

Comparing means of two groups (t-test)

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Comparing means of two groups (t-test)

- Independent sample "t" test
- Paired sample "t" test

Independent sample "t" test

- Basic concept & research methodology
 - Study design, types of variables, measurements
 - Data analysis
 - Dummy table

Independent sample "t" test

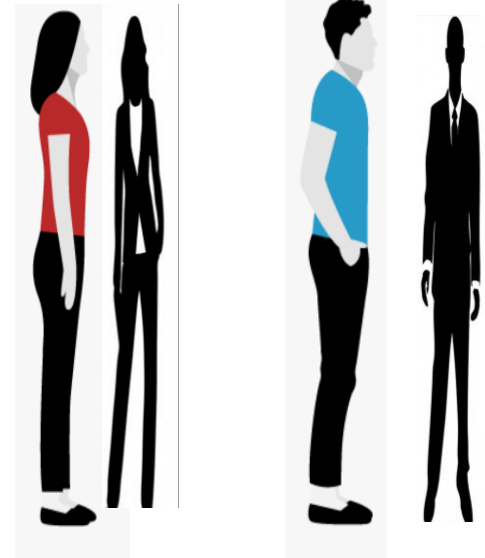
Research methodology

Research question: Is there any difference in height between male and female?

Hypothesis:
There is no difference in height
between male and female.

5 feet

4 feet

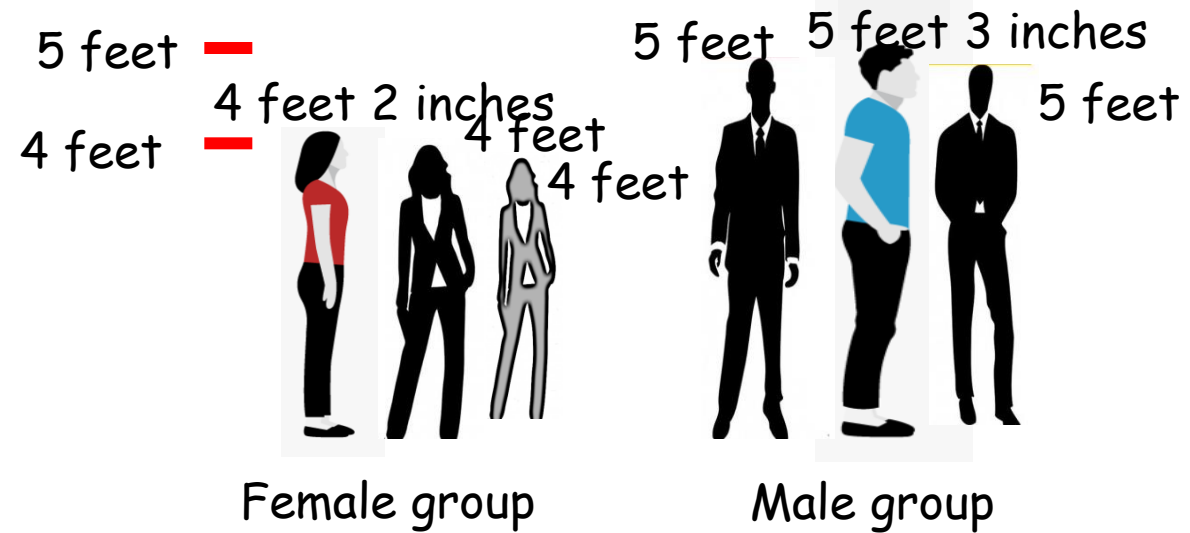
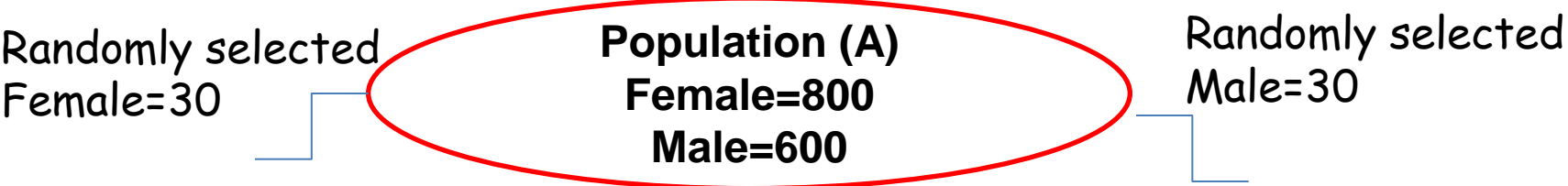


