

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

- | | |
|--------------------------|--|
| n/a | Confirmed |
| ☐ | ☒ The exact sample size (<i>n</i>) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ A description of all covariates tested |
| ☐ | ☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☐ | ☒ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☐ | ☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☐ | ☒ Estimates of effect sizes (e.g. Cohen's <i>d</i> , Pearson's <i>r</i>), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection	Quality control and adapter trimming of the fastq sequence files were performed with FastQC (v0.11.8), fastx-toolkits (v0.0.13), Trim Galore! (v0.6.4), and Cutadapt (3.4). Options were set to remove Illumina TruSeq adapters and end sequences to retain high-quality bases with phred score > 20 and a remaining length > 20 bp. Successful processing was verified by re-running FastQC. Reads was mapped and quantified to the killifish genome Nfu_20140520 using STAR 2.7.6a. Differential gene expression between rag2 mutant and WT fish was performed using the edgeR package (v3.32.1).
Data analysis	The code is available in the GitHub repository for this paper: https://github.com/Harel-lab/An-Antagonistically-Pleiotropic-Gene-Regulates-Vertebrate-Growth-Maturity-and-Lifespan

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

GEO Repository: GSE226279

GEO Repository: GSE300596

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	N/A
Reporting on race, ethnicity, or other socially relevant groupings	N/A
Population characteristics	N/A
Recruitment	N/A
Ethics oversight	N/A

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	Sample sizes for all experiments are similar to those reported in previous publications for similar experiments performed in killifish (see citations in the manuscript).
Data exclusions	Fish were excluded from the lifespan cohort if they did not develop normally (e.g. did not inflate the swim bladder, or deformed) or did not die a natural death (e.g. jumped out of a tank during routine maintenance). These criteria were pre-established. Otherwise, no data was excluded.
Replication	All experiments were repeated independently with similar findings at least twice. All attempts at replication were successful. This excludes the RNA-seq datasets and fish lifespan that had independent biological replicates.
Randomization	All fish were randomly assigned to each experimental group while controlling for age and genotype.
Blinding	Visual scoring of melanoma presence and size, maturity and size assessment, sperm content measurements, scoring of images including proliferation and DNA damage were performed independently and blindly by two researchers.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☐	☒ Antibodies
☐	☒ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☐	☒ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	mouse anti-PCNA antibody (Abcam 29, 1:200); rabbit anti-Histone H2A.XS139ph (GeneTex 127342, 1:100) antibody. Secondary antibodies: Goat anti-rabbit AlexaFluor 488 (Invitrogen A11088); donkey anti-rabbit Alexa Fluor 549 secondary antibody (Abcam, 150064, 1:500).
Validation	All antibodies are well known and validated by the manufacturer (https://www.abcam.com/en-us/products/primary-antibodies/pcna-antibody-pc10-ab29 , https://www.genetex.com/Product/Detail/Histone-H2A-XS139ph-phospho-Ser139-antibody/GTX127342?srsltid=AfmBOoo7jj1hyYa_G-PJR3N8LOWkVetXYCintKBozefHqtmMs9qMhEnq)

Eukaryotic cell lines

Policy information about [cell lines and Sex and Gender in Research](#)

Cell line source(s)	Primary cell line produced in our lab from killifish, genotypes and sex indicated in the manuscript.
Authentication	N/A
Mycoplasma contamination	The cell line was tested and found negative for mycoplasma.
Commonly misidentified lines (See ICLAC register)	N/A

Animals and other research organisms

Policy information about [studies involving animals](#); [ARRIVE guidelines](#) recommended for reporting animal research, and [Sex and Gender in Research](#)

Laboratory animals	The African turquoise killifish (GRZ strain) was used in this study at the indicated ages (see Methods section).
Wild animals	N/A
Reporting on sex	Lifespan and growth experiments were performed on both sexes. All other in-vivo experiments were performed on males since they are the only sex presenting nuptial color and melanocytic tails.
Field-collected samples	N/A
Ethics oversight	All turquoise killifish care and uses were approved by the Subcommittee on Research Animal Care at the Hebrew University of Jerusalem (IACUC protocols #NS-18-15397-2, #NS-22-16915-3 and #HU-24-17607-4).

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Plants

Seed stocks	<i>Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.</i>
Novel plant genotypes	<i>Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.</i>
Authentication	<i>Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosaicism, off-target gene editing) were examined.</i>