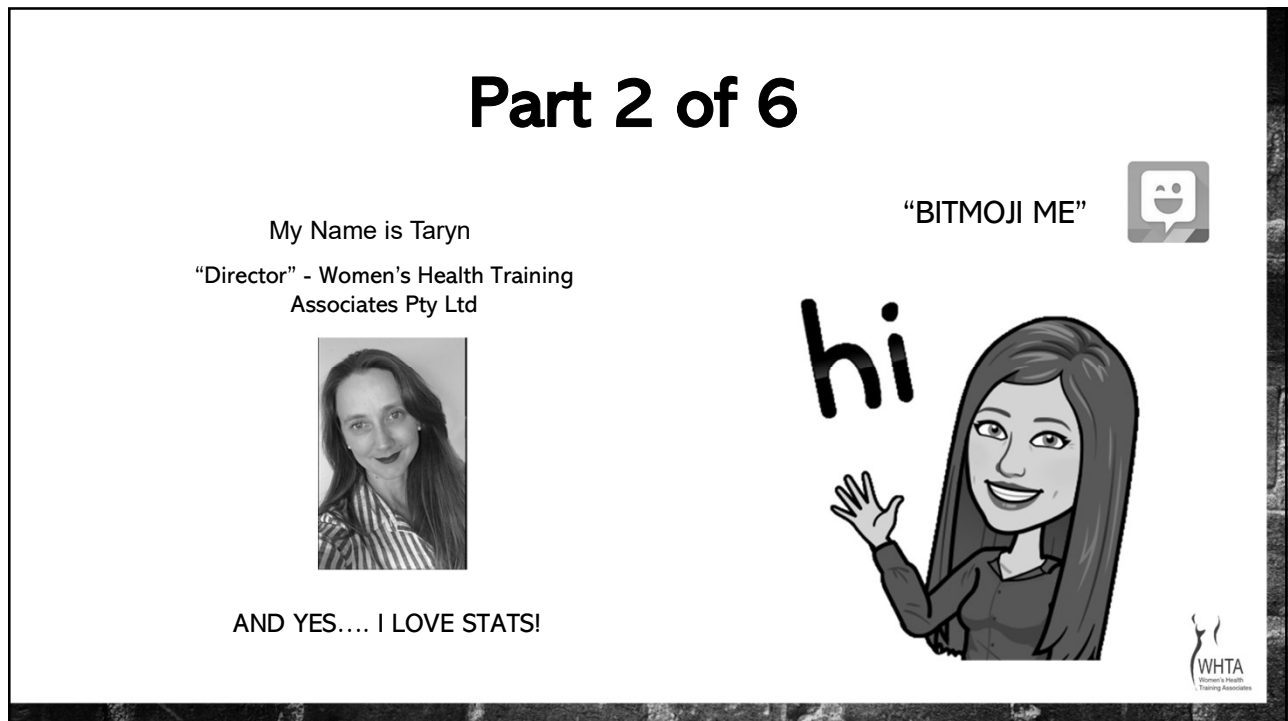




1



2



**BEFORE WE START AGAIN....
(this is pt 2)**

Let's remind ourselves to at least be open to the idea that.....


Stats are AMAZING!

And they don't need to be hard

3

REMINDER: MY LITTLE DISCLAIMER


- I am deliberately **OVERSIMPLIFYING** this series.
- You are not trying to be a **biostatistician**
- You just need '**enough understanding**' to understand the research you are reading
- *So I acknowledge I am oversimplifying, but with the hope that*
 - *You have enough information to get the general idea*
 - *You don't have so much information that you get confused*



4

6 SECTIONS TO THIS SERIES

1. Basics Maths

Fractions
Percentages (% , ‰ , ‰‰)
Decimals
Section 1 

2. Averages and Distribution

Mean vs Median
Standard Deviation
95% Confidence Intervals

3. Significance

Statistical significance?
Clinical significance?
P-value

4. Risk Comparison

Relative Risks - 'RR'
Odds Ratios - 'OR'

5. Correlations

Intra-class Correlation Co-efficient- 'ICC'
Rank Correlation - 'r-value'

6. Other


Intention to Treat - ITT
Number needed to treat - NNT



5

LET'S START!!

