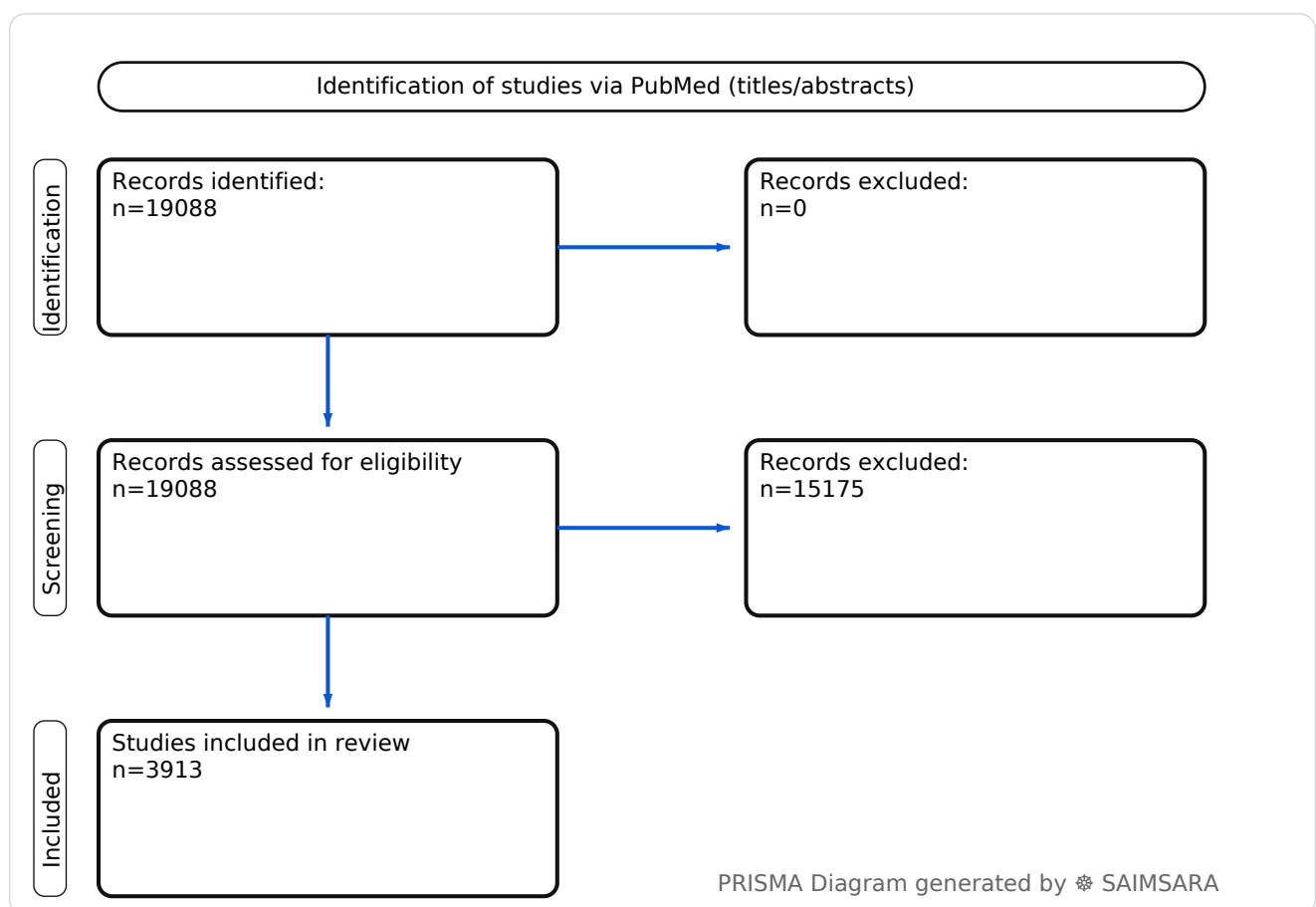


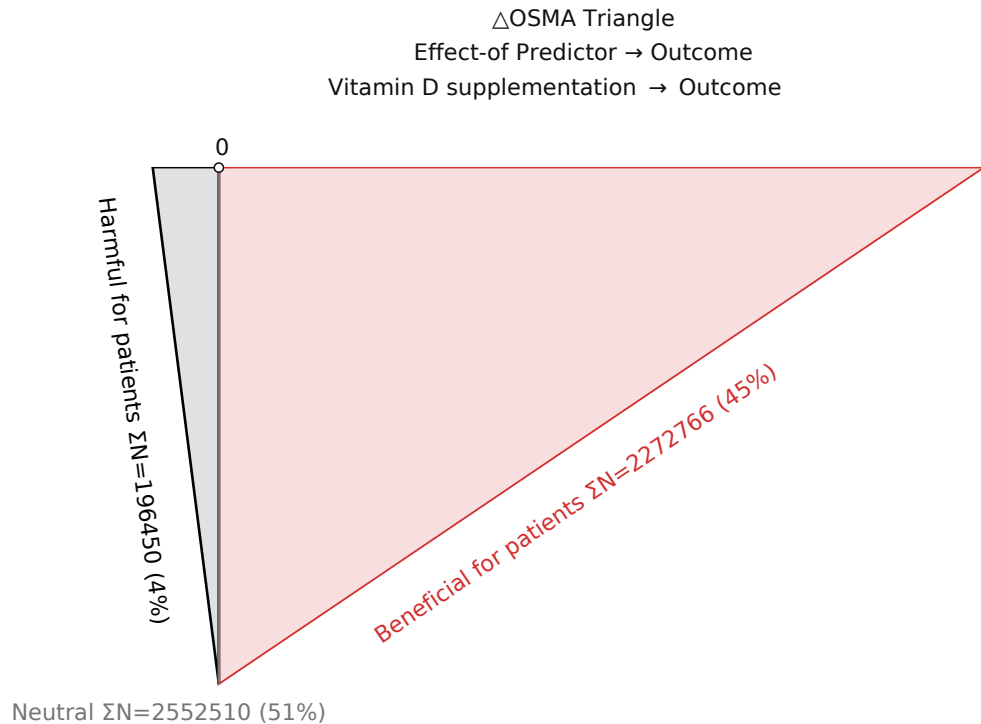
Vitamin D Supplementation: Systematic Review with SAIMSARA.

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Review Stats

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- Included original Abstracts/Papers: 3913
- Total study participants (naïve ΣN): 5021726





△OSMA Triangle generated by SAIMSARA

Outcome-Sentiment Meta-Analysis (OSMA): (LLM-only)

Frame: Effect-of Predictor → Outcome • *Source:* PubMed

Outcome: Outcome Typical timepoints: peri/post-op, 6-mo. Reported metrics: %, CI, p.

Common endpoints: Common endpoints: complications, mortality, qol.

Predictor: Vitamin D supplementation — exposure/predictor. Doses/units seen: 400 iu, 500 ml, 1000 iu, 800 iu, 000 iu, 50 iu.... Routes seen: oral, im, topical, intramuscular.... Typical comparator: controls, insufficiency, individuals with normal weight, those diagnosed with pud....

- **1) Beneficial for patients** — Outcome with Vitamin D supplementation — [1], [3], [5], [7], [12], [13], [15], [17], [21], [22], [23], [27], [28], [29], [30], [31], [32], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [46], [47], [48], [49], [50], [52], [54], [57], [61], [63], [68], [69], [70], [73], [75], [76], [77], [79], [82], [85], [86], [88], [93], [96], [97], [100], [101], [106], [107], [110], [113], [115], [118], [119], [121], [122], [123], [127], [128], [129], [130], [131], [132], [133], [134], [136], [137], [140], [143], [144], [146], [148], [149], [153], [159], [160], [162], [164], [165], [166], [169], [173], [177], [178], [183], [184], [185], [186], [192], [193], [197], [198], [199], [201], [203], [205], [206], [207], [209], [211], [215], [216], [217], [218], [219], [222], [223], [225], [227], [228], [232], [237], [241], [242], [244], [245], [246], [247], [250], [252], [268],

