Letter to the Editor: Prediction of peak oxygen uptake using the modified shuttle test –

2 Methodological concerns and implications for clinical practice.

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9 To the Editor

10 We note with interest the paper by Vendrusculo et al (1) and their attempt to predict the peak

11 oxygen uptake (VO2peak) using the modified shuttle test (MST) in children and adolescents with

12 cystic fibrosis (CF). The authors conclude “that it is possible to predict VO2peak using the MST”

13 (page 6). However, the issue is not whether one variable can predict another variable, but it is

14 the accuracy and error of the prediction that is of most importance. Therefore, we have serious

15 concerns about the conclusions based on this data set regarding: 1) the variation and error in

16 the model at an individual level; 2) the development of the regression model; and 3) the

17 measurement of the criterion variable.

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19 Firstly, there is a high level of variation and error in the estimate, such that on any given test,

20 the variation around an individual measure is ~ 8 mL.kg-1.min-1, which seems unacceptable

21 given the likely change from exercise or other interventions. We support the authors in their

22 rationale for assessing exercise capacity, given its association with mortality (2), however if

23 such a prediction were genuinely applied in a clinical setting, it could have serious

24 consequences regarding treatment options, which may be unnecessary and unethical (e.g.

25 referral for lung transplant).

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27 Secondly, in developing the model, it is noteworthy that the presented prediction equation has

28 failed to account for several independent factors that may influence VO2peak, such as age, sex

29 and lung function. The authors state in their methodology that they have utilised a multiple

30 linear regression to derive the equation, but provide no account of the type of model used nor

31 explain how variables were considered and selected. If no additional factors have been
32 included, this should be confirmed by authors. This apparent failure to control for such factors
33 is further surprising given the significant correlations reported between FEV1 and both MST
34 distance \((r = 0.62, p = 0.001)\) and VO2peak \((r = 0.47, p = 0.02)\). Importantly, the authors fail to
use an independent validation group for its prediction equations. Prediction equations are
36 influenced by a low sample size \((n = 24)\), which is heterogeneous in its clinical characteristics
37 (i.e. FEV1 = 76.4 ± 23.8% Predicted) and therefore will inflate the \(r\) value. The work needed
38 validation on another sample before any conclusions surrounding its ability to predict VO2peak
39 could be made.

Lastly, a reliance upon primary (plateau in VO2) and secondary (i.e. RPE, HRmax, RER) criteria
42 to determine a maximal effort has been previously advocated to establish the validity of the
43 criterion measurement i.e., VO2peak. However, the authors fail to report how many participants
44 displayed a plateau in VO2, and the use of secondary criteria is inherently flawed (3),
45 particularly in a paediatric cohort. As a result, supramaximal verification bouts should be
46 considered during cardiopulmonary exercise testing (CPET) to ensure confidence that a ‘true’
47 maximal value has been achieved (4). Unfortunately, no such verification testing has been
48 undertaken in the present study to confirm the maximality of patients’ efforts. As an example,
49 it appears that the maximum VE value is very low and published data from our own Centre (5),
50 as well as further unpublished data on 37 patients with a similar age (age range 8-20 years;
51 mean 14.7 ± 3.4 y) as Vendrusculo et al., found a mean VE peak of 90 ± 38.8 L.min⁻¹, a value in
52 stark contrast to the reported 47 ± 15 L.min⁻¹. This contrast of maximum VE values is further
53 compromised as our values were obtained on a cycle ergometer, whilst Vendrusculo et al. were
54 on a treadmill, which should on average attain higher values than cycle ergometry tests.
55 Consequently, if participants in this study have not achieved a maximal effort during their
56 CPET, then the accuracy of the prediction equation developed is further brought into doubt.

In summary, whilst the rationale for this study is well intentioned, we respectfully interpret the
59 findings of this study differently. Firstly, the error in the prediction is likely too large for clinical
60 decision making. Secondly, without external validation of the model, its utility has to be
61 questioned. And thirdly, having used invalid procedures to determine the criterion measure,
62 the precision of the VO2peak values cannot be verified. In light of these concerns, we would
advocate that CF centres continue to use CPET, and where this is not feasible nor possible, use distance walked during the MST as a discrete result, and to not estimate VO2peak using the presented equation.

References