

## Original Article

# Physical Activity and Exercise Capacity in Severe Asthma: Key Clinical Associations

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**What is already known about this topic?** People with severe asthma seem to engage in lower levels of activity than controls. Low physical activity in severe asthma is associated with impulse oscillometric airway resistance and small airway dysfunction.

**What does this article add to our knowledge?** Physical activity measured as steps per day is strongly associated with exercise capacity and systemic inflammation in severe asthma. To a lesser extent, activity and sedentary time are associated with asthma control, health status, and lung function.

**How does this study impact current management guidelines?** These results suggest that addressing inactivity and sedentary time may be a potential nonpharmacological approach in the management of severe asthma.

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This research was supported by a University of Newcastle and Priority Research Centre for Healthy Lungs postgraduate scholarship and the Hunter Medical Research Institute, Australia.

Conflicts of interest: L. Cordova-Rivera has received research support from John Hunter Hospital Charitable Trust and Hunter Medical Research Institute. P. G. Gibson has participated in educational symposia funded by AstraZeneca, Boehringer Ingelheim, GlaxoSmithKline, and Novartis; has participated in studies funded by GlaxoSmithKline and AstraZeneca; and holds a National Health and Medical Research Council (NHMRC) Practitioner Fellowship. P. A. Gardiner is supported by an NHMRC-Australian Research Council Dementia Research Development Fellowship and has participated in an educational symposium funded by Boehringer Ingelheim. V. M. McDonald has received research support from John Hunter Hospital Charitable Trust and Hunter Medical Research Institute, NHMRC Translating Research Into Practice (TRIP) fellowship, University of Newcastle, Cyclopharm, AstraZeneca, GlaxoSmithKline, and Lung Foundation Australia; has received lecture fees for participation in educational symposia funded by AstraZeneca, GlaxoSmithKline, Novartis, and Menarini; has participated in advisory boards for GlaxoSmithKline, AstraZeneca and Menarini; and has received travel support from Menarini. The rest of the authors declare that they have no relevant conflicts of interest.

Received for publication June 19, 2017; revised September 9, 2017; accepted for publication September 28, 2017.

Available online ■ ■ ■

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2213-2198

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<https://doi.org/10.1016/j.jaip.2017.09.022>

**BACKGROUND:** Physical inactivity and sedentary time are distinct behaviors that may be more prevalent in severe asthma, contributing to poor disease outcomes. Physical activity and sedentary time in severe asthma however have not been extensively examined.

**OBJECTIVE:** We aimed to objectively measure physical activity and sedentary time in people with severe asthma compared with age-matched control participants, describing the associations of these behaviors with clinical and biological outcomes. We hypothesized that people with severe asthma would be less active and more sedentary. In addition, more activity and less sedentary time would be associated with better clinical outcomes and markers of systemic and airway inflammation in people with severe asthma.

**METHODS:** Adults with severe asthma (n = 61) and sex- and age-matched controls (n = 61) underwent measurement of lung function, exercise capacity, asthma control, health status, and airway and systemic inflammation. Physical activity and sedentary time were measured using an accelerometer.

**RESULTS:** The severe asthma and control groups were matched in terms of age and sex (32 [53%] females in each group).

Individuals with severe asthma accumulated less minutes per day in moderate and higher intensity activity, median (IQR) 21.9 (12.9-36.0) versus 41.7 (29.5-65.2) ( $P < .0001$ ) and accumulated 2,232 fewer steps per day ( $P = .0002$ ). However, they engaged in more light-intensity physical activity. No differences were found for sedentary time. In a multivariate regression model, steps per day were strongly and independently associated with better exercise capacity in participants with severe asthma (coefficient, 0.0169; 95% CI, 0.008-0.025;  $P < .001$ ).

**CONCLUSIONS:** People with severe asthma perform less moderate and vigorous activity than do controls. Higher levels of activity and lower levels of sedentary time are associated with

**Abbreviations used**

6MWD- 6-minute walk distance  
 ACQ- Asthma Control Questionnaire  
 AQLQ- Asthma Quality of Life Questionnaire  
 COPD- Chronic obstructive pulmonary disease  
 FENO- Fractional exhaled nitric oxide  
 hs-CRP- High-sensitivity C-reactive protein  
 MVPA- Moderate- to vigorous-intensity physical activity

**better exercise capacity, asthma control, and lower levels of systemic inflammation.** © 2017 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2017;■:■-■)

**Key words:** Severe asthma; Physical activity; Sedentary time; Accelerometry; Exercise capacity; Associations; Clinical outcomes

Severe asthma is a heterogeneous and complex disease in which diverse clinical and physiological presentations are common.<sup>1</sup> Severe asthma represents a high patient and health care burden.<sup>2</sup> It is, thus, necessary to explore novel strategies to improve health status in severe asthma and to minimize this burden. The importance of multidisciplinary management approaches in severe asthma has been recognized.<sup>3</sup> Within these, the identification and subsequent management of modifiable risk factors or behaviors, such as inactivity, can be seen as an adjunct strategy for the management of the disease.<sup>4</sup>