[269], [271], [272], [274], [277], [281], [282], [283], [284], [287], [288], [289], [290], [294], [297], [298], [300], [301], [303], [308], [310], [313], [314], [315], [317], [323], [325], [329], [330], [331], [334], [335], [337], [338], [339], [340], [341], [346], [348], [353], [354], [358], [359], [361], [364], [366], [367], [368], [369], [370], [372], [382], [384], [386], [389], [393], [394], [396], [398], [399], [400], [401], [402], [406], [407], [408], [410], [412], [413], [414], [415], [416], [418], [419], [422], [423], [424], [425], [426], [427], [428], [434], [435], [437], [439], [440], [443], [445], [446], [448], [449], [451], [452], [453], [455], [456], [460], [462], [463], [464], [467], [468], [472], [475], [476], [479], [480], [482], [484], [486], [487], [490], [491], [498], [500], [503], [506], [507], [509], [510], [513], [515], [516], [519], [521], [522], [523], [527], [530], [533], [534], [538], [540], [541], [543], [544], [545], [546], [547], [548], [549], [550], [551], [555], [557], [559], [561], [572], [574], [581], [583], [584], [585], [588], [589], [595], [597], [602], [604], [610], [612], [615], [617], [621], [623], [629], [630], [632], [633], [637], [638], [640], [643], [644], [645], [647], [649], [651], [656], [658], [660], [661], [662], [664], [665], [670], [672], [673], [674], [676], [679], [680], [681], [682], [683], [690], [693], [695], [700], [702], [704], [707], [712], [713], [714], [718], [719], [721], [722], [723], [724], [726], [727], [728], [729], [730], [732], [733], [736], [737], [738], [739], [740], [741], [742], [744], [745], [747], [749], [751], [752], [753], [754], [756], [761], [762], [763], [764], [766], [770], [771], [774], [776], [779], [782], [783], [787], [788], [789], [792], [793], [794], [795], [798], [799], [800], [801], [805], [809], [812], [813], [815], [817], [819], [822], [825], [828], [833], [834], [835], [838], [839], [841], [843], [846], [847], [849], [850], [853], [857], [858], [866], [867], [868], [869], [872], [873], [875], [878], [880], [881], [882], [883], [884], [886], [887], [888], [890], [892], [897], [900], [905], [908], [912], [913], [914], [916], [918], [919], [921], [923], [924], [926], [928], [935], [936], [938], [939], [940], [942], [944], [947], [950], [954], [957], [961], [966], [974], [975], [976], [980], [981], [982], [983], [984], [988], [990], [992], [993], [997], [999], [1002], [1006], [1007], [1008], [1011], [1014], [1015], [1017], [1020], [1022], [1024], [1025], [1026], [1035], [1037], [1038], [1039], [1041], [1044], [1046], [1047], [1050], [1051], [1054], [1056], [1060], [1063], [1066], [1068], [1069], [1070], [1072], [1077], [1078], [1081], [1082], [1086], [1087], [1088], [1090], [1091], [1094], [1096], [1110], [1112], [1119], [1124], [1125], [1126], [1127], [1130], [1137], [1140], [1145], [1146], [1147], [1150], [1151], [1152], [1154], [1155], [1156], [1159], [1160], [1161], [1162], [1164], [1166], [1168], [1169], [1171], [1172], [1177], [1178], [1179], [1180], [1182], [1183], [1184], [1185], [1186], [1190], [1191], [1192], [1194], [1198], [1203], [1205], [1206], [1207], [1208], [1212], [1214], [1215], [1216], [1218], [1219], [1223], [1227], [1228], [1229], [1230], [1235], [1237], [1238], [1240], [1241], [1243], [1244], [1245], [1246], [1247], [1251], [1252], [1254], [1255], [1261], [1263], [1264], [1267], [1269], [1271], [1275], [1276], [1277], [1282], [1288], [1291], [1293],

[1295], [1296], [1297], [1299], [1300], [1303], [1304], [1306], [1308], [1310], [1311], [1312], [1313], [1315], [1316], [1317], [1318], [1319], [1320], [1323], [1330], [1331], [1332], [1335], [1336], [1337], [1338], [1341], [1342], [1343], [1344], [1346], [1347], [1350], [1357], [1358], [1363], [1365], [1366], [1367], [1370], [1372], [1373], [1374], [1375], [1379], [1380], [1381], [1384], [1387], [1388], [1390], [1391], [1392], [1393], [1397], [1398], [1402], [1406], [1407], [1409], [1410], [1411], [1412], [1413], [1414], [1416], [1420], [1422], [1424], [1426], [1428], [1429], [1430], [1431], [1435], [1437], [1439], [1441], [1444], [1456], [1459], [1461], [1462], [1463], [1465], [1472], [1473], [1475], [1476], [1481], [1486], [1487], [1493], [1496], [1499], [1501], [1502], [1503], [1504], [1508], [1517], [1520], [1521], [1522], [1525], [1526], [1536], [1538], [1544], [1546], [1552], [1553], [1554], [1557], [1558], [1571], [1573], [1580], [1581], [1585], [1591], [1592], [1593], [1598], [1608], [1609], [1612], [1613], [1614], [1618], [1619], [1620], [1621], [1622], [1623], [1626], [1631], [1634], [1635], [1637], [1640], [1646], [1652], [1653], [1658], [1659], [1663], [1664], [1666], [1668], [1670], [1673], [1678], [1679], [1680], [1681], [1682], [1683], [1684], [1685], [1689], [1695], [1698], [1700], [1701], [1703], [1704], [1705], [1706], [1707], [1708], [1709], [1714], [1716], [1719], [1721], [1726], [1730], [1731], [1732], [1733], [1734], [1736], [1737], [1738], [1739], [1741], [1744], [1745], [1746], [1747], [1750], [1752], [1753], [1754], [1759], [1760], [1762], [1763], [1766], [1767], [1768], [1770], [1774], [1778], [1782], [1783], [1784], [1789], [1795], [1798], [1799], [1800], [1804], [1807], [1808], [1814], [1816], [1820], [1821], [1825], [1827], [1830], [1833], [1834], [1836], [1837], [1838], [1839], [1840], [1841], [1842], [1844], [1850], [1855], [1856], [1857], [1858], [1860], [1864], [1865], [1866], [1872], [1875], [1881], [1883], [1885], [1886], [1887], [1889], [1890], [1891], [1898], [1901], [1903], [1905], [1909], [1912], [1913], [1914], [1919], [1930], [1931], [1932], [1934], [1939], [1940], [1944], [1946], [1947], [1948], [1950], [1952], [1956], [1958], [1960], [1961], [1965], [1967], [1971], [1973], [1974], [1976], [1979], [1980], [1981], [1984], [1987], [1990], [1992], [1995], [2000], [2003], [2006], [2008], [2012], [2014], [2016], [2029], [2032], [2033], [2034], [2036], [2037], [2042], [2045], [2046], [2053], [2057], [2060], [2062], [2064], [2069], [2072], [2075], [2077], [2080], [2082], [2083], [2085], [2088], [2090], [2097], [2098], [2100], [2102], [2104], [2110], [2111], [2114], [2115], [2116], [2118], [2120], [2122], [2123], [2126], [2127], [2128], [2130], [2134], [2138], [2139], [2140], [2143], [2145], [2146], [2148], [2149], [2152], [2154], [2157], [2161], [2164], [2172], [2177], [2178], [2179], [2181], [2184], [2186], [2187], [2188], [2189], [2192], [2195], [2196], [2199], [2201], [2204], [2205], [2206], [2208], [2209], [2211], [2214], [2218], [2221], [2223], [2229], [2231], [2232], [2234], [2239], [2241], [2244], [2245], [2247], [2249], [2256], [2257], [2262], [2266], [2268], [2269], [2270], [2274], [2275], [2278], [2280], [2281], [2282], [2283], [2284], [2286], [2290], [2293], [2295], [2297], [2301], [2303], [2306], [2310], [2312], [2316], [2317], [2318],

