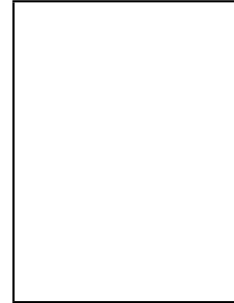


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Aerobic fitness questionnaires - Still not enough to estimate VO_2 peak in cardiac patients!

Questionários de aptidão aeróbica - Ainda não são suficientes para estimar o VO_2 máximo em doentes cardíacos!

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Maximum oxygen uptake (VO_{2max}) during the maximal cardiopulmonary exercise test (CPET) is the gold standard for aerobic fitness determination, however, CPET is underutilized (1). There been several attempts to find an alternative, simple and accessible method to be used for accurate determination of aerobic fitness.

Some questionnaires have been proposed with reasonable results in specific populations, such as the Veterans Specific Activity Questionnaire (VSAQ)(2), CLINIMEX Aerobic Fitness Questionnaire (C-AFQ) (3), FitMáx questionnaire (FitMáx)(4), Duke Activity Status Index (DASI) (5) and Specific Activity Questionnaire (SAQ) (6). Several limitations need to be highlighted in these questionnaires. Because of the heterogeneity of the population samples in the various studies (age, sex, educational level, geography, sample size, aerobic capacity, response rate, presence of cardiovascular (CV) disease and risk factors), the results obtained cannot be extrapolated to other populations without adequate validation.

The present study by Lima et al. (7) "*Validation of an Aerobic Fitness Questionnaire to estimate VO_2 peak in a cohort of adult cardiac patients – Is it enough?*", intends to validate the CLINIMEX Aerobic Fitness Questionnaire (C-AFQ) (3), comprising a list of activities, in a Portuguese population sample of 124 CV patients (93% male, mean age 61 years old, 61% with heart failure), who were referred for CPET and cardiac rehabilitation. In this prospective study, which enrolled exclusively CV patients (mainly male), C-AFQ was not sufficiently accurate to predict functional capacity measured by VO_2 peak. Despite a numerically strong and positive correlation between measured and estimated by C-AFQ VO_2 peak founding ($r=0.723$, $p<0.001$), high levels of disagreement in the Bland-Altman plot analysis were observed (7).

Of note, C-AFQ (3) was determined in a large and varied Brazilian population sample of 686 individuals, almost 70% male, mean age 55 (14 - 96) years, 22% considered healthy, less than 50% with CV disease and others with hypertension, dyslipidemia and/or diabetes. This sample was comprised primarily of white subjects, high educational level and/or upper

socioeconomical class, which is one of the reasons why the results obtained in this study (3) cannot be generalized and this questionnaire cannot be applied to other populations without validation. A high correlation with CPET ($r=0.91$) was demonstrated, however an interview was used to complete the C-AFQ in the validation study, and this could have contributed to a high correlation, as was the case with the validation of the DASI (5).

Prior to C-AFQ (3), VSAQ (2) was developed to estimate the maximal metabolic equivalents (MET) value in 212 consecutive middle-aged and old male American veterans to estimate the cardiac respiratory fitness (CRF) expressed in VO_{2peak} . Limitations were the length of time spent, the exclusion of women and many healthy exercisers and athletes (13 METS as upper limited score), and the low discrimination for those in the lower range of aerobic fitness (unique one-MET interval in scale). Also, a major drawback was the use of activities, such as basketball and skiing, which are not practiced globally. The capacity to perform daily activities such as walking and stair climbing are more generalized and directly related to CRF.

A simpler questionnaire is the FitMáx (4), consisting of three single-answer questions about the maximum capacity of life activities, walking, and cycling, all frequently performed by the general Dutch population, in which the questionnaire was administered. It included a total of 127 participants (84 men and 43 women), mean age 62 years old. One strength of this questionnaire is the use of three different activities in crescent intensity. The authors report that it is a valid and accessible questionnaire in clinical practice, better than other questionnaires, however, in many countries cycling is not a generalized activity, especially for old people. Subjects estimate their capacity in each activity separately, instead of using several activities together.

The DASI (5) was developed to estimate aerobic capacity in CV patients and used to monitor rehabilitation progress. It is a 12-item questionnaire that assesses daily activities such as personal care, walking, household tasks, sexual function and recreation, with respective metabolic costs for each item.

Most questionnaires have not assessed women for criterion validity. The ability of a physical activity and functional capacity assessment questionnaire to predict functional capacity measured by treadmill exercise stress testing, as well as to correlate with CV risk factors and angiographic coronary artery disease (CAD) in women was evaluated (8) in a National Heart, Lung and Blood Institute (NHLBI)-sponsored cross-sectional population study, "The Women's Ischemia Syndrome Evaluation (WISE)", involving four academic medical centers (9). It enrolled 476 women with CV risk factors undergoing coronary angiography for evaluation for suspected myocardial ischemia. The main outcome measures were functional capacity measured during exercise treadmill testing, CV risk factors, and CAD, using core laboratory-determined measures. Physical activity measured by the Postmenopausal Estrogen and Progesterone Intervention physical activity questionnaire (PEPI-Q) and functional capacity measured by the DASI questionnaire, correlated with functional capacity measured in METS. It was concluded that the DASI questionnaire is a reasonable correlate of functional capacity

achieved during symptom-limited treadmill exercise testing in women with suspected myocardial ischemia. The study suggested that the DASI and, to a lesser extent, the PEPI-Q have criterion validity for use in health-related research in women (8).

