The webinar, "Moving more to breathe better: Associations between physical activity, sitting time, and lung function in the CLSA," will begin shortly.

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CLSA Webinar Series

Moving More to Breathe Better: Associations Between Physical Activity, Sitting Time, and Lung Function in the CLSA

Dr. Shilpa Dogra, University of Ontario Institute of Technology

12 pm to 1 pm ET | November 22, 2018

Smoking is known to accelerate the age-associated decline in lung function. Evidence suggests that physical activity may attenuate this decline among smokers. However, little work has been done to determine whether physical activity or sitting time are modifiable determinants of lung function. This webinar will present research that used data from the Canadian Longitudinal Study on Aging to assess associations of self-reported movement behaviours (sitting time, walking, different intensities of physical activity and strengthening activities) with lung function in middle-aged and older adults who either reported having an obstructive respiratory disease, or who reported no respiratory disease. Our findings suggest that physical activity and sitting time may be modifiable determinants of lung function and respiratory health among adults with and without respiratory disease.

Dr. Shilpa Dogra is an Associate Professor in the Faculty of Health Sciences (Kinesiology) at the University of Ontario Institute of Technology. Her research expertise is in the area of exercise science, respiratory health and active aging.

Register online at: bit.ly/clsawebinars

Webinars will be broadcast using WebEx.
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Canadian Longitudinal Study on Aging
Étude longitudinale canadienne sur le vieillissement

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Moving More to Breathe Better:

Associations Between Physical Activity, Sitting Time, and Lung Function in the CLSA

Shilpa Dogra, PhD

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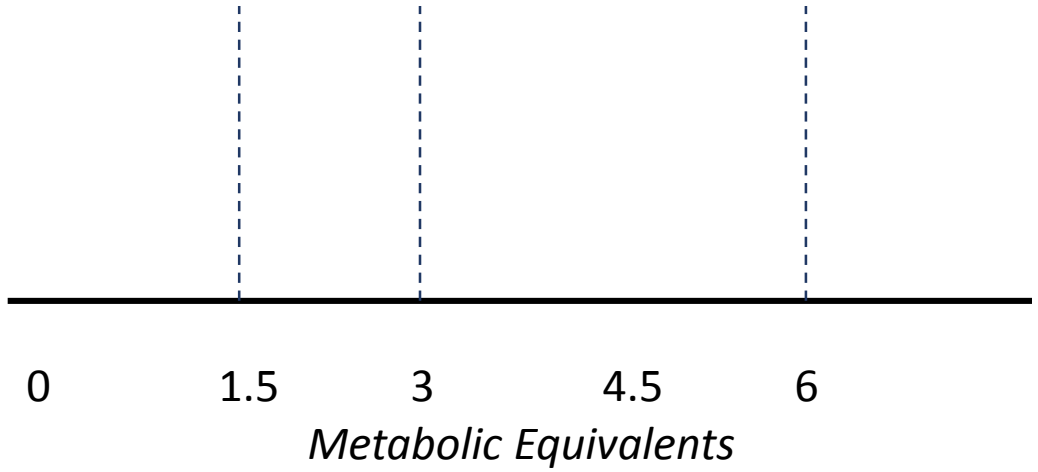
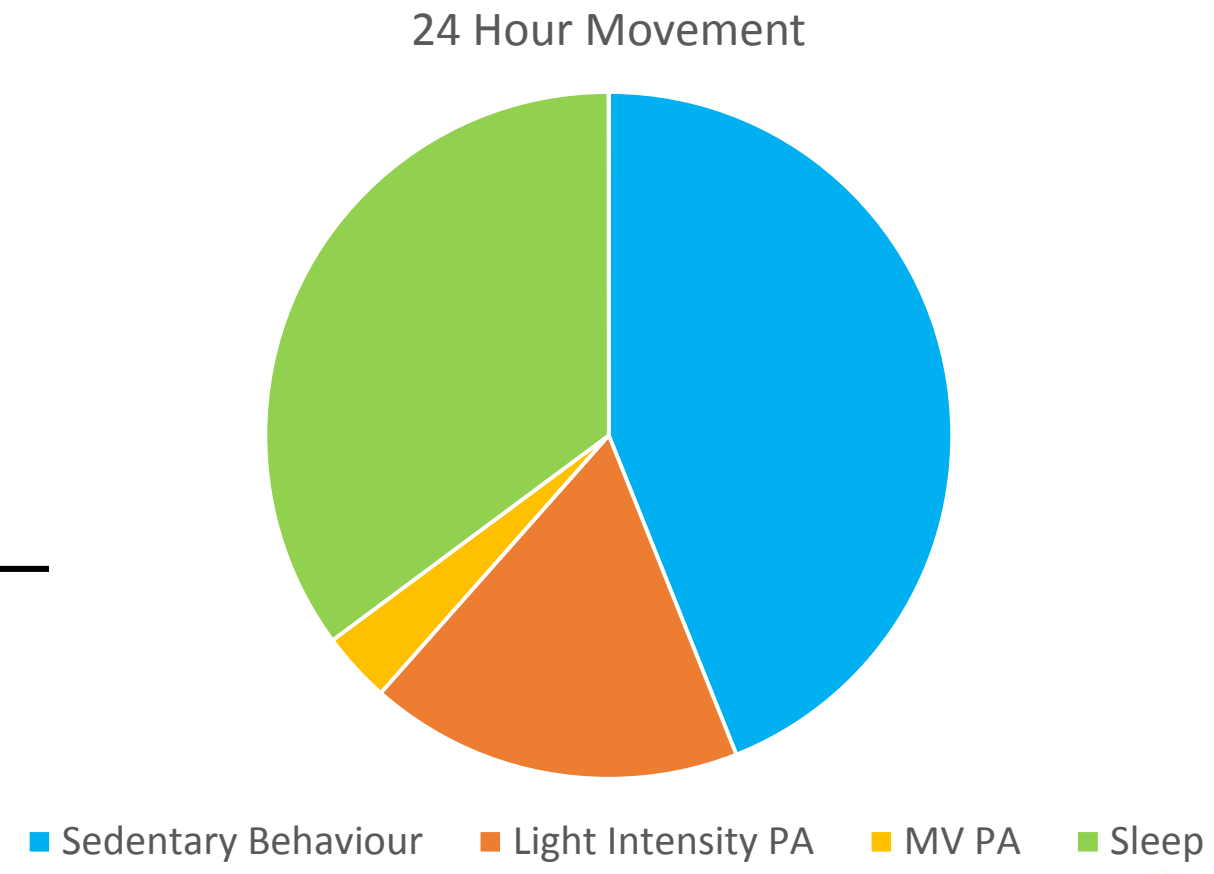
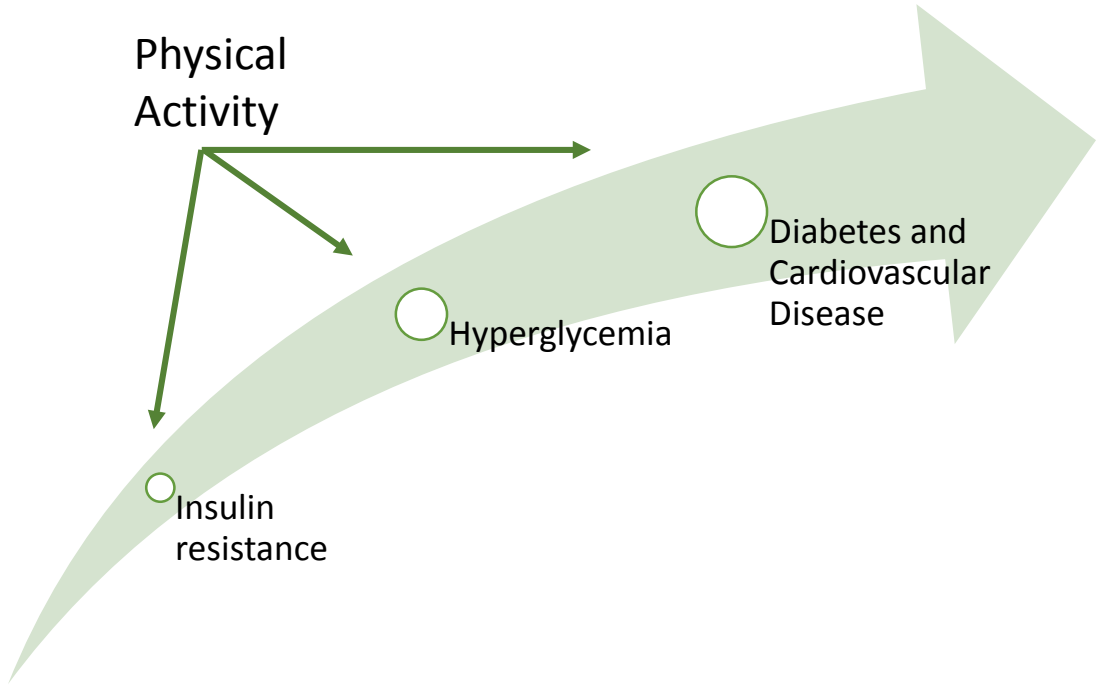
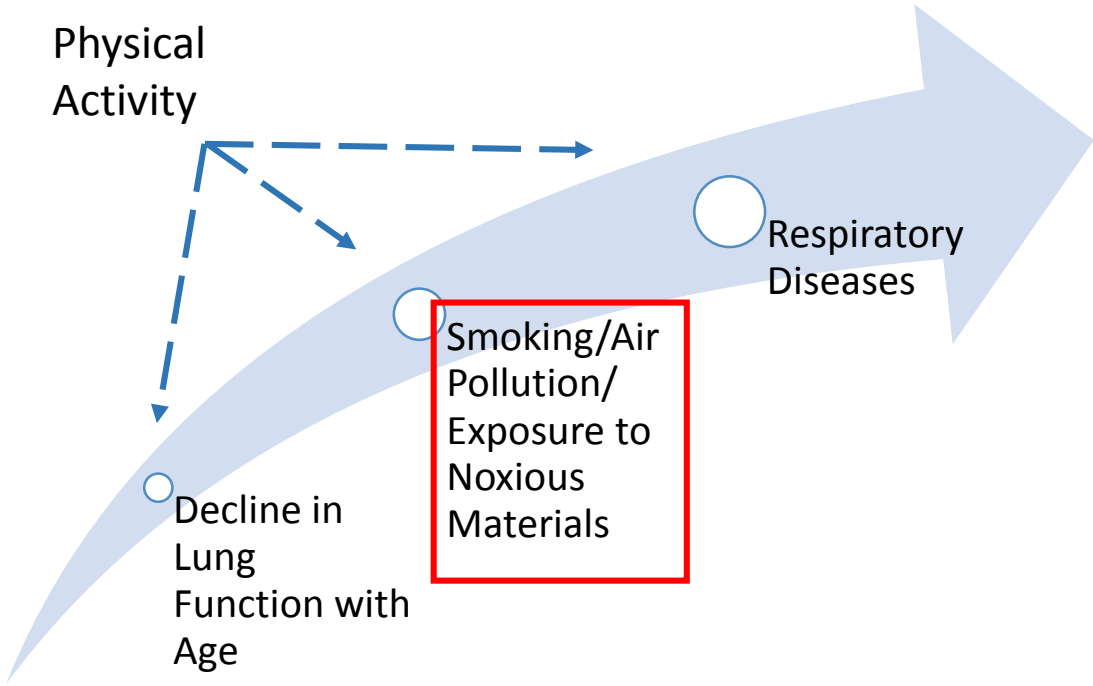
Movement Behaviours