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[3348], [3349], [3351], [3352], [3357], [3359], [3360], [3363], [3369], [3372], [3373], [3374], [3377], [3378], [3381], [3387], [3388], [3391], [3395], [3397], [3402], [3403], [3405], [3411], [3412], [3413], [3415], [3417], [3422], [3423], [3426], [3431], [3434], [3436], [3437], [3439], [3441], [3447], [3448], [3452], [3458], [3459], [3463], [3465], [3472], [3473], [3475], [3478], [3479], [3483], [3484], [3485], [3486], [3489], [3493], [3494], [3497], [3499], [3502], [3503], [3505], [3506], [3507], [3508], [3509], [3515], [3517], [3518], [3520], [3521], [3525], [3532], [3535], [3538], [3540], [3543], [3544], [3549], [3550], [3551], [3553], [3554], [3568], [3569], [3570], [3574], [3577], [3579], [3583], [3587], [3591], [3595], [3598], [3604], [3607], [3609], [3611], [3612], [3613], [3614], [3615], [3616], [3617], [3618], [3621], [3622], [3628], [3629], [3630], [3632], [3637], [3643], [3649], [3652], [3656], [3657], [3660], [3665], [3668], [3671], [3674], [3675], [3678], [3679], [3680], [3681], [3683], [3684], [3688], [3691], [3692], [3693], [3696], [3697], [3699], [3700], [3704], [3705], [3707], [3709], [3710], [3711], [3717], [3720], [3721], [3723], [3725], [3729], [3733], [3734], [3737], [3743], [3756], [3768], [3773], [3775], [3777], [3778], [3780], [3783], [3784], [3785], [3786], [3787], [3788], [3793], [3794], [3797], [3798], [3801], [3807], [3808], [3809], [3812], [3814], [3815], [3818], [3820], [3822], [3825], [3826], [3830], [3835], [3836], [3837], [3839], [3840], [3841], [3842], [3843], [3844], [3851], [3852], [3853], [3857], [3858], [3859], [3865], [3867], [3869], [3872], [3875], [3876], [3877], [3878], [3880], [3881], [3889], [3893], [3895], [3896], [3897], [3899], [3900], [3902], [3909], [3910] — $\Sigma N=2272766$

- **2) Harmful for patients** — Outcome with Vitamin D supplementation — [4], [44], [116], [135], [141], [326], [469], [483], [532], [601], [631], [657], [711], [765], [777], [797], [863], [1057], [1104], [1109], [1122], [1222], [1464], [1562], [1624], [1764], [1769], [1779], [1780], [1787], [1852], [1871], [1920], [2023], [2156], [2207], [2228], [2353], [2399], [2575], [2576], [2627], [2721], [2724], [2735], [2755], [2829], [2944], [2958], [3052], [3096], [3137], [3142], [3175], [3321], [3407], [3464], [3491], [3519], [3557], [3560], [3740], [3813], [3834], [3854], [3871] — $\Sigma N=196450$

- **3) No clear effect** — Outcome with Vitamin D supplementation — [2], [6], [8], [9], [10], [11], [14], [16], [18], [19], [20], [24], [25], [26], [33], [45], [51], [53], [55], [56], [58], [59], [60], [62], [64], [65], [66], [67], [71], [72], [74], [78], [80], [81], [83], [84], [87], [89], [90], [91], [92], [94], [95], [98], [99], [102], [103], [104], [105], [108], [109], [111], [112], [114], [117], [120], [124], [125], [126], [138], [139], [142], [145], [147], [150], [151], [152], [154], [155], [156], [157], [158], [161], [163], [167], [168], [170], [171], [172], [174], [175], [176], [179], [180], [181], [182], [187], [188], [189], [190], [191], [194], [195], [196], [200], [202], [204], [208], [210], [212], [213], [214], [220], [221], [224], [226], [229], [230], [231], [233], [234], [235], [236], [238], [239], [240], [243], [248], [249], [251], [253], [254], [255], [256], [257], [258], [259], [260], [261], [262], [263], [264], [265], [266], [267], [270], [273], [275], [276], [278], [279], [280],

[285], [286], [291], [292], [293], [295], [296], [299], [302], [304], [305], [306], [307], [309], [311], [312], [316], [318], [319], [320], [321], [322], [324], [327], [328], [332], [333], [336], [342], [343], [344], [345], [347], [349], [350], [351], [352], [355], [356], [357], [360], [362], [363], [365], [371], [373], [374], [375], [376], [377], [378], [379], [380], [381], [383], [385], [387], [388], [390], [391], [392], [395], [397], [403], [404], [405], [409], [411], [417], [420], [421], [429], [430], [431], [432], [433], [436], [438], [441], [442], [444], [447], [450], [454], [457], [458], [459], [461], [465], [466], [470], [471], [473], [474], [477], [478], [481], [485], [488], [489], [492], [493], [494], [495], [496], [497], [499], [501], [502], [504], [505], [508], [511], [512], [514], [517], [518], [520], [524], [525], [526], [528], [529], [531], [535], [536], [537], [539], [542], [552], [553], [554], [556], [558], [560], [562], [563], [564], [565], [566], [567], [568], [569], [570], [571], [573], [575], [576], [577], [578], [579], [580], [582], [586], [587], [590], [591], [592], [593], [594], [596], [598], [599], [600], [603], [605], [606], [607], [608], [609], [611], [613], [614], [616], [618], [619], [620], [622], [624], [625], [626], [627], [628], [634], [635], [636], [639], [641], [642], [646], [648], [650], [652], [653], [654], [655], [659], [663], [666], [667], [668], [669], [671], [675], [677], [678], [684], [685], [686], [687], [688], [689], [691], [692], [694], [696], [697], [698], [699], [701], [703], [705], [706], [708], [709], [710], [715], [716], [717], [720], [725], [731], [734], [735], [743], [746], [748], [750], [755], [757], [758], [759], [760], [767], [768], [769], [772], [773], [775], [778], [780], [781], [784], [785], [786], [790], [791], [796], [802], [803], [804], [806], [807], [808], [810], [811], [814], [816], [818], [820], [821], [823], [824], [826], [827], [829], [830], [831], [832], [836], [837], [840], [842], [844], [845], [848], [851], [852], [854], [855], [856], [859], [860], [861], [862], [864], [865], [870], [871], [874], [876], [877], [879], [885], [889], [891], [893], [894], [895], [896], [898], [899], [901], [902], [903], [904], [906], [907], [909], [910], [911], [915], [917], [920], [922], [925], [927], [929], [930], [931], [932], [933], [934], [937], [941], [943], [945], [946], [948], [949], [951], [952], [953], [955], [956], [958], [959], [960], [962], [963], [964], [965], [967], [968], [969], [970], [971], [972], [973], [977], [978], [979], [985], [986], [987], [989], [991], [994], [995], [996], [998], [1000], [1001], [1003], [1004], [1005], [1009], [1010], [1012], [1013], [1016], [1018], [1019], [1021], [1023], [1027], [1028], [1029], [1030], [1031], [1032], [1033], [1034], [1036], [1040], [1042], [1043], [1045], [1048], [1049], [1052], [1053], [1055], [1058], [1059], [1061], [1062], [1064], [1065], [1067], [1071], [1073], [1074], [1075], [1076], [1079], [1080], [1083], [1084], [1085], [1089], [1092], [1093], [1095], [1097], [1098], [1099], [1100], [1101], [1102], [1103], [1105], [1106], [1107], [1108], [1111], [1113], [1114], [1115], [1116], [1117], [1118], [1120], [1121], [1123], [1128], [1129], [1131], [1132], [1133], [1134], [1135], [1136], [1138], [1139], [1141], [1142], [1143], [1144], [1148], [1149], [1153], [1157], [1158], [1163], [1165], [1167], [1170], [1173], [1174], [1175], [1176], [1181], [1187], [1188],

