

Powerlifting Analysis

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Data Cleaning Pipeline Summary

Started: 3,692,155 → Ended: 1,407,813

Step	Before	After	Removed	% Lost
Remove unused columns	3,692,155	3,692,155	0	0.00%
Remove duplicates	3,692,155	3,515,277	176,878	4.80%
Remove NA age/bodyweight ¹	3,515,277	2,185,208	1,330,069	37.80%
Remove invalid ranges	2,185,208	2,184,180	1,028	0.00%
Filter only SBD (full-power) events ²	2,184,180	1,407,813	776,367	35.50%

¹ NA removal: Rows lacking age or bodyweight were excluded as these fields are essential for analysis.

² SBD events: Powerlifting meets can include any combination of Squat, Bench Press, and Deadlift (e.g., full meets with all three lifts, or partial meets with only one or two).

Ways to Improve Data Retention

- 1. Imputation for Missing Values:** Consider using age/bodyweight imputation based on similar lifters (same sex, weight class, experience level). Reduces loss from NA removal while maintaining analytical integrity.
- 2. Partial Meet Inclusion:** Refactor current pipline to allow single-lift or two-lift competitions. Create separate analyses for different event types.

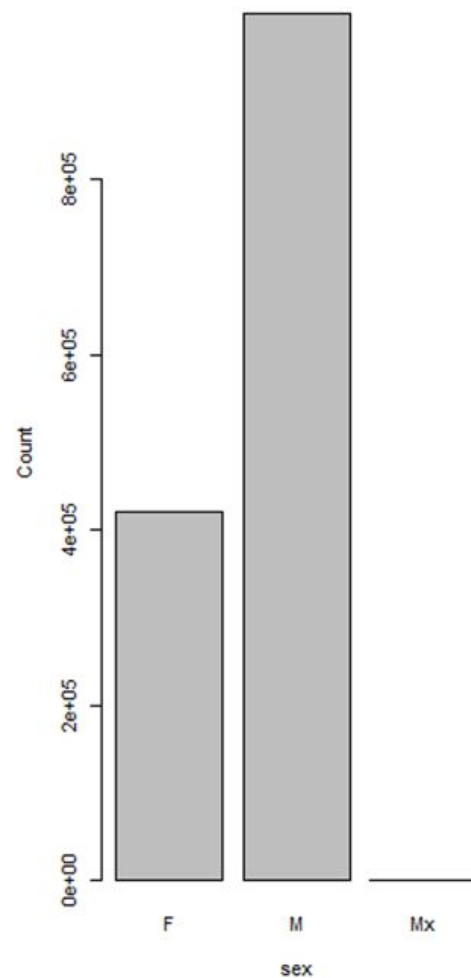
Summary Statistics: sex

Count: 1407813

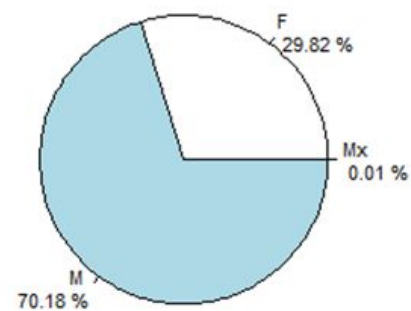
Missing: 0

Unique: 3

Frequency of sex



Proportions of sex



Summary Statistics: age

Count: 1407813 Missing: 0

Mean: 28.323 Median: 25

