

# The 2D:4D Ratio in Accordance with Hand Grip Strength Among College Students

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## INTRODUCTION

The exposure of a fetus to testosterone during the first months of pregnancy has many potential effects on embryonic development, such as the second to fourth digit ratio (2D:4D) in both males and females. This ratio is now continuously being studied, and the results of those studies have shown that men tend to have a lower 2D:4D ratio (the fourth digit is longer than the second digit), while females tend to have a higher 2D:4D ratio (the fourth digit is shorter than or the same height as the second digit). This is why the smaller 2D:4D ratio has adopted the title, "masculine ratio."

Many believe that this exposure to higher testosterone levels is the reason that men are typically stronger than women, and in turn will have a stronger hand grip strength compared to women. In this study we ignored gender differences and focused on handgrip strength as well as the 2D:4D ratio between men and women, categorized by types of athletic activity. It is believed that people who have longer fourth fingers will have a stronger hand grip. This led us to ask if those with a masculine 2D:4D ratio (regardless of gender) are more likely to be involved in athletic activities that require an above average hand grip strength, such as power sports.

## METHODS

Data were collected from students enrolled in A&P 1 and 2 during the Spring 2016 semester, students participating in official FGCU Sports Club teams, as well as student athletes competing at the NCAA level. Participation was voluntary and data was collected using an anonymous survey that collected anthropometric data (height and weight), athletic activity related information, right/left handedness, and physiological data (vital lung capacity and handgrip strength). Hand grip strength was measured using a hand-held electronic grip meter (figure 1). Students were asked to answer 13 questions overall, among them "Which sport, if any, are you actively involved in?" and "How many hours per week do you spend training?" The right and left hands of participants were photocopied and the copies attached to their survey. The length of index (2D) and ring (4D) fingers were measured (in mm) using digital Vernier calipers. Each hand was measured twice independent of each other and the measurements were averaged, for both finger length as well as hand grip strength.