AVERAGES AND DISTRIBUTION

1. Mean vs Median 
2. Standard Deviation
3. Confidence interval



6

MEAN vs MEDIAN

- To be honest.....It's a bit hard to understand the mean vs the median without having a sample set of scores to work with
- So let's start by looking at a sample set:

EXAMPLE

- A Physiotherapist assesses the pelvic floor contraction pressure of 30 women using a peritron perineometer.
 - The measures are in cmH₂O after zeroing the rest pressure

Pt	cmH ₂ O	Pt	cmH ₂ O
1	22	16	36
2	46	17	6
3	11	18	18
4	26	19	22
5	21	20	26
6	15	21	18
7	34	22	17
8	21	23	26
9	19	24	14
10	32	25	27
11	88	26	36
12	105	27	41
13	12	28	39
14	15	29	22
15	24	30	12



7

MEAN vs MEDIAN

THE MEAN

- The "MEAN" is simply the "AVERAGE"
- It is calculated by adding up all the scores and then dividing by the total number of scores

STEP ONE: Add all the scores

$$22+46+11+26+21+15+34+21+19+32+.....$$

$$= 851$$

STEP TWO: Divide by total number of scores



$$= 851 \div 30$$

$$= 28.3\text{cmH}_2\text{O}$$

Pt	cmH ₂ O	Pt	cmH ₂ O
1	22	16	36
2	46	17	6
3	11	18	18
4	26	19	22
5	21	20	26
6	15	21	18
7	34	22	17
8	21	23	26
9	19	24	14
10	32	25	27
11	88	26	36
12	105	27	41
13	12	28	39
14	15	29	22
15	24	30	12



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MEDIAN

- The “MEDIAN” is not the Average
- The median is the “MIDDLE SCORE”
- It is calculated by putting all the scores in order and then finding the middle score

STEP ONE: Arrange the scores in order
→ Smallest to largest

STEP TWO: Find the middle score

(in this sample there isn't a single middle score so it is half way between score 15 and 16 which are both the same)

MEDIAN = 22

	cmH2O		cmH2O
1	6	16	22
2	11	17	24
3	12	18	26
4	12	19	26
5	14	20	26
6	15	21	27
7	15	22	32
8	17	23	34
9	18	24	36
10	18	25	36
11	19	26	39
12	21	27	41
13	21	28	46
14	22	29	88
15	22	30	105



9

MEAN VS MEDIAN

Why do research papers sometimes use the mean and sometimes use the median?

When using the mean..... **all individual values** will have an impact on the result,

When using the median.... **most values won't influence** the result at all.



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MEDIAN

With the median most values won't influence the result
With the mean all values influence the results

Is this a good or a bad thing?

ANSWER: It depends.

So which will a researcher use?

Ideally the one that is the most honest reflection of outcomes.

(But in truth.....usually the one that makes their data look better.)

	cmH2O		cmH2O
1		16	22
2		17	
3		18	
4		19	
5		20	
6		21	
7		22	
8		23	
9		24	
10		25	
11		26	
12		27	
13		28	
14		29	
15	22	30	



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MEAN VS MEDIAN

EXAMPLE OF USING THE MEAN VS THE MEDIAN

Let's pretend a drug company has created a new drug to relieve pain in chronic back pain. Being a new drug they sample it on just 5 people.....

Patient	Pain at Baseline	Pain after new drug	Change in Pain
1	7/10	5/10	-2
2	8/10	6/10	-2
3	5/10	9/10	+4
4	8/10	6/10	-2
5	6/10	9/10	+3
Avg	6.8	7.0	

What was the 'mean' change in pain (average) ?

Add scores: $(-2) + (-2) + (+4) + (-2) + (+3) = +1$
Divide by total = $+1 \div 5 =$ worse by 0.2

The average change in pain was 0.2/10 worse on a VAS scale

What was the median change in pain?

Start by putting scores in order: -2 -2 -2 +3 +4

If the drug company uses "Mean" they have to say the drug made people worse by 0.2/10
Instead the drug company could say that the median change in pain was 2/10.



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MEAN vs MEDIAN

Does that mean researchers shouldn't use the median????

