# A Detailed Statistical Analysis of Anterior Chest Wall Muscle Recruitment

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# Introduction

› The Pectoralis Major Muscle is the largest muscle on the anterior chest wall

› Previous EMG research has been conducted on activation during different types of exercise but not on ADLs & IADLs

› Purpose to conduct a detailed statistical analysis on EMG results to evaluate the extent to which the Move in the Tube (MINT) movement strategy must be put in place to reduce asymmetrical pull across the chest wall

# Move in the Tube

› Movement strategy that advocates for keeping the upper arm close to the body

› Creates a shorter lever arm during lifting which could allow more activity without increasing stress across the sternum
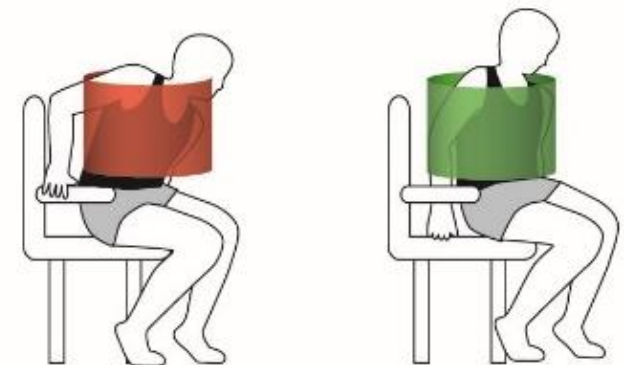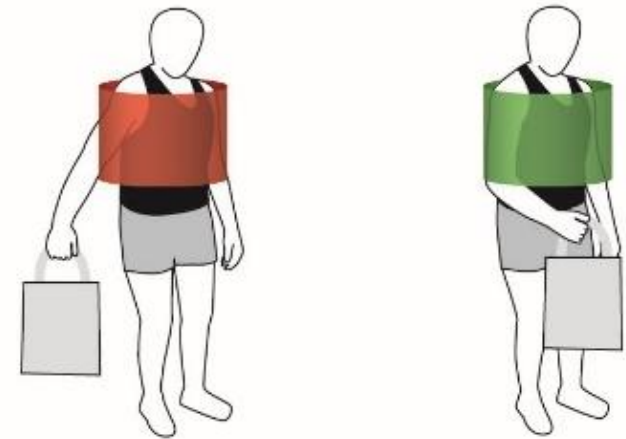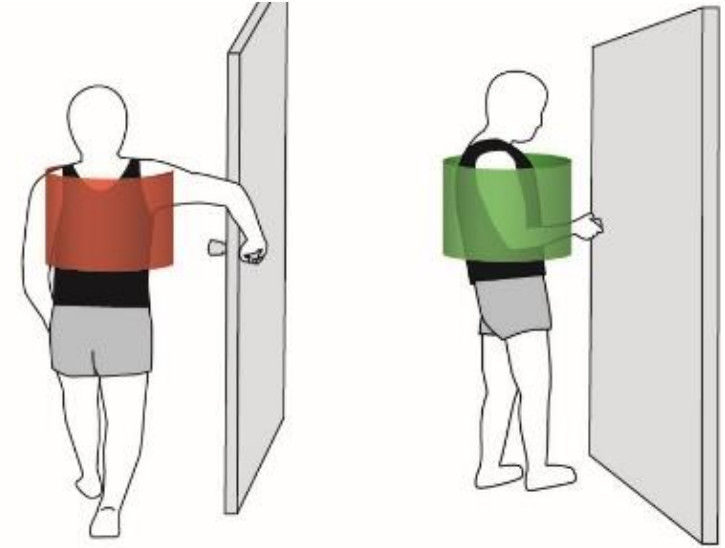
From Bayl Univ Med. Center

# Methods

› Retrospective data on previously collected data on Pectoralis Major recruitment on the anterior chest wall

› Independent variables
  – Age = Young (18-40 years) or Old (60-85 years)
  – Movement Strategy = Self-selected or Move in the Tube
  – ADL / IADL Task (10)
    › Bag – Lifting a bag with 10 lb weight from shopping cart to a table
    › Basket – Lifting a laundry basket with 10 lb from the floor to a table
    › Sit Edge of Bed (EOB) – Standing up from the edge of a bed
    › Pour – Pouring a gallon of water into a cup for 3 seconds
    › Pull Chair – Pulling a chair out from underneath a table
    › Pull Door – Standing in front of a closed door, pulling it open, and walking through
    › Push Chair – Pushing a pulled-out chair into a table
    › Push Door – Standing in front of a closed door, pushing it open, and walking through
    › Scoot Chair – Sitting in a chair and scooting it under a table
    › Vacuum – Vacuuming a floor until instructed to stop

