

世代研究的描述性統計 (2)

醫學研究部生統小組

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2025/11/25

醫學研究常用統計

Table 2. Percentage of articles in corpus ($N = 113,450$) citing the following 16 Delphi panel–derived statistical methods groups

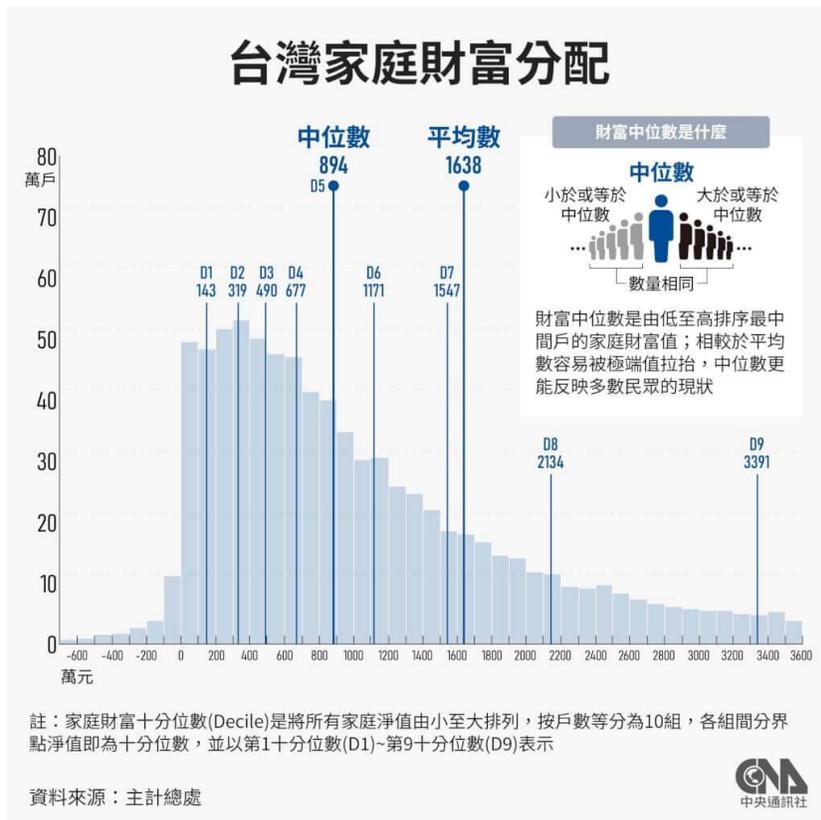
Method groups	Percentage of articles citing specific method group overall and by strata				Relative percent change in method group over time ^a			Examples of commonly occurring terms in each statistical method group
	Overall ^b	95-05 ^c	06-10 ^d	11-15 ^e	06-10 vs. 95-05 ^f	11-15 vs. 06-10 ^g	11-15 vs. 95-05 ^h	
Numeric summary measures	96.4	92.8	96.4	96.8	3.9	0.4	4.3	Average, mode, percentage, standard deviation
Epidemiological measures of risk/effect	53.5	38.0	52.3	55.7	37.5	6.5	46.5	Prevalence, incidence, odds ratio, hazard ratio
Statistical inference concepts	52.9	36.4	52.1	55.0	43.2	5.7	51.4	<i>P</i> -value, confidence interval, multiple comparisons
Epidemiological concepts of classification	40.1	43.7	39.8	39.9	−9.0	0.2	−8.8	Sensitivity, specificity, ROC curve
Specific hypothesis test	28.8	23.8	29.0	29.2	21.8	0.7	22.7	<i>t</i> -test, Fisher exact test, chi-square test
ANOVA	23.2	14.9	22.2	24.4	49.0	9.8	63.6	ANOVA, ANCOVA, RMANOVA
Regression	22.6	11.9	21.6	24.1	82.1	11.5	103.0	Linear, logistic, poisson regression
Graphics	8.8	8.5	8.7	8.8	2.7	1.3	4.0	Histogram, scatter plot, box plot
Survival analysis	6.8	3.0	6.6	7.3	123.2	11.0	147.6	Cox regression, Kaplan–Meier
Missing data	6.8	2.4	5.9	7.6	148.4	28.0	217.9	Missing data, multiple imputation, LOCF
Computationally intensive algorithms	6.3	3.8	6.2	6.5	63.5	4.5	70.9	Simulation, bootstrap, Monte Carlo, MCMC
Multivariate methods	5.9	3.1	5.5	6.4	73.6	16.6	102.5	Cronbach α , factor analysis, PCA, cluster analysis
Correlated data analysis	4.1	1.6	3.7	4.6	137.3	23.1	192.2	GEE, LMM, GLMM, multilevel model
Machine learning	3.1	1.8	3.0	3.3	66.0	9.9	82.5	Lasso, wavelet, neural network
Time series	1.4	0.9	1.3	1.5	48.8	12.0	66.7	ARIMA, forecasting, spectral analysis
Causal inference observational studies	1.0	0.2	0.8	1.2	268.3	57.8	481.2	Propensity score, instrumental variable

Data type/Statistical method

Data type	Two groups		Three groups	Correlation
	獨立樣本	相依樣本	獨立樣本	
Continuous				
-parametric	Independent T-test	Paired T-test	ANOVA	Pearson correlation
-nonparametric	Mann-Whitney U test	Wilcoxon signed-rank test	Kruskal-Wallis test	Spearman rank correlation

Mean / Median

➤ 平均數易受到極端值的影響



➤ 無母數原理

Caseno	Height	Rank	Group
1	212	9	1
2	151	1	1
3	155	4	1
4	159	8	1
5	152	2	2
6	153	3	2
7	156	5	2
8	157	6	2
9	158	7	2