In general populations, physical activity and exercise are regarded as highly beneficial, leading to positive health outcomes.<sup>5-7</sup> Engagement in excess sedentary time is an important risk factor for the development of several chronic diseases and premature mortality.<sup>8,9</sup> *Physical activity* is defined as any bodily movement generated by the skeletal muscles and resulting in energy expenditure. Depending on intensity and metabolic equivalent of task units, it is classified as light, moderate, or vigorous physical activity, where light corresponds to the lower metabolic equivalent of tasks or energy expenditure.<sup>5</sup> Mild stretching, low impact dancing, and running correspond to examples of light, moderate, and vigorous physical activity, respectively.<sup>10</sup> *Sedentary time* refers to activities performed while awake in a lying or sitting position and expending low levels of energy ( $\leq 1.5$  metabolic equivalent of tasks).<sup>11</sup> The physical activity and sedentary guidelines recommend engaging in at least 150 min/wk of moderate activity, or 75 min/wk of vigorous activity (or equivalent combination), and to sit less and for shorter periods of time.<sup>12</sup> In other obstructive airway diseases such as chronic obstructive pulmonary disease (COPD), physical inactivity and sedentary time are increased compared with healthy controls.<sup>13,14</sup> These behaviors have been independently associated with worse clinical and inflammatory outcomes,<sup>15</sup> and increased mortality in this disease.<sup>16,17</sup> In asthma, a potential link between inactivity and mortality has not been reported. However, higher adherence to physical activity in asthma has been associated with better asthma control,<sup>18</sup> reduced exacerbations,<sup>19</sup> and reduced health care use.<sup>20</sup> Data on inflammatory parameters are scarce.<sup>21</sup>

In severe asthma, inactivity and sedentary time are likely to be particularly extreme due to the poor disease control and associated comorbidities, such as obesity, anxiety, and depression.<sup>1</sup> Despite this, very few studies have objectively measured physical activity in this population,<sup>22</sup> and the prevalence of sedentary

time has not been addressed in severe asthma. In addition, very few studies have assessed the impact of these behaviors on health outcomes in the disease.<sup>22</sup>

The aims of this study therefore were to objectively measure physical activity and sedentary time in a severe asthma population compared with age-matched controls, and to describe the associations of these behaviors with clinical measures such as asthma control, health status, exercise capacity, lung function, and markers of airway and systemic inflammation.

We hypothesized that people with severe asthma are less active and more sedentary than are their age- and sex-matched counterparts, and that higher levels of physical activity and lower levels of sedentary time in severe asthma are associated with better clinical outcomes and lower levels of systemic and airway inflammation. In addition, we sought to test the hypothesis that moderate-intensity physical activity can counteract the detrimental health outcomes associated with high levels of sedentary time, as it has been previously suggested.<sup>23,24</sup>

## METHODS

### Participant selection

A cross-sectional characterization study was conducted. Adults with severe asthma and sex- and age-matched controls were recruited and underwent a multidimensional assessment with objective measures of physical activity and sedentary time. Participants with severe asthma were recruited consecutively from the respiratory ambulatory care clinics at John Hunter Hospital (Newcastle, Australia) and the clinical research databases of the Priority Research Centre for Healthy Lungs at the University of Newcastle (Newcastle, Australia). Participants with respiratory physician-diagnosed severe asthma were eligible if they met the current guideline definition for severe asthma<sup>1</sup>: prescribed Global Initiative for Asthma step 4 treatment or above, defined as 1,000  $\mu\text{g}$  inhaled corticosteroid fluticasone equivalent and long-acting  $\beta_2$ -agonists,<sup>25</sup> had evidence of airflow limitation ( $\text{FEV}_1 < 80\%$  predicted), and ongoing poor asthma control (Asthma Control Questionnaire [ACQ]<sup>26</sup> score  $\geq 1.5$  units or had experienced a severe exacerbation in the last 12 months requiring oral corticosteroids). Participants were clinically stable during visits (no increase in asthma symptoms in the last 4 weeks). Otherwise, their enrolment was postponed until they were stable. Exclusion criteria included malignancy with poor prognosis ( $< 3$  months).

Age- and sex-matched controls were recruited via the research database of the Hunter Medical Research Institute and community advertisement, and were eligible if they were older than 18 years and nonsmokers and had no objective evidence of chronic respiratory disease.

Ethics approval was granted by the human research ethics committees of the Hunter New England Local Health District (08/08/20/3.10) and the University of Newcastle, Australia. The study was conducted according to Good Clinical Practice Guidelines and each participant provided written informed consent.

### Procedures

**Clinical measurements.** Participants underwent a multidimensional assessment<sup>27</sup> involving measurement of height and weight, allergy skin prick tests, serum IgE, comorbidities,<sup>28</sup> anxiety and depression,<sup>29</sup> and smoking status. Further assessments are described below.

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