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Proposal for a global quality indicator for the municipal public health system – GQIMPHS

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ABSTRACT

The evaluation of composite indicators is essential for improving health systems. Data Envelopment Analysis (DEA) and the Benefit of the Doubt method are two approaches widely used in this context. Data Envelopment Analysis assesses the relative efficiency of production units, while the Benefit of the Doubt recognizes the uncertainty of composite indicators, allowing for more flexible analyses. Together, these approaches provide a comprehensive view, identifying areas for improvement in health systems and considering both efficiency and the complexity and uncertainties associated with composite indicators. Based on this, this work proposes a framework to generate a single indicator in the health system of 57 counties in the state of Minas Gerais with more than 30 thousand inhabitants, considering three dimensions: infrastructure, service and health status.

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Figures and tables

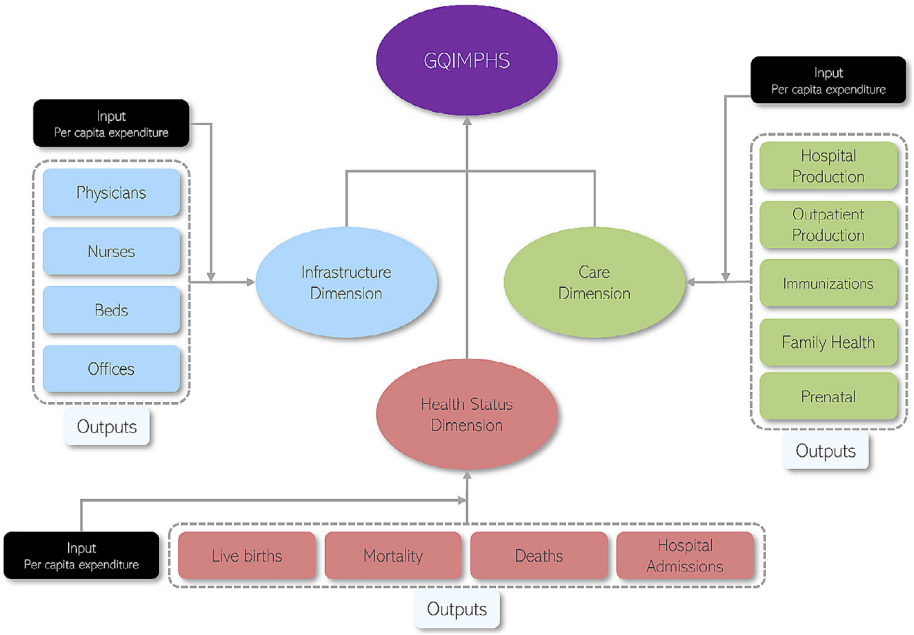


Fig. 1. The diagram of the framework and structure. The method adopted in the construction of the global composite indicator, using BoD, was based on the result of dimensions, using DEA, which express the capacity of the public system to deliver quality, availability and efficiency of health services.

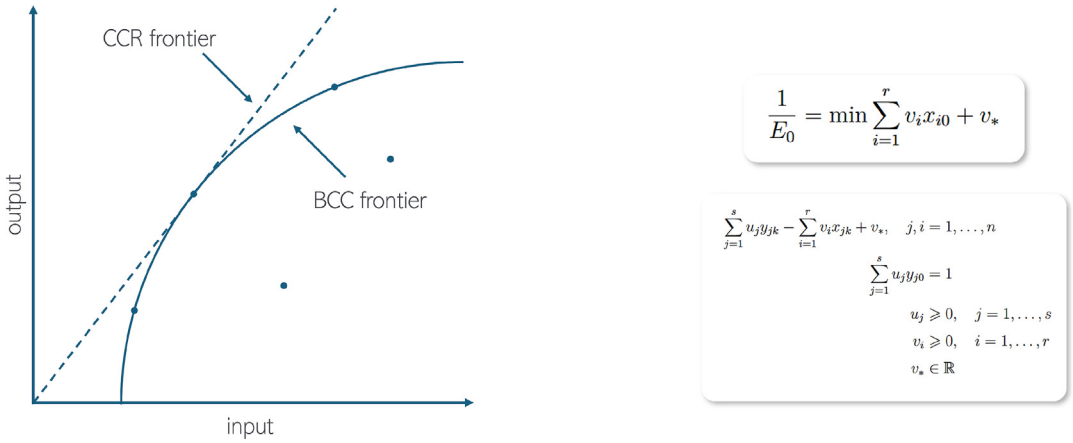
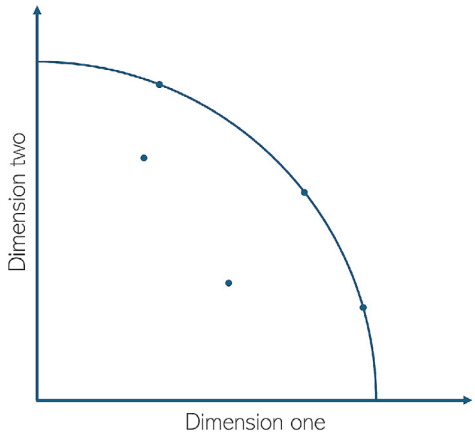


