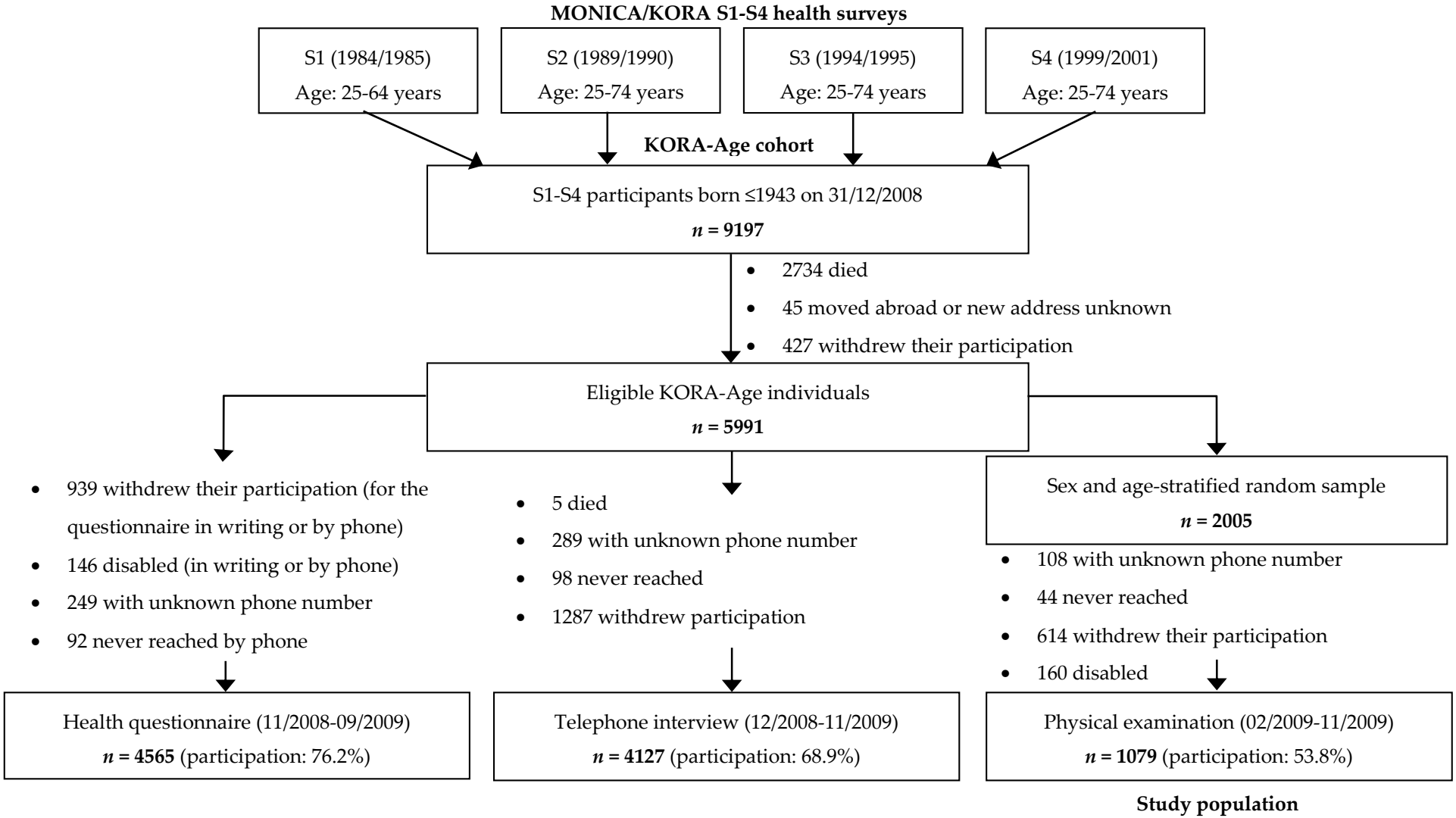

Figure S1: Flowchart of the KORA-Age 2008/2009 recruitment and retention profile.

Table S1: Description of data collection and categorization methods for the investigated predictors in KORA-Age 2008/2009.