[1189], [1193], [1195], [1196], [1197], [1199], [1200], [1201], [1202], [1204], [1209], [1210], [1211], [1213], [1217], [1220], [1221], [1224], [1225], [1226], [1231], [1232], [1233], [1234], [1236], [1239], [1242], [1248], [1249], [1250], [1253], [1256], [1257], [1258], [1259], [1260], [1262], [1265], [1266], [1268], [1270], [1272], [1273], [1274], [1278], [1279], [1280], [1281], [1283], [1284], [1285], [1286], [1287], [1289], [1290], [1292], [1294], [1298], [1301], [1302], [1305], [1307], [1309], [1314], [1321], [1322], [1324], [1325], [1326], [1327], [1328], [1329], [1333], [1334], [1339], [1340], [1345], [1348], [1349], [1351], [1352], [1353], [1354], [1355], [1356], [1359], [1360], [1361], [1362], [1364], [1368], [1369], [1371], [1376], [1377], [1378], [1382], [1383], [1385], [1386], [1389], [1394], [1395], [1396], [1399], [1400], [1401], [1403], [1404], [1405], [1408], [1415], [1417], [1418], [1419], [1421], [1423], [1425], [1427], [1432], [1433], [1434], [1436], [1438], [1440], [1442], [1443], [1445], [1446], [1447], [1448], [1449], [1450], [1451], [1452], [1453], [1454], [1455], [1457], [1458], [1460], [1466], [1467], [1468], [1469], [1470], [1471], [1474], [1477], [1478], [1479], [1480], [1482], [1483], [1484], [1485], [1488], [1489], [1490], [1491], [1492], [1494], [1495], [1497], [1498], [1500], [1505], [1506], [1507], [1509], [1510], [1511], [1512], [1513], [1514], [1515], [1516], [1518], [1519], [1523], [1524], [1527], [1528], [1529], [1530], [1531], [1532], [1533], [1534], [1535], [1537], [1539], [1540], [1541], [1542], [1543], [1545], [1547], [1548], [1549], [1550], [1551], [1555], [1556], [1559], [1560], [1561], [1563], [1564], [1565], [1566], [1567], [1568], [1569], [1570], [1572], [1574], [1575], [1576], [1577], [1578], [1579], [1582], [1583], [1584], [1586], [1587], [1588], [1589], [1590], [1594], [1595], [1596], [1597], [1599], [1600], [1601], [1602], [1603], [1604], [1605], [1606], [1607], [1610], [1611], [1615], [1616], [1617], [1625], [1627], [1628], [1629], [1630], [1632], [1633], [1636], [1638], [1639], [1641], [1642], [1643], [1644], [1645], [1647], [1648], [1649], [1650], [1651], [1654], [1655], [1656], [1657], [1660], [1661], [1662], [1665], [1667], [1669], [1671], [1672], [1674], [1675], [1676], [1677], [1686], [1687], [1688], [1690], [1691], [1692], [1693], [1694], [1696], [1697], [1699], [1702], [1710], [1711], [1712], [1713], [1715], [1717], [1718], [1720], [1722], [1723], [1724], [1725], [1727], [1728], [1729], [1735], [1740], [1742], [1743], [1748], [1749], [1751], [1755], [1756], [1757], [1758], [1761], [1765], [1771], [1772], [1773], [1775], [1776], [1777], [1781], [1785], [1786], [1788], [1790], [1791], [1792], [1793], [1794], [1796], [1797], [1801], [1802], [1803], [1805], [1806], [1809], [1810], [1811], [1812], [1813], [1815], [1817], [1818], [1819], [1822], [1823], [1824], [1826], [1828], [1829], [1831], [1832], [1835], [1843], [1845], [1846], [1847], [1848], [1849], [1851], [1853], [1854], [1859], [1861], [1862], [1863], [1867], [1868], [1869], [1870], [1873], [1874], [1876], [1877], [1878], [1879], [1880], [1882], [1884], [1888], [1892], [1893], [1894], [1895], [1896], [1897], [1899], [1900], [1902], [1904], [1906], [1907], [1908], [1910], [1911], [1915], [1916], [1917], [1918], [1921], [1922], [1923], [1924], [1925], [1926], [1927], [1928],

[1929], [1933], [1935], [1936], [1937], [1938], [1941], [1942], [1943], [1945], [1949], [1951], [1953], [1954], [1955], [1957], [1959], [1962], [1963], [1964], [1966], [1968], [1969], [1970], [1972], [1975], [1977], [1978], [1982], [1983], [1985], [1986], [1988], [1989], [1991], [1993], [1994], [1996], [1997], [1998], [1999], [2001], [2002], [2004], [2005], [2007], [2009], [2010], [2011], [2013], [2015], [2017], [2018], [2019], [2020], [2021], [2022], [2024], [2025], [2026], [2027], [2028], [2030], [2031], [2035], [2038], [2039], [2040], [2041], [2043], [2044], [2047], [2048], [2049], [2050], [2051], [2052], [2054], [2055], [2056], [2058], [2059], [2061], [2063], [2065], [2066], [2067], [2068], [2070], [2071], [2073], [2074], [2076], [2078], [2079], [2081], [2084], [2086], [2087], [2089], [2091], [2092], [2093], [2094], [2095], [2096], [2099], [2101], [2103], [2105], [2106], [2107], [2108], [2109], [2112], [2113], [2117], [2119], [2121], [2124], [2125], [2129], [2131], [2132], [2133], [2135], [2136], [2137], [2141], [2142], [2144], [2147], [2150], [2151], [2153], [2155], [2158], [2159], [2160], [2162], [2163], [2165], [2166], [2167], [2168], [2169], [2170], [2171], [2173], [2174], [2175], [2176], [2180], [2182], [2183], [2185], [2190], [2191], [2193], [2194], [2197], [2198], [2200], [2202], [2203], [2210], [2212], [2213], [2215], [2216], [2217], [2219], [2220], [2222], [2224], [2225], [2226], [2227], [2230], [2233], [2235], [2236], [2237], [2238], [2240], [2242], [2243], [2246], [2248], [2250], [2251], [2252], [2253], [2254], [2255], [2258], [2259], [2260], [2261], [2263], [2264], [2265], [2267], [2271], [2272], [2273], [2276], [2277], [2279], [2285], [2287], [2288], [2289], [2291], [2292], [2294], [2296], [2298], [2299], [2300], [2302], [2304], [2305], [2307], [2308], [2309], [2311], [2313], [2314], [2315], [2319], [2323], [2324], [2325], [2327], [2328], [2329], [2330], [2331], [2332], [2333], [2335], [2338], [2339], [2340], [2341], [2343], [2344], [2346], [2347], [2348], [2349], [2351], [2352], [2354], [2355], [2357], [2358], [2362], [2364], [2365], [2366], [2368], [2369], [2371], [2372], [2374], [2376], [2378], [2379], [2382], [2383], [2384], [2385], [2386], [2388], [2389], [2390], [2393], [2394], [2395], [2396], [2397], [2400], [2401], [2403], [2407], [2408], [2409], [2410], [2411], [2415], [2416], [2417], [2418], [2422], [2423], [2426], [2427], [2429], [2432], [2434], [2435], [2436], [2440], [2442], [2444], [2445], [2448], [2449], [2451], [2453], [2455], [2457], [2460], [2462], [2463], [2464], [2465], [2468], [2470], [2471], [2473], [2475], [2477], [2478], [2479], [2480], [2484], [2485], [2486], [2488], [2489], [2490], [2491], [2492], [2493], [2494], [2495], [2497], [2499], [2501], [2502], [2504], [2505], [2508], [2510], [2511], [2512], [2515], [2516], [2518], [2520], [2521], [2522], [2524], [2525], [2526], [2528], [2530], [2532], [2533], [2534], [2535], [2536], [2537], [2540], [2542], [2543], [2545], [2546], [2548], [2549], [2550], [2554], [2555], [2557], [2558], [2559], [2560], [2562], [2563], [2564], [2566], [2567], [2568], [2569], [2572], [2573], [2581], [2583], [2585], [2586], [2587], [2589], [2593], [2599], [2600], [2602], [2603], [2604], [2607], [2612], [2613], [2614], [2615], [2616], [2617], [2619], [2620], [2622], [2623], [2626], [2628], [2629], [2630], [2632], [2634],