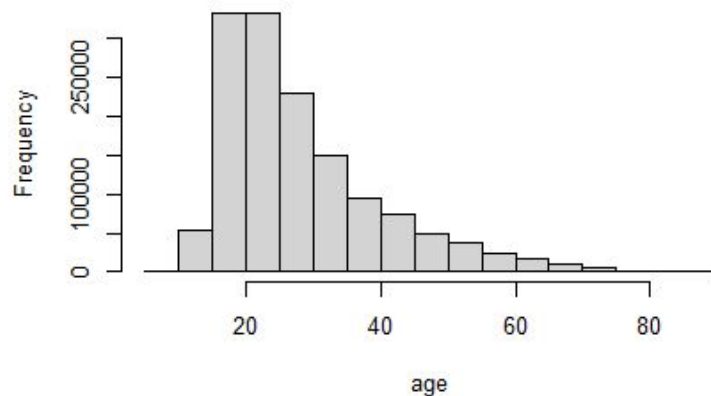
Min: 8 Max: 88.5

Q1: 19.5 Q3: 33.5

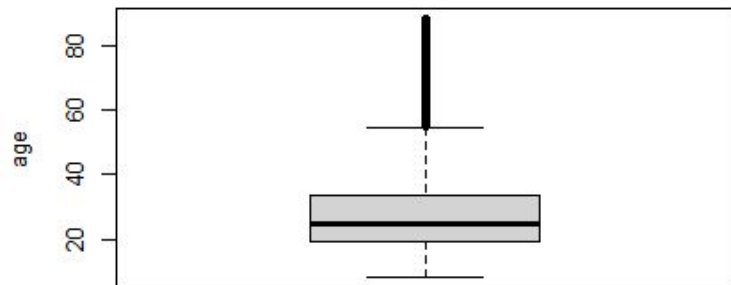
SD: 11.861 IQR: 14

Variance: 140.672

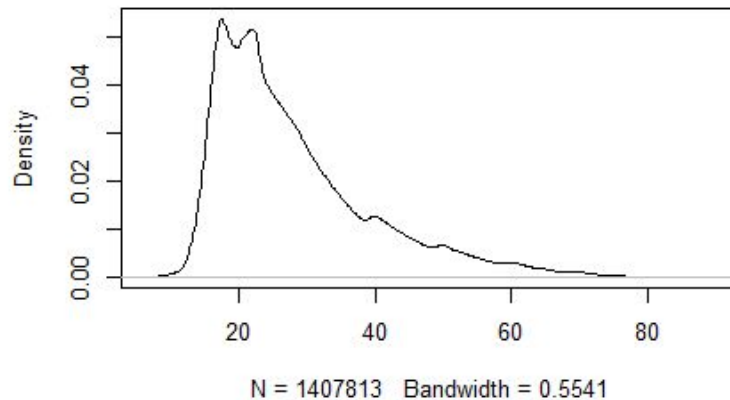
Histogram of age



Boxplot of age



Density of age



Summary Statistics: bodyweight_kg

Count: 1407813 Missing: 0

Mean: 83.534 Median: 81.5

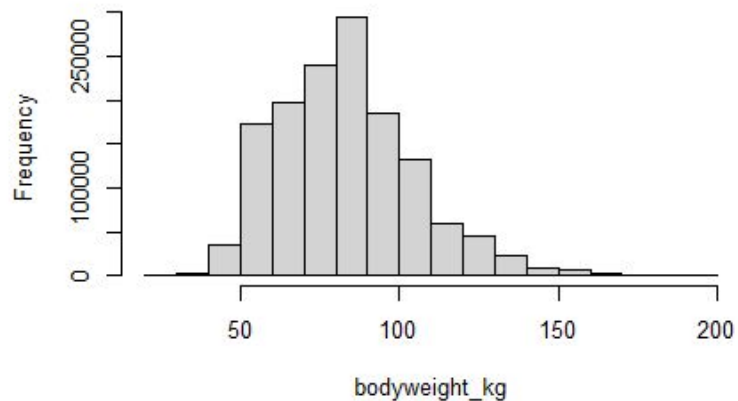
Min: 20 Max: 191.5

Q1: 67 Q3: 97.4

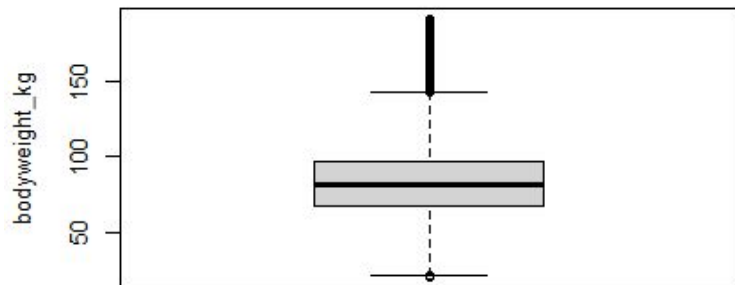
SD: 22.035 IQR: 30.4

Variance: 485.557

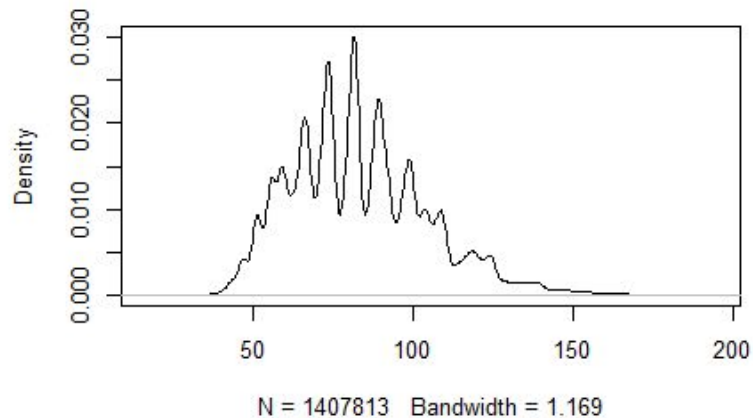
Histogram of bodyweight_kg



Boxplot of bodyweight_kg



Density of bodyweight_kg



Summary Statistics: best3squat_kg

Count: 1407813 Missing: 37834

Mean: 180.348 Median: 177.5

