nature portfolio

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# 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.

Please do not complete any field with "not applicable" or n/a. Refer to the help text for what text to use if an item is not relevant to your study.
For final submission: please carefully check your responses for accuracy; you will not be able to make changes later.

## 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 (*n*) 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<br>*Only common tests should be described solely by name; describe more complex techniques in the Methods section.* |
| ☐ | ☒ | 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. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted<br>*Give P values as exact values whenever suitable.* |
| ☒ | ☐ | 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 *d*, Pearson's *r*), 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 | No software was used |
| Data analysis | The manuscript describes custom algorithms for which code will be provided for reproducibility at https://github.com/eerdil/BAT |

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

The datasets used in the current study are not publicly available due to privacy reasons.
Some of the datasets can be made available after deidentification for any researcher who provides methodologically sound proposals.
The proposals should be directed to ertunc.erdil@vision.ee.ethz.ch.

Once a proposal is accepted, the requestors will be given access to data upon signing a data access agreement.
The proposals may be submitted up to 60 months following the article's publication.

## 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 | The paper does not consider sex and gender in the study design. We did not study whether the findings apply to only one sex and gender. Sex and/or gender was determined based on self-reporting. The Basel cohort consists of only men participants, whereas the Granada cohort consists of 34 men and 63 women participants. The consent for sharing the individual-level data has not been obtained. In Zurich and MSKCC cohorts, this information has not been collected. The reason for the lack of sex- and gender-based analyses is the unavailability of the data that can serve for this purpose. We did not collect any specific data for this study, rather used data that were already collected for previous studies. |
| Reporting on race, ethnicity, or other socially relevant groupings | The paper does not report on race, ethnicity or other socially relevant groupings. We did not collect any confounding variable information (race, ethnicity, socially relevant groupings) for this study. |
| Population characteristics | The subjects in the Basel cohort are aged between 19 and 33 years, with an average age of 24.45 years and a standard deviation of 4.38. Their BMI values range from 18.6 to 27.5, with a mean BMI of 22.5 and a standard deviation of 2.31. The subjects in the Granada cohort are aged between 18 and 27 years, with an average age of 22.07 years and a standard deviation of 2.23. Their BMI values range from 17.2 to 39.40, with a mean BMI of 24.91 and a standard deviation of 4.62. These information are not available for the Zurich and MSKCC cohorts. Any other covariate relevant population characteristics of the participants are not available. |
| Recruitment | In Basel cohort, healthy male volunteers were recruited between September 2017 and April 2019.<br>The participants underwent a screening visit during which cold-induced thermogenesis (CIT) was measured, and $n=16$ participants with a CIT above 5% of resting energy expenditure (REE) were enrolled. In the Granada cohort, the study was advertised through social networks, local media, and via posters. The inclusion criteria included self-reported sedentary lifestyle (performing a maximum of 20 min of moderate-to-vigorous physical activity per day on less than three days per week), being a nonsmoker, not taking any medication, and having a stable body weight over the last three months. The exclusion criteria were: having been diagnosed with diabetes, hypertension, or any other significant medical condition (either life-threatening or that might interfere with or be aggravated by exercise), being pregnant, using medication deemed to affect energy metabolism, or to be frequently exposed to cold temperature. Zurich and MSKCC cohorts are the retrospective cohorts that include data if the patients went to the corresponding hospitals. No specific recruitment process was applied. |
| Ethics oversight | The data used in this study was approved by ethics committee of University of Basel, University of Granada, University Hospital of Zurich, and Memorial Sloan Kettering Cancer Center. |

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

# Life sciences study design

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

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| Sample size | Experiments in this study were conducted using the data from previous studies and no sample-size calculation was performed for this study. The sample sizes are sufficient since, to our knowledge, this is the largest study to date for predicting PET activity of BAT from CT scans. Also, we conduct rigorous statistical analysis of our results to show statistical significance. |
| Data exclusions | All the data from the previous studies were used in this study without any exclusion criteria. The only exception to this is some corrupted data that we could not use from the Granada cohort as we explain in Section 2.1. |
| Replication | Training code will be made available for reproducibility purpose. Some of the datasets can be made available after deidentification for any researcher who provides methodologically sound proposals. Both code and data can be used for external reproducibility. Reproducibility was tested internally with k-fold cross validation as reported in the manuscript. |
| Randomization | We did not collect data for this study ourselves and instead relied on data collected in prior work as referenced in Section 2. |
| Blinding | We did not collect data for this study ourselves and instead relied on data collected in prior work as referenced in Section 2. |

# 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 |

## Clinical data

Policy information about clinical studies

All manuscripts should comply with the ICMJE guidelines for publication of clinical research and a completed CONSORT checklist must be included with all submissions.

| | |
|---|---|
| Clinical trial registration | Basel cohort: NCT03269747, Granada cohort: NCT02365129 |
| Study protocol | The study protocols for each cohort were approved by the Institutional Review Board (IRB) of the centers, as detailed below and in the corresponding sections for each cohort in the main manuscript. These original approvals included permission for the datasets to be used in future research. As a result, specific approval for this study has been waived based on these prior approvals.<br><br>Basel cohort: The regional ethics committee at the University of Basel approved the study protocol (approval number EKNZ 2016-01859), and the study was registered at clinicaltrials.gov (NCT03269747) on 2017-09-01. Granada cohort: The study was approved by the Ethics Committee on Human Research of the University of Granada (no. 924) and by the Servicio Andaluz de Salud (Centro de Granada, CEI-Granada, Spain) and was registered at clinicaltrials.gov (NCT02365129) on 2015-02-18. Zurich cohort: study protocol was approved under ethics approval number KEK ZH 2015-0282. MSKCC cohort: the study protocol was approved under IRB approval 19-184. |
| Data collection | The details about data collection can be found in section 2 and the references where the primary outcomes of the cohorts have been published: Basel cohort: reference [32], Granada cohort: reference [30]. |
| Outcomes | The details about the primary outcomes of the cohorts can be found in the following references: Basel cohort: reference [32], Granada cohort: reference [30]. |