[2635], [2637], [2640], [2641], [2643], [2644], [2646], [2651], [2652], [2655], [2657], [2667], [2669], [2674], [2676], [2677], [2678], [2680], [2681], [2683], [2684], [2685], [2686], [2687], [2688], [2689], [2691], [2692], [2693], [2695], [2696], [2697], [2698], [2699], [2700], [2703], [2705], [2706], [2707], [2710], [2711], [2712], [2713], [2720], [2728], [2730], [2731], [2734], [2736], [2737], [2742], [2744], [2745], [2747], [2748], [2749], [2750], [2751], [2752], [2757], [2758], [2759], [2760], [2761], [2762], [2765], [2766], [2768], [2771], [2773], [2774], [2777], [2778], [2779], [2782], [2784], [2785], [2786], [2787], [2789], [2791], [2792], [2793], [2794], [2796], [2797], [2798], [2802], [2803], [2806], [2808], [2809], [2811], [2812], [2813], [2815], [2816], [2817], [2819], [2821], [2825], [2826], [2830], [2832], [2835], [2837], [2838], [2839], [2840], [2842], [2844], [2845], [2846], [2847], [2850], [2852], [2853], [2854], [2855], [2857], [2859], [2862], [2863], [2864], [2865], [2867], [2868], [2870], [2871], [2872], [2874], [2878], [2880], [2886], [2888], [2889], [2890], [2891], [2892], [2900], [2904], [2905], [2907], [2908], [2911], [2920], [2922], [2923], [2925], [2926], [2928], [2930], [2933], [2934], [2938], [2939], [2940], [2941], [2942], [2943], [2946], [2948], [2949], [2952], [2956], [2959], [2960], [2963], [2964], [2967], [2969], [2971], [2972], [2973], [2976], [2978], [2979], [2980], [2981], [2982], [2985], [2986], [2987], [2989], [2990], [2991], [2992], [2993], [2994], [2996], [2997], [2999], [3001], [3002], [3004], [3005], [3006], [3011], [3012], [3014], [3016], [3017], [3019], [3021], [3022], [3023], [3024], [3025], [3026], [3027], [3028], [3029], [3031], [3032], [3033], [3034], [3035], [3036], [3037], [3038], [3039], [3040], [3041], [3042], [3043], [3044], [3045], [3046], [3048], [3049], [3050], [3051], [3053], [3054], [3055], [3057], [3058], [3059], [3060], [3061], [3062], [3063], [3064], [3066], [3067], [3069], [3071], [3072], [3073], [3074], [3075], [3076], [3077], [3078], [3079], [3085], [3086], [3090], [3093], [3094], [3097], [3098], [3100], [3101], [3103], [3104], [3105], [3106], [3107], [3108], [3110], [3112], [3113], [3114], [3117], [3118], [3121], [3122], [3124], [3126], [3128], [3129], [3132], [3133], [3135], [3136], [3141], [3143], [3145], [3146], [3147], [3150], [3152], [3154], [3155], [3157], [3158], [3160], [3161], [3162], [3164], [3165], [3169], [3170], [3172], [3174], [3177], [3179], [3181], [3182], [3184], [3185], [3186], [3187], [3189], [3192], [3193], [3195], [3196], [3197], [3198], [3199], [3200], [3201], [3202], [3203], [3205], [3206], [3207], [3208], [3209], [3210], [3213], [3214], [3215], [3218], [3219], [3220], [3222], [3224], [3226], [3227], [3229], [3234], [3236], [3237], [3239], [3240], [3241], [3242], [3243], [3244], [3245], [3246], [3248], [3249], [3252], [3253], [3254], [3255], [3257], [3260], [3262], [3263], [3264], [3268], [3271], [3273], [3278], [3281], [3282], [3283], [3285], [3286], [3289], [3290], [3292], [3295], [3296], [3297], [3299], [3300], [3301], [3302], [3303], [3304], [3305], [3306], [3307], [3309], [3316], [3317], [3323], [3324], [3325], [3327], [3329], [3331], [3332], [3334], [3338], [3339], [3343], [3344], [3347], [3350], [3353], [3354], [3355], [3356], [3358], [3361], [3362], [3364], [3365], [3366], [3367], [3368],

[3370], [3371], [3375], [3376], [3379], [3380], [3382], [3383], [3384], [3385], [3386], [3389], [3390], [3392], [3393], [3394], [3396], [3398], [3399], [3400], [3401], [3404], [3406], [3408], [3409], [3410], [3414], [3416], [3418], [3419], [3420], [3421], [3424], [3425], [3427], [3428], [3429], [3430], [3432], [3433], [3435], [3438], [3440], [3442], [3443], [3444], [3445], [3446], [3449], [3450], [3451], [3453], [3454], [3455], [3456], [3457], [3460], [3461], [3462], [3466], [3467], [3468], [3469], [3470], [3471], [3474], [3476], [3477], [3480], [3481], [3482], [3487], [3488], [3490], [3492], [3495], [3496], [3498], [3500], [3501], [3504], [3510], [3511], [3512], [3513], [3514], [3516], [3522], [3523], [3524], [3526], [3527], [3528], [3529], [3530], [3531], [3533], [3534], [3536], [3537], [3539], [3541], [3542], [3545], [3546], [3547], [3548], [3552], [3555], [3556], [3558], [3559], [3561], [3562], [3563], [3564], [3565], [3566], [3567], [3571], [3572], [3573], [3575], [3576], [3578], [3580], [3581], [3582], [3584], [3585], [3586], [3588], [3589], [3590], [3592], [3593], [3594], [3596], [3597], [3599], [3600], [3601], [3602], [3603], [3605], [3606], [3608], [3610], [3619], [3620], [3623], [3624], [3625], [3626], [3627], [3631], [3633], [3634], [3635], [3636], [3638], [3639], [3640], [3641], [3642], [3644], [3645], [3646], [3647], [3648], [3650], [3651], [3653], [3654], [3655], [3658], [3659], [3661], [3662], [3663], [3664], [3666], [3667], [3669], [3670], [3672], [3673], [3676], [3677], [3682], [3685], [3686], [3687], [3689], [3690], [3694], [3695], [3698], [3701], [3702], [3703], [3706], [3708], [3712], [3713], [3714], [3715], [3716], [3718], [3719], [3722], [3724], [3726], [3727], [3728], [3730], [3731], [3732], [3735], [3736], [3738], [3739], [3741], [3742], [3744], [3745], [3746], [3747], [3748], [3749], [3750], [3751], [3752], [3753], [3754], [3755], [3757], [3758], [3759], [3760], [3761], [3762], [3763], [3764], [3765], [3766], [3767], [3769], [3770], [3771], [3772], [3774], [3776], [3779], [3781], [3782], [3789], [3790], [3791], [3792], [3795], [3796], [3799], [3800], [3802], [3803], [3804], [3805], [3806], [3810], [3811], [3816], [3817], [3819], [3821], [3823], [3824], [3827], [3828], [3829], [3831], [3832], [3833], [3838], [3845], [3846], [3847], [3848], [3849], [3850], [3855], [3856], [3860], [3861], [3862], [3863], [3864], [3866], [3868], [3870], [3873], [3874], [3879], [3882], [3883], [3884], [3885], [3886], [3887], [3888], [3890], [3891], [3892], [3894], [3898], [3901], [3903], [3904], [3905], [3906], [3907], [3908], [3911], [3912], [3913] — ΣN=2552510

1) Introduction

Vitamin D, a fat-soluble secosteroid, plays a crucial role in maintaining calcium homeostasis and bone health. Beyond its traditional functions, emerging research highlights its involvement in a wide array of physiological processes, including immune modulation, metabolic regulation, neurological function, and cellular proliferation. Consequently, vitamin D deficiency has been implicated in numerous health

conditions, spurring extensive investigation into the therapeutic potential of vitamin D supplementation across diverse populations and disease states. This systematic review synthesizes recent findings on the efficacy and impact of vitamin D supplementation.

2) Aim

This paper aims to systematically review and synthesize the current evidence on the effects of vitamin D supplementation across various health outcomes, populations, and clinical contexts, identifying principal findings, clinical implications, research gaps, and future directions.

3) Methods

Systematic review with multilayer AI research agent: keyword normalization, retrieval & structuring, and paper synthesis (see SAIMSARA About section for details).

- **Bias:** Study designs varied, with a notable presence of randomized controlled trials (RCTs) and prospective cohort studies, offering higher internal validity for causal inference [2, 15, 23, 27, 74, 89, 97, 128, 134, 137, 141, 142, 1551, 1581, 1619, 1627, 1647, 1729, 1794, 2027, 2031, 2050, 2058, 2075, 2089, 2092, 2093, 2364, 2403, 2504, 2530, 2556, 2558, 2716, 2717, 2758, 2772, 2825, 2847, 2908, 2955, 2978, 3141, 3191, 3231, 3260, 3299, 3304, 3306, 3353, 3399, 3658, 3665, 3666, 3668, 3682, 3688, 3694]. However, a substantial number of mixed-design, retrospective, cross-sectional, and experimental (animal/in vitro) studies were also included [3, 6, 7, 10, 13, 25, 29, 30, 33, 36, 38, 40, 43, 47, 51, 53, 55, 69, 73, 86, 87, 92, 93, 99, 108, 109, 122, 126, 130, 143, 152, 157, 164, 167, 168, 174, 175, 178, 181, 184, 185, 202, 203, 205, 206, 207, 211, 214, 215, 219, 221, 229, 232, 237, 238, 244, 245, 247, 255, 263, 267, 269, 272, 276, 278, 283, 289, 292, 294, 296, 297, 298, 301, 303, 307, 308, 317, 318, 319, 322, 325, 328, 331, 334, 335, 337, 341, 342, 348, 350, 353, 355, 356, 359, 362, 366, 367, 368, 374, 380, 382, 383, 384, 385, 394, 395, 397, 398, 399, 400, 405, 410, 411, 413, 414, 417, 418, 420, 428, 429, 430, 431, 432, 434, 435, 436, 437, 438, 441, 444, 447, 449, 450, 452, 455, 457, 458, 459, 462, 465, 466, 467, 471, 472, 473, 476, 477, 478, 480, 485, 488, 490, 491, 492, 495, 496, 497, 500, 502, 503, 506, 507, 508, 509, 510, 511, 517, 518, 519, 520, 521, 523, 526, 528, 532, 534, 536, 537, 539, 541, 542, 544, 547, 548, 550, 552, 561, 562, 566, 572, 576, 578, 594, 600, 605, 619, 635, 638, 664, 680, 688, 689, 691, 695, 700, 712, 713, 715, 719, 723, 724, 742, 744, 746, 748, 749, 754, 764, 769, 774, 780, 781, 782, 787, 788, 799, 800, 805, 808, 811, 814, 815, 820, 823, 825, 826, 828, 829, 833, 834, 837, 839, 840, 842, 844, 845, 846, 847, 851, 854, 856, 859, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 878, 881, 887, 888, 890, 892, 893, 898, 905, 907, 909, 910, 915, 916, 923, 924, 925, 929, 940, 944, 945, 949, 950, 953, 955, 956, 961, 966, 970, 977, 979, 981, 982, 983, 984, 985, 986, 987, 990, 993, 995, 1001, 1004, 1008, 1009, 1016, 1019, 1021, 1022, 1025, 1026, 1027, 1029, 1031, 1036, 1037,

