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***Physical Activity and Sedentary  
Behaviour in Obstructive Airway  
Diseases.***

**Laura Cordova Rivera**

**BPhty (Hons)**

A Thesis Submitted for the  
Degree of Doctor of Philosophy – Medicine

**September 2018**

School of Medicine and Public Health

The University of Newcastle

This Research was supported by an Australian Government  
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## ***STATEMENT OF ORIGINALITY***

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I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision. The thesis contains no material which has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968 and any approved embargo.

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25<sup>th</sup> September 2018

**Date**

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**Laura Cordova Rivera**

## ***STATEMENT OF THESIS BY PUBLICATION***

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I hereby certify that this thesis is in the form of a series of papers. I have included as part of the thesis a written declaration from each co-author, endorsed in writing by the Faculty Assistant Dean (Research Training), attesting to my contribution to any jointly authored papers

## ACKNOWLEDGEMENTS

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It's funny to think that a few months/years ago I was so looking forward to be at the time when I finally could be writing these acknowledgements. Now that the time has finally come, I wish I had another year to keep enjoying the experience of being a researcher and doing a PhD. In this journey, I have had the fortune to have the support of my supervisors Professor Vanessa McDonald, Professor Peter Gibson, and Doctor Paul Gardiner, who have guided me through this process and helped me to discover my love for research.

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## ***PUBLICATIONS INCLUDED AS PART OF THIS THESIS***

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- **Cordova-Rivera L**, Gibson PG, Gardiner PA, McDonald VM. A systematic review of associations of physical activity and sedentary time with asthma outcomes. *The Journal of Allergy and Clinical Immunology: In Practice* 2018 Nov - Dec; 6(6):1968-1981 (Chapter 1)
- **Cordova-Rivera L**, Gibson PG, Gardiner PA, Powel H, McDonald VM. Physical activity and exercise capacity in severe asthma: Key clinical associations. *The Journal of Allergy and Clinical Immunology: In Practice* 2018 May - Jun; 6(3):814-822 (Chapter 2)
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## STATEMENT OF CONTRIBUTION OF OTHERS

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By signing below, I confirm that Research Higher Degree candidate, Laura Cordova Rivera, provided substantial intellectual input and contributions to defining the topic of literature review, gathering and evaluating source materials, critically analysing and synthesising information from published sources and manuscript preparation/writing to the publication entitled:

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Signature:

Full Name of Co-Author: **Prof Vanessa McDonald**

Signature:

Full name of Assistant Dean Research Training: **Prof Derek Laver**

Date: 17/09/2018

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- **Cordova-Rivera L**, Gibson PG, Gardiner PA, Hiles SA, McDonald VM. Extrapulmonary associations of health status in severe asthma and bronchiectasis: comorbidities and functional outcomes. (*Currently under peer-review*)

Signature:

Full Name of Co-Author: **Prof Vanessa McDonald**

Signature:

Full name of Assistant Dean Research Training: **Prof Derek Laver**

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Signature:

Full Name of Co-Author: **Prof Peter Gibson**

Signature:

Full name of Assistant Dean Research Training: **Prof Derek Laver**

Date: 17/09/2018

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Signature:

Full Name of Co-Author: **Dr. Paul Gardiner**

Signature:

Full name of Assistant Dean Research Training: **Prof Derek Laver**

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Signature:

Full Name of Co-Author: **Ms Heather Powell**

Signature:

Full name of Assistant Dean Research Training: **Prof Derek Laver**

Date: 17/09/2018

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Signature:

Full Name of Co-Author: **Dr. Sarah Ashley Hiles**

Signature:

Full name of Assistant Dean Research Training: **Prof Derek Laver**

Date: 17/09/2018

## **CONFERENCE PRESENTATIONS & PUBLICATIONS FROM THIS THESIS**

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Oral presentation by Laura Cordova Rivera

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Milan, Italy.**

Poster presentation by Laura Cordova Rivera

Cordova-Rivera L, Gibson PG, Gardiner PA, McDonald VM.PG. Physical inactivity and sedentary time in severe asthma: prevalence and associations *ERJ* 2017; 50: PA PA775.

