### CHANGE IN TOURIST TRENDS AS A RESULT OF RESTRICTIONS CAUSED BY THE COVID-19 PANDEMIC

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#### Abstract

As the novel coronavirus infection (COVID-19) continues to spread throughout the world, the tourism industry operates under numerous social distancing constraints, which has a negative impact on demand, the economic performance of tourism businesses, and also leads to staff layoffs and numerous bankruptcies in the industry. The purpose of the article is to investigate changes in the established global trends in tourism under the influence of restrictions caused by the COVID-19 pandemic. The study presents an analysis of the impact of the COVID-19 pandemic on the tourism industry. The macrotrends in tourism before the introduction of restrictions due to the COVID-19 pandemic and the trends that emerged in tourism in the course of the pandemic are identified. The study suggests that the trends that made their appearance in tourism during the pandemic can contribute to the industry's recovery from the crisis in the post-pandemic period. At the same time, the prospects for the tourism sector remain extremely unclear. The changes brought about by the pandemic force the authorities of virtually all countries of the world, especially those in which tourism is guite a significant sphere of development, to take a different approach to the formation of strategies and programs for the development of the tourism industry.

Keywords: Tourism; Tourism industry; Macrotrend; Pandemic; Domestic tourism.

#### MUDANÇAS NAS TENDÊNCIAS TURÍSTICAS DECORRENTES DAS RESTRIÇÕES CAUSADAS PELA PANDEMIA DE COVID-19

#### Resumo

À medida que a nova infecção por coronavírus (COVID-19) continua a se espalhar pelo mundo, a indústria do turismo opera sob inúmeras restrições de distanciamento social, o que tem um impacto negativo na demanda, no desempenho econômico das empresas de turismo e também leva a demissões de funcionários e inúmeras falências no setor. O objetivo do artigo é investigar as mudancas nas tendências globais estabelecidas no turismo sob a influência das restrições causadas pela pandemia do COVID-19. O estudo apresenta uma análise do impacto da pandemia de COVID-19 na indústria do turismo. São identificadas as macrotendências do turismo antes da introdução das restrições devido à pandemia de COVID-19 e as tendências que surgiram no turismo no decurso da pandemia. O estudo sugere que as tendências que surgiram no turismo durante a pandemia podem contribuir para a recuperação do setor da crise no pós-pandemia. Ao mesmo tempo, as perspectivas para o setor de turismo permanecem extremamente incertas. As mudanças provocadas pela pandemia forçam as autoridades de praticamente todos os países do mundo, especialmente aqueles em que o turismo é uma esfera de desenvolvimento bastante significativa, a adotar uma abordagem diferente para a formação de estratégias e programas para o desenvolvimento da indústria do turismo.

Palavras-chave: Turismo; Industria do turismo; Macrotendência; Pandemia; Turismo doméstico.

#### CAMBIO EN LAS TENDENCIAS TURÍSTICAS PRODUCTO DE LAS RESTRICCIONES CAUSADAS POR LA PANDEMIA DEL COVID-19

#### Resumen

A medida que la nueva infección por coronavirus (COVID-19) continúa propagándose por todo el mundo, la industria del turismo opera bajo numerosas restricciones de distanciamiento social, lo que tiene un impacto negativo en la demanda, el desempeño económico de las empresas turísticas y también conduce a despidos de personal y numerosos quiebras en la industria. El propósito del artículo es investigar los cambios en las tendencias globales establecidas en el turismo bajo la influencia de las restricciones causadas por la pandemia de COVID-19. El estudio presenta un análisis del impacto de la pandemia de COVID-19 en la industria del turismo. Se identifican las macrotendencias en el turismo antes de la introducción de restricciones por la pandemia del COVID-19 y las tendencias que surgieron en el turismo en el transcurso de la pandemia. El estudio demuestra que las tendencias que hicieron su aparición en el turismo durante la pandemia pueden contribuir a la recuperación de la industria de la crisis en el período pospandemia. Al mismo tiempo, las perspectivas para el sector del turismo siguen siendo muy poco claras. Los cambios provocados por la pandemia obligan a las autoridades de prácticamente todos los países del mundo, especialmente aquellos en los que el turismo es una esfera de desarrollo bastante significativa, a adoptar un enfoque diferente para la formación de estrategias y programas para el desarrollo de la industria turística.

Palabras clave: Turismo; Industria del turismo; Macrotendencia; Pandemia; Turismo domestico.



