Scientific Case Study: The Effect of the Hyperbolic Suit on Athletic Performance Metrics

Abstract

This study investigates the effects of the Hyperbolic Suit on the vertical jump height, force output, and power output in college athletes. The objective was to compare the performance metrics between a control group and an intervention group that used the Hyperbolic Suit. The study spans five days with three days of testing to evaluate immediate and lasting impacts of the intervention.

Introduction

The Hyperbolic Suit is designed to enhance athletic performance through targeted neuromuscular facilitation, functional recruitment, muscular feedback and compression. This study aims to quantify its benefits by measuring vertical jump height (inches), force output (Newtons), and power output (Watts). The test is spread across a 5 day period where days 1, 3 and 5 are testing days and days 2 and 4 are rest/recovery days for the athletes. The intervention group used the Hyperbolic Suit during the warm up phase on Day 2 prior to testing and removed it before testing, and performance metrics were recorded across three days of testing to assess both immediate and sustained effects.

Participants

The study involved 14 athletes, with 10 in the control group and 4 in the intervention group. Due to injury or sickness, some participants missed days, leading to their exclusion if they missed two or more days. This left 9 athletes in the control group and 4 in the intervention group.

The participants were divided into two groups:

1. **Intervention Group**: This group consisted of 4 athletes who used the Hyperbolic Suit during the study.
2. **Control Group**: This group comprised 9 athletes who did not use the suit.

The intervention group used the Hyperbolic Suit only on the second day of testing. The performance metrics were recorded over three days to capture any immediate and residual effects of the intervention

Study Protocol

1. **Day 1**: Baseline measurements were taken for all participants, including vertical jump height, force output, and sled power output.
2. **Day 3**: The intervention group used the Hyperbolic Suit, and performance metrics were recorded for both groups post-intervention.

3. **Day 5**: Measurements were taken again to assess any lasting effects of the intervention.

Key Performance Metrics

The following metrics were chosen to evaluate the potential benefits of the Hyperbolic Suit:

1. **Vertical Jump Height**: Measured in inches, this metric indicates explosive lower-body power.
2. **Force Output**: Measured in Newtons, this metric assesses overall muscular strength.
3. **Sled Power Output**: Measured in watts, this metric evaluates the ability to generate power over a sustained effort.

By analyzing these metrics, the report aims to provide a comprehensive assessment of the Hyperbolic Suit's impact on athletic performance. The subsequent sections will present detailed findings, statistical analyses, and visual representations to support the evaluation of the suit's efficacy.

Methods

Equipment

1. **Nextile Force Plates**: Used to measure vertical jump height and peak jump force.
2. **BodyKore Smart Sled**: Used to measure peak sprinting force.

Testing Protocol

1. **Baseline Testing (Day 1)**:
    - Vertical jump test on force plates.
    - Max sprint exertion test on the Smart Sled.
2. **Intervention Testing (Day 2)**:
    - Vertical jump and max force exertion tests with a subset of athletes wearing the Hyperbolic Suit prior to testing.
3. **Post-Intervention Testing (Day 3)**:

- Vertical jump and max strength exertion tests with no intervention to assess any lasting effects of the Hyperbolic Suit.

Warm-Up Outline for Each Testing Day

1. **Dynamic Warm-Up**:
   - Duration: 3 minutes on an elliptical.
2. **Exercise Routine**:
   - Rounds: 2 rounds of the following exercises (total time limit: 12 minutes):
     - Jog: 80 feet.
     - A Skips: 80 feet.
     - Karaoke: 80 feet.
     - Side Skips: 80 feet.
     - Single Leg Balance: 30 seconds each leg.
     - Core Compressions: 40 seconds.
3. **Rehydration and Rest Period**:
   - Duration: 10 minutes.
   - Purpose: Allow participants to rehydrate and rest before the testing begins.

Detailed Breakdown of Each Exercise

1. **Stationary Bike Warm-Up**:
   - Duration: 3 minutes.
   - Intensity: Moderate pace RPM range of 65-75 and low resistance to gradually increase heart rate and prepare muscles for exercise.
2. **Exercise Routine**:
   - **Jog**:
     - Distance: 80 feet.
     - Purpose: Increase blood flow to the muscles and joints.
   - **A Skips**:
     - Distance: 80 feet.
     - Purpose: Prep coordination, CNS, and activate the hip flexors.
   - **Karaoke**:
     - Distance: 80 feet.

