UDC 614.4: 578.834
DOI: 10.21668/health.risk/2021.4.02.eng

Read online

Research article

SCORE ESTIMATE OF COVID-19 RISKS AS PER SOCIO-HYGIENIC AND BEHAVIORAL INDICATORS

T.S. Isiutina-Fedotkova, D.Yu. Kazieva, V.A. Sukhov, O.V. Mitrokhin

I.M. Sechenov First Moscow State Medical University, bldg. 2, 8 Trubetskaya Str., Moscow, 119991, Russian Federation

Epidemiologic situation remains a serious concern all over the world due to the coronavirus infection spread. It is vital to adhere to measure of non-specific COVID-19 prevention. According to literature data, the highest risks of the infection spread occur in public transport, retail outlets where foods and nonfoods are sold, medical organizations, and chemists' shops.

Our research objects were socio-hygienic and behavioral indicators that were risk factors of the coronavirus infection. Our research aim was to substantiate a score estimate of the COVID-19 contagion risk based on socio-hygienic and behavioral indicators.

Questioning was applied to determine frequency of visiting public places and adherence to basic measurements of non-specific COVID-19 prevention; overall, 400 respondents took part in it. A questionnaire was developed by experts of the Department of General Hygiene at Sechenov University and contained questions aimed at revealing informative signs (risk factors) of the coronavirus infection spread. Cluster analysis was applied to group respondents' questions and to identify informative signs for further development of a scale showing risk categories. Factor analysis in a form of principal component analysis was applied to questions that had the highest number of statistically significant indicators of Spearman's correlation coefficient.

We developed a procedure for assessing risks of COVID-19 contagion according to socio-hygienic and behavioral indicators and substantiated risk categories. The most significant risk factors were indicators related to mandatory mask wearing when visiting specific social objects (risk objects); when taking trips by various means of public transport and duration of such trips; keeping social distance when visiting social objects. We performed score estimate of risk categories regarding COVID-19 contagion.

Key words: *pandemic, COVID-19, coronavirus infection, risk factors, risk objects, risk categories, non-specific prevention, social distancing, obligatory mask wearing.*

The pandemic of new coronavirus infection (SARS-CoV-2) is a serious threat for the global society regarding many aspects. According to data provided by the WHO, on April 21, 2021 more than 140.0 million confirmed cases of the disease were registered all over the world including 4.6 million cases in the Russian Federation (RF for short) [1]. Studies established that it was possible to determine whether a person was infected with SARS-CoV-2 virus 1–3 days prior to occurring symptoms ("pre-symptoms" period) [2–4]. A share of symptomless carriers varies significantly across the population and is assumed to be from 18 to 81 % [5].

We should note that at present there is a descending trend in incidence with the coronavirus infection due to activities aimed at COVID-19 prevention being implemented everywhere [6]. But the existing epidemiologic situation is still rather unfavorable [7].

Tatiana S. Isiutina-Fedotkova – Candidate of Medical Sciences, Associate Professor of the General Hygiene Department (e-mail: isyutina-fedotkova_t_s@staff.sechenov.ru; tel.: +7 (499) 248-51-55; ORCID: https://orcid.org/0000-0001-8423-9243).

Diana Yu. Kazieva – assistant of the General Hygiene Department (e-mail: kazieva_d_yu@staff.sechenov.ru; tel.: +7 (916) 648-65-65; ORCID: https://orcid.org/0000-0002-4301-7393).

Vitaly A. Sukhov – assistant of the General Hygiene Department (e-mail: sukhov_v_a@staff.sechenov.ru; tel.: +7 (999) 458-47-79; ORCID: https://orcid.org/0000-0003-2993-0108).

Oleg V. Mitrokhin – Doctor of Medical Sciences, Professor, Head of the General Hygiene Department (e-mail: mitrokhin_o_v@staff.sechenov.ru; tel.: +7 (499) 248-53-85; ORCID: http://orcid.org/0000-0002-6403-0423).

Research works accomplished in 2020–2021 concentrated on assessing risks of the coronavirus infection spread among various occupational groups [8] assessing and managing COVID-19-related risks at a workplace [9], and examining SARS-CoV-2 transmission in public transport in China [10].

These and some other publications [11, 12] are based on using risk assessment methodology which is highly informative and efficient given the existing conditions of the COVID-19 pandemic.

Authors of a study that involved visualizing occupations with the highest risks of COVID-19 occurrence applied several risk assessment criteria, notably a number of people in occupational groups under exposure, exposure value (dose), and some others [8].

