Supplementary Table 1 Serum vitamin D levels in patients with chronic schizophrenia.

Studies	Subjects nSZ(nMale) nCtrl(nMale)	Mean age (Year)	25OHD (nM) Mean ± SD		Definition of deficiency and insufficiency (nM) and prevalence (%)			In/Out Patient	Country	Outcomes (Association between vitamin D levels and symptoms, biochemistry and brain structure in SZ patients)
			SZ	Ctrl	nM	SZ	Ctrl			
Yazici et al. 2019a [1]	189(108) 109(59)	41.4	43.8 ± 24.1	53.2 ± 27.3	< 50 < 75	66.5% 21.9%	51.5% 35.0%	In	Turkey	N/A
Yazici et al. 2019b [2]	30(30) 28(28)	40.5	28.4 ± 11.5	34.2 ± 12.3				Out	Turkey	No correlation between serum vitamin D levels and PANSS scores
Van der Leeuw et al. 2019 [3]	347(268) 282(118)	30.3	47.0 ± 26.1**	60.1 ± 26.5	< 75	82.8%	62.5%	Both	Netherland	An inverse association between serum vitamin D levels and positive and negative symptom scores
Malik et al. 2019 [4]	40(26) 40(18)	40.0	37.6	37.6	< 25 < 50	25.0% 67.5%	30.0% 50.0%	Out	Pakistan	N/A
Peitl et al. 2019 [5]	97(45)	40.2	53.6 ± 29.0					In	Croatia	A positive association between serum vitamin D levels and neuregulin 1
Arranz et al. 2019 [6]	199(103)	47	42.0		< 50	73.7%		Out	Spain	An inverse association between serum vitamin D and the risk of presenting metabolic syndrome
Zoghbi et al. 2019 [7]	196(118)	37.3			< 50	46.5%		In	Lebanon	Severe vitamin D deficiency was associated with an increase in MRSS score
Fond et al. 2019 [8]	251(180)	35.4			< 25	27.5%		Out	France	An inverse association between serum vitamin D levels and negative symptoms, high suicide risk, anti-depressant consumption.
Ikonen et al. 2019 [9]	40(22) 4659(2315)	31	65.5	74.3	< 30 < 50	2.5% 27.5%	3.2% 25.2%	Out	Northern Finland	N/A
Coentre et al. 2019 [10]	33(23)	41.2	40.5 ± 28.2					Out	Portugal	An inverse association between serum vitamin D levels and general psychopathology
Gurholt et al. 2018 [11]	90 (43) 91(54)	30.6	48.8 ± 17.6	53.5 ± 20.0				Both	Norway	A positive association between serum vitamin D levels and intracranial volume
Patel et al. 2018 [12]	18	40.6	29.5 ± 10.3					In	UK	N/A
Bruins et al. 2018 [13]	1840(1174)	44.7	48.5 ± 27.4		< 50	67.2%		Out	Netherland	Logarithmic serum vitamin D levels was association with the logarithmic PANSS Negative Subscale
Kulaksizoglu et al. 2017 [14]	64(36) 54(31)	38.3	25.2 ± 6.6	27.2 ± 8.6				Out	Turkey	A negative correlation between serum vitamin D levels and PANSS-negative symptom score, and triglyceride and insulin levels. A positive correlation between vitamin D levels and HDL levels

