.20 [-18.00, -2.40] | 2010 |
| Grzanka et al., 2014 | 27.2 | 11.07 | 35 | 31.1 | 6.41 | 33 | 5.1% | -3.90 [-8.17, 0.37] | 2014 |
| Abdel-Rehim et al., 2014 | 11.36 | 3.63 | 22 | 41.8 | 30.72 | 20 | 2.4% | -30.44 [-43.99, -16.89] | 2014 |
| Boonpiyathad et al., 2014 | 17.27 | 9.73 | 60 | 31.11 | 4.87 | 40 | 5.4% | -13.84 [-16.73, -10.95] | 2014 |
| Chandrashekar et.al, 2014 | 12.7 | 2.7 | 45 | 24.3 | 13.5 | 45 | 5.2% | -11.60 [-15.62, -7.58] | 2014 |
| Oguz Topal et al., 2015 | 11.38 | 11.17 | 58 | 18.43 | 13.14 | 45 | 4.9% | -7.05 [-11.85, -2.25] | 2015 |
| Rasool et al., 2015 | 17.87 | 1.22 | 192 | 27.65 | 1.65 | 210 | 5.8% | -9.78 [-10.06, -9.50] | 2015 |
| Wu et al., 2015 | 20.56 | 10.81 | 225 | 18.16 | 9.94 | 1321 | 5.7% | 2.40 [0.89, 3.91] | 2015 |
| Woo et al., 2015 | 11.86 | 7.16 | 72 | 20.77 | 9.74 | 72 | 5.5% | -8.91 [-11.70, -6.12] | 2015 |
| Movahedi et al., 2015 | 15.8 | 1.5 | 114 | 22.6 | 1.6 | 187 | 5.8% | -6.80 [-7.16, -6.44] | 2015 |
| Lee et al., 2017 | 22.9 | 4.9 | 57 | 20 | 5.1 | 3159 | 5.7% | 2.90 [1.62, 4.18] | 2017 |
| Nasiri-Kalmarzi et al., 2017 | 19.26 | 1.26 | 110 | 31.72 | 7.14 | 110 | 5.7% | -12.46 [-13.81, -11.11] | 2017 |
| Rather et al., 2018 | 19.6 | 6.9 | 110 | 38.5 | 6.7 | 110 | 5.6% | -18.90 [-20.70, -17.10] | 2018 |
| Mohamed et al., 2020 | 25 | 1.01 | 77 | 40.2 | 1.1 | 67 | 5.8% | -15.20 [-15.55, -14.85] | 2020 |
| Ma et al. 2020 | 18.08 | 5.97 | 90 | 20.31 | 3.43 | 90 | 5.7% | -2.23 [-3.65, -0.81] | 2020 |
| Vurgun et al., 2020 | 9.1 | 5.1 | 30 | 17.2 | 8.8 | 30 | 5.3% | -8.10 [-11.74, -4.46] | 2020 |
| **Subtotal (95% CI)** | | | **1322** | | | **5564** | **83.4%** | **-8.72 [-11.28, -6.17]** | |
| Heterogeneity: Tau² = 23.83; Chi² = 2066.43, df = 15 (P < 0.00001); I² = 99% | | | | | | | | | |
| Test for overall effect: Z = 6.69 (P < 0.00001) | | | | | | | | | |
| **1.2.2 Acute urticaria** | | | | | | | | | |
| Woo et al., 2015 | 14.12 | 5.56 | 26 | 20.77 | 9.74 | 72 | 5.4% | -6.65 [-9.75, -3.55] | 2015 |
| Ozdemir et al., 2016 | 13.17 | 4.36 | 30 | 28.27 | 7.4 | 30 | 5.4% | -15.10 [-18.17, -12.03] | 2016 |
| Lee et al., 2017 | 20 | 5 | 567 | 20 | 5.1 | 3159 | 5.8% | 0.00 [-0.45, 0.45] | 2017 |
| **Subtotal (95% CI)** | | | **623** | | | **3261** | **16.6%** | **-7.16 [-16.53, 2.20]** | |
| Heterogeneity: Tau² = 66.88; Chi² = 106.49, df = 2 (P < 0.00001); I² = 98% | | | | | | | | | |
| Test for overall effect: Z = 1.50 (P = 0.13) | | | | | | | | | |
| **Total (95% CI)** | | | **1945** | | | **8825** | **100.0%** | **-8.56 [-11.33, -5.79]** | |
| Heterogeneity: Tau² = 34.54; Chi² = 3761.72, df = 18 (P < 0.00001); I² = 100% | | | | | | | | | |
| Test for overall effect: Z = 6.06 (P < 0.00001) | | | | | | | | | |
| Test for subgroup differences: Chi² = 0.10, df = 1 (P = 0.75), I² = 0% | | | | | | | | | |