Chinese experts accomplished a study on "SARS-CoV-2 transmission in public transport in Hunan Province, China" that involved assessing risks of contagion through building up routes of an imaginary infected person who used public transport. The research showed that SARS-CoV-2 was transmitted quite effectively in closed overcrowded spaces.

In October 2020 in Great Britain a scientific research project was initiated that focused on assessing risks of COVID-19 transmission in public transport and determining optimal measures aimed at controlling the virus spread. The participating researchers have been developing a model showing potential virus spread through airflows. This research known as a project on assessing COVID-19-related transport risks is going to be accomplished in buses and trains including light railways [13].

A study by British scientists on coronavirus (COVID-19) involved developing a guide on safe transport for operators and also used such criteria as a number of exposed population, duration and value (dose) of exposure [12].

In Russia several measures have been implemented to reduce risks of COVID-19 spread; they involved imposing certain limitations on passenger flows in public transport (a number of passengers in transport per a unit of time), making passenger flows less dynamic (shortening duration of trips using public transport), as well as improving ventilation systems[1].

According to data provided by Rosstat more than 3.4 billion people use metro in Russia[2]. In

[1] O dopolnitel'nykh merakh po nedopushcheniyu rasprostraneniya COVID-2019: Postanovlenie Glavnogo gosudarstvennogo sanitarnogo vracha RF ot 30.03.2020 № 9 [On additional measures aimed at preventing COVID-2019 spread: The Order by the RF Chief Sanitary Inspector dated March 30, 2020, No 9]. Available at: http://publication.pravo.gov.ru/Document/View/0001202004010005?index=3&rangeSize=1 (March 05, 2021) (in Russian); Vremennye rekomendatsii po profilakticheskim meram dlya obespecheniya protivoepidemicheskoi bezopasnosti passazhirskikh perevozok zheleznodorozhnym transportom, napravlennye na snizhenie riska vozniknoveniya i rasprostraneniya koronavirusnoi infektsii (COVID-19) (utv. Ministrom transporta RF 25.05.2020) [Temporary recommendations on prevention measures for providing anti-epidemic safety of passenger trips by railways transport, aimed at reducing risks of COVID-19 infection occurrence and spread (approved by the RF Minister of Transport on may 25, 2020)]. Available at: https://mintrans.gov.ru/documents/10/10628 (March 09, 2021) (in Russian); Vremennye metodicheskie rekomendatsii po organizatsii raboty predpriyatii avtomobil'nogo transporta, gorodskogo nazemnogo elektricheskogo transporta i vneulichnogo transporta v tselyakh zashchity passazhirov i personala v usloviyakh neblagopriyatnoi epidemiologicheskoi obstanovki i poetapnogo snyatiya ogranichenii, svyazannykh s rasprostraneniem novoi koronavirusnoi infektsii (COVID-19) (utv. Ministrom transporta RF 25.05.2020) [Temporary methodical recommendations on organizing motor transport activities, city surface electrical transport and off-road transport in order to protect passengers and personnel given the unfavorable epidemiologic situation and step-by-step removal of limitations elated to spread of the new coronavirus infection (COVID-19) (approved by the RF Minister of Transport on may 25, 2020)]. Available at: https://mintrans.gov.ru/search?value=Временные+методические+рекомендации+по+организации+работы+предприятий+автомобильного+транспорта (March 09, 2021) (in Russian); O dopolnitel'nykh merakh po snizheniyu riskov rasprostraneniya COVID-2019 pri organizatsii zimnikh passazhirskikh perevozok zheleznodorozhnym transportom v period sezonnogo pod"ema zabolevaemosti ostrymi respiratornymi virusnymi infektsiyami 2020–2021 gg.: Postanovlenie Glavnogo gosudarstvennogo sanitarnogo vracha po zheleznodorozhnomu transportu RF ot 30.10.2020 N 10 (red. ot 16.11.2020) [On additional measures aimed at reducing risks of COVID-19 spread when organizing passenger trips by railway transport in winter during a seasonal rise in indigence with acute respiratory viral infections in 2020–2021: The Order by the RF Chief Sanitary Inspector on Railway Transport issued on October 30, 2020 No. 10 (last edited on November 16, 2020)]. *KonsultantPlus*. Available at: http://www.consultant.ru/document/cons_doc_LAW_366742/ (March 12, 2021) (in Russian).

[2] Osnovnye itogi raboty transporta [Basic results of transport activities]. *The Federal State Statistic Service*, 2020. Available at: https://rosstat.gov.ru/folder/23455 (March 20, 2021) (in Russian).