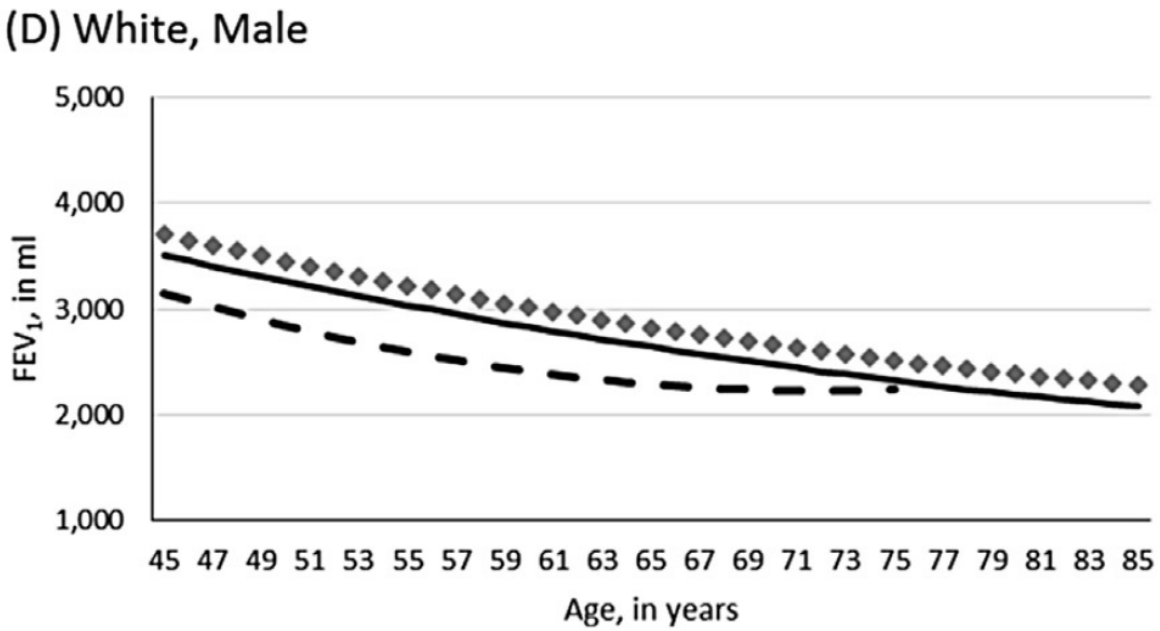


Chronic Disease Prevention





Age Associated Decline in Lung Function

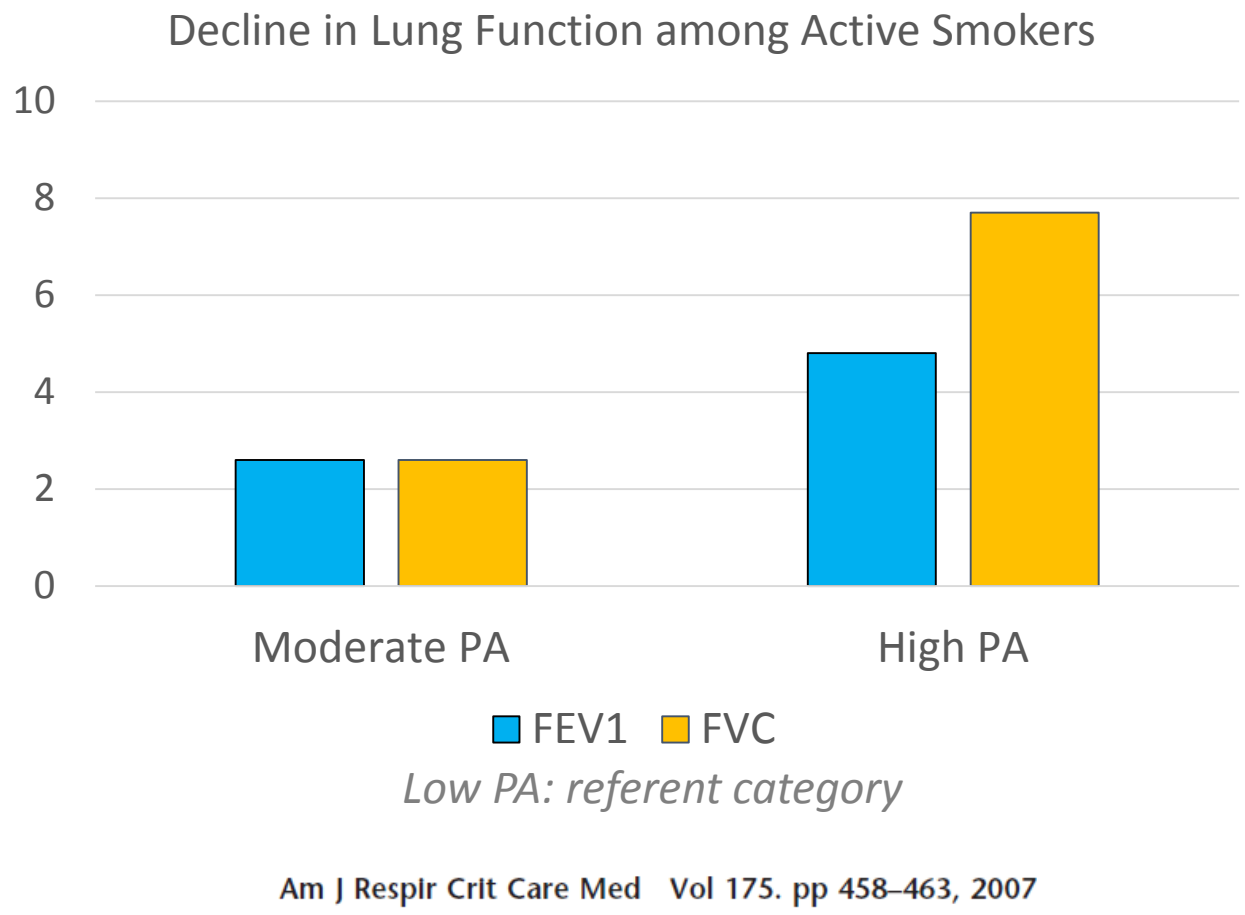


- 30-50ml/year loss
- > loss among smokers

Respiratory Medicine 113 (2016) 57–64

- Rate of decline affected by:
  - History of asthma
  - Sex and ethnicity
  - Exposed to noxious materials (eg. asphalt)
  - Poor diet
  - Smoking status

Smoking and Physical Activity on Lung Function



Am J Respir Crit Care Med Vol 175. pp 458–463, 2007

- Those who decreased their physical activity during follow-up had an increased lung function decline and COPD risk
- Trend was significant when all smokers types were pooled together

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Biological Plausibility

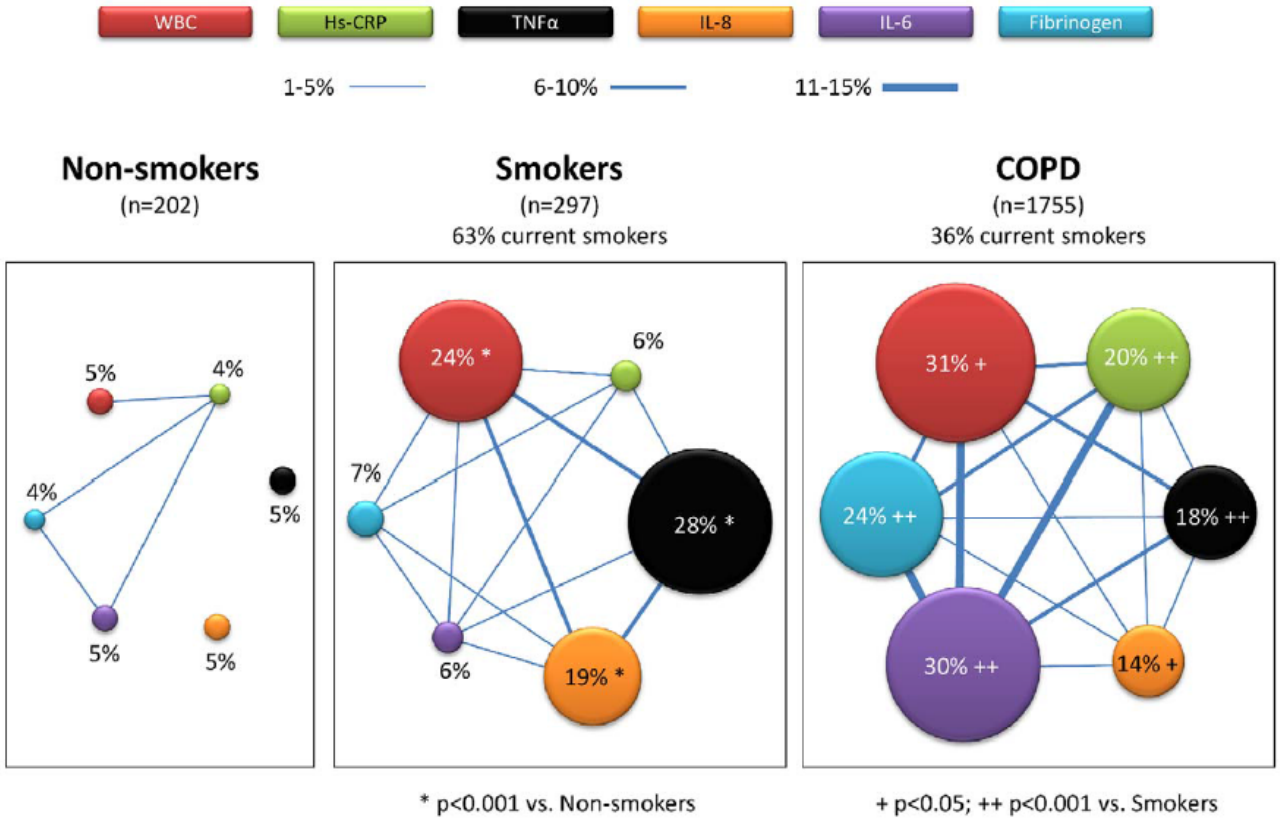

Figure 2. Network layout of the systemic inflammatory response (inflammome) in non-smokers (n = 202), smokers with normal lung function (n = 297) and COPD patients (n = 1755) at recruitment. Each node of the network corresponds to one of the six inflammatory biomarkers determined in this study (see color code), and its size is