Female group Male group

Methodology

- Study Design (Cross sectional, case control, RCT)
- Type of variables (Height: **Continuous**, Gender: **Binary** categorical)
- Measurements - Independent (Explanatory) Gender
Dependent (Outcome) Height

Basic concept: Example 1



	Female	Male
Height	Mean±SD	Mean±SD

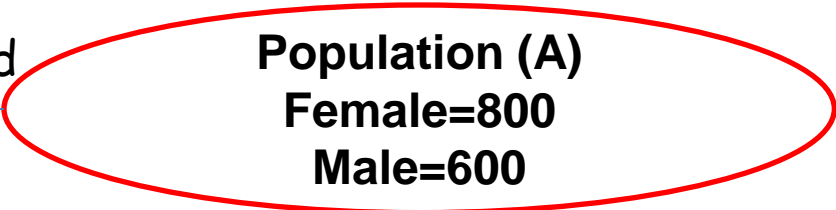
Data analysis

Descriptive statistics

Data will be presented by mean and standard deviation for continuous variables

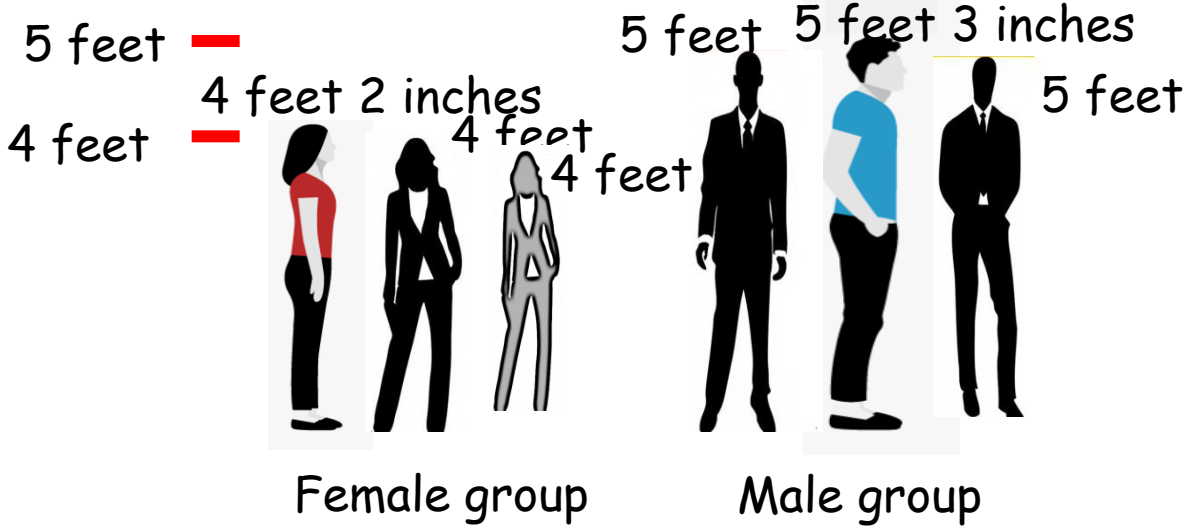
Basic concept: Example 1

Randomly selected
Female=200



Randomly selected
Male=200

Independent sample:
Independent
• Measurement
• Group



$$t \text{ score} = \frac{\text{Difference between group (Mean)}}{\text{Difference within group (SD)}} = \frac{(5.1 - 4.1)}{(0.2 - 0.1)} = \frac{1.0}{0.1} = 10$$

Data analysis
Inferential statistics

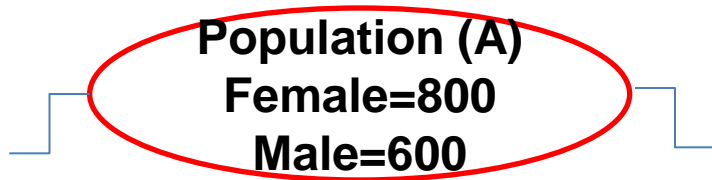
Independent sample t test will be used to find out gender difference in height.

Our problems

Weight of Male and Female in Population A: t score=10

Difference in height
between male and female

Significant difference??



By chance??

Our decision maker

Hypothesis:

There is no difference in height between male and female.

What is the meaning of "no difference"?