Parametric vs Non-parametric test

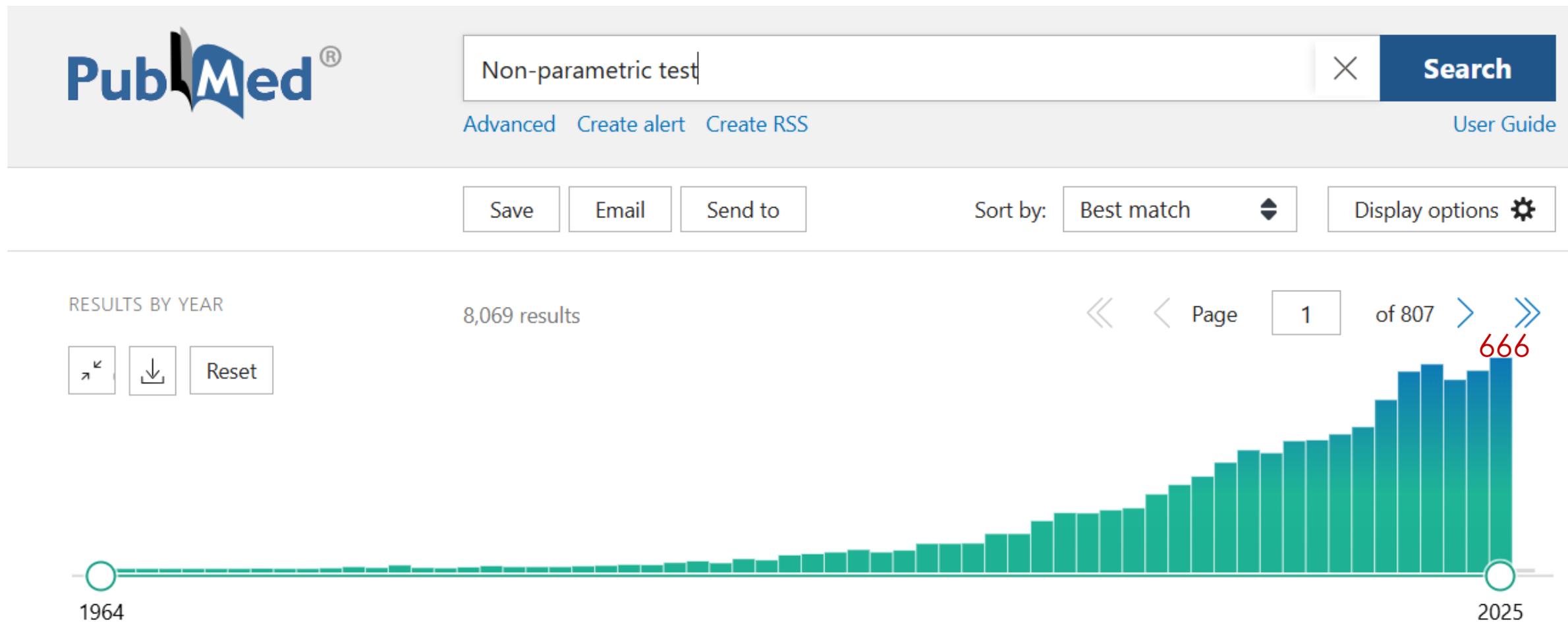
Parametric test

- 優點
 - Power較高
 - 以真實觀察值統計
- 缺點
 - 需要常態分佈
 - 樣本數大
 - 容易有測量誤差

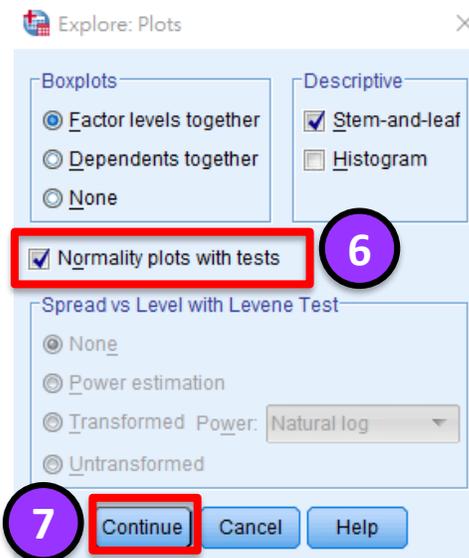
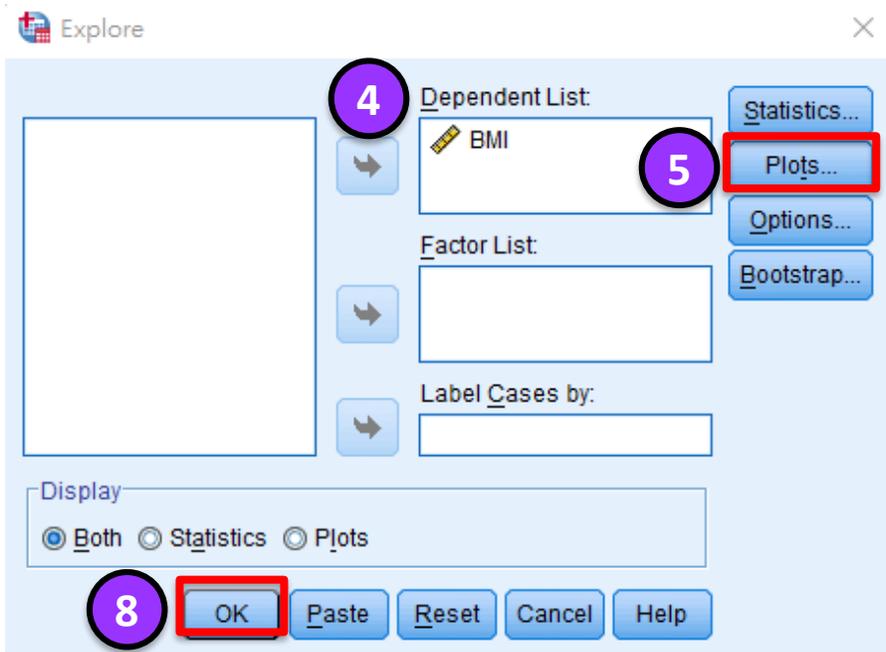
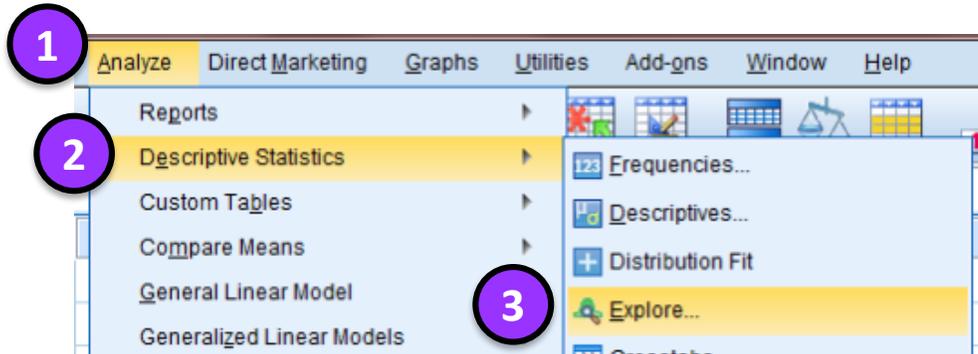
Non-parametric test

- 優點
 - 不需要為常態分佈
 - 樣本數小
 - 對於測量誤差較不敏感
- 缺點
 - Power較低，且需要較多樣本數才能達顯著差異
 - 計算依據Rank而非真實數值

Pubmed non-parametric test



分析>描述性統計>探索



Test of Normality

	N>50 Tests of Normality			N<50		
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
BMI	.076	40	.200 [*]	.981	40	.710

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

$p < 0.05$ 代表資料呈非常態分佈

Two groups-獨立樣本

Independent T-test

- 檢定兩組的平均數是否有顯著不同
- 資料需符合常態分佈

Mann-Whitney U test

- 檢定兩組的中位數是否有顯著不同
- 小樣本且資料不符合常態分佈

Independent T-test example

- Independent variable : Male and Female (Two groups)
- Dependent variable : BMI 、 Height and Weight.... (Continuous)

J Nutr Health Aging. 2020;24(6):650-658

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PREDICTING NEW-ONSET DIABETES MELLITUS BY COMPONENT COMBINATIONS OF PREMORBID METABOLIC SYNDROME AMONG OLDER ADULTS IN TAIWAN

C.-S. LIN^{1,2,3,4}, W.-J. LEE^{4,5,6}, S.-Y. LIN^{2,6}, H.-P. LIN⁷, R.-C. CHEN^{6,7}, C.-H. LIN⁷, L.-K. CHEN^{4,6,8}

Table 1
Demographic data of study participants

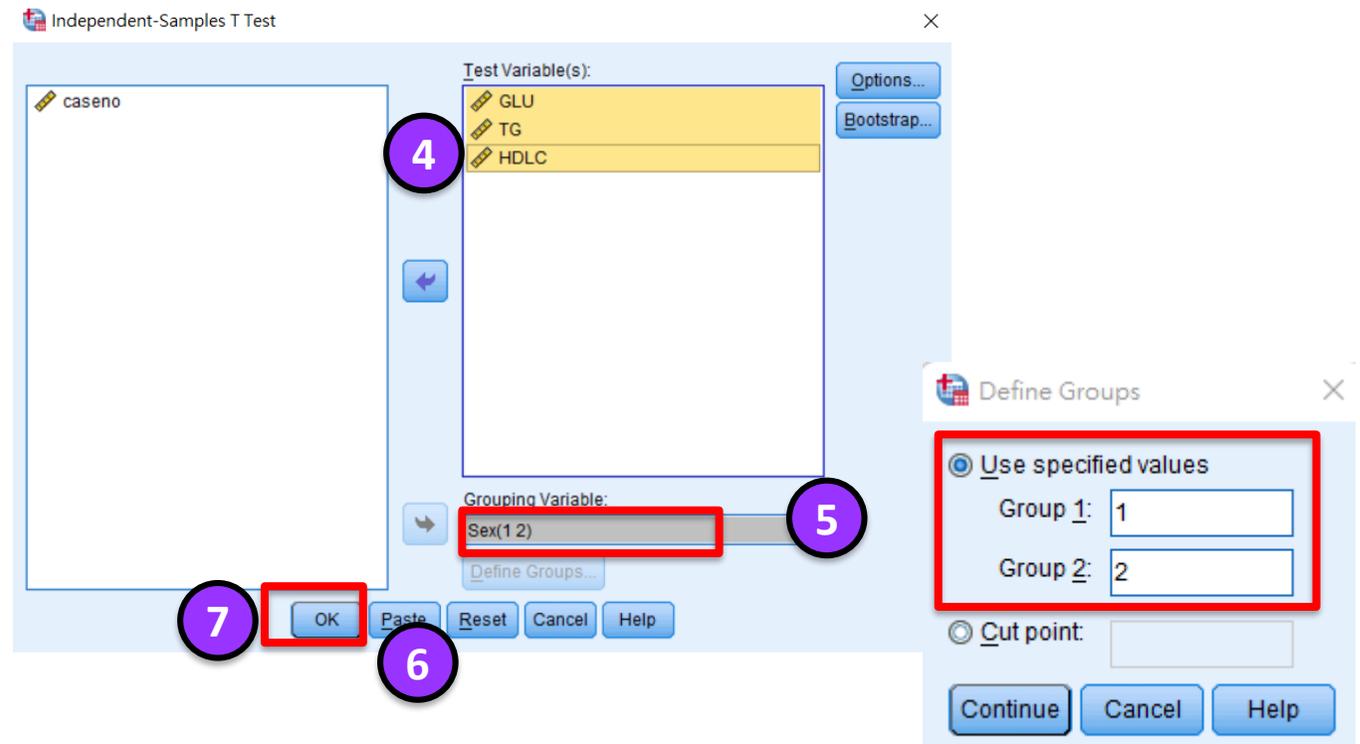
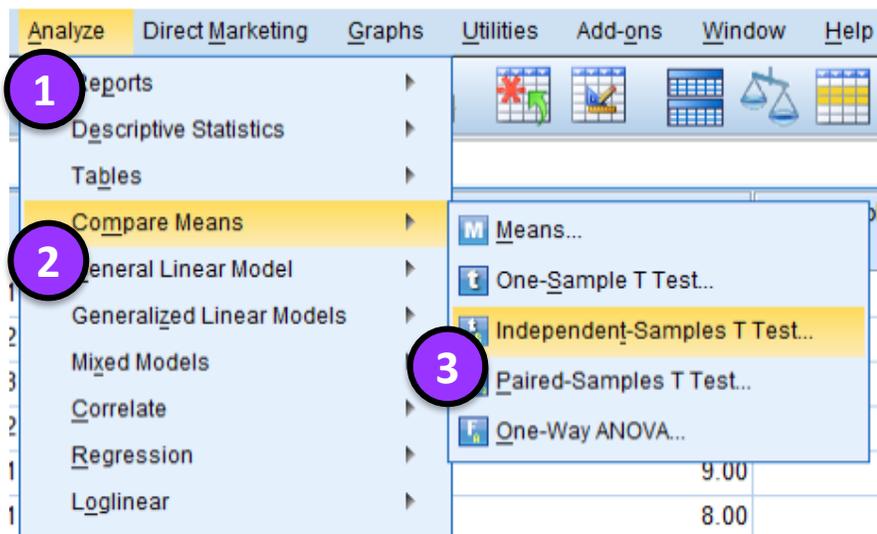
	Total (n=29164) n%	Male (n=12331) n%	Female (n=16833) n%	p value
Fasting plasma glucose (mg/dl)	107.38±31.87	107.69±32.46	107.15±31.43	0.155
Triglycerides (mg/dl)	122.82±76.57	118.75±78.45	125.80±75.02	<0.001**
HDL cholesterol (mg/dl)	55.64±18.10	51.43±15.88	58.72±18.98	<0.001**