1040, 1041, 1043, 1044, 1045, 1046, 1055, 1056, 1062, 1081, 1082, 1085, 1087, 1092, 1097, 1098, 1104, 1106, 1108, 1116, 1130, 1155, 1175, 1176, 1178, 1179, 1181, 1183, 1184, 1187, 1189, 1191, 1193, 1194, 1195, 1196, 1197, 1199, 1202, 1204, 1205, 1218, 1224, 1226, 1228, 1235, 1243, 1244, 1250, 1253, 1258, 1268, 1270, 1272, 1279, 1280, 1285, 1289, 1292, 1296, 1301, 1303, 1306, 1315, 1439, 1466, 1482, 1588, 1599, 1664, 1687, 1688, 1709, 1711, 1726, 1745, 1761, 2046, 2062, 2079, 2080, 2082, 2088, 2095, 2356, 2379, 2385, 2432, 2436, 2447, 2485, 2541, 2558, 2741, 2752, 2778, 2804, 2829, 2867, 2878, 2919, 3145, 3169, 3300, 3353, 3379, 3467, 3553, 3589, 3602, 3624, 3635].

These non-RCT designs are prone to selection bias, confounding, and may limit the generalizability of findings. Furthermore, variations in vitamin D dosage, duration of supplementation, baseline vitamin D status of participants, and methods of outcome assessment introduce heterogeneity, impacting the ability to draw definitive conclusions.

4) Results

4.1 Study characteristics:

The studies encompassed a broad range of designs, with RCTs being prominent, alongside mixed-design, cohort, cross-sectional, and experimental studies. Populations investigated were diverse, including men with prostate cancer [2], patients undergoing knee replacement [3], children with allergic rhinitis [13], adolescents with HIV [15, 23, 496], patients with chronic pain [7], pregnant women [185, 238, 276, 297, 303, 317, 394, 450, 477, 521, 539, 552, 561, 815, 839, 846, 847, 859, 905, 907, 944, 1004, 1081, 1175, 1183, 2447, 2504, 2804, 2847, 3213, 3668], older adults [141, 283, 414, 430, 434, 444, 465, 511, 526, 600, 713, 746, 788, 863, 864, 867, 888, 955, 1016, 1041, 1116, 1176, 1184, 1599, 1627, 2058, 2075, 2092, 2095, 2385, 3141, 3299, 3635], and various animal models [6, 10, 36, 47, 55, 99, 109, 126, 155, 164, 322, 355, 356, 368, 383, 384, 399, 436, 437, 441, 478, 495, 517, 532, 534, 576, 689, 781, 782, 820, 826, 851, 854, 1019, 1027, 1040, 1106, 1108, 1181, 1193, 1195, 1204, 1270, 1280, 1726, 2079, 2432, 3300]. Follow-up periods ranged from short-term (e.g., 24 hours [142, 380]) to several years (e.g., 6 years [185], 10 years [432]).

4.2 Main numerical result aligned to the query:

Vitamin D supplementation consistently increased serum 25-hydroxyvitamin D (25(OH)D) levels. Across 23 studies reporting quantitative changes in 25(OH)D, the median increase was 12 ng/mL, with a range from 5.88 ng/mL [226] to 25.77 ng/mL [1289]. Specific increases included 12 ng/mL [7], 20 ng/mL [29], 10.8 ng/mL [43], 18.31 ng/mL [51], 5.88 ng/mL [226], 11.7 ng/mL [397], 10.9 ng/mL [410], 9.28 ng/mL [664], 11.47 ng/mL [1009], 16.124 ng/mL [1021], 8.13 ng/mL [1199], 25.77 ng/mL [1289], 18.832 ng/mL [2053], 10.7 ng/mL and 14.6 ng/mL [2908], 7.6 ng/mL, 13.4 ng/mL, and 18.2 ng/mL [3299], 13.424 ng/mL [3306], 13.88 ng/mL [3561], 8.3 ng/mL [3563], and 20.5 ng/mL [3665]. This indicates that supplementation is generally effective in raising circulating vitamin D

concentrations.

4.3 Topic synthesis:

- **Bone Health and Fracture Risk:** Vitamin D supplementation improved bone density in adolescents with HIV [15, 23], enhanced implant osseointegration [86, 507], reduced bone mineral density (BMD) loss in prostate cancer patients on androgen deprivation therapy (ADT) [983], and was crucial for preventing hungry bone syndrome after parathyroid adenoma removal [267, 298] and in denosumab-treated CKD patients [272]. It also improved bone mineralization in very low birth weight infants [202, 572] and reduced fracture risk in orthopedic patients [40, 334]. However, one study showed no significant reduction in bone stress injuries in collegiate athletes [359], and another found no improvement in lower extremity function in postmenopausal women with osteopenia/osteoporosis [430].
- **Metabolic and Endocrine Health:** Supplementation showed benefits in reducing insulin requirements and fasting blood glucose in pediatric Type 1 Diabetes Mellitus (T1DM) [27, 232, 1056, 2556, 2717], improved glycemic control and lipid profiles in Type 2 Diabetes Mellitus (T2DM) [137, 164, 207, 211, 384, 537, 695, 764, 1019, 1040, 2716, 2717, 2908], and was associated with lower rates of gestational diabetes, preeclampsia, and gestational hypertension in pregnant women [297, 303, 335, 437, 905, 1081, 1726, 3668]. However, it did not improve insulin resistance markers in overweight elderly individuals [429] or reduce T2D incidence in older US adults [434], and one study noted increased calcium excretion and stone-forming risk in calcium nephrolithiasis patients [2829].
- **Immune Function and Infectious Diseases:** Vitamin D pretreatment suppressed ferroptosis and enhanced bacterial clearance in hybrid yellow catfish [6], improved outcomes in critically ill ARF patients [128], reduced acute respiratory tract infections (ARTI) in children [400, 1439] and care home residents [788], and was associated with reduced odds of SARS-CoV-2 infection and symptoms [1026]. It also showed potential in suppressing inflammation in neonatal calves with sepsis [355] and reducing mortality in COVID-19 patients [301, 325, 509, 1581]. However, it did not significantly reduce tuberculosis risk [292, 808] or COPD exacerbations in the general adult population [526, 1116], though severe deficiency was a predictor of exacerbations [541].
- **Neurological and Mental Health:** Supplementation improved spatial memory in aged rats [10], reduced pain intensity and interference in chronic pain patients [7, 97], alleviated anxiety symptoms in adolescents [38], reduced depressive symptom scores [205, 420, 782, 805, 846], and improved cognitive performance in university students [152] and older adults with cognitive deficits [283, 713]. It also alleviated tic phenotype in Tourette syndrome-like rats [126] and children with chronic tic disorders [467, 868], and improved sleep habits in

children with restless legs syndrome (RLS) [510]. However, some studies found no benefit on cognition in older adults [414, 1258] or RLS symptoms [811].

