

ACCURACY OF A MINITURIZED, FACE WORN VO₂ ANALYZER

Vafa, Ramin. 1
Weber, Sebastian.2,

1: German Sport University Cologne, cologne, germany
2: STAPS Human Performance lab, cologne, germany

Introduction

Gas breath-by-breath analyzers are widely used tools in the training and testing of athletic performance. The size and footprint of these systems have shrunk over the years. Following this trend, the latest offspring of such trend is an entirely face-worn micro VO₂ Analyzer ("VO₂ Master Pro Beta V2", VO₂ Master Health Sensors Inc., Canada). However, accuracy and validity of such small devices appear questionable.

Methods

A VO₂ Master Pro Beta Version 2 gas analyzer utilizing a size "large" Venturi tube was attached to an automated respiratory gas exchange simulator (Vacumed Metabolic Simulator Model 17056, Gore et al.). The testing protocol consisted of 15 strokes at 5 different BF (12-59 min⁻¹) at VT of 1,5L/2,0L/2,5L/3,0L/4,0L. FeO₂ was adjusted to simulate VO₂ of 1000mL;2000mL;3000mL;4000mL. Effects of simulated BF, VT and VO₂ on measured BF, VT and VO₂ was assessed.

Results

Measured and simulated values correlated significant (p<0,01); R² values were: VO₂=0,991; FeO₂=0,981; BF=0,999; VT=0,999, VE=0,998. Measured vs. simulated VO₂ values over all settings for 1000mL;2000mL;3000mL;4000mL VO₂ were: 955mL±26,1; 1919mL±53,4; 2995mL±103,7; 3825mL±79,8. The coefficients of variation were: 2,73%; 2,78%; 3,46%; 2,09%. No significant effect of neither BF nor VT on the accuracy of measured BF, VT, VE, FeO₂ and VO₂ (p=0,00). However, a non-significant tendency to underestimate VO₂ for certain low-end BF at VT < 3L: for VT 1,5L at a BF <30 min⁻¹; for VT=2L at a BF <40min⁻¹ and for VT=2,5L at a BF <30min⁻¹ was observed.

Discussion

For the full range of VT and BF tested in this study measured data were in good agreement with control values. Interestingly high BF did not alter the accuracy of the device, which seems important in testing competitive athletes. The tendency of underestimating VO₂ at low VE, might be due to the use of the large Venturi tube only. It is recommended by the manufacturer to use smaller size Venturi tubes for low VE testing and even bigger sizes for high VE testing. The underestimation of VO₂ values at high simulated VO₂ seemed to be a result of an underestimating of VE. The accuracy determined by the coefficient of variation is similar to the most popular lab carts (Carter & Jeukendrup 2002) and even below some of the portable systems currently available on the market (Duffield et al.).

References

Gore, C.J. et al., Med.Sci. Sports Exerc 29:1095-1103, 1997
Carter J, Jeukendrup AE, Eur J Appl Physiol. 2002 Mar;86(5):435-41.
Duffield R1, et al. J Sci Med Sport. 2004 Mar;7(1):11-22.

Contact

Sebastian Weber [sebastian@inscyd.com]



