THE POPULATION TYPOLOGY OF CONSPIRACY BELIEFS ABOUT SARS-COV-2 ORIGIN IN RUSSIA BASED ON PREDICTIVE MODELLING OF COMET-G STUDY DATA: INCOHERENT ATTITUDE INDICATOR AS A PREDISPOSING FACTOR FOR DEVELOPING MENTAL DISTURBANCES

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SUMMARY

Background: *We examined the prevalence and spread of conspiracy beliefs about the origins of the COVID-19 pandemic among representatives of the Russian population. Our study aimed to identify belief clusters and develop predictive models to understand the factors that influence conspiracy beliefs, particularly in the context of how they might evolve in response to socio-political events and cause mental disturbances, thus in relation to specific pathways of the infodemic and psychodemic waves that spread among vulnerable population groups.*

Methods: *Data respondents to the international COMET-G study living in Russia during pandemic period (n=7,777) were analyzed using descriptive statistics, K-means clustering, and various machine learning models, including gradient boosting. We identified distinct populations depending on predominant beliefs about COVID-19 pandemic origins, and applied game theory (Shapely additive explanations) to determine the most influential variables in predicting cluster membership.*

Results: *Four distinct belief clusters emerged, which we designate as Naturalists, Conspiracists, COVID-Sceptics, and the Incoherent Attitude groups. The Incoherent Attitude cluster constituted 20.8% of the sample, and was particularly associated with mental health signs such as sleep disturbances and the use of psychotropic medications. Internet use and mental health-related factors, as well as the respondents' education level, were key predictors of mental disturbances with mediating effects of the conspiracy views across all clusters. Conspiracy beliefs about COVID-19 origin were highly fluid/variable, often being shaped by external sociopolitical factors rather than objective health data.*

Conclusions: *The cluster with Incoherent Attitude regarding COVID-pandemic origins, which had an association with psychoticism, showed a greater predisposition for mental health problems, than did the Conspiracist, Naturalist and Sceptic clusters. We suppose that underlying psychoticism bears a relation to their sleep problems and resorting to use of psychotropic medications. These results emphasizes the global health need for implementing target-focused and selective strategies that address public misinformation and promote the adoption of critical thinking skills to mitigate the impact of conspiracy theories, considering the factors of education level and pre-existing mental disorders.*

Key words: *: conspiracy beliefs – COMET-G study – COVID-19 – incoherent attitude - internet use - mental health – psychoticism – scepticism - sleep disturbances – vulnerable population groups*

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INTRODUCTION

The SARS-Cov-2 (COVID-19) coronavirus pandemic has become a test for humanity on a scale unprecedented perhaps since the Spanish Influenza or HIV pandemics. The initial spreading of SARS-Cov-2 was associated with a high degree of uncertainty regarding its origins, mode of transmission, and health risks of the infection. The very first months of the pandemic saw an avalanche-like growth in internet search queries about the origin of the coronavirus, including a significant proportion of queries related to conspiracy theories.

(Rovetta 2021). A large body of research has indicated an association between belief in conspiracy theories and refusal to comply with protective measures such as social isolation (Al-Qudah et al. 2022, Haakonsen & Furnham 2022, Hartmann & Muller 2022, Hughes et al. 2022, Kowalski et al. 2020, Lo Moro et al. 2022, Pavela Banai et al. 2022, Ripp & Roer 2022, Sobol et al. 2022, Soveri et al. 2021, Stasielowicz 2022, van Prooijen et al. 2022), and subsequently with refusal to undergo vaccination (Eshel et al. 2022, Hughes et al. 2022, Hughes & Machan 2021, Iannello et al. 2022, Seddig et al. 2022, Simione et al. 2021). One study showed that belief in conspiracy theories plays a protective role against the development of depressive affect in the face of the pandemic (Fountoulakis et al. 2021).

Indeed, the COVID-19 pandemic and associated syndemics represented "not merely biological phenomena", but were obviously shaped by people's "psychological, social, political and spiritual responses to them", when "even a new normality (pathological normality or normal pathology) associated with COVID-19 pandemic and infodemic (epistemic hypervigilance and mistrust; people also "tend to find someone to blame, stigmatize or demonize") have been reported" across academic literature (Jakovljevic et al. 2020a p. 221, Jakovljevic 2021, p. 462). "As more people have been infected with SARS-Cov-2, the more "whose fault" questions and use of blame in personal posts have been registered", including governments, public institutions, healthcare professionals etc. (Jakovljevic et al. 2020a p. 223, Liao et al. 2020).

Overall, many studies have indicated that there are several narratives for common conspiracy theories about the pandemic, such as a hidden scenario, a conspiracy orchestrated by governments or pharmaceutical companies, escape of a biological weapon, effects of uncontrolled use of 5G technology, or divine punishment (Tsamakis et al. 2022). A recent systematic review summarized the negative consequences of incorrect beliefs at personal, interpersonal, and social levels: refusal of protective behaviors and vaccination, and self-centered and misguided behaviors such as hoarding and pseudoscientific health practices, which are detrimental to psychological wellbeing and can bring negative social consequences such as discrimination and violence (van Mulukom et al. 2022). That review also analyzed risk factors for the emergence of conspiracy theories, with the aim of identifying and monitoring risk groups. This included sociodemographic, psychological, and other factors, but from the perspective of individual trains under separate consideration. However, there have been no published studies designed to enable prediction of the emergence and typology of conspiracy theories based on some set of variables or prevailing factors. The aim of our present work was to identify the risk factors for

the formation of conspiratorial beliefs about the emergence of the coronavirus pandemic, and to assess their predictive power in relation to certain categories of conspiracy theories. For this purpose, we compiled the results of the COMET-G study in the Russian population and analyzed the distribution of responses to items describing opinions regarding the origin of COVID-19. We thereby tested a hypothesis that the study population would contain subgroups of individuals with characteristic attitudes towards the origin of the coronavirus. Based on this clustering, we tested created predictive models of adherence to conspiratorial beliefs about the emergence of the pandemic. Drawing upon, social, environmental, demographic, and anamnestic indicators, we thereby identified predictive factors explaining the type of attitude towards the emergence of the pandemic.

METHODS

The detailed questionnaire description is provided elsewhere (Syunyakov et al. 2022). To answer our research questions, we used two population sets. A subpopulation of participants who had responded during the 10 weeks upon starting the survey beginning (i.e. from April 29 to June 24, 2020, n=7136) served to establish a baseline and evolution of views regarding the SAR-Cov-2 origin, while data from the entire whole population (n=7777) served in our analysis of the relationships between misbeliefs with other variables.

Statistical analyses were performed using TIBCO Statistica software 13.3 and Python (sklearn, xgboost, scipy, numpy libraries). First, we evaluated the study population by means of descriptive statistics, with categorical variables described as absolute and relative frequencies and continuous variables as means and standard deviations. Second, we conducted k-means clustering of items J1-J7 of the questionnaire to determine each respondent's cluster membership (J1 "Do you believe that the COVID-19 vaccine was ready even before the virus broke out and they conceal it from us for the benefit of pharmaceutical companies?", J2 "Do you believe that COVID-19 was created in a laboratory to be used as a biochemical weapon for the extermination of the human population?", J3 "Do you believe that COVID-19 is the result of 5G technology antenna?", J4 "Do you believe that COVID-19 appeared accidentally from human contact with animals and it was something that generally happens and was generally expected?", J5 "Do you believe that COVID-19 has much lower mortality rate, but there is misinformation and terror-inducing propaganda?", J6 "Do you believe that COVID-19 is a creation of the world's powerful leaders to create a global economic crisis?", J7 "Do you believe that COVID-19 is a sign of divine power to destroy our planet?").