› Dependent variable = Pectoralis Major EMG

# Statistical Analyses

› 2-way Analysis of Variance (ANOVA)
  – Differences and interactions between Age x Movement Strategy
  – Alpha level set at 0.05

› 1-way ANOVA
  – Differences among 10 ADL / IADL Tasks
  – Alpha level set at 0.05

› Tukey's Honestly Significant Difference
  – Post-hoc Test
  – Alpha level set at 0.05

› Pearson Product Moment Correlations
  – Alpha level set at 0.05
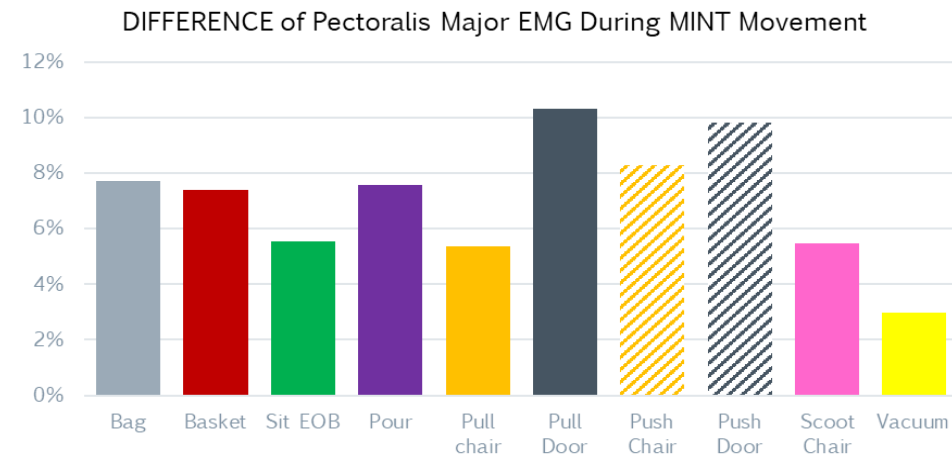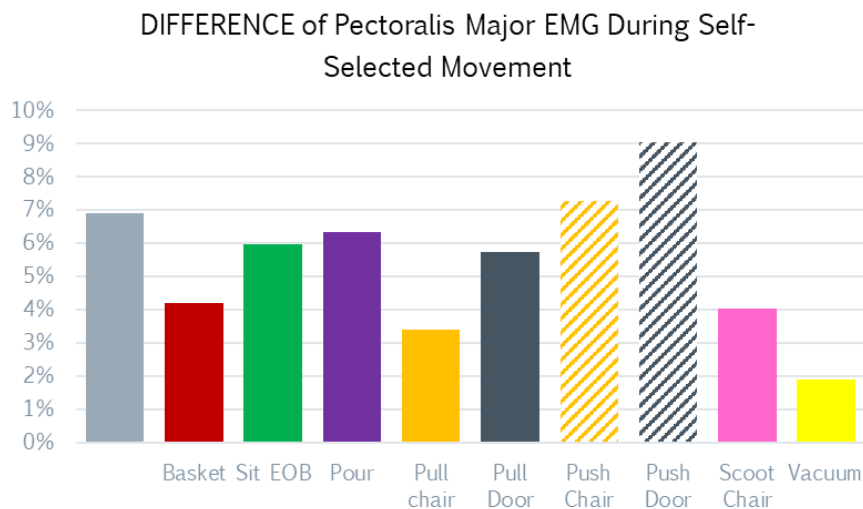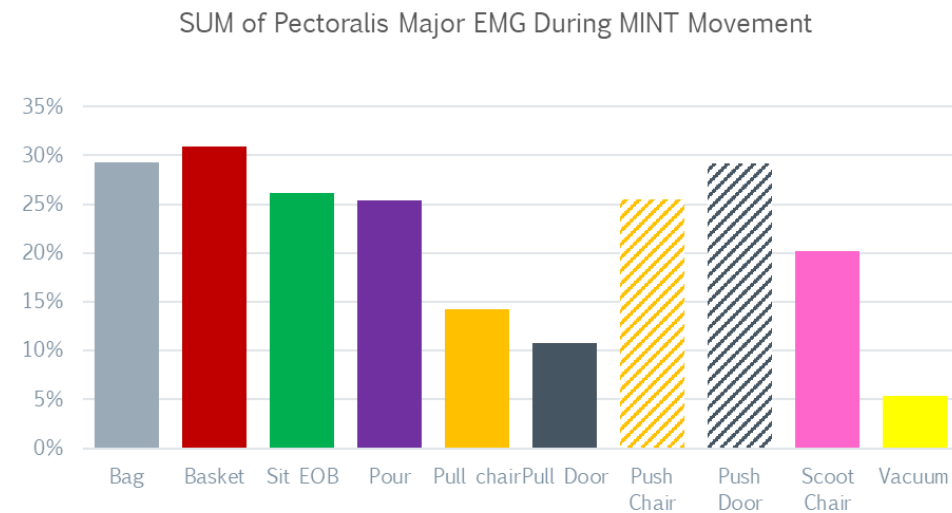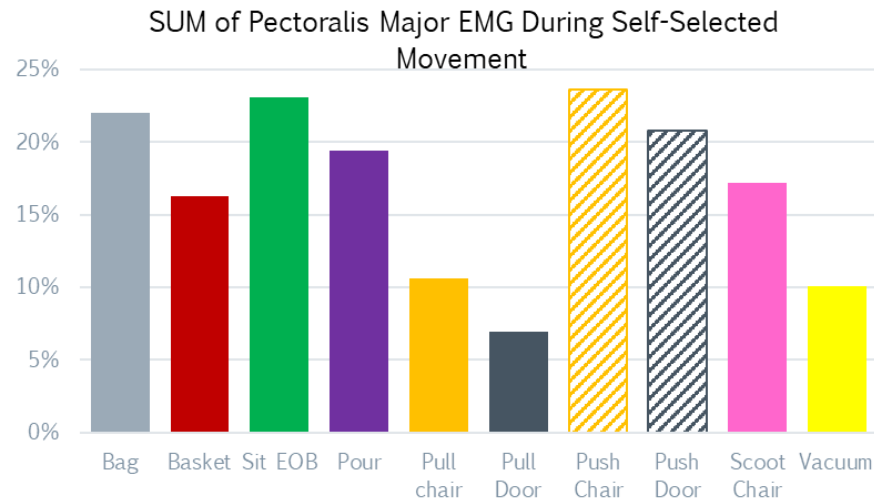
# Results – 2-way ANOVA

