Is Exercise Protective Against Influenza-Associated Mortality?

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Background information
Major health benefits associated with exercise

<table>
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<tr>
<th>CONDITION</th>
<th>EFFECTS</th>
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<tr>
<td>Heart disease</td>
<td>Risks ↓</td>
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<td>Stroke</td>
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<td>Overweight and obesity</td>
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<td>Type 2 diabetes</td>
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<td>Colon cancer</td>
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<td>Breast cancer</td>
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<td>Depression</td>
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<td>Falls in older people</td>
<td>Risks ↓</td>
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<tr>
<td>Psychological well-being</td>
<td>Improved</td>
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<td>Musculoskeletal health</td>
<td>Improved</td>
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(WHO 2006 - "Physical activity and health in Europe: Evidence for Action")

Studies showed exercise is beneficial to health

Adjusted odds ratios for major categories of death decrease with increasing physical activity

Exercise can reduce the risks of death in general

(Lam TH et al 2004, Ann Epidemiol, 14:391-398)
From a Hong Kong study, we demonstrated the harmful effects of air pollution

Annual death rates per 100,000 population (1996-1999)

(Combined effects of 4 air pollutants and based on exceedance of WHO AQG)

Would the beneficial effects of exercise reduce the harmful effect of air pollution?

Our more recent study tells us YES …BUT…

Change in excess risk (%) of death per 10 µg m⁻³ increase in PM₁₀ between respective exercise levels and never-exercise (reference) groups

Yes! Exercise can reduce the harmful effects of air pollution. However, the beneficial effects are only found in those who do low/moderate exercise but not in those with daily exercise.
Flu is a common disease, but not a trivial disease

From our studies in Hong Kong, we showed the harmful effect of influenza

Would the beneficial effects of exercise reduce the harmful effect of influenza?
Our paper recently published in the online Journal PLoS ONE

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Methods used in this study

Subjects: Adults who died at the age 30+ (Based on Lifestyle and Mortality (LIMOR) study), n=24,656

Collected info about them: Causes of deaths, socioeconomic and demographic characteristics, lifestyle habits (10 yrs before death) including habitual exercise frequencies.

Time-series data in this study: Type A (H1N1 or H3N2) and Type B Influenza viruses activity

• Air pollution concentrations
• Meteorological conditions

Methods

Measure for influenza virus activity – influenza intensity

• The Public Health Virology Laboratory of the Department of Health receives specimens from hospitals, outpatient clinics and general practitioners for making diagnosis of influenza

• *Influenza intensity*: Proportion of weekly number of positive influenza isolates divided by total number of all specimens received for making the diagnosis
### Exercise habits – number of times exercised for ≥30 min

**Never/seldom – exercised never or <1/M**

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### Exercise habits – number of times exercised for ≥30 min

**Low/moderate – exercised 1/M to 3/Wk**

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Frequent – exercised ≥4/Wk

Exercise habits – number of times exercised for ≥30 min

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Statistical Methods

(a) Stratified analysis of odds ratios by potential confounders for the association between influenza epidemic and habitual exercise frequencies.

(b) Poisson Regression* to assess the excess risks of never/seldom exercise group.

(c) Logistic Regression to assess the change in excess risks of influenza-associated mortality from never/seldom group to more frequent exercise groups.

*Adjustments were made for seasonality, temperature, humidity, solar radiation, PM10 and O3 concentration, smoking, drinking, job nature, and the duration of ill-time before death.
Results of this study

Measures for influenza virus activity - epidemic

Plots of weekly proportion of total specimens positive for influenza isolation in Hong Kong in 1998 (Figure 2 of this paper)
Results for mortality associated influenza epidemic

Odds ratios of death associated with influenza epidemic for low/moderate exercise and for frequent exercise relative to never/seldom exercise (Figure 1 of this paper) – Low/moderate exercise showed reduction in the odds ratios, greater for non-smokers and non-drinkers.

Results show that for those ≥ 65 yrs, mild/moderate exercise is beneficial in reducing influenza associated mortality, but more frequent (≥ 4/wk) exercise is NOT

Change in excess risk (%) of death associated with influenza epidemic for low/moderate exercise and frequent exercise relative to never/seldom exercise adjusted for confounding factors (Table 1 of this paper)
333 premature deaths (age 65+) associated with influenza were avoided due to low/moderate exercise relative to never/seldom exercise.

Note: 18940 deaths of all natural causes were taken in account.

Change in excess risk (%) of death associated with each 10% increase in influenza positive isolation proportion for low/moderate and frequent exercise relative to the never/seldom exercise (Table 2 of the paper)

More not always better.....

At least in relation to protecting from influenza associated mortality in the ≥ 65 year old group?

What is the possible explanation?
Discussion of this study

A U.S. study showed that immunity is reduced for some hours following severe exercise

Natural killer cell activity response to marathon running (62 experienced runners)

Immunity against infections

'Open window' for infection

Duration after running

This “Open window” has also been hypothesized in Denmark two years ago (Pedersen et al 1998. Acta Physiol Scand. 162:325-332)

Open Window Theory for human beings cannot be confirmed with only n=62 subjects who are athletes.

In our study, we are able to demonstrate an effect which may be related to the Open Window Theory at a general population scale with a representative large sample.

LIMOR Study (24,000+ deaths)

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Public Health Implications

**U.S. Department of Health and Human Services**

"Substantial health benefits occur with a moderate amount of activity (e.g., at least 30 minutes of brisk walking) on 5 or more days of the week."


**U.K. Department of Health**

“For general health benefit, adults should achieve a total of at least 30 minutes a day of at least moderate intensity physical activity on 5 or more days of the week. ….. The recommendations for adults are also appropriate for older adults."


In Hong Kong the recommendation is to do exercise everyday. These recommendations have not taken into account the interactions with influenza or with air pollution.
Conclusions

- In general, exercise is good for you!! Those who exercise have lower death risks than those who never/seldom exercise. However in term of reduction in mortality risk associated with influenza, low to moderate exercise frequency may be better than daily exercise for those over 65 years of age.

- Exercising for 4 times or more per week, each lasting for 30 min or more, does provide health benefits in reducing mortality risk. However this exercise habit does not reduce influenza associated mortality risk.

Recommendations

- Regular exercise is important to your health.

- For the general public, particularly older adults, they should not exercise excessively during period when influenza activity is high.

- Do not smoke and drink if you want to enjoy the benefit of exercise.
Acknowledgements

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3. Department of Health and Dr KH Mak for their collaboration in the LIMOR study;
4. The Hong Kong Observatory for providing meteorological data;
5. Environmental Protection Department (Hong Kong Govt.) for providing air pollution concentration data.
6. All the researchers in The Hong Kong Lifestyle and Mortality Study (LIMOR), led by Prof. TH Lam, for their great efforts in gathering all the questionnaire data.

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