proportional to the prevalence of abnormal values (>95th percentile of non-smokers) of that particular biomarker in that particular group of subjects (precise figure shown inside of each node). Two nodes are linked if more than 1% of subjects in the network share abnormal values of these two biomarkers, its width being proportional to that proportion. For further explanations, see text.
doi:10.1371/journal.pone.0037483.g002 PLoS ONE 7(5): e37483. doi:10.1371/journal.pone.0037483

- Persistently inflamed individuals had worse all-cause mortality and exacerbations
- Those with COPD have higher levels of CRP (Eagan et al., ERJ 2010)
- IL-8 and TNF-α levels are higher in asthma (Silvestri et al., Clin Ex All 2006)

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Sedentary Time and Inflammation

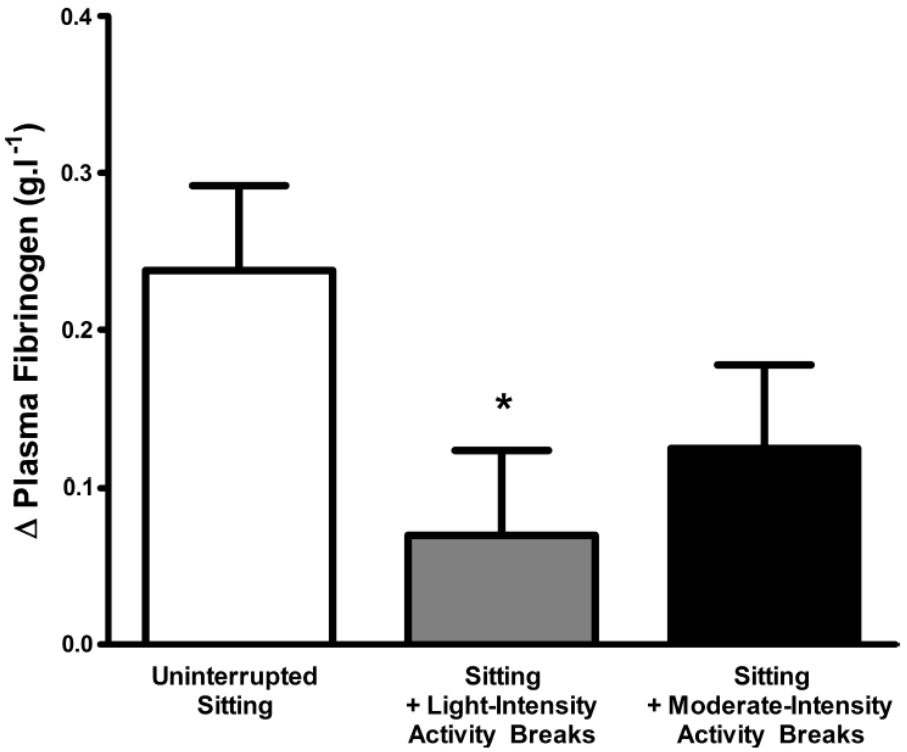

FIGURE 1—The effect of the three-trial conditions on D plasma fibrinogen corrected for plasma volume. Data represent marginal mean ± SEM (adjusted for age, sex, body mass, baseline outcome values, and order effects). *Significantly different from uninterrupted sitting condition, $P < 0.05$.

