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The biopsychological indicators of age significantly influence the severity of COVID-19

Tatiana N. Berezina^{1,*}, Stanislav A. Rybtsov²

¹ Doctor of Psychology, Professor, Moscow State University of Psychology and Education, 123290, Moscow, Russia; Shelepikhinskaya Naberezhnaya, 2A/1. Office 207;

² PhD in Genetics, Senior Fellow, Centre for Regenerative Medicine, Institute for regeneration and repair, University of Edinburgh. United Kingdom.

* Corresponding author: tanberez@mail.ru



Московский
Государственный
Психолого-Педагогический
Университет



Centre for
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Research Objectives. To investigate the effect of biological and psychological age on the likelihood of infection and the severity of COVID-19.

Highlights

- During the second half of 2020 in Russian Federation, the number of COVID-19 cases reached 31% in the group of working people.
- The awareness of the representatives of the risk group about the possible consequences of infection prompted them to observe the quarantine rules 1.6 times stricter than the group of working individuals.
- Compliance with the quarantine rules significantly reduces the likelihood of illness. No cases were found in the risk group (0%).
- An increase in the relative biological age of an individual compared with the expected biological age significantly augmented the risk of developing complications of the disease ($P < 0.05$) and the risk of death ($p < 0.001$).
- A decrease in the relative psychological age in comparison with the calendar age raises the tendency to be infected ($p = 0.06$) and sharply increases of death risk of infected persons ($p < 0.001$).
- A rise of the relative biological age and a decline of the psychological one is the most dangerous scenario for the development of a severe COVID-19.