Definition of no difference

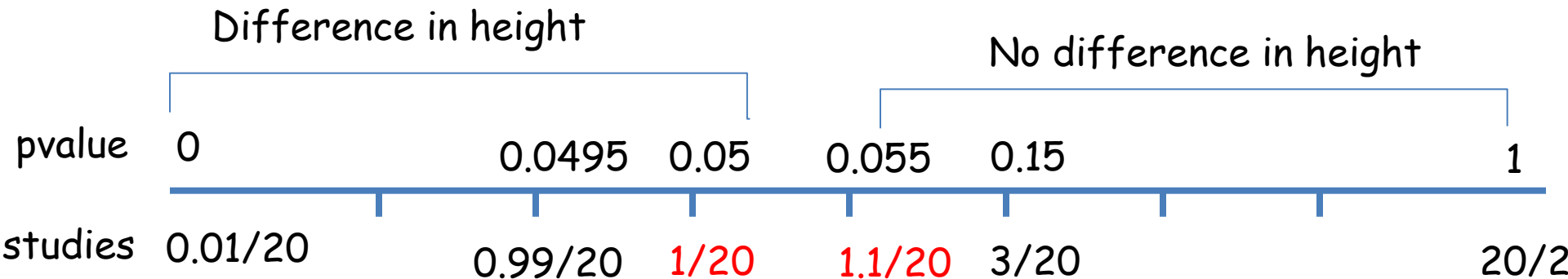
Significant pvalue set at 0.05 (1/20=5% probability=5% chance)

"No difference" is defined as

if at least one out of 20 studies falsely deciding that difference exist when it does not exist.

အကြိမ် (၂၀) မှာ ရှိတယ်ကို တစ်ခါလေးတောင်မှ မှားမပြော

အကြိမ် (၂၀) မှာရှိတယ်ကို တစ်ခါလောက် မှားပြော



Solving our problems

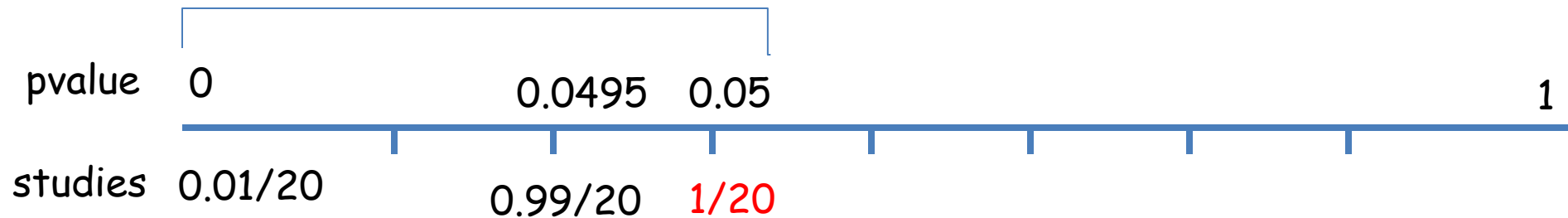
Weight of Male and Female in Population A: t score=10

p-value = 0.03842

Change "t score" to pvalue

အကြိမ် (၂၀) မှာ ရှိတယ်ကို တစ်ခါလေးတောင်မှ မှားမပြော

Difference in height



Inferential statistics

Independent sample t test will be used to find out gender difference in height. **Significant pvalue** will be set at 0.05 level.

Example Dummy Table

Table (1) shows gender difference in height

Variables	Female (n=??)	Male (n=??)	pvalue*
	Mean±SD	Mean±SD	
Height in population A			
Height in Population B			