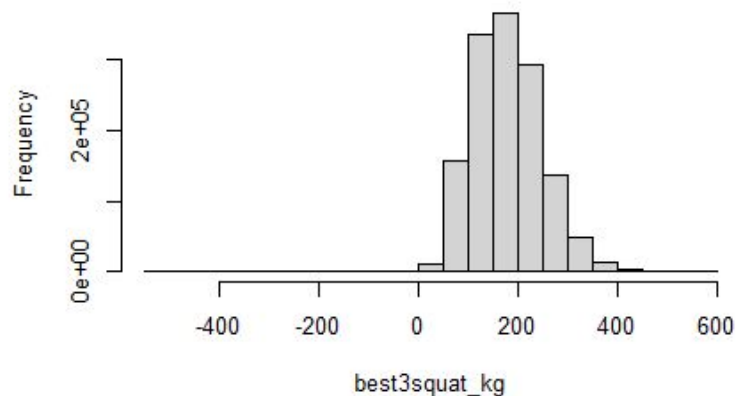
Min: -508.02 Max: 595

Q1: 127.5 Q3: 225

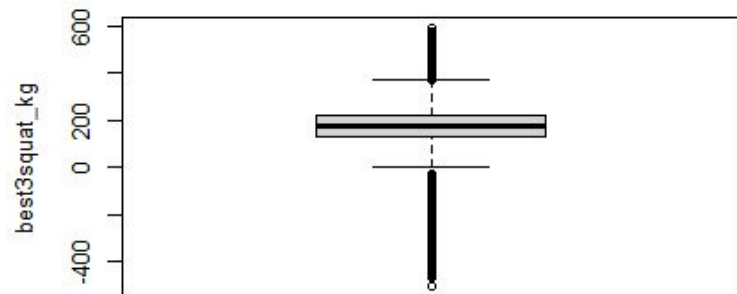
SD: 70.537 IQR: 97.5

Variance: 4975.432

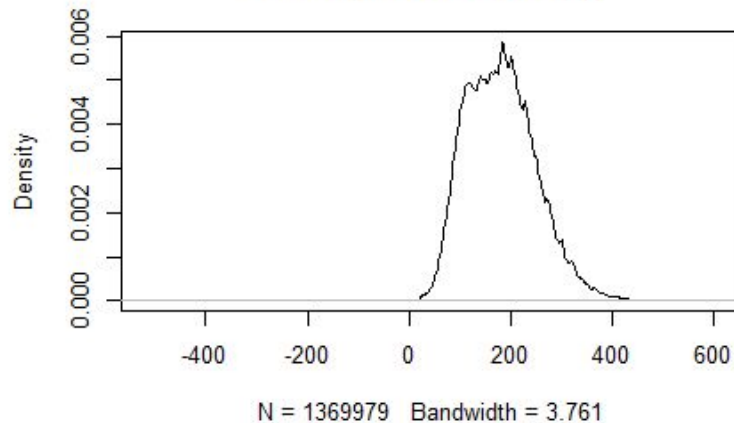
Histogram of best3squat_kg



Boxplot of best3squat_kg



Density of best3squat_kg



Summary Statistics: best3bench_kg

Count: 1407813 Missing: 50261

Mean: 115.423 Median: 115

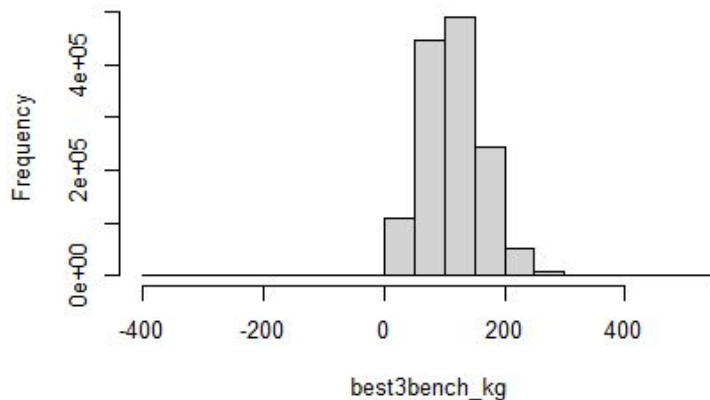
Min: -365 Max: 544.31

Q1: 75 Q3: 147.5

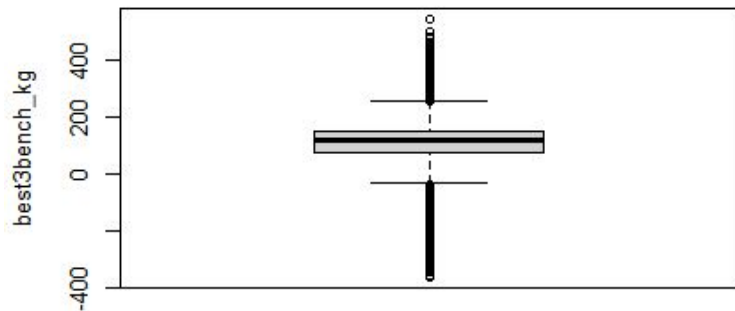
SD: 50.253 IQR: 72.5

Variance: 2525.398

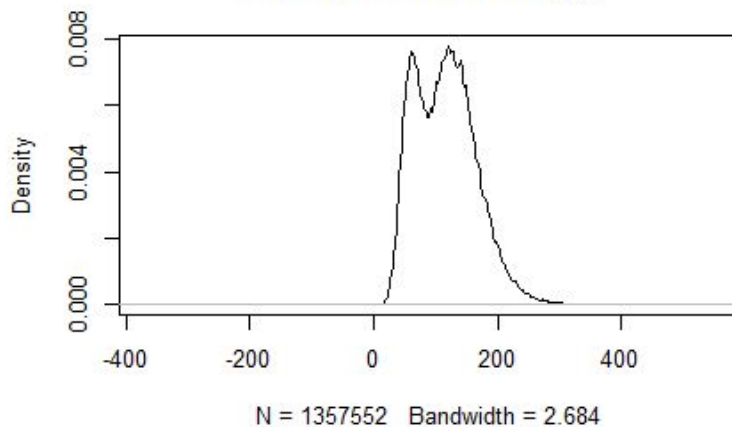
Histogram of best3bench_kg



Boxplot of best3bench_kg



Density of best3bench_kg



Summary Statistics: best3deadlift_kg

