COLLÈGE D'ÉTUDES OSTÉOPATHIQUES
MANUAL PRACTICE - HALIFAX CAMPUS

STATS HELP

RESEARCH IN OSTEOPATHY

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1

AGENDA

- REVIEW OF MATERIAL
  - HYPOTHESIS/RESEARCH QUESTION
  - P-VALUE
  - STUDY DESIGNS
  - VARIABLES AND MEASUREMENTS
- DESCRIPTIVE STATISTICS
- INFERENTIAL STATISTICS
  - PARAMETRIC TESTS
  - NON-PARAMETRIC TESTS
- SAMPLE SIZE DETERMINATION
- CHOOSING MEASUREMENT INSTRUMENT/TOOL
- QUASI-EXPERIMENTAL DESIGNS
- RELIABILITY STUDIES

2

REVIEW: RESEARCH QUESTION

1. WHY DO PATIENTS SEEK OSTEOPATHIC TREATMENT?
2. DOES OSTEOPATHIC INTERVENTION X EFFECTIVELY REDUCE PATIENTS' PAIN AFTER 5 SESSIONS?
3. IS THERE AN ASSOCIATION BETWEEN THE AGE OF PARTICIPANTS AND THE NUMBER OF OSTEOPATHIC SESSIONS ATTENDED?
4. IS THERE A DIFFERENCE BETWEEN OSTEOPATIC INTERVENTION X AND INTERVENTION Y IN INCREASING THE PARTICIPANTS' QUALITY OF LIFE?
5. HOW RELIABLE IS A PARTICULAR TECHNIQUE IN DIFFERENTIATING EMPTY VS FILLED BLADDER?
6. IS THERE A CONSENSUS IN PUBLISHED STUDIES REGARDING THE EFFECTIVENESS OF INTERVENTION X?

REVIEW: HYPOTHESIS

Hypothesis = Research Question + Measurement Tool + "$p \leq 0.05$"

Examples of Hypothesis formulation:

1. Osteopathic treatment will significantly reduce the redness associated with acne as measured by infra-red photography, $p \leq 0.05$.
2. Five sessions of osteopathic intervention X will result in significant reduction in patients' pain as measured by Visual Analog Scale, $p \leq 0.05$.
3. Three trained osteopathy students at the end of their curriculum could achieve at least moderate agreement on osteopathic sacral palpatory diagnostic tests, evaluated using Fleiss K (Kappa) statistics, $p \leq 0.05$.
4. Osteopathic treatment X is more effective than osteopathic intervention Y in increasing the participants' quality of life as measured by WHOQOL questionnaire, $p \leq 0.05$.

REVIEW: HYPOTHESES AND P-VALUE

Null Hypothesis (H_0):

Osteopathic treatment **will NOT** significantly reduce the redness associated with acne as measured by infra-red photography, $p > 0.05$.

Alternative (Experimental) Hypothesis (H_1):

Osteopathic treatment **will** significantly reduce the redness associated with acne as measured by infra-red photography, $p \leq 0.05$.

$p < 0.05$	0.05	$p > 0.05$
Reject null and accept an alternative hypothesis. There is statistically significant reduction of acne skin redness as a result of osteopathic treatment.		Failed to reject the null hypothesis. There is insufficient evidence to conclude that osteopathic treatment is effective.

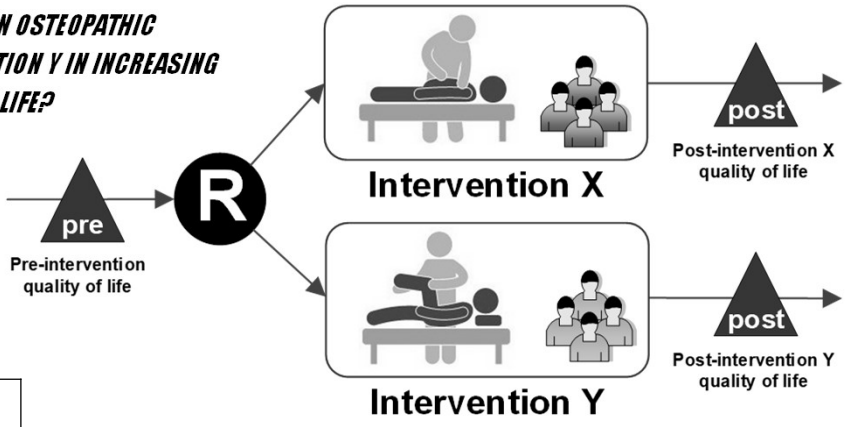
p-value

5

REVIEW: EXPERIMENTAL (RCT)

RESEARCH QUESTION:

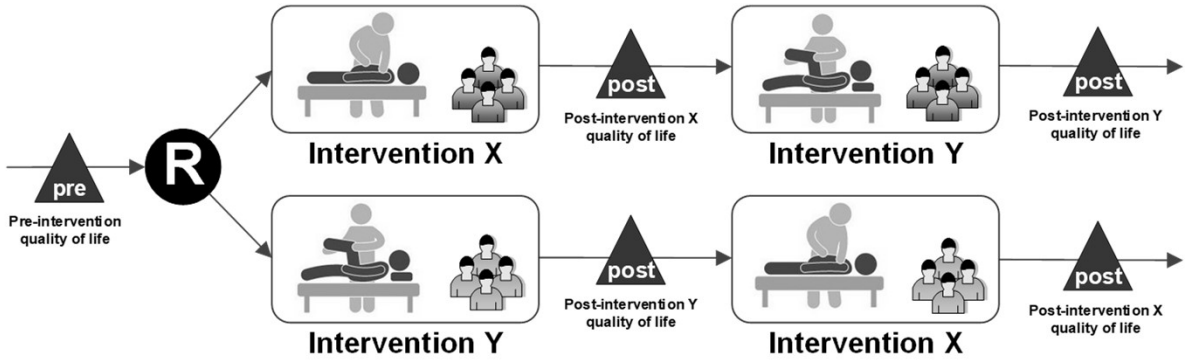
IS THERE A DIFFERENCE BETWEEN OSTEOPATHIC INTERVENTION X AND INTERVENTION Y IN INCREASING THE PARTICIPANTS' QUALITY OF LIFE?



R	O	X_1	O
R	O	X_2	O

6

REVIEW: QUASI-EXPERIMENTAL (CROSSOVER)



R	O	X_1	O	washout	O	X_2	O
R	O	X_2	O	washout	O	X_1	O

7

REVIEW: QUASI-EXPERIMENTAL (WITHIN SUBJECT)

RESEARCH QUESTION:

DOES OSTEOPATHIC INTERVENTION X EFFECTIVELY REDUCE PATIENTS' PAIN AFTER 5 SESSIONS?

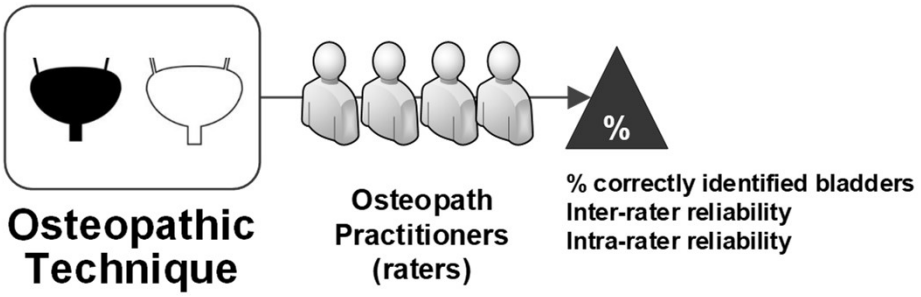
O	X	O

8

REVIEW: RELIABILITY STUDY

RESEARCH QUESTION:

HOW RELIABLE IS A PARTICULAR TECHNIQUE IN DIFFERENTIATING EMPTY VS FILLED BLADDER?



9

REVIEW: VARIABLES

Variable is a thing that changes in experiment. A variable is any factor, trait, or condition that can exist in differing amounts or types.

Independent Variable – the variable that is changed or controlled in a scientific experiment. Usually the Treatment: technique, global or regional osteopathic intervention vs control.

Dependent Variable – the outcome of interest, what we are hoping to change or alter.

Variable type: Numerical (Age) or Categorical (Gender, Group)

10

TWO AREAS OF STATISTICS

DESCRIPTIVE statistics

- SUMMARIZE SAMPLE DATA
  - MEAN, MEDIAN, MODE
  - STANDARD DEVIATION, RANGE
  - FREQUENCY, PROPORTIONS (%)
- VISUALIZE DATA IN A SAMPLE
  - HISTOGRAM
  - BAR GRAPH
  - BOX-WHISKER PLOT

INFERENTIAL statistics

- INFER/GENERALIZE RESULTS TO THE TARGET POPULATION
- CONFIDENCE INTERVALS (95% CI)
- STATISTICAL TESTS (P-VALUE)
  - PARAMETRIC VS NON-PARAMETRIC
- TYPE I AND TYPE II ERRORS

11

DESCRIPTIVE STATISTICS

Table 1
Demographic Characteristics of Subjects (N = 14)*

Variable	Treatment Group (n = 7)	Control Group (n = 7)
Age, y	82.3 ± 4.7	84.3 ± 5.6
Gender, No. (%)		
Female	6 (86)	6 (86)
Male	1 (14)	1 (14)
Race/ethnicity, No. (%)		
White	7 (100)	7 (100)
Received flu shot in past year, No. (%)		
Yes	6 (86)	7 (100)
Not known	1 (14)	0 (0)
History of dementia, No. (%)		
Yes	1 (14)	1 (17)
No	6 (86)	5 (83)

*Data are presented as mean ± SD for continuous variables and as number (percent of group) for categorical variables. Total counts may not add up to n due to missing values.