Fig. 2. Data Envelopment Analysis. In the work, the Data Envelopment Analysis model oriented to the Output and with variable returns to scale was adopted, the BCC model, a model that considers the possibility of Variable Returns to Scale. This approach allows to evaluate the efficiency of the municipalities in terms of the production of the health sector considering the financial resources invested. This model considers the variable returns to scale, maximizing the outputs without the need to reduce the inputs. As for orientation, the choice is because the objective is to optimize the resources, the outputs, with the inputs that were made available to the observed units.



$$I_{\hat{i}} = \max_{i \in I} \left(\frac{\sum_{j=1}^{n} w_{\hat{i}j} x_{\hat{i}j}}{\max_{i \in I} \sum_{j=1}^{n} w_{\hat{i}j} x_{ij}} \right)$$

$$\sum_{j=1}^{n} w_{\hat{i}j} = 1, \quad w_{\hat{i}j} \geq L_{inf.}, \quad w_{\hat{i}j} \leq L_{sup.}$$

Fig. 3. Benefit of the Doubt. Benefit of the Doubt is a DEA approach, where the composite indicator is defined as the ratio between the actual performance of a unit (numerator of the formula) and its benchmark performance (denominator of the formula). The unit's performance is obtained by optimizing a linear programming problem to find the weights that maximize its performance. In practice, the algorithm must find the weights for the unit under analysis that, when applied to all units, do not violate the constraints. This approach allows us to evaluate the overall performance of each municipality by identifying benchmarks and optimizing weights.

Table 1
Benefit of the doubt - weight limit.