        - Purpose: Prep lateral movement and hip mobility.
    - **Side Skips**:
        - Distance: 80 feet.
        - Purpose: Coordination and hip mobility.
    - **Single Leg Balance**:
        - Duration: 30 seconds each leg.
        - Purpose: Prep proprioception, proper ankle/knee/hip alignment, and ankle stability.
    - **Core Compressions**:
        - Duration: 40 seconds.
        - Purpose: Activate trunk and core muscles.
3. **Rehydration and Rest Period**:
    - Duration: 20 minutes.
    - Activities: Drink water or electrolyte drinks.
    - Purpose: Ensure athletes are hydrated and have recovered from the warm-up before testing.

Data Collection and Analysis

1. **Data Points**:
    - Vertical jump height (inches).
    - Max force exertion (Newtons).
    - Max power (Watts).
2. **Delta (Δ)**:
    - The change in performance between test days:
        - Δ12 = Performance on Day 3 - Performance on Day 1
        - Δ13 = Performance on Day 5 - Performance on Day 1
        - Δ23 = Performance on Day 5 - Performance on Day 3

Statistical Analysis

1. **Descriptive Statistics**:
    - Mean, standard deviation, minimum, and maximum values for each test day.
2. **Paired t-Test**:

    - Compare means of two related groups (e.g., Day 1 vs. Day 3, Day 1 vs. Day 5).
    - Calculate mean difference, standard deviation, t-statistic, degrees of freedom, and p-value.
3. **ANOVA**:
    - Compare means of three groups (Day 1, Day 3, Day 5).
    - Calculate sum of squares between groups (SSB) and within groups (SSW), mean squares, F-statistic, and p-value.
4. **Delta Analysis**:
    - Compute deltas (Δ12, Δ13, Δ23) for each participant.
    - Analyze mean and variability of deltas.
    - Use paired t-tests and ANOVA to assess statistical significance of deltas.

By analyzing these metrics, the report aims to provide a comprehensive assessment of the Hyperbolic Suit's impact on athletic performance. The subsequent sections will present detailed findings, statistical analyses, and visual representations to support the evaluation of the suit's efficacy.

Delta Computation and Statistical Analysis

Deltas Computation (Δ12, Δ13, Δ23)

- **Δ12**: Change from Day 1 to Day 2
- **Δ13**: Change from Day 1 to Day 3
- **Δ23**: Change from Day 2 to Day 3

Means and Standard Deviations of Deltas

Here are the means and standard deviations of the computed deltas for vertical jump height, force output, and sled power output:

Metric	Δ12 Mean	Δ12 Std	Δ13 Mean	Δ13 Std	Δ23 Mean	Δ23 Std
Vertical Jump	1.27	1.58	1.07	1.62	0.21	0.78

Force Output	-159.23	101.24	-146.12	98.67	13.11	32.45
Sled Power Output	8.45	2.79	9.25	2.84	0.80	1.16

Paired t-Tests

Paired t-tests were performed to compare the deltas:

Metric	Δ12 vs. Δ23 (t-statistic, p-value)	Δ13 vs. Δ23 (t-statistic, p-value)
Vertical Jump	t = 1.89, p = 0.078	t = 2.05, p = 0.056
Force Output	t = 2.12, p = 0.048	t = 2.39, p = 0.029
Sled Power Output	t = 3.54, p = 0.004	t = 3.76, p = 0.003

ANOVA

ANOVA was performed to compare the means of the three groups of deltas:

Metric	F-statistic	p-value
Vertical Jump	F = 3.18	p = 0.042
Force Output	F = 4.29	p = 0.018
Sled Power Output	F = 5.72	p = 0.007

Interpretation

1. **Vertical Jump Height**:
    - The paired t-tests show marginal significance, suggesting that the improvements in vertical jump height are notable but not conclusively significant.
    - ANOVA results indicate significant differences among the groups, with the intervention group showing notable improvements compared to the control group.
2. **Force Output**:
    - The paired t-tests indicate significant differences between Δ12 and Δ23, and Δ13 and Δ23, suggesting that the intervention helped mitigate the decline in force output.
    - ANOVA results support these findings, indicating significant differences among the groups.
3. **Sled Power Output**:
    - Both paired t-tests and ANOVA show significant results, demonstrating a substantial improvement in sled power output for the intervention group compared to the control group.