MEASURES OF CENTRAL TENDENCY

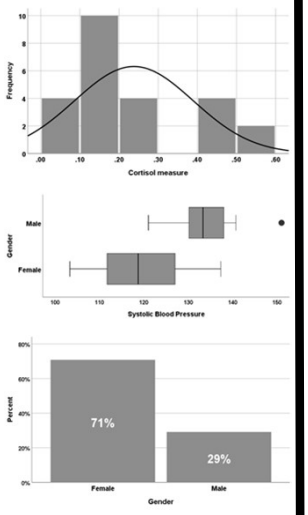
- MEAN = AVERAGE
- MEDIAN = 50/50 CUT-OFF
- MODE = MOST FREQUENT

MEASURES OF VARIABILITY

- STANDARD DEVIATION
- IQR OR RANGE

CATEGORICAL (QUALITATIVE) DATA

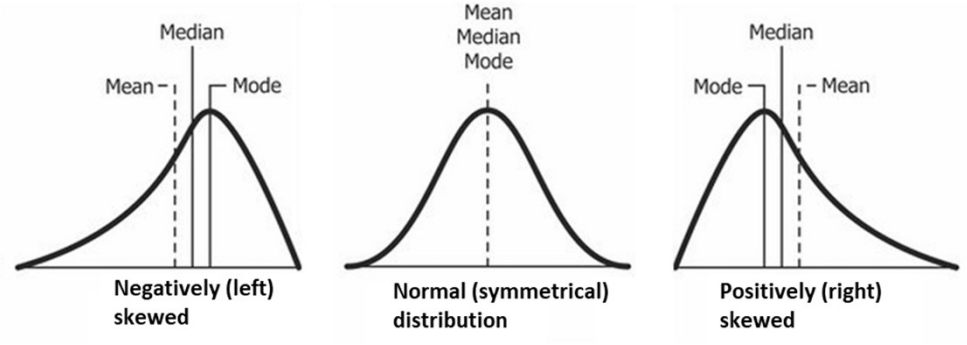
- FREQUENCY
- PROPORTIONS (%)



Reference: Donald R. Noll, Brian F. Degenhardt, Melissa Stuart, Rene McGovern & Michelle Matteson (2004). Effectiveness of a Sham Protocol and Adverse Effects in a Clinical Trial of Osteopathic Manipulative Treatment in Nursing Home Patients. JAOA vol 104 (3).

12

NORMAL DISTRIBUTION



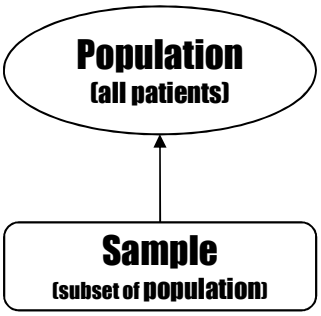
ASSESSED BY HISTOGRAMS AND COMPARING MEAN AND MEDIAN

NORMAL DISTRIBUTION IS DESIRED FOR (PARAMETRIC) STATISTICAL ANALYSIS

13

INFERENTIAL STATISTICS

HELPS US TO INFER AND GENERALIZE THE FINDINGS IN A SAMPLE (INDIVIDUAL STUDY) TO THE ENTIRE POPULATION



1) CONFIDENCE INTERVALS (CI)

- ESTIMATE POPULATION PROPORTION
- ESTIMATE POPULATION MEAN

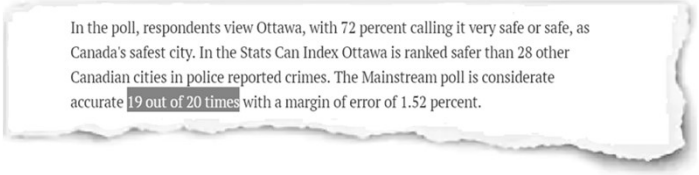
2) STATISTICAL HYPOTHESIS TESTS

- EVALUATE (SAMPLE) EVIDENCE TO MAKE CONCLUSION ABOUT UNKNOWN POPULATION CHARACTERISTIC
- COURTROOM EXAMPLE: NULL HYPOTHESIS = NOT GUILTY, ALTERNATIVE HYPOTHESIS = GUILTY

14

CONFIDENCE INTERVALS

MOST COMMONLY USED – 95% CONFIDENCE INTERVALS (CORRECT 19 OUT OF 20 TIMES)


In the poll, respondents view Ottawa, with 72 percent calling it very safe or safe, as Canada's safest city. In the Stats Can Index Ottawa is ranked safer than 28 other Canadian cities in police reported crimes. The Mainstream poll is considerate accurate 19 out of 20 times with a margin of error of 1.52 percent.