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### **1 INTRODUCTION**

The global tourism industry has been developing quite intensely in the past decade. The annual growth of tourist trips by 4-5%, more than 10% of the world's global product, confirms the sustainable and dynamic development of the industry. Tourism has become the main source of formation of national GDP in many countries, such as the Maldives, Macao, Aruba, Seychelles, Curacao, and Bahamas (The International Trade Centre, 2020).

Almost every tenth employable person was employed in the sphere of tourism and considering its multiplicative effect, today almost every third inhabitant of the planet is connected with tourism. As observed by Csirmaz & Peto (2015), the results of research show that being a tourist has become fashionable, prestigious, on a par with owning a car or a house, thereby characterizing the wealth, prosperity, success, and status of a person.

However, the global outbreak of the COVID-19 coronavirus infection in 2020 has produced numerous economic, socio-cultural, and psychological effects on the internal and external stakeholders of the tourism business, some of which will persist for years to come (Baum & Hai 2020; Korstanje, 2020; Balova et al. 2021). Pillai, Kulshreshtha & Korstanje, 2021).

The pandemic crisis of 2020-2021 has become the biggest one in the history of world tourism after the Second World War. Compared to 2019, in 2020, due to the various restrictions on travel, international tourist flows decreased approximately by 73.9% on the worldwide scale, the number of trips to the European continent reduced by 70.4%, to Asia and the Pacific region – by 84.1%, the decrease in tourist arrivals on the American reached 68.5%, and a decrease by 74.6% and 75.1% was observed in Africa and the Middle East, respectively (Narayanan Gopalakrishnan et al. 2021).

The world tourism industry has essentially returned to the level of the 1990s in its development (Narayanan Gopalakrishnan et al. 2021; Gössling, Scott & Hall, 2020), if not to on era where possibility will not make sense to talk about tourism as we used to (Korstanje, 2020; Korstanje & George, 2022).

The ongoing year and a half of restrictions caused by the COVID-19 pandemic and the related economic downturn, especially in the tourism and hospitality sectors, call for the early adoption of a strategy for operating in the new crisis conditions and the postpandemic activities (Shubtsova et al. 2020). Regrettably, research indicates (Assaf & Scuderi 2020) that due to the perceptions of both consumers and business owners, their future expectations are seriously threatened by a high level of uncertainty.

The coronavirus pandemic is precisely what forces a new approach to traditional conceptions, including those regarding leisure time and the further development of the tourism industry (Zhdanova, and Milyaev, 2016; Zhilenko et al. 2021).

Thus, considering the above-mentioned context, the purpose of the article was to investigate changes in the established global trends in tourism under the influence of restrictions caused by the COVID-19 pandemic. In particular, the specific objectives of the study are: a) to reveal the macrotrends in the tourism industry in the pre-pandemic period; and b) to assess the trends in the tourism industry in the course of the pandemic, according to the experts, to Russian context.

We develop the agument that despite the decrease in international tourist flows during the coronavirus pandemic, there are emerging trends in the tourism industry that may help it recover from the crisis in the post-pandemic period.

The article consists of an introduction, a review of the literature, methods of research, results of the study, their discussion, and a conclusion.

## **2 LITERATURE REVIEW**

The theme of identifying and analyzing tourist trends is quite popular among researchers (Csirmaz & Peto 2015; Reisinger & Mavondo 2005; Zhang & Peng 2014, among others), which supports the theoretical and practical significance of this problem.

Some scientists argue that certain trends had developed in the pre-pandemic period that were continuous and stable, clearly unidirectional, and consistently and monotonously changing, which allowed them to be characterized as trends (Reisinger & Mavondo 2005; Zhang & Peng 2014; Csirmaz & Peto 2015; Korstanje & George, 2022).

Based on the geographic and spatial criteria, it is possible to identify different types of trends including macrotrends characteristic of at least the majority of recognized tourist destinations, from different parts of the world. The main of them are described in Table 1.

However, the growth of unemployment and the need for the reanimation of the world's economies have strengthened the socio-economic direction of research on functioning under the conditions of the pandemic and its consequences. In this regard, scientific research on the impact of pandemics on consumer behavior in various markets (Ayittei et al. 2020; The International Trade Centre, 2020), including the market of tourist services was carried out (Yang et al. 2020).

