USING COMBINED ACCELEROMETER AND HEART RATE DATA TO ESTIMATE PHYSICAL FITNESS

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INTRODUCTION

Insight into a subjects' physical fitness and monitoring training progress of athletes and patients participating in rehabilitation programs is often performed using VO_{2max}, the maximum oxygen uptake of a subject during exercise. However, downside of most (sub) maximal exercise tests is that it gives a momentary estimate of VO_{2max} and often the test is too strenuous for the patients to maintain. Ideally, an estimate of VO_{2max} is obtained from monitoring subjects during their daily life activities, without the need for a predefined exercise protocol. As a first step in obtaining VO_{2max} from daily life activities we researched whether we can obtain a VO_{2max} estimate from combining heart rate and level of activity during walking at a treadmill at different speeds.

METHOD

Twenty five healthy subjects (18 male/ 7 female) aged between 21 and 29 years were recruited. Reference VO_{2max} was obtained by performing a sub-maximal single stage treadmill walking test [1]. Daily life walking exercise was simulated by walking at two different speeds on a treadmill (4 and 5.5 kmh^{-1}), during which heart rate and 3D accelerometer data were measured using a Mobi8-MT9 and MT9b sensor. The relation between measured heart rate and accelerometer output during steady state exercise (>3min) at the different walking speeds was used as indication of exercise intensity. Stepwise linear regression analysis was performed on general subject measures (age, gender, weight, length, BMI) and intercept and slope of the relation between heart rate and accelerometer output as independent variables for estimating VO_{2max}.

RESULTS

A linear regression model using a combination of the slope and intercept parameters of the relation between heart rate and level of activity, together with gender revealed the highest percentage of explained variance (R^2=0.92) and had a standard errors of the estimate (SEE) of 1.70 ml $O_2kg^{-1}min^{-1}$ with VO_{2max}. Fig. 1 shows the estimates versus measured VO_{2max} scores.

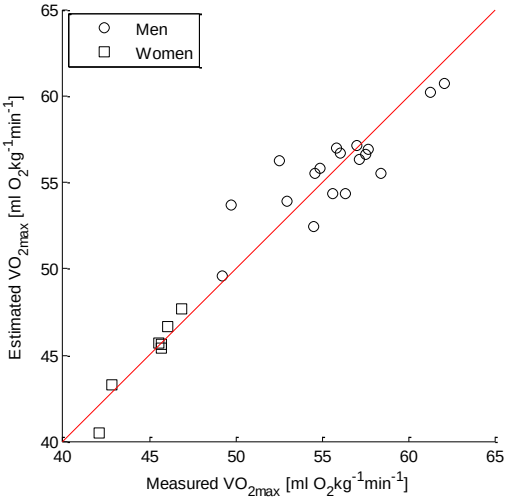

Fig. 1 *Measured vs estimated VO_{2max} of 25 healthy subjects using a linear regression model*

DISCUSSION AND CONCLUSION

Fusing heart rate and accelerometer data during steady state activities seems promising for ambulant estimation of $VO_{2max.}$ Our results show a good estimation of VO_{2max} which is comparable to commonly used sub-maximal laboratory tests. The next step is to find out whether in daily life sufficient steady state activity moments exist for an accurate estimation of VO_{2max}. Furthermore subject age range and physical fitness level should be expended to get a more generally applicable estimation.

REFERENCES

[1] Ebbeling CB, Ward A, Puleo EM, Widrick J and Rippe JM. Development of a single-stage submaximal treadmill walking test. Medicine and Science in Sports and Exercise, 1991, vol. 23, 8:966-973.