Limit	Calculation	Value
Lower	0.33 * (1–0.5)	0.17
Upper	0.33 * (1 + 0.5)	0.50

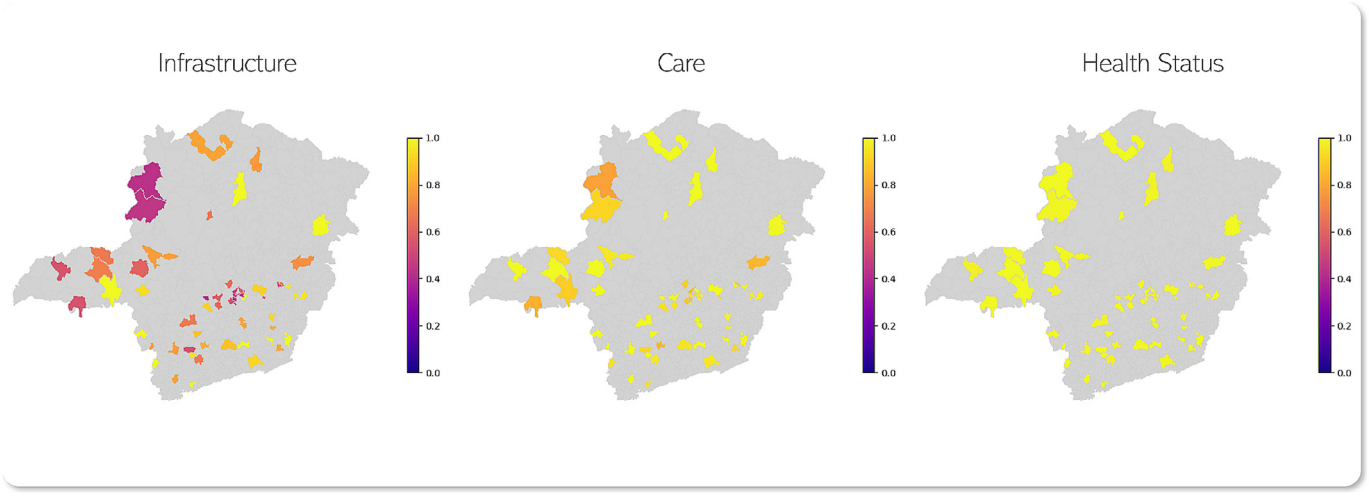


Fig. 4. DEA - Dimensions: Infrastructure, Care and Health Status - 2018.

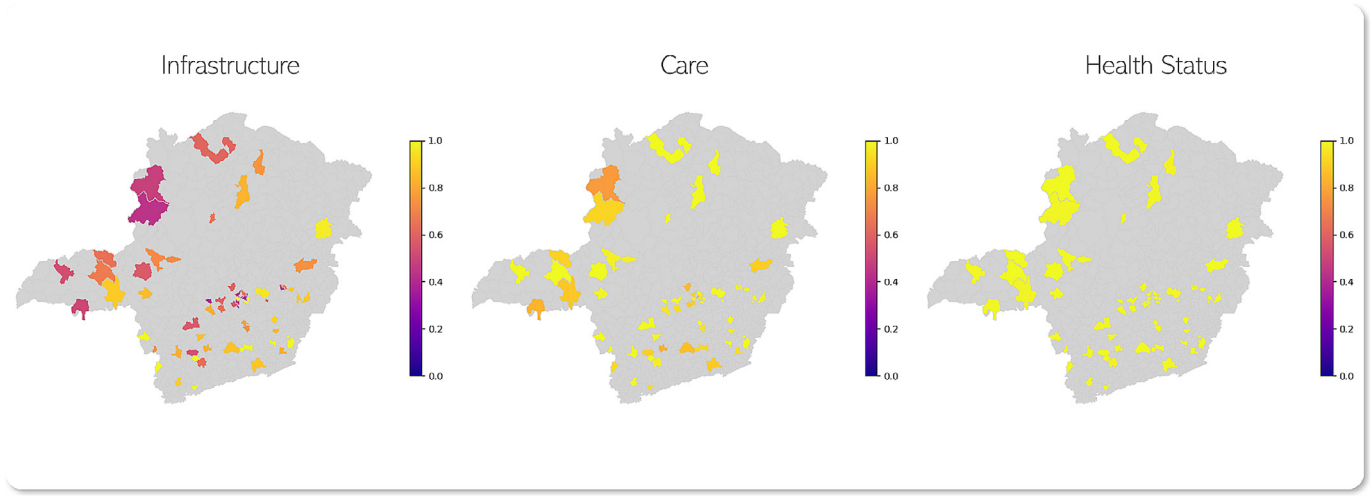


Fig. 5. DEA - Dimensions: Infrastructure, Care and Health Status - 2019.

