



Research article

## THEORETICAL GROUNDS FOR ASSESSING HEALTH RISKS FACTORS CAUSED BY SELF-ISOLATION

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*Billions of people had to face self-isolation for several months due to COVID-19 pandemic; given that, it seems quite vital to provide theoretical grounds for sanitary-hygienic health risk assessment.*

*Our research objects were people who had to self-isolate during COVID-19 pandemic. In our research we provided theoretical substantiation for priority health risk factors determined by hypodynamia, hypoxia, improper nutrition, distorted work and leisure regime, and psychoemotional strain. These factors can result in growing morbidity with non-communicable diseases among population.*

*Our research goal was to give theoretical grounds for sanitary-hygienic assessment of health risk factors caused by self-isolation, to reveal priority health risk factors causing morbidity with non-communicable diseases, and to give recommendations on how to prevent it.*

*We applied analytical, information, and statistical procedures in our research. Data were obtained from regulatory and legal documents on sanitary-hygienic standardization in the Russian Federation, specifically, data on nutrition hygiene, occupational hygiene, children and teenagers hygiene, etc.; we also revised scientific works published by Russian and foreign authors and analyzed documents issued by the World Health Organization as well as by public healthcare authorities in different countries during COVID-19 pandemic.*

*When developing theoretical grounds for sanitary-hygienic assessment of health risk factors causing morbidity with non-communicable diseases due to self-isolation, we determined priority risk factors and suggested certain hygienic criteria for assessing self-isolation. We provided theoretical substantiation for a suggested hygienic self-isolation index and its score estimate. The existing system for sanitary-hygienic standardization in the RF fixes requirements for nutrition, work, and leisure regime as well as people's physical activity; it was applied for performing hygienic assessment of self-isolation and self-isolation index score estimates.*

*We suggested certain activities aimed at minimizing health risks under self-isolation; these activities were based on sanitary-hygienic standards. Since hypodynamia and hypoxia are primary sanitary-hygienic health risk factors, we suggest sticking to adequate nutrition with optimal energy capacity, proper physical activity, as well as proper work and leisure regimes.*

**Key words:** COVID-19, self-isolation, health risk assessment, sanitary-hygienic standardization, prevention, hygiene, risk factors, population health.

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Self-isolation is a set of enforced administrative, sanitary-hygienic, sanitary-epidemiological, and preventive activities aimed at preventing infectious agents from transfer to susceptible and contact people; the basic aim here is to prevent risks of coronavirus infec-

tion spread and new contagions among population [1].

From hygienic point of view, self-isolation should be defined as forced long-term (longer than one month) amount of time spent by a person within limited space, with lower

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physical activity, and insufficient amount of time spent outdoors [2].

There are several types of self-isolation: a scientific experiment; healthy people and patients with mild forms of a disease isolating themselves at home; medical personnel isolating themselves at their workplaces [3].

Self-isolation first became a part of a scientific experiment when research was being accomplished on space flights in late 60-ties last century by the RAS Institute for Medical and Biological Issues<sup>1</sup>. There was profound diagnostic research on nutritional status, food habits or changes in them that occurred due to the same diet being consumed for a long period of time in isolated conditions [4]. The tests also revealed that isolated people started to suffer from crucial mental issues [5].

In 2020 SIRIUS-19, an international isolation experiment, started with its program covering a 5-year period. The research focuses on examining space crew activity in an artificial environment; it will allow developing optimal medical and sanitary standards, determining relevant food resources and prevention activities. As a result, a series of examinations will enable creating medical and sanitary requirements to layouts of personal space inside future space bases and ships. The experiment results will also provide an opportunity to predict risk factors producing negative effects under isolation and how to prevent them as well as to develop various procedures for improving crew members' health. This self-isolation is voluntary as people give their consent to take part in scientific experiments and they are provided with constant medical surveillance and support<sup>2</sup>.

People who had mild forms of the disease, those who had contacts with infected people, elderly people who were older than 65, and even healthy people had to keep self-isolation at home for a long period of time in order to prevent the infectious agent spread in population. Certain measures were introduced to

make people keep «social distance» and use antiseptics and personal protective equipment (face masks and gloves) in public places; mass media provided people with relevant data on how to prevent the coronavirus infection spread among population [6].

Long periods of time spent indoors, minimized social interaction, nutrition and physical activity being in disharmony lead to greater health risks for population due to occurring and exacerbating somatic and mental diseases [7].