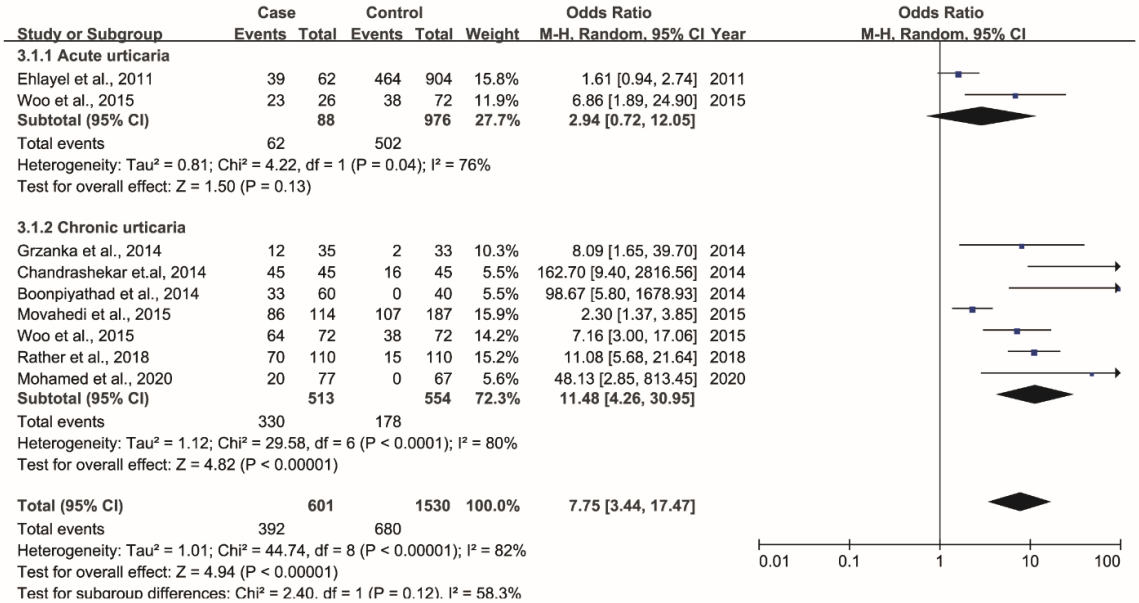

(b)



