Comparison of Metabolic Cart with Douglas Bags and Computerised Metabolic Cart

By
[Donny Malin]

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Signature: ________________________

Date: __________________________

DECLARATION

I, (your name), would like to declare that all the material of this study is solely my own work that has been performed without any aid. This work had not been submitted previously at any academic or professional level. The views represented in this study are my own and not those associated with other university.

Signed ___________________ Date __________________

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Introduction

This critical literature review is based on the comparison of metabolic cart with Douglas bag method (DBM) and computerised metabolic cart. Various variables of oxygen metabolism were considered for evaluation of the validity and reliability of different metabolic cart with DBM and computerised metabolic cart. The critical review of some recently published studies is performed to obtain acceptable results regarding the efficacy of metabolic cart with Douglas bag method (DBM) and computerised metabolic cart. A search of the electronic databases Pubmed, ScienceDirect, and MEDLINE was performed from the year 2010 to 2014 for accessing relevant articles. The keywords used included "Douglas bag method", "computerised metabolic cart", and "validity and reliability".

Critical Literature Review

Rosdahl et al (2013) examined the Moxus metabolic system with the DBM. Thirteen athletes participated in the study by exercising on a cycle ergometer at VO_2max and five submaximal powers. Measurement of gas variables was simultaneously performed with data collection at different days to randomize between turbine flowmeter (MT) and Moxus with pneumotachometer (MP). Reliability of both the sensors was comparable to DBM. Coefficient of variation (CV) for Moxus metabolic system were 3.8 ± 1.5 for VCO_2 and 3.0 ± 1.3 for VO_2 when evaluated through MP while they were 4.7 ± 0.4 for VCO_2 and 2.7 ± 0.3 for VO_2 in case of MT. The differences for these variables through DBM were +5 to -4 % for VCO_2 and +5 to -3 % for VO_2. Thus, no significant differences were present in the efficacy of DBM and Moxus metabolic system. Similarly, Rosdahl et al (2010) also compared the efficiency of DBM and Oxycon Mobile portable metabolic systems (OMPS1 and OMPS2) with metabolic variables VCO_2, VE, and VO_2. These variables were measured in moderately trained people and athletes by maximal cycle ergometer exercise. CVC for these variables ranged between 2% to 7% measured at different rates of work and were similar to those obtained by DBM. However, with OMPS1, there were some errors in VCO_2 and VO_2. VCO_2 was measured to be 5-9% while VO_2 was 6-14% higher than DBM at submaximal work rates. Measurements of VO_2 were slightly lower for OMPS2 while those for VCO_2 were overestimated. Underestimations were present at VO_{2max} with accurate measurements at V_E. Thus, OMPS1 and OMPS2 both provide reliable measurements of VO_2 but lack accuracy for VCO_2 and V_E. A similar evaluation was performed by Medbø, Mamen, and Resaland (2012) who also analysed and compared the accuracy of MetaMax ®I with DBM. Maximal O_2 measurements were taken with school children and analysed through both the old and new version of the software. In the next process, 5 minutes cycling was performed at constant powers between 50 and 350 W by 5 healthy subjects and O_2 measurements were taken simultaneously by DBM and MetaMax ®I at last minute of the exercises. Maximal O_2 uptake in school children was 3% lower when analysed by newer version as compared to the former version. No differences were observed when O_2 uptake was measured for adults through DBM and MetaMax ®I with moderate random error.

Beltrami et al (2014) also evaluated the efficacy of Moxus metabolic system with DBM during high intensity exercise. Two maximal incremental running tests were performed by 12 trained runners while analysis of gas exchange was conducted by these two systems for interval of 30 seconds on each test. Comparisons were made for measurement of VO_2 and V_E for fractions of CO_2 and O_2. Significantly higher readings were produced by Moxus for VO_2 and V_E. Therefore, measuring minimal changes in VO_2 during exercise is not possible through this system. Nieman et al (2013) analysed the accuracy of Quark cardiopulmonary exercise testing (CPET) metabolic mixing chamber system with DBM. Thirty-two physically active men aged between 18 and 34 years were included in the study. Maximal O_2 was measured during the first session of the test through both DBM and CPET. In the second session, exercise was performed at treadmill by the subjects and measurements were taken through these systems at steady state and end of each 3-minute stage. No considerable variations were observed in the measures of VCO_2, RER, VO_2, and V_E. Thereby, it was evident that CPET provides accurate and comparable results with that of the DBM during aerobic exercise. Macfarlane and Wong (2012) compared the stability, reliability, and validity of portable Cortex Metamax 3B gas analysis system (MM3B) with DBM as reference. Analysis was performed using human exercise and simulated exercise. MM3B was observed to be similarly reliable for taking measurements of V_E, VO_2, and VCO_2. Stability in measuring gas fractions was observed over a period of 3 hours by MM3B. Validity of MM3B was tested against DBM and Jaeger Oxycon Pro system by using 8 healthy subjects at rest, moderate, and vigorous cycle ergometry. Overestimation of both VCO_2 and VO_2 were noted for MM3B with no difference in accuracy for measurements for V_E through DBM. These variations ranged between 10-17% at vigorous and moderate exercise when compared to DBM and at all levels in comparison to Oxycon Pro. Thus, the validity of MM3B was questionable for measuring VCO_2 and VO_2 during moderate and rigorous exercise but its stability and reliability are acceptable.

Likewise, Macfarlane and Wu (2013) evaluated the inter-unit performance of two similar automated gas analysis systems namely ParvoMedics TrueOne 2400. The analysis was performed during maximal steady-state exercises. Participants included 15 male adults who performed exercise on an electro-magnetic cycle ergometer on two distinct days at 30, 60, 90, and 120 Watts. V_E, VO_2, and VCO_2 were measured for both the systems present only minimum statistical differences between the two systems. Thus, inter-unit agreement of both the systems was equal and reliable. However, this study requires comparison of these systems with DBM to ensure their validity and reliability. Correspondingly, Schrack, Simonsick, and Ferrucci (2010) also demonstrated the efficacy of Cosmed $K4b^2$ portable metabolic analyser in comparison to the DBM during submaximal walking exercise. Participants included 19 men and women with average age 39.8 years. Two sessions of 400 meter walk were conducted using the two systems at treadmill. Comparison of VO_2 and VCO_2 were made for both the systems at each walk. No significant differences were obtained for both the systems when measured for VO_2 and VCO_2.

Conclusion

It can be observed from afore presented critical literature review that computerised metabolic cart systems have to some extent similar efficacy as that of metabolic cart with DBM. However, some considerations related to the accuracy of computerised metabolic cart systems for determining VO_2, V_E, VCO_2, and other variables of metabolic oxygen consumption persist. These considerations are related with the variations observed in the differences present among measurements obtained from computerised metabolic cart systems and metabolic cart with DBM. Therefore, further evaluation is necessitated for determining if computerised metabolic cart systems can also be used as effectively as the metabolic cart with DBM for evaluating various variables of metabolic oxygen consumption.

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