Self-isolation concerns a great share of population including people of different sex and age and those who already suffer from various chronic diseases. Self-isolation is aggravated with great nervous tension and its long periods, up to several months [8].

**Our research goal** was to give theoretical grounds for sanitary-hygienic assessment of health risk factors caused by self-isolation, to reveal priority health risk factors causing morbidity with non-communicable diseases, and to give recommendations on how to prevent it.

**The research tasks were as follows:**

1. To reveal health risk factors for people who isolated themselves;
2. To provide theoretical grounds for complex hygienic assessment of self-isolation as per priority criteria;
3. To provide theoretical grounds for developing hygienic self-isolation index and a score estimate for assessing health risks for population;
4. To recommend activities aimed at minimizing health risks for people who were self-isolated.

**Data and methods.** We applied statistical, information, and analytical procedures in our research, analyzed databases containing regulatory and legal documents on sanitary-hygienic standardization issued in the Russian Federation.

We took data from hygienic standards and physiological regulations on the following subjects: nutrition hygiene (determining physical activity coefficient during self-isolation,

<sup>1</sup> «Mars 500» project. *Mars 500*. Available at: <http://mars500.imbp.ru/history.html> (05.06.2020) (in Russian).

<sup>2</sup> «Mars 500» experiment has come to its end. *Roscosmos*. Available at: <https://www.roscosmos.ru/17692/> (05.06.2020) (in Russian).

standards fixing proper caloric content in food for different age and sex groups, etc.); children and teenagers hygiene (working space layout, nutrition, a child's physical activity); occupational hygiene; etc.

We also analyzed documents and methodical recommendations issued by the WHO that focused on preventing psychoemotional disorders and alimentary-dependent diseases among population as well as experience gained by public healthcare systems in other countries during the coronavirus infection pandemic.

**Results and discussion.** Self-isolation led to new risk factors occurring and it called for accomplishing sanitary-hygienic assessment and developing activities aimed at preventing negative effects produced by them on people's health [9]. These risk factors include the following:

- hypodynamia (low physical activity) due to a person spending long periods of time indoors in a limited space [10];
- hypoxia (poor blood saturation with oxygen) due to limited amount of time spent in the open air [11];
- alimentary factors (probable improper nutrition when people consume food with high caloric contents but their physical activity is too low for that) [12];
- changes in work and leisure regimes [13].

In the Russian Federation a database of sanitary-hygienic standards was created that included hygienic standards and recommended physiological norms concerning food, physical activity, and work and leisure regime [14].

Sanitary-hygienic standards are applied to assess proper nutrition according to energy inputs by different sex and age groups. Hygienic standards are applied to fix physiologically op-

timal amount of time spent indoors<sup>3</sup>, to determine proper parameters of microclimate, physical activity, and work and leisure regime<sup>4</sup>.

It seems advisable and necessary to apply hygienic standards to assess self-isolation.

In Russia there are standards for physiological need in energy and nutrients for different population groups; these standards determine physiologically grounded consumption rates for essential nutrients and energy sources.

Need in energy and nutrients depends on physical activity that is characterized with physical activity coefficient. This coefficient is determined as a ratio of energy inputs necessary to accomplish a specific task and basic metabolism value. Overall adult population is divided into 5 groups for men and 4 groups for women depending on energy inputs; this division is accomplished taking into account physical activity at workplaces and other energy inputs. It seems advisable to apply group I for self-isolation since it is characterized with such a risk factor as low physical activity both for men and women. This group predominantly includes people with intellectual labor (researchers, HEE lecturers, students, medical personnel, etc.). Physical activity coefficient is equal to 1.4 for these occupational groups<sup>5</sup>.

Students who attend secondary schools as well as educational establishments for primary and secondary vocational training and who have to switch to distance learning should adhere to recommended nutrition standards. SER 2.4.5.2409-08 provide a draft menu that was developed taking into account need in basic nutrients and sticking to recommended caloric contents in day ration; the menu is differentiated as per age groups (8–11; 12–18)<sup>6</sup>.

<sup>3</sup> SER 2.1.2.2645-10. Sanitary-epidemiologic requirements to living conditions: Sanitary-epidemiologic rules and standards. *KODEKS: an electronic fund for legal and reference documentation*. Available at: <http://docs.cntd.ru/document/902222351> (05.06.2020) (in Russian).

<sup>4</sup> SER 2.2.4.3359-16. Sanitary-epidemiologic requirements to physical factors at workplaces: Sanitary-epidemiologic rules and standards. *KODEKS: an electronic fund for legal and reference documentation*. Available at: <http://docs.cntd.ru/document/420362948> (05.06.2020) (in Russian).