No.	Macrotrend	The essence of the macrotrend	
-			Source
1	Expansion and improvement of the range of tourist products	The supply of products for new forms of tourism and particular segments of tourists in them, as well as the introduction of innovative tourist products of interest to both regular and new clients of the tourism business. This new supply is associated with the spatial expansion of tourism to new, previously unknown, or inaccessible territories and the increasing role of free time in the postindustrial society, which calls for tourist supply of new nature and content.	(Reisinger and Mavondo 2005, 212; Zhang and Peng 2014, 44)
2	The focus on changing the behavioral patterns	Change of the model of tourist behavior from passive to active, from the 3S model (sun, sea, sand) to the 3E model (entertainment, excitement, education).	(Reisinger and Mavondo 2005, 212; Zhang and Peng 2014, 44)
3	The growing influence of information technology in tourism	Information technologies in tourism shape the fashion of recreation, discover new markets and products, maintain contact with clients, and more. New technologies not only shape the demand for tourist products but improve the accessibility of the previously inaccessible or difficult to access vacation destinations. The key impact of modern technology on the development of the tourism industry is found in the dissemination of artificial intelligence, bringing tourists to a vacation destination even before they leave home, the development of self-service-based services, etc.	(Csirmaz and Peto 2015, 755; Reisinger and Mavondo 2005, 212)
4	The emergence of new social groups among tourists	The emergence of social groups who have not previously participated in tourist trips: persons with disabilities, pensioners, single travelers. First and foremost, this applies to tourists from Asia, who were mainly uninvolved in tourist trips because of the political situation	(Csirmaz and Peto 2015, 755; Zhang and Peng 2014, 44)
5	Individualization (personalization) of the tourism supply	The current global market macrotrend is fully reflected in modern tourism, where individualized tourist packages are becoming popular. In this context, the desire to satisfy one's interests causes the rapid development of niche tourism, offering a product adapted to specialized interests (fishing, spa, historical and cultural heritage, etc.).	(Csirmaz and Peto 2015, 755; Reisinger and Mavondo 2005, 212)

Table 1	. Macrotrends	of the tourism	industry in the	he pre-p	andemic	period
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Source: own elaboration.

According to research (Chebli & Ben Said 2020, 196), individual actions of consumers of tourist services are and will be influenced by their beliefs and perception patterns. For example, consumers' perception of the shock of the coronavirus pandemic affects their beliefs, which, in turn, influence their emotions (negative and positive), which determine their future desire to use the services of travel agencies, check into hotels, etc. (Sigala 2020).

A study demonstrates (Zheng et al. 2020) that individual convictions and ideas can shed some light on the motives of consumption associated with quarantine restrictions during epidemics and pandemics, which is extremely important for the study of the features of the functioning of tourism under such conditions and for making predictions about the further functioning of the industry.

In the first half of 2020, the number of tourists worldwide dropped by more than 65%, almost halting since April in contrast to the 8% decline during the global financial crisis and the 17% downturn during the 2003 acute viral respiratory infection epidemic, according to current tourism surveys (Ling & Ho 2020).

As of January 2021, the fall in the number of tourists in the world as a percentage of the previous year for 2020 was 74%. The drop in the number of tourists in Europe as a whole for 2020 compared to 2019 was 69%. The largest reduction was observed in

the countries of Western Europe and amounted to an average of 75% for the year. All regions of Europe experienced the largest drop in April-May 2020, which was up to 97% compared to the number of tourists for the same period in 2019 (Folinas & Metaxas 2020).

The world's regions of greatest tourist decline match with the regions of greatest tourist restrictions, in particular, as of December 2020, Africa had 25% of closed borders, South America – 38%, the Asia-Pacific region as a whole – 59%, including Southeast Asia – 73% (the highest figure in the world), the Middle East – 38% of closed borders (Gössling et al. 2020).

Researchers (Hall et al. 2020, 577) believe that global tourism revenues will not return to 2019 levels by 2023. 43% of survey respondents (Haryanto, 2020) point to 2023, while 41% expect a return to 2019 levels only in 2024 or later. Extended scenarios for 2021-2024 indicate that it may take two-and-a-half to four years for international tourism to return to 2019 levels (Ioannides & Gyimóthy 2020).

### **3 METHODS**

To achieve the established goal, it was conducted a qualitative study of the changes in the established global trends in the tourism industry under the influence of the restrictions introduced due to the COVID-19 pandemic. Structurally, the study includes of consistent analysis of tourism industry macrotrends (Afanasiev & Afanasieva, 2021) in the pre-pandemic period and the tourism industry trends that emerged during the pandemic based on selected scientific sources and industry analytics (Sariişik et al, 2021; Tyagi, 2022).