NO!

Sometimes the **median** is more reflective of the true change



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MEAN vs MEDIAN

EXAMPLE #2 OF USING THE MEAN VS THE MEDIAN

A company makes a new vaginal e-stimulation unit for increasing pelvic floor strength. They measure the strength of the pelvic floor using peritron before and after 12 weeks treatment

Patient	Baseline cmH2O	12/52 cmH2O	Change in cmH2O
1	6	15	+9
2	14	19	+5
3	11	17	+6
4	14	20	+6
5	16	54	+38
Avge	12.2	25	

What was the 'mean' change in strength (ie average)?

Add scores: $(9) + (5) + (6) + (6) + (38) = +64$
Divide by total = $+64 \div 5 = +12.8\text{cmH2O}$

The average increase in strength was 12.8cmH2O in 12 weeks?

What is the median change in strength?

Put scores in order: +5 +6 +6 +9 +38

When there is one or two significant outliers they can skew the result of the mean and make it look better than it really is.



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ANOTHER TIME I'M CYNICAL.....

When researchers only give mean percentage change..... Not the mean of the raw data

Example 3: Another company makes a new vaginal e-stimulation unit for increasing pelvic floor strength. They measure the strength of the pelvic floor using peritron before and after 6/52 Rx

Patient	Baseline cmH2O	6/52 cmH2O	Change	% Change
1	6	9	+3	3/6 = 50%
2	8	12	+4	4/8 = 50%
3	20	22	+2	2/20 = 10%
4	10	16	+6	6/10 = 60%
5	12	15	+3	3/12 = 25%
Avg	11.2	14.8	3.6	39%

What was the 'mean' (avg) change in squeeze pressure?

The average change was 3.6cmH2O ↑ over 6 weeks

What was the median change in squeeze pressure?

The median change was a 3cmH2O ↑ over 6 weeks

What was the average % change in squeeze pressure

Women averaged a 39% increase in strength in 6/52.



15

ANOTHER TIME I'M CYNICAL.....

When researchers only give mean percentage change..... Not the mean of the raw data

Example 3: Another company makes a new vaginal e-stimulation unit for increasing pelvic floor strength. They measure the strength of the pelvic floor using peritron before and after 6/52 Rx

STUDY RESULTS:

Women averaged a 39% increase in strength in 6/52.

MORAL OF THE STORY:..... be careful when raw numbers aren't given!



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WHICH ONE??

Ideally I like researchers to give both.

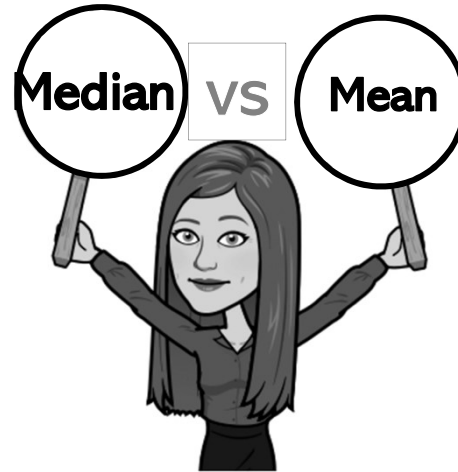
If they are significantly different it probably means that there were some large outliers that skewed the mean.

- If they only give the mean, were their data skewed by a few people who had amazing outcomes and they didn't want us to know that the median change was lower??

I can also be suspicious if a researcher only gives me the median

- What was the range of outcomes?

I'm even more suspicious when they only give me a mean percentage change without the actual mean.



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WHERE ARE WE UP TO?

AVERAGES AND DISTRIBUTION

1. Mean vs Median



2. Standard Deviation



3. Confidence interval



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STANDARD DEVIATION

Patients like to think we can give them an exact number for how they will respond to treatment

In reality we don't know what their EXACT response to treatment will be.

Example

A woman comes to see you in clinic saying she feels weak in her pelvic floor especially during sex. She reports that she used to feel a stronger tightening of her PFM during orgasm. Your assessment shows that she has a Max PFC squeeze pressure of 18cmH₂O. You suggest she does PFMT.