Using a predefined workflow in Python, all independent continuous and ordinal variables were normalized and centered on a scale from -1 to +1 during preprocessing, and the 20 most influential variables based on the information gain criteria were selected to enter the learner to predict cluster membership. We split the data into 70% training and 30% testing sets using stratified random sampling with 20 repeat/train cycles. To produce a prediction model, we compared a standard set of methods for predictive models: Decision Tree (from `sklearn.tree`), Random Forest (from `sklearn.ensemble`), Extreme Gradient Boosting Random Forest (XGBoost RF, from `xgboost`), Support Vector Machine (SVM, from `sklearn.svm`), Logistic Regression (from `sklearn.linear_model`), Naive Bayes (from `sklearn.naive_bayes`), Extreme Gradient Boosting (XGBoost, from `xgboost`), and Gradient Boosting (from `sklearn.ensemble`). The optimal model was chosen based on the F1 parameter results (a weighted harmonic mean of precision and recall) averaged across all clusters.

Finally, to explain which variables most contributed to each specific cluster, we calculated the predictor's SHapley Additive Explanations values (SHAP values) using the `shap` library. These values deriving from game theory represent the impact of each variable on the model output. We then visualized 15 of the 20 most influential variables using bee swarm plots.

RESULTS

We present the distributions of J1-J7 responses by study period and corresponding subpopulation sizes in Figure 1. The number of participants was highest in the first two weeks of the survey (n=3104 and n=958, respectively). Between weeks 3 and 10, the number of participants decreased and fluctuated over time ranging from n=105 to n=640, while enrollment rates were rather low in the period extending from week 11, making difficult a reliable analysis. The responses to J items in the questionnaire were also unevenly distributed over time. The distribution of responses registered in week 6 of the survey (n=532) and in weeks 13 to 27 of the survey (n=63) shows significant differences from responses at other time points. For example, the proportion of "I don't believe it at all" responses during these periods was lowest for question J4 and highest for all other questions (J1, J2, J3, J5 and J6) (Table 1).

To assess the biasing effect of small samples on the distribution of survey results, we created and evaluated funnel plots of the deviation of the proportions of respondents who answered "I don't think so at all" as a function of the size of the subpopulation in each time-period (Figure 2). All funnel charts passed the test for asymmetry, indicating minimal bias in relation to size of the subsample. This indicates a low probability that the changes in response rates observed in week 6 were due to an insufficient number of respondents.
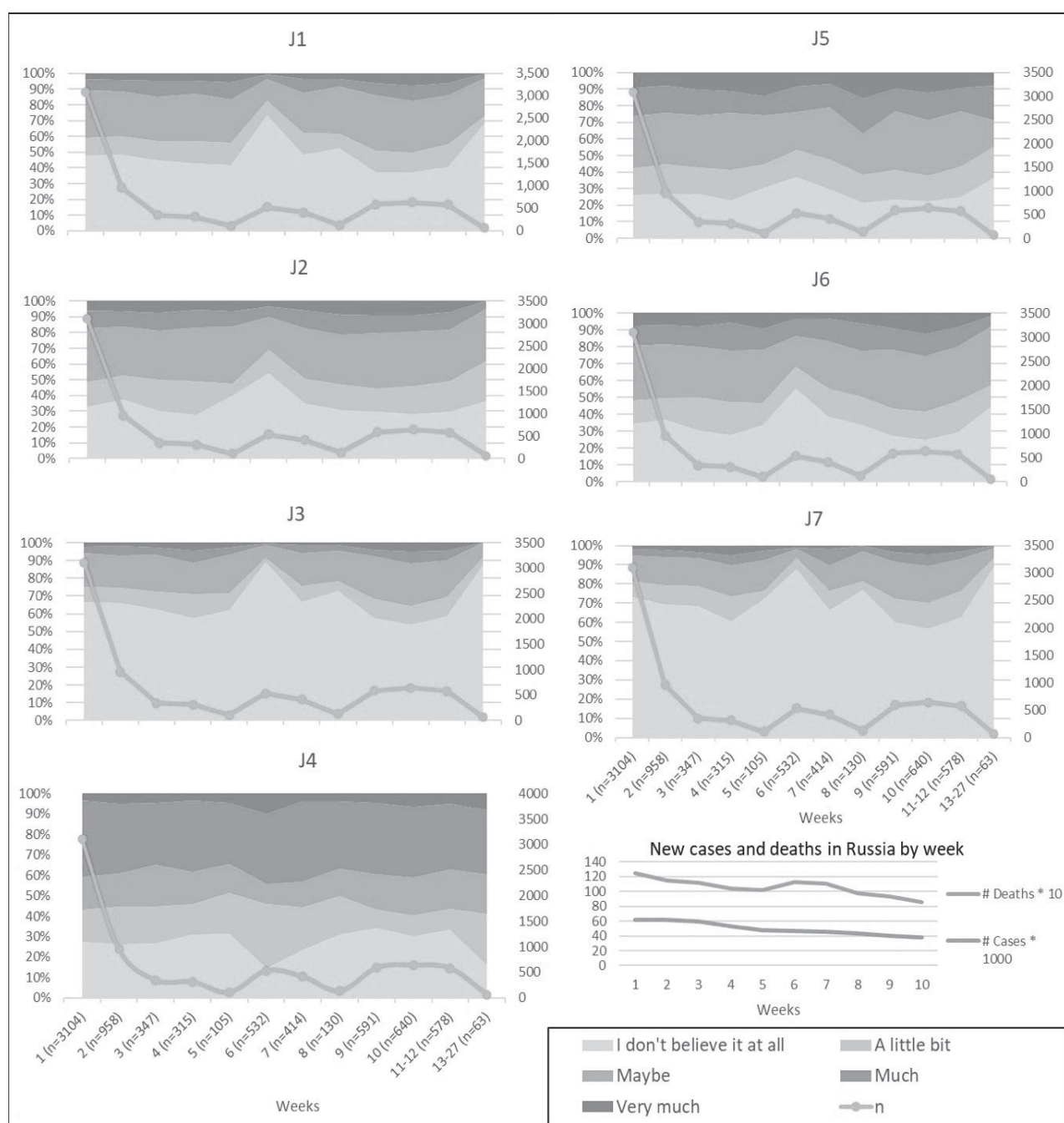
The overall proportions of respondents who answered 'I don't believe it at all' to questionnaire items assessing their opinion on the incidence of new coronavirus infection varied from question to question (J1 47.4%, J2 33.78%, J3 65.46%, J4 27.43%, J5 26.53%, J6 34.24%, and J7 69.65%), thus comprising up to two-thirds when asked about the emergence due to 5G technology (J3) or divine will (J7). The smallest proportions of respondents (about a quarter) disagreed that the virus had a natural origin (J4) and questioned the reliability of information available on the internet (J5).

Population groups by their affinity to conspiracy theories related to COVID's origin

K-means clustering was performed to identify distinct population groups based on their views on conspiracy theories related to the pandemic origin beliefs (COVID origin belief groups). Overall, we chose four clusters to distinguish unique subsets of participants based on J1-J7 responses. The mean profiles of these clusters on J1-J7 items are depicted in Figure 3. Based on these profiles, we designated Cluster 1 as "Conspiracists" (n=1486, 19.1%), Cluster 2 as "COVID-sceptics" (n=2593, 33.3%), Cluster 3 as "Naturalists" (n=2080, 26.7%), and Cluster 4 as "Incoherent Attitude" (inconsistent, ambivalent) (n=1618, 20.8%).