95% CI FOR POPULATION PROPORTION IS 72±1.52%
OR BETWEEN 70.48% AND 73.52%

OSTEOPATHIC EXAMPLES:

- ESTIMATING PROPORTION OF PATIENTS THAT FIND OSTEOPATHIC TREATMENT HELPFUL
- ESTIMATING RANGE OF MOTION FOR PATIENTS IN CONTROL AND EXPERIMENTAL GROUPS
- ESTIMATING AVERAGE NUMBER OF GLOBAL OSTEOPATHIC TREATMENT SESSIONS
- ESTIMATING AVERAGE CHANGE IN QUALITY OF LIFE FOR PATIENTS AFTER THE SET OF THERAPY SESSIONS

Source: http://www.digitaljournal.com/news/crime/poll-finds-almost-half-of-canadians-say-toronto-is-an-unsafe-city/article/472625

STATISTICAL HYPOTHESIS TESTS

EVALUATE (SAMPLE) EVIDENCE TO MAKE CONCLUSION ABOUT UNKNOWN POPULATION CHARACTERISTIC

STEP 1: FORMULATE NULL AND ALTERNATIVE/EXPERIMENTAL HYPOTHESES

STEP 2: CHOOSE STATISTICAL TEST AND LEVEL OF SIGNIFICANCE (USUALLY ALPHA=0.05)

- WHAT ARE INDEPENDENT AND DEPENDENT VARIABLES?
- DOES THE DEPENDENT VARIABLE FOLLOW NORMAL DISTRIBUTION? (PARAMETRIC VS NON-PARAMETRIC)
- IS RESEARCH QUESTION DIRECTIONAL? (ONE- OR TWO- TAILED TEST)

STEP 3: CALCULATE TEST STATISTICS VALUE AND CORRESPONDING P-VALUE

STEP 4: COMPARE P-VALUE WITH ALPHA AND MAKE DECISION ABOUT NULL HYPOTHESIS

STEP 2: CHOOSING STATISTICAL TEST

PARAMETRIC TESTS: ASSUME DEPENDENT VARIABLE IS (APPROXIMATELY) NORMALLY DISTRIBUTED

NON-PARAMETRIC TESTS: HAVE NO ASSUMPTIONS ABOUT DISTRIBUTION

ONE-TAILED WHEN HYPOTHESIS IS DIRECTIONAL, OTHERWISE TWO-TAILED

		Dependent variable	
		Categorical	**Numerical**
Independent variable	**Categorical**	Chi-square test Fisher's Exact (2x2 only) McNeimar test Binomial test Kappa (for reliability) Z-test for 2 proportions	One sample t-test Paired-samples t-test / Wilcoxon Signed-Rank Independent samples t-test / Mann-Whitney One-way ANOVA / Kruskal-Wallis Two-way (factorial) ANOVA Repeated measures ANOVA / Friedman
	Numerical	Binary, ordinal or multinomial logistic regression	Correlation: Pearson or Spearman Linear regression analysis Interclass correlation coefficient (for reliability)

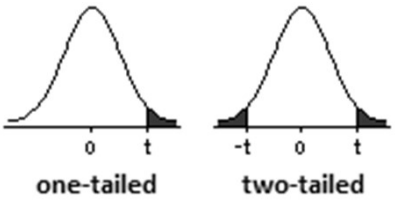
17

STEP 3: CALCULATE TEST STATISTICS

$$t = (\bar{x} - \mu_0)/(s/\sqrt{n}) \qquad z = \frac{(\hat{p}_1 - \hat{p}_2) - p_0}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \qquad \hat{p} = \frac{n_1 \hat{p}_1 + n_2 \hat{p}_2}{n_1 + n_2}$$

$$z = (\hat{p} - p_0)/\sqrt{p_0(1-p_0)/n}$$

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - \mu_0}{\sqrt{S^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \qquad S^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \qquad F = \frac{MSTR}{MSE} \qquad \chi^2 = \Sigma \frac{(f_o - f_e)^2}{f_e}$$



Can use formula or statistical software to calculate (Excel, SPSS, STATA, R)

Test statistics value indicate amount of evidence against null hypothesis (in favour of alternative)

P-value is the "*tail*", it's probability of observing a sample (like ours) if null hypothesis was true

Larger test statistics → smaller p-value (tail) → more evidence against null → more likely null is false

18

STEP 4: P-VALUE AND DECISION

Null Hypothesis (H_0):

Osteopathic treatment **will NOT** significantly increase the number of headache free days per week assessed by headache dairy, $p > 0.05$.