Pic1: VacuMed Lung Simulator



Pic2: VO2master Beta-Prototype V2, entirely face worn VO2 analyzer

INSCYD

STAPS

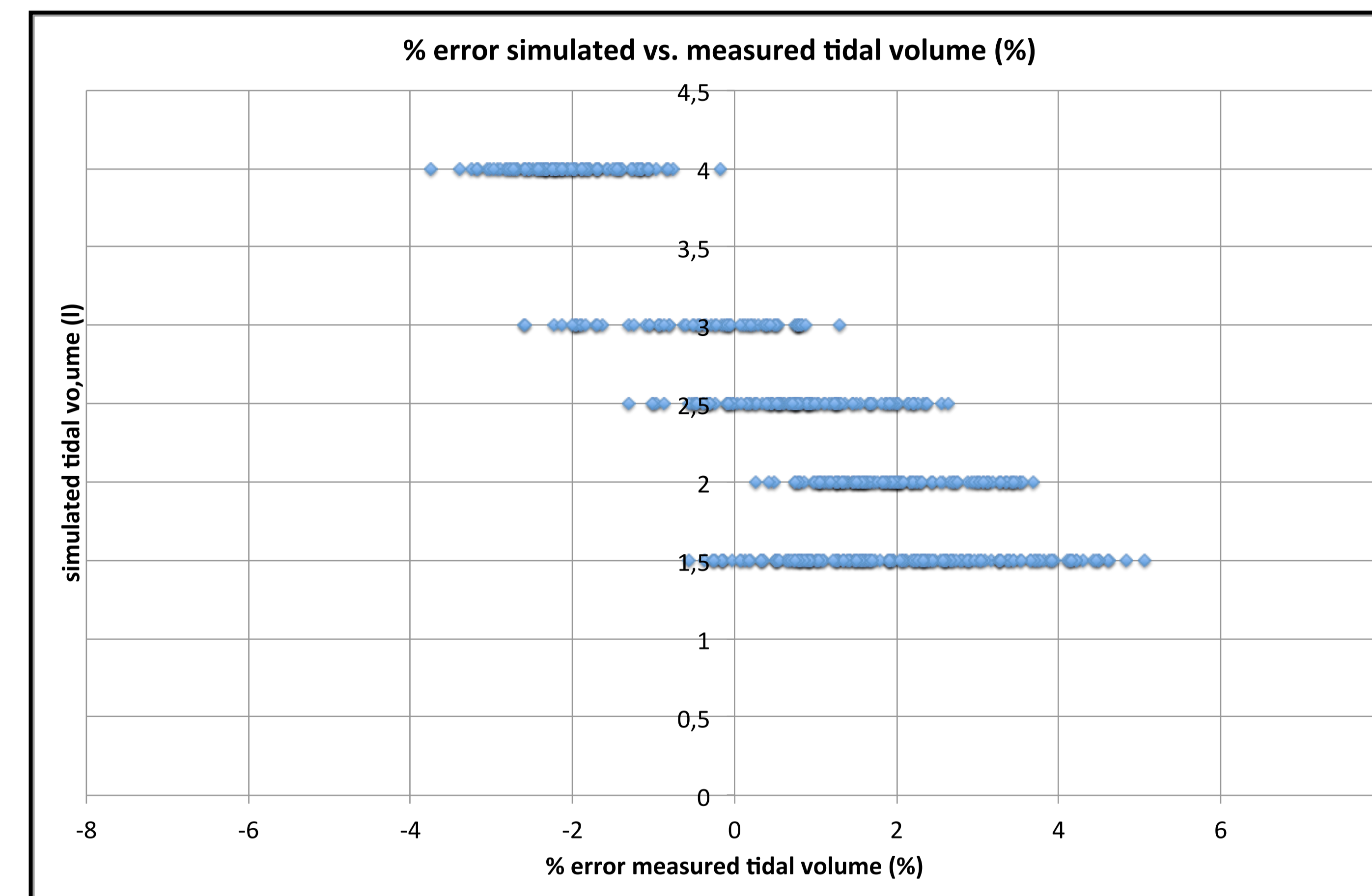


Fig 1: error (%) of tidal volume (simulated vs. measured Td) in relation to the simulated volumes of 1.5 – 4.0 l