Moscow the overall passenger flow taken in different periods of time amounts to 8.5 million people a day or up to 163 thousand people a day at one station [14].

Dynamism of passenger flow is a substantial factor influencing spread of the coronavirus infection. A great number of stations (332) and lines (14) in Moscow underground railways makes for dynamic overlapping of passenger flows and this can cause a potential epidemiologic threat since such flows can include symptomless SARS-CoV-2 carriers and people who are reaching the end of the incubation period [15].

A number of passengers in public transport and duration of their trips can be quite high thus making for more rapid spread of the infectious agent. It is rather difficult or almost next to impossible to keep social distance under such conditions.

We should note that heat emission by passengers in underground carriages leads to temperature rise inside them and it makes for better spread of the infectious agent in this medium [16]. In this situation it is advisable to provide efficient ventilation. It was established that open windows and high air circulation speed always resulted in slower infection spread under any conditions [17].

In Russian a number of passengers who use land public transport (buses, trams, trolleybuses, electrical buses etc.) amounts to more than 10 billion people per year[2] or 4 million people a day [18].

Air ventilation in a bus can rely on inside air recirculation; in this case a probability of the infectious agents spread and, consequently, of passengers getting infected with it grows by several times [19].

At the very beginning of the pandemic Chinese researchers performed a retrospect subject study on SARS-CoV-2 transmission from a "primary" patient in public transport in Hunan province. They revealed 12 cases confirmed by laboratory tests that were directly related to one person infected with COVID-19 and spreading the diseases during bus trips [10].

We should bear in mind that risks of the infection spread grow in case we assume that people use both underground and surface transport. E.A. Starodumova built a mathematical model that involved using six different means of public transport: fixed-run taxi, bus, tram, electrical train (in-city and suburban), and metro during both rush and calm hours [20]. An imaginary infected person who was not wearing a face mask was "placed" inside different means of transport and then the model was used to determine in which transport the greatest number of people would be in a zone where contagion was the most probable. The results revealed that a probability to find oneself at a hazardous distance from the infections sources amounted to 100.0 % in a fixed-run taxi; 69.7 % in a bus; 36.7 % in a suburban electrical train; 34.0 % in an in-city electrical train on the Moscow Central Ring; 31.0 % in a tram; 29.6 % in a metro carriage. The said model was built based on an assumption that passengers were 4.5 meters away from a supposed source of the infection.

Suburban passenger trains are an important component of a transport system in a city agglomeration. And we should note that suburban transport is an object with risks of COVID-19 spread since duration of contacts between passengers together with dynamism of transport flows is only growing at present. A carriage of a suburban electric train may carry up to 260 passengers during rush hours and 116 passengers beyond them. It was established that on average 42 people were within a possible contagion zone in a suburban electric train during calm hours and the number grew to 95 people during rush hours.

According to the Order by Moscow mayor[3] (March 2020) respiratory personal pro-

[3] O vvedenii rezhima povyshennoi gotovnosti: Ukaz mera Moskvy ot 5 marta 2020 goda N 12-UM (v red. 06 oktyabrya 2020) [On introducing red alert regime: The Order by Moscow mayor issued on March 05, 2020 No. 12-UM (last edited on October 06, 2020)]. Available at: http://docs.cntd.ru/document/564377628 (March 09, 2021) (in Russian).

tective equipment (face masks or respirators) and personal protective equipment for hands (gloves) became obligatory in public transport and in retail outlets. Since the Order by the RF Chief Sanitary Inspector came into force[4] (October 2020) face masks that protected respiratory organs became obligatory in all public places in the country.

Visits to food-selling outlets create certain risks of contagion for population. Moscow Urbanism Center accomplished a study together with Habidatum analytical company with its aim to determine the most epidemiologically unfavorable districts in the capital according to economic activities that were allowed when quarantine measures were valid [21]. Three basic indicators were used: a number of people who used the same elevator (a risk to get infected from neighbors taking into account how close person-to-person interactions were) a number of people per outlets selling essential goods and items, notably, per 1 chemist's within a 10-minute distance and per 1 square meter in a retail outlet within a 5–20-minute distance.

Each of these indicators was standardized via linear scaling and summated. Minimal values were established for central and western districts in Moscow. It was due to Moscow downtown being quite different from dormitory areas in various aspects, notably, lower population density, a small number of people per one elevator (apartment blocks are different in these two types of city districts) and well-developed infrastructure.