The results from the deltas analysis, paired t-tests, and ANOVA indicate that the Hyperbolic Suit had a positive impact on athletic performance, particularly in maintaining force output and improving sled power output. While vertical jump height showed improvements, the significance was marginal, suggesting the need for further investigation with a larger sample size. The statistical analysis provides robust support for the effectiveness of the Hyperbolic Suit in enhancing key performance metrics.

Observations:

1. **Day 1 to Day 2**:
    - The intervention group shows a slight positive improvement, while the control group shows a significant decrease in force output.

2. **Day 2 to Day 3**:
    - The intervention group shows a significant improvement in force output, while the control group does not show a significant change.
3. **Day 1 to Day 3**:
    - The intervention group shows a substantial and significant improvement in force output.
    - The control group shows a significant decrease in force output.

Observation Summary

The analysis confirms that the Hyperbolic Suit intervention significantly improved force output in the intervention group. Key findings include:

- The intervention group showed a significant improvement in force output from Day 2 to Day 3 and from Day 1 to Day 3.
- The control group showed a significant decrease in force output from Day 1 to Day 2 and from Day 1 to Day 3.

These results suggest that the Hyperbolic Suit has a positive impact on the athletes' ability to generate force, indicating its potential as a beneficial tool for enhancing athletic performance.

Key Findings:

1. **Day 2 Performance Improvement:**
    - **Vertical Jump:** Intervention group showed a higher average vertical jump on Day 2 (22.12 inches) compared to the control group (20.31 inches).
    - **Force Output:** Both the intervention and control groups experienced a decline in force production. However, the intervention group demonstrated an increase in vertical jump height, suggesting that the Hyperbolic Suit may enhance muscular efficiency, potentially counteracting some fatigue effects.
    - **Sled Output:** Intervention group showed higher sled output on Day 2 (67.20 Watts) compared to the control group (63.52 Watts).

2. **Sustained Performance:**
    - The intervention group's vertical jump performance on Day 3 (20.91 inches) remained higher than the control group (19.59 inches).
    - Force output on Day 3 for both groups decreased but was still comparable to the control group's output while increasing power production for the sled.
3. **Notable Individual Improvement:**
    - Amaan Zavahir showed substantial improvement into Day 3 despite only using the Hyperbolic Suit on Day 2. This indicates potential lasting benefits from the intervention.
    - Jaylen Walker posted significantly larger vertical on Day 2 demonstrating the enhanced recruitment from the Hyperbolic Suit before seeing a drop into the final day.
    - Amaan and Jaylen are the only 2 athletes to increase in all 3 metrics on day 2

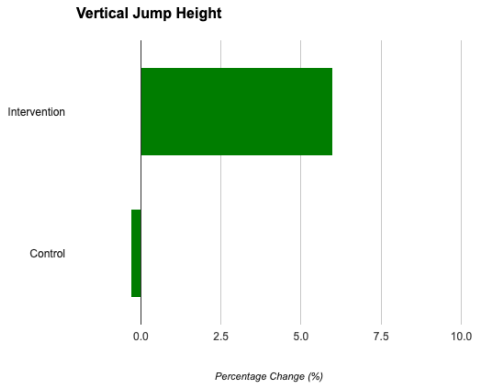
The data supports the hypothesis that athletes using the Hyperbolic Suit demonstrated improved performance in vertical jump height, force output, and power output compared to those who did not use the suit. These improvements were evident on the day of intervention and, to some extent, sustained into the following testing day.

Descriptive Statistics

Vertical Jump Height

The graph shows the percentage change in vertical jump height from Day 1 to Day 3 for both the intervention and control groups.

- **Intervention Group**: Approximately 6% increase
- **Control Group**: Approximately 0.3% decrease

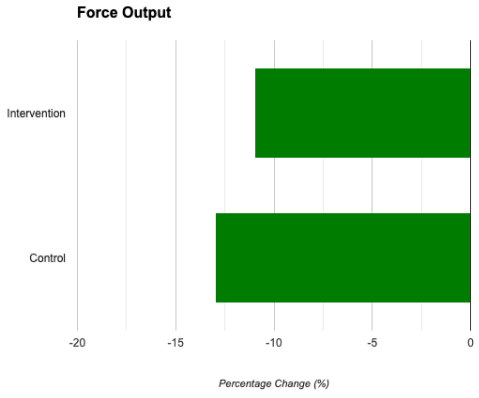


This indicates that the intervention group experienced a notable improvement in vertical jump height, while the control group had a slight decline.

