Reply: The effectiveness of singing *versus* exercise training

Received: 01 Dec 2021
Accepted: 10 Dec 2021

Reply to A.W. Vaes and co-workers:

We are happy to learn that you have read our paper [1] with great interest.

As mentioned in the methods section of the abstract, our study was an effectiveness study, which relates to how well a treatment works in practice, as opposed to efficacy, which measures how well it works in randomised controlled trials or laboratory studies [2, 3].

The objective was to investigate Singing for Lung Health (SLH) as a non-superior, rather than a superior, alternative to conventional physical exercise training (PExT) as part of pulmonary rehabilitation in COPD, as requested by, for example, the European Respiratory Society/American Thoracic Society [4, 5].

The data reporting is highly transparent and our study only suggests, and does not claim, non-inferiority, as mentioned in the conclusions section of the abstract. Also, we do call for future studies to address reproducibility, long-term effects and health economics.

An additional paper, on various secondary outcomes from our randomised controlled trial, is in preparation, as already mentioned in the discussion section.

We do agree that the impact on 6-min walk distance (6MWD) in our study is modest and are aware of the fact that some (but far from all) studies have demonstrated a higher impact. However, the Cochrane review by McCarthy *et al.* [6] concluded: "Similar to previous outcomes on maximal exercise, both the six-minute walk test and the analyses demonstrated substantial heterogeneity" and "Future research studies should focus on identifying which components of pulmonary rehabilitation are essential, its ideal length and location, the degree of supervision and intensity of training required and how long treatment effects persist."

Furthermore, the change in 6MWD is related to the starting value of 6MWD, as recently demonstrated in the study by Kerti *et al.* [7]. In our study, mean 6MWD was relatively high (around 400 m) and thus, more likely to demonstrate only a small effect.

In many of the well-conducted randomised controlled trials that demonstrated a positive effect on 6MWD (*e.g.* van Wetering *et al.* [8], which is included in the Cochrane review [5]), the effect was measured as change in mean difference and compared to usual care (without training). The effect in the study by van Wetering *et al.* [8] was exclusively driven by a smaller deterioration in 6MWD in the intervention group than in the control group. No increase in 6MWD was generated, even after 4 months. Still, the study is regarded as "positive" with respect to change in 6MWD. In our study, we do demonstrate a small and dose-dependent effect in 6MWD.

We provided transparent information and explicit descriptions regarding content and approach in both SLH and PExT, which also includes endurance training (for SLH, *e.g. via* the combination of singing and dance/movement at the same time, along with prolonging controlled expiration through vocal exercises and sung phrases). Please refer to the appendices S1 and S2, items 6 and 7, and the subsequent "Elaboration of content elements" and "Physical and vocal stamina", in our supplementary material.

Shareable abstract (@ERSpublications)
This paper reports a proof-of-concept study, clarifying that singing actually affects 6MWD, and this finding is promising when offering PR to patients who for some reason cannot or will not participate in conventional exercise training https://bit.ly/3276d7b

Cite this article as: Løkke A, Kaasgaard M, Andreasson KH, *et al.* Reply: The effectiveness of singing *versus* exercise training. *Eur Respir J* 2022; 59: 2103051 [DOI: 10.1183/13993003.03051-2021].

In Denmark, pulmonary rehabilitation is conducted in a decentralised and community-based manner. Our pulmonary rehabilitation study was conducted pragmatically in this everyday, clinical, non-academic setting including 11 centres with patients referred from many different areas. Participating sites conformed to the pulmonary rehabilitation conduction criteria of the Danish Health Authorities, yet we indeed observed a difference in training load optimisation between included centres, ranging from fast to less fast progression of participants' training load. Community-based, decentralised pulmonary rehabilitation in general appears to be less effective than hospital-based, centralised programmes [9]. There are no high-output, academic, centralised pulmonary rehabilitation clinics in Denmark. Thus, the Danish pulmonary rehabilitation programme is not as highly specialised as in, for example, the Netherlands, Germany, Canada or Australia, and this may affect our results negatively. On the other hand, decentralised programmes are closer to patients' homes, which affects attendance rates positively [10–12].

Our paper reports a proof-of-concept study, clarifying that singing actually affects 6MWD, and this finding is promising when offering pulmonary rehabilitation to patients who for some reason cannot or will not participate in conventional exercise training. Physical exercise remains untouched as the gold standard of exercise training in pulmonary rehabilitation [4].

We know our study is not perfect but we consider it to be valid and important.

> "Le mieux est l'ennemi du bien [The perfect is the enemy of the good]." — François-Marie Arouet (AKA Voltaire), Dictionnaire Philosophique, 1764.

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Conflict of interest: M. Kaasgaard holds a Diploma Graduate Degree from the Royal Danish Academy of Music in Voice and Voice Pedagogy. P. Vuust is leader of the research centre, Center for Music in the Brain. No other author had any experience of or knowledge within any singing field. No author had prior relationships with any training facilitator or study participant, and no author or close relative has economic interests within the field of singing, including lung choirs.

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