- **Cancer Outcomes:** Vitamin D supplementation did not prevent prostate cancer progression [2], but reduced prevalence of lymphocytic CBMN markers may indicate a benefit [2]. It significantly affected pathological complete response (pCR) in breast cancer patients undergoing neoadjuvant systemic therapy (NST) [418, 462, 866], and was associated with improved overall survival and treatment response in cancer patients receiving immunotherapy [178]. However, it did not affect cancer incidence in generally healthy older adults [465].
- **Reproductive and Maternal/Child Health:** Supplementation improved bone density in peripubertal adolescents with HIV [15, 23], was a protective factor against early childhood caries (ECC) [30], reduced allergic rhinitis severity in children [13], and improved neonatal outcomes in pregnant women [297, 847, 905, 944, 1004, 1081]. It also improved laying performance and produced vitamin D-enriched eggs in hens [25]. However, maternal supplementation did not affect placental angiogenic factors [276] or significantly reduce respiratory tract infections and allergy-related outcomes in children [328, 742].
- **Other Clinical Applications:** Vitamin D supplementation improved quality of life in adults with comorbidities [43], reduced residual dizziness in BPPV patients [245, 500, 1243], alleviated symptoms in ASD rat models [296] and children with ASD [219, 845], and improved sperm motility and DNA integrity in infertile men [108, 221, 2062, 1189]. It also showed benefits in periodontal health [382, 984, 1205, 1482], reduced uterine fibroid size [353], and improved wound healing in burn patients [523] and aged mice [356]. Conversely, it did not improve growth patterns in adolescents with HIV [496] or consistently improve sarcopenia-related parameters in the elderly [1016, 1036].

5) Discussion

5.1 Principal finding:

Vitamin D supplementation consistently increased serum 25-hydroxyvitamin D (25(OH)D) levels, with a median increase of 12 ng/mL (range: 5.88 ng/mL [226] to 25.77 ng/mL [1289]) across studies, demonstrating its efficacy in improving vitamin D status.

5.2 Clinical implications:

- **Targeted Supplementation:** Patients with pre-existing vitamin D deficiency or insufficiency, particularly those with chronic conditions like T1DM [27, 232], T2DM [137, 2716], HIV [15, 23, 664], or certain cancers [178, 418, 462], are more likely to benefit from supplementation.

- **Bone Health Support:** Routine screening and supplementation are recommended for orthopedic patients to reduce infections, support bone healing, and lower fracture risk [40, 86], as well as for high-risk groups like adult children of proximal femur fracture patients [33] and post-surgical patients (e.g., knee replacement) [3].
- **Maternal and Pediatric Health:** Adequate vitamin D supplementation during pregnancy is crucial for improving neonatal outcomes [297, 847, 905, 944, 1004, 1081], and in infants and children, it can protect against early childhood caries [30], reduce allergic rhinitis severity [13], and decrease ARTI days [400].
- **Mental and Neurological Benefits:** Clinicians should consider vitamin D supplementation for patients experiencing chronic pain [7, 97], anxiety [38], depression [205, 805], or cognitive deficits [283], especially if deficiency is present.
- **Monitoring and Personalized Dosing:** Given varied responses and potential for adverse effects at very high doses [532], monitoring serum 25(OH)D levels and tailoring supplementation based on individual needs, ethnicity [898], and comorbidities is essential [43, 459].

5.3 Research implications / key gaps:

- **Optimal Dosing Regimens:** Further RCTs are needed to determine optimal vitamin D dosing strategies for specific populations (e.g., critically ill patients [476], cancer patients on immunotherapy [178]), considering factors like baseline deficiency, body mass index (BMI) [862], and genetic polymorphisms [459, 865].
- **Long-term Efficacy and Safety:** Long-term prospective studies are required to assess the sustained benefits and potential risks of vitamin D supplementation on outcomes such as cardiovascular disease (CVD) [466, 1008], dementia incidence [414], and cancer prevention [465].
- **Mechanistic Pathways:** More experimental and clinical research is needed to elucidate the precise molecular mechanisms by which vitamin D exerts its pleiotropic effects, particularly in areas like gut microbiota modulation [263, 366, 769, 1055], anti-inflammatory pathways [51, 380, 520, 542], and neuroplasticity [449, 1193, 1195].
- **Combination Therapies:** Research should explore the synergistic effects of vitamin D with other nutrients or interventions (e.g., calcium, exercise, probiotics, other vitamins) on various health outcomes, as combined therapies often show enhanced benefits [15, 23, 155, 175, 269, 297, 348, 438, 518, 519, 562, 712, 845, 915, 990, 1019, 2031, 2432, 2485, 2878, 3306].
- **Underrepresented Populations:** Studies should prioritize diverse populations (e.g., specific ethnic groups [898, 157, 472, 982], individuals with rare diseases [255, 342, 2741],

and those in low-resource settings [226, 2804, 3467]) to ensure generalizability and address unique needs and risk factors.

5.4 Limitations:

- **Heterogeneous Study Designs** — The included studies featured a wide variety of designs, from RCTs to retrospective cohorts and animal models, which limits the comparability and strength of evidence across different outcomes.
- **Variability in Dosing and Duration** — Doses of vitamin D and supplementation durations varied significantly, making it challenging to establish optimal regimens or compare efficacy directly.
- **Inconsistent Outcome Reporting** — Different studies measured and reported outcomes using diverse metrics and timepoints, hindering quantitative synthesis and meta-analysis for many health endpoints.
- **Baseline Vitamin D Status** — Many studies included populations with pre-existing vitamin D deficiency, potentially overestimating effects in a general, vitamin D-sufficient population.
- **Potential for Publication Bias** — The review process did not explicitly assess for publication bias, which could lead to an overrepresentation of studies with positive findings.

5.5 Future directions:

- **Standardized Dosing Protocols** — Develop and test standardized vitamin D supplementation protocols for specific conditions and populations.
- **Longitudinal RCTs** — Conduct large-scale, long-term randomized controlled trials with consistent endpoints to assess chronic disease prevention.
- **Personalized Supplementation Strategies** — Investigate genotype-guided or biomarker-informed approaches for tailored vitamin D interventions.
- **Mechanistic Biomarker Studies** — Explore the molecular pathways and cellular changes induced by vitamin D supplementation using multi-omics data.
- **Implementation Science Research** — Evaluate effective strategies for improving patient adherence and clinician education on vitamin D supplementation guidelines.

6) Conclusion

Vitamin D supplementation consistently increased serum 25-hydroxyvitamin D (25(OH)D) levels, with a median increase of 12 ng/mL (range: 5.88 ng/mL [226] to 25.77 ng/mL [1289]) across studies,

demonstrating its efficacy in improving vitamin D status. This improvement in vitamin D status is associated with a wide range of benefits across diverse populations and health outcomes, including bone health, metabolic regulation, immune function, and neurological well-being. However, the heterogeneous study designs and variability in dosing and duration across the literature represent the most significant limitation to drawing definitive conclusions. Future research should focus on conducting large-scale, long-term randomized controlled trials with standardized protocols to establish optimal dosing and confirm the long-term efficacy and safety of vitamin D supplementation for specific health conditions.

References

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Figure 1. Publication-year distribution of included originals

