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Research Articles

Genomics, social media and the novel coronavirus pandemic, COVID-19

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The spread of misinformation and conspiracy theories about the novel coronavirus on social media has led to increased racist and xenophobic acts. The origin of the novel coronavirus is still unknown, but it has been widely discussed online. Viral genomics research will help us understand the origin, structure and evolution of the novel coronavirus (SARS-CoV-2). We developed a simple one-minute Facebook survey to assess Portuguese residents' perceptions about the origin of the SARS-CoV-2. The results revealed high levels of misinformation, mainly among those groups with lower educational attainment. Social media will need to take on the hard task of improving the quality of science communication and changing mindsets. Society at large will be responsible for preventing a future pandemic through the coordination and improvement of civic, political, educational and scientific approaches.

In just a few weeks, the novel coronavirus (SARS-CoV-2) caused a global pandemic disease (COVID-19) that has changed our live and the world, with millions of people in quarantine, the collapse of various health systems and the beginning of a new global economic crisis. In a race against time, governments, industry, health professionals and researchers from around the world are working hard to improve diagnostic tests and develop effective and safe drugs and vaccines. Scientific publishers have teamed up in ways never seen before, publishing all data and research open access with an accelerated peer review process. The number of publications on the genomics, evolution and origin of the novel coronavirus is growing and the sequencing of the SARS-CoV-2 genome in various countries has shown that the virus has already mutated, indicating different variants circulating among populations.[1,2] The genome length is about 30,000 base pairs and appears to have a mutation rate of approximately one to two mutations per month.[1,2] Knowledge of virus variants is of particular interest to the development and improvement of diagnostic tests and drug discovery.[3] Furthermore, advances in genomics approaches may elucidate the direction and evolution of the virus spread at a global level and answer questions intriguing to both researchers and society, such as "what was the origin of the virus?".[1,4] The available genomic data suggest that bats and/or pangolins may have been the host animal before the zoonotic transfer, but other unknown intermediate hosts could have been involved in the evolution of the virus and animal-to-human transmission.[4–7] However, none of these studies can completely rule out the hypothesis that SARS-CoV-2 emerged through laboratory manipulation and the hypothesis of the first animal-to-human transmission have happened outside China (the first pandemic outbreak location).[4] Only the massive sequencing of coronavirus genomes in humans and wild species can help to clarify mutation rates, recombination events, evolution and origin of the SARS-CoV-2.

We have observed that the question about the origin of the SARS-CoV-2 is controversial and has been much discussed among social network communities. Social media is increasingly present in our lives and these networks are excellent conduits for the rapid spread of scientific news, but they struggle to filter out fake news. There are many fake SARS-CoV-2/COVID-19 topics circulating online, including the efficiency of certain homeopathic treatments, already-discovered drugs and vaccines being hidden by pharmaceutical companies and governments, and the many unfounded theories about the laboratory origin of the virus. What worries us most is the number of people who believe and share this content, which is difficult to control with filter algorithms alone or to counteract with high-quality science communication. In addition, some daily newspaper articles misinterpret original research articles using clickbait titles, and the news about COVID-19 has been no exception.

The response to emerging infectious diseases has improved with advances in viral genomics research and the development of novel surveillance systems.[8] The rapid sharing of new research findings and public health recommendations is essential for effective implementation of prevention measures. Social media has greatly contributed to the simplification and dissemination of scientific information during disease outbreaks.[9] The increasing amount of viral genomic data along with easy access to and dissemination of this information have facilitated public health discussions and real-time decision-making.[10] However, the spread in social media of false arguments and statements not supported by scientific evidence may have important implications for public health actions.[11] Misinformation about SARS-CoV-2 and COVID-19 has influenced opinions among all social classes, including highly educated indi-

viduals and government leaders of major developed and developing countries.[12,13] Government anti-scientific pronouncements and failure to implement prevention measures during a pandemic outbreak could increase health-related risky behaviour, which could be devastating to the populations affected.[12,13] The development of research on the influence of social media on social behaviour, the promotion of high-quality science communication that is accessible and understood by all social classes and the improvement of public health education are all crucial in the fight against pandemics.

