



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Letter to the editor



Letter of concern on evaluating the consistency between two clinical COVID-19 diagnostic methods

ARTICLE INFO

Keywords

SARS-CoV-2, COVID-19
Polymerase chain reaction
RT-LAMP
Agreement
Cohen's kappa

To the Editor,

We read with interest the article entitled: "Clinical COVID-19 diagnostic methods: Comparison of reverse transcription loop-mediated isothermal amplification (RT-LAMP) and quantitative RT-PCR (qRT-PCR)" [1]. This study compares the RT-LAMP assay with qRT-PCR using the Loopamp™ SARS-CoV-2 Detection Kit. RT-LAMP shows similar performance to qRT-PCR for 151 nasopharyngeal swab and 88 sputum samples. Therefore, the article states that RT-LAMP is a highly reliable and at least equivalent to qRT-PCR in utility. Although this article provides valuable information, we believe that when the authors evaluated the consistency between qRT-PCR and RT-LAMP, some results are worth discussing. According to the authors' evaluation, the concordance rates for nasopharyngeal samples, sputum samples, and total samples between qRT-PCR and RT-LAMP assays were 93.4 (141/151), 93.2 (82/88), and 93.3% (223/239), respectively. We notice that the agreement of the qRT-PCR and RT-LAMP were not assessed. However, it should be noted that to evaluate intraobserver consistency, applying overall concordance rate is not always appropriate. It depends on the prevalence of each observer. For example, Table 1 shows that in both (a) and (b) conditions, the prevalence of concordant data is 95.0% and discordant data is 5.0%. Meanwhile, the overall concordance rates are 95.0% in both conditions. However, we get different Cohen's kappa values (0.260 as minimal agreement and 0.900 as strong agreement), respectively.

Table 1

Limitation of overall concordance rate to assess consistency of two observers with different prevalence in the two categories.

| Observer 2 | Observer 1 | | | Concordance rate | |
|---------------------|------------|----|-------|------------------|--------------------|
| | + | - | total | | |
| Condition (a) | | | | | |
| $k = 0.260$ | + | 94 | 2 | 96 | 95.0%, (94+1)/100 |
| (minimal agreement) | - | 3 | 1 | 4 | |
| | total | 97 | 3 | 100 | |
| Condition (b) | | | | | |
| $k = 0.900$ | + | 47 | 2 | 49 | 95.0%, (47+48)/100 |
| (strong agreement) | - | 3 | 48 | 51 | |
| | total | 50 | 50 | 59 | |

<https://doi.org/10.1016/j.jcv.2022.105241>

Received 27 June 2022; Received in revised form 7 July 2022;

Available online 11 July 2022

1386-6532/© 2022 Elsevier B.V. All rights reserved.

Cohen's kappa analysis is suitable for evaluating consistency between two observers [2] and calculated as follows:

$$k = \frac{\sum_{i=1}^n (p_{ii} - p_i q_i)}{1 - \sum_{i=1}^n p_i q_i}, \quad (1)$$

where k is the kappa value and p and q are the sample frequencies. According to McHugh [3], the kappa result should be interpreted as follows: 0–0.20 as indicating no agreement, 0.21–0.39 as minimal agreement, 0.40–0.59 as weak agreement, 0.60–0.79 as moderate agreement, 0.80–0.90 as strong agreement, and 0.91–1.00 as almost perfect agreement.

Therefore, we recommend combining Cohen's kappa analysis and concordance rate in the consistency analysis between qRT-PCR and RT-LAMP assays. Here, according to the authors' data, we calculated the Cohen's kappa values. The Cohen's kappa values for nasopharyngeal samples, sputum samples, and total samples between qRT-PCR and RT-LAMP assays were 0.868, 0.840, and 0.864, respectively (Table 2). It showed strong agreement between qRT-PCR and RT-LAMP assays.

Table 2

Cohen's kappa values for calculating agreement between qRT-PCR and RT-LAMP.

| qRT-PCR | RT-LAMP | | | Concordance rate | |
|----------------------------------------|---------|----|-------|------------------|---------------------|
| | + | - | total | | |
| Nasopharyngeal swab and sputum samples | | | | | |
| $k = 0.864$ | + | 94 | 14 | 108 | 93.3%, (94+129)/239 |
| (strong agreement) | - | 2 | 129 | 131 | |
| | total | 96 | 143 | 239 | |
| Nasopharyngeal samples | | | | | |
| $k = 0.868$ | + | 70 | 9 | 79 | 93.4%, (70+71)/151 |
| (strong agreement) | - | 1 | 71 | 72 | |
| | total | 71 | 80 | 151 | |
| | | | | | |
| | + | | | | 93.2%, (70+71)/151 |
| Sputum samples | - | 24 | 5 | 29 | |
| $k = 0.840$ | - | 1 | 58 | 59 | |
| (strong agreement) | total | 25 | 63 | 88 | |

Note: The data has been cited from the article published by Kitajima et al. [1] and undergone modification. k in the table is the Cohen's kappa value calculated by us.

Funding

This research was supported by a grant (LH2020C110) from the Joint Guidance Project of Natural Science Foundation of Heilongjiang Province of China, a grant (YSTS XK201881) from the Fundamental Research Funds in Heilongjiang Provincial Universities.

Declaration of Competing Interest

The authors report no declarations of interest. There are no any ethical/legal conflicts involved in the article.

References

- [1] H. Kitajima, Y. Tamura, H. Yoshida, H. Kinoshita, H. Katsuta, C. Matsui, A. Matsushita, T. Arai, S. Hashimoto, A. Iuchi, T. Hirashima, H. Morishita, H. Matsuoka, T. Tanaka, T. Nagai, Clinical COVID-19 diagnostic methods:

comparison of reverse transcription loop-mediated isothermal amplification (RT-LAMP) and quantitative RT-PCR (qRT-PCR), *J. Clin. Virol.* 139 (2021), 104813, <https://doi.org/10.1016/j.jcv.2021.104813>.

- [2] M.T. Cibulka, M.J. Strube, The conundrum of kappa and why some musculoskeletal tests appear unreliable despite high agreement: a comparison of Cohen kappa and Gwet AC to assess observer agreement when using nominal and ordinal data, *Phys. Ther.* 101 (2021), <https://doi.org/10.1093/ptj/pzab150> pzab150.
- [3] M.L. McHugh, Interrater reliability: the kappa statistic, *Biochem. Med. (Zagreb)*. 22 (2012) 276–282, <https://doi.org/10.11613/BM.2012.031>.

Ming Li^a, Tianfei Yu^{b,*}

^a College of Computer and Control Engineering, Qiqihar University, Qiqihar 161006, China

^b College of Life Science and Agriculture Forestry, Qiqihar University, Qiqihar 161006, China

* Corresponding author.

E-mail address: yutianfei@qqhru.edu.cn (T. Yu).