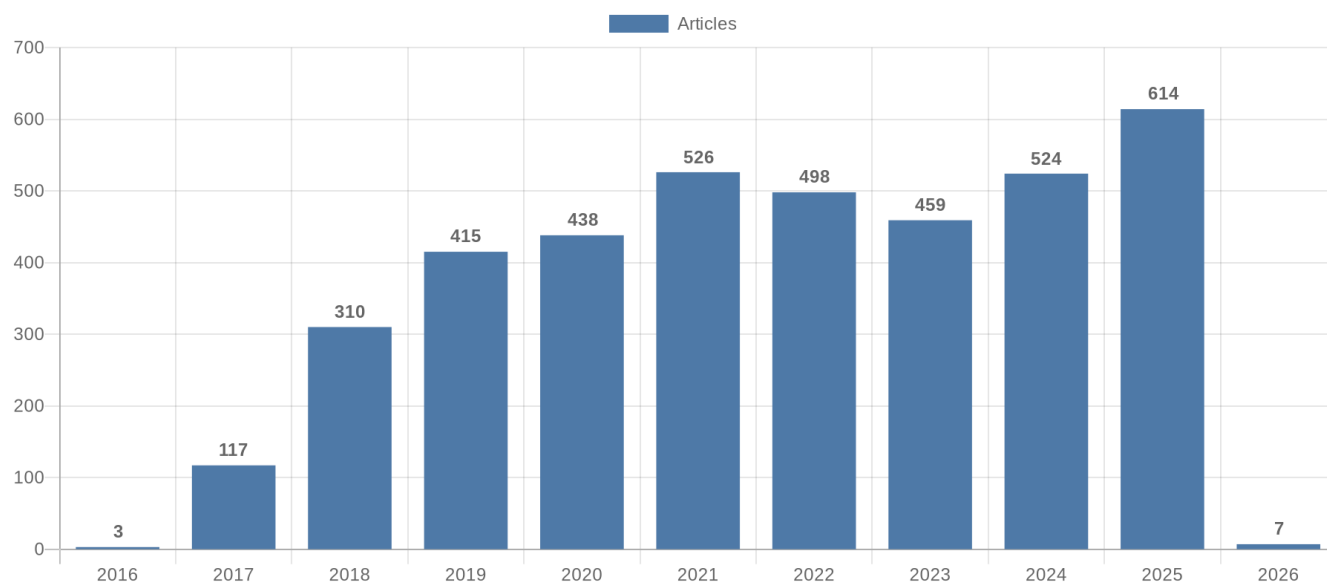


Figure 2. Study-design distribution of included originals

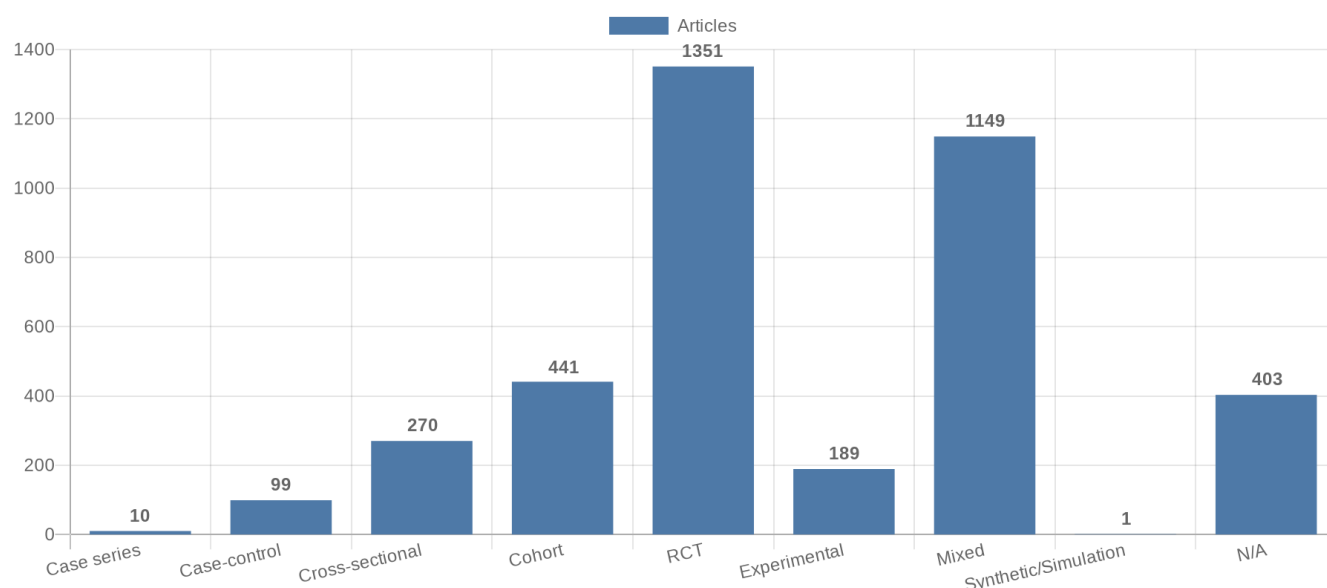


Figure 3. Study-type (directionality) distribution of included originals

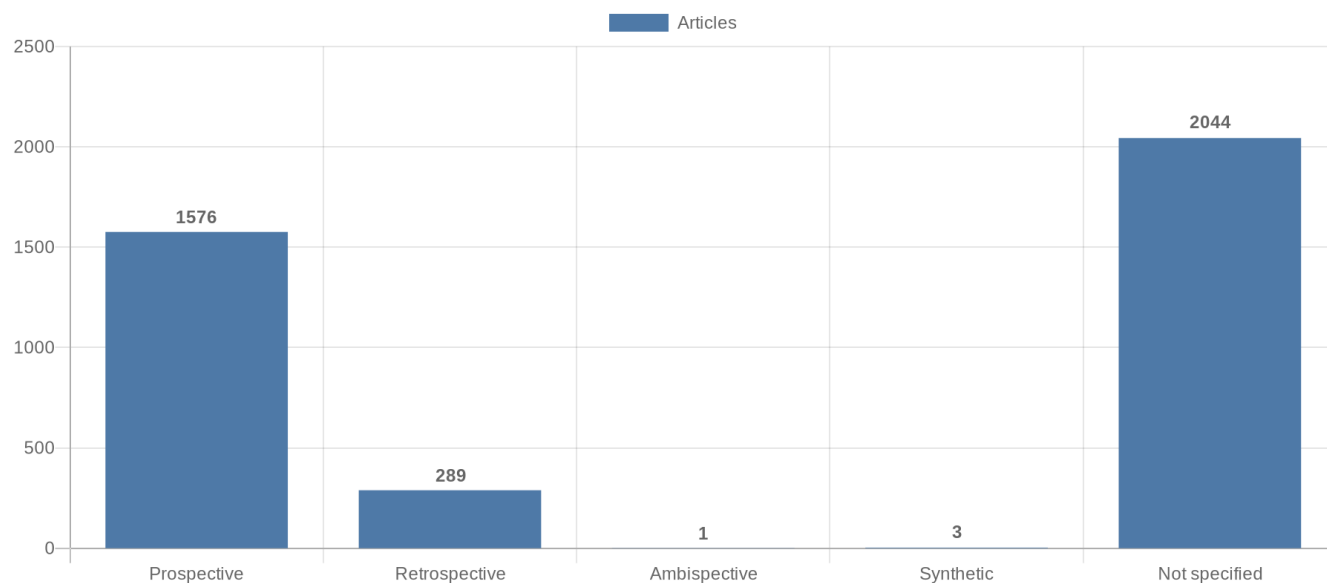


Figure 4. Main extracted research topics

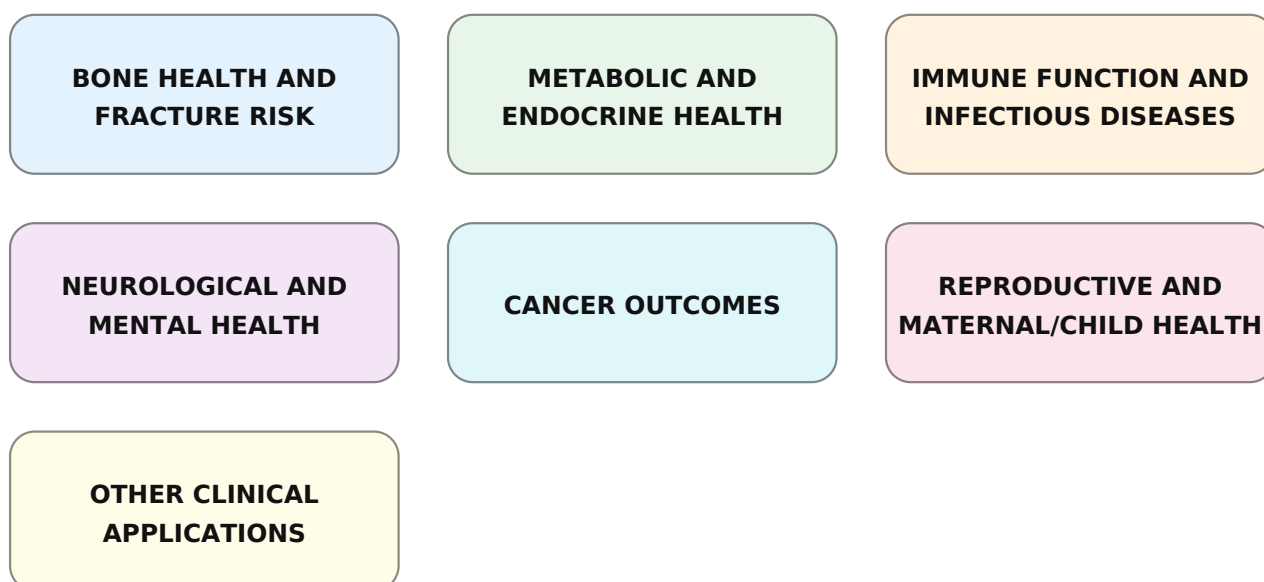


Figure 5. Limitations of current studies (topics)



Figure 6. Future research directions (topics)