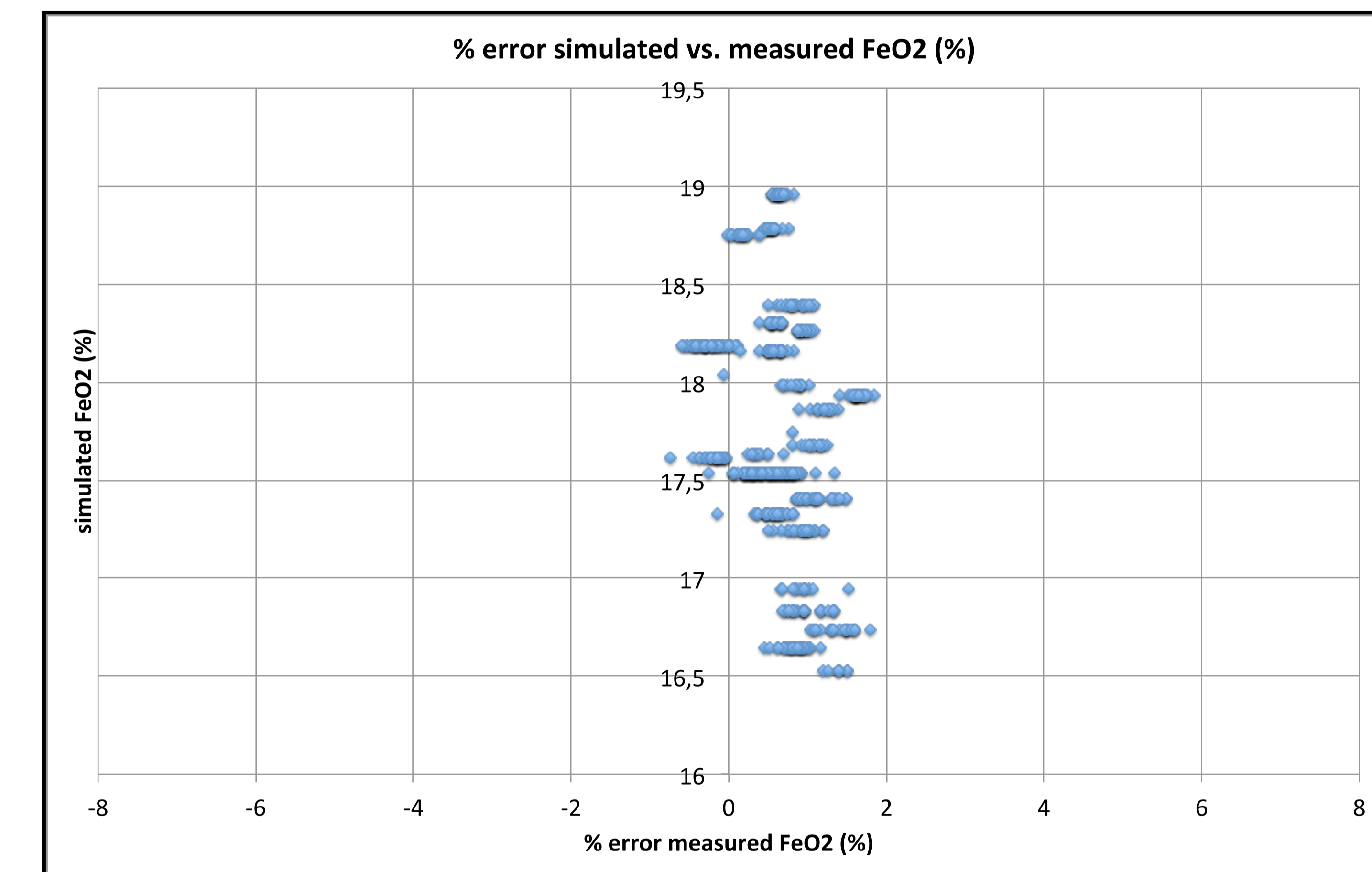


Fig 2: error (%) of FeO₂ (simulated vs. measured FeO₂) in relation to the FeO₂ (range: 16.5% - 19%)