COVID origin belief groups prediction

We depict the best predictors for COVID origin belief groups sorted by an information gain criteria values in Table 2. According to the information gain criteria, the top 20 variables (in descending order) associated with cluster membership were: K2 (Misinformation on the internet about COVID-19), L3 (Use of sleeping pills), L4 (Having 'trapped' dreams in the last 3 weeks), K1 (Worry about COVID-19 information on the internet), O13 (Lifetime suicide attempts), P1 (Changes in spirituality or religiousness), M6 (Increased use of illegal substances during isolation), K4 (Usage of social media during isolation), O11 (Changes in suicidality), D3 (Following WHO precautions to prevent virus spread), A9 (Employment status), A6 (Number of children), H3 (Increased frequency and intensity of physical workouts during lockdown), A7 (Education level), D2 (Being locked up in the house), D4 (Sufficiency of information about preventive measures), C4 (Fear of social rejection after contracting the coronavirus), A4 (Marital status), I3 (General behavior during lockdown), O12 (Lifetime self-harm). These variables were entered the model pipeline to predict cluster membership.

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Note: This figure illustrates the weekly distribution of responses to the questions on the key conspiracy-related statements (J1-J7) about COVID-19 pandemic and SARS-CoV-2 infection, and confront the identified trends with the number of new cases incidence and death rates indicators registered in Russia during this period.

Variables of the COMET-G study protocol: *J1: "Do you believe that the COVID-19 vaccine was ready even before the virus broke out and they conceal it from us for the benefit of pharmaceutical companies?"; J2: "Do you believe that COVID-19 was created in a laboratory to be used as a biochemical weapon for the extermination of the human population?"; J3: "Do you believe that COVID-19 is the result of 5G technology antenna?"; J4: "Do you believe that COVID-19 appeared accidentally from human contact with animals and it was something that generally happens and was generally expected?"; J5: "Do you believe that COVID-19 has much lower mortality rate but there is misinformation and terror-inducing propaganda?"; J6: "Do you believe that COVID-19 is a creation of the world's powerful leaders to create a global economic crisis?"; J7: "Do you believe that COVID-19 is a sign of divine power to destroy our planet?" The shaded areas represent different levels of agreement with each statement, ranging from "I don't believe it at all" to "Very much," while the line graph shows the corresponding weekly data on new cases and deaths.*

Figure 1. Distribution of responses related to the COVID-19 pandemic and SARS-CoV-2 origin-associated beliefs over time period in connection with the indicators of the new cases incidence and death rates in the Russian Federation

Table 1. Socio-demographic characteristics of the Russian population sample of the COMET-G study respondents

| Variable / category	Week 1-10 subsample (n=7136)	Overall (N=7777)
A1. Gender		
Female	4401 (61.7%)	4736 (60.9%)
Male	2547 (35.7%)	2836 (36.5%)
Other	188 (2.63%)	205 (2.6%)
Age		
Mean (SD)	33.2 (12.1)	33.0 (11.9)
Range	18.0-91.0	18.0-91.0
A3. Residence		
Capital City	1059 (14.8%)	1144 (14.7%)
City > 1 million population	2192 (30.7%)	2318 (29.8%)
City (100.000-1 million population)	1897 (26.6%)	2082 (26.8%)
Town (20.000-100.000 inhabitants)	866 (12.1%)	977 (12.6%)
Town (<20.000 inhabitants)	302 (4.23%)	329 (4.2%)
Rural area – Village	820 (11.5%)	927 (11.9%)
A4. Marital status		
Divorced (or estranged)	568 (7.96%)	595 (7.7%)
Live with someone without an official relationship	789 (11.1%)	863 (11.1%)
Married (or in a civil partnership)	2974 (41.7%)	3231 (41.5%)
Other	645 (9.04%)	702 (9.0%)
Single	2059 (28.9%)	2278 (29.3%)
Widower	101 (1.42%)	108 (1.4%)
A5. Number of people in the household		
Alone	989 (13.9%)	1082 (13.9%)
2	2202 (30.9%)	2352 (30.2%)
3	1791 (25.1%)	1969 (25.3%)
4	1372 (19.2%)	1516 (19.5%)
5+	782 (11.0%)	858 (11.0%)
A6. Number of children		
0	3653 (51.2%)	4000 (51.4%)
1	1686 (23.6%)	1824 (23.5%)
2	1363 (19.1%)	1471 (18.9%)
3	308 (4.3%)	348 (4.5%)
4	126 (1.8%)	134 (1.7%)
A7. Education		
Basic school	597 (8.37%)	701 (9.0%)
High school	2550 (35.7%)	2815 (36.2%)
Bachelor's degree	1261 (17.7%)	1377 (17.7%)
Master's degree	2419 (33.9%)	2549 (32.8%)
Scientific degree	309 (4.33%)	335 (4.3%)
A9. Employment		
Civil	1747 (24.5%)	1889 (24.3%)
Private	1642 (23.0%)	1781 (22.9%)
Self-employed	565 (7.92%)	612 (7.9%)
Student	1078 (15.1%)	1166 (15.0%)
Allowance due to health condition	61 (0.85%)	68 (0.9%)
Disability pension	44 (0.62%)	49 (0.6%)
Housekeeper	273 (3.83%)	300 (3.9%)
Not working by choice	89 (1.25%)	105 (1.4%)
Retired	251 (3.52%)	272 (3.5%)
Unemployed	770 (10.8%)	858 (11.0%)
Other	616 (8.63%)	677 (8.7%)
A11. Work during lockdown		
No	3228 (45.2%)	3535 (45.5%)
Yes	3908 (54.8%)	4242 (54.5%)
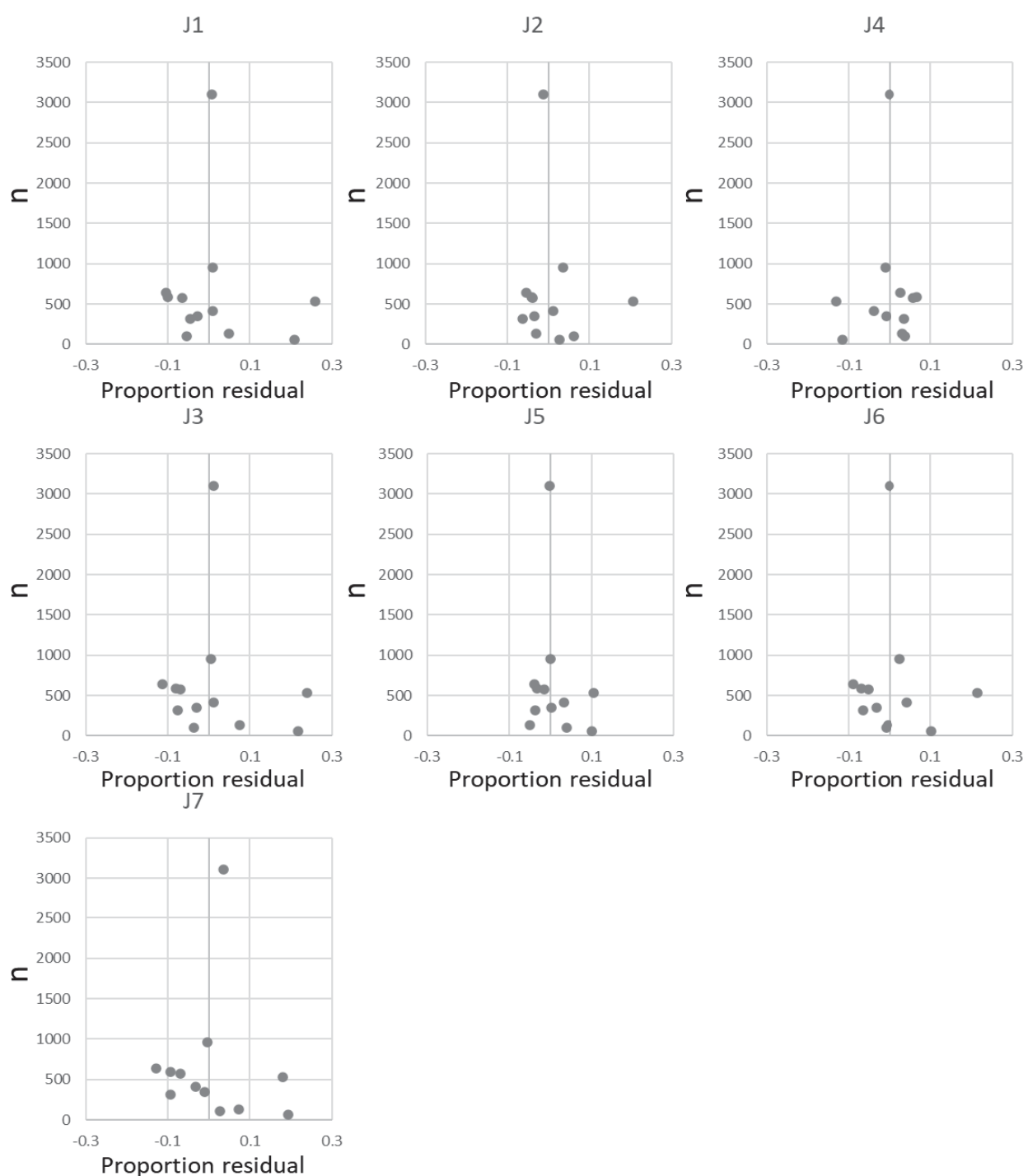
Figure 2. Funnel plots describing the proportions of residuals of the seven COMET_G study protocol questionnaire items about common misbeliefs related to the COVID-19 pandemic and SARS-CoV-2 infection origin, presented with the weekly numbers of participants