A number of people visiting retail outlets that sell non-food goods and dynamism of such buyer flows are less apparent in comparison with public transport. However we should note that elevated number of factors that can lead to transmission makes such objects rather hazardous when it comes down to risks of COVID-19 spread. It is well known that viability of any infectious agent depends on a surface type, air temperature and some other factors [22–24].

Certain limitations were imposed in medical organizations to mitigate risks of COVID-19 spread[5].

Data taken form literature, accomplished studies, and issued regulatory documents on restricting COVID-19 spread give grounds for preliminary conclusion that the highest risks related to the infection spread occur in public

[4] O dopolnitel'nykh merakh po snizheniyu riskov rasprostraneniya COVID-19 v period sezonnogo pod"ema zabolevaemosti ostrymi respiratornymi virusnymi infektsiyami i grippom: Postanovlenie Glavnogo gosudarstvennogo sanitarnogo vracha RF ot 16 oktyabrya 2020 goda № 31 (v red. 13.11.2020) [On additional measures aimed at mitigating risks of COVID-19 spread during seasonal rise in incidence with acute respiratory viral infections and influenza: The Order by the RF Chief Sanitary Inspector issued on October 16, 2020 No. 31 (last edited on November 13, 2020)]. Available at: http://docs.cntd.ru/document/566108530 (March 09, 2021) (in Russian).

[5] O vremennom poryadke organizatsii raboty meditsinskikh organizatsii v tselyakh realizatsii mer po profilaktike i snizheniyu riskov rasprostraneniya novoi koronavirusnoi infektsii COVID-19: Prikaz Ministerstva zdravookhraneniya RF ot 19 marta 2020 № 198n (v red. 04.12.2020) [On temporary organization of activities performed by medical organizations to implement measures aimed at preventing and reducing risks of the new coronavirus infection COVID-19: The Order by the RF Public Healthcare Ministry dated March 19, 2020 No. 198n (last edited on December 04, 2020)]. Available at: http://www.consultant.ru/document/cons_doc_LAW_348101/2ff7a8c72de3994f30496a0ccbb1ddafdaddf518/ (March 09, 2021) (in Russian); MR 3.1.0209-20. Rekomendatsii po organizatsii protivoepidemicheskogo rezhima v meditsinskikh organizatsiyakh pri okazanii meditsinskoi pomoshchi naseleniyu v period sezonnogo pod"ema zabolevaemosti ostrymi respiratornymi infektsiyami i grippom v usloviyakh sokhraneniya riskov infitsirovaniya novoi koronavirusnoi infektsiei (COVID-19): Metodicheskie rekomendatsii (utv. Federal'noi sluzhboi po nadzoru v sfere zashchity prav potrebitelei i blagopoluchiya cheloveka 20.08.2020) [MR 3.1.0209-20. Guideline on organizing anti-epidemic regime in medical organizations when rendering medical aid to population during seasonal rise in incidence with acute respiratory viral infections and influenza given persisting risks of contagion with the new coronavirus infection (COVID-19): Methodical guidelines (approved by the Federal Service for Surveillance over Consumer Rights protection and Human Wellbeing on August 20, 2020)]. Available at: https://www.garant.ru/products/ipo/prime/doc/74541600/#review (March 22, 2021) (in Russian); Vremennye metodicheskie rekomendatsii. Profilaktika, diagnostika i lechenie novoi koronavirusnoi infektsii (COVID-19) (utv. Zamestitelem Ministra zdravookhraneniya RF) (versiya 10 ot 08.02.2021) [Temporary methodical recommendations. Prevention, diagnostics and treatment of the new coronavirus infection (COVID-19) (approved by the Deputy to the RF Public Healthcare Minister) (Version 10 issued on February 08, 2021)]. Available at: https://static-0.minzdrav.gov.ru/system/attachments/attaches/000/054/804/original/Временные_МР_COVID-19_%28v.10%29-08.02.2021-2.1_%28003%29.pdf (March 22, 2021) (in Russian).

transport, retail outlets selling both foods and non-food products, as well as medical organizations and chemists'.

Research aim and tasks. The research aim was to substantiate a score estimate of the COVID-19 contagion risk based on socio-hygienic and behavioral indicators.