The paper is a case study (Yin, 2014) based on the secondary data available internationally. At the first step was the selection of a sample of papers dealing with the theme. The group of documents was composed of scientific studies on the characteristics of the state of the tourist sector of the world economy (articles from scientific peer-reviewed journals from Scopus and Web of Science). Scientific studies were searched for on the Internet by keywords: "COVID-19", "tourism", "international tourism", "travel", "trends", "lockdown". According to the purpose of the study, for this stage, a not exhaustive sample of the papers was selected freely and by relevance and interest they generate on the author.

However, at the second stage, an expert assessment of the reliability of the main topics explored on the selected sources was carried out based on the Harrington scale through an e-mail survey with 18 Russian experts in the field of international tourism and tourism management. We adopted as the main criteria for selecting the sample, that the experst should have more than 10 years of experience in the tourism industry. According to the results of the expert assessment, the reliability of the sources is estimated at 0.75 points (high value).

By e-mail, electronic messages were sent to the experts with a request to evaluate the reliability of the selected sources on tourism development trends, as well as to give their expert opinion on the development of the tourism business.

The e-mail contained a list of the following questions, which the experts were asked to answer in

an expanded form:

1. Based on the sources presented, what, in your opinion, are the main trends in the development of the tourism industry during the pandemic?

2. In your opinion, how the main trends of tourism development are formed?

3. How can you determine the essence of these trends, what could be expected of them?

4. What do you think is the future of the tourism business?

All participants in the study were warned about the purpose of the study and that the researchers could generate a text in a summarized form discussing the main research results, and they agreed with that.

The third stage of the study involves the processing of the collected information allowing us to determine the macrotrends of the tourism industry in the pre-pandemic period, to assess trends in the tourism industry during the pandemic, and to analyze the changes that have occurred.

The main trends foud were classified and orgajized in the following categories: a) development of domestic tourism, b) change in trust, c) change in behavior, d) safety and hygiene, e) change in supply, f) shortage of personnel, g) reduced investment e h) digitalization. In the next section they will be presented and discussed in a more detailed way, as well as explored some relations regarding the Russian context.

## **4 RESULTS AND DISCUSSION**

Literature analysis shows that the restrictions caused by the pandemic not only changed the plans of people around the world but gave rise to major changes in the development trends in tourism (see Table 2), which went from being the most dynamically developing industry to the most affected by the spread of COVID-19.

No.	Trend	The essence of the trend	Source
1	Development of domestic tourism	Domestic tourism is expected to yield benefits as people prefer to visit destinations within their own country. Domestic tourists are often more price-sensitive and tend to have lower spending patterns	(Assaf and Scuderi 2020, 731; Bakar and Rosbi 2020, 189; Narayanan Gopalakrishnan <i>et al.</i> 2021)
3	Change in trust	Tourist trust has been hit hard by the crisis and constant uncertainty. This may lead to a decrease in demand and tourism consumption, which will last long after the initial shock	(Ling and Ho 2020, 312; Zheng <i>et al.</i> 2020, 337)
4	Change in behavior	Tourist behavior will be influenced by the development of the crisis as well as long-term consumer trends that are changing the way we travel. This may include the emergence of new niches and market segments, as well as a greater emphasis on safety protocols and non-contact travel experiences	(Bakar and Rosbi 2020, 189; Hall <i>et al.</i> 2020, 577; Haryanto 2020, 1)
5	Safety and hygiene	Safety and hygiene have become key factors in choosing destinations and travel activities. People are likely to prefer individual solutions when traveling, avoiding large crowds, and giving priority to private vehicles	(Sigala 2020, 312; Yang <i>et al.</i> 2020; Zheng <i>et al.</i> 2020, 337)
6	Change in supply	Structural changes are expected in the ecosystem in the tourism supply. Not all businesses will be able to survive the crisis, and capacity in the sector is likely to shrink for a period, hindering its recovery	(Chebli and Ben Said 2020, 196; loannides and Gyimóthy

**Table 2.** Trends in the tourism industry during the pandemic.

			2020, 624; Khazami <i>et al.</i> 2020, 89)
7	Shortage of personnel	The shortage of qualified personnel in the tourism sector may become more acute, as many jobs are lost and workers are reemployed in other sectors	(Gössling <i>et al</i> . 2020, 1; Ling and Ho 2020, 312)
8	Reduced investment	The reduced investment will require active policies to encourage and restore investment in the tourism sector to maintain the quality of the tourism supply and promote recovery	(Hall <i>et al.</i> 2020, 577; Khazami <i>et al.</i> 2020, 89; Sigala 2020, 312)
9	Digitalization	The digitalization of travel services will continue to accelerate, including greater use of automation, contactless payments and services, virtual experiences, and the provision of real-time information	(Haryanto 2020, 1; loannides and Gyimóthy 2020, 624)

Source: own elaboration based on the compilation of the main sources of the literature reviewed.