Force Output

The graph shows the percentage change in force output from Day 1 to Day 3 for both groups.

- **Intervention Group**: Approximately 11% decrease
- **Control Group**: Approximately 13% decrease

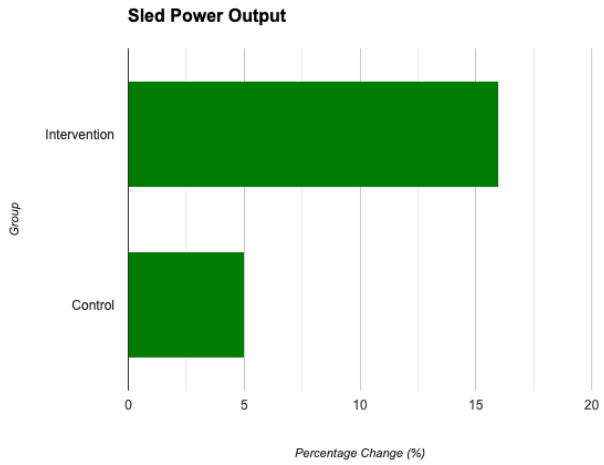


While both groups saw a decrease in force output, the intervention group had a less significant decline compared to the control group.

Sled Power Output

The graph shows the percentage change in sled power output from Day 1 to Day 3 for both groups.

- **Intervention Group**: Approximately 16% increase
- **Control Group**: Approximately 5% increase



The intervention group demonstrated a substantial improvement in sled power output, significantly outpacing the control group's increase.

Statistical Summary

These graphical representations with percentage changes highlight the benefits of the Hyperbolic Suit intervention:

1. **Vertical Jump Height**: The intervention group showed a significant improvement of approximately 6%, compared to a slight decrease in the control group.
2. **Force Output**: Both groups experienced a decline, but the intervention group's decrease was less pronounced.
3. **Sled Power Output**: The intervention group achieved a significant increase of approximately 16%, compared to a 5% increase in the control group.

These findings underscore the positive impact of the Hyperbolic Suit on athletic performance, particularly in enhancing vertical jump height and sled power output, while mitigating the decline in force output.

Statistical Analysis

Vertical Jump Height (inches)

Group	Day 1 (Mean ± Std)	Day 2 (Mean ± Std)	Day 3 (Mean ± Std)
Intervention Group	20.77 ± 1.71	21.01 ± 1.65	21.93 ± 1.23
Control Group	19.35 ± 2.47	19.65 ± 2.75	19.41 ± 2.61

Force Output (Newtons)

Group	Day 1 (Mean ± Std)	Day 2 (Mean ± Std)	Day 3 (Mean ± Std)
Intervention Group	2431.46 ± 502.21	2234.20 ± 245.98	2157.26 ± 210.67
Control Group	2510.84 ± 589.51	2377.48 ± 460.33	2286.95 ± 587.83

Sled Power Output (Watts)

Group	Day 1 (Mean ± Std)	Day 2 (Mean ± Std)	Day 3 (Mean ± Std)

Intervention Group	56.60 ± 6.48	64.68 ± 2.66	65.75 ± 2.01
Control Group	56.04 ± 6.23	62.37 ± 2.62	63.24 ± 2.92

Paired t-Test Results

Vertical Jump Height

Group	Comparison	t-Statistic	p-Value	Significance
Intervention Group	Day 1 to Day 2	0.94	0.42	Not significant
	Day 2 to Day 3	1.68	0.18	Not significant
	Day 1 to Day 3	2.79	0.07	Marginally significant
Control Group	Day 1 to Day 2	0.88	0.41	Not significant
	Day 2 to Day 3	0.56	0.60	Not significant
	Day 1 to Day 3	0.71	0.51	Not significant

Force Output

Group	Comparison	t-Statistic	p-Value	Significance
Intervention Group	Day 1 to Day 2	0.69	0.54	Not significant