Among the evaluated models, based on the average F1 value for all predicted categories, we selected the Gradient Boosting (Scikit-learn) model, since it demonstrated the best overall performance in balancing accuracy and minimizing misclassifications. The best model achieved correct classification for 3454 (44.4%) of the 7777 total cases. This model allowed for the correct classification of 65.5% of "COVID-sceptics",

followed by 46.7% of the "Incoherent" group (), 30.2% of the "Naturalists" (30.2%), and 24.4% of the "Conspiracists" (Table 3, 4). The latter two groups were misclassified in 47.2% and 31.1% of cases, respectively, as "COVID-sceptics". In the "Naturalists" group, 47.2% were misclassified as "COVID-sceptics", while among "Conspiracists", 29.2% were misclassified as "Naturalists" and 31.1% as "COVID-sceptics".

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Table 2. The list of the best modelling-based predictors that classify the population study groups by the factor of COVID-19 pandemic and SARS-CoV-2 origin-related type of beliefs and presented according to the information gain criterion in descendent order

| No.	Feature	Information Gain	χ^2
1	K2 (Misinformation on the internet about COVID-19)	0.055	340.755
2	L3 (Use of sleeping pills)	0.054	765.506
3	L4 (Having trapped dreams in the last 3 weeks)	0.050	492.172
4	K1 (Worry about COVID-19 information on the internet)	0.044	513.971
5	O13 (Lifetime suicide attempts)	0.025	421.227
6	P1 (Changes in spirituality or religiousness)	0.024	437.628
7	M6 (Increased use of illegal substances during isolation)	0.023	37.475
8	K4 (Usage of social media during isolation)	0.022	53.709
9	O11 (Changes in suicidality)	0.021	25.762
10	D3 (Following WHO precautions to prevent virus spread)	0.020	119.411
11	A9 (Employment status)	0.020	20.963
12	A6 (Number of children)	0.019	165.210
13	H3 (Increased frequency and intensity of physical workouts during lockdown)	0.019	134.538
14	A7 (Education level)	0.019	14.565
15	D2 (Being locked up in the house)	0.019	104.510
16	D4 (Sufficiency of information about preventive measures)	0.019	122.046
17	C4 (Fear of social rejection after contracting the coronavirus)	0.017	216.376
18	A4 (Marital status)	0.017	43.294
19	I3 (General behavior during lockdown)	0.017	81.231
20	O12 (Lifetime self-harm)	0.015	116.865
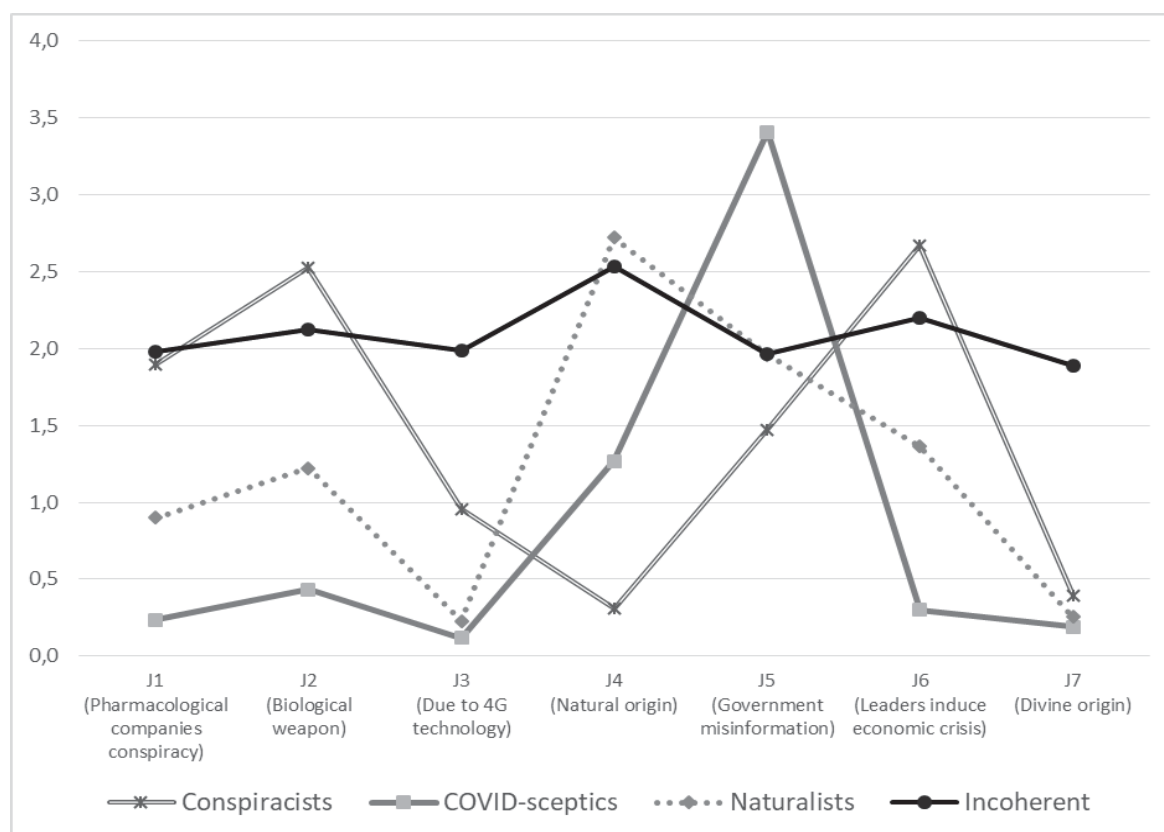
Figure 3. The clusters' mean profiles that describe the respondents' answers to the particukar COMET-G protocol questionnaire items on the common misbeliefs related to the COVID-19 pandemic and SARS-CoV-2 infection origin

Table 3. Key indicators of predictive classification models describing the respondents' clusters based on the COVID-19 pandemic and SARS-CoV-2 origin-related beliefs