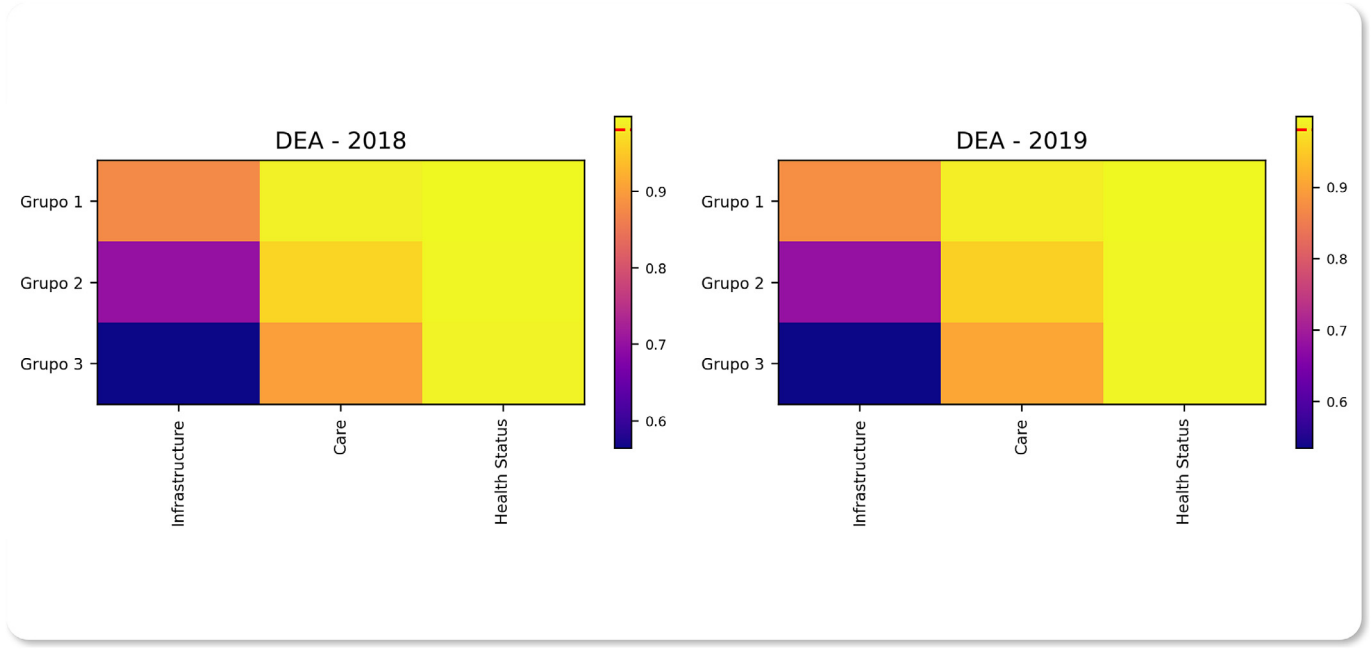


Fig. 6. DEA - Average efficiency of municipalities in the dimensions: Infrastructure, Care and Health Status.

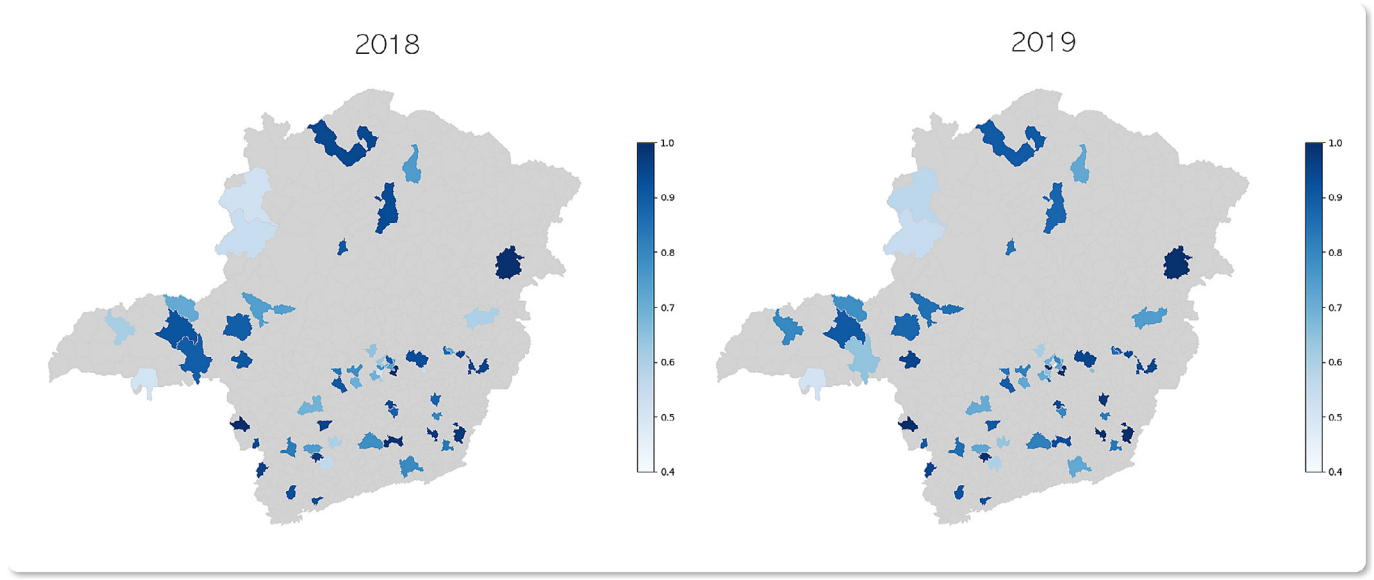


Fig. 7. Results of the composite indicators calculated with the Benefit of the Doubt.