She asks: "If I do my pelvic floor exercises for 3/12 how much will my strength increase??"

She would like your response to be exact:

eg "If you do your exercises your strength will go up by 15cmH₂O in 12/52"

In reality, at best we can probably say:

eg "The average increase a woman gets in 12 weeks is ~15cmH₂O, but it can vary anywhere from 5cmH₂O to 25cmH₂O."

Where does the range come from??

This is what STANDARD DEVIATION tells us.



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STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

PATIENT	1	2	3	4	5	6	7	8	9	10	11	12
Baseline	14	18	12	13	15	19	11	10	13	14	15	11
12 wks	24	23	14	28	25	30	28	13	19	24	30	16
CHANGE	+10	+5	+2	+15	+10	+11	+17	+3	+6	+10	+15	+5

PATIENT	13	14	15	16	17	18	19	20	21	22	23	24
Baseline	14	16	12	20	14	16	11	15	12	16	13	12
12 weeks	14	26	32	45	19	31	21	31	22	30	22	19
CHANGE	+0	+10	+20	+25	+5	+15	+10	+16	+10	+14	+9	+7

Let's start by putting them in order from smallest change to largest change



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STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

PATIENT	1	2	3	4	5	6	7	8	9	10	11	12
Baseline	14	12	10	11	14	18	13	12	13	11	12	14
12 wks	14	14	13	16	19	23	19	19	22	21	22	24
CHANGE	+0	+2	+3	+5	+5	+5	+6	+7	+9	+10	+10	+10

PATIENT	13	14	15	16	17	18	19	20	21	22	23	24
Baseline	14	15	16	19	16	13	16	15	15	11	12	20
12 weeks	24	25	26	30	30	28	31	30	31	28	32	45
CHANGE	+10	+10	+10	+11	+14	+15	+15	+15	+16	+17	+20	+25

Now we are going to group them



21

STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

PATIENT	1	2	3	4	5	6	7	8	9	10	11	12
Baseline	14	12	10	11	14	18	13	12	13	11	12	14
12 wks	14	14	13	16	19	23	19	19	22	21	22	24
CHANGE	+0	+2	+3	+5	+5	+5	+6	+7	+9	+10	+10	+10

PATIENT	13	14	15	16	17	18	19	20	21	22	23	24
Baseline	14	15	16	19	16	13	16	15	15	11	12	20
12 weeks	24	25	26	30	30	28	31	30	31	28	32	45
CHANGE	+10	+10	+10	+11	+14	+15	+15	+15	+16	+17	+20	+25

Now we are going to group them



22

STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

Change in Strength	# of women
0 – 4	3
5 – 9	6
10 -14	8
15 – 19	5
>19	2

RESULTS

Average Change at 12/52: ↑ 10.4cmH2O
 (add all change scores ÷ 24 people)

Median Change: 10cmH2O

But is this how much a woman WILL CHANGE??



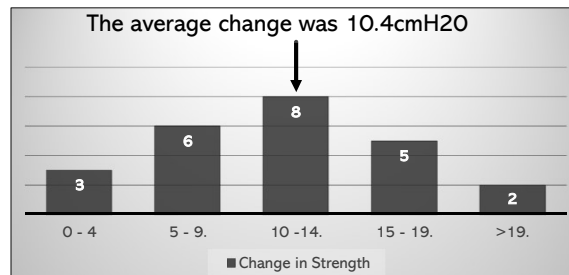
23

STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

Change in Strength	# of women
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15 – 19	5
>19	2