Biological age testing

Epigenetic age clock

Histone Modification
DNA modification
Telomere length
regulation

Immunological Age

Blood factors
Immune reaction

Reparation -
regeneration age

Metabolic age

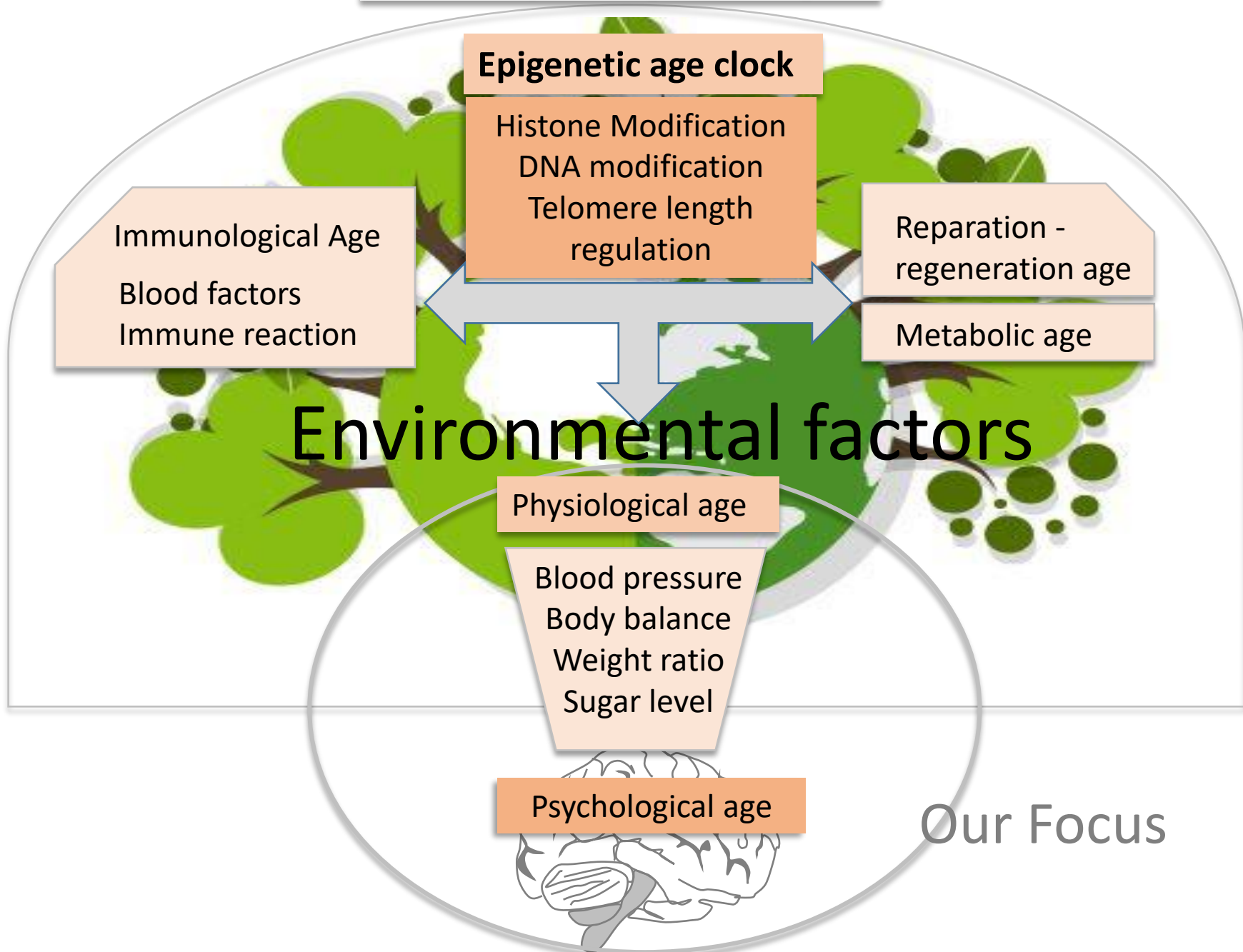
Environmental factors

Physiological age

Blood pressure
Body balance
Weight ratio
Sugar level

Psychological age

Our Focus



Background

Age is the main risk factor for the development of severe forms of virus infection.

Calendar age as risk factor.

Older adults are at higher risk of serious illness and COVID-19 associated death than younger adults (including hospitalisation, admission to the intensive care unit (ICU) and death): Research in the Chinese population (Liu et al 2020) ; Research in USA (Bialek et al.,2020).

Biological age.

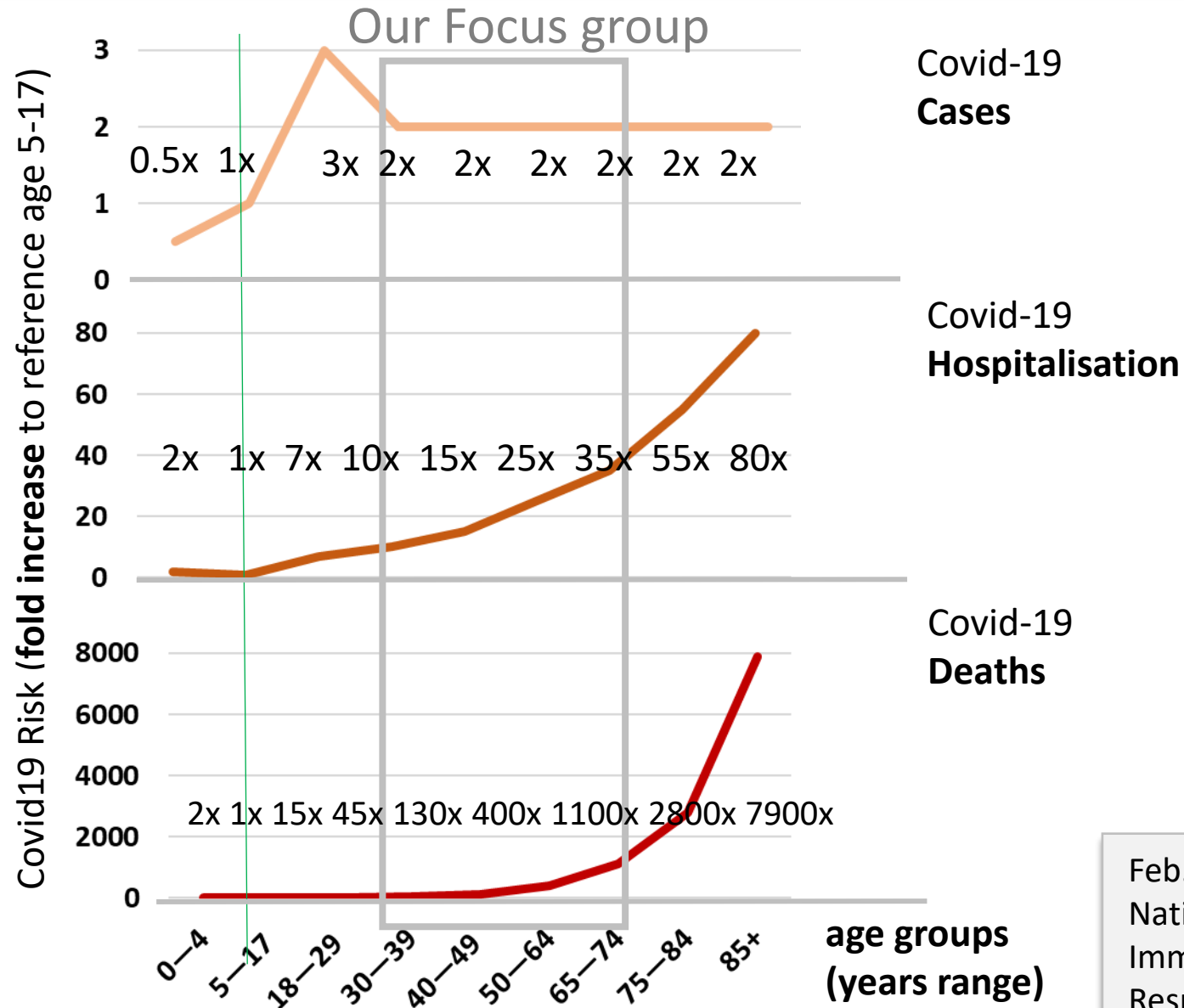
Accelerated biological aging 10-14 years before the start of the pandemic influenced the risk of COVID-19 infection and mortality. Study in the USA (Chia-Ling Kuo et al 2020).