Model	F1	AUC	CA	Precision	Recall	MCC
Average acroos the groups						
Gradient boosting (Scitkit-learn)	0.429	0.691	0.444	0.433	0.441	0.231
XGboost	0.412	0.665	0.418	0.411	0.418	0.202
Logistic Regression	0.407	0.681	0.434	0.414	0.434	0.221
XGboost random forest	0.406	0.656	0.420	0.412	0.420	0.199
Random Forest	0.390	0.639	0.398	0.391	0.398	0.172
Tree	0.338	0.562	0.339	0.340	0.339	0.105
SVM	0.276	0.509	0.286	0.329	0.286	0.061
Conspiracists						
Gradient boosting (Scitkit-learn)	0.305	0.679	0.778	0.38	0.255	0.184
Logistic Regression	0.299	0.676	0.783	0.389	0.242	0.185
XGboost	0.285	0.644	0.763	0.336	0.248	0.149
XGboost RF	0.280	0.640	0.770	0.349	0.234	0.154
SVM	0.280	0.516	0.517	0.196	0.492	0.011
Tree	0.263	0.545	0.687	0.240	0.293	0.068
Random Forest	0.260	0.614	0.754	0.305	0.226	0.118
COVID-sceptics						
Logistic Regression	0.561	0.711	0.625	0.46	0.718	0.280
Gradient boosting (Scitkit-learn)	0.555	0.721	0.65	0.481	0.656	0.286
XGboost RF	0.537	0.682	0.626	0.457	0.65	0.249
XGboost	0.522	0.696	0.648	0.477	0.578	0.250
Random Forest	0.500	0.665	0.622	0.447	0.568	0.207
Tree	0.428	0.579	0.609	0.418	0.438	0.131
SVM	0.349	0.615	0.63	0.422	0.297	0.104
Incoherent						
Gradient boosting (Scitkit-learn)	0.499	0.768	0.807	0.544	0.461	0.382
XGboost	0.474	0.741	0.791	0.498	0.452	0.345
Logistic Regression	0.471	0.755	0.785	0.484	0.459	0.336
XGboost RF	0.443	0.724	0.796	0.513	0.39	0.325
Random Forest	0.442	0.720	0.785	0.482	0.408	0.312
Tree	0.350	0.608	0.743	0.369	0.333	0.191
SVM	0.117	0.451	0.772	0.304	0.072	0.054
Naturalists						
XGboost	0.316	0.581	0.635	0.317	0.315	0.067
SVM	0.308	0.439	0.652	0.329	0.290	0.077
Gradient boosting (Sc itkit-learn)	0.307	0.601	0.648	0.324	0.292	0.072
Random Forest	0.305	0.562	0.634	0.310	0.300	0.057
XGboost RF	0.305	0.582	0.648	0.323	0.289	0.071
Tree	0.271	0.518	0.638	0.294	0.252	0.032
Logistic Regression	0.244	0.590	0.674	0.321	0.197	0.054

Note: XGBoost: extreme gradient boosting model;   XGBoost RF: XGBoost random forest model;   Tree: decision tree model; SVM: support vector machine model

Table 4. Confusion matrix presenting the distributions of predicted and actual group memberships across the four identifies population clusters (Naturalists, Incoherent, COVID-Sceptics, and Conspiracists) in the study sample of respondents living in Russia during COVID-19 pandemic (n=7,777)

	Predicted Naturalists	Predicted Incoherent	Predicted COVID-Sceptics	Predicted Conspiracists	Total (Predicted)
Actual Naturalists	30.2% (632)	10.0% (208)	47.2% (985)	12.5% (263)	2080
Actual Incoherent	17.4% (281)	46.7% (754)	24.5% (395)	11.4% (184)	1618
Actual COVID-Sceptics	20.8% (540)	7.8% (202)	65.3% (1694)	6.1% (158)	2593
Actual Conspiracists	29.2% (435)	14.3% (213)	31.1% (463)	25.4% (378)	1486
Total (Actual)	1882	1378	3535	982	7777

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Figure 4. The contribution degree of selective sociodemographic variables into predictive classification modelling describing the overall COVID-19 pandemic-related beliefs across the identified respondents' clusters distribution
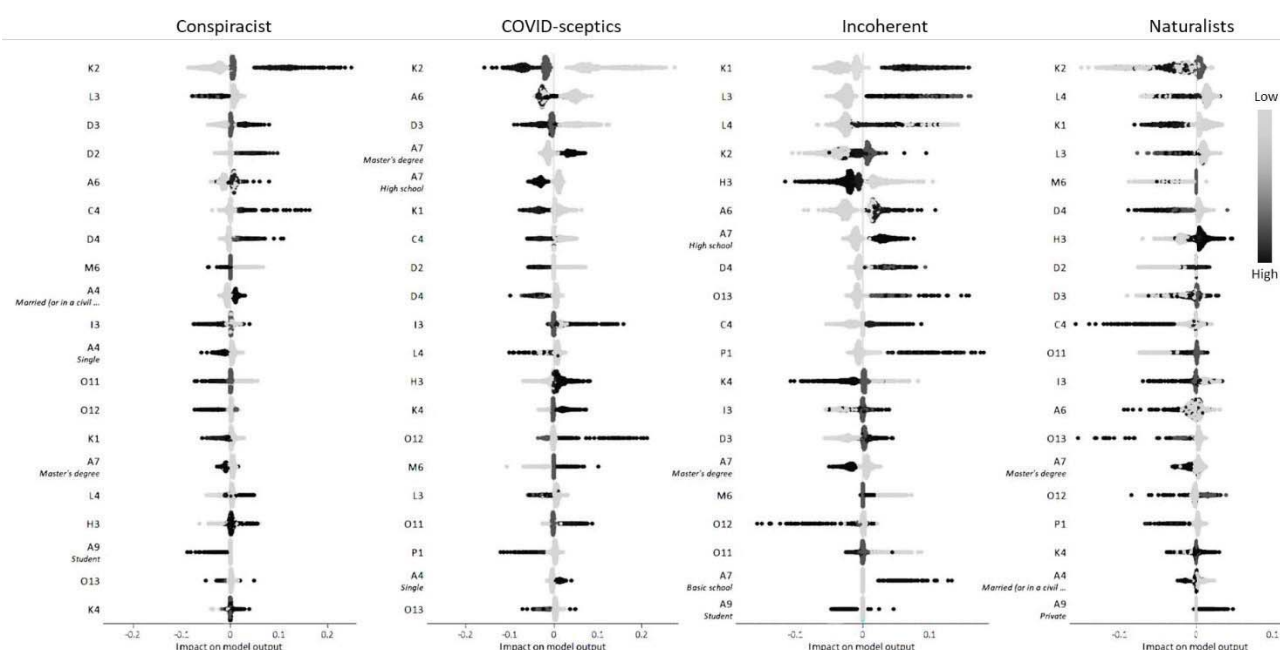
Note: The X-axis represents the impact on the model output, with positive values (right) indicating the factors favoring cluster membership and negative values (left) indicating factors against cluster membership. Darker color shades represent higher variable values, whereas lighter color shades represent lower variable values. Each row corresponds to a different factor, with the distribution of SHAP values demonstrating the variability and strength of that particular factor's influence on the cluster type assignment.

COMET-G study protocol variablea: A4 - marital status,   A6 - number of children,   A7 - education level,   A9 - employment status,   C4 - fear of being ostracized if infected,   D2 - degree of lockdown,   D3 - perception of WHO guidelines,   D4 - perception of sufficiency of information about COVID-19 measures,   H3 - increased frequency and intensity of physical workouts,   I3 - change in body weight,   K1 - concern about COVID-19 information on the internet,   K2 - belief that most internet sources regarding COVID-19 are misleading,   K4 - social media usage increase during lockdown,   L3 - quality of sleep,   L4 - nightmares of being trapped,   M6 - use of illegal substances during lockdown,   O11 - change in suicidality,   O12 - history of self-harm,   O13 - history of suicide attempts,   P1 - change in spirituality/religiousness.

Figure 5. SHAP (SHAPley Additive exPlanations) values illustrating the impact of various factors on the statistical indicators of membership across the four identified COVID-19 pandemic-related beliefs' clusters: Conspiracist, COVID-sceptics, Incoherent, and Naturalists

Based on the gradient boosting modelling of selected features, we present in descending order the importance of predictors in Figure 4, showing major loading from distrust of the internet, and least loading from increased media usage. We depict details of the impacts of individual variables on every specific cluster in the SHAP-plot (Figure 5).

