

PHYSICAL ACTIVITY AND RISK OF POSTOPERATIVE DELIRIUM

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BACKGROUND

- **Post-operative delirium (POD)** affects between 9.9-67%¹ of older adults undergoing non-cardiac surgery and can have devastating long-term sequelae such as cognitive dysfunction, decline in functional status, increased morbidity and mortality.²⁻⁴ Many intraoperative measures to prevent POD have shown limited benefit.
- **Physical activity (PA)** has been associated with decreased incidence of dementia⁵, but this association is not observed when PA is studied in the context of leisure activities as a proxy for late life **cognitive reserve**⁶.
- While cognitive reserve has been shown to decrease the incidence and severity of POD,⁷ the role of baseline PA on risk for POD has been understudied.

OBJECTIVES

- To determine the effect of baseline physical activity on the **incidence and severity of POD** in older patients undergoing elective orthopedic surgery
- To determine whether the association of PA on POD risk is **independent of cognitive reserve**
- To examine whether **gender** as a biological variable moderates the association of physical activity on risk of POD

We hypothesize that physical activity protects against post-operative delirium by bolstering the physiologic reserve needed to withstand the stressors of surgery.

METHODS

- We performed a secondary analysis of a prospective, single-center cohort study at an urban academic medical center.
- 132 non-demented, English-speaking adults over 60 years old undergoing elective orthopedic surgery were screened on postoperative days 1-2 for incidence of POD using the Confusion Assessment Method and delirium severity using the and the Memorial Delirium Assessment of Severity scale.
- Baseline cognitive activities and PA were assessed with a validated Leisure Activity Scale (LAS).
- Regular PA was categorized as 6-7 days per week.
- Association of regular PA with incidence of POD was assessed using multivariable logistic regression adjusting for age, sex, Charlson Comorbidity Index, cognitive reserve and cognitive function.
- Linear regression was used to assess the association of delirium severity with regular PA.

RESULTS

| Risk Factors | Total (N=132) | No POD (N=91) | POD (N=41) | p value |
|--|------------------|------------------|----------------|---------|
| Age, years ^a | 70.5 (64.5-76.3) | 69.8 (64.4-75.8) | 72.7 (65-76.6) | 0.46 |
| Sex, N (%) | | | | 0.36 |
| Male | 47 (35.6) | 31 (34.0) | 16 (39.0) | |
| Female | 85 (64.4) | 60 (65.9) | 25 (61.0) | |
| Years of Education ^b | 13.2 ± 0.3 | 13.5 ± 0.3 | 12.5 ± 0.7 | 0.15 |
| Body mass index kg/m ² ^b | 32.6 ± 0.6 | 32.9 ± 0.7 | 32.0 ± 0.9 | 0.47 |
| Charlson Comorbidity Index, N (%) | | | | 0.38 |
| 0 | 54 (40.9) | 38 (41.8) | 16 (39.0) | |
| 1 | 40 (30.3) | 25 (27.5) | 15 (36.6) | |
| 2 | 22 (16.7) | 14 (15.4) | 8 (19.5) | |
| 3 | 11 (8.3) | 9 (9.9) | 2 (4.9) | |
| 4 | 5 (3.8) | 5 (5.5) | 0 (0) | |
| ADL scale (1-14) ^a | 1 (0, 1) | 1 (0, 1) | 1 (0, 1) | 0.53 |
| Geriatric Depression Scale | | | | <0.01 |
| >5 | 12 (9.2) | 11 (12.1) | 1 (2.5) | |
| 5-9 (at risk for depression) | 115 (87.8) | 80 (87.9) | 35 (87.5) | |
| 10-12 (indicative of depression) | 4 (3.1) | 0 (0) | 4 (10.0) | |
| MMSE (0-30) ^a | 29 (27- 30) | 29 (27.5-30) | 27 (25-29) | <0.01 |
| Cognitive Activity Scale (0-41) ^a | 13.5 (7-19) | 14.5 (8-22) | 7.5 (2-15) | <0.01 |
| PA, days per week ^a | 1 (0-6) | 1 (0-7) | 1 (0-4) | 0.15 |
| Regular PA (6 or more days), N (%) | 35 (26.5) | 28 (80.0) | 7 (20.0) | 0.40 |
| MDAS ^c | 5 (3-7) | 4 (2.5-5) | 8 (7-9) | <0.001 |