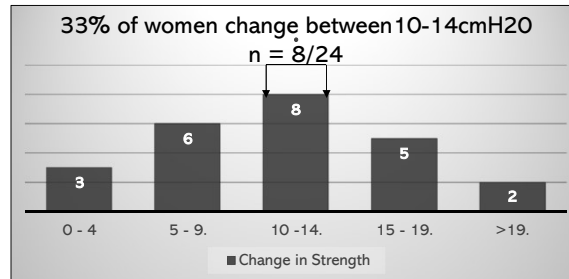
24

STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

Change in Strength	# of women
0 – 4	3
5 – 9	6
10 -14	8
15 – 19	5
>19	2



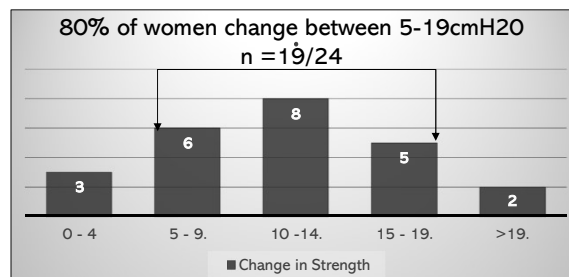
25

STANDARD DEVIATION

Example – Let's pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

Change in Strength	# of women
0 – 4	3
5 – 9	6
10 -14	8
15 – 19	5
>19	2



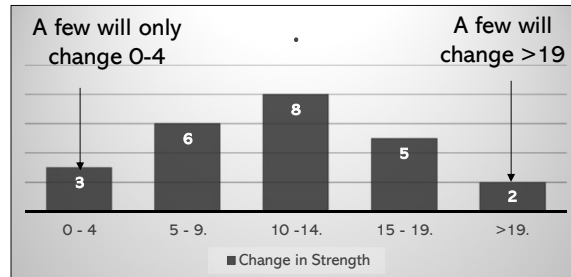
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STANDARD DEVIATION

Example – Let’s pretend we have 24 women with the same circumstance (wanting to strengthen their pelvic floor for better sexual response with orgasm)

They are all given 12 weeks of PFMT

Change in Strength	# of women
0 – 4	3
5 – 9	6
10 -14	8
15 – 19	5
>19	2

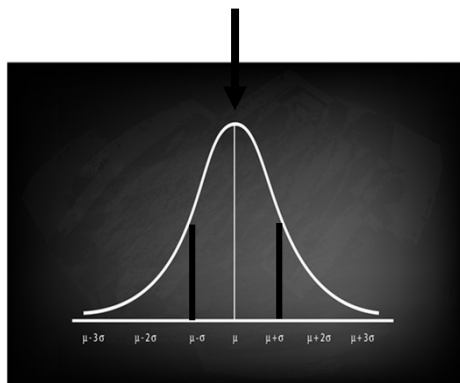


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SO WHAT IS STANDARD DEVIATION?

Standard deviation tells us how far people are likely to “DEVIATE FROM THE MEAN”

You start by having the “mean” and acknowledge this is simply what the average person will be



This is definitely not what everyone will be

Standard Deviation then enables us to tell people the range of outcomes and their likelihood.

Moving 1SD either side of the mean tells us.....

The range that more than 50% of people will fall into (to be specific..... 68% of people)

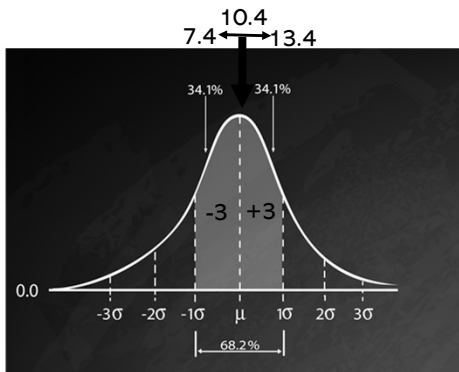


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SO WHAT IS STANDARD DEVIATION?

Standard deviation tells us how far people are likely to “DEVIATE FROM THE MEAN”

You start by having the “mean” and acknowledge this is simply what the average person will be



Example:

Our research trial states that the average strength change was 10.4cmH₂O with a SD of 3

$$10.4 - 3 = 7.4$$

$$10.4 + 3 = 13.4$$

The average strength change is 10.4cmH₂O

BUT

68% of people will change b/w 7.4 to 13.4cmH₂O

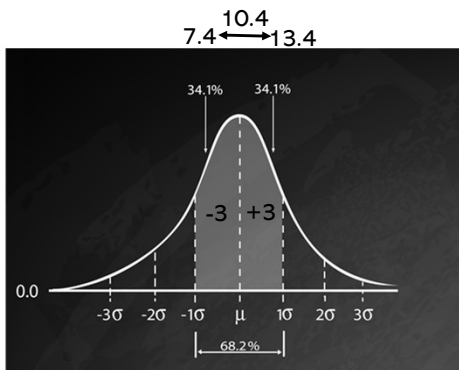


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SO WHAT IS STANDARD DEVIATION?