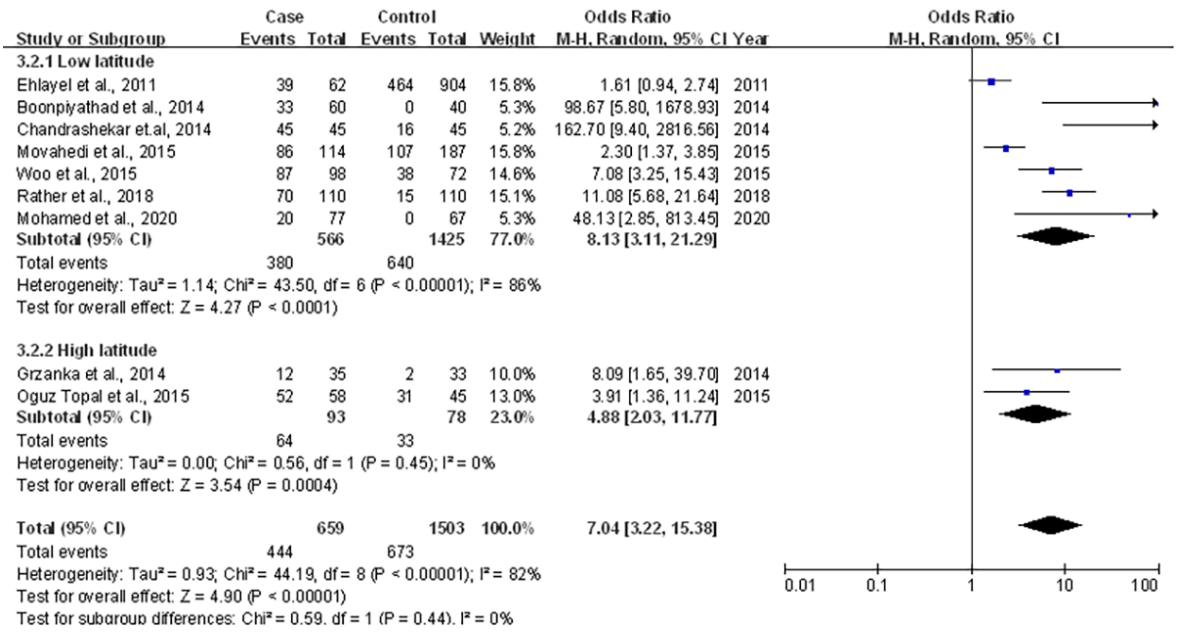

(c)

Fig. 2 (a) Subgrouped by age (b) Subgrouped by disease type (c)Subgrouped by latitude

**Supplemental Figure 3. Forest Plot for sub-analysis of vitamin D deficiency and urticaria.**



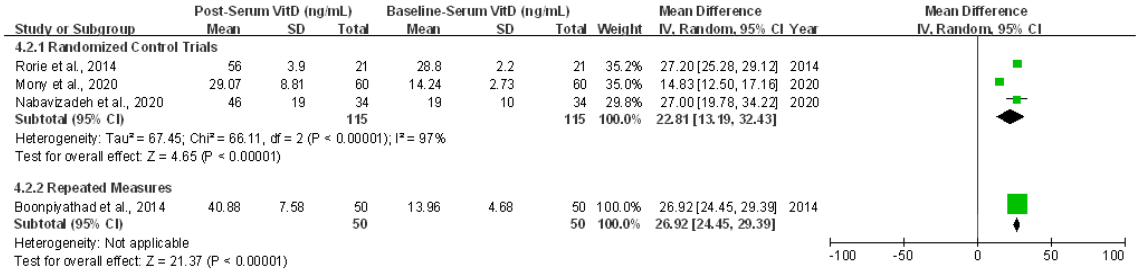

(a)



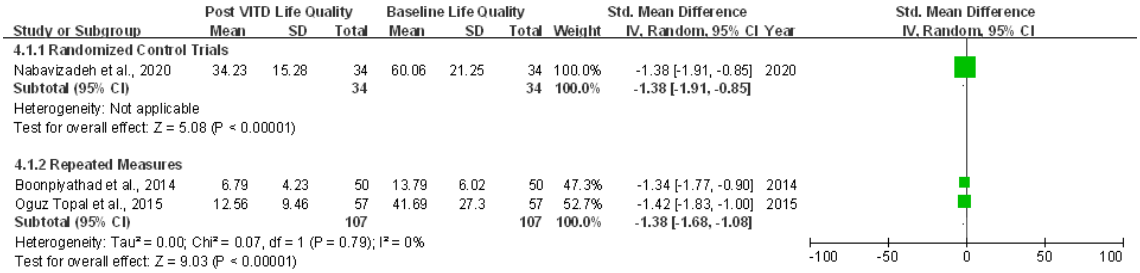

(b)