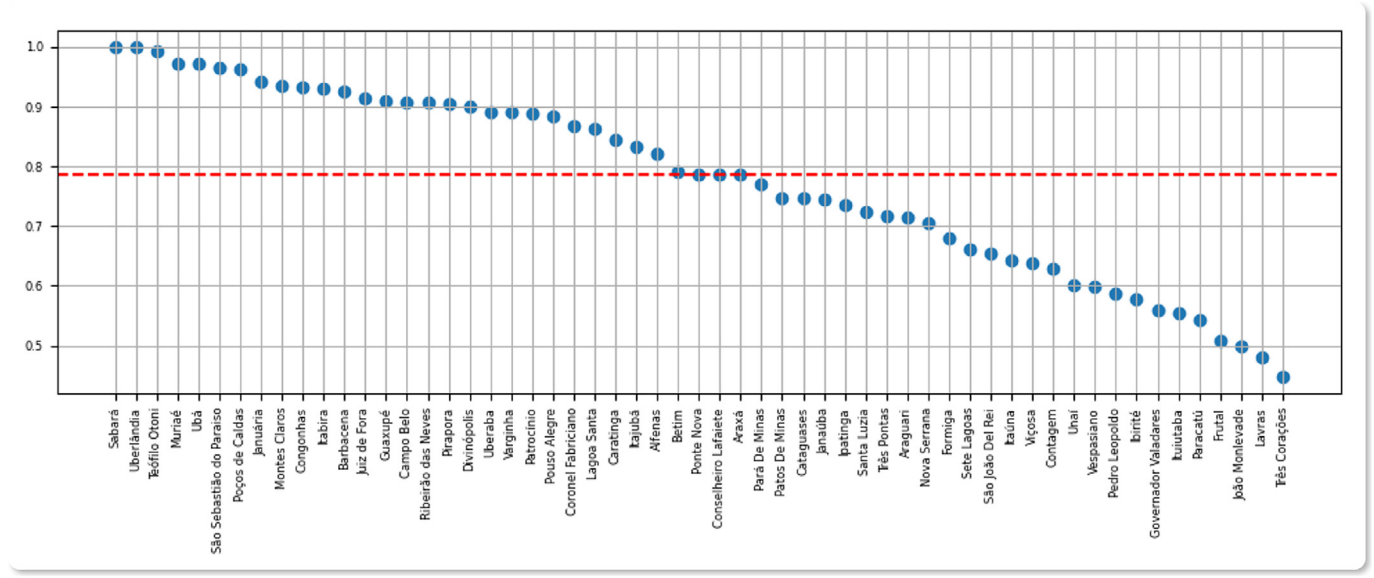


Fig. 8. Composite indicator – overall ranking 2018.