Count: 1407813 Missing: 52681

Mean: 198.24 Median: 200

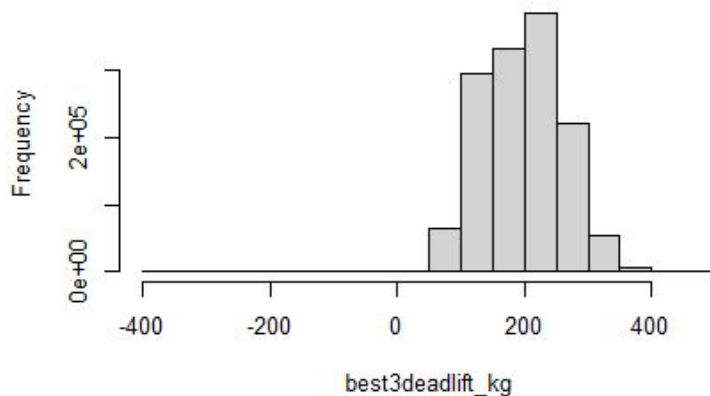
Min: -400 Max: 487.5

Q1: 150 Q3: 245

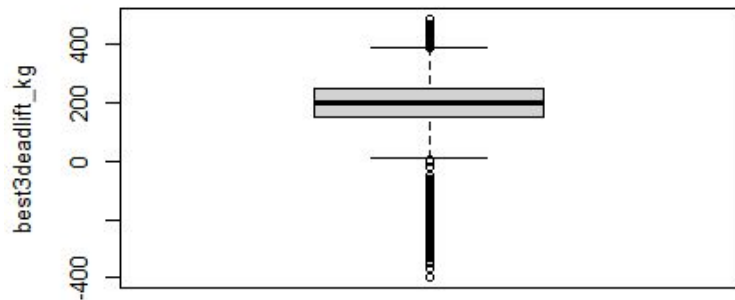
SD: 62.548 IQR: 95

Variance: 3912.305

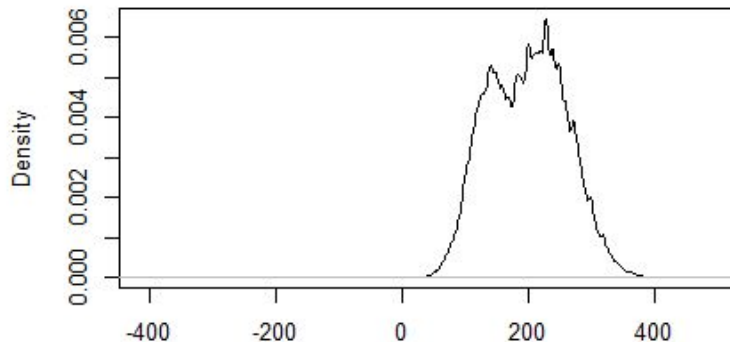
Histogram of best3deadlift_kg



Boxplot of best3deadlift_kg



Density of best3deadlift_kg



N = 1355132 Bandwidth = 3.342

Summary Statistics: total_kg

Count: 1407813 Missing: 76361

Mean: 494.822 Median: 495

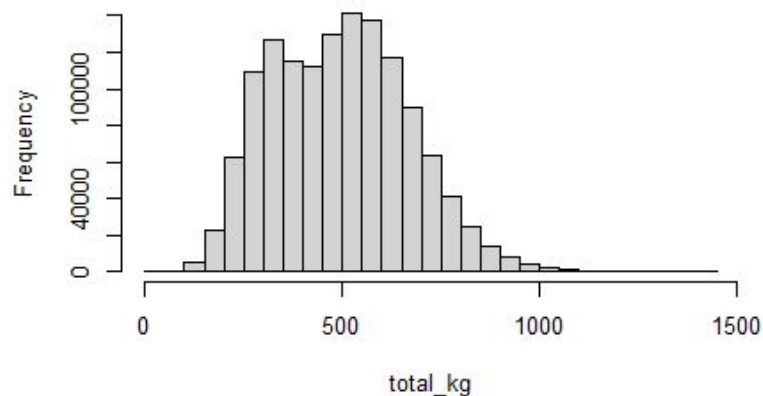
Min: 7 Max: 1407.5

Q1: 353.5 Q3: 615

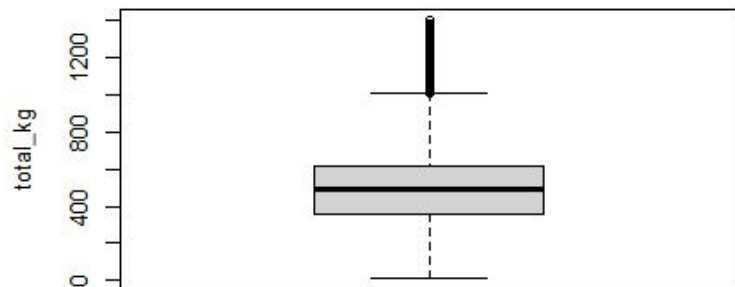
SD: 172.791 IQR: 261.5

Variance: 29856.698

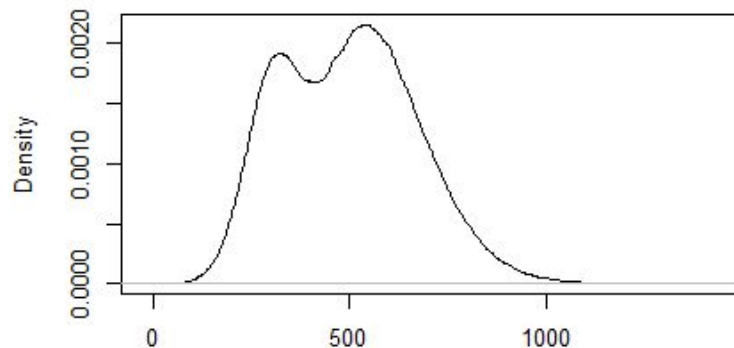
Histogram of total_kg



Boxplot of total_kg