Independent T-test SPSS dataset

caseno	Sex	GLU	TG	HDLC
10	1	98.00	139.0	35.0
11	1	93.00	113.0	38.0
12	1	76.00	74.0	39.0
13	1	96.00	149.0	39.0
14	1	92.00	128.0	37.0
15	1	98.00	95.0	39.0
16	2	95.00	138.0	46.0
17	2	94.00	146.0	46.0
18	2	88.00	101.0	46.0
19	2	98.00	110.0	37.0
20	2	99.00	143.0	41.0
21	2	99.00	71.0	39.0
22	2	97.00	128.0	43.0

Independent T-test SPSS analysis

分析>比較平均數法>獨立樣本T檢定



Independent T-test SPSS output

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
GLU	1	12331	107.6853	32.45993	.29231
	2	16833	107.1483	31.42916	.24224
TG	1	12331	118.749	78.4492	.7065
	2	16833	125.805	75.0194	.5782
HDLC	1	12331	51.432	15.8843	.1430
	2	16833	58.720	18.9806	.1463

在TG的部分，
女性和男性有統計差異
女性平均高於男性($p < 0.001$)

Levene檢定

- 變異數相同($p > 0.05$)
- 變異數不相同($p < 0.05$)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
GLU	Equal variances assumed	.464	.496	1.421	29162	.155	.53698	.37776	-.20344	1.27740
	Equal variances not assumed			1.414	26072.906		.53698	.37964	-.20714	1.28110
TG	Equal variances assumed	.009	.923	-7.783	29162	.000	-7.0560	.9066	-8.8331	-5.2789
	Equal variances not assumed			-7.729	25876.449		-7.0560	.9129	-8.8454	-5.2666
HDLC	Equal variances assumed	41.955	.000	-34.662	29162		-7.2876	.2103	-7.6997	-6.8755
	Equal variances not assumed			-35.618	28651.285	.000	-7.2876	.2046	-7.6887	-6.8866

Mann-Whitney U test example

- Independent variable : Grade 0 and Grade 1 & 2 (Two groups)
- Dependent variable : Global alignment angle、Shell angle and Lordotic angle..(Continuous)



The Spine Journal 20 (2020) 1211–1218

Clinical Study

Anterior bone loss after cervical Bryan disc arthroplasty:
insight into the biomechanics following total disc
replacement

Tse-Yu Chen, MD^a, Wen-Hsien Chen, MD^{b,c},
Chung-Yuh Tzeng, MD, PhD^{d,e}, Chi-Wei Huang, MD^a,
Chih-Chang Yang, MD^a, Hsien-Te Chen, MD, PhD^{f,g,h},
Chien-Chun Chang, MD^{g,h,i}, Cheng-Ying Lee, MD^a,
Hsi-Kai Tsou, MD, PhD^{j,k,l,*}

THE
SPINE
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Table 2
Anterior bone loss of the upper adjacent level by grade

	Grade 0 (n=68)		Grades 1 & 2 (n=53)		p Value
Sex					.828
Female	32	(47.1%)	23	(43.4%)	
Male	36	(52.9%)	30	(56.6%)	
Age, years	50.5	(44.3, 56.0)	49.0	(43.5, 60.5)	.599
Operative level					.338
C3–4	6	(8.8%)	1	(1.9%)	
C4–5	20	(29.4%)	20	(37.7%)	
C5–6	38	(55.9%)	30	(56.6%)	
C6–7	4	(5.9%)	2	(3.8%)	
Hybrid					.688
No	37	(54.4%)	26	(49.1%)	
Yes	31	(45.6%)	27	(50.9%)	
Global alignment angle	15.0	(7.0, 22.8)	19.0	(9.0, 26.0)	.218
Shell angle	5.0	(1.3, 8.0)	7.0	(4.0, 10.5)	.026*
Lordotic angle	4.9	(–0.0, 8.8)	4.6	(–0.7, 9.7)	.878
Mean degree of angle of the endplate with horizontal line	–16.2	(–20.3, –11.8)	–15.5	(–18.5, –11.2)	.349
Global ROM	40.0	(35.0, 55.0)	45.0	(38.0, 53.0)	.226
Index level ROM	9.0	(6.0, 13.0)	10.0	(5.0, 14.0)	.593

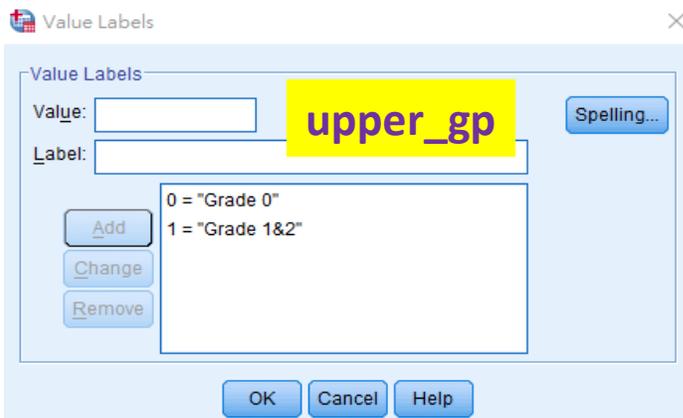
Chi-square test, Mann-Whitney *U* test, Median (interquartile range).

ROM, range of motion.

* $p < .05$.

Mann-Whitney U test SPSS dataset

age	upper_gp	GA	SA	ROMG	ROMADR
57	.00	.0	8.0	2.0	2.0
58	.00	16.0	13.0	35.0	14.0
55	1.00	22.0	7.0	49.0	9.0
48	1.00	33.0	16.0	63.0	8.0
64	.00	37.0	10.0	39.0	3.0
49	1.00	9.0	4.0	63.0	14.0
56	.00	47.0	15.0	45.0	13.0
61	1.00	19.0	11.0	6.0	3.0
70	1.00	20.0	4.0	41.0	14.0
47	.00	15.0	7.0	35.0	6.0



Note

GA: Global alignment angle

SA: Shell angle

ROMG: Global ROM

ROMADR: Index level ROM

Mann-Whitney U test SPSS analysis-1

分析>無母數檢定>歷史對話記錄
>2個獨立樣本

The screenshot shows the SPSS 'Analyze' menu with the following items:

- Reports
- Descriptive Statistics
- Tables
- Compare Means
- General Linear Model
- Generalized Linear Models
- Mixed Models
- Correlate
- Regression
- Loglinear
- Neural Networks
- Classify
- Dimension Reduction
- Scale
- Nonparametric Tests** (highlighted)
- Forecasting
- Survival
- Multiple Response
- PS Matching
- Missing Value Analysis...
- Multiple Imputation
- Complex Samples
- Simulation...
- Quality Control
- ROC Curve...

The 'Nonparametric Tests' sub-menu is open, showing:

- One Sample...
- Independent Samples...
- Related Samples...
- Legacy Dialogs** (highlighted)

