Cells are cultured in controlled incubators according to standard protocols. But cells grow and "breathe" over time, exchanging gases with their surrounding environment. This affects the local environment in which they grow and can change parameters like culture acidity and dissolved oxygen and carbon dioxide. These changes can affect cell function and could make conditions different from those found in the living human body.

"Our study highlights the extent to which scientists neglect to monitor and control cellular environments, as well as neglect to report the specific methodologies that allow them to reach their scientific conclusion," says Klein.

For example, the researchers found that around half of the papers analyzed failed to report the temperature and carbon dioxide settings of their cell cultures. Less than 10 percent reported the atmospheric oxygen levels in the incubator and less than 0.01 percent reported the medium's acidity. No papers reported the dissolved oxygen or carbon dioxide in their media.

"We were very surprised that researchers largely overlooked the maintenance of environmental factors, like culture acidity, at levels relevant to the physiological body over the full course of the cell cultures, despite it being well known that this is important for cell function," says Ph.D. student Samhan Alsolami.

The team, led by KAUST's marine ecologist Carlos Duarte and stem cell biologist Mo Li in collaboration with developmental biologist Juan Carlos Izpisua Belmonte from the Salk Institute, who is currently a visiting professor at KAUST, recommends that biomedical scientists develop standard reporting and control and measuring procedures, in addition to employing purpose-built instruments for
controlling the culture environments of different cell types. And scientific journals should establish reporting standards while requiring adequate monitoring and control of culture medium acidity and dissolved oxygen and carbon dioxide.

"Better reporting, measurement and control of the environmental conditions of cell cultures should improve how well scientists can repeat and reproduce experimental results," says Alsolami. "More careful attention could drive new discoveries and increase the relevance of preclinical research to the human body."

"Mammalian cell cultures are fundamental to manufacturing viral vaccines and other biotechnologies," explains marine scientist, Shannon Klein. "They are used to study basic cell biology, replicate disease mechanisms and investigate the toxicity of novel drug compounds before they are tested on animals and humans."

The study is published in Nature Biomedical Engineering.

**More information:** A prevalent neglect of environmental control in mammalian-cell culture calls for best practices, Nature Biomedical Engineering, doi.org/10.1038/s41551-021-00775-0

Provided by King Abdullah University of Science and Technology

APA citation: Better reporting, measurement and control of the environmental conditions of cell cultures is needed (2021, August 13) retrieved 16 August 2021 from https://medicalxpress.com/news/2021-08-environmental-conditions-cell-cultures.html

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