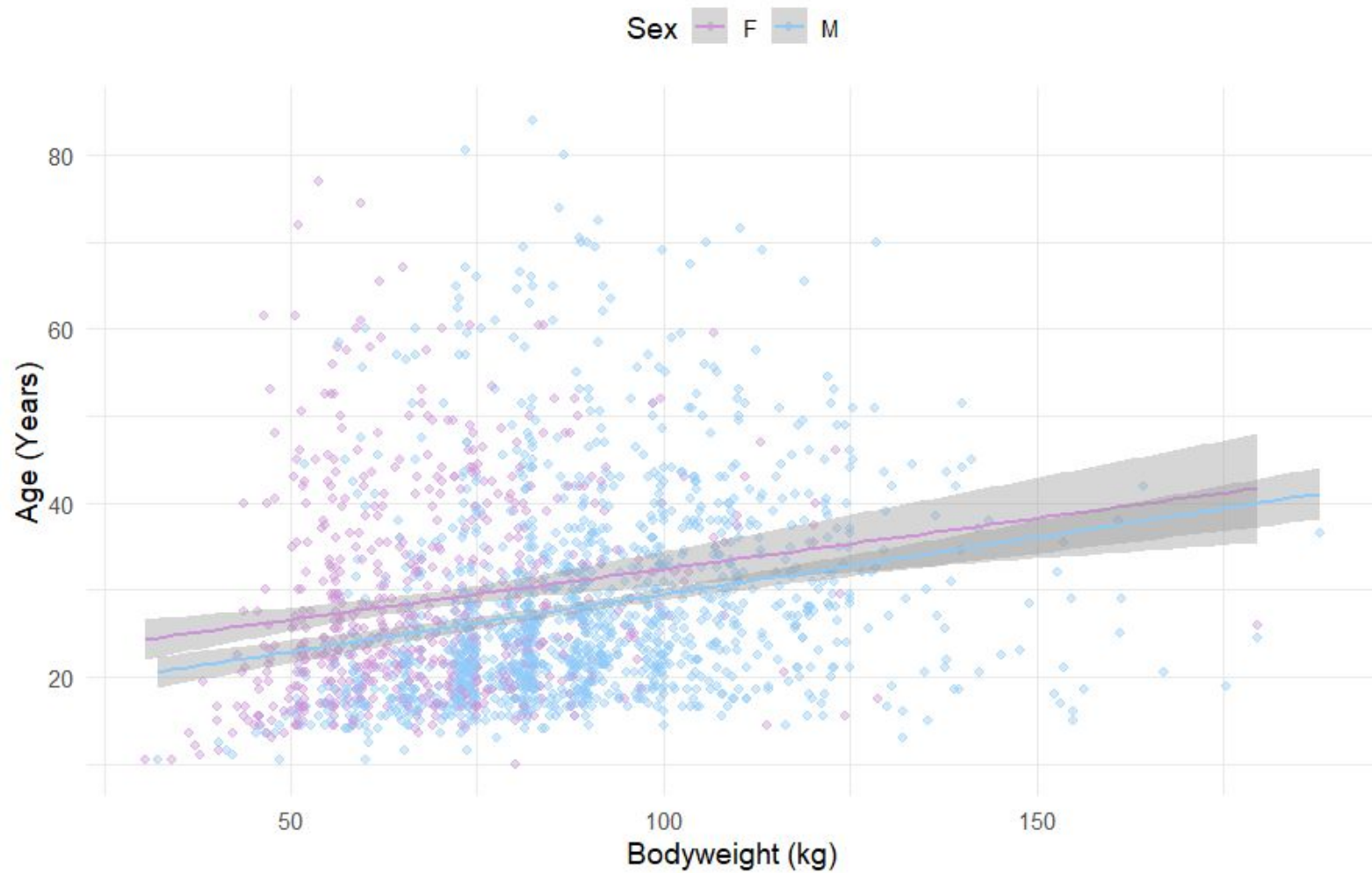


Density of total_kg

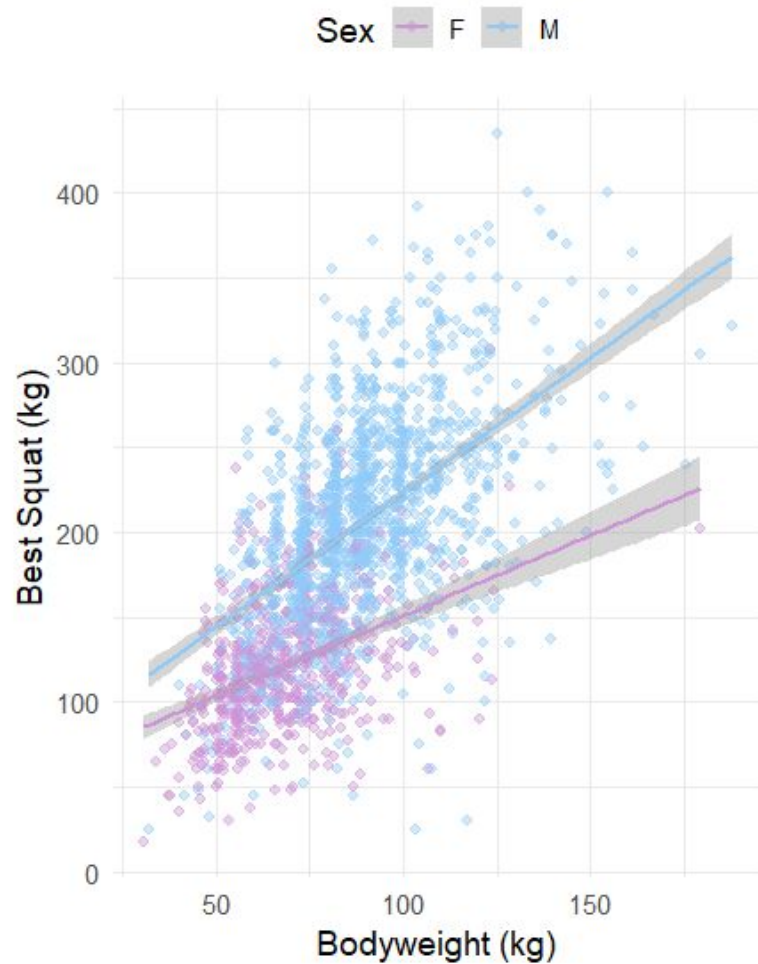


N = 1331452 Bandwidth = 9.266

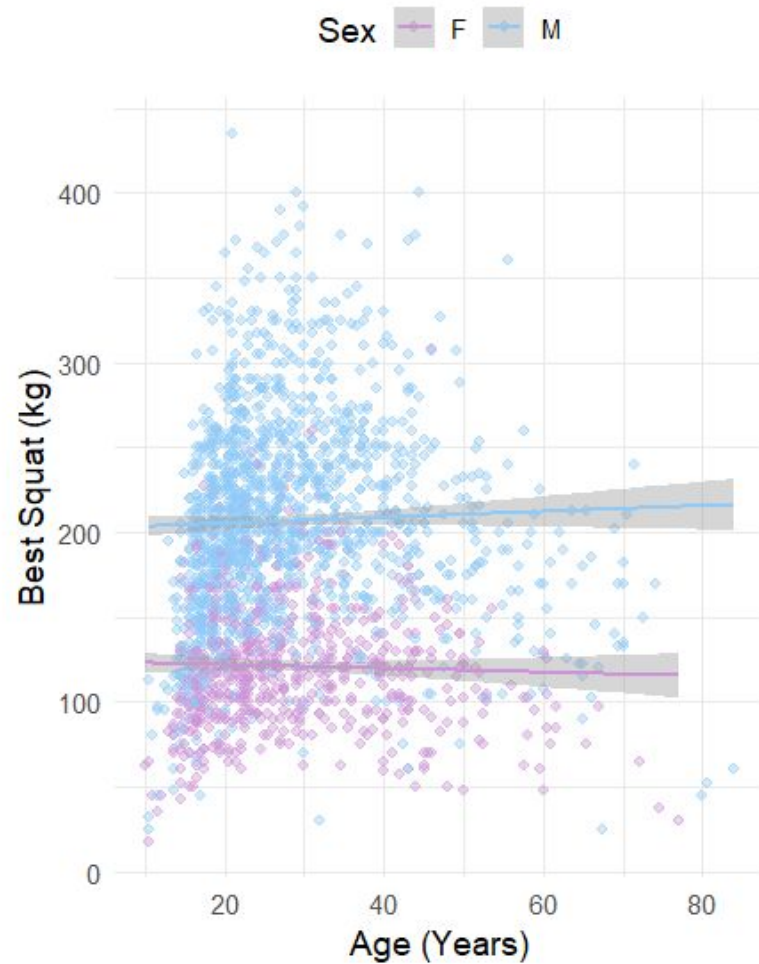
Bodyweight vs Age by Sex



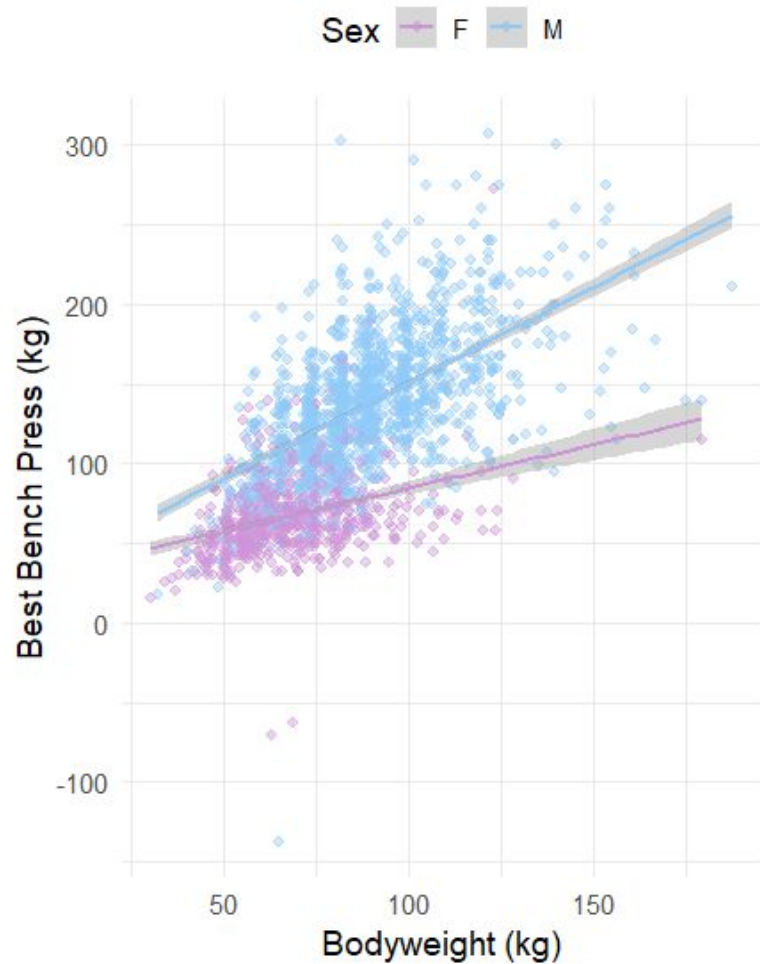
Bodyweight vs Best Squat by Sex



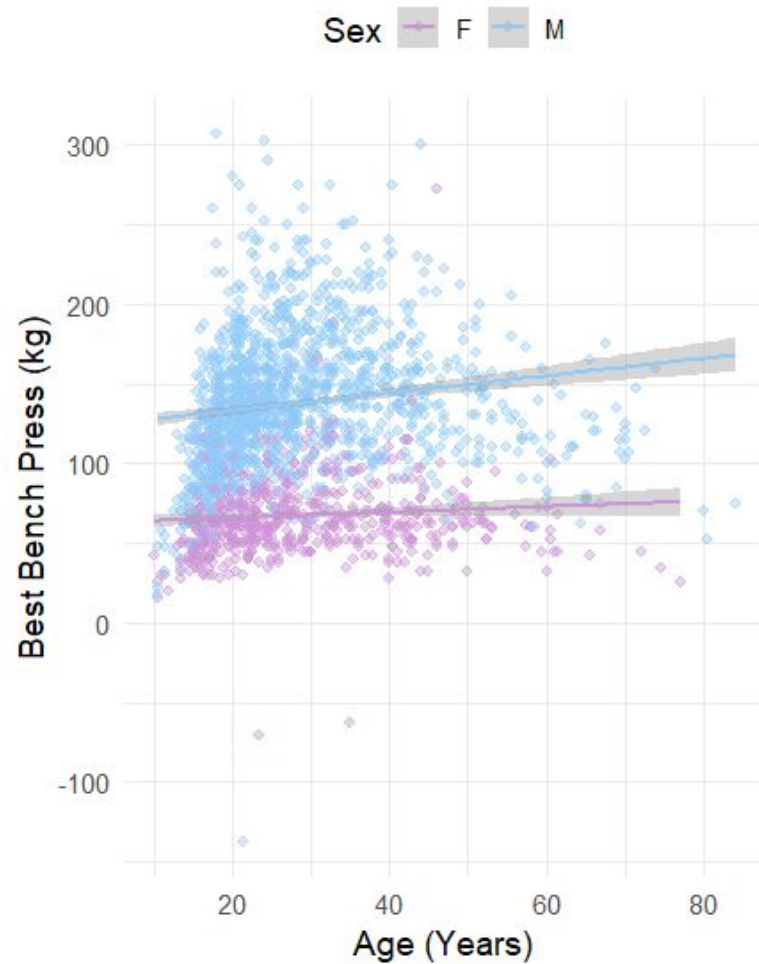
Age vs Best Squat by Sex



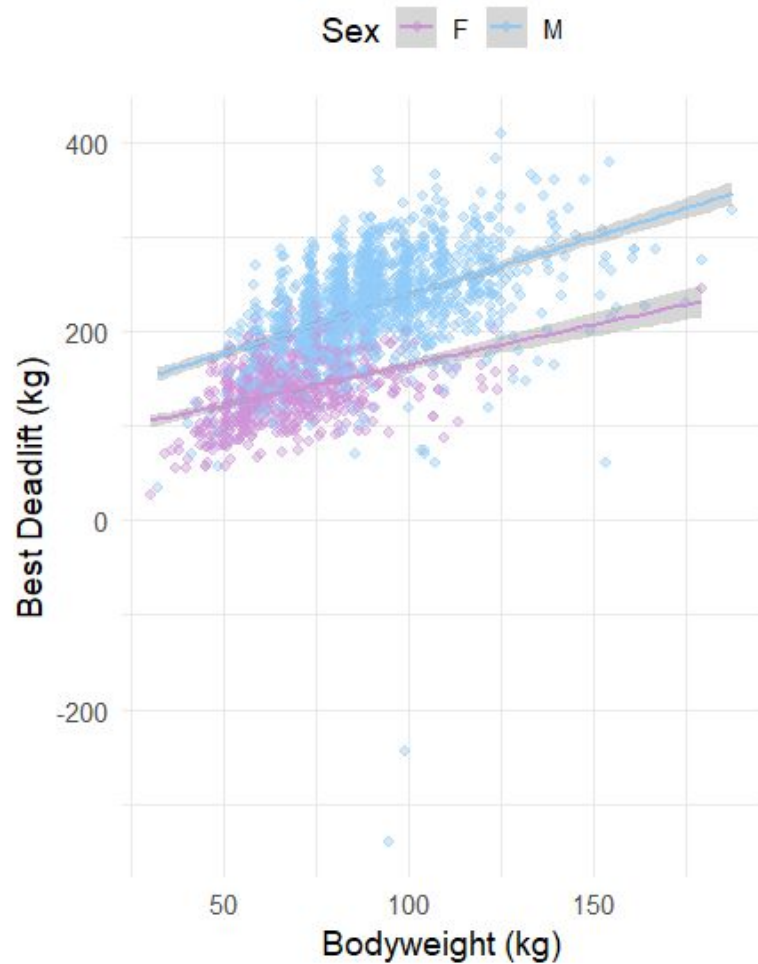
Bodyweight vs Best Bench Press by Sex



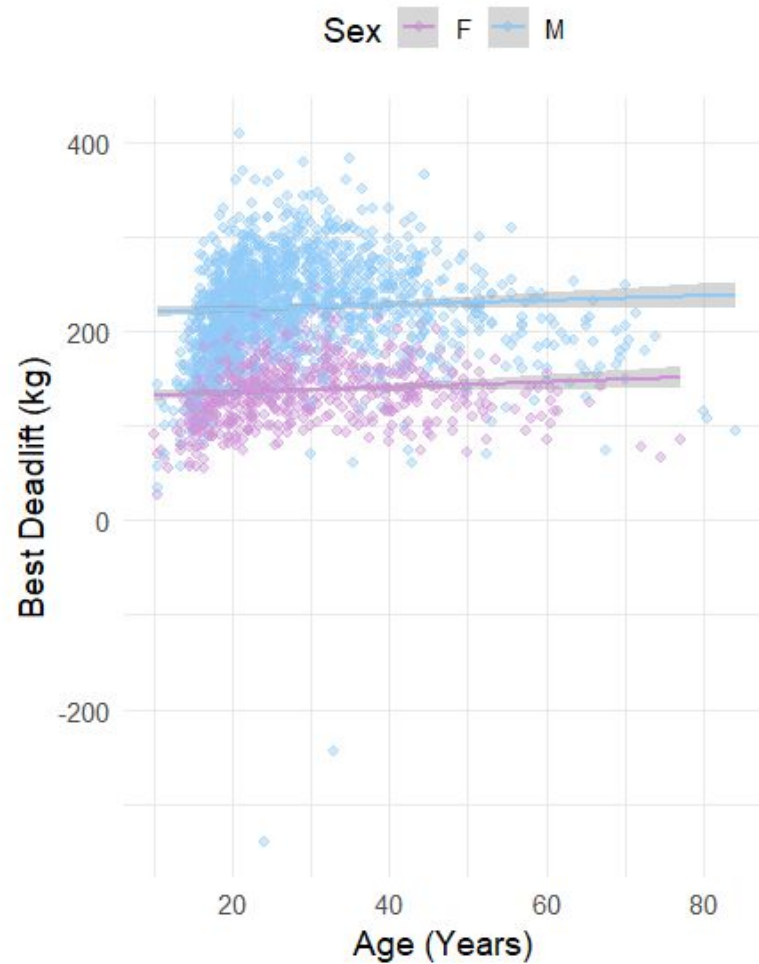
Age vs Best Bench Press by Sex



Bodyweight vs Best Deadlift by Sex



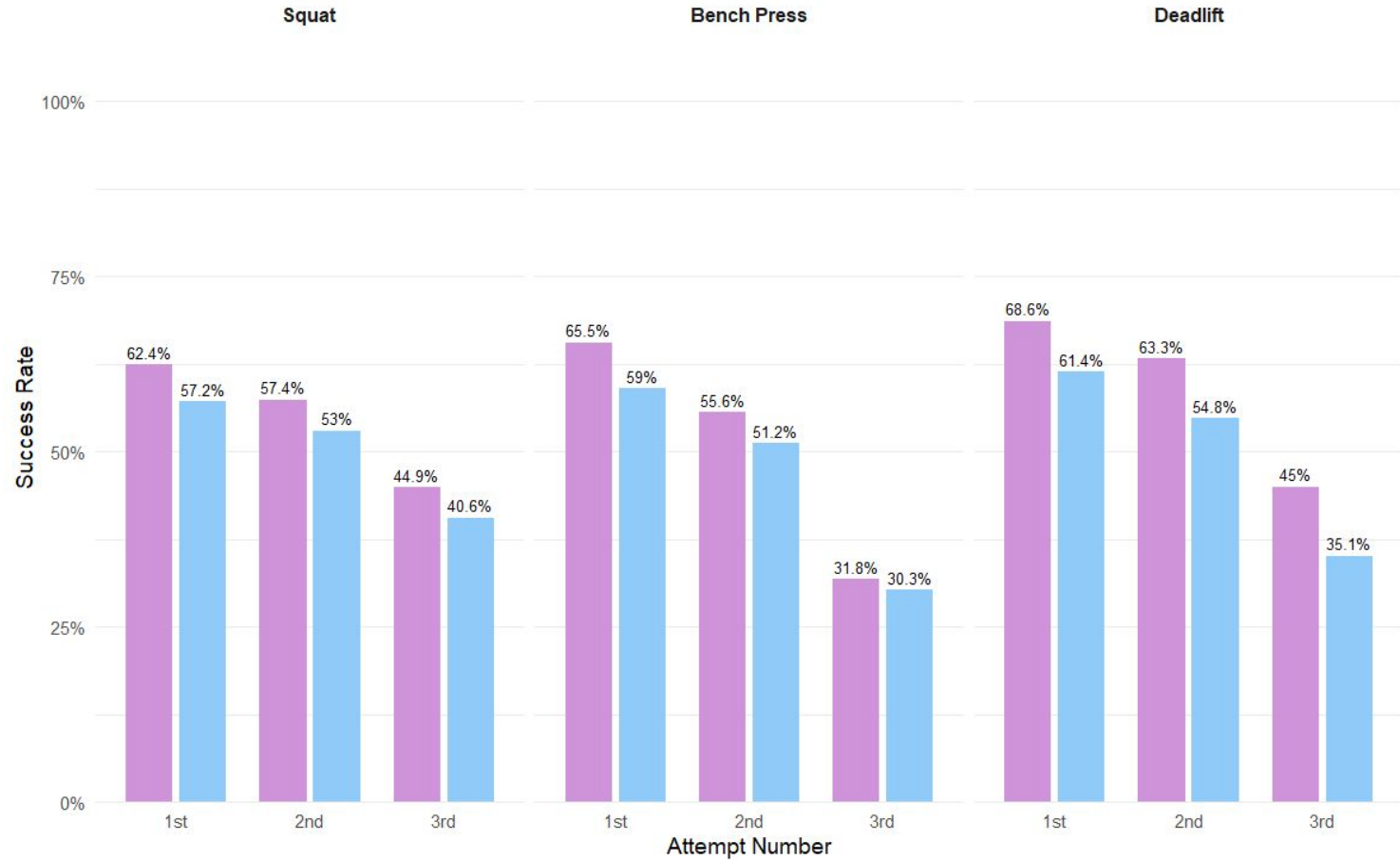
Age vs Best Deadlift by Sex



Success Rate Comparison Across All Lifts

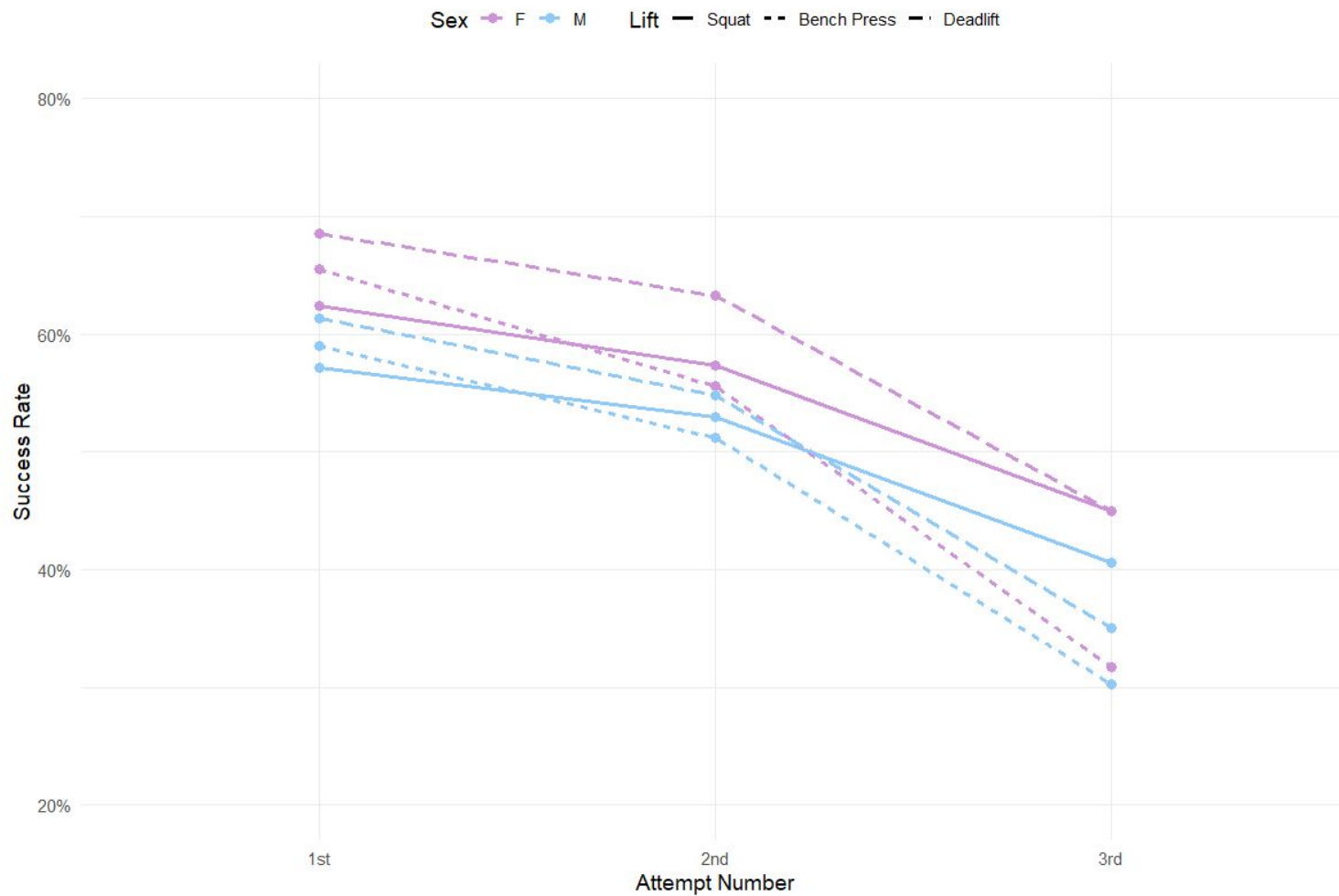
F (n=419,754), M (n=987,949)