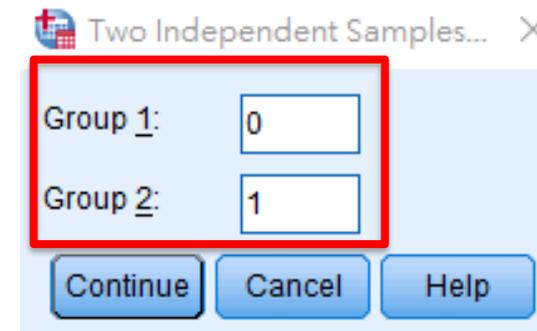
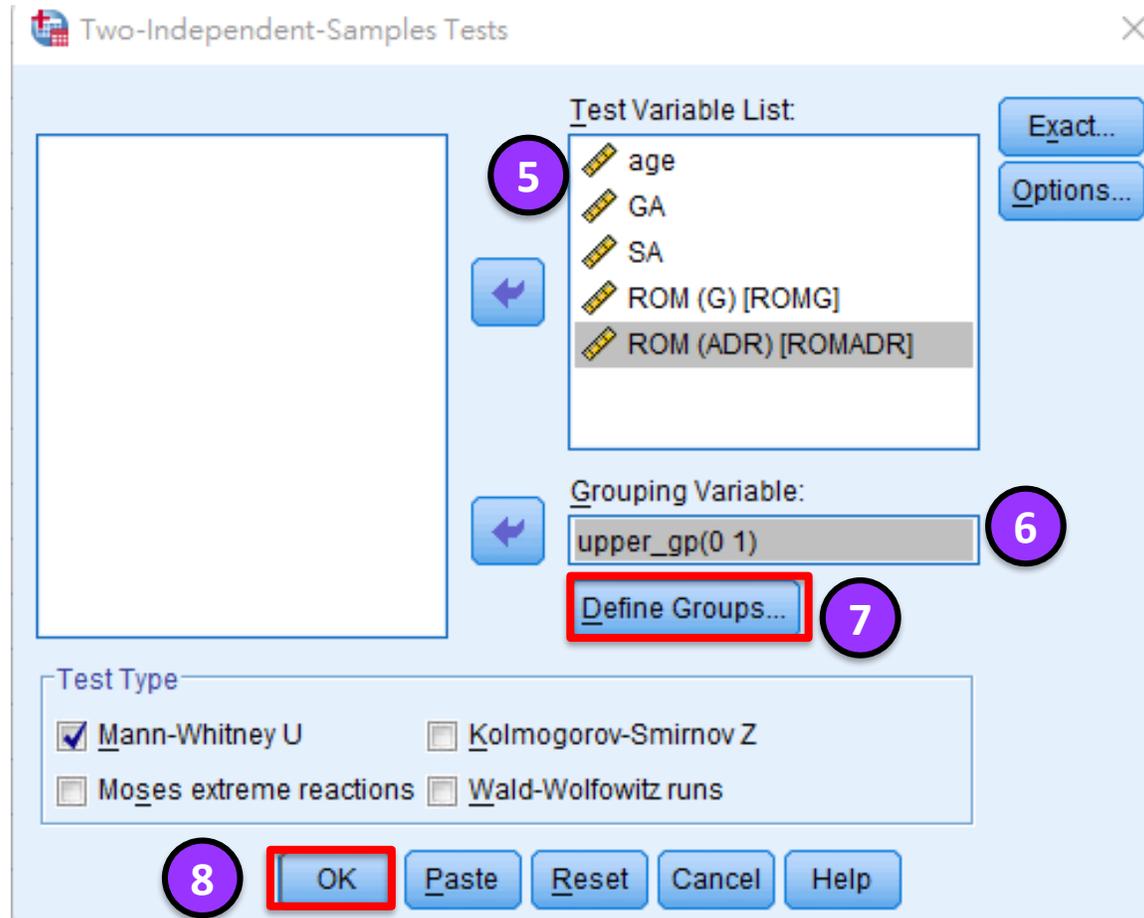
The 'Legacy Dialogs' sub-menu is open, showing:

- Chi-square...
- Binomial...
- Runs...
- 1-Sample K-S...
- 2 Independent Samples...** (highlighted)
- K Independent Samples...
- 2 Related Samples...
- K Related Samples...

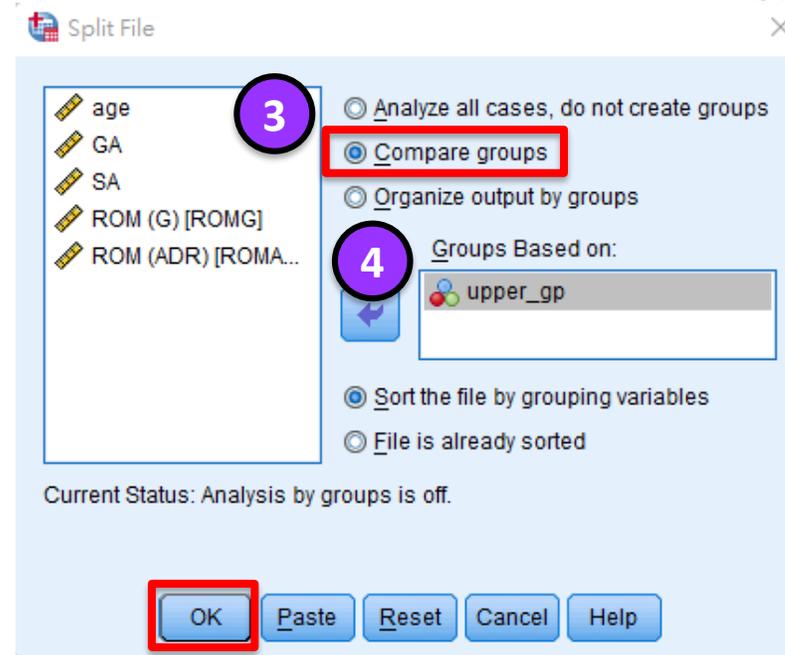
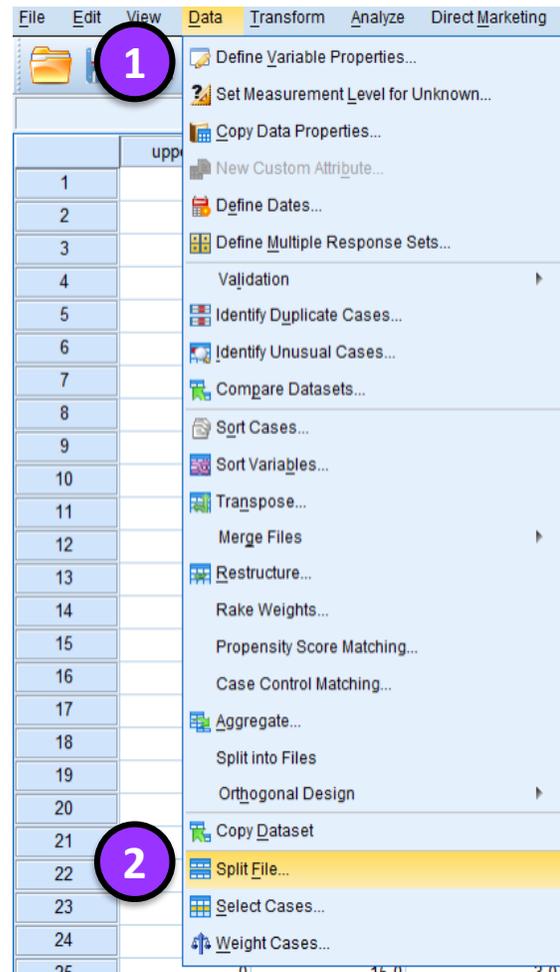
The background data grid shows the following data:

IG	ROMADR	var	var	var
2.0		2.0		
35.0		14.0		
49.0		9.0		
63.0		8.0		
39.0		3.0		
63.0		14.0		
45.0		13.0		
6.0		3.0		
41.0		14.0		
35.0		6.0		
23.0		4.0		
27.0		5.0		
59.0		13.0		
46.0		11.0		
65.0		10.0		
16.0		8.0		
18.0		4.0		
43.0		9.0		
55.0		10.0		
17.0		8.0		
		50.0		
		19.0		

Mann-Whitney U test SPSS analysis-2

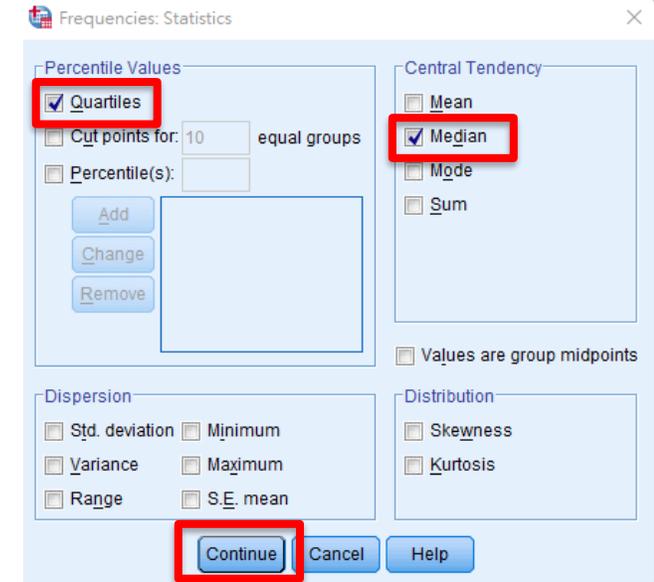
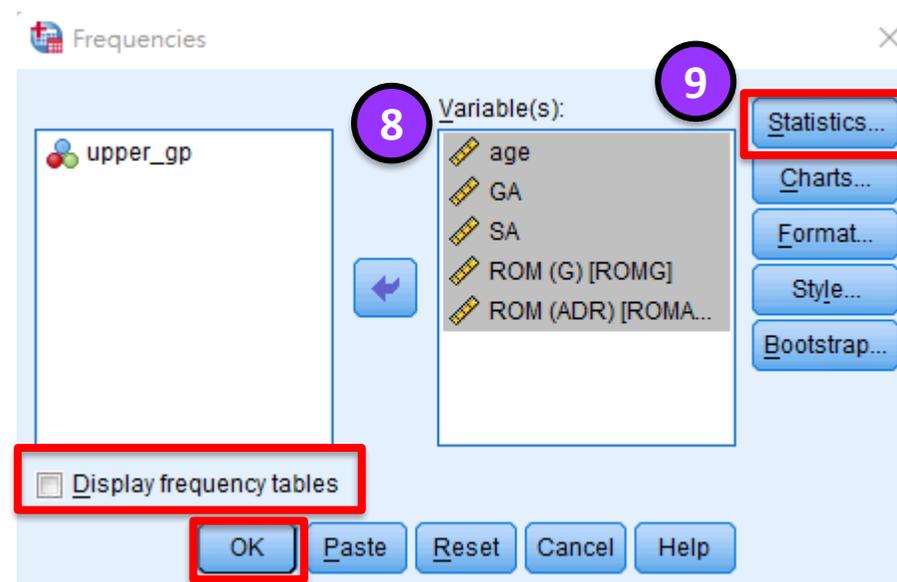
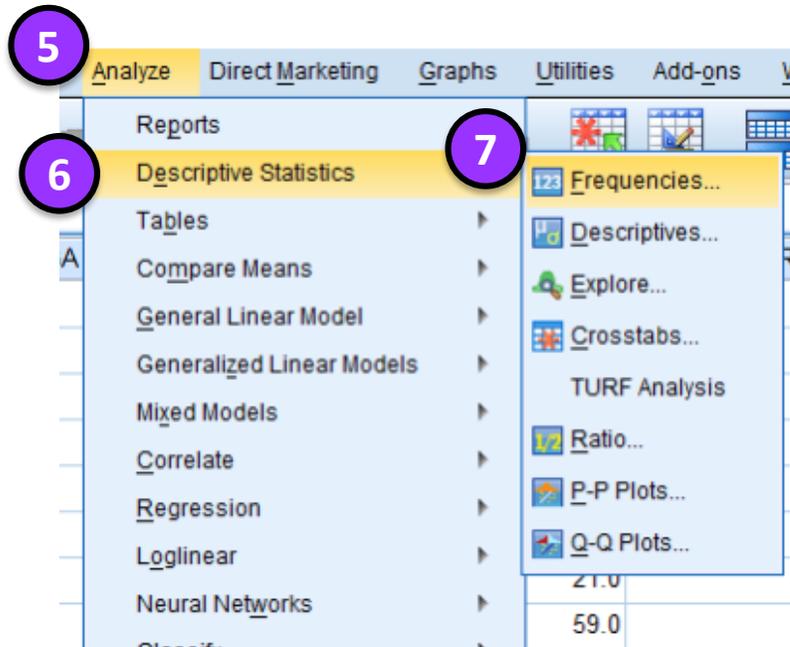