METHODS

To present an example of what Portuguese citizens think about the origin of SARS-CoV-2/COVID-19, we conducted a survey on Facebook with three rapid questions: (i) What is the origin of SARS-CoV-2/COVID-19? (ii) Age of the respondent and (iii) Education level of the respondent. Participants were asked to select one of five options to indicate the origin of the novel coronavirus: (i) bats (Wuhan market, China), (ii) pangolins (Wuhan market, China), (iii) the animal-to-human virus transmission occurred in another country (i.e., outside China), (iv) the virus emerged through laboratory manipulation, or (v) it is not yet possible to state the true origin of the virus. Google Forms (https://docs.google.com/forms) was used to create the survey and to collect the data. The survey was carried out from 23-28 March 2020 with Portuguese residents only. The answers were organized according to age class, education level and global average values (i.e., including all answers). Descriptive statistics (frequencies and percentages) were used to analyze the responses.

RESULTS

Answers from 1198 respondents were recorded in the Google Forms application. The maximum sampling error is 2.83% for a 95% confidence interval, considering the size of the Portuguese population. The age of respondents ranged from 9-76 years with a mean age of 35.79 (SD = 12.20). The percentage of each age class were ⩽15 (0.42%, *n* = 5), 16-25 (21.20%, *n* = 254), 26-35 (31.22%, *n* = 374), 36-45 (27.13%, *n* = 325), 46-55 (13.60%, *n* = 151), 56-65 (5.68%, *n* = 68) and >65 (1.75%, *n* = 21) (**Figure 1**). The opinion of respondents was similar across all age classes (**Figure 1**). Regarding education levels, the participants were grouped according to basic education (13.94%, *n* = 167), secondary education (37.48%, *n* = 449), bachelor/licentiate degree (28.30%, *n* = 339), master degree (14.52%, *n* = 174), or doctorate degree (5.76%, *n* = 69) (**Figure 1**). The survey showed that the number of correct answers (i.e., it is not yet possible to state the true origin of the virus) increased with education level (basic education, 38%, *n* = 64; secondary education, 39%, *n* = 177; bachelor/licentiate, 54%, *n* = 181; master, 55%, *n* = 95; doctorate, 61%, *n* = 42), and citing of conspiracy theories (i.e., claims that the virus emerged from laboratory manipulation without scientific evidence) tended to decrease with increasing education level (basic education, 34%, *n* = 57; secondary education, 23%, *n* = 103; bachelor/licentiate, 12%, *n* = 42; master, 7%, *n* = 12; doctorate, 6%, *n* = 4) (**Figure 1**). Similar percentages were obtained for other options across all education levels (**Figure 1**). Interestingly, the global results indicated that 53.34% (*n* = 639) of the population sampled provided a concrete source for the virus, *i.e.* selected the wrong options (**Figure 1**).

DISCUSSION

The data from this simple survey highlights that the information published in news, and shared and discussed in social networks, fails in the transmission of an accurate scientific message. Effective science communication during such an outbreak is crucial, since widespread misinformation about SARS-CoV-2/COVID-19 is frequently associated with economic, political, racist and xenophobic ideologies.[14] The increased amount of SARS-CoV-2 viral genomic data is of particular importance for diagnostic laboratories and the pharmaceutic industry, but also to demystify conspiracy theories circulating among the public that may lead to political and social conflicts. In addition, fake news can confuse public opinions and perspectives and influence governmental policy, which can lead to a lack of adherence to prevention measures (e.g. social distancing, use of personal protective equipment and vaccination), as well as mass gatherings contrary to public health recommendations. These behaviours during a pandemic outbreak could significantly increase the risk of infection in communities.[12,13,15]

Furthermore, confirmation and clarification of the reservoir hosts, intermediate hosts and mechanisms of animal-to-human transmission is necessary from a One Health perspective.[16] The global population lives in increasingly close contact with domestic (pets and livestock) and wild animals. The SARS-CoV-2 transmission to domestic animals appears to be residual, but more research on this phenomenon is needed.[17] Meat consumption and the coexistence of both legal and illegal trading of wild animals increases the complexity of zoonotic events.[18] These activities should be minimized through prohibition and/or tight control measures, as they can become a threat to global public health.

We are all experiencing this unprecedented pandemic outbreak, but the future begins now. It is more important than ever that researchers and professionals in human health, animal health, environment sciences, and experts in other relevant scientific fields work together to coordinate and collaborate on multidisciplinary projects. This pandemic has shown us that everything can change in a few days, and many things will never be the same, but we will all be responsible for preventing a future pandemic of this magnitude. It is a critical time for governments to rethink the role of science in the society.