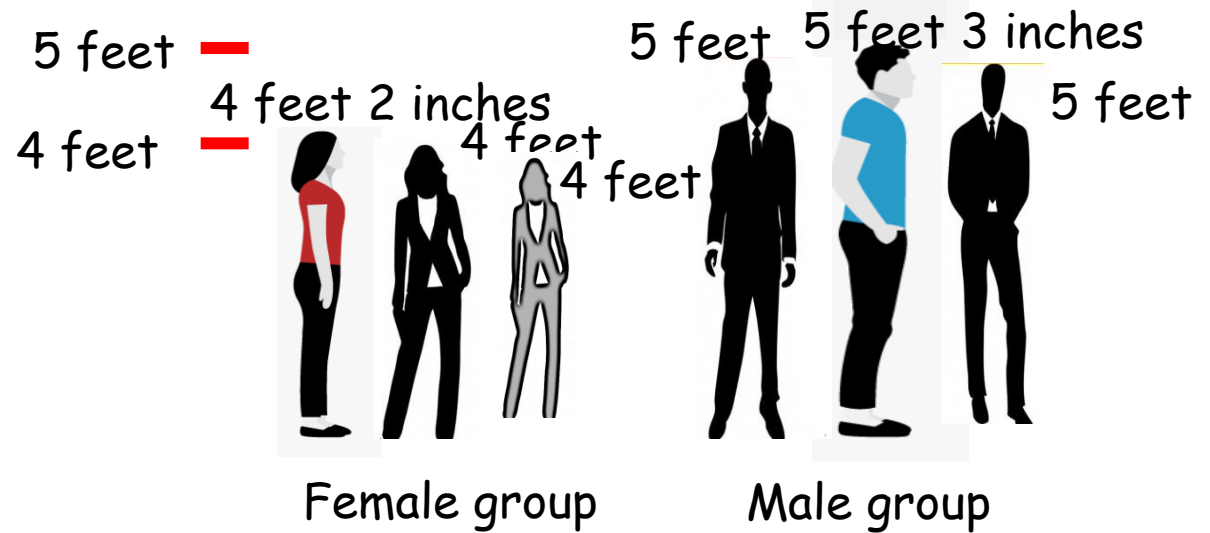
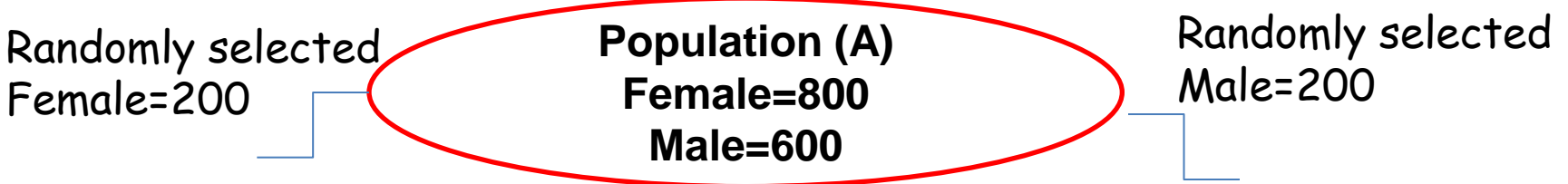
pvalue of independent sample t test; *Significant pvalue is set at ≤ 0.05 .

Table (1) shows gender difference in height

Variables	Female (n=??)	Male (n=??)	pvalue*
Height in population A			
Mean±SD			
Height in Population B			
Mean±SD			

pvalue of independent sample t test; *Significant pvalue is set at ≤ 0.05 .

Independent sample t test: Example 1



$$t \text{ score} = \frac{\text{Difference between group (Mean)}}{\text{Difference within group (SD)}} = \frac{(5.1 - 4.1)}{(0.2 - 0.1)} = \frac{1.0}{0.1} = 10$$

p-value = 0.03842

Independent sample t test: Example 1

Randomly selected
Female=2



Randomly selected
Male=2

6 feet 3 inches

5 feet
4 feet

4 feet 2 inches

4 feet 4 feet



Female group

Male group

$$t \text{ score} = \frac{\text{Difference between group}}{\text{Difference within group}} = \frac{(5.1 - 4.1)}{(1.6 - 0.1)} = \frac{1.04}{1.5} = 0.69$$