資料>分割檔案

Mann-Whitney U test SPSS
analysis-3

Mann-Whitney U test SPSS analysis-4

分析>描述性資料>次數分配表



Mann-Whitney U test SPSS output

Mann-Whitney Test

Ranks

	upper_gp	N	Mean Rank	Sum of Ranks
age	0	68	59.52	4047.50
	1	53	62.90	3333.50
	Total	121		
GA	0	68	57.54	3912.50
	1	53	65.44	3468.50
	Total	121		
SA	0	68	54.76	3724.00
	1	53	69.00	3657.00
	Total	121		
ROM (G)	0	67	57.08	3824.50
	1	53	64.82	3435.50
	Total	120		
ROM (ADR)	0	67	58.99	3952.50
	1	53	62.41	3307.50
	Total	120		

Test Statistics^a

	age	GA	SA	ROM (G)	ROM (ADR)
Mann-Whitney U	1701.500	1566.500	1378.000	1546.500	1674.500
Wilcoxon W	4047.500	3912.500	3724.000	3824.500	3952.500
Z	-.525	-1.231	-2.220	-1.211	-.535
Asymp. Sig. (2-tailed)	.599	.218	.026	.226	.593

a. Grouping Variable: upper_gp

Frequencies

Statistics

upper_gp			age	GA	SA	ROM (G)	ROM (ADR)
0	N	Valid	68	68	68	67	67
		Missing	0	0	0	1	1
	Median		50.50	15.000	5.000	40.000	9.000
	Percentiles		25	44.25	7.000	1.250	35.000
		50	50.50	15.000	5.000	40.000	9.000
		75	56.00	22.750	8.000	55.000	13.000
1	N	Valid	53	53	53	53	53
		Missing	0	0	0	0	0
	Median		49.00	19.000	7.000	45.000	10.000
	Percentiles		25	43.50	9.000	4.000	38.000
		50	49.00	19.000	7.000	45.000	10.000
		75	60.50	26.000	10.500	53.000	14.000

在SA的部分，
Grade0和Grade1&2有統計差異
Grade1&2中位數高於Grade0 (p=0.026)

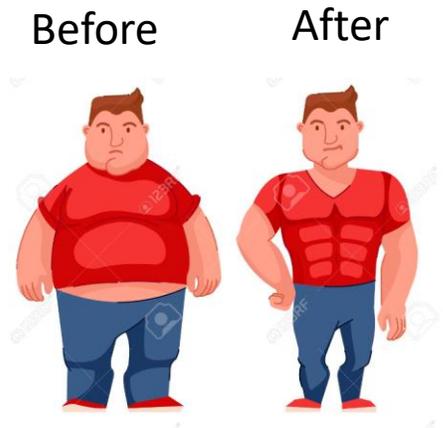
Two groups-相依樣本

Paired T-test

- 檢定兩組相依樣本的**平均值**是否有差異
- 適用於配對樣本，資料需符合**常態**分佈

Wilcoxon signed-rank

- 檢定兩組相依樣本的**中位數**是否有差異
- 適用於配對樣本，資料呈**非常態**分佈



Paired T-test example

- Independent variable : 2014 and 2016 (Paired)
- Dependent variable : Age 、 BMI 、 Height and Weight....(Continuous)



Subtypes of Premorbid Metabolic Syndrome and Associated Clinical Outcomes in Older Adults

Chu-Sheng Lin^{1,2,3,4}, Wei-Ju Lee^{4,5,6}, Shih-Yi Lin², Hui-Ping Lin⁷, Ran-Chou Chen^{5,7}, Chi-Hung Lin^{4,5,8} and Liang-Kung Chen^{4,5,9,10*}

TABLE 1 | Demographic data of study participants in 2014 and 2016.

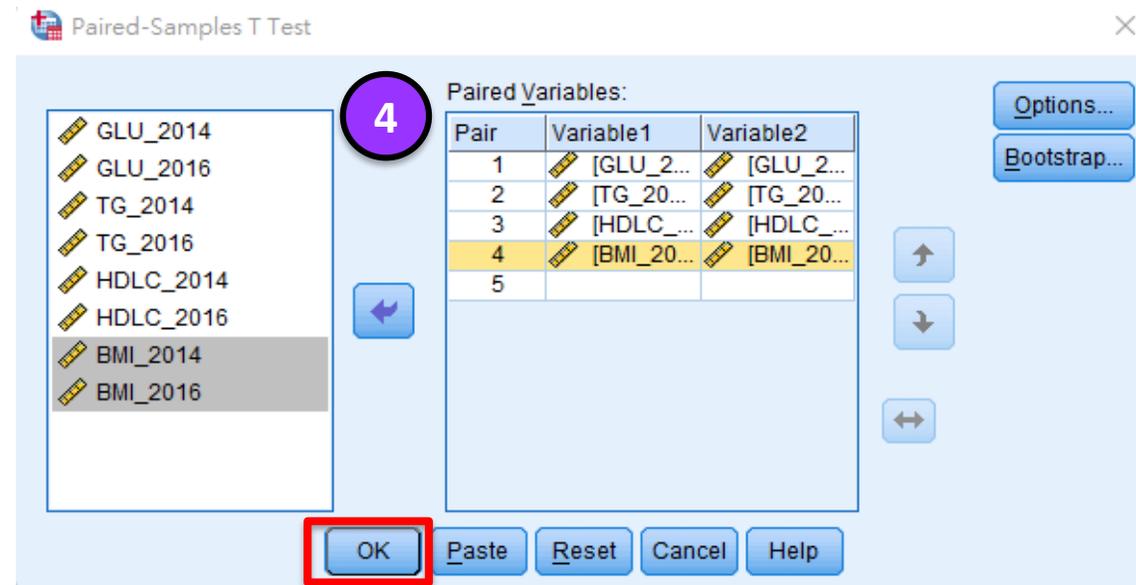
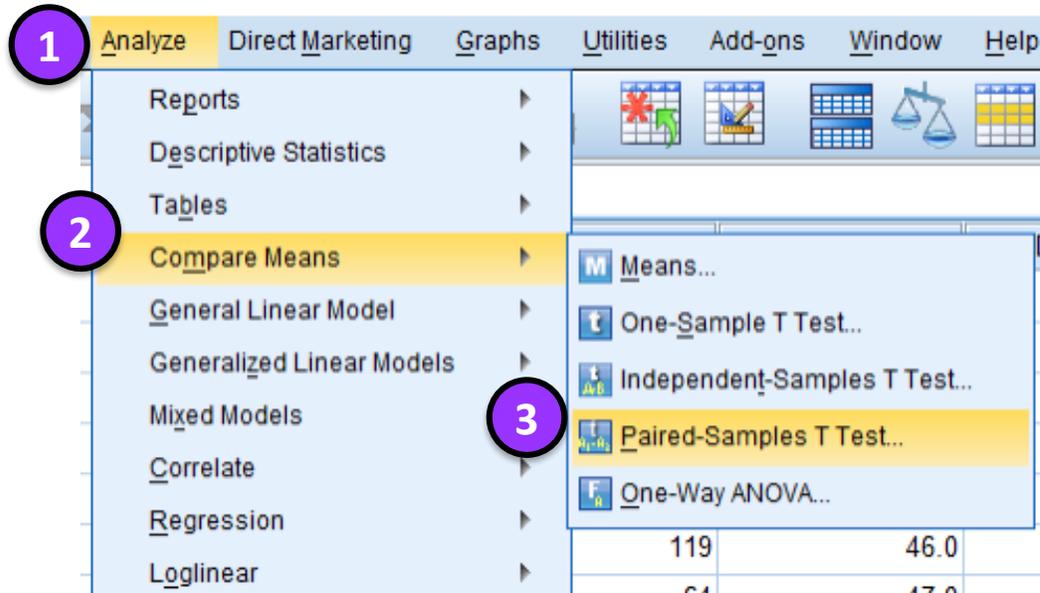
	2014 (n = 4,537)		2016 (n = 4,537)		p-value
	n	%	n	%	
Age	71.75	±5.93	73.75	±5.93	–
Gender					1.000
Male	2,207	(48.6%)	2,207	(48.6%)	
Female	2,330	(51.4%)	2,330	(51.4%)	
Smoking	309	(6.8%)	297	(6.5%)	0.119
Drinking	547	(12.1%)	581	(12.8%)	0.862
Exercise	3,237	(71.3%)	3,462	(76.3%)	0.930
BMI	24.49	±3.47	24.41	±3.42	0.004**
Height (cm)	157.67	±8.15	157.59	±8.12	0.063
Weight (kg)	60.99	±10.38	60.78	±10.47	<0.001**
Waist (cm)	83.20	±9.72	84.59	±9.66	<0.001**
SBP (mmHg)	133.91	±18.19	134.63	±18.52	0.007**
DBP (mmHg)	78.14	±10.91	77.21	±11.26	<0.001**
Pulse pressure (mmHg)	55.77	±13.82	57.42	±13.74	<0.001**
Fasting plasma glucose (mg/dl)	104.02	±21.92	104.89	±25.17	0.009**
Triglycerides (mg/dl)	117.03	±66.71	114.85	±67.83	0.024*
HDL cholesterol (mg/dl)	55.61	±15.66	55.60	±15.78	0.922

