Physical activity and COPD development. Time to advocate

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Physical activity is nowadays a widely accepted determinant of the progression of COPD.[1] However, its role in preventing COPD development remains unclear. Several epidemiological analyses using population-based adult cohorts have reported longitudinal associations between higher physical activity levels and higher lung function levels, attenuated lung function decline and/or lower COPD incidence.[2–7] In cohorts of patients with asthma[8 9] or COPD,[10] higher physical activity levels appear to attenuate lung function decline. In childhood, higher physical activity levels (assessed by accelerometer) relate to higher lung function at adolescence,[11] which will likely impact on adult COPD risk.[12]

In the current issue of *Thorax*, Hansen *et al*[13] provide additional evidence supporting a role for physical activity on COPD risk, although they used *physical fitness* as a marker of *physical activity*. The authors report a longitudinal association between cardiorespiratory fitness (determined as maximal oxygen uptake (VO_2max) by ergometer test) and both COPD incidence and mortality in 4730 Danish adult men (mostly active smokers at baseline) followed for 46 years, after adjustment for age, socioeconomic status, smoking intensity, alcohol consumption, self-reported physical activity, body mass index, arterial hypertension and diabetes mellitus. In order to remove reverse causation (ie, COPD affects physical fitness via reduced physical activity), Hansen and colleagues restricted the analysis to events that happened 10 years or more after baseline. This approach is of special relevance because reverse causation has been a strong argument against the prospect that physical activity could causally affect future lung function. Some limitations of Hansen's paper are the inclusion of only men and the potential misdiagnosis of COPD due to the use of medical records instead of spirometry. However, these limitations are unlikely to explain the results given the strong and significant associations observed in the several analyses conducted. Hansen *et al* conclude that '*fitness* enhancing *physical activity* should be encouraged (…) to delay development, progression and death from COPD'.

The consideration of physical fitness (instead of physical activity) as the exposure variable rends the interpretation of Hansen's results challenging. Both in the introduction and discussion, the authors use physical fitness and physical activity indistinctly, while acknowledging that they correspond to different concepts. Traditionally, physical activity (*what people actually do*) is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. Physical fitness (*what people can do*) is defined as a set of attributes (eg, cardiorespiratory endurance, muscular strength) that determine the ability to carry out physical activities.[14] Of importance, physical fitness is a 'capacity' while physical activity is a 'behaviour'. Thus, although they are highly correlated at the population level (the higher the capacity, the higher the activity), there is important individual-level variability. Indeed, some subjects with good physical fitness (ie, high capacity) choose to practice low levels of physical activity, while others with poor physical fitness (ie, reduced capacity) are motivated enough to still perform high levels of physical activity.[15]

The key is whether the effects of physical fitness and physical activity on COPD risk can be interpreted in a like manner, as done by Hansen *et al*. For instance, to state that physical fitness and COPD (ie, low lung function) are associated is somewhat redundant because lung function is a component of physical fitness. The results might have been easier to interpret if physical activity had been the exposure variable instead of physical fitness. A second issue is that the close relationship between physical fitness and physical activity affects their association with further COPD risk. Hansen's study, and many others which have tested the independent roles of physical fitness and physical activity on health (using mutually adjusted models), find that the effects of physical activity are largely attenuated once physical fitness parameters are considered[13 16 17] Surprisingly, the (apparent) victory of physical fitness (over physical activity) is in contradiction with the discussion sections of the same papers, where the potential explanations for the effects of physical fitness point towards physical activity-related biological mechanisms and the main implication of the findings is that physical activity should be encouraged.

These contradicting results and interpretations, when physical fitness and physical activity are included in the same study, are due to the complex relationships between these parameters, as well as their changes and dependencies over time, which requires the use of complex research methods. First, the ideal data collection should include several repeated measurements of physical fitness and physical activity during follow-up. Second, researchers should not only make explicit the hypothesised causal relationships between variables involved in the research question under study (figure 1 of Hansen's Supplement) but also ensure that the manuscript introduction, analysis and interpretation are consistent with such causal hypotheses. If, as suggested in Hansen's manuscript, physical activity can both affect and be affected by physical fitness, then the mutually adjusted analysis using standard statistics provides biased estimates (likely underestimations) of the associations of both variables with COPD risk. Finally, issues such as bidirectionality, reverse causation and time-dependent confounding need to be properly addressed. As previously mentioned, Hansen's approach removed the possibly of reverse causation but other sources of bias could not be explored.

All things considered, Hansen *et al* provide evidence favouring the hypothesis that increased physical activity may reduce COPD risk. Still, the role of physical activity in preventing respiratory diseases is overlooked in reference documents. For example, the last report from the Global Initiative for Chronic Obstructive Lung Disease consortium does not mention low physical activity among the factors that influence COPD development.[18] More generally, the Global Burden of Disease Project does not consider any respiratory disease among the health effects of low physical activity.[19] The abovementioned complex relationships between physical activity, physical fitness and COPD could have contributed to such limited translation of research results into guidelines. Interestingly, disentangling such complexity was not necessary for the research community or society to accept that low levels of physical activity increase the risk of cancers and cardiovascular

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diseases. Thus, in addition to improving research methods, we (all those in the respiratory area) should advocate more in favour of physical activity, so that proper measures are taken to improve respiratory health and the health of those suffering from respiratory diseases. Identifying and engaging stakeholders and communicating findings to those with interest and/or power should be key steps to ensuring research translation. Actions such as the 'Take the active option' 2015 theme of the Healthy Lungs for Life campaign by the European Respiratory Society and the European Lung Foundation (ELF) are a good starting point.[20] The close link of physical activity with active transportation, air quality, climate change and sustainability, all called by the sustainable development goals adopted by United Nations in 2015,[21] is an exceptional opportunity to promote physical activity beyond the medical arena. Let's keep moving.

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