| SUM MVIC | Self-Selected | | Move in the Tube | | P-Age | P-Movement |
|---|---|---|---|---|---|---|
| ADL | Young | Old | Young | Old | | |
| Bag | 16.7 ± 17.1 | 26.9 ± 23.7 | 19.4 ± 12.2 | 36.2 ±25.7 | 2.53E-12 | 0.001 |
| Basket | 11 ± 7.36 | 20.1 ± 13.3 | 18.5 ± 14.7 | 39.7 ± 27.4 | 9.86E-06 | 0.000 |
| Sit EOB | 12.9 ± 17.3 | 30 ± 20 | 13.8 ± 9.2 | 34.4 ± 22 | 6.23E-11 | 0.137 |
| Pour | 10.2 ± 5.3 | 26 ± 25.1 | 14.6 ± 8.5 | 33 ± 29 | 4.39E-22 | 0.000 |
| Pull Chair | 5.8 ± 3.2 | 13.9 ± 8.9 | 6.7 ± 5.9 | 19.5 ± 12.7 | 1.01E-08 | 0.002 |
| Pull Door | 4.0 ± 2.9 | 8.9 ± 8.0 | 6.2 ± 4.2 | 15.6 ± 12.2 | 4.93E-12 | 0.000 |
| Push Chair | 15 ± 9.3 | 29.5 ± 14.9 | 13 ± 9.4 | 34.3 ± 17.6 | 3.76E-12 | 0.206 |
| Push Door | 12.6 ± 8.2 | 27.3 ± 18.5 | 16.4 ± 9 | 38.6 ± 24.4 | 1.84E-15 | 0.000 |
| Scoot Chair | 8.2 ± 6.5 | 23.5 ± 16.2 | 9.8 ± 9.2 | 27.4 ± 18.4 | 1.75E-11 | 0.060 |
| Vacuum | 5.8 ± 4.5 | 13 ± 10.7 | 6.3 ± 5.6 | 20.6 ± 23 | 0.006 | 0.000 |

| DIFFERENCE MVIC | Self-Selected | | Move in the Tube | | P-Age | P-Movement |
|---|---|---|---|---|---|---|
| ADL | Young | Old | Young | Old | | |
| Bag | 6.8 ± 9.5 | 6.9 ± 6.4 | 5.1 ± 6.1 | 9.6 ± 8 | 0.001 | 0.456 |
| Basket | 2.6 ± 3.6 | 5.3 ± 6.6 | 3.3 ± 3.3 | 10.3 ± 10.8 | 3.46E-09 | 0.000 |
| Sit EOB | 2.9 ± 5 | 7.8 ± 9.5 | 3 ± 5.6 | 7.1 ± 7.8 | 1.71E-06 | 0.664 |
| Pour | 4 ± 3.7 | 8.1 ± 10.6 | 6.9 ± 5.3 | 8 ± 9.3 | 5.3E-10 | 0.152 |
| Pull Chair | 1.5 ± 1.5 | 4.8 ± 4.3 | 2.3 ± 4.3 | 7.5 ± 8.7 | 0.001 | 0.024 |
| Pull Door | 3 ± 3 | 7.7 ± 8.2 | 5 ± 4.4 | 14 ± 12.2 | 4.27E-12 | 0.000 |
| Push Chair | 5.3 ± 6.4 | 9 ± 8.4 | 4.8 ± 7.6 | 10.7 ± 11.4 | 9.15E-13 | 0.213 |
| Push Door | 6 ± 6.7 | 11.9 ± 10.1 | 6.8 ± 7.1 | 12.3 ± 11.1 | 2.55E-06 | 0.502 |
| Scoot Chair | 1.5 ± 1.5 | 5.7 ± 7.2 | 2 ± 2.9 | 7.9 ± 9.2 | 5.97E-12 | 0.031 |
| Vacuum | .5 ± .5 | 2.8 ± 4.2 | .5 ± .6 | 4.7 ± 7.6 | 2.46E-07 | 0.061 |