DISCUSSION

We analyzed a large sample (n=7777) of the Russian population in 2020 to characterize common conspiracy theories regarding the origin and consequences of the COVID-19 pandemic. We found that the prevalence and distribution of different perceptions of pandemic emergence was a time-dependent trait that was unrelated to morbidity and mortality rates and probably not attributable to selection bias. These results are consistent with an earlier study tracing the dynamics of the proportion of internet searches for different conspiratorial views in several years preceding and for more than a year after the onset of the pandemic (Rovetta 2021). Most respondents gave intermediate answers to the questions (i.e. neither categorical agreement nor disagreement). Interestingly, in the 6th week of the study there was a shift towards to a relative increase in the number of people who gave negative answers to the items that did not reflect the natural scientific origin of coronavirus, thus indicating a shift towards affirmation of its natural origin. At the same time, the distribution of answers as a function of time did not correlate with the contemporaneous official morbidity and mortality rates, nor were the results influenced by the lower number of responses with time. On the other hand, the abnormal responses peak coincided with the removal of the lockdown and subsequent events in socio-political life in the country.

Our study identified four distinct clusters based on individuals' beliefs regarding the origins of COVID-19 and their related attitudes, which we designated as Naturalists, Conspiracists, COVID-Sceptics, and Incoherent groups. Predictive modelling showed that these clusters are not entirely distinct. Instead, there was a continuum between these groups, with significant overlap in beliefs and attitudes. This mixity suggests that individuals often hold a combination of beliefs that can place them between categories, which makes their strict classification a challenging matter.

COVID-sceptics were the largest group, accounting for one third of all cases (n=2593, 33.3%) and likewise the most distinct group, with 65.3% (1694 individuals) being correctly classified by our best model. However, 20.8% (540 individuals) of the COVID-sceptics were misclassified as Naturalists, which may reflect the overlap in their scepticism and cautious acceptance of the pandemic's severity or natural origins. COVID-sceptics tended to have doubts about the severity and origins of COVID-19, but expressed stronger beliefs that the dangers of the pandemic were overstated (J5). Although the Sceptics share a degree of distrust in official narratives, this was generally less extreme than that observed in Conspiracists. COVID-sceptics distrust authority and official information (D3), and are apt to believe readily in misleading online narratives (K2). They tend to have been less affected by changes in mental health, such as suicidality (O11) or self-harm (O12), but showed a mild association with increase in substance use during lockdown (M6). They were generally less concerned about online information (K1) and had varying experiences with lockdown measures (D2). Family-oriented concerns, represented by having more children (A6), appear to be an important factor for this group.

Following the COVID-sceptics, the Incoherent group (n=1618, 20.8%) was somewhat distinct, with 46.7% (754 individuals) being correctly identified through the model. Members of this group held a pronounced conviction in bizarre and seemingly contradictory beliefs, such as the idea that 5G technology causes COVID-19 (J3), or that the pandemic is a result of divine intervention (J7). Moreover, their beliefs were characterized by a disparate mix of all other beliefs, including natural origin, thus not adhering to a single, consistent narrative, but manifesting a cognitive dissonance. Our results indicate that these individuals may have experienced a vulnerability to overload from COVID-19 information in the internet (K1). There was a positive association of being a member of this group and lower education level (A7). Members of the Incoherent group also tended to use hypnotics (L3), experience sleep disturbances (L4), and otherwise show potential vulnerability to mental health challenges (O11, O12, O13). They exhibited relatively low fear of being ostracized if infected (C4), with less consistent changes in their habits during pandemic, like physical activity (H3) and substance use (M6).

Naturalists (n=2080, 26.7%) strongly adhered to the natural origins of COVID-19 (J4), and demonstrated high levels of trust in scientific explanations and public health institutions. Their rejection of conspiracy theories positioned them as the group most aligned with official health recommendations. Indeed, they tended to follow WHO recommendations (D3) and expressed trust in online information about COVID-19 (K2), possibly indicating that they preferred credible sources and evidence-based information. At the same time they exhibited negative associations with signs of mental health problems, like having nightmares (L4) or history of self-harm and suicidal attempts (O12, O13), and demonstrated good resilience in mental health (O11), while maintaining healthy habits like exercise (H3) and balanced eating (I3). They also showed a slight increase in social media use during the lockdown (K4).

Conspiracists (n=1486, 19.1%) exhibited a strong adherence to various conspiracy theories surrounding the

origins and management of the COVID-19 pandemic. This group is characterized by a profound belief that COVID-19 resulted from deliberate actions by powerful entities, including pharmaceutical companies (J1), biological weaponry (J2), and government misinformation (J5). Their deep distrust of official information and health authorities often leads to resistance against public health measures and a propensity to engage with conspiracy content online. Their unwavering conviction in these theories suggests a rigid belief system that significantly influenced their behavior and attitudes toward the pandemic. Conspiracists firmly embraced alternative explanations and distrust authorities (K2, D3), exhibiting a strong belief in misleading online information and a negative view of the WHO. They were prone to experience anxieties, potentially reflected in poorer sleep quality (L3) and possibly a greater frequency of nightmares (L4). They tended to use the internet and social media more (K4) and tended to show a slight increase in substance use (M6). Social factors, like being single (A4), seem to have played a minor role in their profile, and they generally reported less fear of being ostracized if infected (C4).

The Naturalist and Conspiracist groups were less distinct, with substantial misclassification between them and other clusters. Naturalists, while largely aligned with scientific explanations, were often misclassified as COVID-Sceptics (47.2%, 985 individuals). Similarly, Conspiracists showed significant overlap with both COVID-Sceptics and Naturalists, reflecting a blend of scepticism, conspiracy beliefs, and, in some cases, acceptance of natural origins.

These portraits of core aspects of the identified clusters correspond to the results of a number of studies showing that low level of education facilitates the formation of conspiracy ideas (Al-Qudah et al. 2022, Constantinou et al. 2021, Hettich et al. 2022, Rezgale et al. 2022). This scenario is indirectly evidenced by the predictor characteristic of this cluster in the form of their relatively rapid changes in worldview; the interval between the first virus penetration into Russia to the time when an overwhelming majority of respondents had given their answers was not more than three months. That brief interval saw changes in worldview, in particular religiosity, which are otherwise expected to be rather stable. A number of studies have also found a correlation between religiosity and the formation of inadequate religious beliefs (Leibovitz et al. 2021), while other studies have found that conspiracy adherents tend to accept various multiple conspiracy ideas, (De Coninck et al. 2021, Georgiou et al. 2020), which may explain the coexistence of different views in our Incoherent group. Our results are consistent with other studies that have also identified groups of individuals convinced of one or the other variant of COVID-19 origin narratives sceptics (Celia et al. 2022, Zakharova

et al. 2020), indicating that there is a relatively large population group that is vulnerable to such beliefs (Lowicki et al. 2022). It is noteworthy that the present Incoherent group revealed disproportionately high values of predictors reflecting mental health issues , and primarily sleep disturbances, nightmare dreams and fears, and taking psychotropic medications, as compared to the other clusters. These findings may be suggestive of the presence of an underlying psychiatric disorder, which seems in line with numerous studies finding relationship and similarities between belief in conspiracy theories and delusional beliefs (Acar et al. 2022, Ferreira et al. 2022, Kosarkova et al. 2022, Kowalski et al. 2020, Sobol et al. 2022). Further studies are needed to assess whether illogical incoherent responses about the origin of the coronavirus are related to a relatively low level of education and are characterized by an uncritical attitude toward inconsistent responses, or whether inconsistent responses reflect the presence of an underlying psychiatric disorder.