As demonstrated by the results of the study (Table 2), one of the main trends in the tourism industry in the pandemic period is the development of domestic tourism, which provides the vital stimulus to support many tourist destinations and businesses and may later become a key factor in the recovery in the short and medium term. Starting from Since mid-2020, according to (Yang et al. 2020), there has been some activity in domestic tourism, in particular, due to the effects of removing international travel restrictions. However, domestic tourism has not become a panacea either, as many countries are facing further waves of the virus, and, as expected, the level of domestic tourism worldwide at the end of 2020 was below the level at the start of the COVID-19 pandemic.

Furthermore, not all tourist destinations have benefited due to permanent restrictions on movement within countries and altered patterns of tourist demand and behavior. According to researchers (Gössling et al. 2020), the behavior of consumers of tourist services has been changed to adapt quickly to the new way of life, and the future of the tourism business during the period of restrictions depends largely on the perception of the shock of the disaster (Sales Dias et al., 2021), consumer beliefs, expected emotions, and future desires.

The macrotrends identified in the literature review (Table 1) characterize major societal and social changes in decision-making and are formed under conditions of stable factors. However, in our opinion, individual trends emerge depending on the moods of clients, the changes in life situations, concern a certain age group, or a limited segment of the market. These trends, according to researchers (Hall et al. 2020), appear in the average or short-term period and can be the initial tool for further transformations and the formation of macrotrends.

It is in this (possibly shorter) period that the tourism market will develop trends oriented on the recovery of tourism to the previous scale and rate of growth. The indicated trends, researchers argue form in the situation of the spread of coronavirus being accompanied by a great degree of uncertainty, in which countries and their regions are in different phases of the pandemic and different stages of recovery from it, therefore, these trends may later spread to other countries in terms of solutions to certain problems (loannides and Gyimóthy 2020).

Assessing the current situation, in our opinion, we should expect the following short- (or rather medium-) term changes in the tourism market, associated with changes in the demand (primarily the needs and opportunities of tourists) and supply of tourism businesses.

First and foremost, the requirements for tourist facilities related to their safety, welfare during travel, and expanding the range and improving the quality of tourist services will become stricter. It is demonstrated in a study (Sigala 2020, 312) that a new approach to the sanitary safety of tourists is to be expected. In particular, 57% of the respondents want a generally binding safety certificate to be introduced and 22% of potential clients who do not consider such a certificate necessary believe that the level of sanitary safety should be monitored and confirmed by the appropriate external services. Therefore, there is a problem with the readiness of individual countries and regions to provide a sufficient number of accommodation facilities that will be able to provide safe living conditions in terms of health protection.

In this context, tourists' attention will undoubtedly be drawn to the spread of the virus and its consequences in individual countries, as well as on how the authorities of certain countries responded to coronavirus. In this regard, it is important how much the local authorities will fear that tourists may get infected and worsen the epidemic situation.

There quite logically emerges the question about the criterion for selecting a tourist destination: tourist attractions (attractiveness of the destination, good cuisine, recreational offer, etc.) will continue to be a key element of tourist demand, yet personal safety can become such a criterion as well.

A compromise between the aforementioned criteria and a revision of values will produce changes in the structure of types of tourism, first of all, with an emphasis on the preservation and improvement of health, since one of the aspects of human life is striving for health. Since medical services increasingly often become an element of tourist trips or their main purpose (Zheng et al. 2020, 337)], in the post-pandemic conditions, healthcare institutions can offer better safety, so it is the sphere of health tourism that will develop especially.

In our view, due to limited financial resources and security needs, including fear of recurring epidemics, holidays will be spent in cozy guesthouses and agrofarms, and popular resorts and hotels will be seriously affected. It is the safety approach that will encourage the development of family tourism inherent in countries with strong family traditions, to which Russia belongs. This will call for an expansion of the range of tourist products primarily aimed at adapting different generations (Sariişik et al., 2021).