Alternative (Experimental) Hypothesis (H_1):

Osteopathic treatment **will** significantly increase the number of headache free days per week assessed by headache dairy, $p \leq 0.05$.

$p < 0.05$ | 0.05 | $p > 0.05$

Reject null and accept an alternative hypothesis.

There is statistically significant increase in number of headache free days as a result of osteopathic treatment.

Failed to reject the null hypothesis.

There is insufficient evidence to conclude that osteopathic treatment is effective.

p-value

Source: Rosemary Anderson & Caryn Seniscal (2006). A comparison of selected osteopathic treatment and relaxation for tension-type headaches. American Headache Society, doi: 10.1111/j.1526-4610.2006.00535.x

19

TYPE I AND TYPE II ERRORS

Null Hypothesis (H_0): Osteopathic treatment IS NOT effective.
Alternative (Experimental) Hypothesis (H_1): Osteopathic treatment IS effective.

		Reality (The Truth)	
		Osteopathic treatment IS NOT effective (H_0 is true)	Osteopathic treatment IS effective (H_0 is false)
Hypothesis test conclusion (based on collected sample)	p-value > α: Osteopathic treatment IS NOT effective	Correct [1-α]	Type II error [β] false negative
	p-value ≤ α: Osteopathic treatment IS effective	Type I error [α] false positive	Correct [1-β] power of the test

Type I error = α = level of statistical significance (usually 0.05, chosen by researcher)
Type II error = β (usually around 20%)
Statistical power = 1- β = probability of finding effect if it really exists (desired to be at least 80%)

20

UNDERSTANDING RESEARCH ARTICLES

Table 1.—Headache Measures-Comparison of Means and *t*-Tests

	Group	N	Std. Mean	Range Deviation	Range Minimum	Maximum	*t*-Value	Sig. df	2-tailed
HA free days per week									
	C	12	.21 days	1.685 days	−3	4	−2.589	24	.016
	E	14	1.79 days	1.424 days	−1	4			
	Total	26	1.06 days	1.717 days	−3	4			
HA degree of improvement									
	C	12	.656	1.953	−2.58	2.36	−1.860	24	.075
	E	14	1.881	1.394	.00	4.46			
	Total	26			−2.58	4.46			

C = control group; E = experimental group.

Source: Rosemary Anderson & Caryn Seniscal (2006). A comparison of selected osteopathic treatment and relaxation for tension-type headaches. American Headache Society, doi: 10.1111/j.1526-4610.2006.00535.x

21

UNDERSTANDING RESEARCH ARTICLES

Table 2 Comparison of the VAS, MOV and ROM values between OMT and CCT groups ($n = 25$) at T0, T1 and T2.

		OMT		CCT		*t*	*P*
T0	VAS[a]	6.9	±0.88	6.40	±1.42		NS
	MOV[b]	35.1	±4.36	34.9	±34.5		NS
	ROM[c]	62.4	±10.67	64.5	±9.55		NS
T1	VAS[a]	1.5	±0.85	2.6	±0.7	−4.995	0.000
	MOV[b]	46.0	±4.78	41.3	±4.52	3.572	0.000
	ROM[c]	81.9	±10.31	71.9	±9.05	3.654	0.000
T2	VAS[a]	3.8	±1.26	4.4	±1.75		NS
	MOV[b]	42.9	±2.69	40.4	±2.41	3.461	0.001
	ROM[c]	80.5	±5.44	72.4	±2.95	6.545	0.000

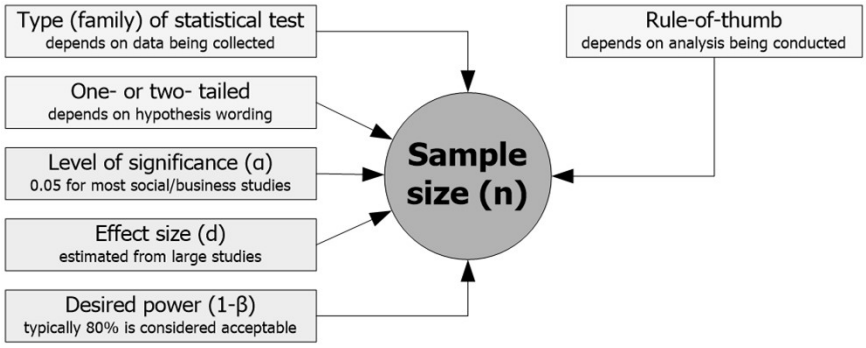
[a] The visual analogue pain scale was scored from 0 to 10.
[b] Measure in millimeters.
[c] Measure in degrees.

