Higher redox state of Coenzyme Q10 is associated with higher risk of all-cause mortality in a sample from the northern German general population

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Background and research aim

Coenzyme Q10 (CoQ10) is an endogenously synthesized lipid-soluble molecule with important implications in human health, for example through the antioxidant function of its reduced form (ubiquinol) [1]. Evidence has accumulated that CoQ10 supplementation could reduce hospitalization and mortality risk in heart failure patients [2,3]. However, the long-term health effects of circulating CoQ10 in the population remain largely unknown. Therefore, we aimed to assess the association of different biomarkers of serum CoQ10 status (total CoQ10, ubiquinol, ubiquinone (oxidized CoQ10), and redox state of CoQ10, which describes the percentage of ubiquinone in total CoQ10) with all-cause mortality risk in a community-based sample from the northern German general population.

Methods

The analytical sample comprises three subsamples:

- A: healthy blood donors from the „popgen controls“ from the popgen Biobank [4]
- Food Chain Plus cohort [5]
  - B: random sample from the population-registry in Kiel
  - C: sample from an Obesity Outpatient Clinic in Kiel

- Ubiquinol and ubiquinone measured in serum samples using high-pressure liquid chromatography with electrochemical detection and ubiquinol-9 and ubiquinone-9 as internal standards [6]
  - Total CoQ10 = sum of ubiquinol and ubiquinone
  - CoQ10 redox state = percentage of ubiquinone in total CoQ10

- Associations of CoQ10 markers with mortality assessed using Kaplan-Meier-Curves with Log-rank tests and seperate Cox regression models
  - Model 1: adjusted for age and sex
  - Model 2: further adjusted for body mass index, smoking habits, systolic blood pressure, diabetes prevalence, and total cholesterol
  - Model 3: further adjusted for C-reactive protein

Results

Table: Characterization of the study sample

	Overall sample (n=1,333)	Alive[1] (n=1,210)	Deceased[1] (n=123)
Female sex, n (%)	801 (60.1%)	748 (61.8%)	53 (43.1%)
Age [years]	48.0 [37.7; 58.0]	47.0 [36.6; 56.0]	61.0 [50.8; 69.5]
Survival time [years]	12.9 [12.4; 17.1]	13.0 [12.5; 17.2]	8.5 [4.8; 10.8]
Total Coenzyme Q10 [µmol/L]	0.82 [0.64; 1.03]	0.82 [0.64; 1.02]	0.90 [0.63; 1.09]
Ubiquinol [µmol/L]	0.71 [0.55; 0.89]	0.71 [0.55; 0.88]	0.76 [0.54; 0.94]
Ubiquinone [µmol/L]	0.11 [0.08; 0.13]	0.11 [0.08; 0.13]	0.12 [0.09; 0.14]
Coenzyme Q10 redox state [%]	13.0 [11.8; 14.4]	12.9 [11.7; 14.3]	13.5 [12.4; 14.9]

[1] At vital status assessment in 2024 (subsample A) and 2025 (subsamples B and C)