Med. Sci. Sports Exerc., Vol. 45, No. 7, pp. 1285–1291, 2013

- sedentary time is detrimentally associated with CRP and IL-6
- breaks in sedentary time are significantly inversely associated with IL-6 and leptin

Henson et al, PLoS ONE 8(10): e78350. doi:10.1371/journal.pone.0078350

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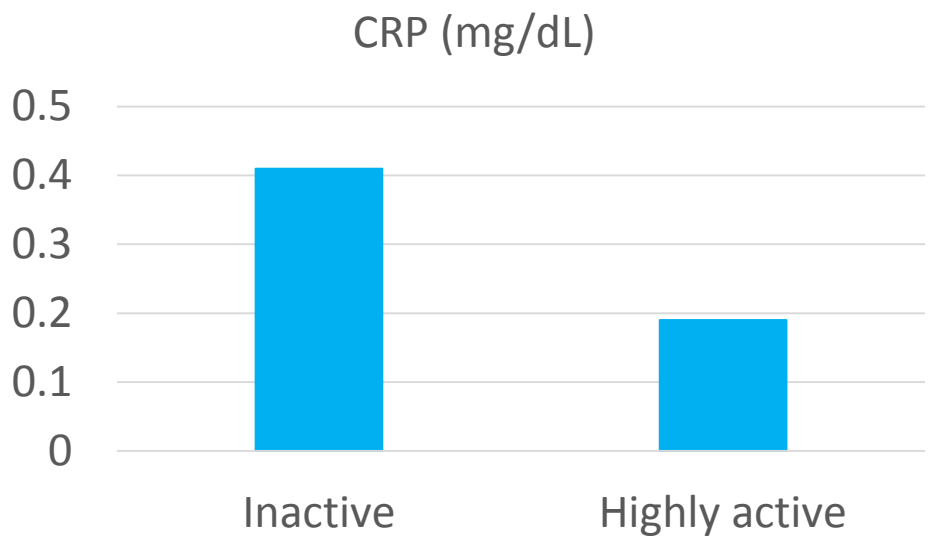
Physical Activity and Inflammation



N = 627; 20–49 years

Clin Physiol Funct Imaging (2016)

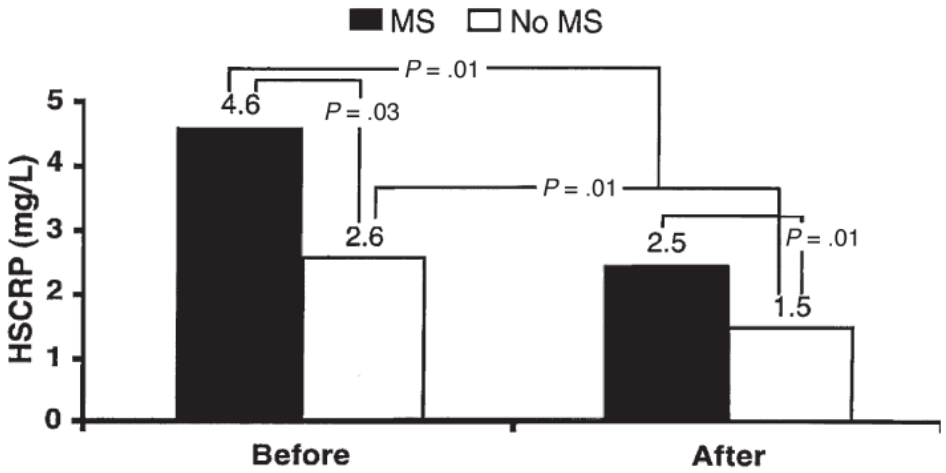


Figure 3. Median levels of high-sensitivity C-reactive protein (hsCRP) before and after cardiac rehabilitation and exercise training in patients with and without metabolic syndrome (MS). Reproduced with permission from Milani et al.[52] Copyright © 2003 Elsevier.

Journal of Cardiopulmonary Rehabilitation and Prevention 2011;31:137–145

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Physical Activity and Inflammation

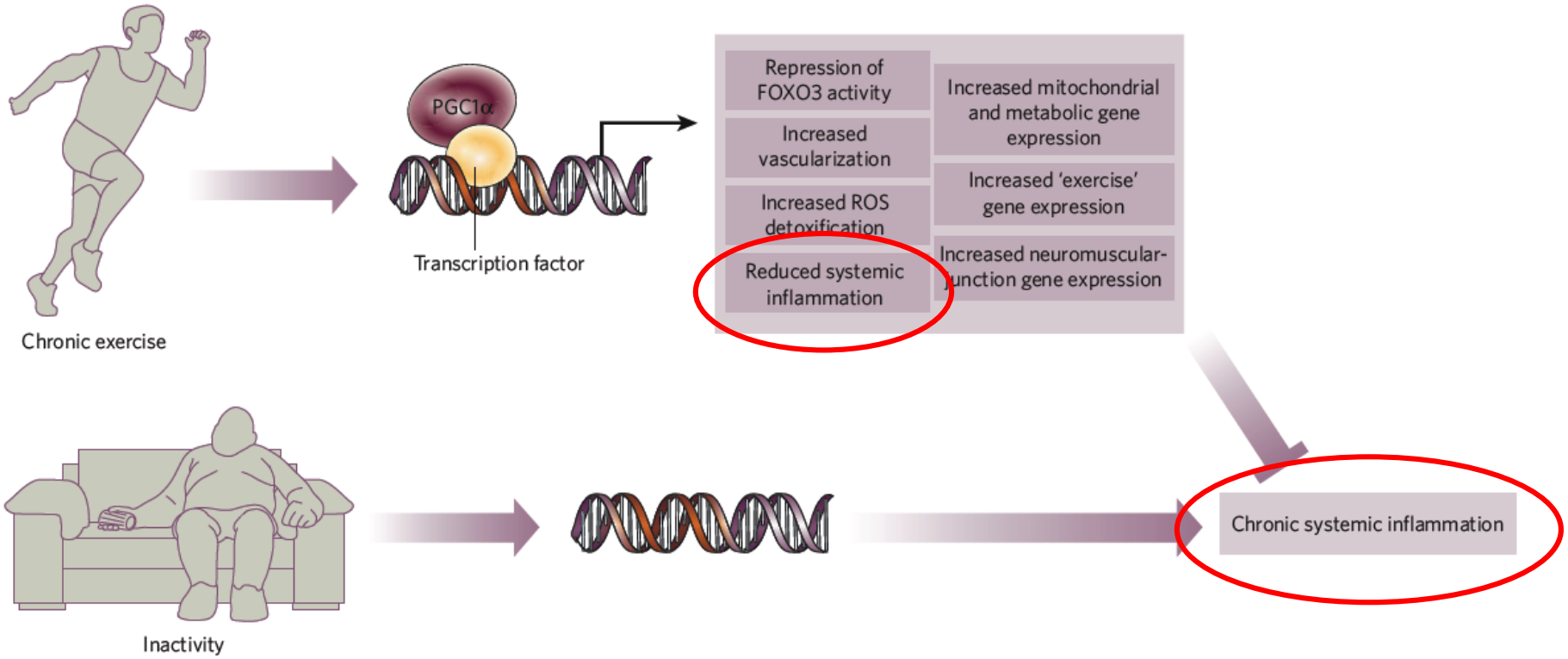

Figure 2 | Effect of PGC1α on chronic systemic inflammation. Physical activity determines the amount of PGC1α in skeletal muscle: the more activity, the more PGC1α. PGC1α, in turn, controls the adaptation of muscle fibres to exercise and confers several benefits. Consequently, a reduction in systemic inflammation is observed in individuals who exercise, particularly in those who engage in chronic exercise. By contrast, inactivity, and thus small amounts of PGC1α in skeletal muscle, results in a chronic systemic inflammatory state, which has serious pathological consequences. This inactivity-driven systemic inflammation is further exacerbated by obesity (not shown). FOXO3, forkhead box O3; ROS, reactive oxygen species.