p-value = 0.5283

Paired sample "t" test

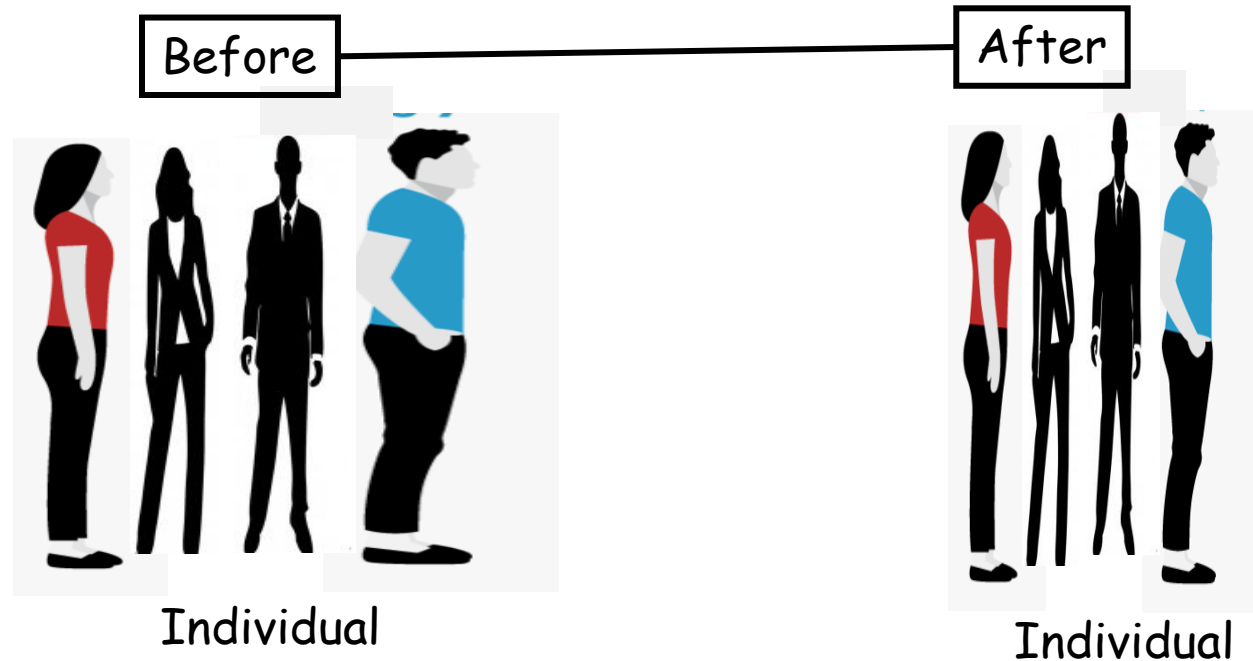
- Basic concept & research methodology
 - Study design, types of variables, measurements
 - Data analysis
 - Dummy table

Paired sample "t" test

Research methodology

Research question: Is there any difference in weight before and after exercise?

Hypothesis:
There is no
difference in weight
before and
after exercise



Methodology

- Study Design (Longitudinal study, Case control, before and after study, Intervention study)
- Type of variables (Weight: **Continuous**)
- Measurements - Independent (Explanatory)

Dependent (Outcome)

Weight

Basic concept: Example 1

Population (A)

Female=800

Male=600

Randomly selected n=40

Before

After



Individual



Individual

	Before	After	Before-After
Weight	Mean±SD	Mean±SD	Mean±SD

Data analysis

Descriptive statistics

Data will be presented by mean and standard deviation for continuous variables

Basic concept: Example 1

Population (A)

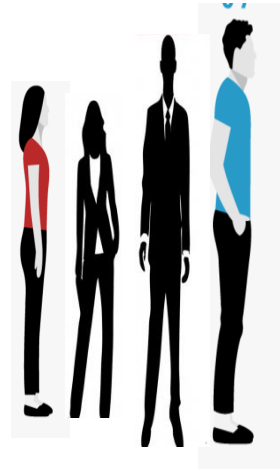
Female=800

Male=600

Randomly selected n=40

Before

After



Individual

Individual

Paired sample:

- Measurement are related
- Same individual but different times

$$t \text{ score} = \frac{\text{Mean (Before-after)}}{\text{SD (Before-after)/sqrt(n)}}$$

Data analysis

Inferential statistics

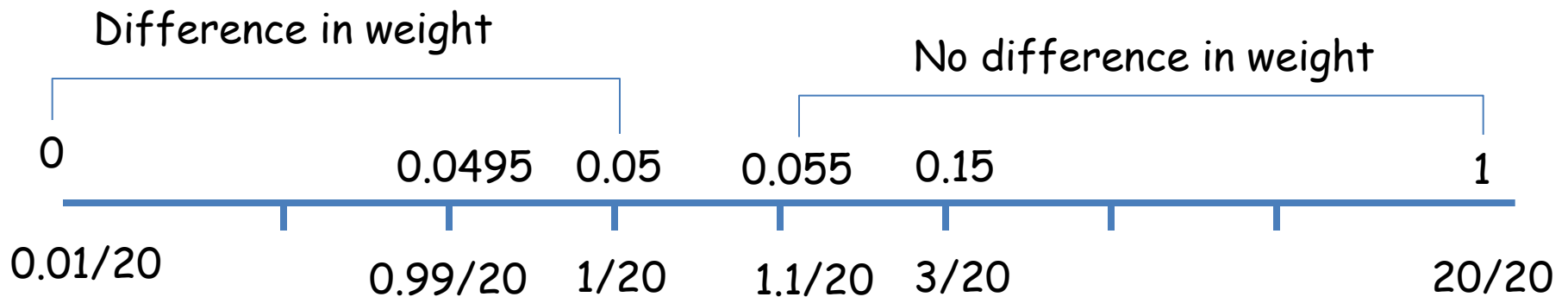
Paired sample t test will be used to find out weight difference before and after exercise