| | Physical Activity only | | Fully Adjusted Model | | Fully Adjusted Model Stratified by Sex | | | |
|-----------------------------------|-------------------------|-------------|-------------------------|-------------|--|-------------|-------------------------|-------------|
| | OR (95% CI) | p-value | OR (95% CI) | p-value | Men | | Women | |
| | | | | | OR (95% CI) | p-value | OR (95% CI) | p-value |
| Regular PA ^a | 0.25 (0.08-0.79) | 0.02 | 0.27 (0.08-0.85) | 0.03 | 0.99 (0.19-5.16) | 0.99 | 0.07 (0.01-0.62) | 0.02 |
| Cognitive activities ^b | * | * | 0.93 (0.88-0.98) | 0.01 | 0.95 (0.861-1.06) | 0.36 | 0.90 (0.83-0.97) | <0.01 |
| Age | 0.97 (0.91-1.03) | 0.37 | 0.97 (0.91-1.04) | 0.38 | 1.01 (0.92-1.12) | 0.82 | 0.95 (0.87-1.04) | 0.24 |
| Female sex | 0.62 (0.26-1.49) | 0.29 | 0.68 (0.28-1.66) | 0.40 | * | * | * | * |
| MMSE ^c | 0.61 (0.48-0.77) | <0.01 | 0.66 (0.52-0.84) | <0.01 | 0.53 (0.34-0.81) | <0.01 | 0.71 (0.52-0.96) | 0.03 |
| CCI ^d | 0.73 (0.48-1.09) | 0.13 | 0.77 (0.51-1.16) | 0.21 | 0.75 (0.37-1.48) | 0.40 | 0.82 (0.48-1.40) | 0.50 |