Subjective self-assessment questionnaires may be useful, if they are simple, and are applicable across a range of conditions, easy to administrate, available in different languages, validated for different subpopulations and present in multiple administration formats (telephone or in person self-reported vs. proxy). However, we must be aware that some limitations exist, especially in populations like CV patients (10), and cannot be used indifferently in populations that have not been tested, without appropriate validation. One of the main groups that has been more difficult to evaluate by questionnaires are women.

The difference in results from the study by Lima (7) and the previous study of Araujo (3) is probably very much related to the fact that all participants were CV patients and not healthy people, and also, that the sample was not very large.

I would say that questionnaires are useful, when validated, to define or classify groups of subjects, rather than for individuals, and probably the relation of these with VO₂peak max obtained with CPET may be better in apparently healthy people than in CV patients. Questionnaires may be used for screening and research but, until now, not for individual accurate determination of aerobic fitness (at least for CV patients) in clinical practice. Models based on questionnaires, but which integrate other variables might be closer to VO₂peak estimation.

Cardiopulmonary exercise testing is still the main tool to determine aerobic functional capacity; it also provides several prognostic indicators for CV patients. CPET underutilization, mainly due to the equipment cost in comparison with standard exercise testing, to the lack of knowledge, training and experience, and the complexity of interpretation, needs to be strongly addressed through education and training of cardiologists and technicians and also through promotion of its unique clinical value.

References

1. Dores H, Mendes M, Abreu A, Durazzo A, Rodrigues C, Vilela E, Cunha G, Gomes Pereira J, Bento L, Moreno L, Dinis P, Amorim S, Clemente S, Santos M. Cardiopulmonary exercise testing in clinical practice: Principles, applications, and basic interpretation. *Rev Port Cardiol* 2024;43(9):525-536
2. Myers J, Do D, Herbert W, Ribisl P, Froelicher VF. A nomogram to predict exercise capacity from a specific activity questionnaire and clinical data. *Am J Cardiol.* 1994 Mar 15;73(8):591-6. doi: 10.1016/0002-9149(94)90340-9. PMID: 8147307.
3. Araujo CGS, Castro CL, Franca JF, et col. CLINIMEX Aerobic Fitness Questionnaire: Proposal and validation. *International Journal of Cardiovascular Sciences* 2019;32(4):331-342

4. Meijer R, van Hooff M, Papen-Botterhuis NE, Molenaar CJL, Regis M, Timmers T, van de Poll-Franse LV, Savelberg HHCM, Schep G. Estimating VO_{2peak} in 18-90 Year-Old Adults: Development and Validation of the FitMáx©-Questionnaire. *Int J Gen Med*. 2022 Apr 5;15:3727-3737. doi: 10.2147/IJGM.S355589. PMID: 35411174; PMCID: PMC8994663
5. Hlatky MA, Boineau RE, Higginbotham MB, Lee KL, Mark DB, Califf RM, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). *Am J Cardiol* 1989;64(10):651-654
6. Rankin SJ, Briffa TG, Morton AR, Hung J. A specific activity questionnaire to measure the functional capacity of cardiac patients. *Am J Cardiol* 1996;77(14):1220-3
7. Lima MR, Amador R, Presume J, Cunha G, Moreno L, Durazzo A, Araujo CG, Mendes M. Validation of an aerobic fitness questionnaire to estimate VO_{2peak} in a cohort of adult cardiac patients – is it enough? *Rev Port Cardiol* 2025. <https://doi.org/10.1016/j.repc.2024.10.00>
8. Bairey Merz CN, Olson M, Mc Gorry S, Pakstis DL, Zell K, Rickens CR, Kelsey SF, Bittner V, Sharaf BL, Sopko G. Physical activity and functional capacity measurement in women: a report from NHLBI-sponsored WISE study. *J Womens Health Gend Based Med* 2000 Sep;9(7):769-77. Doi:10.1089/15246090050147745
9. Merz CN, Kelsey SF, Pepine CJ, Reichek N, Reis SE, Rogers WJ, Sharaf BL, Sopko G. The women's ischemia syndrome evaluation (WISE) study: protocol design, methodology and feasibility report. *J Am Coll Cardiol* 1999;33(6):1453-61
10. Piepoli M, Spoletini I, Rosano G. Monitoring functional capacity in heart failure. *Eur Heart J Supplements* 2019;21 Supplement_M:M9-M12. <https://doi.org/10.1093/euroheartj/suz216>