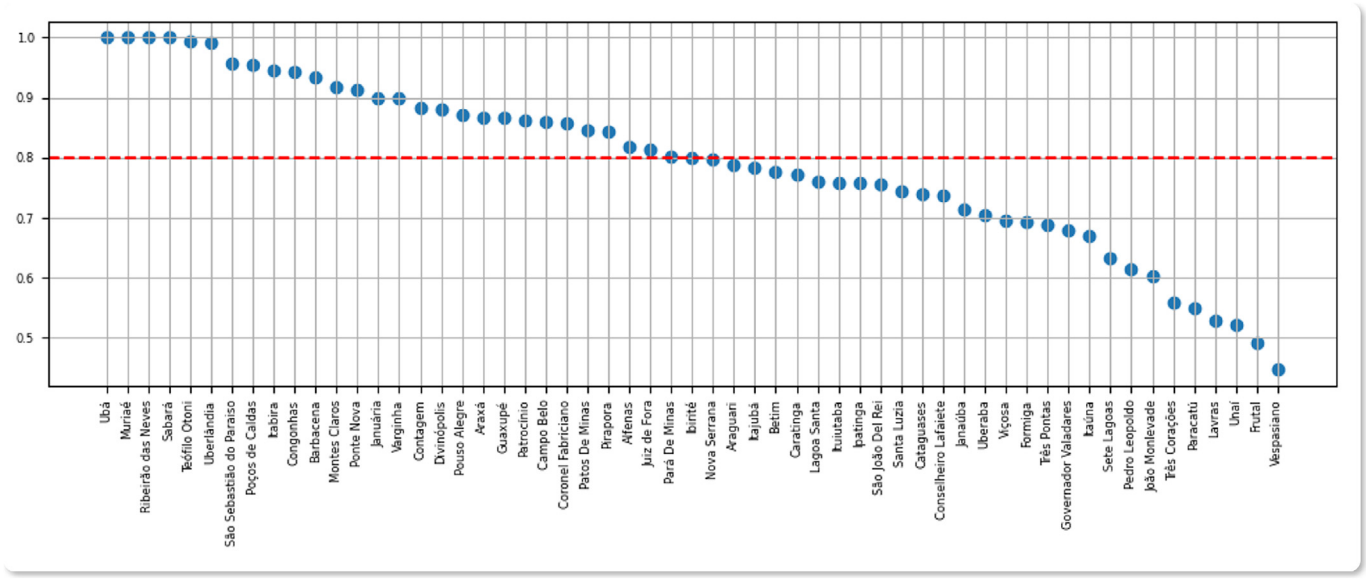


Fig. 9. Composite indicator – overall ranking 2019.

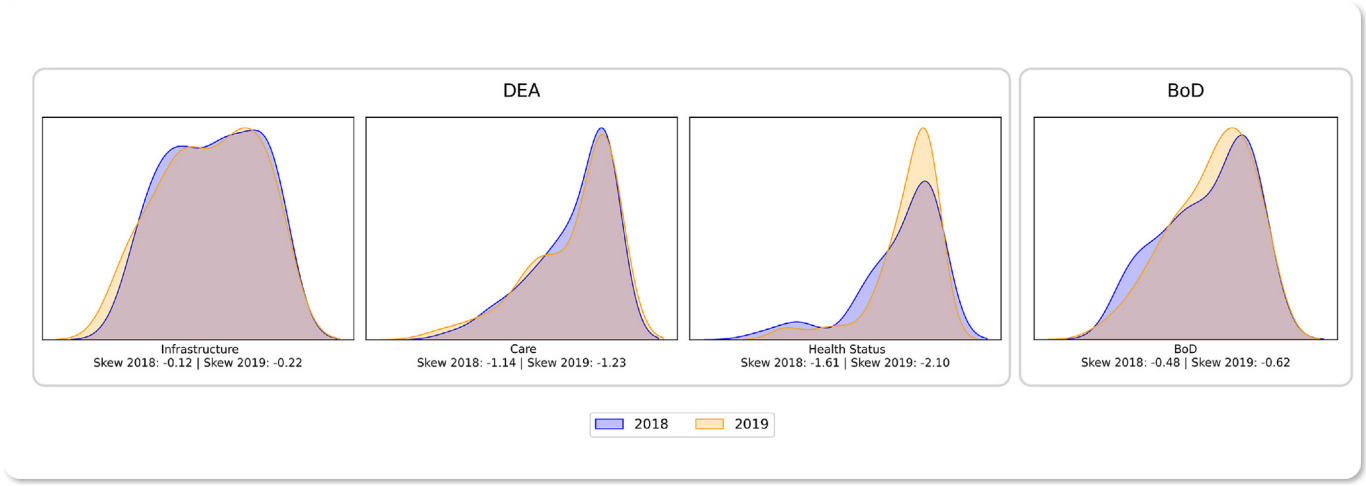


Fig. 10. Distribution of the dimensions and BoD composite indicator.

CRediT authorship contribution statement

André Gomes Coimbra: Writing – original draft. **Otil C.D. dos Santos:** Writing – original draft. **Angélica C.G. Santos:** Writing – original draft. **João B. Mendes:** Writing – review & editing. **Marcos F.S.V. D'Angelo:** Writing – review & editing, Resources, Project administration. **Matheus P. Libório:** Writing – original draft, Supervision. **Reginaldo M. Macedo:** Writing – review & editing. **Elisa Fusco:** Writing – original draft, Supervision. **Petr Ekel:** Writing – review & editing.

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Data availability

I have shared the link to my data/code at the Attach File step

Further reading

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