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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SMCLSA 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 behaviors (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.

Webinars will be broadcast using WebEx. Further instructions will be sent by email.

Register online at: bit.ly/clsawebinars

www.clsa-elcv.ca
Moving More to Breathe Better: Associations Between Physical Activity, Sitting Time, and Lung Function in the CLSA

Shilpa Dogra, PhD
Movement Behaviours

24 Hour Movement

Metabolic Equivalents

- Sedentary Behaviour
- Light Intensity PA
- MV PA
- Sleep
Chronic Disease Prevention

- Insulin resistance
- Hyperglycemia
- Diabetes and Cardiovascular Disease
- Decline in Lung Function with Age
- Smoking/Air Pollution/Exposure to Noxious Materials
- Physical Activity
- Respiratory Diseases
Age Associated Decline in Lung Function

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

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

Respiratory Medicine 113 (2016) 57–64
Smoking and Physical Activity on Lung Function

- 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.

Decline in Lung Function among Active Smokers

- Moderate PA
- High PA

FEV1, FVC

Low PA: referent category

Biological Plausibility

- 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)
Sedentary Time and Inflammation

- 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

Physical Activity and Inflammation

**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. Copyright © 2003 Elsevier.

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

Clin Physiol Funct Imaging (2016)
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.
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
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
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.
Table 1 Sample characteristics according to smoking history and sex

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Never Smoked</th>
<th>&lt; 10 Pack Years</th>
<th>10 or more Pack Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males (n = 3872)</td>
<td>Females (n = 4540)</td>
<td>Males (n = 2067)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>60.7 ± 10.0</td>
<td>62.0 ± 10.3</td>
<td>62.1 ± 9.9</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.9 ± 4.6</td>
<td>27.0 ± 5.5</td>
<td>27.9 ± 4.1</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>3.4 ± 0.7</td>
<td>2.4 ± 0.5</td>
<td>3.3 ± 0.7</td>
</tr>
<tr>
<td>FVC (L)</td>
<td>4.3 ± 0.8</td>
<td>3.0 ± 0.6</td>
<td>4.3 ± 0.8</td>
</tr>
<tr>
<td>FEV₁% predicted</td>
<td>98.6 ± 14.6</td>
<td>101.0 ± 15.7</td>
<td>99.3 ± 14.8</td>
</tr>
<tr>
<td>FVC% predicted</td>
<td>92.8 ± 13.1</td>
<td>95.8 ± 14.1</td>
<td>93.5 ± 12.6</td>
</tr>
</tbody>
</table>

*p < 0.05 for Never Smoked vs. < 10 pack years

*p < 0.05 for Never Smoked vs. 10 or more pack years

*p < 0.05 for < 10 pack years vs. 10 or more pack years
Study 1: Main Findings

- time spent sitting, walking, in different intensities of physical activity, and in strengthening activity are all associated with FEV$_{1\%\text{pred}}$ and FVC$_{\%\text{pred}}$ regardless of smoking history after adjusting for several covariates.

- research is needed to evaluate the cumulative effect of changing all behaviours on lung function.
Physical activity and sedentary time are related to clinically relevant health outcomes among adults with obstructive lung disease

Shilpa Dogra¹, Joshua Good¹, Matthew P. Buman², Paul A. Gardiner³, Jennifer L. Copeland⁴ and Michael K. Stickland⁵

- 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.

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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Asthma (n = 2569)</th>
<th>COPD (n = 877)</th>
<th>Below LLN for FEV₁ (n = 1545)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>60.9 ± 9.7</td>
<td>65.0 ± 9.9</td>
<td>61.7 ± 9.9</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29.0 ± 6.1</td>
<td>29.2 ± 6.3</td>
<td>29.6 ± 6.6</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167.0 ± 9.6</td>
<td>166.3 ± 9.5</td>
<td>170.8 ± 9.7</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>2.5 ± 0.7</td>
<td>2.2 ± 0.8</td>
<td>2.0 ± 0.6</td>
</tr>
<tr>
<td>FEV₁ % predicted</td>
<td>91.2 ± 17.3</td>
<td>85.1 ± 20.4</td>
<td>65.4 ± 9.7</td>
</tr>
<tr>
<td>FVC (L)</td>
<td>3.4 ± 0.9</td>
<td>3.1 ± 0.9</td>
<td>2.9 ± 0.8</td>
</tr>
<tr>
<td>FVC % predicted</td>
<td>90.6 ± 14.6</td>
<td>85.9 ± 16.1</td>
<td>70.6 ± 10.8</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>0.75 ± 0.07</td>
<td>0.72 ± 0.09</td>
<td>0.69 ± 0.09</td>
</tr>
<tr>
<td>FEV₁/FVC % predicted</td>
<td>99.9 ± 9.4</td>
<td>97.3 ± 12.0</td>
<td>92.9 ± 12.0</td>
</tr>
</tbody>
</table>
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

\[
\text{Lung Function change} = \text{intercept} + (b1) \text{ sitting time} + (b2) \text{ light or moderate intensity physical activity} + (b3) \text{ strenuous/strengthening activities} + (b4) \text{ sleep} + (b5) \text{ total activity} + (b6) \text{ covariates}
\]
Study 3: Sample

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Adults with OLD</th>
<th>SD</th>
<th>Healthy adults</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (%, male)</td>
<td>43.8</td>
<td></td>
<td>48.8</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>61.5</td>
<td>9.9</td>
<td>62.2*</td>
<td>10</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.9</td>
<td>6.1</td>
<td>27.5*</td>
<td>4.9</td>
</tr>
<tr>
<td>FEV₁ (L)</td>
<td>2.4</td>
<td>0.8</td>
<td>2.9*</td>
<td>0.7</td>
</tr>
<tr>
<td>FVC (L)</td>
<td>3.2</td>
<td>0.9</td>
<td>3.7*</td>
<td>0.9</td>
</tr>
<tr>
<td>FEV₁ % predicted</td>
<td>82.3</td>
<td>18</td>
<td>98.6*</td>
<td>12.7</td>
</tr>
<tr>
<td>FVC % predicted</td>
<td>87.4</td>
<td>15.9</td>
<td>98.7*</td>
<td>12</td>
</tr>
</tbody>
</table>
Study 3: Healthy Adults

- all movement variables were significantly associated with $\text{FEV}_{1\%\text{pred}}$ and $\text{FVC}_{\%\text{pred}}$
- 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 $\text{FEV}_{1\%\text{pred}}$
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$_{1\%pred}$ ($\beta=0.65$, 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$_{\%pred}$ ($\beta=0.49$, 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$_{1\%pred}$ ($\beta=0.71$, 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$_{\%pred}$ ($\beta=1.13$, 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
Thank You!

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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/clsa-webinars