Incidence and Severity of POD

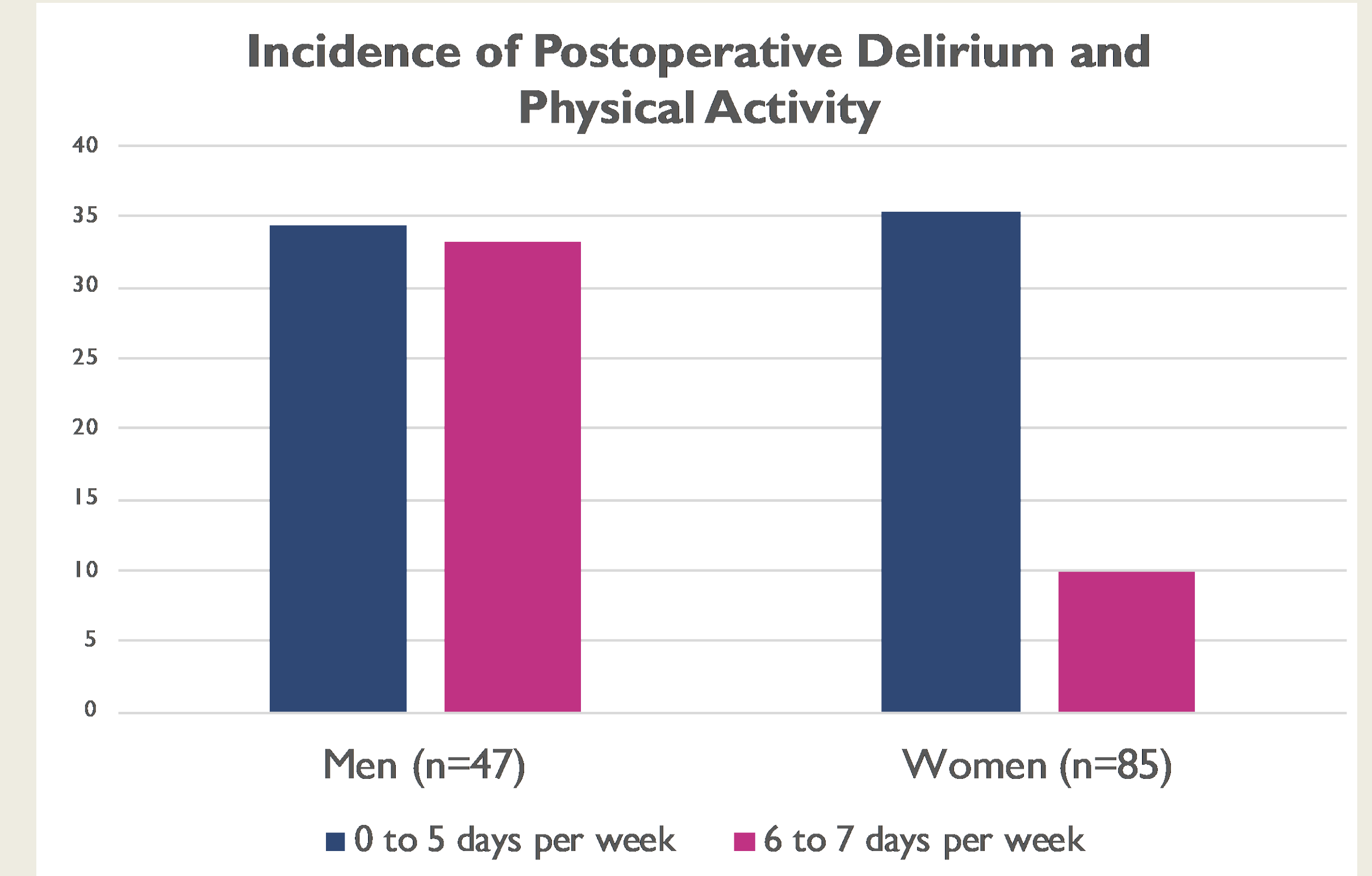
- Of the 132 subjects, 41 developed POD, making the incidence 31.1%
- Using logistic regression model adjusting for age, sex, cognitive status, cognitive reserve and comorbidity index, older adults who took part in regular PA (6 or more days per week) had a decreased odds of developing POD compared to those who do not (OR 0.27 95% CI 0.08-0.85).
- The median delirium severity score (MDAS) was 4 (2.5-5) in the non-delirious group compared to 8 (7-9) among those developing POD(p<0.01).
- In fully adjusted linear regression model, there was a trend towards a reduction in MDAS among those who exercised 6-7 days per week but this did not reach statistical significance (β= -0.99, p=0.06).

Independence of PA from cognitive reserve

- There was no significant interaction between cognitive reserve and regular physical activity (p=0.70), indicating that cognitive reserve and regular physical activity were independently associated with risk of POD.

Gender

- 16 of 47 (34%) men developed POD compared to 25 of 85 (29.4%) women (p=0.36).
- Women taking part in regular PA had dramatically lower odds of developing POD (OR 0.07 95%CI 0.01-0.62), which was not observed among men, OR 0.99 (95% CI 0.19-5.16).



CONCLUSIONS

- Regular physical activity was associated with a 73% reduction in odds of developing POD, even while controlling for comorbidity, cognitive status, sex and age.
- When adjusting for cognitive activities, a high threshold of 6-7 days of PA per week was required before a difference was observed.
- Modestly intense activity seemed to be adequate, as 66.7% of participants who took part in regular PA reported walking as their mode of activity.
- The independence of cognitive reserve and PA on incidence of POD has possible implications that persons with mild cognitive impairment or relatively low cognitive reserve will likely still benefit from exercise if tolerated. Conversely, patients with joint pain or injuries who find it difficult to exercise may benefit from engaging in stimulating cognitive activities such as reading or doing puzzles.
- Women who partake in regular PA have a dramatically reduced odds of developing POD compared to men.
- This analysis should be replicated in larger datasets. If the relationships hold, randomized controlled trials to test the efficacy of regular PA on incidence and severity of POD may be warranted, as causation cannot be established with this study.
- The biological mechanisms of the observed gender difference in response to PA should be explored.

References

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