Our most consistent findings are that trust or distrust in information in the internet was the strongest predictor for adherence in all groups. This observation could open up a discussion on the mechanisms for propagation of misinformation spreads in the digital age, particularly in the context of a global crisis, and a renewed consideration of social networks might play a modifying role on the acceptance of official information and formation of conspiracy ideas. This scenario is consistent with the findings of other studies that social networks, rather than official reports, play the most significant role in the formation of conspiracy ideas (Allington et al. 2021).

To address misinformation and build up the trust and credibility to the recommendations given by healthcare institutions or governments (thus, to limit the spread of conspiracy misbeliefs among the representatives of the general population), the elements and principles of affective communication should be applied. These principles in action would help to cope with the conspiracy beliefs spread among people to return them back to the awareness and normal perception of the pandemic context, distracting from the contagious ideas of minorities or majorities of the "moral strangers" and "epistemic strangers" producing distrust and variety of misbeliefs (Jakovljevic 2021, p. 465, Lolas 2016). However, this should be done not via dictating the rules and violent restrictions affecting people's life quality, causing stress, anxiety and other mental disturbances in them, as well as via ignoring global ethics and human rights, but have to be done via empathetic communication, compassionate understanding of misbeliefs and diversities existed, creating clear and well-elaborated public messages, disseminating original multidisciplinary research data, taking into account the goals and values of every human being, focusing on the person-centred style of conversation, solidarity,

cooperation and partnership, though it requires significant efforts and time resources from mental health professionals (Jakovljevic 2017, 2021, Jakovljevic et al. 2020a,b, Jakovljevic & Tomic 2016). However, there are no obstacles, but just a desire and intention to act, when each of us – a doctor, a health professional, a human - chooses his path to serve for the sake of humanity and a better reality for all of us.

CONCLUSIONS

Our analysis of beliefs about COVID-19 in a large quasi-population study (n=7777) in the Russian Federation found that beliefs about the origins of the pandemic were very fluid, and often evolved in response to external events rather than changing in response to actual morbidity or mortality rates from COVID-19. We saw significant shifts in opinion from week to week, suggesting that external factors may have played a crucial role in shaping public perception in the early days of the pandemic.

Based on their belief in different types of origin of COVID-19, we identified four population groups: Naturalists strongly believed in the natural origin of COVID-19 and showed high trust in scientific explanations and public health institutions. Conspiracists held strongly to various conspiracy theories about COVID-19, while expressing a deep distrust of official narratives and health authorities, COVID-sceptics expressed a high level of scepticism about the severity and origins of COVID-19. without fully endorsing conspiracy theories, and the Incoherent group displayed a mixture of contradictory beliefs, often reflecting cognitive dissonance.

Internet and mental health-related variables and lower education levels were consistently associated with higher susceptibility to conspiracy theories, reflecting the complex and nuanced nature of public beliefs and their intersections with Internet use and mental health factors. The Incoherent group was disproportionately associated with certain specific forms of beliefs (technological or divine influence), a high prevalence of mental health symptoms including sleep problems and nightmares, and present use of psychotropic medications. These results suggest a possible link between conspiracy beliefs and underlying psychiatric disorders, particularly those related to psychoticism.

Present results could inform responses to future crises, calling for a more responsible approach to information dissemination and close collaboration between public health authorities with social media, as well as placing a greater focus on developing critical thinking skills through education to strengthen resilience to misinformation and reduce the risk of mental health problems for vulnerable populations. The fluid nature of beliefs and identified predictors during the early pandemic phase indicates a need for flexible and responsive public health strategies. Tailored communication efforts that consider the nuanced belief systems and cognitive vulnerabilities within the general population are essential. Addressing the specific needs of vulnerable groups, particularly those at risk for mental health problems, seems critically important for preventing the perpetuation of conspiracy theories and improving overall public health outcomes in the face of a public health crisis.

Limitations

Because our quasi-population study is based on results from online questionnaires, the results are susceptible to possible selection bias. Therefore, our results may have limited applicability to the broader population. Furthermore, our use of self-reported data presents a significant limitation, as it can be affected by recall and social desirability biases, potentially affecting its accuracy. Therefore, caution should be exercised when interpreting the study results, as such factors may have influenced the overall conclusions of the study.

References

1. *Acar K, Horntvedt O, Cabrera A, Olsson A, Ingvar M, Lebedev AV, et al.: COVID-19 conspiracy ideation is associated with the delusion proneness trait and resistance to update of beliefs. Sci Rep 2022; 12:10352. doi:10.1038/s41598-022-14071-7*

2. *Al-Qudah MA, Al-Shaikh AF, Hamouri S, Haddad H, AbuRashed S & Zureikat ZA: COVID-19-related conspiracy beliefs and their determinants among 18 to 45 years old: A cross-sectional study. Medicine (Baltimore) 2022; 101:e30836. doi:10.1097/MD.0000000000030836*

3. *Allington D, Duffy B, Wessely S, Dhavan N & Rubin J: Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. Psychol Med 2021; 51:1763-1769. doi:10.1017/S003329172000224X*

4. Celia G, Lausi G, Girelli L, Cavicchiolo E, Limone P, Giannini AM, et al.: COVID-19 related conspiracy beliefs and their relationship with defense strategies, emotions, powerlessness, attitudes, and time perspective. Front Psychol 2022; 13:939615. doi:10.3389/fpsyg.2022.939615

5. Constantinou M, Kagialis A & Karekla M: COVID-19 scientific facts vs. Conspiracy theories: Is science failing to pass its message? Int J Environ Res Public Health 2021; 18. doi:10.3390/ijerph18126343

6. De Coninck D, Frissen T, Matthijs K, d'Haenens L, Lits G, Champagne-Poirier O, et al.: Beliefs in conspiracy theories and misinformation about COVID-19: Comparative perspectives on the role of anxiety, depression and exposure to and trust in information sources. Front Psychol 2021; 12:646394. doi:10.3389/fpsyg.2021.646394

7. Eshel Y, Kimhi S, Marciano H & Adini B: Conspiracy claims and secret intentions as predictors of psychological coping and vaccine uptake during the COVID-19 pandemic. J Psychiatr Res 2022; 151:311-318. doi:10.1016/j.jpsychires.2022.04.042

8. Ferreira S, Campos C, Marinho B, Rocha S, Fonseca-Pedrero E & Barbosa Rocha N: What drives beliefs in COVID-19 conspiracy theories? The role of psychotic-like experiences and confinement-related factors. Soc Sci Med 2022; 292: 114611. doi:10.1016/j.socscimed.2021.114611

9. Fountoulakis KN, Apostolidou MK, Atsiova MB, Filippidou AK, Florou AK, Gousiou DS, et al.: Self-reported changes in anxiety, depression and suicidality during the COVID-19 lockdown in greece. J Affect Disord 2021; 279:624-629. doi:10.1016/j.jad.2020.10.061

10. Georgiou N, Delfabbro P & Balzan R: COVID-19-related conspiracy beliefs and their relationship with perceived stress and pre-existing conspiracy beliefs. Pers Individ Dif 2020; 166:110201. doi:10.1016/j.paid.2020.110201

11. Haakonsen JMF & Furnham A: COVID-19 vaccination: Conspiracy theories, demography, ideology, and personality disorders. Health Psychol, 2022. doi:10.1037/hea0001222

12. Hartmann M & Muller P: Acceptance and adherence to COVID-19 preventive measures are shaped predominantly by conspiracy beliefs, mistrust in science and fear - a comparison of more than 20 psychological variables. Psychol Rep 2022; 332941211073656. doi:10.1177/00332941211073656

13. Hettich N, Beutel ME, Ernst M, Schliessler C, Kampling H, Kruse J, et al.: Conspiracy endorsement and its associations with personality functioning, anxiety, loneliness, and sociodemographic characteristics during the COVID-19 pandemic in a representative sample of the german population. PLoS One 2022; 17:e0263301. doi:10.1371/journal.pone.0263301