Psychological age.

No studies of the relationship between Psychological age and the risk of severe form of COVID-19 development have been carried out.

However, one study on the impact of the consequences of the COVID-19 pandemic on the subjective perception of time has been found (Maffoni et al, 2020)

Age-related Risks of Covid-19 (Cases, Hospitalisation and Death). Shown as relative increase to reference age group (5 - 17 years old) – indicated by green line



Feb. 18, 2021
 National Center for
 Immunization and
 Respiratory Diseases
 (NCIRD), USA.

Methods

- **Biological Age (BA)** is assessed by measuring indicators of the cardiovascular system, respiratory system, musculoskeletal system and balance system, and metabolic indicator (body weight), as well as psychological indicators (including subjective health and scores of disease severity).(Calculation according to V.P. Voitenko and methods developed in-house: Berezina et al., 2020, 2021).
- **Relative Biological Age index (RBA)**. The difference between the biological age and the expected (statistical) biological age (BA - EBA).
- Self-assessment of personal (**psychological**) **age (PA)**, scale from 0 to 100, according to K.A. Abulkhanova and T.N., Berezina et al.2020.
- **Index of Relative Psychological Aging (RPA)**: psychological age - calendar age (PA - CA).
- **Quarantine compliance scale**. 0 points - did not comply at all. 1 point - minimum compliance. 2 points - met the basic requirements. 3 points - complied with all the requirements, 4 points - complete self-isolation.

