Received: 26 March 2024 | Accepted: 27 March 2024

DOI: 10.1111/sms.14622

LETTER TO THE EDITOR

WILEY

Response to Mr. Di Pietro

We would like to thank Mr. Di Pietro from one of the manufacturers (COSMED) who's device was included in our experiments for his comments on our study. Here we provide a short response to clarify some of the points raised in these comments.

First, we indeed used multiple trials for devices that were present multiple days at our research facility to assess the between-day reliability. It is correct that the use of multiple trials for some systems can decrease the standard deviation of the error and influence the mean value. For most devices, the use of multiple trials, however, had only a minimal impact on the results due to the high between-day reliability (generally <1.6% difference in the measured gas exchange values between repeated measurements; see supplemental Excel dataset). For two devices with lower between-day reliability (VO_2masterPro and PNOĒ), the use of multiple trials does potentially meaningfully reduce the standard deviation of the error and the mean error, thus warranting caution when comparing the results from these devices with the other devices. Nevertheless, despite the use of multiple tests, these devices generally showed larger errors and variability in these errors compared to the other assessed devices, and we, therefore, do not anticipate the use of one measurement would have altered the study conclusions.

Second, Mr. Di Pietro correctly notes that the average concentration of ambient CO_2 of 0.17% is higher than would be anticipated for a well-ventilated testing environment (0.04%). While the room was ventilated by opening multiple windows and doors, this observation indicates that such procedures may not sufficiently ventilate rooms. We do however consider this observation a strength to the ecological validity of our findings rather than a limitation, as a similar effect may occur in other laboratories or clinical testing facilities where multiple research staff individuals, clinicians, or coaches with support staff may be present in the same room, or where multiple tests are performed in a small time window. These findings do however suggest that the results reflect indoor testing accuracy, instead of outdoor testing accuracy. Moreover, such findings imply that CPET manufacturers may need to measure the ambient CO_2 continuously during testing instead of estimating these, or using the start test ambient CO_2 as reference throughout the test procedure.

The third point raised relates to the lack of necessary corrections during simulated tests. In this regard, we would like to emphasize that all results are in fact BTPS (ventilation and tidal volume) or STPD (VO_2, VCO_2) corrected, thereby accounting for the notion that the exhaled temperature of the metabolic simulator is in room conditions. This is also described in section 2.6 of the manuscript, contrary to the suggestion made in the letter. For COSMED, we asked the COSMED staff present at the testing facility to turn off the human-subject BTPS correction as described in this section. It is unfortunate to learn that this was not implemented for the K5 device. To this purpose, we have applied a post-hoc correction to the K5 results, which leads to an overall mean relative percentage error of 1.55% and 3.60% for the VO_2 or VCO_2 values obtained from K5 considering the ambient conditions of the day at which K5 was tested.

Fourth, Mr. Di Pietro noted a discrepancy between the results reported in Table 2 compared to the table reported in the supplementary study material for the relative percentage error for the VCO_2 of COSMED K5 and MGC Diagnostics Ergocard. Please note that this discrepancy was only shortly present in the Epub ahead of print version of the paper, and this has already been corrected during the proofing process. The values in the published paper are therefore correct and in line with the data in the supplementary file.

The fifth point relates to the recertification of the metabolic simulator during the study. It is important to clarify that the metabolic simulator was only verified against the certification reference standard, and no adjustments were made. For our study, this indicates a verification of the simulator's precision accuracy within the metabolic simulator's original specifications and certification. As such, this is not a reason for concern but rather strengthens the interpretation of the metabolic simulator results in our study.

The sixth and final point raised is the use of two metabolic devices as a reference, and the use of three devices in the first test. We have clearly articulated the decision for this in the original manuscript in section 2.8 and will elaborate this again here: Vyntus CPX and Oxycon Pro were used to calculate the reference value because these systems

showed generally high accuracy during the simulation experiments and showed good-to-acceptable between-day reliability. We also corrected the measured values of these systems for the error observed during the simulation experiments, as described in the original manuscript. We believe this procedure ensured an accurate and consistent reference range during the human experiments. If we had instead used multiple systems with unknown between-day reliability, this could have compromised the consistency. This decision should therefore also be regarded as a strength rather than a limitation.

Overall, we thank Mr. Di Pietro for raising his concerns and for allowing us to clarify that the points raised generally have minimal impacts on our findings.

FUNDING INFORMATION

No funding was received.

DATA AVAILABILITY STATEMENT

No data is generated.

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