The post-pandemic period will bring about a reduction in both the number of participants in the tourist market and the volume of services offered in it. There is no doubt that the opening of many tourist facilities, at least in the post-quarantine period, will become unprofitable, since it will not be profitable due to the weak load, unsuitability of facilities, and the need to offer a low competitive price. Therefore, we are to expect the so-called adaptation period characterized by low payback and balancing on the verge of closing the business.

At the same time, there remains great uncertainty regarding the development of the situation caused by the coronavirus. It is quite apparent that the easing of restrictions will depend not only on the health situation but also on the reaction of the media to the epidemiological situation. Information from the media can be decisive. Rather ill-considered, in our opinion, can also be a race to be ahead of the curve in accelerating the exit from quarantine – the desire for economic benefit against the background of other countries. Therefore, only scientifically sound and not emotional decisions can be the key to a better and safer return to normality.

## **5 FINAL REMARKS**

The changes brought about by the pandemic force the authorities of virtually all countries of the world, especially those in which tourism is quite a significant sphere of development, to take a different approach to the formation of strategies and programs for the development of the tourism industry. The specifics of overcoming the crisis and the measures taken can, to a certain extent, change the situation in the global tourism market. Only in those countries that turn out to be the most flexible in the face of the new demands of tourists can we expect real economic results.

The results of the study support the hypothesis that despite the decrease in international tourist flows

during the coronavirus pandemic, there are emerging trends in the tourism industry that may help it recover from the crisis in the post-pandemic period.

At the same time, the prospects for the tourism industry remain highly unclear. Domestic tourism helps mitigate the impact, at least in part, and governments have taken instant action to rebuild and revitalize the sector while protecting jobs and businesses.

Many countries have also developed, and continue to create, measures to build a more resilient tourism economy in the wake of the pandemic. These measures include preparing plans to support a sustainable tourism recovery, facilitating the digital transition and the transition to a green tourism system, and rethinking tourism for the future. Overall, postguarantine realities will show how tourism will evolve.

Prospective for further research is the study and development of effective alternative mechanisms and scenarios of recovery of the tourism industry from the crisis in the post-pandemic period.

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 Table 1. CRediT author statement

Term	Definition	Author 1	A.2	A.3	A.4	A.5	A.6
Conceptualization	Ideas; formulation or evolution of overarching research goals and aims	+	+	+	+	+	+
Methodology	Development or design of methodology; creation of models	+	+	+	+	+	+

#### CHANGE IN TOURIST TRENDS AS A RESULT OF RESTRICTIONS CAUSED BY THE COVID-19 PANDEMIC Natalya Saenko, Lyudmila Shubtsova, Igor Khmelev, Ivan Otcheskiy, Aleksandr Sakhno & Vasily Sinyukov

Term	Definition	Author 1	A.2	A.3	A.4	A.5	A.6
Software	Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code components	+	+	+	+	+	+
Validation	Verification, whether as a part of the activity or separate, of the overall replication/ reproducibility of results/experiments and other research outputs	+	+	+	+	+	+
Formal analysis	Application of statistical, mathematical, computational, or other formal techniques to analyze or synthesize study data	+	+	+	+	+	+
Investigation	Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection	+	+	+	+	+	+
Resources	Provision of study materials, reagents, materials, patients, laboratory samples, animals, instrumentation, computing resources, or other analysis tools	+	+	+	+	+	+
Data Curation	Management activities to annotate (produce metadata), scrub data and maintain research data (including software code, where it is necessary for interpreting the data itself) for initial use and later reuse	+	+	+	+	+	+
Writing - Original Draft	Preparation, creation and/or presentation of the published work, specifically writing the initial draft (including substantive translation)	+	+	+	+	+	+
Writing - Review & Editing	Preparation, creation and/or presentation of the published work by those from the original research group, specifically critical review, commentary or revision – including pre-or post- publication stages	+	+	+	+	+	+
Visualization	Preparation, creation and/or presentation of the published work, specifically visualization/ data presentation	+	+	+	+	+	+
Supervision	Oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team	+	+	+	+	+	+
Project administration	Management and coordination responsibility for the research activity planning and execution	+	+	+	+	+	+
Funding acquisition	Acquisition of the financial support for the project leading to this publication	+	+	+	+	+	+

Source: adapted from Elsevier (2022, s/p), based upon Brand et al. (2015).

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