Paired T-test SPSS dataset

caseno	GLU_2014	GLU_2016	TG_2014	TG_2016	HDLC_2014	HDLC_2016	BMI_2014	BMI_2016
1	91	91	245	180	34.0	42.0	27.68	27.27
2	103	224	89	104	45.0	35.0	19.15	20.16
3	92	96	96	56	54.0	47.0	20.94	23.57
4	97	96	123	92	57.0	57.0	25.54	25.57
5	88	307	125	106	42.0	87.0	18.97	17.10
6	94	94	101	119	46.0	47.0	21.50	21.79
7	92	91	49	64	47.0	50.0	25.67	26.58
8	151	89	83	69	39.0	47.0	24.61	26.37
9	97	97	120	59	42.0	44.0	23.95	24.31
10	149	156	142	128	50.0	50.0	25.54	23.84
11	113	124	337	104	58.0	80.0	23.28	23.74
12	99	92	114	76	67.0	60.0	20.20	20.57

Paired T-test SPSS analysis

分析 > 比較平均數法 > 成對樣本T檢定



Paired T-test SPSS output

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	GLU_2014	104.02	4537	21.923	.325
	GLU_2016	104.89	4537	25.166	.374
Pair 2	TG_2014	117.03	4537	66.712	.990
	TG_2016	114.85	4537	67.833	1.007
Pair 3	HDLC_2014	55.615	4537	15.6628	.2325
	HDLC_2016	55.598	4537	15.7802	.2343
Pair 4	BMI_2014	24.4877	4537	3.46738	.05148
	BMI_2016	24.4141	4537	3.41873	.05076

在Glucose的部分，
2014和2016有統計差異
2016平均高於2014 (p=0.009)

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	GLU_2014 - GLU_2016	-.869	22.503	.334	-1.524	-.214	-2.600	4536	.009
Pair 2	TG_2014 - TG_2016	2.186	65.013	.965	.294	4.078	2.265	4536	.024
Pair 3	HDLC_2014 - HDLC_2016	.0164	11.3191	.1680	-.3131	.3458	.098	4536	.922
Pair 4	BMI_2014 - BMI_2016	.07361	1.73773	.02580	.02303	.12418	2.853	4536	.004

Wilcoxon signed-rank test example

- Independent variable : Before and After (Paired)
- Dependent variable : BMD and T-score (Continuous)

Clinical Rheumatology
<https://doi.org/10.1007/s10067-023-06735-0>

ORIGINAL ARTICLE



Potential alleviation of bone mineral density loss with Janus kinase inhibitors in rheumatoid arthritis

Yun-Wen Chen^{1,2} · Hsin-Hua Chen^{1,2,3,4,5,6,7} · Wen-Nan Huang^{1,3,4,8} · Jun-Peng Chen^{9,10} · Yi-Hsing Chen^{1,4} · Yi-Ming Chen^{1,3,4,10,11}

Table 2 Comparisons of the changes in BMD and T-score from the pretreatment to posttreatment assessment based on the RA treatment

	Before			After			<i>p</i> -value
JAKi							
BMD, L spine	1.02	(0.92,	1.20)	1.03	(0.88,	1.21)	0.597
BMD, left femoral neck	0.84	(0.76,	0.90)	0.84	(0.76,	0.92)	0.168
BMD, right femoral neck	0.87	(0.77,	0.92)	0.87	(0.75,	0.94)	0.829
T-score, L spine	-1.5	(-2.5,	-0.6)	-1.6	(-2.5,	-1.0)	0.836
T-score, left femoral neck	-1.5	(-2.0,	-1.0)	-1.7	(-2.6,	-1.1)	0.073
T-score, right femoral neck	-1.4	(-1.9,	-0.8)	-1.8	(-2.7,	-1.0)	0.032*

Wilcoxon signed-ranks test. * $p < 0.05$, ** $p < 0.01$

Wilcoxon signed-rank SPSS dataset

caseno	BMD_SPINE.1	BMD_SPINE.2	BMD_LT.1	BMD_LT.2	BMD_RT.1	BMD_RT.2
1	.805	.788	.747	.749	.756	.745
2	.866	.900	.610	.634	.629	.633
3	.804	.868	.583	.619	.612	.659
4	.714	.839
5	.973	.813	.791	.674	.762	.635
6	.	.	.913	.900	.902	.890
7	.823	.798	.645	.618	.623	.615
8	1.151	1.232	.746	.824	.784	.842
9	1.086	.	.925	.901	1.040	1.033
10	.989	.866	.848	.805	.798	.827
11	1.169	1.078	.876	.851	.953	.944
12	.899	.881
13	1.232	1.199	.888	.982	.929	1.003
14	1.020	.974	.881	.918	.869	.895
15	1.081	1.030	.772	.783	.796	.782

Wilcoxon signed-rank SPSS analysis-1

分析>無母數檢定>歷史對話記錄
>2個相關樣本

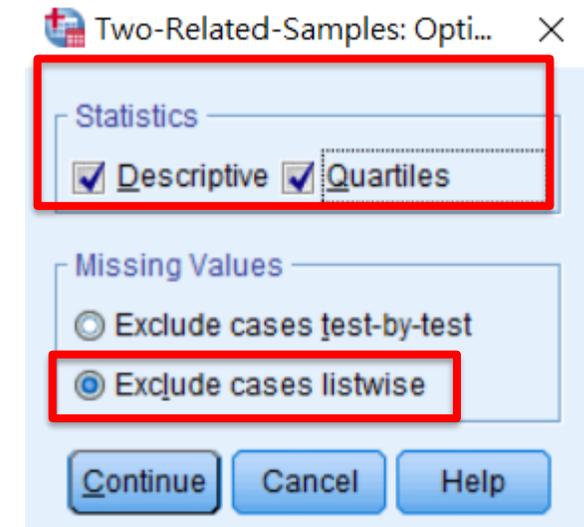
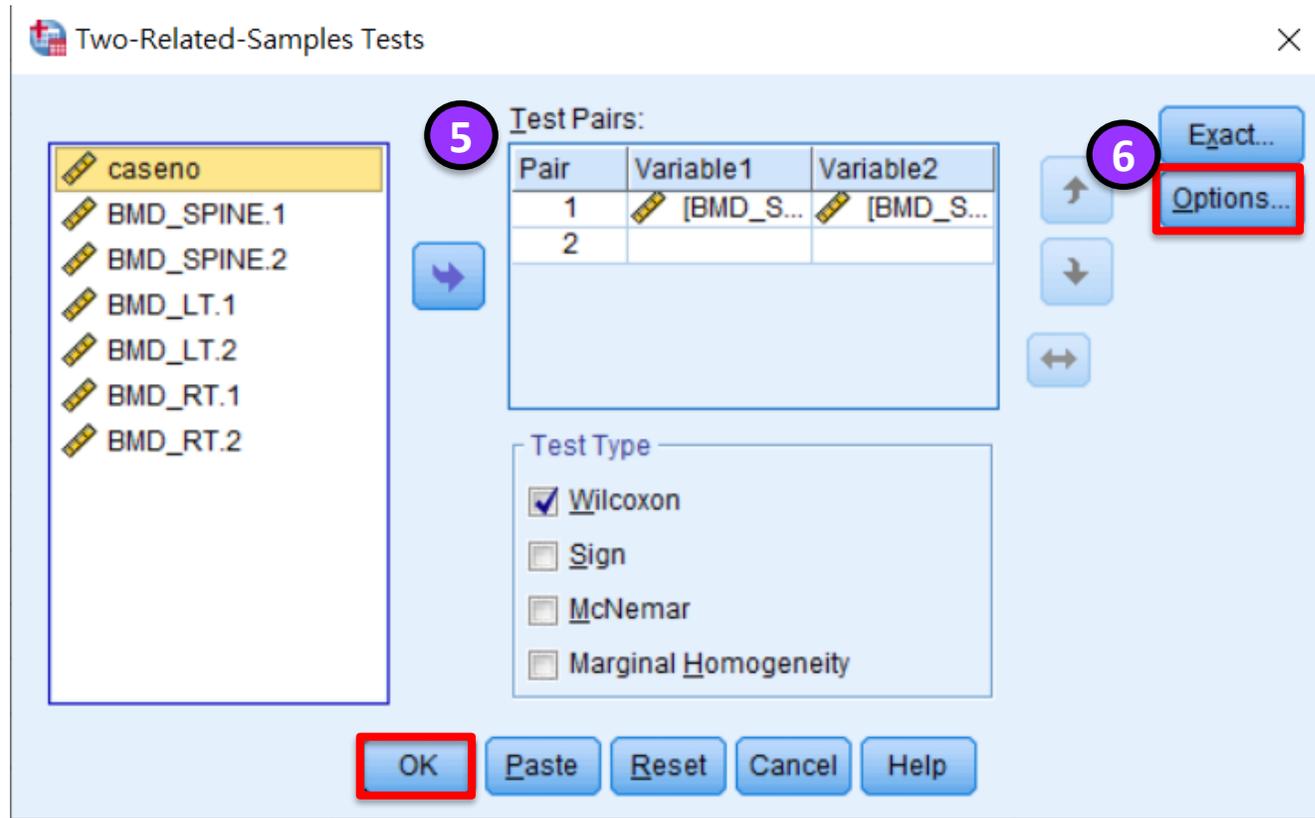
The screenshot shows the SPSS 'Analyze' menu with the following path highlighted:

- 1. Analyze
- 2. Nonparametric Tests
- 3. Legacy Dialogs
- 4. 2 Related Samples...

The background shows a data table with columns BMD_LT.2, BMD_RT.1, and BMD_RT.2. The data rows are as follows:

	BMD_LT.2	BMD_RT.1	BMD_RT.2
47	.749	.756	.745
10	.634	.629	.633
83	.619	.612	.659
.	.	.	.
91	.674	.762	.635
13	.900	.902	.890
45	.618	.623	.615
46	.824	.784	.842
25	.901	1.040	1.033
48	.805	.798	.827
76	.851	.953	.944
.	.	.	.
12	.817	.	.
26	.833	.	1.003
14	.835	.	.869
40	1.048	.	.
64	.908	.	.
94	.885	.	.
88	.752	.	.
72	.890	.	.
08	.945	.	.

Wilcoxon signed-rank SPSS analysis-2



Wilcoxon signed-rank SPSS output

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
BMD_SPINE.1	27	1.05478	.188744	.714	1.478	.92400	1.01800	1.19700
BMD_SPINE.2	27	1.05933	.189103	.788	1.463	.88100	1.03000	1.20900

Test Statistics^a

	BMD_SPINE.2 - BMD_SPINE.1
Z	-.529 ^b
Asymp. Sig. (2-tailed)	.597

- a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

在BMD spine的部分，使用JAK Before和After無統計差異 After的中位數高於Before (p=0.597)

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
BMD_LT.1	28	.82861	.131799	.536	1.097	.76075	.83700	.90450
BMD_LT.2	28	.83682	.135854	.553	1.110	.75550	.84100	.91550

Test Statistics^a

	BMD_LT.2 - BMD_LT.1
Z	-1.378 ^b
Asymp. Sig. (2-tailed)	.168

- a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
BMD_RT.1	28	.84746	.141434	.579	1.187	.76650	.87050	.92300
BMD_RT.2	28	.84875	.146636	.560	1.194	.75375	.87250	.93675

Test Statistics^a

	BMD_RT.2 - BMD_RT.1
Z	-.216 ^b
Asymp. Sig. (2-tailed)	.829

- a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Three groups-獨立樣本

One-way ANOVA

- 檢定3組以上的平均數是否相等
 - ✓ 組別為2組以上也可使用
- 適用於常態分佈資料

Kruskal-Wallis test

- 檢定3組以上的中位數是否相等
- 適用於非常態分佈資料

One-way ANOVA example

- Independent variable : CKD stage (Three groups+)
- Dependent variable : Lab data, pH 、 HCO₃⁻ 、 PT and INR...(Continuous)

Article

Patients with Different Stages of Chronic Kidney Disease Undergoing Intravenous Contrast-Enhanced Computed Tomography—The Incidence of Contrast-Associated Acute Kidney Injury

Ming-Ju Wu ^{1,2,3,4,5} and Shang-Feng Tsai ^{1,5,6,7,*}

Table 1. Baseline characteristics of all participants divided according to their stages of CKD.

	CKD Stage										Total (n = 12,271)	p- Value	
	I	II	IIIA	IIIB	IV	V							
Laboratory data of blood													
Hb (n = 12,242)	12.30 ±2.45	12.36 ±2.49	11.98 ±2.58	11.56 ±2.67	11.05 ±2.75	10.13 ±2.72	12.08 ±2.57	<0.001					
Albumin (n = 6940)	3.42 ±0.74	3.44 ±0.73	3.31 ±0.72	3.18 ±0.72	3.00 ±0.73	3.07 ±0.67	3.35 ±0.74	<0.001					
Calcium (n = 9455)	7.81 ±1.71	8.00 ±1.70	8.06 ±1.62	7.93 ±1.78	7.92 ±1.67	7.80 ±1.86	7.91 ±1.71	<0.001					
Uric acid (n = 730)	4.98 ±2.09	6.42 ±2.60	7.26 ±2.11	8.34 ±2.94	8.73 ±3.07	8.38 ±2.61	6.67 ±2.81	<0.001					
Sodium (n = 12,153)	137.36 ±5.37	137.91 ±5.37	137.42 ±6.19	137.56 ±6.79	138.07 ±7.56	137.20 ±6.72	137.59 ±5.80	<0.001					
Potassium (n = 12,146)	3.98 ±0.64	4.03 ±0.65	4.10 ±0.75	4.23 ±0.87	4.34 ±0.90	4.46 ±1.02	4.07 ±0.72	<0.001					

Table 1. Cont.

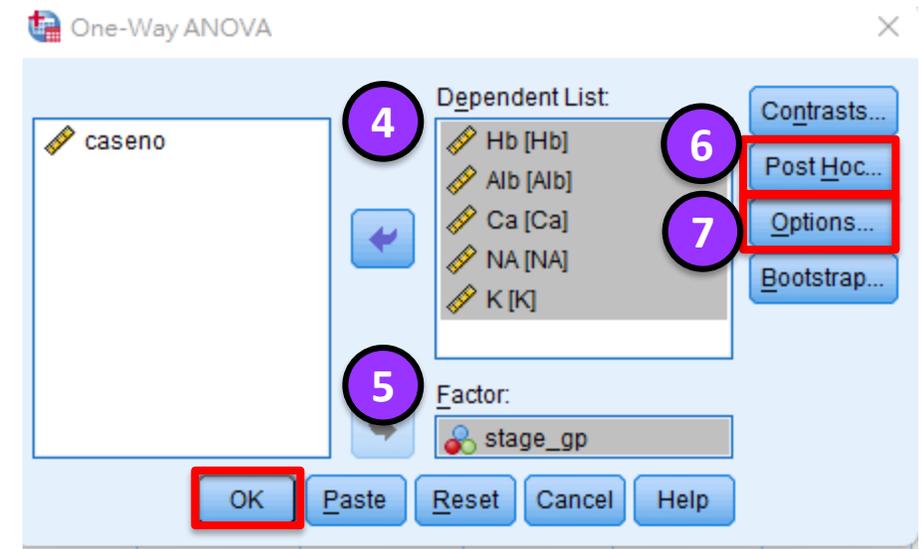
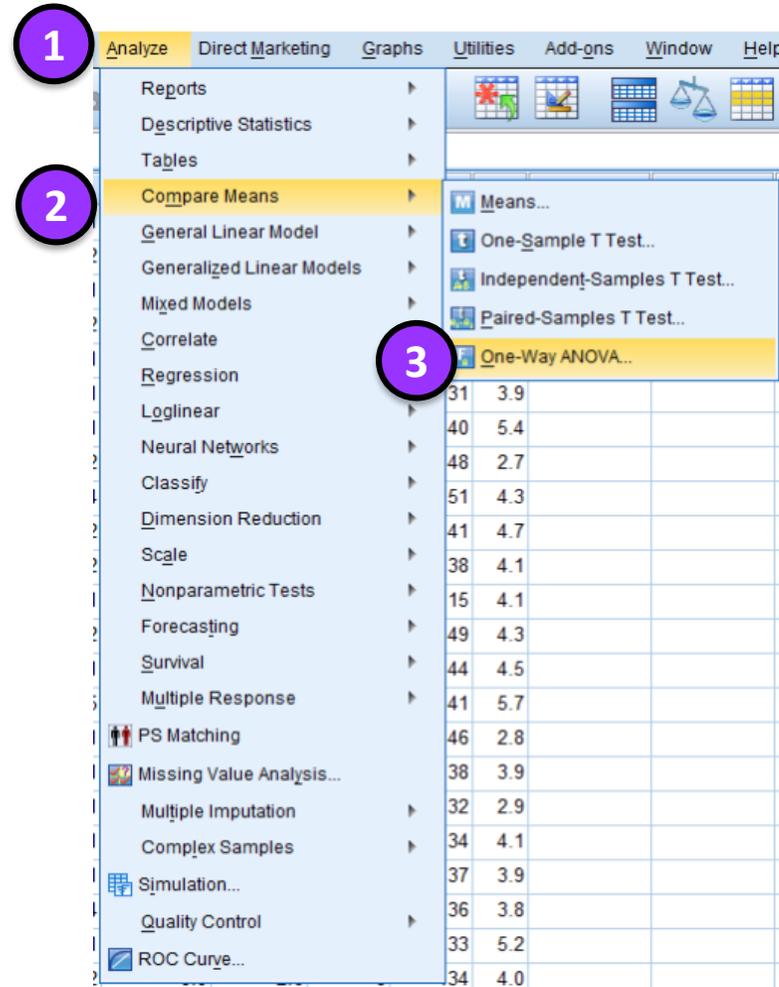
	CKD Stage										Total (n = 12,271)	p- Value
	I	II	IIIA	IIIB	IV	V						
pH (n = 9348)	6.89 ±0.80	6.82 ±0.86	6.82 ±0.89	6.92 ±0.85	7.01 ±0.81	7.27 ±0.56	6.89 ±0.83	<0.001				
HCO ₃ ⁻ (n = 5768)	25.14 ±4.44	24.55 ±4.82	23.68 ±5.13	22.55 ±5.54	20.31 ±5.77	20.51 ±5.89	23.84 ±5.22	<0.001				
PT (n = 9863)	11.49 ±3.21	11.79 ±5.41	12.00 ±4.70	12.91 ±7.26	13.58 ±7.50	12.80 ±6.77	11.93 ±5.04	<0.001				
INR (n = 9857)	1.09 ±0.24	1.12 ±0.49	1.15 ±0.46	1.23 ±0.67	1.30 ±0.74	1.20 ±0.49	1.14 ±0.45	<0.001				
Medications												
NSAID	2788 (57.3%)	1858 (49.8%)	608 (40.7%)	427 (37.8%)	204 (31.6%)	91 (22.7%)	5976 (48.7%)	<0.001				
ASPIRIN	561 (11.5%)	749 (20.1%)	391 (26.2%)	337 (29.8%)	201 (31.2%)	130 (32.4%)	2369 (19.3%)	<0.001				
COX2i	541 (11.1%)	460 (12.3%)	231 (15.5%)	154 (13.6%)	74 (11.5%)	38 (9.5%)	1498 (12.2%)	<0.001				
Aminoglycoside	2285 (46.9%)	1651 (44.3%)	590 (39.5%)	407 (36.0%)	218 (33.8%)	114 (28.4%)	5265 (42.9%)	<0.001				
Loop diuretics	2230 (45.8%)	1921 (51.5%)	946 (63.3%)	816 (72.1%)	497 (77.1%)	251 (62.6%)	6661 (54.3%)	<0.001				