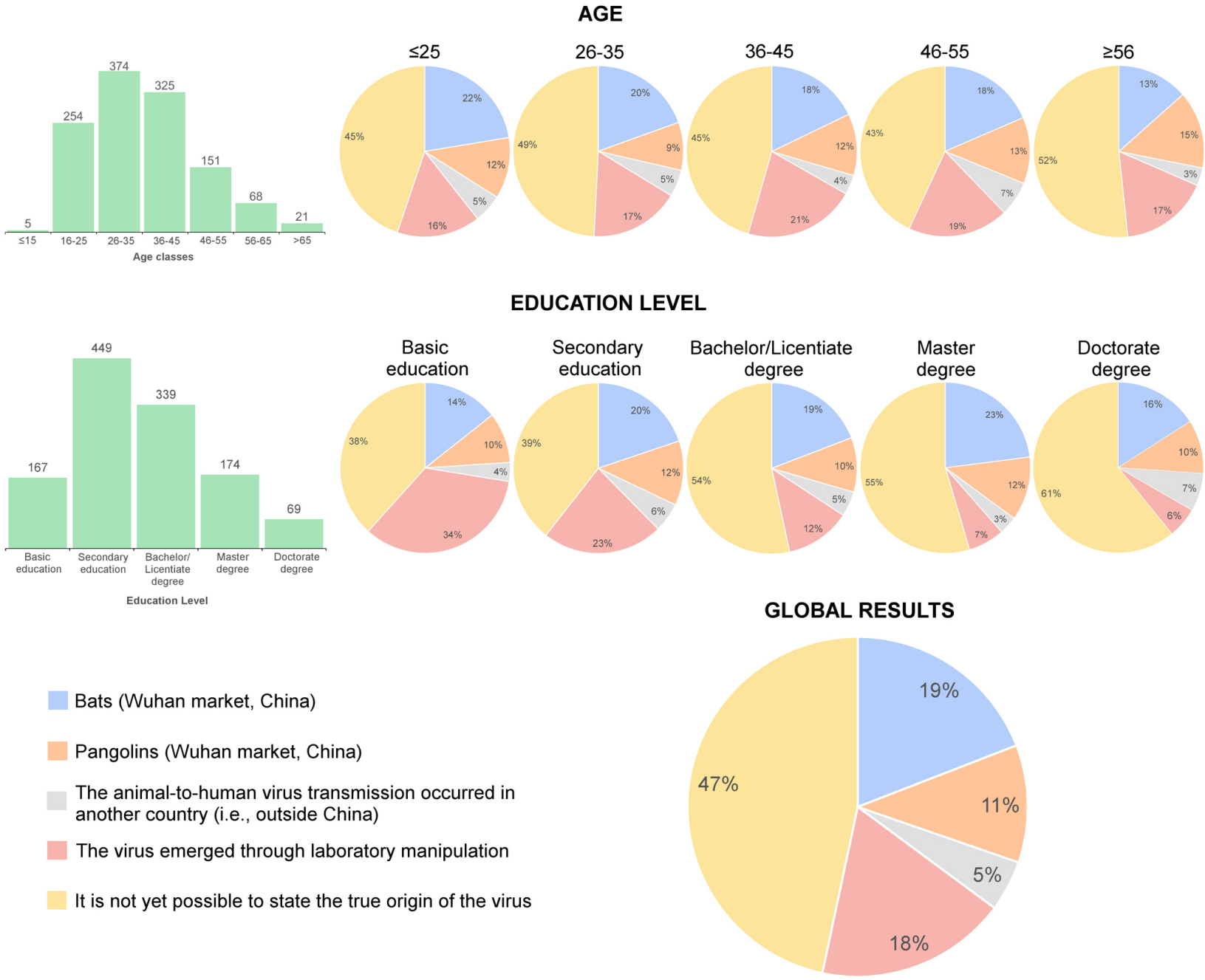

Figure 1. Results of Facebook survey on the origin of the novel coronavirus (SARS-CoV-2).

Descriptive statistics are presented according to age class, education level and global average values (*i.e.*, including all 1198 answers).

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