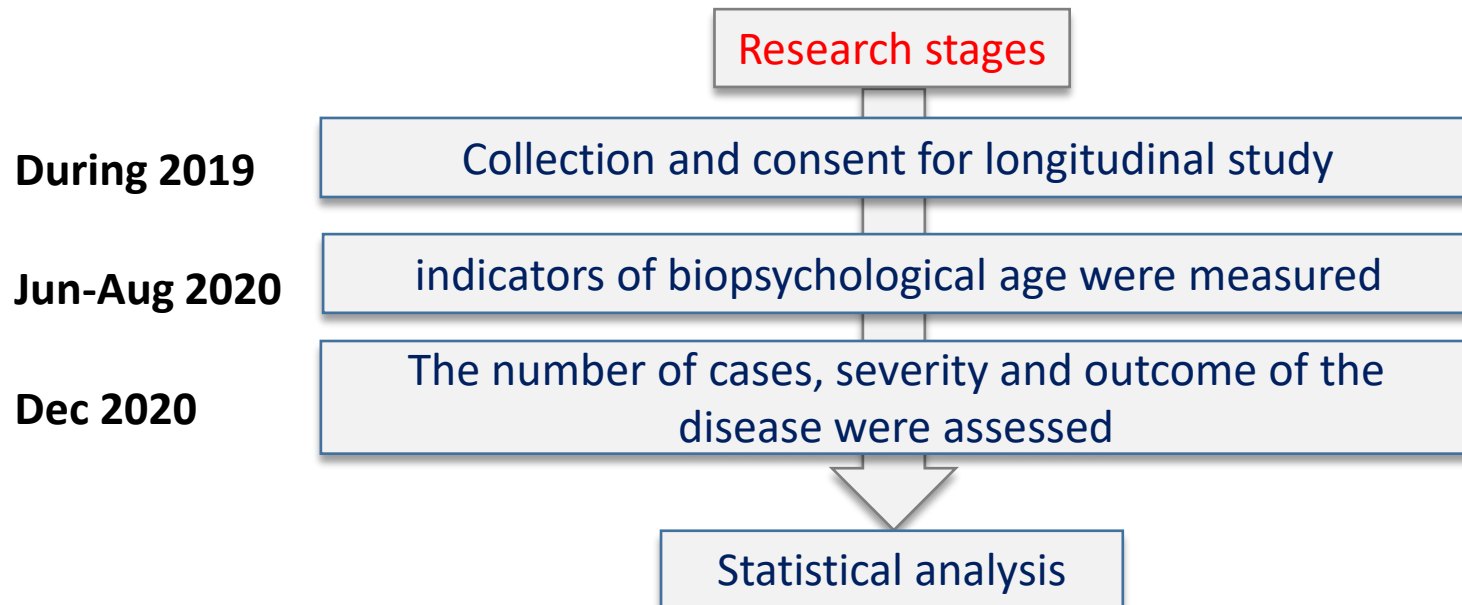
Statistical Analysis:

1. One Way Analysis of Variance (ANOVA),
2. Regression analysis (linear regression).

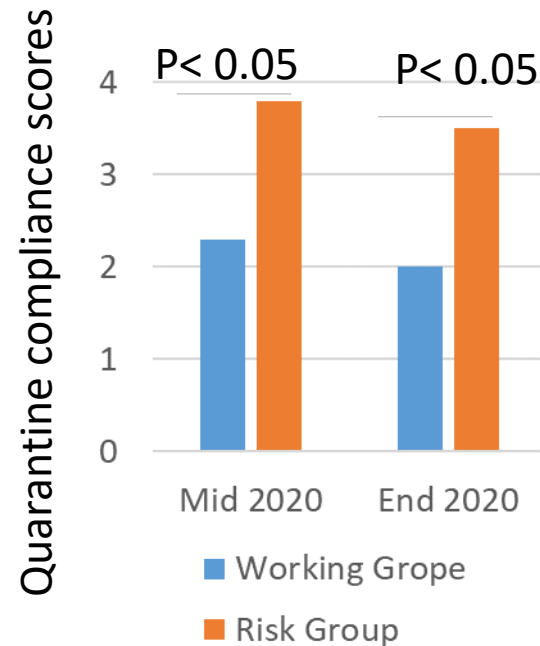
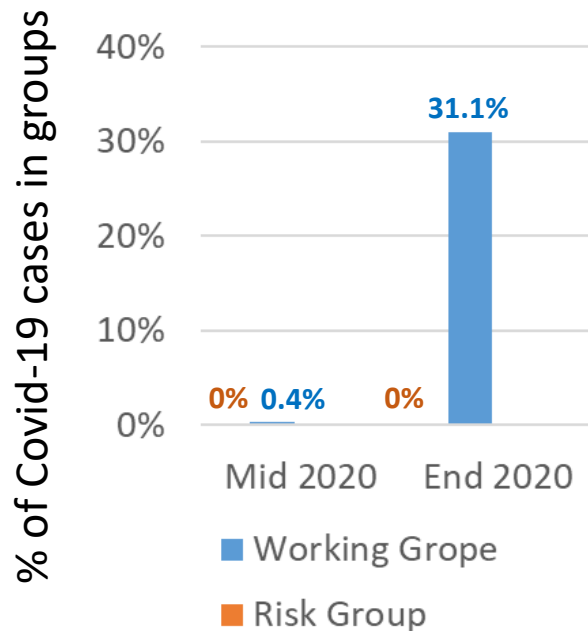
Samples

447 people (306 women) aged 35-70 were involved in a longitudinal study;

- 1) working adults - 239 people (155 women). Average age: women 47.7; men - 51.9, Survey was carried out at the place of work or study;
- 2) Risk group (retirees with chronic diseases) - 208 people (151 women). Average age: women 64.7; men - 66.8. The survey was carried out on the basis of a medical center.