Akinlade et al. 2017 [15]	60 30	35.1	49.4 ± 13.0***	70.2 ± 14.1	< 50 < 75	58.3% 40.0%	6.7% 56.7%	In	Nigeria	No correlation between serum vitamin D levels and PANSS scores
Dogan Bulut et al. 2016 [16]	80(42) 74(39)	36.6	58.7 ± 35.0	59.2 ± 24.0	< 25 < 50	25.0% 13.8%	8.1% 28.4%	Out	Turkey	An inverse association between serum vitamin D levels and the severity of positive and negative symptoms
Endres et al. 2016 [17]	60(35) 3917(1706)	33.5	37.5 ± 24.5	45.0 ± 31.5	< 50 < 75	80.0% 15.0%	57.3% 20.8%	In	Germany	N/A
Lally et al. 2016 [18]	324(193)	43.6	31.0 ± 18.3		< 25 < 50	48.8% 37.3%		Out	England	An inverse association between serum vitamin D levels and cardiovascular disease risk factors and metabolic syndrome
Bazzano et al. 2016 [19]	61	44	54.5 ± 29.9		< 50 < 75	51.4% 35.1%		In	USA	N/A
Bogers et al. 2016 [20]	28(24) 29(10)	44	33 median	73 mediam	<50	79%		In	Netherlands	N/A
Shivakumar et al. 2015 [21]	35(20)	32.1	36.3 ± 14.3		< 50 < 75	83.0% 14.0%		Out	India	A positive association between serum vitamin D levels and right hippocampal grey matter
Nerhus et al. 2015 [22]	71(46) 142(92)	28.0	43.0 ± 20.3	45.0 ± 21.4				Both	Norway	No correlation between serum vitamin D levels and PANSS scores
Zhu et al. 2015 [23]	93(41) 93(52)	29.5	26.4 ± 13.3***	43.7 ± 15.2				Out	China	An inverse association between serum vitamin D levels and CRP
Yuksel et al. 2014[24]	41(27) 40(19)	38.9	37.6 (median)	37.6 (median)	< 25 < 50	22.0% 68.3%	30.0% 55.0%	Out	Turkey	A negative correlation between serum vitamin D levels and CGI and PANSS scores
Clelland et al. 2014 [25]	64(31) 90(46)	38.5	79.1 ± 56.6	92.7 ± 56.8	< 75	68.8%	46.7%	In	USA	N/A
Cieslak et al. 2014 [26]	22(13)	44.3	43.3 ± 22.3		< 75	90.9%		Both	USA	A strong inverse association between low serum vitamin D and negative symptoms in males
Itzhaky et al. 2012 [27]	50(34) 50(13)	40.2	37.5 ± 18.3*	50.5 ± 19.5	<37.5 < 75	57.1% 40.8%	24.5% 63.3%	In	Israel	No correlation between serum vitamin D levels and PANSS scores
McCue et al. 2012 [28]	107(70)	43.3	52.8 ± 26.0		< 50	52.3%		In	North America	No relationship between serum vitamin D levels and major psychiatric diagnosis categories
Abdullah et al. 2012[29]	185	40.0	52.5		< 80	88.6%		In	USA	No association between serum vitamin D levels and BPRS
Menkes et al. 2012 [30]	49		34.5 ± 15.4		< 25 < 50	26.5% 59.2%		In	New Zealand	N/A
Murie et al. 2012 [31]	25	47.0			< 25 < 50	56% 36%		In	UK	N/A
Doknic et al. 2011 [32]	26(12) 35(11)	31.3	23.6 ± 2.8 ***	71.9 ± 8.3				Out	Serbia	N/A

Partti et al. 2010 [33]	48(20) 6100(2808)	53.5	38.9	45.1				Out	Finland	N/A
Humble et al. 2010 [34]	20(8)	47.4	35 (median)					Out	USA	N/A
Norelli et al. 2010 [35]	20(15) 20(11)	46.1	50.0 ± 22.3	56.8 ±32.5	< 50 < 75	50.0% 30.0%	45.0% 35.0%	In	USA	N/A
Rey-Sanchez et al. 2009 [36]	73(48) 73(48)	F59.8 M61.9	F 51.1 ± 65.1 *** M 37.8±29.9	F 82.8±48.6 M 45.3±38.6	<37.5	F 74.1% M 69.6%		In	Spain	An inverse association between serum vitamin D levels and hyperparathyroidism, hyperprolactinaemia and accelerated bone turnover in female patients.
Bergemann et al. 2008 [37]	72(0) 71(0)	33.8	40.8 ± 19.8 ***	61.5 ± 28.8				In	Germany	N/A
Schneider et al. 2000 [38]	34(19) 31(19)	38.9	87.8 ± 65.3*	114.8.± 49.5				Out	Germany	N/A
Higuchi et al. 1987 [39]	12(5) 5(5)	35.9	31.5 ± 5.5**	55.8 ± 3.5				In	Japan	N/A

Where indicated serum 25OHD levels were significantly lower in schizophrenia patients compared to the heathy controls (*$p < 0.05$, **$p < 0.01$ ***, $p < 0.001$). Abbreviations in the Table: SZ, schizophrenia; Ctrl, control; CRP, C-reactive protein; PANSS, the Positive and Negative Syndrome Scale; CGI, Clinical Global Impression; MRSS, Morningside Rehabilitation Status Scale; HDL, high density lipoprotein; BPRS, The Brief Psychiatric Rating Scale. N/A indicates that the study did not examine the association between serum 25OHD levels and psychotic symptoms/scores, or other biochemical and brain structural outcome.