14. Hughes JP, Efstratiou A, Komer SR, Baxter LA, Vasiljevic M & Leite AC: The impact of risk perceptions and belief in conspiracy theories on COVID-19 pandemic-related behaviours. PLoS One 2022; 17:e0263716. doi:10.1371/journal.pone.0263716

15. Hughes S & Machan L: It's a conspiracy: COVID-19 conspiracies link to psychopathy, machiavellianism and collective narcissism. Pers Individ Dif 2021; 171:110559. doi:10.1016/j.paid.2020.110559

16. Iannello P, Colautti L, Magenes S, Antonietti A & Cancer A: Black-and-white thinking and conspiracy beliefs prevent parents from vaccinating their children against COVID-19. Appl Cogn Psychol 2022. doi:10.1002/acp.3999

17. Jakovljevic M: Resilience, psychiatry, and religion from public and global mental health From divide to dialogue and cooperation in the search for humanistic self, compassionate society and empathic civilization. Psychiatr Danub 2017; 29:238-244 https://doi.org/10.24869/psyd.2017.238

18. Jakovljevic M: Psychiatria Danubina and Challenges of the COVID-19 Pandemic: The Answer Is in the Knowledge, Empathy, Coherence and Global Ethics. Psychiatr Danub 2021; 33:461-467. doi:10.24869/psyd.2021.461

19. Jakovljevic M, Jakovljevic I, Bjedov S, Mustac F: Psychiatry for Better World: COVID-19 and Blame Games People Play from Public and Global Metal Health Perspective. Psychiatr Danub 2020a; 32:221-228. doi:10.24869/psyd.2020.221

20. Jakovljevic M, Bjedov S, Jaksic N, Jakovljevic I: COVID-19 Pandemia and Public and Global Mental Health from the Perspective of Global Health Securit. Psychiatr Danub 2020b; 32:6-14. doi:10.24869/psyd.2020.6

21. Jakovljevic M & Tomic Z: Global and public mental health promotion for empathic civilization: The role of political psychocultures. Psychiatria Danubina 2016; 28:323-333

22. Kosarkova A, Malinakova K, Novak L, Van Dijk JP & Tavel P: Religious conspiracy theories about the COVID-19 pandemic are associated with negative mental health. Int J Public Health 2022; 67:1604324. doi:10.3389/ijph.2022.1604324

23. Kowalski J, Marchlewska M, Molenda Z, Gorska P & Gaweda L: Adherence to safety and self-isolation guidelines, conspiracy and paranoia-like beliefs during COVID-19 pandemic in poland - associations and moderators. Psychiatry Res 2020; 294:113540. doi:10.1016/j.psychres.2020.113540

24. Leibovitz T, Shamblaw AL, Rumas R & Best MW: COVID-19 conspiracy beliefs: Relations with anxiety, quality of life, and schemas. Pers Individ Dif 2021; 175:110704. doi: 10.1016/j.paid.2021.110704

25. Liao Q, Yuan J, Dong M, Yang L, Fielding R & Lam WTL: Public engagement and government responsiveness in the communication about COVID-19 during the early epidemic stage in China: Infodemiology study on social media data. Journal of Medical Internet Research 2020; 22:e18796 doi:10.2196/18796

26. Lolas F: Global mental health: Challenges for a global ethics. Acta Bioethica 2016; 22:9-14

27. Lo Moro G, Scaioli G, Bert F, Zacchero AL, Minutiello E & Siliquini R: Exploring the relationship between COVID-19 vaccine refusal and belief in fake news and conspiracy theories: A nationwide cross-sectional study in italy. Int J Environ Res Public Health 2022; 19. doi:10.3390/ijerph19159350

28. Lowicki P, Marchlewska M, Molenda Z, Karakula A & Szczepanska D: Does religion predict coronavirus conspiracy beliefs? Centrality of religiosity, religious fundamentalism, and COVID-19 conspiracy beliefs. Pers Individ Dif 2022; 187:111413. doi:10.1016/j.paid.2021.111413

29. Pavela Banai I, Banai B & Miklousic I: Beliefs in COVID-19 conspiracy theories, compliance with the preventive measures, and trust in government medical officials. Curr Psychol 2022; 41:7448-7458. doi:10.1007/s12144-021-01898-y

30. *Rezgale B, Vrublevska J, Sibalova A, Germanenko I & Rancans E: Characterisation of a conspiracy believers and their mental health during the COVID-19 emergency state in latvia. Nord J Psychiatry 2022; 1. doi:10.1080/08039488.2021.2019938*

31. *Ripp T & Roer JP: Systematic review on the association of COVID-19-related conspiracy belief with infection-preventive behavior and vaccination willingness. BMC Psychol 2022; 10:66. doi:10.1186/s40359-022-00771-2*

32. *Rovetta A: The impact of COVID-19 on conspiracy hypotheses and risk perception in italy: Infodemiological survey study using google trends. JMIR Infodemiology 2021; 1:e29929. doi:10.2196/29929*

33. *Seddig D, Maskileyson D, Davidov E, Ajzen I & Schmidt P: Correlates of COVID-19 vaccination intentions: Attitudes, institutional trust, fear, conspiracy beliefs, and vaccine scepticism. Soc Sci Med 2022; 302:114981. doi:10.1016/j.socscimed.2022.114981*

34. *Simione L, Vagni M, Gnagnarella C, Bersani G & Pajardi D: Mistrust and beliefs in conspiracy theories differently mediate the effects of psychological factors on propensity for COVID-19 vaccine. Front Psychol 2021; 12:683684. doi:10.3389/fpsyg.2021.683684*

35. *Sobol M, Zajenkowski M & Jankowski KS: Religious fundamentalism, delusions, and conspiracy beliefs related to the COVID-19 pandemic. Int J Environ Res Public Health 2022; 19. doi:10.3390/ijerph19159597*

36. *Soveri A, Karlsson LC, Antfolk J, Lindfelt M & Lewandowsky S: Unwillingness to engage in behaviors that protect against COVID-19: The role of conspiracy beliefs, trust, and endorsement of complementary and alternative medicine. BMC Public Health 2021; 21:684. doi:10.1186/s12889-021-10643-w*

37. *Stasielowicz L: A continuous time meta-analysis of the relationship between conspiracy beliefs and individual preventive behavior during the COVID-19 pandemic. Sci Rep 2022; 12:11508. doi:10.1038/s41598-022-15769-4*

38. *Syunyakov TS, Pavlichenko AV, Morozov PV, Fedotov IA, Filatova VE, Gayduk AJ, et al.: Modeling suicidality risks and understanding the phenomenon of suicidality under the loupe of pandemic context: National findings of the comet-g study in the russian population. Consortium Psychiatricum 2022; 3:15-36. doi:10.17816/cp167*

39. *Tsamakis K, Tsiptsios D, Stubbs B, Ma R, Romano E, Mueller C, et al.: Summarising data and factors associated with COVID-19 related conspiracy theories in the first year of the pandemic: A systematic review and narrative synthesis. BMC Psychol 2022; 10:244. doi:10.1186/s40359-022-00959-6*

40. *van Mulukom V, Pummerer LJ, Alper S, Bai H, Cavojova V, Farias J, et al.: Antecedents and consequences of COVID-19 conspiracy beliefs: A systematic review. Soc Sci Med 2022; 301:114912. doi:10.1016/j.socscimed.2022.114912*

41. *van Prooijen JW, Amodio DM, Boot A, Eerland A, Etienne T, Krouwel APM, et al.: A longitudinal analysis of conspiracy beliefs and COVID-19 health responses. Psychol Med 2022; 1-8. doi:10.1017/S0033291722002938*

42. *Zakharova NV, Bonkalo TI, Bravve LV, Kalakov AM, Syunyakov TS & Kovalchuk DF: Semantic regulation of anxiety expectations during the COVID-19 pandemic: Conspiracy trends. Health Care of the Russian Federation 2020; 64:329-335. doi:10.46563/0044-197x-2020-64-6-329-335*

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