NATURE|Vol 454|24 July 2008|doi:10.1038/nature07206

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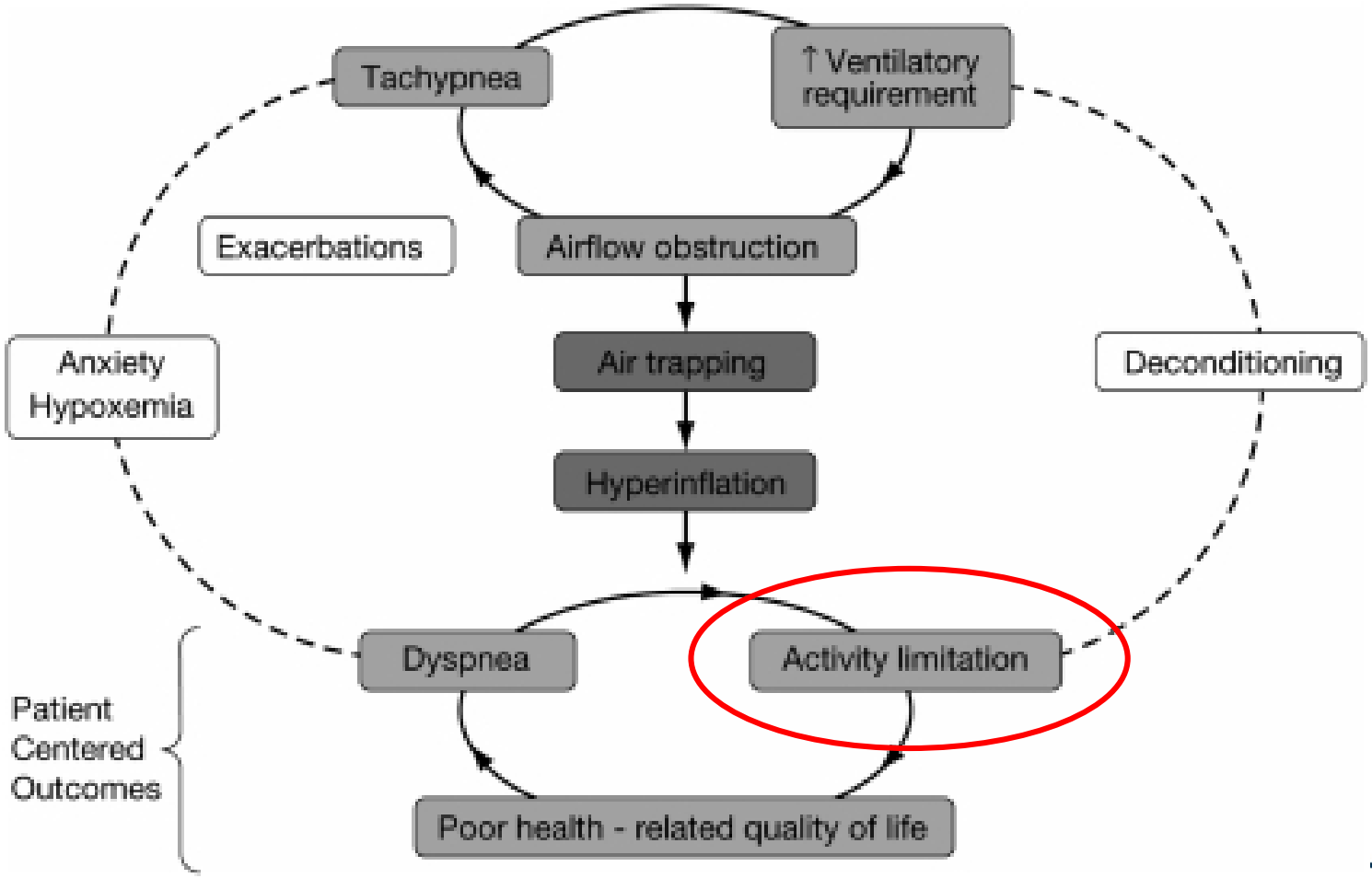
Dyspnea

Deconditioning, that is, low levels of fitness influence disease process and thus disease management.

Physical activity may affect clinical symptoms and physiological pathways.



COPD. 2009 Jun;6(3):211-25.

Rationale

What we know

- Movement affects inflammatory pathways & leads to physiological adaptations associated with prevention and management of chronic disease.
- MVPA is good for dyspnea and clinical outcomes in OLD.

Gaps

- Unclear if all intensities of PA influence prevention and management of OLD.
- The role of sedentary behaviour is poorly understood.

Next Steps

- Understand associations at the population level to inform laboratory based and clinical studies
- Provide insight into prescription of movement behaviours to those at risk or with existing OLD

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Data Source

- Canadian Longitudinal Study on Aging
- 30,000+ adults aged 45 and older
- Lung function: measured using handheld spirometer
- Physical Activity Scale for Elderly

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RESEARCH ARTICLE Open Access

Movement behaviours are associated with lung function in middle-aged and older adults: a cross-sectional analysis of the Canadian longitudinal study on aging

Shilpa Dogra[1*], Joshua Good[1], Matthew P. Buman[2], Paul A. Gardiner[3], Michael K. Stickland[4] and Jennifer L. Copeland[5]

- The purpose of this study was to investigate associations of self-reported movement behaviours (i.e., sitting time, walking, different intensities of physical activity, and strengthening activities), with lung function in middle-aged and older adults **without** a respiratory disease, according to their smoking history.

Dogra et al. BMC Public Health (2018) 18:818

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Study 1: Sample

Table 1 Sample characteristics according to smoking history and sex

Characteristics	Never Smoked		< 10 Pack Years		10 or more Pack Years	
	Males ($n = 3872$)	Females ($n = 4540$)	Males ($n = 2067$)	Females ($n = 2278$)	Males ($n = 2328$)	Females ($n = 1756$)
Age (years)	60.7 ± 10.0 [a,b]	62.0 ± 10.3	62.1 ± 9.9 [a,c]	61.6 ± 9.9	64.4 ± 9.5 [b,c]	62.3 ± 9.4
BMI (kg/m^2)	27.9 ± 4.6 [b]	27.0 ± 5.5 [b]	27.9 ± 4.1 [c]	27.2 ± 5.3 [c]	28.9 ± 4.8 [b,c]	28.2 ± 6.1 [b,c]
FEV_1 (L)	3.4 ± 0.7 [b]	2.4 ± 0.5 [a,b]	3.3 ± 0.7 [c]	2.4 ± 0.5 [a,c]	3.0 ± 0.7 [b,c]	2.2 ± 0.5 [b,c]
FVC (L)	4.3 ± 0.8 [b]	3.0 ± 0.6 [a,b]	4.3 ± 0.8 [c]	3.1 ± 0.6 [a,c]	4.0 ± 0.8 [b,c]	2.9 ± 0.6 [b,c]
FEV_1% predicted	98.6 ± 14.6 [b]	101.0 ± 15.7 [b]	99.3 ± 14.8 [c]	101.3 ± 15.1 [c]	92.4 ± 16.2 [b,c]	94.9 ± 16.1 [b,c]
FVC % predicted	92.8 ± 13.1 [b]	95.8 ± 14.1 [a,b]	93.5 ± 12.6 [c]	96.8 ± 13.1 [a,c]	88.3 ± 13.5 [b,c]	92.5 ± 13.5 [b,c]

[a] $p < 0.05$ for Never Smoked vs. < 10 pack years
[b] $p < 0.05$ for Never Smoked vs. 10 or more pack years
[c] $p < 0.05$ for < 10 pack years vs. 10 or more pack years