To do that, the following tasks were set:

1. To establish informative signs (risk factors) of the coronavirus infection spread;

2. To develop a scale showing risk categories for COVID-19 contagion;

3. To suggest a score estimate of risk categories for COVID-19 contagion.

Materials and methods. We relied on questioning to determine how frequently people visited public places and whether they adhered to basic non-specific measures aimed at preventing the coronavirus infection spread. A questionnaire was developed by experts of the Department of General Hygiene at Sechenov University and contained questions that were aimed at revealing the most significant risk factors that could cause contagion with COVID-19 at various social objects. Risk-oriented approach became the methodological grounds for determining objects with elevated risks of the coronavirus infection spread [25, 26]. 400 people took part in the questioning. 11.0 % out of them stated they had already had COVID-19 (75.0 % had mild symptoms and didn't need hospitalization and 25.0 % had to be hospitalized).

Research results were statistically analyzed with STATISTICA Base software package. A correlation between signs was statistically examined using Spearman's non-parametric correlation coefficient (r) with Fisher's z-transformation (z) applied to approximate the exact distribution of the correlation coefficient. Cluster analysis was applied to group respondents' answers and to identify informative signs for further development of a scale showing risk categories. Principal component analysis (at a level being > 0.70) was applied to the questions that had the highest number of statistically significant indicators of Spearman's correlation coefficient. Overall dispersion share was equal to 60.43 %.

Critical significance (p) was taken $p \leq 0.01$ when statistical hypotheses were tested.

Results and discussion. Spearman's correlation analysis revealed that 20 questions out of 51 had the highest number of statistically significant values of the correlation coefficient. Next, we applied principal component analysis to these 20 signs thus identifying the following three factors (Table 1).

Table 1

Factor analysis results applied to identify significant factors

Signs (N = 400)	Significant factors		
	Factor 1	Factor 2	Factor 3
8			0.859833
9			
10			0.856364
13		0.731499	
14		0.786084	
15		0.781985	
17		0.838199	
18		0.816375	
24			
25			
26			
28	0.816092		
29	0.75684		
30	0.750926		
31			
33	0.747646		
34			
37			
38	0.776322		
39			
Expl. Var (dispersion)	5.507479	3.416335	2.090956
Prp. Totl (a share of dispersion)	0.262261	0.162682	0.099569
Cumulative (a share of dispersion)	0.2812	0.2344	0.0887

Factor 1 is the most informative (28.12 %). Its structure is determined by values of positive variables in an answer to a question "What do you do to protect yourself from the coronavirus?" This factor can be identified as "Behavioral strategy". During

the pandemic respondents tried to avoid going to out-patient clinics, food-selling outlets, street vendors, kiosks, retail outlets selling non-foods; they also kept social distance.

Factor 2 has informative value equal to 23.44 % and is represented by positive responses given by participants who mentioned several city objects where risks of COVID-19 contagion were higher such as public land transport, suburban electric trains, chemists' and non-foods shops. This factor can be identified as "Outer conditions for contagion". Most respondents mentioned exactly these city objects when selecting those with high risks of COVID-19 contagion.

Factor 3 has informative value equal to 8.87 % and includes only positive variables regarding obligatory face masks wearing. Respondents mentioned wearing a face mask in public transport, at a workplace, in shop and a chemist's as a more important factor that could prevent COVID-19 contagion. This factor can be identified as "obligatory mask wearing".

Hierarchical cluster analysis aimed at grouping respondents' answers allowed identifying clusters of indicators that can later be applied to distribute questioned people into several groups as per estimated signs and to test differences between these groups including those related to risks of COVID-19 contagion (Figure).

Risk factors were selected according to nearest neighbor algorithm as per consequent agglomeration table. It provided an opportunity to trace dynamics of growing differences as per clusterization steps and determine a step at which a drastic increase in differences took place. 16 factors were selected out of total 46. Having calculated hierarchy of the informative signs, we obtained data given in Table 2 (a threshold for selecting leading factors for clusterization is the hierarchy coefficient equal to 0.7).

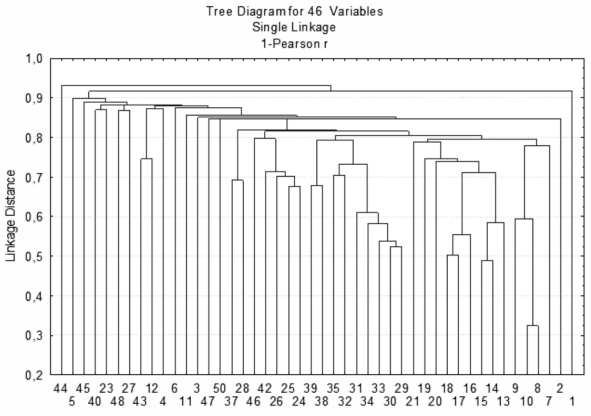

Figure. Results of cluster analysis

Table 2

Hierarchy of informative signs (risk factors)