Sex F M



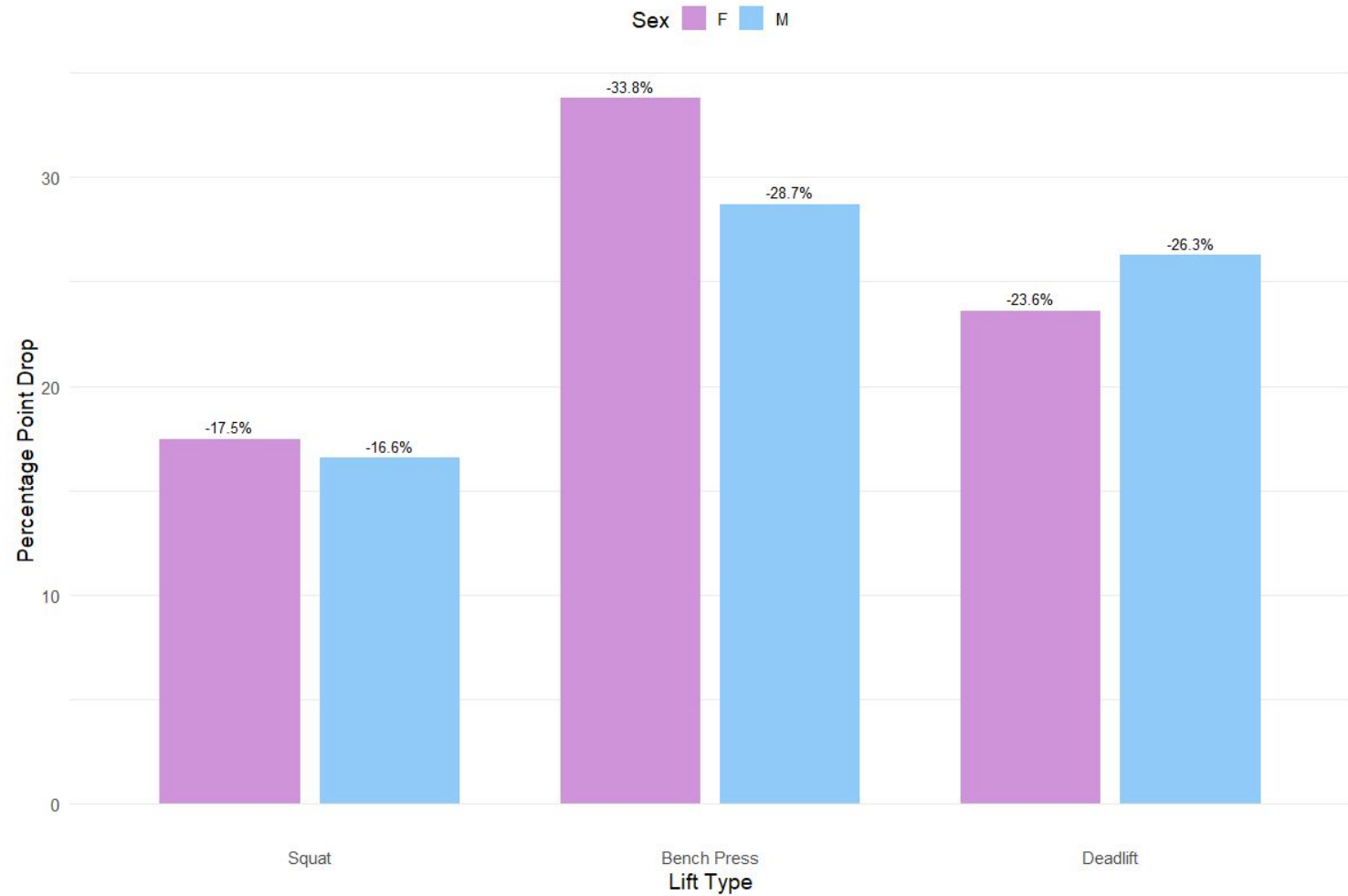
Success Rate Decline Pattern by Lift and Sex

F (n=419,754), M (n=987,949)