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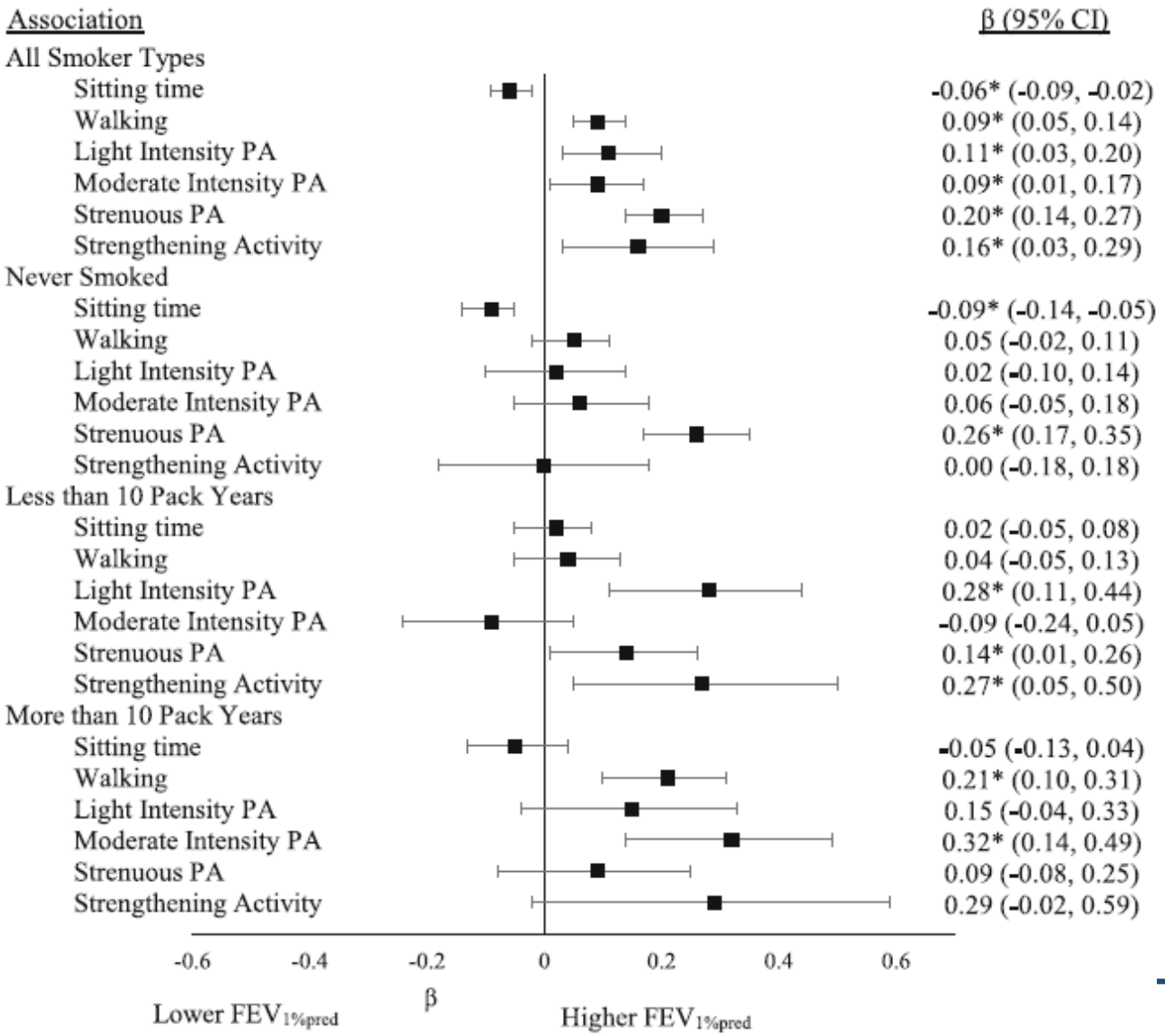
Study 1: Main Findings



- time spent sitting, walking, in different intensities of physical activity, and in strengthening activity are all associated with $FEV_{1\%pred}$ and $FVC_{\%pred}$ regardless of smoking history after adjusting for several covariates.
- research is needed to evaluate the cumulative effect of changing all behaviours on lung function.

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RESEARCH ARTICLE Open Access

Physical activity and sedentary time are related to clinically relevant health outcomes among adults with obstructive lung disease

Shilpa Dogra[1*], Joshua Good[1], Matthew P. Buman[2], Paul A. Gardiner[3], Jennifer L. Copeland[4] and Michael K. Stickland[5]

- to determine the association between movement behaviours with **clinically relevant outcomes** of lung function, healthcare use, and quality of life, among middle-aged and older adults with self-reported obstructive lung disease (i.e. COPD, asthma).
- associations examined separately among those who had impaired spirometry as per **the LLN**, regardless of whether they had a diagnosed lung disease.

Dogra et al. BMC Pulmonary Medicine (2018) 18:98

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Study 2: Sample

Table 1 Sample Characteristics of Adults with Asthma, COPD, and those below the LLN

Characteristics	Asthma ($n = 2569$)	COPD ($n = 877$)	Below LLN for FEV_1 ($n = 1545$)
Age (years)	60.9 ± 9.7	65.0 ± 9.9	61.7 ± 9.9
BMI (kg/m^2)	29.0 ± 6.1	29.2 ± 6.3	29.6 ± 6.6
Height (cm)	167.0 ± 9.6	166.3 ± 9.5	170.8 ± 9.7
FEV_1 (L)	2.5 ± 0.7	2.2 ± 0.8	2.0 ± 0.6
FEV_1% predicted	91.2 ± 17.3	85.1 ± 20.4	65.4 ± 9.7
FVC (L)	3.4 ± 0.9	3.1 ± 0.9	2.9 ± 0.8
FVC % predicted	90.6 ± 14.6	85.9 ± 16.1	70.6 ± 10.8
FEV_1/FVC	0.75 ± 0.07	0.72 ± 0.09	0.69 ± 0.09
FEV_1/FVC % predicted	99.9 ± 9.4	97.3 ± 12.0	92.9 ± 12.0

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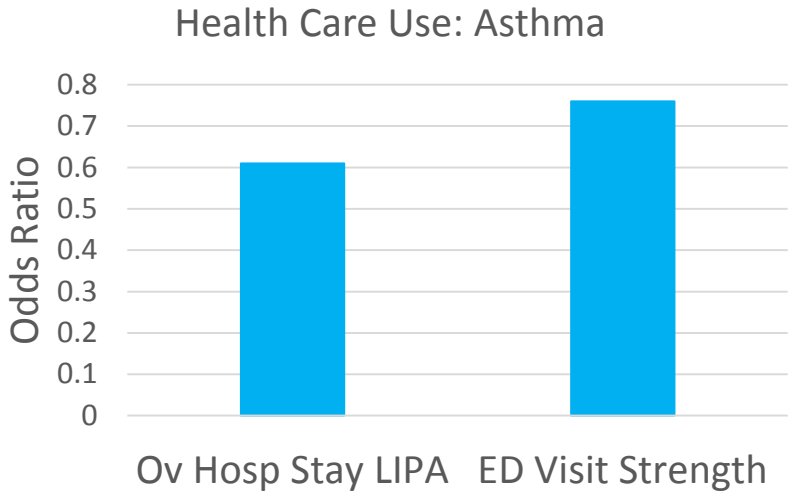
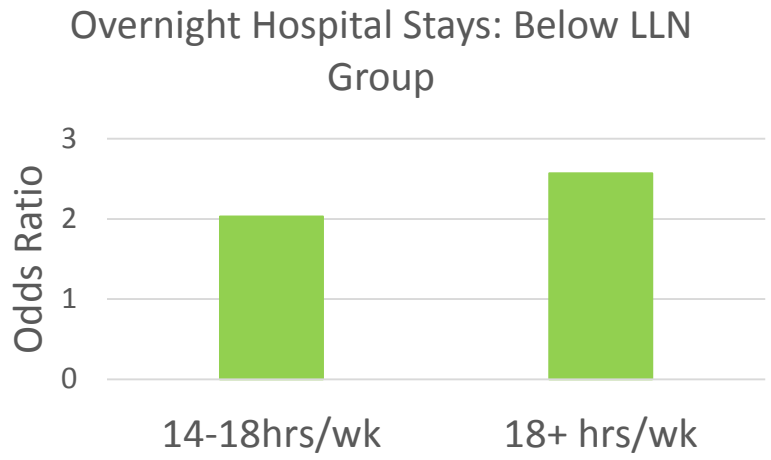
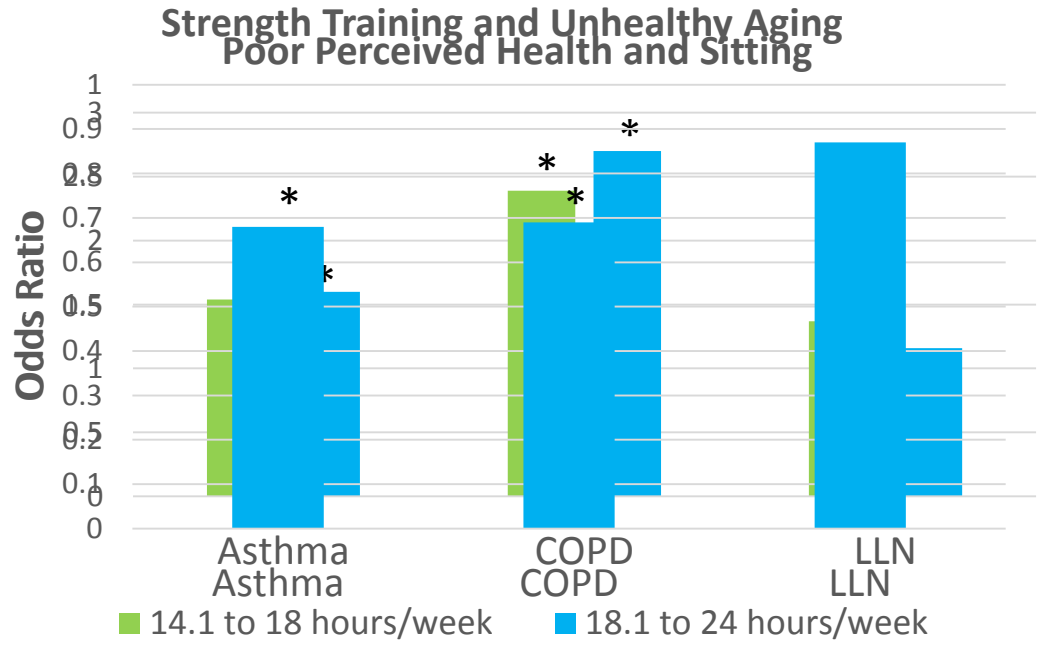
Study 2: Main Findings