Source: A.M. Cuccia et al. Osteopathic manual therapy versus conventional conservative therapy in the treatment of temporomandibular disorders: A randomized controlled trial. Journal of Bodywork & Movement Therapies (2010) 14, 179-184
https://pdfs.semanticscholar.org/849d/3c122af15a27b3dc59de93a76dde196e52a4.pdf

22

SAMPLE SIZE DETERMINATION

Level of significance (Type I error) – chance of finding effect if it does not exist
Effect size – expected amount of change in dependent variable (treatment effect)
Statistical power – credibility of the test, chance of finding effect if it does exist



http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/download-and-register

HOW DO I KNOW EFFECT SIZE?

Approaches to determine effect size:

- Previous (published) studies with similar research question
  - similar Population, Intervention, Outcome
  - look for numbers to quantify effect size (mean, standard deviation, %)
- Pilot study conducted with small group of participants ($n < 10$)
- Based on practical significance
  - Clinically important change, Minimal Important Difference (MID)
- Assume to be medium effect (*Cohen's d* = 0.5)

FINDING PUBLISHED STUDIES

- GOOGLE SEARCH (START WITH GOOGLE SCHOLAR)
- PREVIOUS YEARS CCO STUDENTS' THESIS
- THE JOURNAL OF THE AMERICAN OSTEOPATHIC ASSOCIATION
  HTTP://JAOA.ORG/
- INTERNATIONAL JOURNAL OF OSTEOPATHIC MEDICINE
  HTTP://WWW.JOURNALOFOSTEOPATHICMEDICINE.COM/
- THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE
  HTTPS://WWW.LIEBERTPUB.COM/LOI/ACM
- INTERNATIONAL JOURNAL OF OCCUPATIONAL MEDICINE AND ENVIRONMENTAL HEALTH
  HTTP://IJOMEH.EU/
- INTERNATIONAL JOURNAL OF PHYSIOTHERAPY
  HTTPS://WWW.IJPHY.ORG/

Google Scholar

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25

SAMPLE SIZE – RULES-OF-THUMB

Experimental:	**Minimum 12**
Quasi-Experimental:	**Minimum 16**
Reliability Studies:	**Minimum 40**
Technique Studies:	**Minimum 24**

Final notes on sample size:

- For multiple groups, aim for **balanced** design (equal number of participants in each group).
- Account for **non-response rate** during recruitment.
- Account for **attrition/drop-out rate** during the study.

26

PILOT STUDIES / PRE-STUDIES

Pre-study is a *small (preliminary)* study undertaken before *large* one.

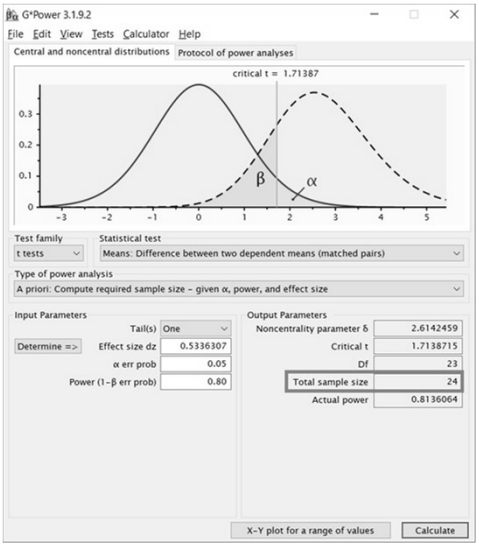
- Applicable when no previous studies are available on the research topic
- **Feasibility** assessment to validate
  - study design and research protocol
  - subjects recruitment strategy, consent rate, dropout rate
  - treatment, intervention
  - outcome measures, instruments, measurement/assessment tools
- Helpful to explore the effect size and determine sample size needed for a large study
- Recommendations for future large-scale study

SAMPLE SIZE DETERMINATION EXAMPLE

Research Question:

A global osteopathic treatment will increase urinary pH levels, as measured using urine test strips.

- crossover design
- "increase" → one-tail test
- literature search → Buscemi et al. (2015) study reported effect size
- G*Power calculation → 24 subjects
- 10% dropout rate → 27 subj to recruit

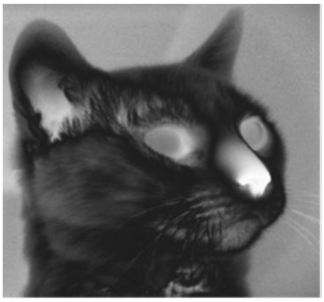


Reference: Buscemi, A., Carbone, J., Tacchi, M., Buttafuoco, S., Rapisarda, A., Perciavalle, V., & Coco, M. (2015). Changes of urine pH after the compression of the fourth ventricle. Medicina, Ricerche, Scienza della vita, Retrieved from http://www.scienza-ricerche.it/

MEASUREMENTS

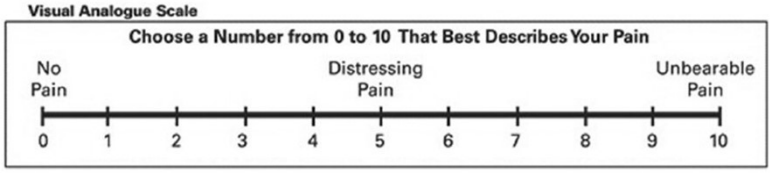
Measurement is a variable that is being assessed (quantified / measured) using a particular technique, tool or instrument.