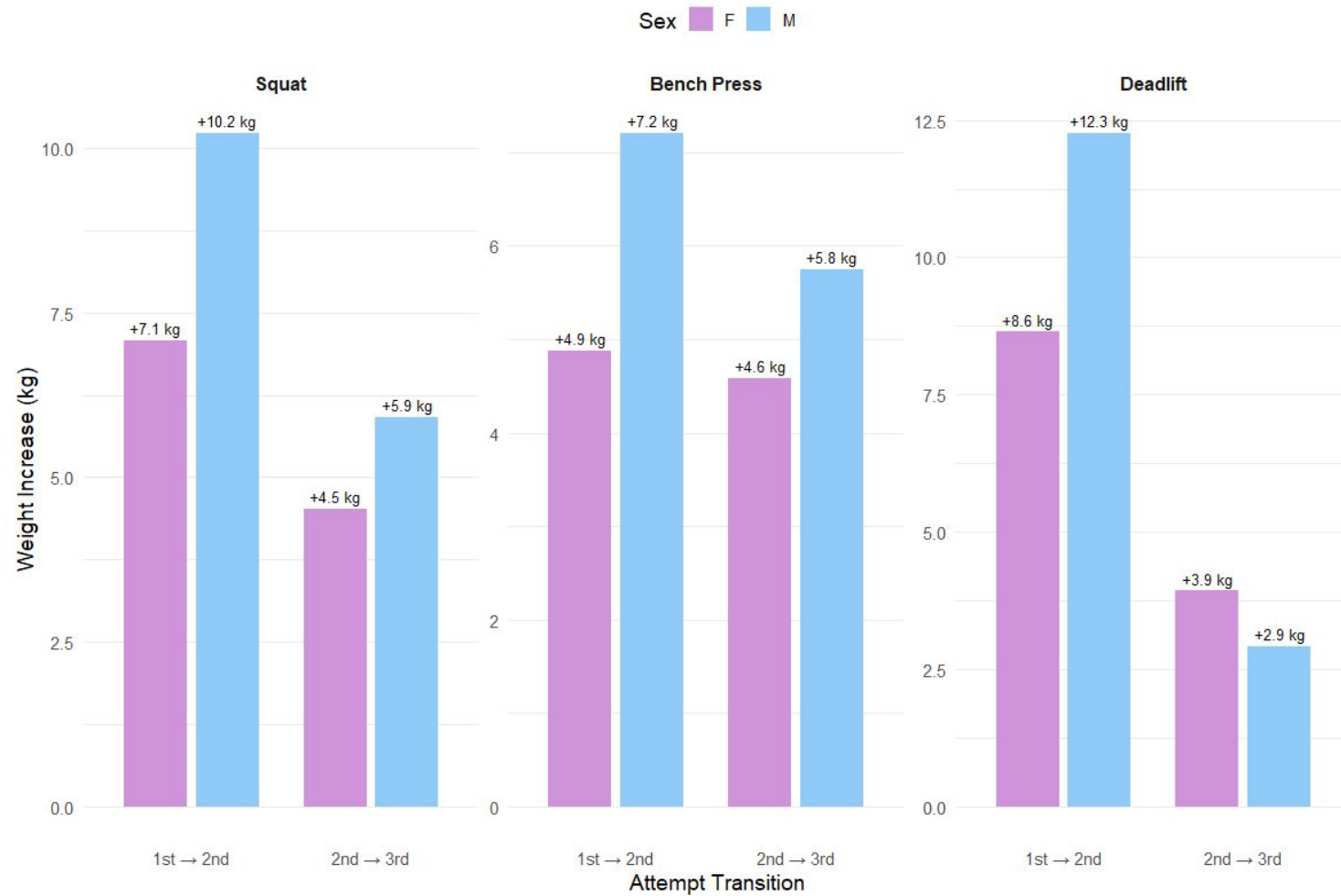
Success Rate Drop: 1st to 3rd Attempt

How much harder does the 3rd attempt get? | F (n=419,754), M (n=987,949)



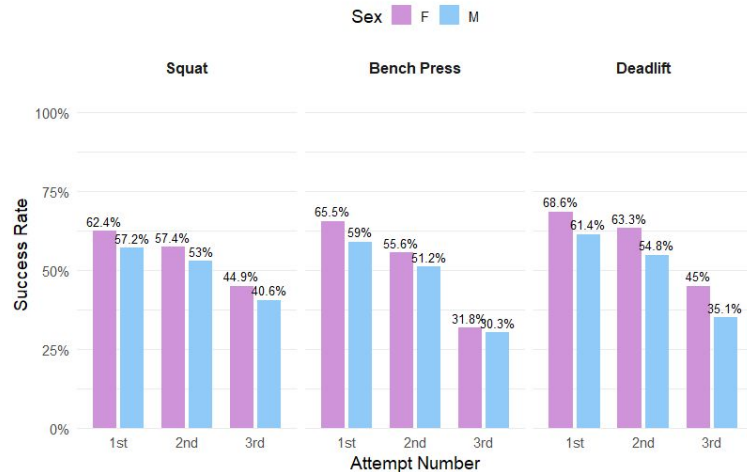
Average Weight Increase Between Attempts (Mean)

F (n=419,754), M (n=987,949)



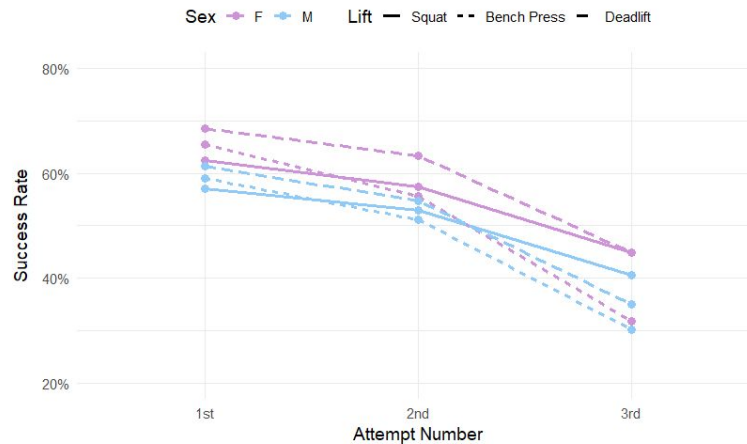
Success Rate Comparison Across All Lifts

F (n=419,754), M (n=987,949)



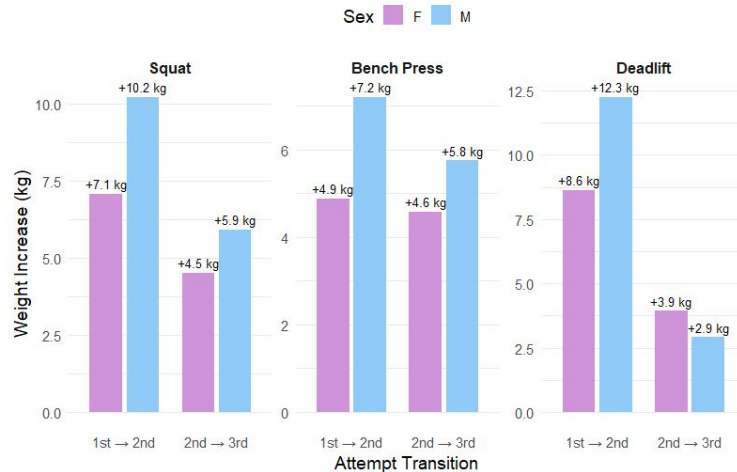
Success Rate Decline Pattern by Lift and Sex

F (n=419,754), M (n=987,949)



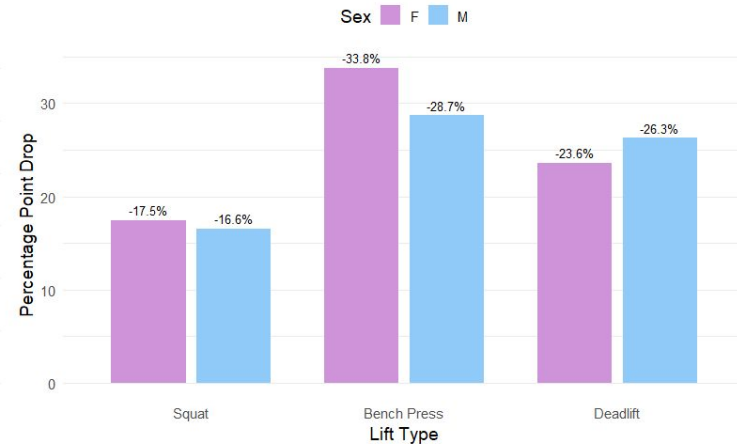
Average Weight Increase Between Attempts (Mean)

F (n=419,754), M (n=987,949)



Success Rate Drop: 1st to 3rd Attempt

How much harder does the 3rd attempt get? | F (n=419,754), M (n=987,949)



Major Findings

1. Dramatic Success Rate Decline

- 1st → 3rd attempt: 17-34 percentage point drop across all lifts
- Bench press most volatile (steepest decline), deadlift most stable
- By 3rd attempt, success rates drop to 35-55% (essentially a coin flip)

2. Sex Differences in Strategy

- Females: Higher initial success, steeper decline, smaller weight jumps
- Males: Lower initial success, better 3rd attempt retention, larger jumps (+1-2 kg per transition)
- Despite larger jumps, males maintain relatively better late-attempt success

Implications for Future Analysis

Research Questions to Pursue:

1. **Optimal attempt selection modeling** - Can we predict ideal 2nd/3rd attempts based on 1st attempt performance?
2. **Why do females decline steeper despite smaller jumps?** - Fatigue resistance? Risk tolerance? Psychological factors?
3. **Does attempt strategy correlate with meet outcomes?** - Do winners take bigger risks or play it safe?
4. **Lift-specific failure patterns** - Are bench press failures technical vs. strength-based?

Practical Applications

For Coaches/Lifters:

- 3rd attempts are high-risk (35-45% success)
- Bench press requires most conservative jumps
- Sex-specific attempt calculators could optimize outcomes

For Future Work:

- Build predictive models for attempt selection
- Investigate psychological vs. physical fatigue factors
- Develop evidence-based guidelines for attempt progressions by lift, sex, and experience level

Bottom Line Summary

Most lifters overreach on 3rd attempts. Future research should determine if this represents optimal risk-taking or systematic overconfidence.