Coenzyme Q10 redox state = percentage of ubiquinone in total Coenzyme Q10

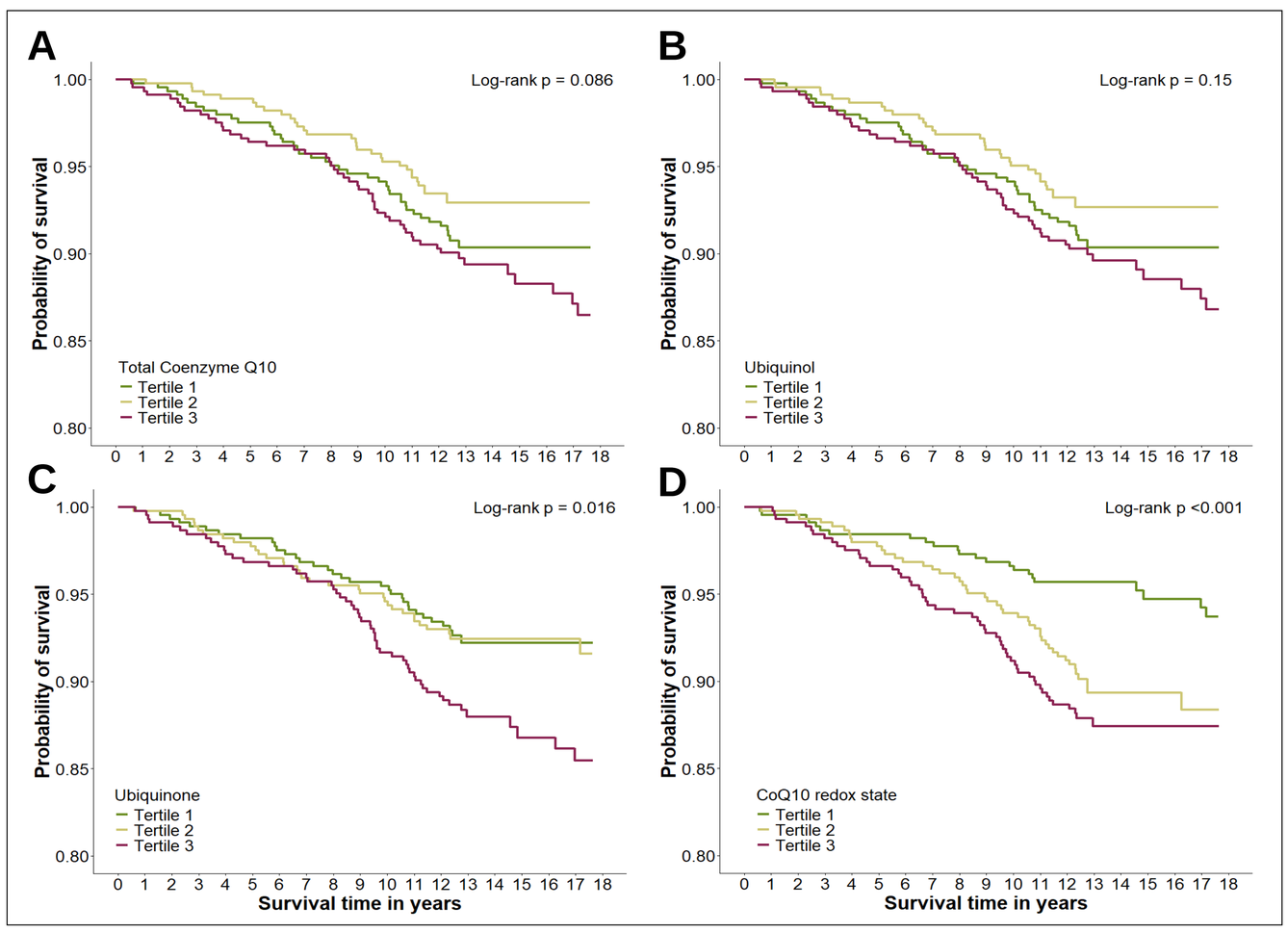

Figure 1: Association of tertiles of total CoQ10 (A), ubiquinol (B), ubiquinone (C), and CoQ10 redox state (D) with survival duration using unadjusted Kaplan-Meier-Curves and Log-rank tests.

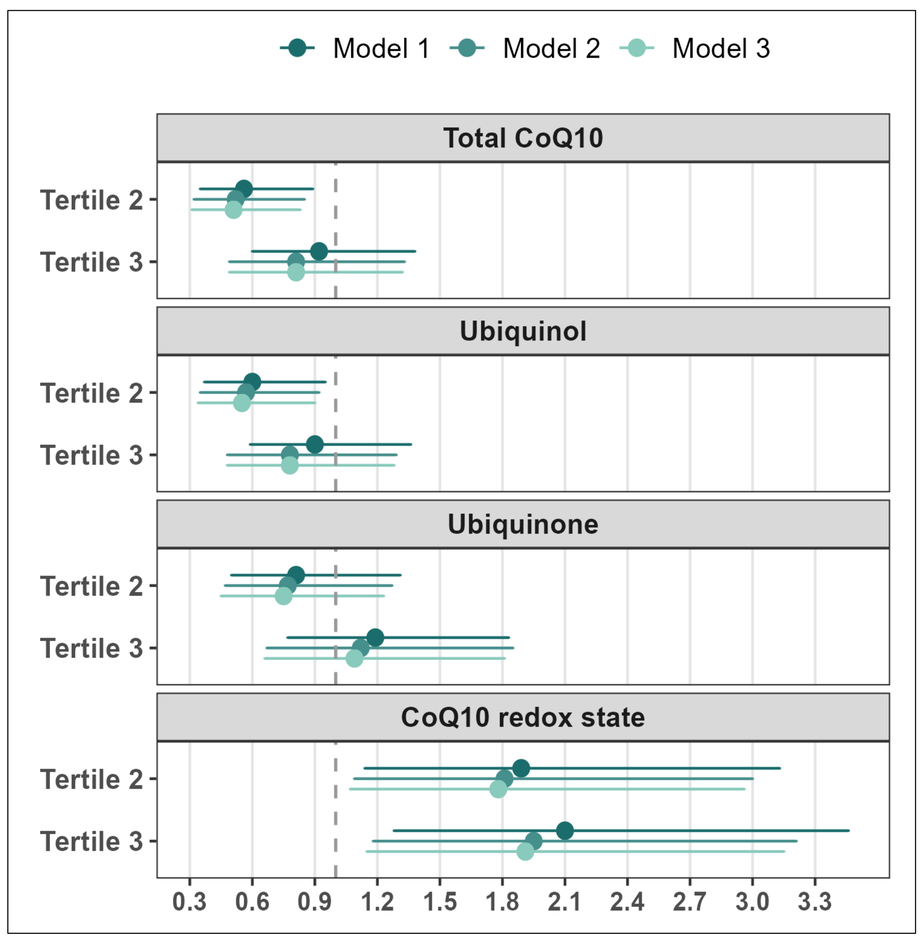

Figure 2: Associations of tertiles of CoQ10 markers with all-cause mortality using multivariable adjusted Cox regression models.

Tertile 1 was used as the reference category.

Conclusion

We observed a higher serum CoQ10 redox state to be associated with a higher risk of all-cause mortality in a sample from the northern German general population. This observation might be indicative of detrimental long-term health effects of a lower antioxidant capacity of CoQ10 in the circulation. As we are the first to study such long-term health effects of serum CoQ10 in the population, further studies are needed to confirm our observation and to clarify its clinical relevance in the general population.

References:

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