Supplementary Table 2. Vitamin D deficiency and First Episode Psychosis (FEP)

Studies	Subjects nFEP(nMale) nCtrl(nMale)	Mean Age (Year)	25OHD (nM) Mean ± SD		Definition of vitamin D deficiency or insufficiency (nM) and prevalence (%)			In/Out Patient	Country	Outcomes (Association between vitamin D levels and symptoms, biochemistry and brain structure in FEP patients)
			FEP	Ctrl	(nM)	FEP (%)	Ctrl (%)			
Yazici et al. (b) 2019 [2]	30(30) 28(28)	40.6	40.5 ± 44.8	34.2 ± 12.3				In	Turkey	No correlation between serum vitamin D levels and PANSS scores
Malik et al. 2019 [4]	40(26) 40(18)	38.7	17.9***	37.5	< 25 < 50	63.5% 30.0%	30.0% 50.0%	Out	Pakistan	N/A
Coentre et al. 2019 [10]	33(23)	31.2	45.4 ± 18.7					In	Portugal	An inverse correlation between vitamin D levels and the severities of depressive and negative symptoms and general psychopathology
Lally et al. 2019 [40]	168(108)	29.3	34.5 ± 23.3		< 50	80.0%		Out	UK	A negative association between baseline serum vitamin D levels and negative psychotic symptoms at one year after FEP.
Salavert et al. 2017[41]	22(16) 22(6)	31.1	32.9 ± 14.9 **	56.6 ± 19.1	< 50 <75	86.4% 13.6%	36.4% 40.9%	In	Spain	N/A
Yee et al. 2016 [42]	31(15) 31(14)	29.1	61.7 ± 26.7	61.3 ± 22.6				In	Singapore	A negative association between serum vitamin D levels and negative symptoms
Graham et al. 2015 [43]	20(12) 20(12)	23	70.5 ± 31.5	74.8 ± 35.8	< 75	55.0%		Out	USA	A reverse correlation between serum vitamin D levels and negative and cognitive deficits.
Nerhus et al. 2015 [22]	71(46) 142(92)	27.3	44.8 ± 19.5	45.1 ± 21.4				Both	Norway	N/A
Yuksel et al. 2014 [24]	40(19) 40(20)	38.1	17.9 (median)	37.6 (median)	< 25 < 50	65.0% 30.0%	30.0% 55.0%	In	Turkey	An inverse association between serum vitamin D levels and negative symptoms
Crews et al. 2013 [44]	69(27) 69(27)	31	36.5 ± 23.0***	53.8 ± 33.0	< 25 < 50	36.2% 39.0%	15.9% 43.0%	In	UK	N/A
Dealberto et al.2013 [45]	20(11)		38.0 ± 10					In	Canada	N/A
Norelli et al. 2010 [35]	20(17) 20(11)	39.4	47.8 ± 24.5	56.8 ± 32.5	< 50 < 75	65.0% 20.0%	45.0% 35.0%	In	USA	N/A

Where indicated serum 25OHD levels were significantly lower in FEP compared to the heathy controls (Ctrl) (**$p < 0.01$ ***, $p < 0.001$). N/A indicates that the study did not examine the association between serum vitamin D levels and psychotic symptoms/scores, or other biochemical and brain structural outcomes.

Supplementary Table 3. Clinical trials of vitamin D supplementation in schizophrenia

Studies	Vitamin D nSupplementation(nMale) nPlacebo (nMale)	Age (Year)	country	Illness Length (Year)	Vitamin D supplementation (dose and duration)	Outcomes (Association between vitamin D supplementation and symptoms and biochemistry in SZ patients)
Ghaderi et al. 2019 [46]	30(28) 30(28)	44.8	Iran	2	50,000 IU every 2 week for 12 weeks plus probiotic	Improved the general and total PANSS scores and metabolic profiles
Fond et al. 2018 [47]	12(8) 30(25)	36	France	16.4	12 months	Improved depressive symptoms and lower rates of current anxiety disorder.
Krivoy et al. 2017[48]	24(18) 23(14)	39.4	Israel	16	14,000IU per week for eight weeks (maintaining clozapine)	A trend to improve cognition
Sheikhmoonesi et al. 2016[49]	40(40) 40(40)	46.2	Iran	6.3	Two intramuscular vitamin D injection at 300 000IU in three month	No improvement
DealBerto et al. 2016 [45]	8 9		Canada		1000IU vitamin D	No improvement
Thakurathi et al. 2013 [50]	19(12)	50.2	USA	4.9	2000IU daily for 8 weeks	Reducing total cholesterol
Tiangga et al. 2008 [51]	17(17)		UK	>1year	Calcium and egocalciferol (400U) for 7 month	Increasing 25OHD levels

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