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Oral presentation by Laura Cordova Rivera

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Oral presentation by Laura Cordova Rivera

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## ***LIST OF ABBREVIATIONS AND ACRONYMS***

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ABPA: Allergic bronchopulmonary aspergillosis

ACQ: Asthma control questionnaire

ACT: Asthma control test

AFL: Airflow limitation

AOR: Adjusted odds ratio

ATS: American Thoracic Society

AQLQ: Asthma quality of life questionnaire

AusDiab: Australian Diabetes, Obesity and Lifestyle

BMI: Body mass index

CAT: COPD Assessment Test

CI: Confidence interval

COPD: Chronic obstructive pulmonary disease

CPM: Count per minutes

ERS: European Respiratory Society

FeNO: Fractional exhaled nitric oxide levels

FER: Forced expiratory ratio (FEV<sub>1</sub>/ FVC)

FEV<sub>1</sub>: Forced expiratory volume in the first second

FVC: Forced vital capacity

GINA: Global Initiative for Asthma

GOLD: Global Initiative for Chronic Obstructive Lung Disease

GORD: Gastroesophageal reflux disease

HRCT: High resolution computed tomography

HRQoL: Health-related quality of life

Hs-CRP: High sensitivity C-reactive protein

ICS: Inhaled corticosteroids

ICU: Intensive Care Unit

IFN  $\gamma$ : Interferon gamma

IgE: Immunoglobulin E

IL: Interleukin

ILC2: Innate lymphoid cells type 2

IQR: Interquartile range

Kcal: Kilocalories

Kg: Kilogram

Mcg: Micrograms

METs: Metabolic equivalent of task

ml: Millilitre

Mg: Milligram

mMRC: Medical Research Council

MVPA: Moderate and vigorous physical activity

NAEPP: National Asthma Education and Prevention Program

NHANES: National Health and Nutrition Examination Survey

LABA: Long-acting  $\beta_2$ -agonist

LAMA: Long-acting anti muscarinic antagonists

OAD: Obstructive airway diseases

OR: Odds ratio

OSA: obstructive sleep apnoea

PA: Physical activity

SABA: Short acting  $\beta_2$  agonist

SD: Standard deviation

SGRQ: Saint George Respiratory Questionnaire

TGF- $\beta$ : Transforming growth factor beta

T<sub>H</sub>2: Type 2 helper

TNF- $\alpha$ : Tumour necrosis alpha

WHO: World Health Organisation

6MWD: six-minute walked distance

6MWT: six-minute walk test

## ***ABSTRACT AND SYNOPSIS***

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Severe asthma, chronic obstructive pulmonary disease (COPD) and bronchiectasis are well-recognised public health priorities by the World Health Organisation. People affected by these obstructive airway diseases (OAD) can suffer from considerable impairment in their quality of life due to the high burden of symptoms, exacerbations/lung attacks, and associated morbidity. All of these shared characteristics may also be detrimental to the person's ability to carry out activities of daily life, and are likely to lead to a vicious circle of physical activity reduction and deconditioning that will impair health-related quality of life.

In the general population, engaging in healthy levels of physical activity and reducing sedentary time have been regarded as highly beneficial in the prevention and treatment of several chronic diseases. In COPD, the impairment in these behaviours has been widely characterised and the importance of addressing them as part of disease management is recognised and accepted. However, in severe asthma and bronchiectasis, the characterisation of physical activity and sedentary time and the role of optimising these behaviours in disease management is largely under-researched.

In this Thesis, I characterise the degree of physical activity levels and sedentary time in a severe asthma population and examined whether the activity levels were comparable to that found in moderate to severe COPD and bronchiectasis. I also investigated the associations between physical activity levels, pulmonary and extrapulmonary characteristics, and health-related quality of life in these diseases. In my studies I found that compared to people without respiratory diseases, people with severe asthma engage in lower levels of moderate and vigorous intensity physical activity but similar levels of sedentary time. Better parameters in both behaviours were associated with better disease features, including exercise capacity, asthma control, and systemic inflammation. When comparing these results

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with bronchiectasis and moderate to severe COPD populations, I found that lower levels of physical activity is a shared behavioural characteristic of people with OAD, albeit to a lesser degree in severe asthma and bronchiectasis. Shared pulmonary characteristics differed between diseases but nevertheless, exercise capacity and airflow limitation explain an important proportion of physical activity levels in OAD. Finally, I demonstrate that physical activity and other extrapulmonary characteristics including skeletal muscle strength and comorbidities, are statistically and clinically associated with health-related quality of life in bronchiectasis and severe asthma. The associations were stronger for the activity and impact domain and suggest that health-related quality of life in these diseases could be improved by addressing these extrapulmonary characteristics.

The findings of this Thesis have extended our knowledge of the characterisation of physical activity and sedentary time in severe asthma and bronchiectasis. Lower levels of physical activity are a prevalent feature in OAD populations and should be considered as a treatable extrapulmonary risk factor for the management of several disease outcomes not only in COPD, but also in severe asthma and bronchiectasis populations.