Predictor	Collection Method	Assessment Method	Categories
Socio-demographic factors			
Sex	Telephone interview	Short form of the Demographic Standards of the German Society of Epidemiology [1]	Men; women
Age groups (years)	Telephone interview	Same as sex	65-74; 75-84; 85-93
Family status	Telephone interview	Same as sex	Living with a partner; living alone, divorced or widowed
Educational level (years)	Telephone interview	Estimated by recording years of school completed	Medium to high (10 to 17); low (8 to 9)
Lifestyle factors			
Nutritional status (GNRI)	Physical examination	Derived by combining information on albumin level, weight and height, defined in [2]	No risk (>98); low risk (92 to 98); moderate/ major risk (<92)
Nutritional status (Nutrition Score)	Telephone interview	Short version of SCREEN II questionnaire covering eating habits (e.g. skipping meals, appetite, daily intake of fruits and vegetables) [3]	Low risk (41 to 48); medium risk (36 to <41); high risk (<36)
Physical activity	Telephone interview	Two four-category questions on time spent per week on sport activities in summer and winter, respectively [4]	Very active (regular sports in summer and winter for >2 hours/week in both seasons) or moderately active (regular sports for ~1 hour/week in at least one season); less active (irregular sports for ~1 hour/week in at least one season) or inactive (no sports in summer or winter)
Alcohol consumption (g/day)	Physical examination	Self-reported amount of alcoholic drinks consumed (beer, wine and spirits) based on the last weekend and the last weekday using a validated recall method [5]	0; >0 to <20; ≥20
Smoking status	Health questionnaire	Questions: 1) Have you smoked more than 100 cigarettes in your life? 2) Do you smoke cigarettes at the moment? 3) Do you smoke regularly or occasionally? [6]	Never smoker (if answer 'no' to question 1); ex-smoker (if answer 'yes' to question 1 but answer 'no' to question 2); current smoker (if answer 'regularly' or 'occasionally' to question 3)

Table S1: *Cont.*

Predictor	Collection Method	Assessment Method	Categories
Health factors			
BMI (kg/m^2)	Physical examination	Body weight in kilograms divided by squared height in meters	According to WHO: normal (18.5 to <25); overweight (25 to <30); obese (≥30). One individual with a BMI of 18.3 was added to the category normal (18.5 to <25).
Frailty	Physical examination	Adapted version of the frailty phenotype proposed by Fried et al. [7], defined by the presence of ≥3 criteria: weight loss (>5 kg in the past 6 months), exhaustion, low physical activity (by self-report), low walking speed and weakness (as measured by grip strength)	Non-frail (no criteria); pre-frail (1-2 criteria); frail (≥3 criteria)
Polypharmacy	Physical examination	Use of ≥5 medications, taken regularly and prescribed (without herbal or homeopathic medications)	No; yes
eGFR (mL/min/1.73m^2)	Physical examination	Estimated from serum creatinine (mg/dL) according to formulas described in [8]	Normal (≥60); low (<60)
Multi-morbidity	Health questionnaire + telephone interview	Suffering from ≥2 morbidities including hypertension, eye disease, heart disease, diabetes mellitus, joint disease, lung disease, gastrointestinal disease, mental disease, stroke, cancer, kidney disease, neurological disease, liver disease [9]	No disease; one disease; two or more diseases
Use of supplements	Physical examination	Use of medications and supplements ingested in the last 7 days collected through a database supported computer software (IDOM) [10], together with mode, dosage and frequency of ingestion [11]. Micronutrient composition of supplements available from a database established by Helmholtz Zentrum München staff [11].	Regular intake; no/irregular intake

GNRI: Geriatric Nutritional Risk Index; SCREEN II: Seniors in the Community Risk Evaluation for Eating and Nutrition, version II; BMI: body mass index; WHO: World Health Organization; eGFR: estimated glomerular filtration rate; IDOM: Instrument for Databased Assessment Of Medication

Table S2: Unadjusted ORs with 95% CIs for subclinical micronutrient deficiencies by categories of potential predictors: Results from binary logistic regression analyses in KORA-Age 2008/2009.