No.	Risk factor	1-*r*	Score
1	Wearing face masks in public land transport	0.324156	1.5
2	Wearing face masks in a shop, chemist's etc.	0.324156	1.5
3	Taking underground trips	0.487818	3.5
4	Taking a suburban electric train	0.487818	3.5
5	Going to a chemist's	0.503621	5.5
6	Going to retail outlets selling non-foods	0.503621	5.5
7	Going to food shops	0.524694	7.5
8	Going to street vendors or kiosks	0.524694	7.5
9	Going to food shops	0.554532	10
10	Going to hairdresser's or beauty shops	0.581808	11
11	Using public land transport	0.583966	12
12	Not wearing a face mask at a workplace	0.594983	13
13	Going to an out-patient clinic	0.678507	14.5
14	Going to a usual in-patient clinic (not for COVID-19-infecte patients)	0.678507	14.5
15	Social distancing	0.691358	16.5
16	Social distancing when visiting medical organizations	0.691358	16.5

Table 3

Score estimates as per risk factors scales (according to data taken form respondents' answers)

No.	Risk factor	Scale	Score	Average
1	Wearing face masks in public land transport	Yes No	0.5 2	1.25
2	Wearing face masks in a shop, chemist's etc.	Yes No	0.5 2	1.25
3	Taking underground trips	Up to 1 hour 1 hour–1.5 hours 2 and more hours	0.5 1 2	1.75
4	Taking a suburban electric train	Up to 1 hour 1 hour–1.5 hours 2 and more hours	0.5 1 2	1.75
5	Going to a chemist's	Yes No	1 0	0.5
6	Going to retail outlets selling non-foods	Yes No	1 0	0.5
7	Going to food shops	Yes No	1 0	0.5
8	Going to street vendors or kiosks	Yes No	1 0	0.5
9	Going to food shops	Yes No	1 0	0.5
10	Going to hairdresser's or beauty shops	Yes No	1 0	0.5
11	Using public land transport	Up to 1 hour 1 hour–1.5 hours 2 and more hours	0.5 1 2	1.75
12	Not wearing a face mask at a workplace	Yes No	1 0	0.5
13	Going to an out-patient clinic	Yes No	3.5 0	1.75
14	Going to a usual in-patient clinic (not for COVID-19-infecte patients)	Yes No	3.5 0	1.75
15	Social distancing	Yes No	0.5 3	1.75
16	Social distancing when visiting medical organizations	Yes No	1 3	2.0

Therefore, we established the most significant risk factors. They are socio-hygienic and behavioral indicators that are related to visiting various social objects and trips (and their duration) on different kinds of public transport, wearing face masks and keeping social distance when visiting various objects (risk objects). Next, score estimates were given as per scales of informative signs based on data taken from respondents' answers (Table 3).

At this stage in our research we gave score estimates as per scales of informative signs which would later allow calculating odds ratio (*OR*) between groups included into a study with a greater number of respondents, first of all, those who have already had COVID-19.

To assign a respondent into a risk category, it is necessary to give a score estimate as per each informative sign (Table 4). An average identification value (a range from 16.1 to 20.0) and higher calculated for a respondent indicates that non-specific preventive measures are required to reduce risks of contagion.

Conclusions:

1. The most significant "factors" that can protect from the coronavirus infection include indicators that characterize the following: respondents' "behavioral strategy"

Table 4

Risk categories (score estimates)

Risk category	Scores (summated)
Low	< 8.0
Below average	8.1–16.0
Average	16.1–20.0
Above average	21.1–26.0
High	> 26.1

(avoiding public places); "outer conditions for contagion" at various objects; obligatory face mask wearing. Risk factors of contagion with the coronavirus infection are indicators that characterize visits to various social objects and trips (and their duration) on various kinds of public transport, wearing face masks and keeping social distance at various objects (risk objects).

2. We developed a procedure for assessing risks of contagion with the coronavirus infection as per risk factors. This procedure can be used to examine distribution and to assess socio-hygienic and behavioral risk factors among population; it can also be used to include people into a study, first of all, those with COVID-19 in their case history, and for further calculation of *OR* between groups of respondents as well as analyzing risks of COVID-19 contagion.

3. We performed score estimates of risks categories for contagion with the coronavirus infection.

Funding. The research was not granted any financial support.