Fig. 3 (a) Subgrouped by disease type (b) Subgrouped by latitude

**Supplemental Figure 4. Forest Plot for changes in clinical urticarial assessments after vitamin D supplementation.**



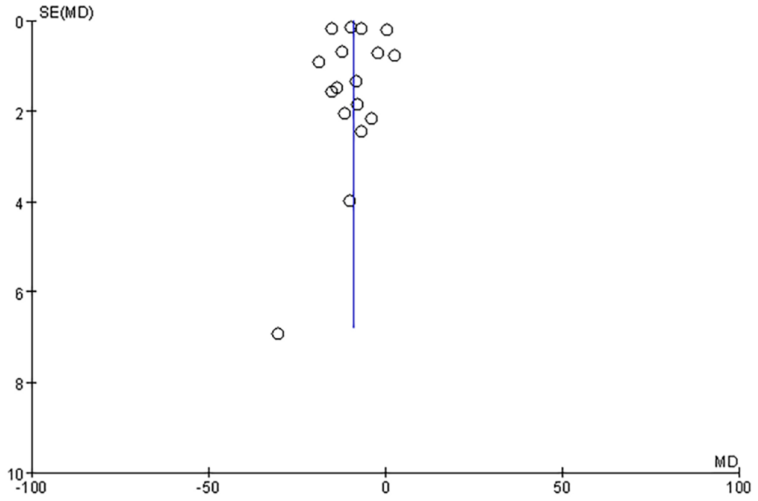

(a)



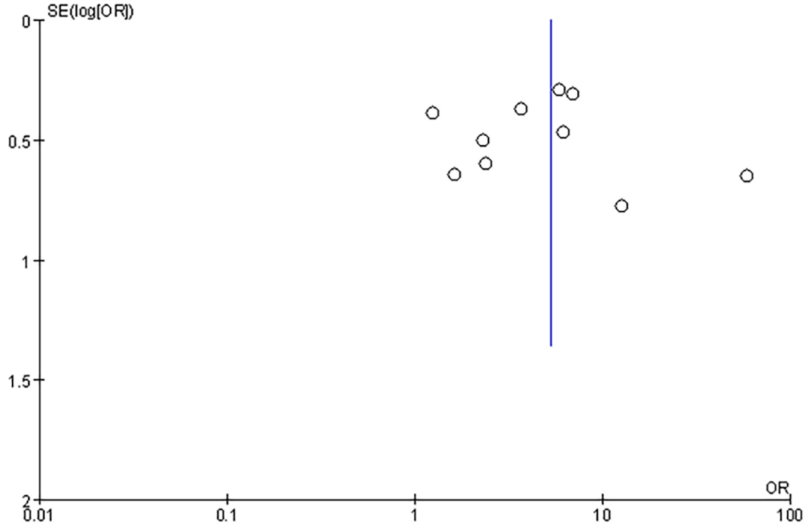

(b)