Compliance with quarantine rules significantly reduces the risk of infection



During the second half of 2020, 31% of the group of “working adults” group fell ill. Nobody from the group of retirees got sick - they observed quarantine rules.

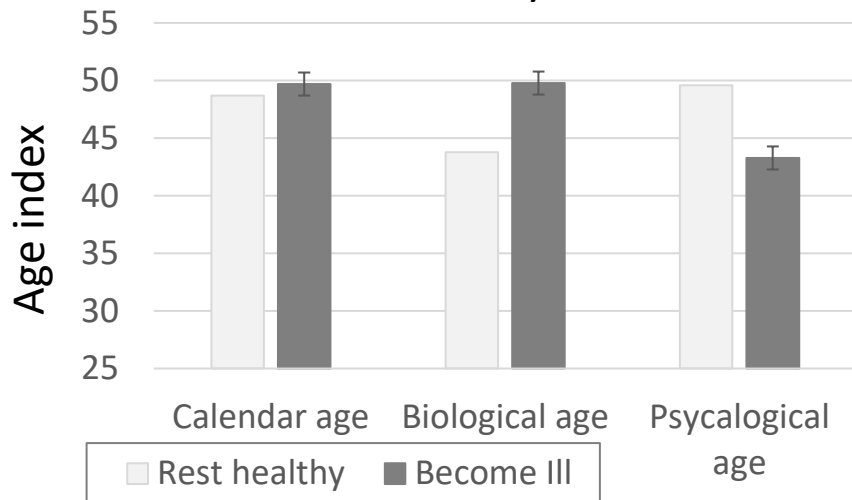
The number of cases, the severity of the disease and compliance with quarantine rules in the middle and end of 2020

	Mid 2020						End 2020					
	Disease severity (% by group)					Quarantine compliance (scores)	Disease severity (% by group)					Quarantine compliance (scores)
	0	1	2	3	4		0	1	2	3	4	
Working group	99,6%	0%	0,4%	0%	0%	2,3*	69%	12.5%	12,5%	4%	2%	2,0*
Risk group	100%	0%	0%	0%	0%	3,8*	100%	0%	0%	0%	0%	3,5*

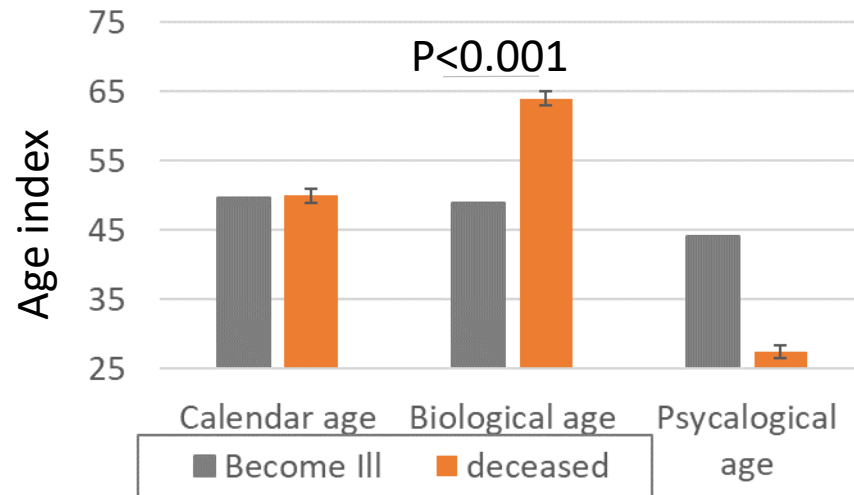
Comparison of age indices and disease severity

