



Supplementary figure 5

## Supplementary Figure 5. Relational Complexity and Model Evaluation Framework

**(a)** Circular bar plot of 66 unique relation types in EvoAge-KG. Bar length indicates triple count (log10 scale), with the outer bar as 'head' type and the inner circle as 'tail' type. **(b)** Chord diagram illustrating relation types and triple counts in the baseline 'Aging' KG. **(c)** Heatmap of relation co-occurrence, indicating existing 'head-tail' node type pairs in the EvoAge-KG. **(d)** Donut charts of 80/10/10 train/validation/test split for the 'Aging' KG (left) and 'EvoAge' KG (right), with absolute triple counts. **(e)** Bar chart confirming the stratified distribution (log10 count) of all 27 relation types across the 'Aging' KG data splits. **(f)** Bar chart confirming the stratified distribution (log10 count) of all 66 relation types across the 'EvoAge' KG data splits. **(g)** Formula for calculating maximum training steps. **(h)** Table of KGE model training and evaluation parameters. **(i)** Formulas for the KGE evaluation metrics: Mean Rank (MR), Mean Reciprocal Rank (MRR), and hit@k. **(j)** Bar chart of Mean Rank (MR) performance for the six initial KGE models on 'Aging' (pink) and 'EvoAge' (blue) KGs. **(k, l)** Training loss curves for the selected models at different embedding sizes (64-512): **(k)** 'Aging'-RESCAL and **(l)** 'EvoAge'-RotatE.