Supplementary Material

Supplementary Table S1. Search strategy on each database.

Database (platform)	Date searched	Search lines (syntax exactly as run)	Records retrieved*
PubMed (MEDLINE)	25 Apr 2025	**#1** ((((1 alpha, 25 dihydroxy 20 epi vitamin D3[MeSH Terms]) OR (1,25 dihydroxy 20 epi vitamin D3[MeSH Terms])) OR (cholecalciferol[MeSH Terms])) OR (ergocalciferol[MeSH Terms])) OR ("vitamin D") OR ("vitamin D levels") OR ("vitamin D serum levels") **#2** ((((length maintenance, telomere[MeSH Terms]) OR (homeostasis, telomere[MeSH Terms])) OR (telomere[MeSH Terms])) OR (telomere)) OR ("telomere length") **Final:** #1 AND #2	89
Cochrane Library	25 Apr 2025	**#1** MeSH descriptor: Vitamin DVitamin D explode all trees **#2** ("vitamin D"):ti,ab,kw OR ("vitamin D serum level"):ti,ab,kw OR ("vitamin D level"):ti,ab,kw OR ("cholecalciferol"):ti,ab,kw OR ("ergocalciferol"):ti,ab,kw **#3** #1 OR #2 **#4** MeSH descriptor: TelomereTelomere explode all trees **#5** ("telomere"):ti,ab,kw OR ("telomere length"):ti,ab,kw OR ("telomere length maintenance"):ti,ab,kw OR ("telomere homeostasis"):ti,ab,kw **#6** #4 OR #5 **Final:** #3 AND #6	14
EMBASE (Ovid)	28 Apr 2025	**#1** 'vitamin d'/exp **#2** '24,25 dihydroxyvitamin d'/exp **#3** '25 hydroxyvitamin d'/exp **#4** 'telomere length'/exp **Final:** (#1 OR #2 OR #3) AND #4	103
Scopus	28 Apr 2025	**Concept 1** **(Vitamin D):** TITLE-ABS-KEY("vitamin D" OR "cholecalciferol" OR "ergocalciferols" OR "vitamin D3" OR "calcidiol" OR "calcifediol" OR "calcitriol" OR "25-hydroxycholecalciferol" OR "25-hydroxyvitamin D" OR "1 25 dihydroxyvitamin D" OR "25(OH)D" OR "dietary supplements" OR "nutritional supplements" OR "vitamin D supplementation") **Concept 2 (Telomere):** TITLE-ABS-KEY("length maintenance, telomere" OR "telomere" OR "telomere length") **Final:** Concept 1 AND Concept 2	314

Supplementary Table S2. Full-text articles excluded from the review (n=21).

#	First author (year)	Title (shortened)	Primary reason for exclusion
1	**Nguyen L.M. (2022)**	Serum Nutrients, Periodontitis and Biological Ageing	Outcome not leukocyte TL (no eligible LTL measurement)
2	**Rahman S.T. (2022)**	Vitamin D Supplementation and TL: D-Health RCT	Randomised controlled trial (non-observational)
3	**Agirbasli D. (2019)**	LTL as a Compensatory Mechanism in Vit D Metabolism	Laboratory/mechanistic study; no observational human data
4	**Wijayabahu A.T. (2021)**	Vit D, ω-6:ω-3 Ratio & Ageing in Chronic-Pain Cohort	Population with chronic disease (> 30 % of sample)
5	**Hakeem S. (2015)**	25(OH)D & TL in the Very-Old (Newcastle 85+)	Exposure categories inadequate (no high/normal vs low comparison)
6	**Bhatt S.P. (2018)**	Sleep-Apnoea Severity, LTL & Vit D in Asian Indians	Clinical-condition cohort (obstructive sleep apnoea)
7	**Zarei M. (2023)**	Relationship between Vit D and Telomere/Telomerase	Narrative review (not original research)
8	**Mazidi M. (2019)**	Serum 25(OH)D & TL: Mendelian-Randomisation Study	Genetic/MR design without measured 25(OH)D exposure
9	**Herrmann M. (2017)**	Short Telomeres & Mortality in Vit B/D Deficiency	All participants vitamin-D-deficient (no normal-Vit D group)
10	**Bao W. (2015)**	25(OH)D & LTL in U.S. Adults: Population-Based Study	Dataset duplicate of included NHANES analysis with inferior covariate control
11	**Tempaku P.F. (2016)**	RE: 25(OH)D & LTL in Young Adults (Letter)	Correspondence/letter, not original data
12	**Stefler D. (2021)**	Dietary Habits & TL in Russian Cohort	Vitamin D not measured or analysed
13	**Cieslak K. (2020)**	Low Vit D Predicts Schizophrenia Features	Disease-specific sample (schizophrenia)
14	**Dudinskaya E.N. (2018)**	Vascular Ageing & TL: Role of Vit D3 Deficiency	Review/opinion piece
15	**Tsoukalas D. (2019)**	Nutraceutical Supplements & Longer TL	Vitamin D not the exposure of interest
16	**Vetter V.M. (2020)**	Epigenetic Clock, LTL & Vit D Status (BASE-II)	25(OH)D not measured in serum/plasma (dietary/supplement proxy)
17	**Lau H. (2019)**	Neuro-protective Factors & Cognitive Ageing in Malaysia	Vitamin D not measured; multi-factor study
18	**Hoffecker B.M. (2015)**	SLE, Vit D Deficiency & Shorter TL	Disease-specific sample (systemic lupus erythematosus)
19	**Borras M. (2022)**	Active Vit D Treatment & TL in Haemodialysis	Severe-disease cohort (end-stage renal disease on dialysis)
20	**Tesovnik T. (2021)**	TL & Vit D in Juvenile Type 1 Diabetes	Participants < 18 y (wrong age group)
21	**Akash C. (2022)**	TL & Vit D in Type 2 Diabetes and Complications	Disease-specific sample (type 2 diabetes)

TL = Telomere length; LTL = Leukocyte telomere length; 25(OH)D = 25-hydroxyvitamin D.

Supplementary Figure S3. Bubble Scatterplot of Included Studies.