<sup>5</sup> MR 2.3.1.2432-08. 2.3.1 issued on December 18, 2008. Rational nutrition. Standards for physiological needs in energy and nutrients for different population groups in the Russian Federation: Methodical guidelines. Moscow, The Federal Service for Surveillance over Consumer Rights Protection and Human Well-being Publ., 2008, pp. 6–8 (in Russian).

<sup>6</sup> SER 2.4.5.2409-08. Sanitary-epidemiologic requirements to organizing meals for students attending secondary schools and educational establishments for primary and secondary vocational training: Sanitary-epidemiologic rules and standards. *KODEKS: an electronic fund for legal and reference documentation*. Available at: <http://docs.cntd.ru/document/902113767> (05.06.2020) (in Russian).

When children have to learn at home, special attention should be paid to pauses between doing learning tasks and studying teaching materials. A room where a child studies should be ventilated regularly and he or she should spend this time in the open air (on a balcony or in a yard) so that fatigue is prevented. Biological needs in physical activity should also be satisfied so parents have to make children do some exercises or do sports on training devices etc.<sup>7</sup>.

We suggest the following sanitary-hygienic criteria for assessing self-isolation as a risk factor causing non-communicable diseases occurrence among population:

- a place where people isolate themselves (an apartment, a country house, a hotel, etc.) since it determine whether they can spend some time outdoors to prevent hypoxia [15];

- a total square per one self-isolated person since it determines, among other things, available physical activity [16];

- physical activity including physical loads, doing sports on training devices, exercises etc. [17];

- amount of time spent outdoors including walking pets, shopping, going to a chemist's, frequent ventilating, spending some time on balconies etc. [18];

- work regime for those who work at home using IT;

- leisure regime [19];

- psychoemotional tension, long time spent indoors, stress [20].

These established sanitary-hygienic criteria for self-isolation assessment provide theoretical grounds for hygienic self-isolation index. This index allows determining risks of non-communicable morbidity during

self-isolation basing on established hygienic standards and recommended physiological ones.

Hygienic self-isolation index (HSI) is directly proportionate to coefficients of physical activity (D), square (air volume) per one isolated person (S), amount of time spent outdoors (T); it is inversely proportionate to caloric contents in consumed food (K).

$$HSI = \frac{D + S + T}{K}$$

where:

D is a coefficient of physical activity that is calculated as per the following formula: actual physical activity (number of kilocalories spent on physical exercises) / time spent on doing physical exercises. Recommendations on physical activity that is necessary to preserve and improve health are given for all age groups on the World Health Organization web-site<sup>8</sup>.

S is a coefficient showing actual square (air volume) indoors; it is 3 m<sup>3</sup>/hour per 1 m<sup>2</sup> of a living space in case overall living space is less than 20 m<sup>2</sup> per one person and not less than 30 m<sup>3</sup>/hour per one person in case overall living space per this one person is more than 20 m<sup>2</sup><sup>9</sup>.

T is amount of time spent outdoors (hours).

K is a coefficient that shows a ratio between actual caloric contents in food (these contents are given on any food product label) and physiological standard for caloric contents in food (adult males require from 2,100 to 4,200 kilocalories a day and adult females, from 1,800 to 3,050 kilocalories a day)<sup>10</sup>.

<sup>7</sup> Global recommendations on physical activity necessary for health. Available at: [https://www.who.int/dietphysicalactivity/factsheet\\_recommendations/ru/](https://www.who.int/dietphysicalactivity/factsheet_recommendations/ru/) (05.06.2020) (in Russian).

<sup>8</sup> Code of instructions: apartments blocks: CI 54.13330.2016 Housing apartments blocks. *KODEKS: an electronic fund for legal and reference documentation*. Available at: <http://docs.cntd.ru/document/456054198> (05.06.2020) (in Russian).

<sup>9</sup> SER 2.3.2.1078-01. Hygienic requirements to safety and nutritional value of food products: Sanitary-epidemiologic rules and standards. *KODEKS: an electronic fund for legal and reference documentation*. Available at: <http://docs.cntd.ru/document/901806306> (05.06.2020) (in Russian).