Predictor	Predictor Categories	Low 25OHD			Low folate			Low vitamin B_{12}			Low iron		
		OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*
Season of blood collection													
Months of blood collection	February-May vs June-August	1.8	1.3 – 2.3	<0.001	.	.	.	.	.	.	.	.	.
Months of blood collection	September-November vs June-August	0.9	0.7 – 1.3	0.713	.	.	.	.	.	.	.	.	.
Socio-demographic factors													
Sex	Women vs men	1.6	1.3 – 2.1	<0.001	1.2	0.8 – 1.8	0.479	0.8	0.6 – 1.1	0.180	0.5	0.3 – 0.7	0.001
Age groups (years)	75-84 vs 65-74	1.6	1.2 – 2.0	0.001	1.2	0.7 – 2.0	0.494	1.3	0.9 – 1.7	0.124	1.5	1.0 – 2.3	0.075
Age groups (years)	85-93 vs 65-74	3.7	2.4 – 5.8	<0.001	3.1	1.7 – 5.6	<0.001	1.9	1.3 – 2.9	0.002	2.8	1.6 – 4.8	<0.001
Family status	Living alone, divorced or widowed vs living with a partner	1.4	1.1 – 1.9	0.006	1.4	0.9 – 2.2	0.105	0.9	0.7 – 1.2	0.545	1.2	0.8 – 1.8	0.348
Educational level (years)	Low (8 to 9) vs medium to high (10 to 17)	1.7	1.2 – 2.3	0.001	1.4	0.8 – 2.2	0.217	1.3	0.9 – 1.7	0.161	1.0	0.6 – 1.7	0.850
Lifestyle factors													
Nutritional status	GNRI: Low (92 to 98) vs no risk (>98)	1.0	0.6 – 1.7	0.923	1.3	0.5 – 2.8	0.614	1.0	0.5 – 1.7	0.926	2.7	1.4 – 5.1	0.003
Nutritional status	GNRI : Moderate/major (<92) vs no risk (>98)	1.5	0.6 – 3.8	0.367	1.2	0.2 – 4.1	0.840	0.6	0.2 – 1.7	0.386	4.8	1.8 – 11.9	0.001
Nutritional status	Nutrition Score: High (<36) vs low risk (41 to 48)	1.5	1.1 – 2.0	0.019	2.0	1.2 – 3.5	0.012	1.2	0.8 – 1.7	0.393	1.7	1.1 – 2.8	0.016
Nutritional status	Nutrition Score: Medium (36 to <41) vs low risk (41 to 48)	1.2	0.9 – 1.7	0.135	1.2	0.7 – 2.1	0.484	1.3	1.0 – 1.8	0.076	0.7	0.4 – 1.1	0.112
Physical activity	Less active or inactive vs very active or moderately active	2.1	1.6 – 2.7	<0.001	2.3	1.5 – 3.7	<0.001	1.5	1.1-1.9	0.006	1.8	1.2 – 2.7	0.003
Alcohol consumption (g/day)	>0 to <20 vs 0	0.8	0.6 – 1.0	0.056	0.9	0.5 – 1.4	0.571	1.1	0.8 – 1.5	0.612	0.9	0.6 – 1.5	0.763
Alcohol consumption (g/day)	≥20 vs 0	0.5	0.4 – 0.7	<0.001	0.4	0.2 – 0.8	0.009	1.3	1.0 – 1.9	0.083	0.9	0.6 – 1.5	0.750
Smoking status	Current smoker vs never smoker	0.8	0.4 – 1.4	0.345	0.9	0.3 – 2.4	0.893	1.6	0.9 – 3.0	0.107	2.2	1.0 – 4.6	0.043
Smoking status	Former smoker vs never smoker	0.6	0.4 – 0.7	<0.001	1.0	0.6 – 1.5	0.920	0.9	0.7 – 1.2	0.425	1.4	0.9 – 2.1	0.101