› Old subjects had higher EMG activity and asymmetrical pull for both Self-selected and MINT

› For sum of bilateral EMG, 7/10 ADL's had higher MINT activity than Self-selected

› For difference of bilateral EMG, 4/10 ADL's had higher asymmetrical pull using MINT than Self-selected

# Results – 1-way ANOVA with Tukey's



SUM of Pectoralis Major EMG During Self-Selected Movement

SUM of Pectoralis Major EMG During MINT Movement

DIFFERENCE of Pectoralis Major EMG During Self-Selected Movement

DIFFERENCE of Pectoralis Major EMG During MINT Movement

› Significant difference amongst all 10 ADL's for Sum and Difference of Pec EMG for both self-selected and MINT strategies

# Results – Pearson Correlations

Self-selected Movement SUM Correlations

| | Bag | Basket | Sit EOB | Pour | Pull Chair | Pull Door | Push Chair | Push Door | Scoot Chair | Vacuum |
|---|---|---|---|---|---|---|---|---|---|---|
| Bag | 1.00 | | | | | | | | | |
| Basket | 0.57 | 1.00 | | | | | | | | |
| Sit EOB | 0.55 | 0.82 | 1.00 | | | | | | | |
| Pour | 0.73 | 0.64 | 0.70 | 1.00 | | | | | | |
| Pull Chair | 0.58 | 0.86 | 0.74 | 0.66 | 1.00 | | | | | |
| Pull Door | 0.51 | 0.71 | 0.78 | 0.64 | 0.74 | 1.00 | | | | |
| Push Chair | 0.56 | 0.75 | 0.79 | 0.62 | 0.78 | 0.72 | 1.00 | | | |
| Push Door | 0.57 | 0.72 | 0.78 | 0.69 | 0.68 | 0.75 | 0.77 | 1.00 | | |
| Scoot Chair | 0.43 | 0.76 | 0.62 | 0.49 | 0.80 | 0.58 | 0.70 | 0.60 | 1.00 | |
| Vacuum | 0.50 | 0.78 | 0.80 | 0.67 | 0.86 | 0.82 | 0.75 | 0.72 | 0.70 | 1.00 |

MINT Movement SUM Correlations

| | Bag | Basket | Sit EOB | Pour | Pull Chair | Pull Door | Push Chair | Push Door | Scoot Chair | Vacuum |
|---|---|---|---|---|---|---|---|---|---|---|
| Bag | 1.00 | | | | | | | | | |
| Basket | 0.64 | 1.00 | | | | | | | | |
| Sit EOB | 0.81 | 0.68 | 1.00 | | | | | | | |
| Pour | 0.84 | 0.63 | 0.75 | 1.00 | | | | | | |
| Pull Chair | 0.63 | 0.74 | 0.50 | 0.68 | 1.00 | | | | | |
| Pull Door | 0.68 | 0.42 | 0.59 | 0.69 | 0.54 | 1.00 | | | | |
| Push Chair | 0.59 | 0.59 | 0.51 | 0.57 | 0.71 | 0.62 | 1.00 | | | |
| Push Door | 0.78 | 0.62 | 0.65 | 0.69 | 0.66 | 0.77 | 0.75 | 1.00 | | |
| Scoot Chair | 0.59 | 0.69 | 0.55 | 0.56 | 0.74 | 0.59 | 0.73 | 0.73 | 1.00 | |
| Vacuum | 0.36 | 0.31 | 0.37 | 0.34 | 0.40 | 0.49 | 0.36 | 0.32 | 0.49 | 1.00 |

› Values greater than 0.25 are significant at P value 0.05

› Correlation between ADL's during self-selected and MINT are all significantly different

# Conclusions

› Older subjects had greater EMG due to more Motor Units needed to generate the same force

› Some activities had greater asymmetry possibly due to movement efficiency

› Subjects **with** the greatest EMG activity during 1 task have the greatest EMG activity during another task

› The results imply that using the MINT movement strategy does not reduce asymmetrical pull for all 10 ADL's

# References

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