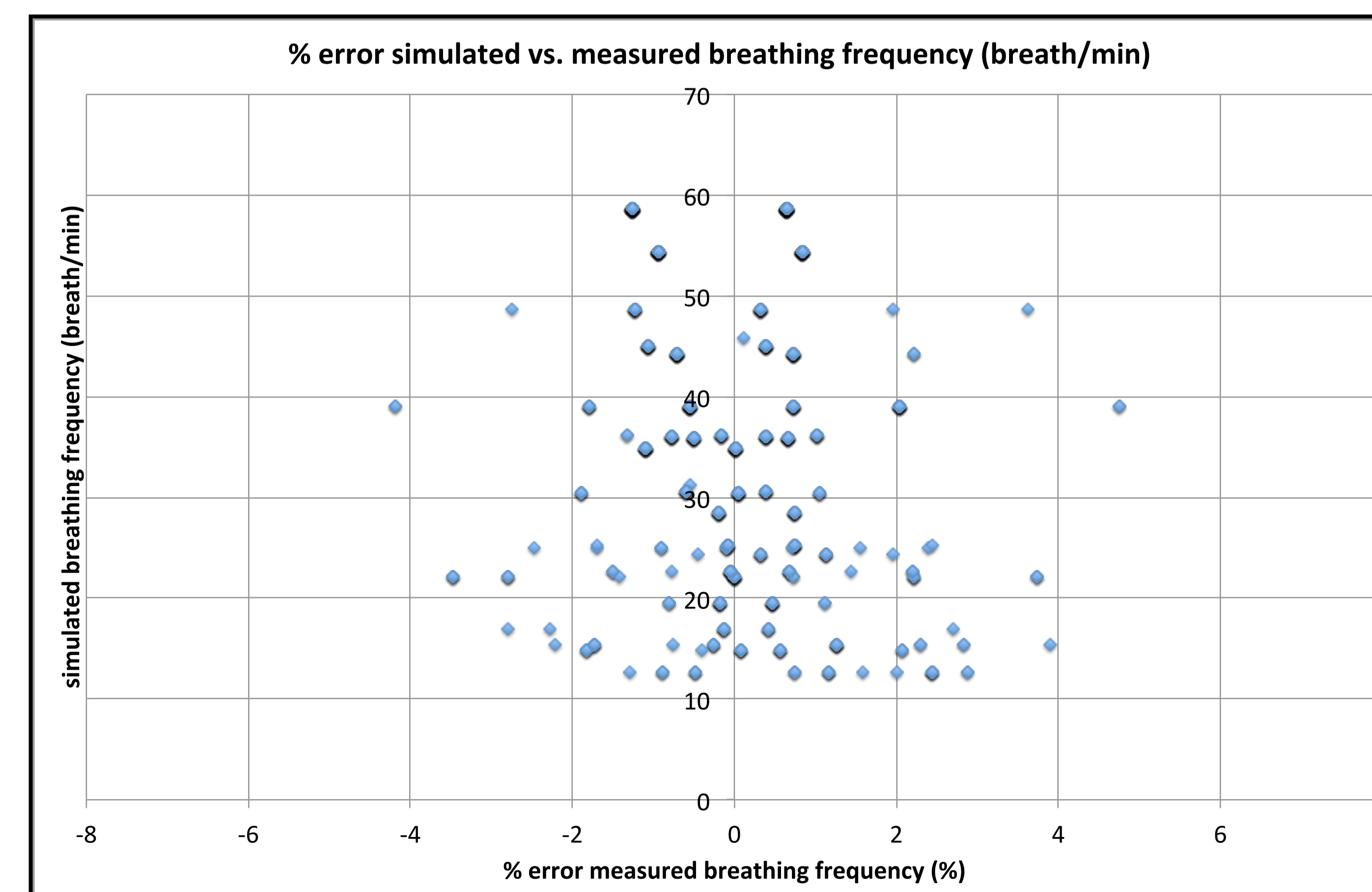


Fig 3: error (%) of breathing frequency (simulated vs. Measured BF) in relation to the BF (range: 10 – 60 breath/min)