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m}^2\text{)}}$$



In the last 4 weeks have you	No Problem	Slight Problem	Moderate Problem	Marked Problem	Extreme Problem
1. Had difficulty moving?	☐	☐	☐	☐	☐
2. Had difficulty walking?	☐	☐	☐	☐	☐
3. Had problems with your balance?	☐	☐	☐	☐	☐
4. Had difficulty standing up without support?	☐	☐	☐	☐	☐
5. Had difficulty speaking?	☐	☐	☐	☐	☐

Visual Analogue Scale



29

MEASUREMENT INSTRUMENT/TOOL

Examples:

Strain	→ **Strain gauge**
Angle	→ **Goniometer** (manual or digital)
Acceleration (3-axis)	→ **Accelerometer** (Fitbit or less expensive alternatives)
Ground reaction force	→ **Force platform/plate**
Object thickness	→ **Caliper**
Time interval	→ **Stopwatch** (iPhone has one built-in)
Weight	→ **Scale**

Clinical measurements (pulse, blood pressure, temperature, respiratory rate)

Ensure sufficient level of **accuracy/precision** and **range**

30

MEASUREMENT INSTRUMENT/TOOL

Google Scholar

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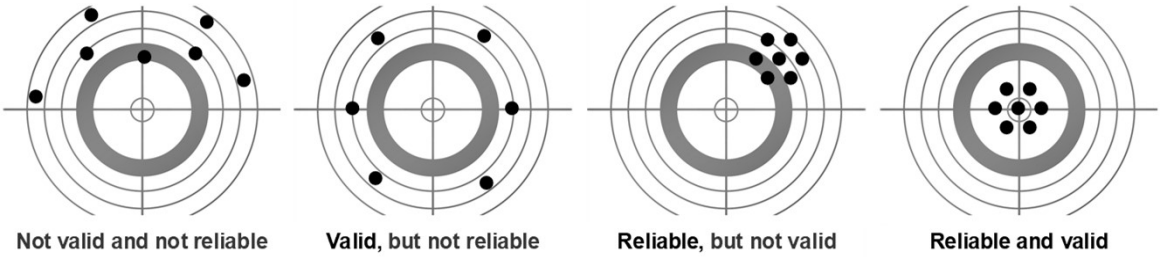
Examples:

Tinnitus symptoms	→ **Tinnitus Handicap Inventory** (THI)
Quality of life	→ **Quality of Life Scale** (QOLS) questionnaire
Pain	→ **Visual Analog Scale** (VAS)
Feet functioning	→ **Foot and Ankle Survey** (FAOS) or **Foot Functioning Index** (FFI)

Good instrument is both **Reliable** and **Valid** (validated).

31

INSTRUMENT RELIABILITY AND VALIDITY



Not valid and not reliable | **Valid**, but not reliable | **Reliable**, but not valid | **Reliable and valid**

32

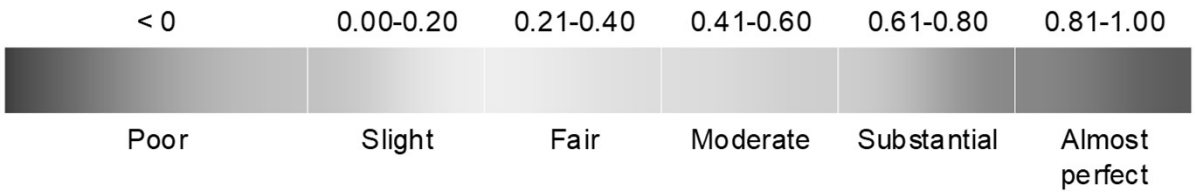
INSTRUMENT RELIABILITY AND VALIDITY

Reliability:

Internal consistency reliability (Cronbach's α > 0.8)
Test-retest reliability correlation (r > 0.7)
Inter-rater (inter-observer) reliability (Kappa > 0.4 or interclass correlation coefficient > 0.7)