Standard deviation tells us how far people are likely to “DEVIATE FROM THE MEAN”

You start by having the “mean” and acknowledge this is simply what the average person will be



68% chance of having a change between 7.4 and 13.4



Most people want a better guarantee than a 68% chance.

That is why we usually use a 2SD Range!

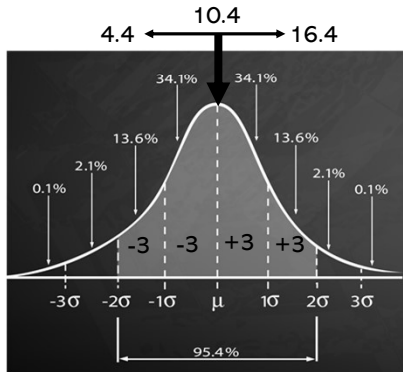


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SO WHAT IS STANDARD DEVIATION?

Standard deviation tells us how far people are likely to “DEVIATE FROM THE MEAN”

You start by having the “mean” and acknowledge this is simply what the average person will be



Example of 2 SD:

Our research trial states that the average strength change was 10.4cmH₂O with a SD of 3

$$10.4 - 6 = 4.4$$

$$10.4 + 6 = 16.4$$

The average strength change is 10.4cmH₂O

BUT

95% of people will change b/w 4.4 to 16.4cmH₂O



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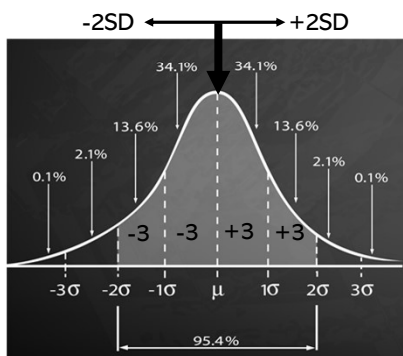
IMPORTANT

The 3 most common numbers given in research are.....

THE MEAN

THE STANDARD DEVIATION

95% Confidence Interval



95% Confidence Interval

Is simply the range starting from 2 SD below the mean to 2 SD above the mean

It is the range that 95% scores fall in

As opposed to just giving the average.



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HOW WILL THIS LOOK IN RESEARCH

Group 1 Examples.....Sometimes they give mean and standard deviation.

1. A research paper states that after 12 weeks of PFMT, the pad weight on a 20min pad test changed an average of 7g +/- 2.2g (mean±SD)

The average reduction is 7g

2SD Range: (7 – 4.4g) → (7 +4.4g)

95% of woman will experience a reduction in leakage between 2.6g and 11.4g

2. After bladder retraining it is found that the day frequency reduced from 14/day to 11 per day +/- 1.4

The average frequency after bladder retraining was 11 per day (a reduction of 3 per day)

2SD range is (11 – 2.8) → (11 + 2.8)

95% of women had a frequency in the range of 8.2 to 13.8 after bladder retraining.



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HOW WILL THIS LOOK IN RESEARCH

Group 2 Examples.....Often they are nice and immediately give you the 95%CI

1. A research paper states that after reducing fluid intake by 25% per day, the day frequency reduced from 13/day to 9/day (95%CI: 7.2 – 10.8)

The average day frequency after fluid restriction was 9/day

95% of woman experienced a day frequency between 7.2 to 10.8 after 25% fluid reduction.

2. After defecation / posture advice, defecation time reduced from an average of 17min to 6min (95%CI 2.1 – 9.9)

The average defecation time after giving posture advice was 6min

95% of women had a defecation time between 2.1 and 9.9min after posture advice.



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WHERE ARE WE UP TO?

1. Basics Maths

Fractions

Percentages (% , ‰ , ‰‰)

Decimals

Section 1



2. Averages and Distribution

Mean vs Median

Standard Deviation

95% Confidence Intervals

Section 2



3. Significance

Statistical significance?

Clinical significance?

P - value

See you soon!