<sup>10</sup> Principles for drawing up a ration for self-isolated people or people on quarantine at home. Ofitsial'nyi sait Upravleniya Federal'noi sluzhby po nadzoru v sfere zashchity prav potrebitel'ei i blagopoluchiya cheloveka po gorodu Moskve. Available at: <http://77.rospotrebnadzor.ru/index.php/napravlenie/profinfab/8142-fits-pitaniya-i-biotekhnologii-razrabotal-printsipy-ratsional-dlya-lits-nakhodyashchikhsya-v-rezhime-samoizolyatsii> (05.06.2020) (in Russian).

Bearing this hygienic self-isolation index in mind, we can conclude that more physical activity a person has outdoors or in a ventilated room and consumes calories in quantities relevant to his or her energy inputs, the lower are health risks caused by such factors as hypodynamia, hypoxia, or obesity [21].

It seems possible to provide score estimate for hygienic assessment of self-isolation. Hygienic self-isolation index which is equal to 3 is optimal; more than 3, favorable; lower than 3; unfavorable.

Accomplished sanitary-hygienic assessment of self-isolation will allow preventing alimentary-dependent diseases, cardiovascular diseases, and diseases of the musculoskeletal system as well as reducing risks of other non-communicable diseases [22].

Self-isolation and keeping social distance during a pandemic (epidemic) are factors that allow reducing risks of people getting infected with infectious agents.

During self-isolation it is important to follow recommendations on survival rations in case of a pandemic or any other emergency (catastrophe) [23].

Infectious epidemics not only influence people's physical health but also exert adverse impacts on mental health and well-being of non-infected people. Research revealed that spread of new communicable diseases and their consequences such as severe acute respiratory syndrome (SARS) could result in greater anxiety, depression, and stress among population in general [24]. These negative emotions influence sleep as well [25].

During COVID-19 epidemic in China some people who had mild diseases, suspected contagion, or close contacts with infected patients or potentially hazardous environment were isolated at their homes. Even if isolated people didn't fall sick with the disease and remained physically healthy, they often suffered from negative mental outcomes [26]. Therefore, it is vital to preserve

mental and physical health of people who isolated themselves due to elevated risks of COVID-19 contagion [27].

#### **Conclusions:**

- we determined leading health risk factors during self-isolation;

- we provided theoretical grounds for sanitary-hygienic criteria that could be applied to assess self-isolation basing on sanitary-hygienic standards existing in the Russian Federation;

- we substantiated and developed hygienic self-isolation index (*HIS*) that is directly proportionate to coefficients of physical activity (*D*), square (air volume) per one isolated person (*S*), amount of time spent outdoors (*T*) and is inversely proportionate to caloric contents in consumed food (*K*);

- we suggested a score estimate for hygienic self-isolation index that provides optimal, favorable, and unfavorable risk assessment for impacts exerted by self-isolation on people's health;

- accomplished sanitary-hygienic assessment of self-isolation will allow preventing communicable morbidity among population and test theoretically well-grounded assessment of health risks caused by self-isolation in field observations.

**Recommendations. Nutrition.** During self-isolation food ration should be given special attention. Food products with high sugar or salt contents, confectionary, and fast food are risk factors that can cause alimentary-dependent diseases [28]. It is necessary to drink not less than 2 liters of water per day and abstain from having sugary and floury products, sweet fizzy drinks, fat meat and cheese, fast food, chips, etc.<sup>11</sup>.

**Physical activity.** During forced self-isolation it is vital to keep relevant physical activity that exerts favorable impacts both on physical and mental health [29]. Physical exercises are recommended to be followed with muscle relaxation<sup>12</sup>.

<sup>11</sup> How to keep physically fit during self-isolation. Available at: <http://cgon.rospotrebнадzor.ru/upload/media-library/34a/34a623bbfeb0a9bd5b0d4fbd23aa5a3d.png> (05.06.2020) (in Russian).

<sup>12</sup> Distant learning for schoolchildren. Available at: <http://cgon.rospotrebнадzor.ru/upload/media-library/8ee/8ee6ead367b43c78a1d3332691200ce.png> (05.06.2020) (in Russian).

**Work and leisure regime.** Self-isolation involves remote working for adults and distant learning for children and comfortable conditions are required for that [30]. Rooms where people work or study should be ventilated and cleaned daily and there should be no irrelevant noise sources<sup>13</sup>. People should sleep for not

less than 8 hours a day, eat rationally and properly, and remain physically active [31].

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<sup>13</sup> How to cope with stress. Available at: <http://cgon.rospotrebnadzor.ru/upload/medialibrary/09a/09a20a55807cf40671f0d7151c609aed.png> (05.06.2020) (in Russian).

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