Absolute

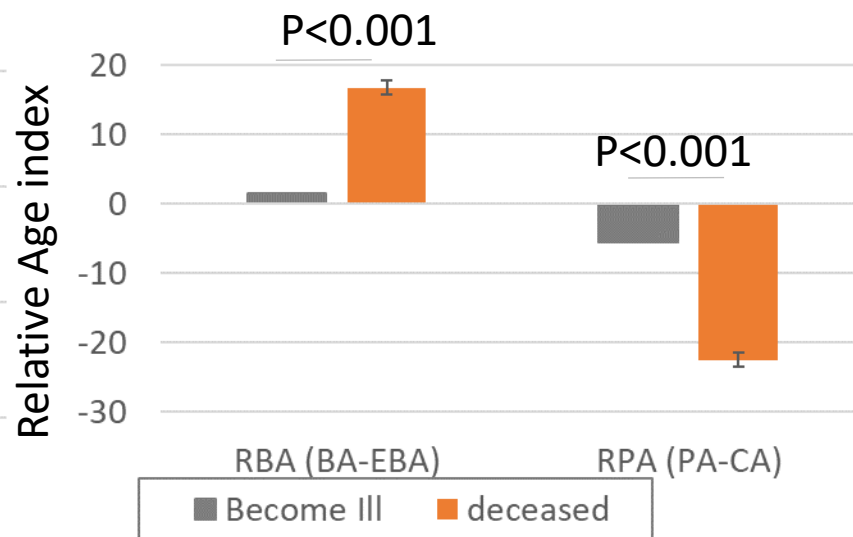
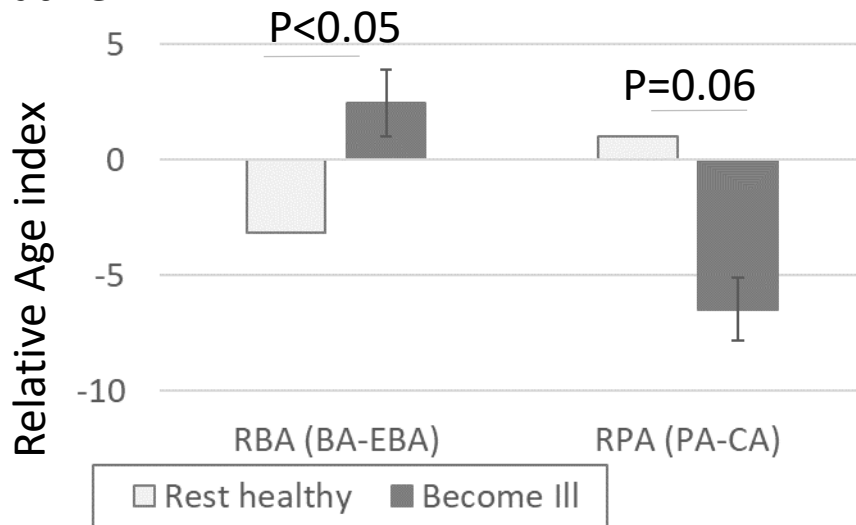
For healthy VS sick