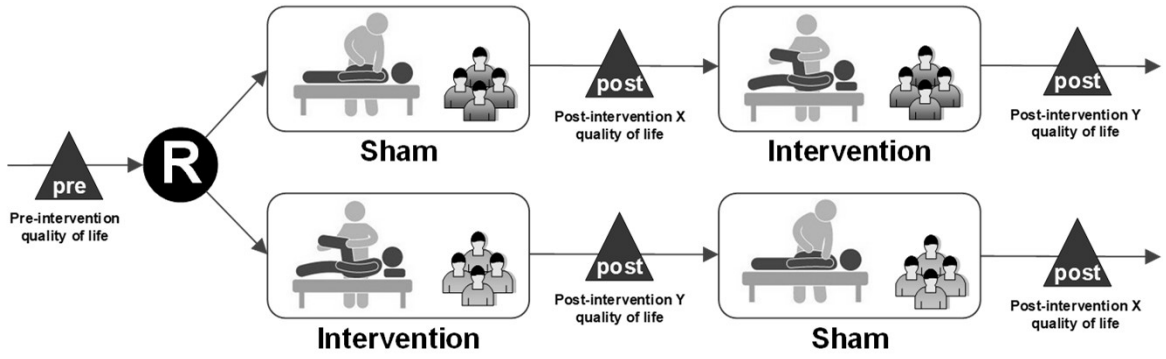
Validity:

Correlation with "gold standard" instrument (r > 0.7)
Overall accuracy with respect to actual state (diagnostic accuracy, sensitivity, specificity, PPV, NPV)



33

QUASI-EXPERIMENTAL (CROSSOVER)



R	O		O	washout	O	X	O
R	O	X	O	washout	O		O

34

QUASI-EXPERIMENTAL (WITHIN SUBJECT)

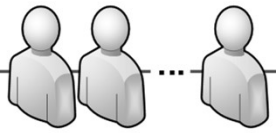
O	X	O						
O_1	O_2	O_3	X	O_4	O_5	O_6		
O_1	X_1	O_2	O_3	X_2	O_4	O_5	X_3	O_6

RELIABILITY/VALIDITY/PALPATION STUDIES

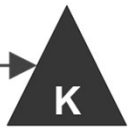
- Practical aspects
  - Live patients or objects (models)
  - Repeated trials to make a diagnosis
- Benefits
  - Relative simplicity in design
  - Contribution to osteopathic profession
  - Improving manual skills
  - Osteopathic students as study participants

RELIABILITY STUDY EXAMPLE

Assessment or Diagnostic Tool



Osteopath Practitioners (raters)



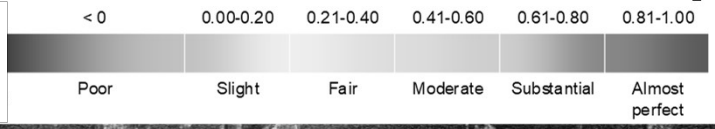
Inter-rater reliability
Intra-rater reliability

Example:

Consorti et al. (2017) study explored inter-rater reliability of Osteopathic Sacral Palpatory Diagnostic Test using 52 patients and 3 trained osteopathy students (raters). Fleiss Kappa ranges between 0.06 to 0.34 (Table 3).

Categorical outcomes:
Cohen's Kappa (2 raters), Fleiss Kappa (3+ raters)

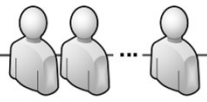
Numerical outcomes:
Cronbach's α, Interclass Correlation Coefficient



37

VALIDITY STUDY EXAMPLE

Osteopathic Palpation Technique



Osteopath Practitioners (raters)

Overall accuracy Sensitivity, NPV, Specificity, PPV

True State (X-Ray, Ultrasound, patient report)

Examples:

- **Assessing accuracy of palpation technique to differentiate between empty and filled bladders**
- **Using wax blocks to assess participants' skills in differentiating two heights (Christopher Reiach study)**
- **Evaluating palpation technique to determine knee problems (validate through radiographs)**
- **Palpation sensitivity study using a hydrodynamic model (Monica Noy project)**

Categorical outcomes:
Overall accuracy, sensitivity, specificity, NPV, PPV

Numerical outcomes:
Correlation coefficient, mean absolute error

38

PALPATION STUDY EXAMPLE

Intervention examples:

- Feedback when using wax blocks
- Take home models to self-practice palpation skills
- Workshops with group practice sessions

39

TRAINING STATION FOR SURGEONS

Presented with the permission of Dr. Ilay Habaz and Dr. Eran Shlomovitz (University Health Network)

40

STUDENTS' RESEARCH

- Proposal (PICO statement)
  - P = patient/problem (research question)
  - I = intervention (experiment design)
  - C = comparison (control)
  - O = outcome (validated instrument to measure)

STUDENTS' RESEARCH – PARTICIPANTS

Recruitment of study participants

- Specialized clinics
- Osteopathic practices
- Social media (Facebook, LinkedIn, Twitter)
  - Post message on your own page
  - Ask friends to re-post your message on their pages
  - Join relevant Facebook group
  - Paid advertisement
- Kijiji and other online posting sites

QUESTIONS? COMMENTS? THOUGHTS?

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Research Proposals | Sample Size Calculation | Methodology/Design | Statistical Data Analysis | Interpretation