Figure 1

Dynamometer - <https://www.topendsports.com/testing/images/dynamometer-300.jpg>

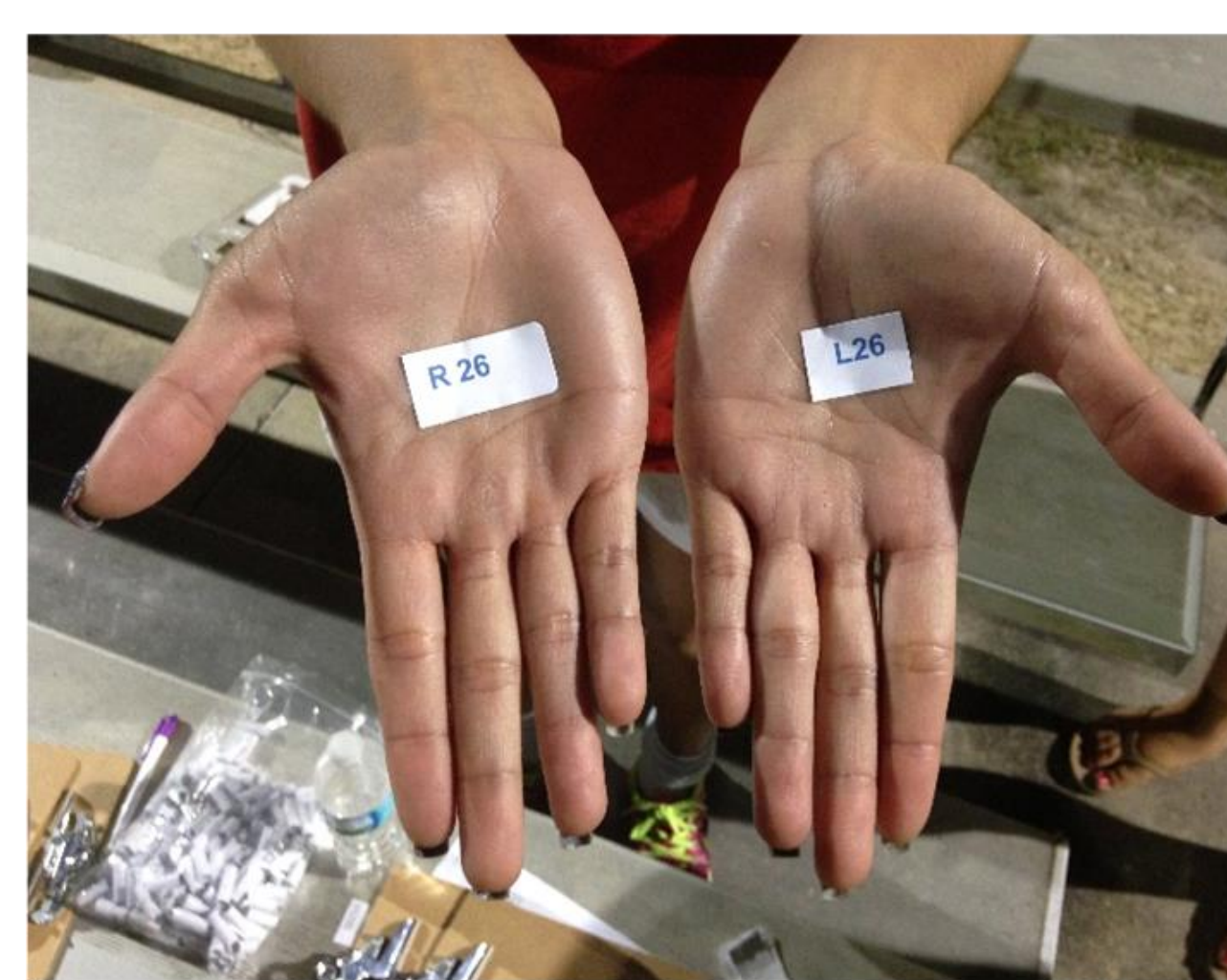


Figure 2

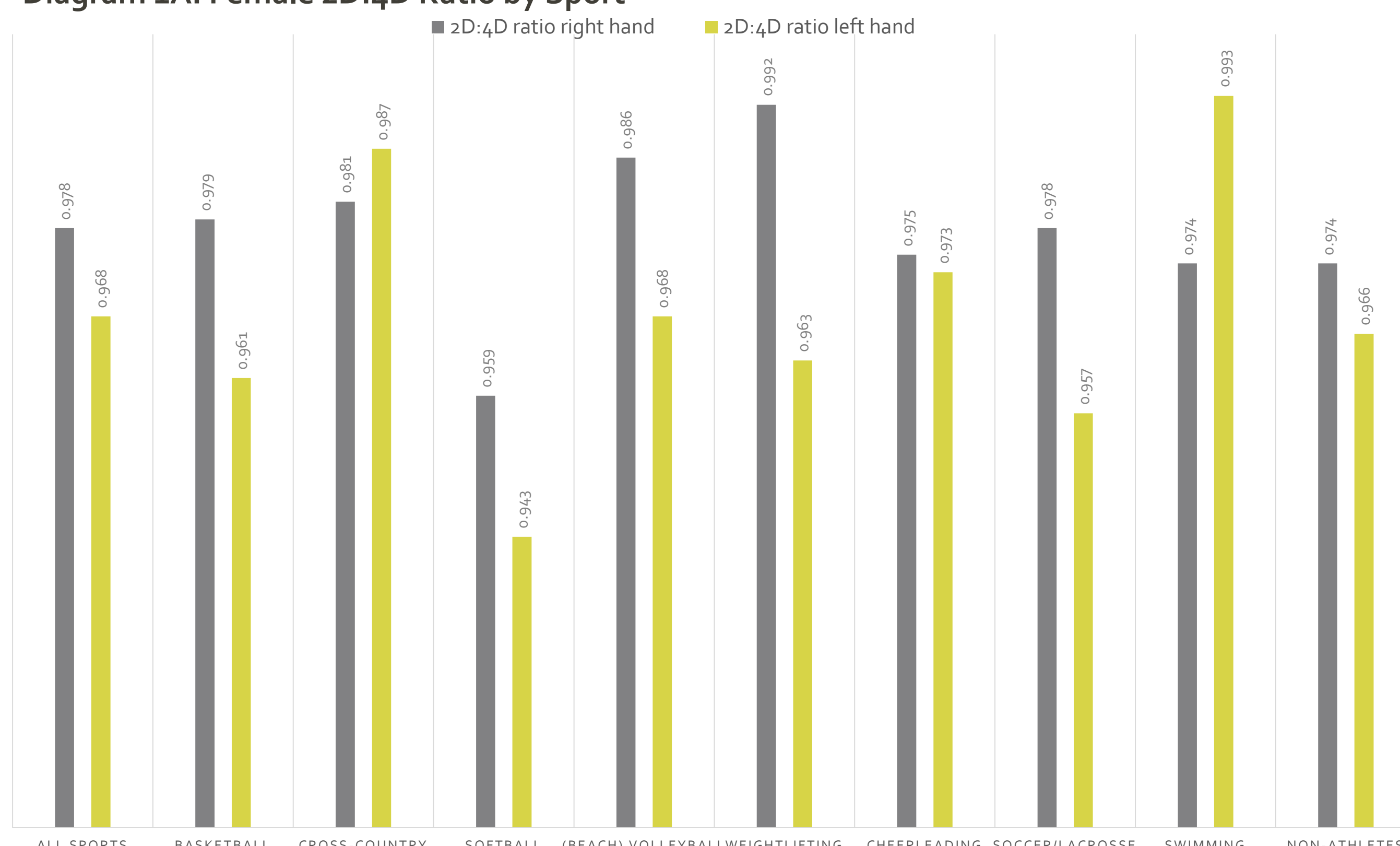
Sample finger length measurement Image

## RESULTS

### 2D:4D Ratio and Hand Grip Strength

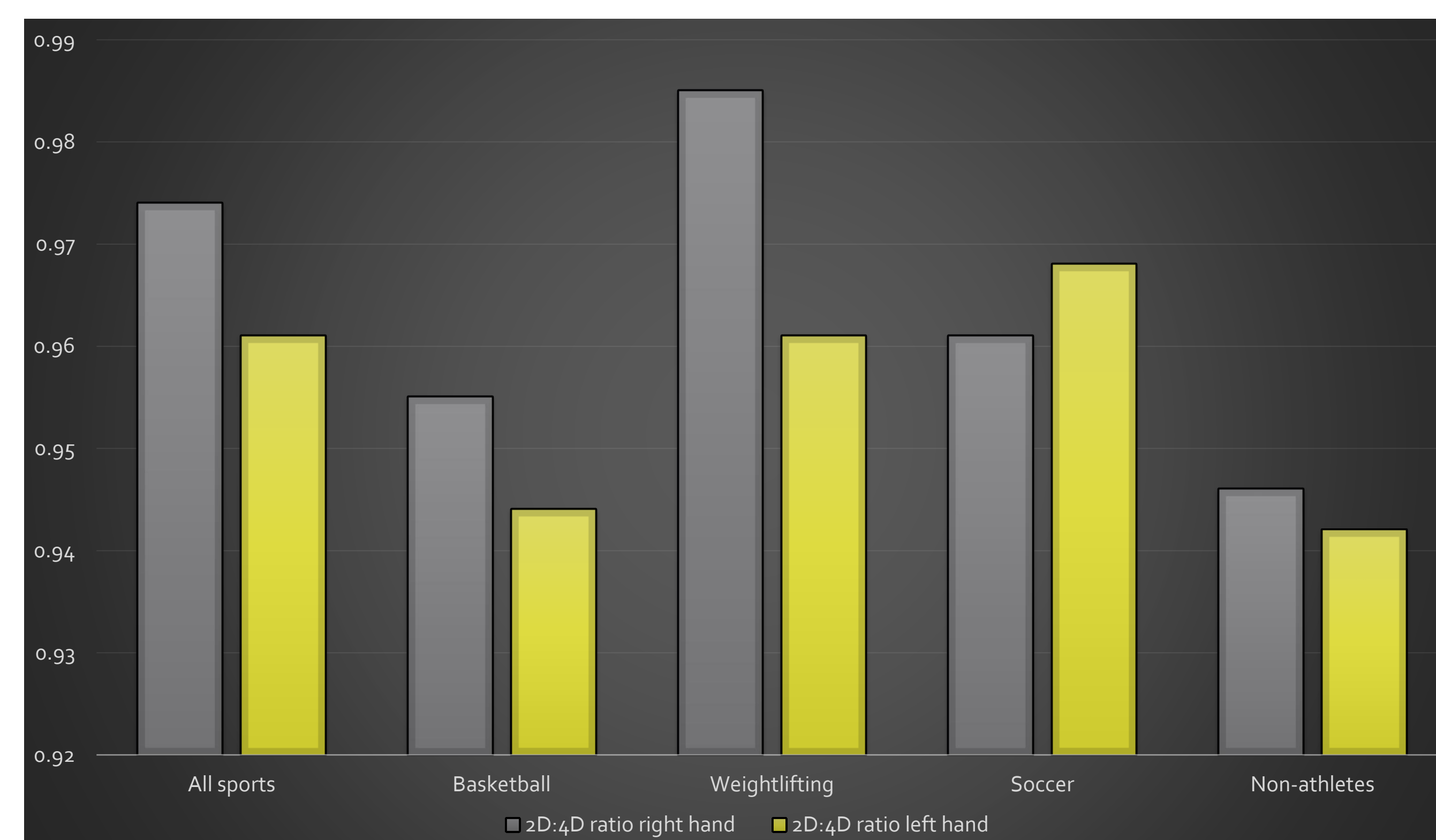
We had a total of 318 participants, of which 31.8% were male and 68.0% were female. Of those males, 84.2% indicated athletic activity while 49.3% of females indicated athletic activity. Out of all 318 participants, 86.6% reported right-handedness, while 14.9% reported left handedness, and 0.3% ambidextrous. Within both genders, 85% of males and females also reported right-handedness to left.

Diagram 1A: Female 2D:4D Ratio by Sport



This graph shows us the 2D:4D ratio for both the left and right hand in females, by sport. Though the graph shows no significant difference between the 2D:4D ratio of each hand, we can observe a slight trend when focusing on the type of sport the individual(s) are involved with. For instance, running/cross country, along with swimming, we see that the left hand actually had a *larger* ratio than the other sports seen in the graph, although these observations are not to statistical significance.

Diagram 1B: Male 2D:4D Ratio by Sport



Like the diagram 1A, diagram 1B shows that there is no significant difference in the 2D:4D ratio of the left or the right hand. This suggests that the ratio of the second and fourth digit--for either hand--does not have much of a correlation between the individual and the sport (or lack of sport) that they're involved in. However, for weight lifting, we find that the right hand had a much *larger* ratio than the left hand. This may show some sort of relationship between the 2D:4D ratio and the handgrip strength for power sports.

Diagram 2A shows that there is indeed a significant difference in the handgrip strength of power sport athletes vs non-power sport athletes, in both the right and left hands, favoring power sport athletes for females.