For sick VS deceased



Relative

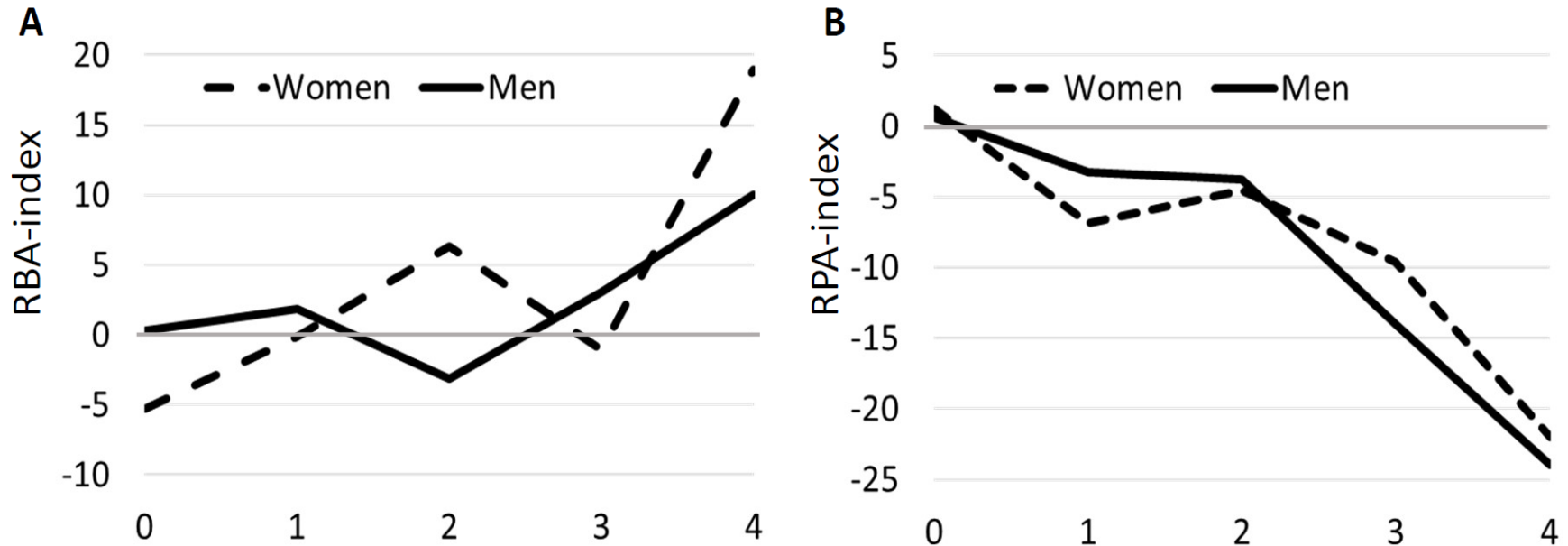


Influence of age indicators on the risk of infection and the probability of death

	Influence on the risk of infection				Influence on the probability of death			
	Average for healthy	Average for the sick	F	p	Average for the sick	Average for the deceased	F	p
Calendar age	48.7	49.7	1.2901	0.12096	49.7	50.0	1.4414	0.13389
Biological age	43.8	49.8	1.1187	0.29346	49.0	64.0	3.0392	0.00045
RBA index	-3.18	2.43	1.4450	0.04574	1.60	16.75	7.9607	0.00000
Psychological age	49.6	43.3	1.0981	0.33131	44.2	27.5	0.29957	0.99495
RPA index	0.99	-6.47	1.3594	0.05954	-5.56	-22.50	4.8475	0.00001

Relative indicators (RBA, RPA), showing how much a person is older or younger than their age standard. These indicators had a particularly strong influence on the severity of the disease.

Dynamics of the RBA - relative biological aging index (A) and RPA -relative psychological aging index (B) in comparison to the severity of the disease in men and women (working group).



(A) - An increase in the RBA index elevates the risk of severe forms of COVID-19, both in men ($F = 1.7104$, $p = 0.17150$) and in women ($F = 1.980$, $p = 0.002$). (B) While, Better alignment of the RPA index of with calendar age, on the contrary, reduces the risk of severe forms of COVID-19, both in men ($F = 2.222$, $p = 0.007$) and in women ($F = 1.837$, $p = 0.004$).

Linear predictive model for predicting the risk of severe forms of COVID-19 using calculated indices of relative biological and relative psychological ages

$$\text{Severe COVID-19 Risk} = 0.32 + 0.01 * \text{RBA index} - 0.003 * \text{RPA index}$$

All addends are significant ($p < 0.01$). The model describes empirical data with validity $F(2,236) = 13.137$, $p < 0.001$, $R = 0.316$.

The model can predict the risks of severe COVID-19. It can be implemented both for further clinical trials on an expanded sample and for smartphone application development for individual use

Conclusions

1. Compliance with quarantine rules is an effective way to prevent COVID-19 spread. Not a single case of COVID-19 infection was detected in the risk group in Russia (retirees with severe chronic diseases) whose representatives observed strict self-isolation measures. In the group of working adults, the disease was registered in 31% of the surveyed (2% of deaths) in 2020.

2. The probability of contracting COVID-19 in working adults in Russia aged 35-70 years was most influenced by the individual relative biological age: the higher the RBA index, the higher the risk of infection ($p = 0.05$), and the probability of death ($p < 0.001$). The relative psychological age had an inverse effect on the risk of infection: the higher the RPA index, the lower the risk of infection ($p = 0.06$) and the risk of death ($p < 0.001$). Calendar age also increased the risk of infection and the risk of death at a trend level below the validity level.

3. The most dangerous is the combination of an increase of the RBA index and an underestimation of the RPA index. In this case the risk of severe forms of the disease increases, up to a lethal outcome.

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Dr Balan I. University of North Carolina, USA
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