Conflict of interests. The authors declare there is no any conflict of interests.

References

1. WHO Coronavirus Disease (COVID-19) Dashboard. *World health organization*, 2020. Available at: https://covid19.who.int/table (21.04.2021).

2. Pan X., Chen D., Xia Y., Wu X., Li T., Ou X., Zhou L., Liu J. Asymptomatic cases in a family cluster with SARS-CoV-2 infection. *Lancet Infect. Dis.*, 2020, vol. 20, no. 4, pp. 410–411. DOI: 10.1016/S1473-3099(20)30114-6

3. Tong Z., Tang A., Li K., Li P., Wang H.-L., Yi J.-P., Zhang Y.-L., Yan J.-B. Potential Presymptomatic Transmission of SARS-CoV-2, Zhejiang Province, China, 2020. *Emerg. Infect. Dis.*, 2020, vol. 26, no. 5. DOI: 10.3201/eid2605.200198

4. Wei W.E., Li Z., Chiew C.J., Yong S.E., Toh M.P., Lee V.J. Presymptomatic Transmission of SARS-CoV-2 – Singapore, January 23–March 16, 2020. *Morb. Mortal. Wkly. Rep. (MMWR),* 2020, vol. 69, no. 14, pp. 411–415. DOI: 10.15585/mmwr.mm6914e1external icon

5. Nikolai L.A., Meyer C.G., Kremsner P.G., Velavan T.P. Asymptomatic SARS Coronavirus 2 infection: Invisible yet invincible. *Inter. J. Infect. Dis.,* 2020, vol. 100, pp. 112–116. DOI: 10.1016/j.ijid.2020.08.076

6. COVID-19 situation in the WHO European region. *World health organization*, 2020. Available at: https://www.arcgis.com/apps/dashboards/ead3c6475654481ca51c248d52ab9c61 (28.03.2021).

7. WHO Weekly epidemiological update on COVID-19 – 16 March 2021. *World health organization*, 2021. Available at: https://www.who.int/publications/m/item/weekly-epidemiological-update---16-march-2021 (28.03.2021).

8. The Front Line: Visualizing the Occupations with the Highest COVID-19 Risk, 2020. Available at: https://www.visualcapitalist.com/the-front-line-visualizing-the-occupations-with-the-highest-covid-19-risk/ (28.03.2021).

9. Zisook R., Monnot A., Parker J., Gaffney S., Dotson S., Unice K. Assessing and managing the risks of COVID-19 in the workplace: Applying industrial hygiene (IH) /occupational and environmental health and safety (OEHS) frameworks. *Toxicol. Ind. Health*, 2020, vol. 36, no. 9, pp. 607–618. DOI: 10.1177/0748233720967522

10. Luo K., Lei Z., Hai Z., Xiao S., Rui J., Yang H., Jing X., Wang H. [et al.]. Transmission of SARS-CoV-2 in Public Transportation Vehicles: A Case Study in Hunan Province, China. *Open Forum Infect. Dis.*, 2020, vol. 7, no. 10, pp. ofaa430. DOI: 10.1093/ofid/ofaa430

11. Gasmi A., Noor S., Tippairote T., Dadar M., Menzel A., Bjørklund G. Individual risk management strategy and potential therapeutic options for the COVID-19 pandemic. *Clin. Immunol.*, 2020, vol. 215, pp. 108409. DOI: 10.1016/j.clim.2020.108409

12. Guidance. Coronavirus (COVID-19): safer transport guidance for operators. *Department for Transport*, 2021. Available at: https://www.gov.uk/government/publications/coronavirus-covid-19-safer-transport-guidance-for-operators/coronavirus-covid-19-safer-transport-guidance-for-operators#risk-assessment (28.03.2021).

13. UKRI funds COVID-19 project on spread and control on public transport. *UK Research and Innovation*, 2020. Available at: https://www.ukri.org/news/ukri-funds-covid-19-project-on-spread-and-control-on-public-transport/ (28.03.2021).

14. O metropolitene [About subway]. *GUP «Moskovskii metropoliten»*. Available at: https://gup.mosmetro.ru/o-metropolitene/ (16.03.2021) (in Russian).