- Lung Function
  - Significant associations in crude models
  - NS in adjusted models
- Health Care Use
  - Some “odd” associations
    - eg. adults with COPD engaging in LIPA 2 times more likely to have ED visit

Study 2: Main Findings



Associations between movement behaviours and perceived health, perceived mental health, and healthy aging were consistently significant in adjusted models across all three groups

Study 3: Replacement Effects

Health Reports, 2019.

- to assess the **replacement effects** of different movement behaviours on lung function among both individuals with an existing obstructive lung disease and individuals who were healthy.

Isotemporal substitution analysis allows the changes in lung function to be modelled in terms of what may be expected in a sample if one behaviour were replaced with another

- e.g., the improvement in lung function when replacing 30 minutes of sitting with 30 minutes of walking, keeping time in other behaviours constant

Study 3: Replacement Effects

Health Reports, 2019.

Isotemporal Substitution Analysis:

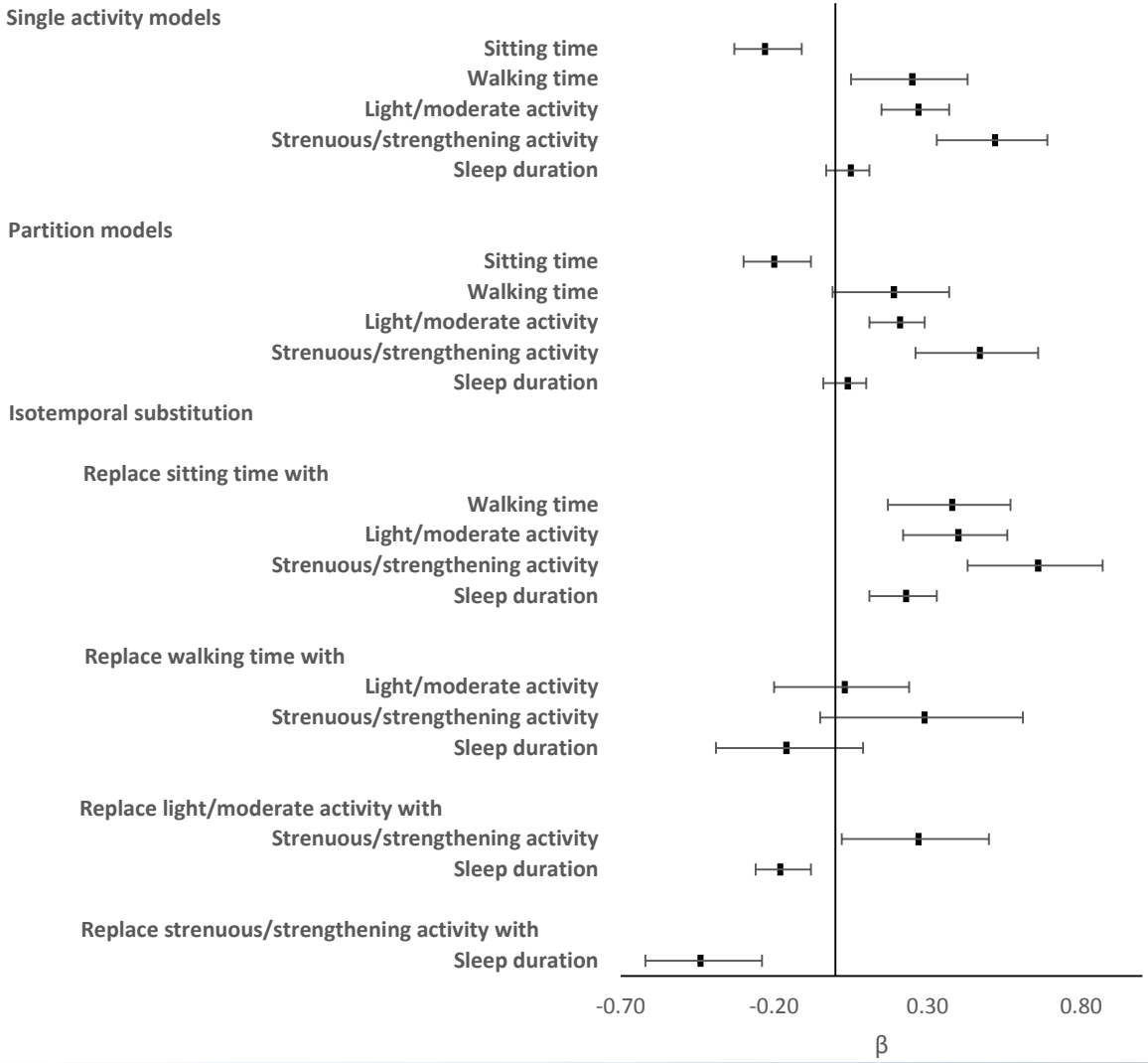
- Movement behaviours were converted into units of 30 mins/day
- A total time variable was created (24 hours)
- Single Activity Models: adjusted linear regressions
- Partition Model: adjusting for other movement behaviours
- Isotemporal Models: behaviour of interest is removed from the model and total time is included to provide replacement effects

Lung Function change = intercept + (b1) sitting time + (b2) light or moderate intensity physical activity + (b3) strenuous/strengthening activities + (b4) sleep + (b5) total activity + (b6) covariates

Study 3: Sample

Characteristics	Adults with OLD	SD	Healthy adults	SD
Sex (%, male)	43.8		48.8	
Age (years)	61.5	9.9	62.2*	10
BMI (kg/m^2)	28.9	6.1	27.5*	4.9
FEV_1 (L)	2.4	0.8	2.9*	0.7
FVC (L)	3.2	0.9	3.7*	0.9
FEV_1 % predicted	82.3	18	98.6*	12.7
FVC % predicted	87.4	15.9	98.7*	12