Solving our problems

Weight difference before and after study: t score=??

p-value = ??

Change "t score" to pvalue



Inferential statistics

Paired sample t test will be used to find out significant difference in weight before and after exercise.

Significant pvalue will be set at 0.05 level.

Example Dummy Table

Variable	n	Mean \pm SD			t	pvalue*
		Before	After	Before- after		
Weight						

pvalue of paired sample t test; *Significant pvalue is set at ≤ 0.05 .

Exercise

Table 1: Socio-demographic characteristics of the participants in intervention and control groups

Characteristic	Control (n=80)	Intervention (n=80)	p-value
Child gender			0.63
Male	33 (41.2)	37 (46.2)	
Female	47 (58.8)	43 (53.8)	
Child age			0.11
Mean \pm SD	12.4 \pm 1.8	12.8 \pm 1.9	
Schooling status			0.008
Out of school	8 (10.0)	22 (27.5)	
In-school	72 (90.0)	58 (72.5)	
School grade (n=58,72)			0.71
Mean \pm SD	6.0 \pm 2.0	5.9 \pm 2.2	
Range	2-10	2-11	

Which variables are used for t.test? / Which t test can be used?
Give the reason?

- Study design, Type of variables, Measurements

Exercise

Table 1: Blood parameters before and after treatment

Parameter	n	Before treatment	After treatment	% change	t value	pvalue
Hb	12	12.7±0.3	12.8±0.2	0.4	0.22	>0.005
ESR	12	26.3±6.2	26.9±8.4	2.7	0.08	>0.005

Hb: Haemoglobin

Which statistic test can be used?

Give the reason?

- Study design
- Type of variables
- Measurements

Table 4 Emotion behaviors of children in control and mindfulness intervention groups

Characteristic	Control (n=80)	Intervention (n=80)	p-value
Emotional behaviors			
Baseline			0.28
Mean \pm SD	3.8 \pm 2.2	4.2 \pm 2.5	
Six months			0.0001
Mean \pm SD	4.2 \pm 2.5	1.0 \pm 0.9	

Which statistic test can be used?

Give the reason?

- Study design
- Type of variables
- Measurements

Exercise

Table 4 Emotion behaviors of children in mindfulness intervention group

Parameter	n	Intervention		pvalue
		Baseline	6 months	
Emotional behaviors	80	4.2±2.5	1.0±0.9	0.003

Table 5 Emotion behaviors of children in control group

Parameter	n	Control		pvalue
		Baseline	6 months	
Emotional behaviors	80	3.8±2.2	4.2±2.5	0.23

Which statistic test can be used?

Give the reason?

- Study design
- Type of variables
- Measurements

References

- Mon, M. M., Liabsuetrakul, T., & Htut, K. M. (2016). Effectiveness of Mindfulness Intervention on Psychological Behaviors among Adolescents with Parental HIV Infection: A Group-Randomized Controlled Trial. *Asia-Pacific Journal of Public Health*, 28(8), 765-775. <https://doi.org/10.1177/1010539516675698>
- Szucs, D., & Ioannidis, J. P. A. (2017, August 3). When null hypothesis significance testing is unsuitable for research: A reassessment. *Frontiers in Human Neuroscience*. Frontiers Media S. A. <https://doi.org/10.3389/fnhum.2017.00390>
- The t-Test - Statistics in a Nutshell, 2nd Edition [Book]. (n.d.). Retrieved February 15, 2020, from <https://www.oreilly.com/library/view/statistics-in-a/9781449361129/ch06.html>
- Whitley, E., & Ball, J. (2002). Statistics review 3: Hypothesis testing and P values. *Critical Care*. BioMed Central. <https://doi.org/10.1186/cc1493>