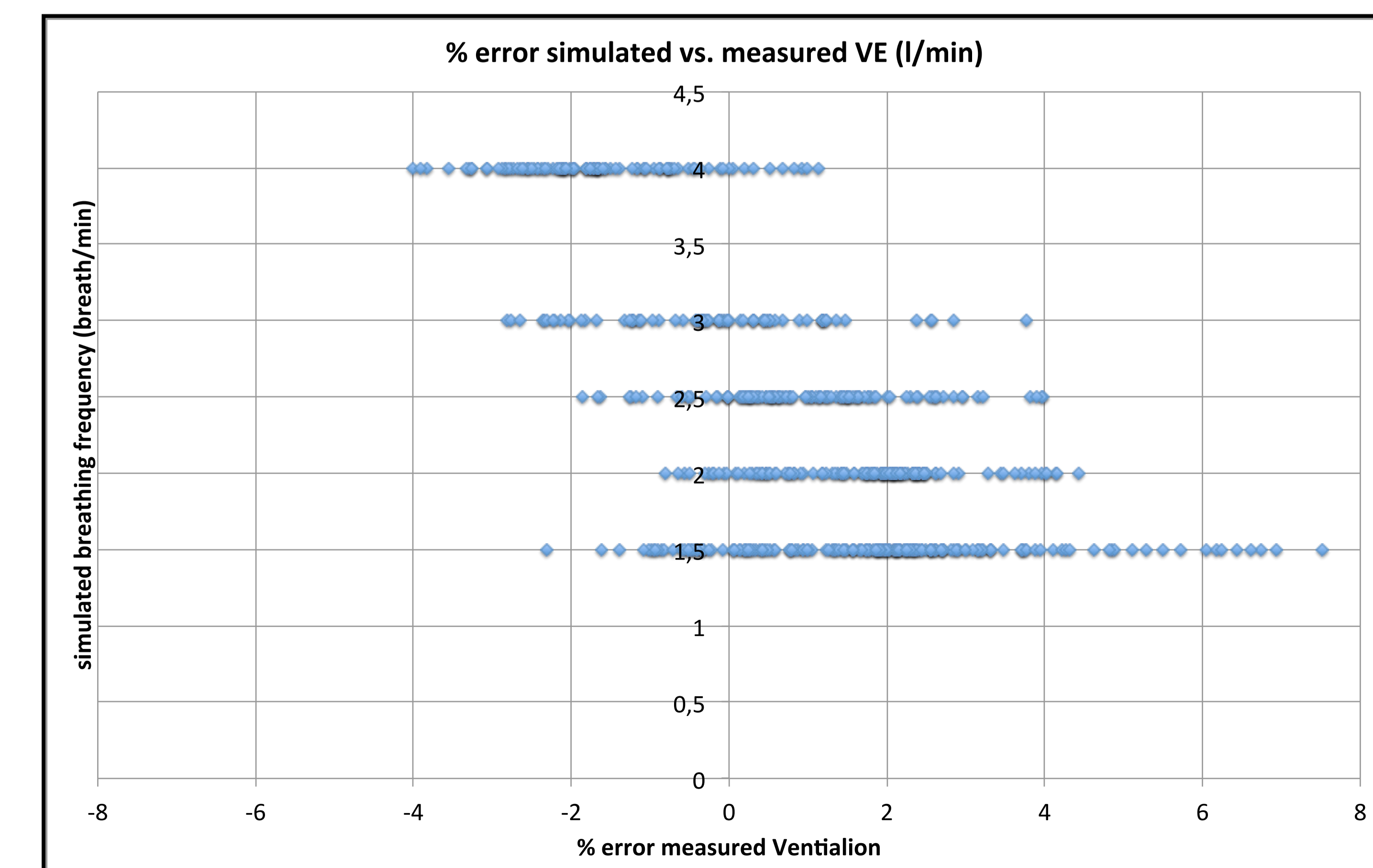


Fig 4: error (%) of ventilation (simulated vs. Measured VE) in relation to the TD (range: 1.5 – 4 l)