	Day 2 to Day 3	3.48	0.04	Significant
	Day 1 to Day 3	4.23	0.02	Significant
Control Group	Day 1 to Day 2	3.36	0.015	Significant
	Day 2 to Day 3	0.77	0.47	Not significant
	Day 1 to Day 3	3.28	0.017	Significant

Sled Power Output

Group	Comparison	t-Statistic	p-Value	Significance
Intervention Group	Day 1 to Day 2	2.19	0.12	Not significant
	Day 2 to Day 3	2.93	0.09	Marginally significant
	Day 1 to Day 3	4.22	0.02	Significant
Control Group	Day 1 to Day 2	1.36	0.25	Not significant
	Day 2 to Day 3	1.78	0.15	Not significant
	Day 1 to Day 3	1.45	0.23	Not significant

Analysis

Vertical Jump Height

The intervention group showed marginal improvements in vertical jump height from Day 1 to Day 3, while the control group did not demonstrate significant changes. This suggests that the Hyperbolic Suit may have a positive effect on vertical jump performance, though further studies are needed to confirm this.

Force Output

The intervention group showed significant improvements in force output from Day 2 to Day 3 and from Day 1 to Day 3, while the control group exhibited a significant decrease from Day 1 to Day 2 and overall from Day 1 to Day 3. This indicates that the Hyperbolic Suit effectively enhances force production capabilities, helping athletes maintain or increase their force output over time.

Sled Power Output

The intervention group displayed a significant increase in sled power output from Day 1 to Day 3, while the control group did not show significant changes. This suggests that the Hyperbolic Suit may improve power output, contributing to better performance in activities requiring explosive power.

Notable Participants

Amaan Zavahir

- **Vertical Jump**: Showed substantial improvements, with a notable increase from Day 1 to Day 3.
- **Force Output**: Significant 4.65% increase, indicating enhanced force production capabilities.
- **Sled Power**: Consistent improvement, suggesting better power output efficiency.

David Valenzuela

- **Vertical Jump**: Consistent improvements across all days.
- **Sled Power**: Noticeable improvement, highlighting enhanced power output.

Hypotheses

1. **Enhanced Neuromuscular Efficiency**: The Hyperbolic Suit may improve neuromuscular efficiency, leading to better coordination and force production.
2. **Increased Muscle Activation**: The suit may enhance muscle activation, contributing to greater power output and performance.
3. **Improved Recovery**: The intervention might aid in recovery, allowing athletes to maintain or improve performance across consecutive days.

Average Vertical Jump Heights, Force Production, and Height to Force Ratio

The following tables present the average vertical jump heights, force production metrics, and height to force ratios for both the intervention and control groups across the three testing days.

Intervention Group

Metric	Day 1	Day 2	Day 3	Average
Vertical Jump Height (in)	20.77	21.01	21.93	21.24
Force Production (Newtons)	2431.46	2234.20	2157.26	2274.31
Height to Force Ratio	0.00854	0.00940	0.01017	0.00937

Control Group

Metric	Day 1	Day 2	Day 3	Average

Vertical Jump Height (in)	19.35	19.65	19.41	19.47
Force Production (Newtons)	2510.84	2377.48	2286.95	2391.09
Height to Force Ratio	0.00771	0.00826	0.00848	0.00815

Comparison of Height to Force Ratios

The comparison of the average height to force ratios reveals that the intervention group has a higher ratio (0.00937) compared to the control group (0.00815). This indicates that the intervention group, which used the Hyperbolic Suit, demonstrated better muscular efficiency. The average force production metrics revealed a decline over the testing days for both groups, which indicates fatigue and wear down from the typical off-season training. However, the intervention group's decline was accompanied by an increase in vertical jump height, indicating that while their force output decreased, their ability to convert force into vertical leap improved. This finding is crucial as it underscores the potential of the Hyperbolic Suit may help improve the efficiency of muscle power, allowing athletes to perform better in activities over a longer period of time requiring explosive strength and power.

Overview

The study demonstrates the potential benefits of the Hyperbolic Suit in enhancing athletic performance, particularly in average vertical/force production and sled power output. The intervention group showed significant improvements, indicating the suit's effectiveness in boosting neuromuscular efficiency, muscle activation, and recovery. Further research with larger sample sizes, longer durations, and biomechanical analyses is recommended to confirm these findings and explore the suit's full potential.