Fig. 4 (a) changes in serum 25(OH)VitD levels (b) changes in life quality scores

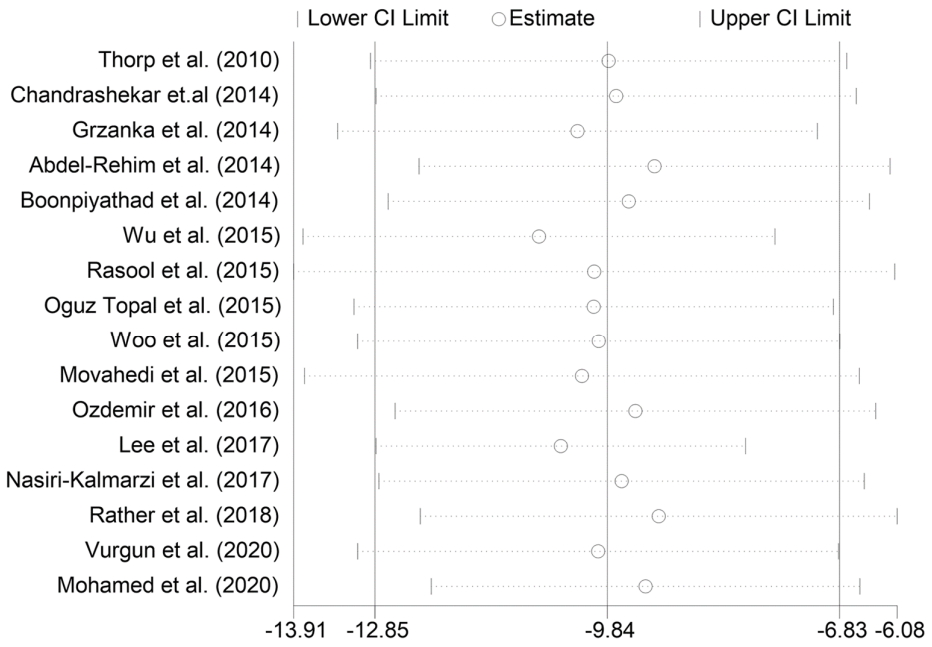
**Supplemental Figure 5. Risk of bias**



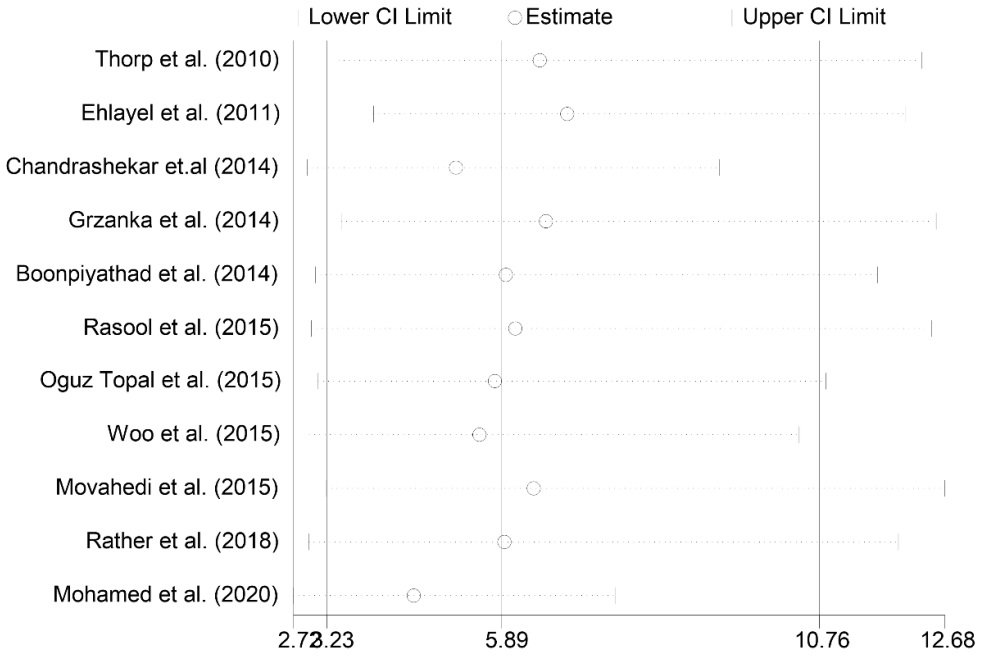

(a)




(b)