Diagram 2A: Right and Left Hand Grip Strength, Power vs Non-Power Sport, Females

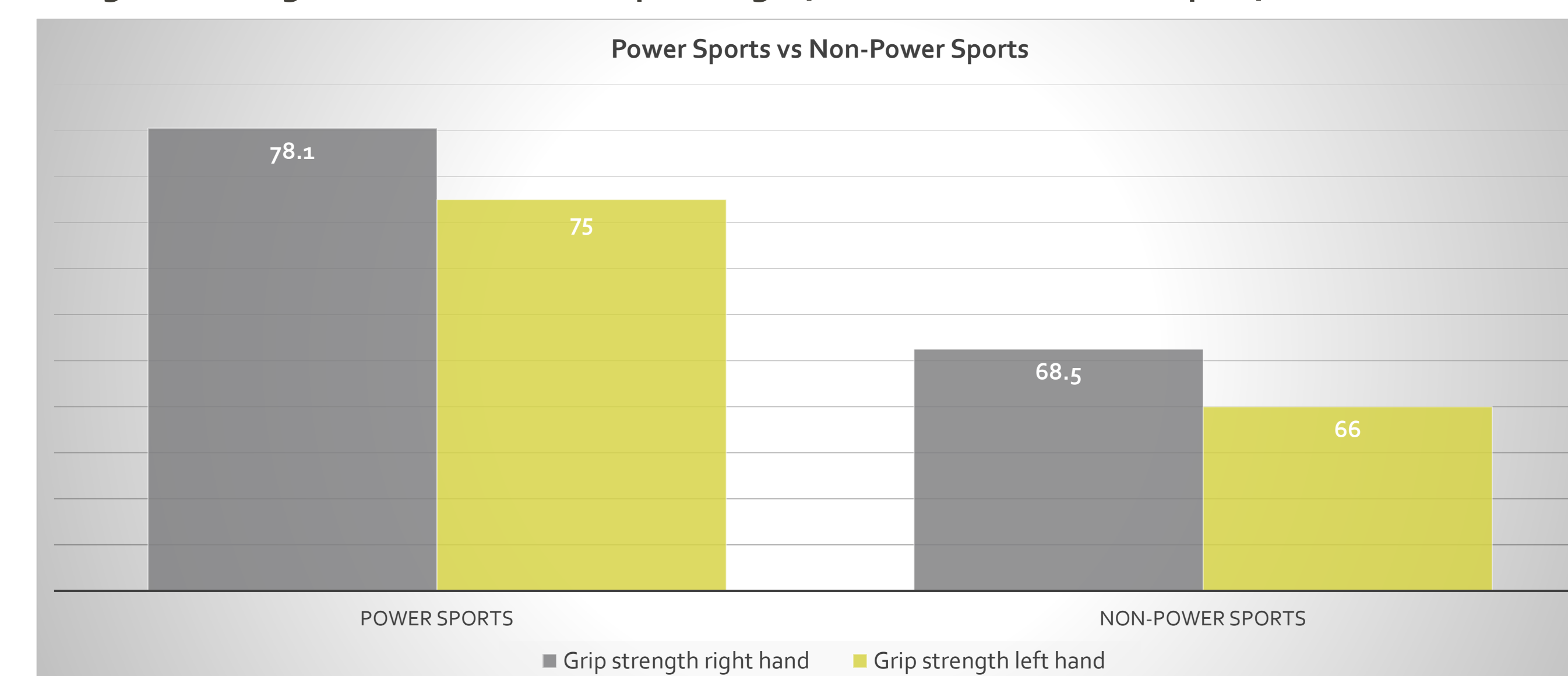
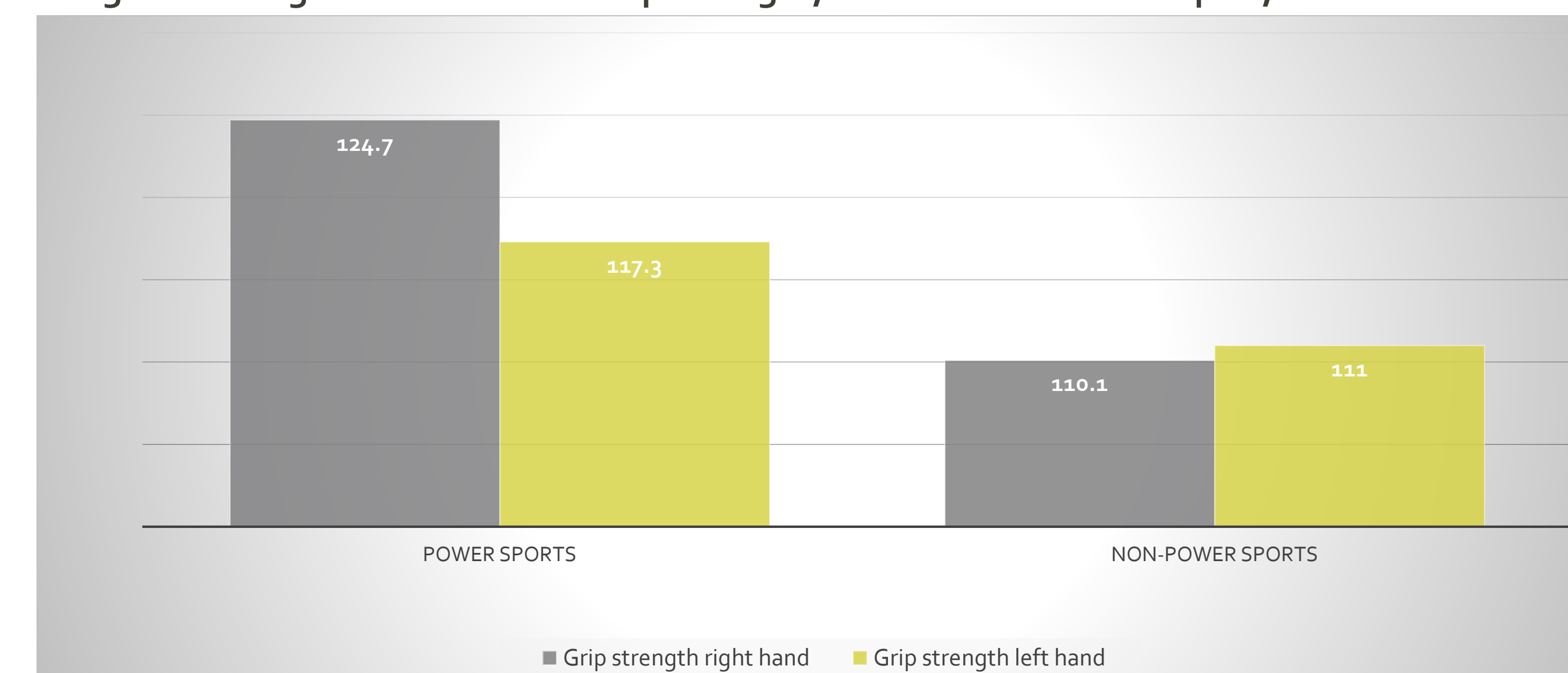