Table S2: *Cont.*

Predictor	Predictor categories	Low 25OHD			Low folate			Low vitamin B_{12}			Low iron		
		OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*	OR	95% CI	*p*
Health factors													
BMI (kg/m²)	Overweight (25 to <30) vs normal (18.5 to <25)	1.0	0.7 – 1.4	0.953	1.1	0.6 – 2.2	0.675	1.2	0.9 – 1.8	0.287	0.7	0.5 – 1.2	0.188
BMI (kg/m²)	Obese (≥30) vs normal (18.5 to <25)	1.7	1.2 – 2.5	0.003	1.6	0.8 – 3.0	0.162	1.2	0.8 – 1.8	0.378	0.5	0.3 – 0.9	0.020
Frailty	Missing value vs non-frail	2.0	1.2 – 3.6	0.016	3.1	1.4 – 6.5	0.003	1.4	0.7 – 2.4	0.297	4.1	1.9 – 8.4	<0.001
Frailty	Pre-frail vs non-frail	2.2	1.7 – 2.8	<0.001	1.5	0.9 – 2.5	0.091	1.2	0.9 – 1.7	0.156	3.3	2.1 – 5.2	<0.001
Frailty	Frail vs non-frail	2.9	1.6 – 5.8	0.001	3.6	1.5 – 7.7	0.002	1.6	0.8 – 2.9	0.158	6.9	3.2 – 14.2	<0.001
Polypharmacy	Yes vs no	1.3	1.0 – 1.6	0.079	1.0	0.7 – 1.6	0.852	0.6	0.4 – 0.8	0.001	2.2	1.5 – 3.2	<0.001
eGFR (mL/min/1.73m²)	Low (<60) vs normal (≥60)	1.6	1.2 – 2.1	0.001	1.5	1.0 – 2.3	0.066	0.1	0.0 – 1.0	0.990	2.0	1.3 – 2.9	0.001
Multi-morbidity	One disease vs no disease	1.6	1.0 – 2.7	0.049	0.8	0.3 – 2.1	0.571	1.3	0.8 – 2.2	0.361	1.3	0.5 – 4.2	0.568
Multi-morbidity	Two or more disease vs no disease	2.4	1.5 – 3.8	<0.001	1.3	0.6 – 3.1	0.571	1.0	0.6 – 1.8	0.861	2.5	1.1 – 7.3	0.051
Use of supplements	Vitamin D: No/irregular intake vs regular intake	3.4	2.3 – 5.2	<0.001	.	.	.	.	.	.	.	.	.
Use of supplements	Folic acid: No/irregular intake vs regular intake	.	.	.	3.8	1.4 – 15.6	0.026	.	.	.	.	.	.
Use of supplements	Vitamin B_{12}: No/irregular intake vs regular intake	.	.	.	.	.	.	4.8	2.5 – 10.4	<0.001	.	.	.
Use of supplements	Iron: No/irregular intake vs regular intake	.	.	.	.	.	.	.	.	.	4.1	0.9 – 73.7	0.164

25OHD=25-hydroxyvitamin D; GNRI: Geriatric Nutritional Risk Index; SCREEN II: Seniors in the Community Risk Evaluation for Eating and Nutrition, version II; BMI: body mass index; eGFR: estimated glomerular filtration rate; OR: odds ratio; CI: confidence interval; *p*: p-value; . : not investigated (see Methods); range of *n* for 25OHD: 1030-1040, folate: 1033-1043, vitamin B_{12}: 1034-1044, iron: 1040-1050; variables with $p < 0.25$ were selected for multiple logistic regression analysis; cut-offs for subclinical micronutrient deficiency: <50 nmol/L (25OHD); <13.6 nmol/L (folate); <221 pmol/L (vitamin B_{12}); men: <11.6 μmol/L, women: <9.0 μmol/L (iron)

Table S3: Predictors with $p < 0.25$ in binary logistic regression which were entered into each multiple logistic regression model

Low 25OHD	Low folate	Low vitamin B_{12}	Low iron
Months of blood collection	.	.	.
Sex*	Sex**	Sex*	Sex*
Age groups*	Age groups*	Age groups*	Age groups*
Family status	Family status	-	-
Educational level	Educational level	Educational level	-
-	-	-	Nutritional status (GNRI)
Nutritional status (Nutrition Score)	Nutritional status (Nutrition Score)	Nutritional status (Nutrition Score)	Nutritional status (Nutrition Score)
Physical activity	Physical activity	Physical activity	Physical activity
Alcohol consumption	Alcohol consumption	Alcohol consumption	-
Smoking status	-	Smoking status	Smoking status
BMI	BMI	-	BMI
Frailty	Frailty	Frailty	Frailty
Polypharmacy	-	Polypharmacy	Polypharmacy
eGFR	eGFR	-	eGFR
Multi-morbidity	-	-	Multi-morbidity
Use of supplements (Vitamin D)	.	.	.
.	Use of supplements (Folic acid)	.	.
.	.	Use of supplements (Vitamin B_{12})	.
.	.	.	Use of supplements (Iron)

25OHD=25-hydroxyvitamin D ; GNRI: Geriatric Nutritional Risk Index; BMI: body mass index; eGFR: estimated glomerular filtration rate; *: variables were forced in every model (**even if non-significant at $p < 0.25$); -: variable not significant at $p < 0.25$; . : not investigated (see Methods); cut-offs for subclinical micronutrient deficiency: <50 nmol/L (25OHD); <13.6 nmol/L (folate); <221 pmol/L (vitamin B_{12}); men: <11.6 μmol/L, women: <9.0 μmol/L (iron

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