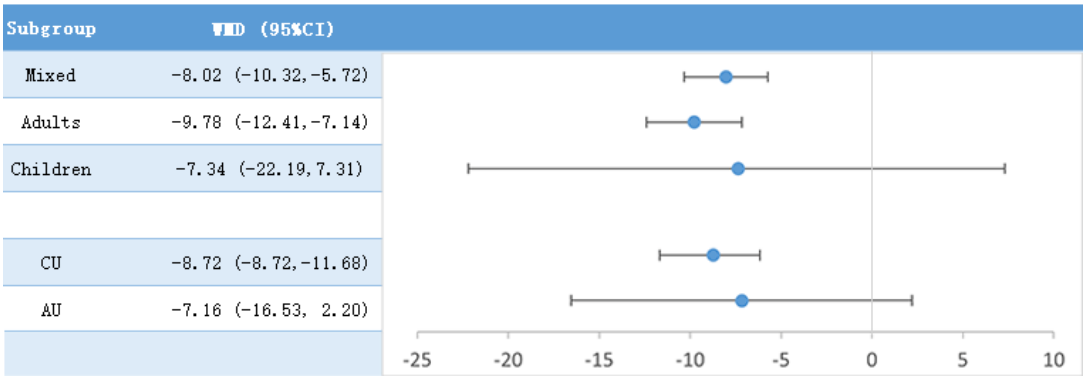

Lower CI Limit
Estimate
Upper CI Limit
Thorp et al. (2010)
Chandrashekar et.al (2014)
Grzanka et al. (2014)
Abdel-Rehim et al. (2014)
Boonpiyathad et al. (2014)
Wu et al. (2015)
Rasool et al. (2015)
Oguz Topal et al. (2015)
Woo et al. (2015)
Movahedi et al. (2015)
Ozdemir et al. (2016)
Lee et al. (2017)
Nasiri-Kalmarzi et al. (2017)
Rather et al. (2018)
Vurgun et al. (2020)
Mohamed et al. (2020)
-13.91
-12.85
-9.84
-6.83
-6.08

(c)


Lower CI Limit
Estimate
Upper CI Limit
Thorp et al. (2010)
Ehlayel et al. (2011)
Chandrashekar et.al (2014)
Grzanka et al. (2014)
Boonpiyathad et al. (2014)
Rasool et al. (2015)
Oguz Topal et al. (2015)
Woo et al. (2015)
Movahedi et al. (2015)
Rather et al. (2018)
Mohamed et al. (2020)
2.72
3.23
5.89
10.76
12.68

(d)

**Supplemental Figure 6. The lack of association of serum vitamin D levels with acute urticaria and children urticaira.**




CU: chronic urticaria; AU: acute urticaria

**Supplemental Table1.** The methodological quality of studies included in the final analysis.

(a) Quality of the case-control studies based on the Newcastle–Ottawa Scale.

| Study | Selection (Score) | | | | Comparability (Score) | Exposure (Score) | | | Total Score |
|---|---|---|---|---|---|---|---|---|---|
| | Adequate definition of patient cases | Representativeness of the cases | Selection of Controls | Definition of Controls | Control for important factor or additional factor | Ascertainment of exposure (blinding) | Same method of ascertainment for participants | Non-response rate | |
| Thorp et al.[1], 2010 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 4 |
| Ehlayel et al. [2], 2011 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| Chandrashekar et al.[3], 2014 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 6 |
| Grzanka et al.[4], 2014 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 6 |
| Abdel-Rehim et al.[5], 2014 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 6 |
| Boonpiyathad et al.[6], 2014 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 6 |
| Wu et al.[7], 2015 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 5 |
| Rasool et al.[8], 2015 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Oguz Topal et al.[9], 2015 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 6 |
| Woo et al.[10], 2015 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 7 |
| Movahedi et al.[11], 2015 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Ozdemir et al.[12], 2016 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Lee et al.[13], 2017 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Nasiri-Kalmarzi et al.[14], 2017 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Rather et al.[15], 2018 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| Vurgun et al.[16], 2020 | 0 | 1 | 0 | 1 | 2 | 1 | 1 | 0 | 6 |
| Mohamed et al.[17], 2020 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 6 |
| Ma et al.[18], 2020 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 8 |

(b) Quality and evidence level of the clinical trials based on the Jadad scale.

| Study | 1.Sequence generation | 2.Allocation concealment | 3.Blinding | 4.Incomplete outcome data | 5.Selective outcome reporting |
|---|---|---|---|---|---|
| Rorie et al., 2014[19] | Low risk | Low risk | Low risk | Low risk | Unclear |
| Ariaee et al. [20] | High risk | Unknown risk | High risk | Low risk | Low risk |
| Mony et al., 2020[21] | Low risk | Low risk | Low risk | Low risk | Low risk |
| Nabavizadeh et al., 2020[22] | Low risk | Low risk | Low risk | Low risk | Unclear |

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