Diagram 2B shows us that males who are involved in power sports do in fact also have, on average, significantly higher hand grip strengths than other athletes who do not participate in power sports.

Diagram 2B: Right and Left Hand Grip Strength, Power vs Non-Power Sport, Males



## DISCUSSION

Among the female participants in our study softball players had the most masculine (lowest) 2D:4D ratio for both the right and left hand, whereas those involved in weightlifting had the most feminine (highest) for the right hand, and slightly below average ratio for the left hand. Among male participants those involved in weightlifting actually had a more feminine ratio for the right hand, and basketball players had a more masculine ratio for both hands.

We saw the same trend among students, who were from either official FGCU NCAA teams or FGCU sports clubs. Men who compete in a sport that does require an above average hand grip strength (e.g., baseball, wrestling, weightlifting) tend to have a higher ratio for the right hand, which is the same for students who are competing in other sports that don't require an above average hand grip strength.

In women, however, those competing in power sports (e.g., softball and weightlifting) actually have opposite ratios (softball having masculine ratios, and weightlifting have feminine ratios) for both hands compared to those participating in non-power sports, which contradicts our hypothesis of higher handgrip strength corresponding to a more masculine ratio.

We can conclude that we have inconclusive results when we focus solely on the 2D:4D ratio. However, if we compare the hand grip strength of males and females, and divide them according to power sport or non-power sport, we find that students in power sports have a greater hand grip strength on either the left or right hand, than students who participate in non-power sports.