15. Wang M., Zhao R., Gao L., Gao X.-F., Wang D.-P., Cao J.-M. SARS-CoV-2: Structure, Biology, and Structure-Based Therapeutics Development. *Front. Cell. Infect. Microbiol.*, 2020, vol. 25, no. 10, pp. 587269. DOI: 10.3389/fcimb.2020.587269

16. Leksin A.G., Evlampieva M.N., Timoshenkova E.V., Morgunov A.V., Kaptsov V.A. Microclimate condition in subway cars in the summer period of the year. *Gigiena i sanitariya*, 2015, vol. 94, no. 3, pp. 63–66 (in Russian).

17. El-Salamony M., Moharam A., Guaily A., Boraey M.A. Correction to: Air change rate effects on the airborne diseases spreading in Underground Metro wagons. *Environ. Sci. Pollut. Res. Int.*, 2021, vol. 28, no. 24, pp. 31908. DOI: 10.1007/s11356-021-13405-8

18. Achievements of the Moscow Transport Complex in 2019 and plans for 2020. Moscow Transport, 2020. Available at: https://transport.mos.ru/common/upload/public/prezentacii/40/itogi-2019-plany-2020-eng.pdf (16.03.2021).

19. Shen Y., Li C., Dong H., Wang Z., Martinez L., Sun Z., Handel A., Chen Z. [et al.]. Community Outbreak Investigation of SARS-CoV-2 Transmission Among Bus Riders in Eastern China. *JAMA Intern. Med.*, 2020, vol. 180, no. 12, pp. 1665–1671. DOI: 10.1001/jamainternmed.2020.5225

20. V kakom transporte samyi vysokii risk podkhvatit' koronavirus?: sait Moskovskogo tekhnicheskogo universiteta svyazi i informatiki [What means of transport create the highest risk of contracting coronavirus?: web-site of the Moscow Technical University of Communications and Informatics]. Available at: https://mtuci.ru/about_the_university/news/2275/ (12.03.2021) (in Russian).

21. Pandemiya i ekonomika goroda: kak Moskva reagiruet na novye vyzovy: onlain-lektsiya [Pandemic and city economy: how Moscow responds to new challenges: online lecture]. Moskovskii tsentr urbanistiki. Available at: https://centerurban.com/events/pandemiya-i-ekonomika-goroda-kak-mosk/ (28.03.2021) (in Russian).

22. Ronca S.E., Sturdivant R.X., Barr K.L., Harris D. SARS-CoV-2 Viability on 16 Common Indoor Surface Finish Materials. *Health Environ. Res. Design. J.*, 2021, vol. 14, no. 3, pp. 49–64. DOI: 10.1177/1937586721991535

23. Choi H., Chatterjee P., Coppin J.D., Martel J.A., Hwang M., Jinadatha C., Sharma V.K. Current understanding of the surface contamination and contact transmission of SARS-CoV-2 in healthcare settings. *Environ. Chem. Lett.*, 2021, vol. 1–10. DOI: 10.1007/s10311-021-01186-y

24. Anelich L.E.C.M., Lues R., Farber J.M., Parreira V.R. SARS-CoV-2 and Risk to Food Safety. *Front Nutr.*, 2020, vol. 7, pp. 580551. DOI: 10.3389/fnut.2020.580551

25. Popova A.Yu., Bragina I.V., Zaitseva N.V., May I.V., Shur P.Z., Mitrokhin O.V., Goryaev D.V. On the scientific and methodological support of the assessment of the performance and effectiveness of the control and supervision activity of the Federal Service For Surveillance On Consumer Rights Protection And Human Wellbeing. *Gigiena i sanitariya*, 2017, vol. 96, no. 1, pp. 5–9. DOI: 10.18821/0016-9900-2017-96-1-5-9 (in Russian).

26. Novikov S.M., Fokin M.V., Unguryanu T.N. Actual problem of methodology and development of evidence-based health risk assessment associated with chemical exposure. *Gigiena i sanitariya*, 2016, vol. 95, no. 8, pp. 711–716. DOI: 10.18821/0016-9900-2016-95-8-711-716 (in Russian).

27. Analitika rynka internet-torgovli za 2020 god [Analytics of the e-commerce market for 2020]. Available at: https://www.shopolog.ru/metodichka/analytics/analitika-rynka-internet-torgovli-za-2020-god/ (12.03.2021) (in Russian).

Isiutina-Fedotkova T.S., Kazieva D.Yu., Sukhov V.A., Mitrokhin O.V. Score estimate of COVID-19 risks as per socio-hygienic and behavioral indicators. Health Risk Analysis, 2021, no. 4, pp. 16–24. DOI: 10.21668/health.risk/2021.4.02.eng

Received: 17.05.2021
Accepted: 12.10.2021
Published: 30.12.2021