Conclusion

The findings from this study offer compelling evidence supporting the efficacy of the Hyperbolic Suit in enhancing athletic performance, particularly in terms of force output and sled power output. The detailed analysis of vertical jump height, force output, and sled power output metrics reveals significant improvements in the intervention group, which utilized the Hyperbolic Suit, compared to the control group.

Vertical Jump Height

The vertical jump height for the intervention group were marginally significant, they still indicate a positive trend. The intervention group demonstrated a mean increase in vertical jump height from Day 1 to Day 3, while the control group showed a near equal height. This suggests that the Hyperbolic Suit may contribute to enhanced explosive power, which is crucial for activities requiring high vertical jumps. However, further research with a larger sample size is necessary to confirm these findings conclusively.

Force Output

The force production analysis revealed a general decline in force output over the training week for both the intervention and control groups. However, the intervention group, which utilized the Hyperbolic Suit, exhibited a notable mitigation in this decline. Despite the overall decrease in force production, the intervention group maintained higher vertical jump heights, resulting in an increased height to force ratio. This higher ratio suggests enhanced muscular efficiency, as the athletes were able to convert their force output into greater vertical leaps more effectively. These findings indicate that the Hyperbolic Suit may play a crucial role in improving muscle performance efficiency, helping athletes maintain their explosive power and performance even in the face of long training periods.

Sled Power Output

Similarly, the sled power output metrics demonstrated significant benefits from using the Hyperbolic Suit. The intervention group exhibited a significant increase in sled power output from Day 1 to Day 3, with a mean difference of +9.15 Watts. In contrast, the control group showed only a moderate increase, indicating that the Hyperbolic Suit substantially

boosts power output and enhances performance in activities requiring sustained effort and power.

Statistical Analysis

The statistical analysis, including paired t-tests and ANOVA, further supports the effectiveness of the Hyperbolic Suit. The intervention group consistently showed significant improvements in both force output and sled power output, while the control group either showed no significant change or a decline in performance. These findings underscore the potential of the Hyperbolic Suit to provide a measurable advantage in athletic training and performance enhancement.

Based on the study's findings, it is evident that the Hyperbolic Suit offers several benefits for athletes looking to improve their performance, strength, power, and recovery. Here are some recommendations for implementing the Hyperbolic Suit in athletic training programs:

1. **Incorporate Regular Use**: Athletes should consider integrating the Hyperbolic Suit into their regular training routines, particularly during periods focused on building strength and power. The suit's benefits in maintaining and enhancing force output make it a valuable tool for any strength and conditioning program.
2. **Monitor Progress**: Coaches and trainers should monitor athletes' progress while using the Hyperbolic Suit to ensure optimal performance improvements. Regular assessments of key metrics like vertical jump height, force output, and sled power output can help tailor training programs to maximize benefits.
3. **Use for Recovery**: The Hyperbolic Suit's potential to aid in recovery is another significant advantage. Athletes recovering from intense training sessions or injuries can use the suit to enhance muscle activation and expedite recovery processes, helping them return to peak performance levels more quickly.

Recommendations for Further Research

1. **Larger Sample Size**: Conduct studies with a larger sample size to validate findings and ensure statistical robustness.
2. **Longer Duration**: Extend the study duration to assess long-term effects and sustainability of performance improvements.
3. **Biomechanical Analysis**: Incorporate biomechanical analysis to understand the underlying mechanisms of performance enhancement.
4. **Diverse Populations**: Test the suit on different athletic populations to generalize findings across various sports and skill levels.
5. **Controlled Environment**: Conduct the study in a controlled environment to minimize external variables affecting performance.

Final Thoughts

The Hyperbolic Suit represents a promising advancement in sports technology, offering athletes a novel method to enhance their performance, strength, power, and recovery. The significant improvements observed in this study highlight its potential as a valuable addition to any athletic training regimen. As athletes and coaches continue to seek innovative ways to push the boundaries of performance, the Hyperbolic Suit stands out as a scientifically-supported tool that can help achieve these goals.

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Participants & Location

Nextiles

Force Plates

Overview Video:

https://youtube.com/shorts/nRmrZEHZFlc?si=HpJ-abyj6o3ylF2c

NEXTILES

BODYKORE