Study 3: Healthy Adults



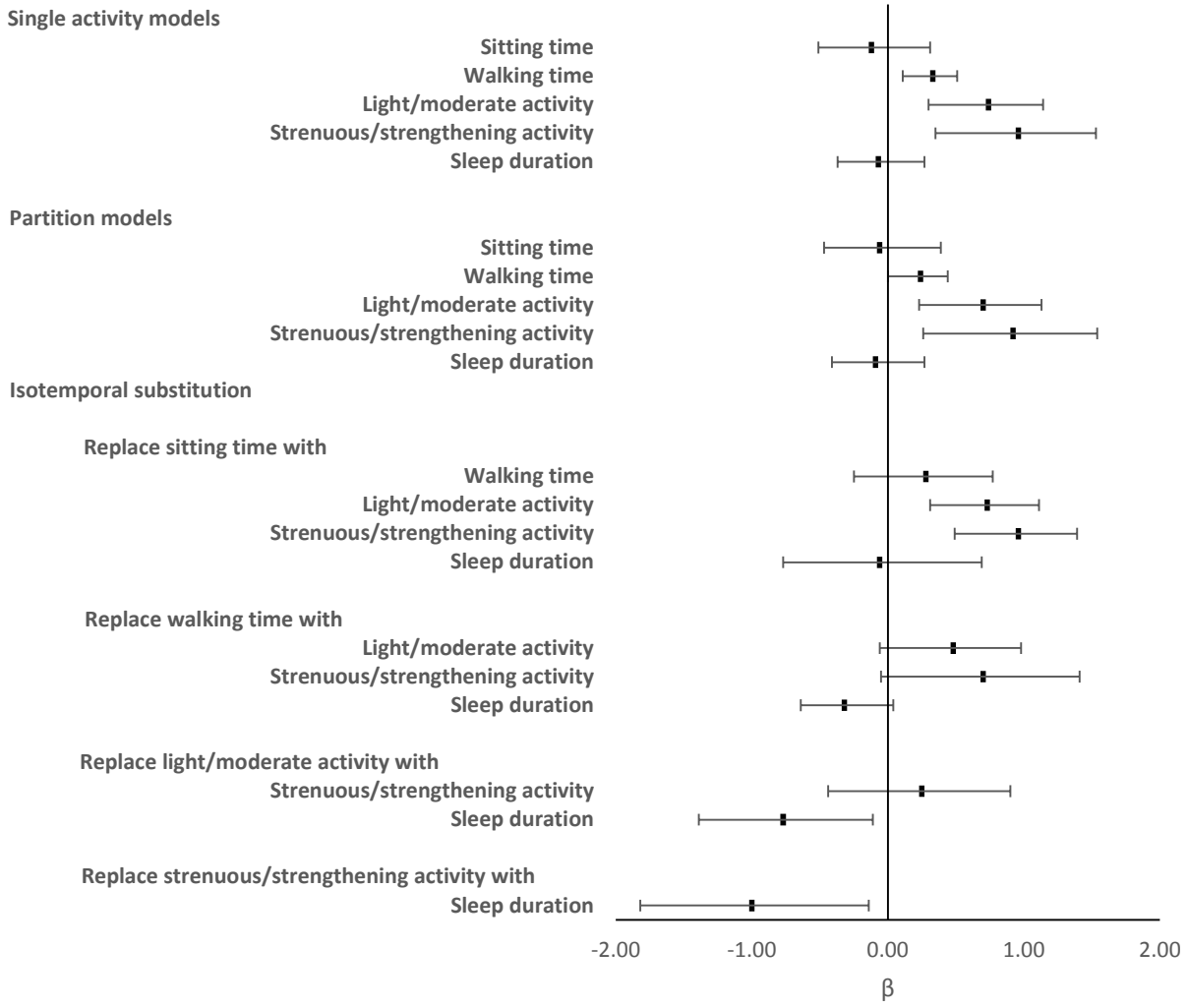
- all movement variables were significantly associated with $FEV_{1\%pred}$ and $FVC_{\%pred}$
- associations remained significant when all movement behaviours were included in the same regression model; except for walking
- Replacing sitting time with 30 minutes per day of any type of physical activity or sleep → an increase in $FEV_{1\%pred}$

Study 3: Healthy Adults

- replacing sitting time with 30 minutes per day of strenuous or strengthening activity was associated with a 0.65 percentage point higher $FEV_{1\%pred}$ (β=0.65, CI: 0.43, 0.88).

- replacing 30 minutes per day of sleep duration with strenuous or strengthening activity was associated with a 0.49 percentage point higher $FVC_{\%pred}$ (β=0.49, CI: 0.27, 0.71).

Study 3: OLD Group



- Light or moderate PA and strenuous or strengthening PA were positively associated with $FEV_{1\%pred}$ and $FVC_{\%pred}$ in single activity and partition models
- walking was significant only in the single activity model
- Replacing 30 mins/day of sitting time or sleep duration with light -moderate PA or strenuous - strengthening PA → improvement in $FEV_{1\%pred}$ and $FVC_{\%pred}$.

Study 3: OLD Group

- replacing 30 minutes per day of sitting time with light or moderate activity was associated with a 0.71 percentage point higher $FEV_{1\%pred}$ (β=0.71, CI: 0.31, 1.12).

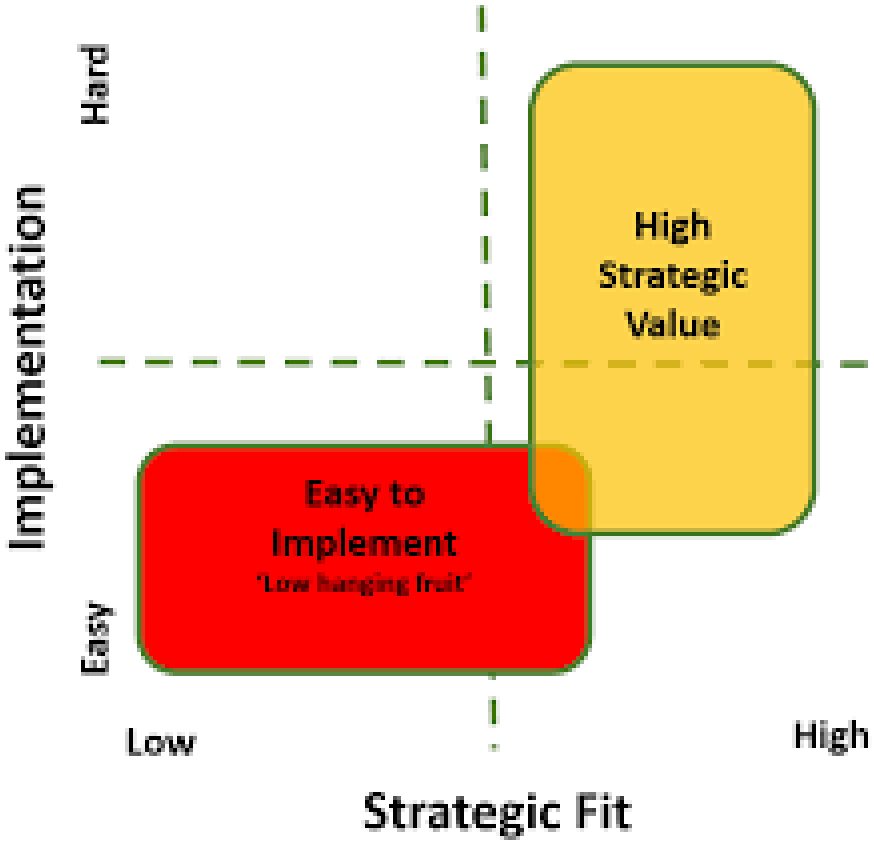
- replacing 30 minutes per day of sleep duration with strenuous or strengthening activity was associated with a 1.13 percentage point higher $FVC_{\%pred}$ (β=1.13, CI: 0.64, 1.63).

Overall Conclusions

- Activities of all intensities and sleep impact respiratory health in individuals who are healthy or who have an OLD
- The combined effect of optimal 24 hour movements may provide greater benefit
- Physical activity may be a modifiable determinant of primary, secondary, and tertiary prevention for respiratory outcomes

Practical/Clinical Applications

- Low hanging fruit:
  - Reduce sitting time
  - Increase sleep (quantity/quality)
- Higher impact of higher intensity
  - But need to build capacity first
- Don’t neglect strength training
- Counsel to the full 24 hours



Future Research

- Experimental Studies
  - Breaking up sedentary time is associated with better cardiorespiratory fitness in healthy older adults (Copeland et al., Health Reports 2017)
  - Light intensity PA is associated with significant health benefits (Fuzeki et al., Sports Medicine, 2017)
- Longitudinal Data
  - Impact on age-associated decline in lung function
- Mechanistic Studies
  - Identify biological pathways

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Thank You!

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Twitter: sdograDOTcom

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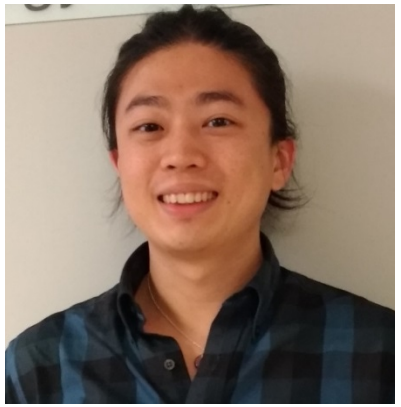
Upcoming CLSA Webinars

Clinical Features of REM Sleep Behavior Disorder in the Population-Based CLSA Cohort: Can We Improve the Screening Tools?

Chun Yao, MSc



December 12, 2018 | 12 p.m. ET

Register: bit.ly/clsawebinars