ANOVA SPSS dataset

caseno	stage_gp	Hb	Alb	Ca	NA	K
2	1	9.6	1.8	4	135	4.3
3	2	8.3	.	4	131	5.6
4	1	7.5	2.2	8	138	4.1
5	2	10.0	2.6	8	136	3.6
6	1	9.1	3.1	6	140	4.7
8	1	14.5	2.6	8	131	3.9
9	1	10.8	2.7	8	140	5.4
12	2	14.5	3.8	8	148	2.7
13	4	10.9	2.1	9	151	4.3
14	2	10.6	2.7	4	141	4.7
15	2	9.6	3.1	8	138	4.1
16	1	15.6	4.1	8	115	4.1

ANOVA SPSS analysis-1

分析>比較平均數法>單因子變異數分析



ANOVA SPSS analysis-2

Post-hoc

One-Way ANOVA: Post Hoc Multiple Comparisons

Equal Variances Assumed

<input checked="" type="checkbox"/> LSD	<input type="checkbox"/> S-N-K	<input type="checkbox"/> Waller-Duncan
<input checked="" type="checkbox"/> Bonferroni	<input type="checkbox"/> Tukey	Type I/Type II Error Ratio: 100
<input type="checkbox"/> Sidak	<input type="checkbox"/> Tukey's-b	<input type="checkbox"/> Dunnett
<input checked="" type="checkbox"/> Scheffe	<input type="checkbox"/> Duncan	Control Category: Last
<input type="checkbox"/> R-E-G-W F	<input type="checkbox"/> Hochberg's GT2	Test
<input type="checkbox"/> R-E-G-W Q	<input type="checkbox"/> Gabriel	<input checked="" type="radio"/> 2-sided <input type="radio"/> < Control <input type="radio"/> > Control

Equal Variances Not Assumed

<input type="checkbox"/> Tamhane's T2	<input type="checkbox"/> Dunnett's T3	<input type="checkbox"/> Games-Howell	<input type="checkbox"/> Dunnett's C
---------------------------------------	---------------------------------------	---------------------------------------	--------------------------------------

Significance level: 0.05

Continue Cancel Help

Options

One-Way ANOVA: Options

Statistics

<input checked="" type="checkbox"/> Descriptive
<input type="checkbox"/> Fixed and random effects
<input checked="" type="checkbox"/> Homogeneity of variance test
<input type="checkbox"/> Brown-Forsythe
<input checked="" type="checkbox"/> Welch

Means plot

Missing Values

<input checked="" type="radio"/> Exclude cases analysis by analysis
<input type="radio"/> Exclude cases listwise

Continue Cancel Help

ANOVA SPSS output-1

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
Hb	stagel	4860	12.301	2.4542	.0352	12.232	12.370	4.3	20.1
	stagell	3722	12.365	2.4885	.0408	12.285	12.445	3.1	19.0
	stagellIA	1489	11.984	2.5768	.0668	11.853	12.115	4.2	19.3
	stagellIB	1128	11.562	2.6699	.0795	11.406	11.718	4.0	19.0
	stageIV	644	11.045	2.7465	.1082	10.833	11.258	4.7	19.1
	stageV	399	10.133	2.7236	.1363	9.865	10.401	3.4	17.5
Total	12242	12.077	2.5737	.0233	12.031	12.122	3.1	20.1	
Alb	stagel	2674	3.418	.7383	.0143	3.390	3.446	.2	5.9
	stagell	2028	3.444	.7257	.0161	3.413	3.476	.8	5.4
	stagellIA	855	3.306	.7158	.0245	3.258	3.354	.4	5.4
	stagellIB	680	3.179	.7195	.0276	3.124	3.233	1.1	5.8
	stageIV	427	2.999	.7309	.0354	2.929	3.068	.5	6.7
	stageV	276	3.071	.6682	.0402	2.992	3.150	1.0	5.2
Total	6940	3.349	.7391	.0089	3.331	3.366	.2	6.7	

在Hb及Alb的部分，
不同CKD stage程度有統計差異
Stage II平均高於其他 ($p < 0.001$)

Hb用Welch結果, 取代ANOVA

Robust Tests of Equality of Means

Hb

	Statistic ^a	df1	df2	Sig.
Welch	85.179	5	2215.976	.000

a. Asymptotically F distributed.

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Hb	15.688	5	12236	.000
Alb	2.103	5	6934	.062

Alb, $p > 0.05$ 三組變異數無差異(同質性)
Hb, 違反同質性假設

ANOVA

Alb

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	126.191	5	25.238	47.763	.000
Within Groups	3663.970	6934	.528		
Total	3790.161	6939			

ANOVA SPSS output-2

Dependent Variable: Alb
Bonferroni

(I) stage_gp	(J) stage_gp	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
stageI	stageII	-.0260	.0214	1.000	-.089	.037
	stageIIIA	.1121*	.0286	.001	.028	.196
	stageIIIB	.2396*	.0312	.000	.148	.331
	stageIV	.4193*	.0379	.000	.308	.531
	stageV	.3472*	.0460	.000	.212	.482
stageII	stageI	.0260	.0214	1.000	-.037	.089
	stageIIIA	.1381*	.0296	.000	.051	.225
	stageIIIB	.2657*	.0322	.000	.171	.360
	stageIV	.4454*	.0387	.000	.332	.559
	stageV	.3732*	.0466	.000	.236	.510
stageIIIA	stageI	-.1121*	.0286	.001	-.196	-.028
	stageII	-.1381*	.0296	.000	-.225	-.051
	stageIIIB	.1276*	.0374	.010	.018	.237
	stageIV	.3073*	.0431	.000	.181	.434
	stageV	.2351*	.0503	.000	.087	.383
stageIIIB	stageI	-.2396*	.0312	.000	-.331	-.148
	stageII	-.2657*	.0322	.000	-.360	-.171
	stageIIIA	-.1276*	.0374	.010	-.237	-.018
	stageIV	.1797*	.0449	.001	.048	.311
	stageV	.1075	.0519	.574	-.045	.260
stageIV	stageI	-.4193*	.0379	.000	-.531	-.308
	stageII	-.4454*	.0387	.000	-.559	-.332
	stageIIIA	-.3073*	.0431	.000	-.434	-.181
	stageIIIB	-.1797*	.0449	.001	-.311	-.048
	stageV	-.0722	.0561	1.000	-.237	.093
stageV	stageI	-.3472*	.0460	.000	-.482	-.212
	stageII	-.3732*	.0466	.000	-.510	-.236
	stageIIIA	-.2351*	.0503	.000	-.383	-.087
	stageIIIB	-.1075	.0519	.574	-.260	.045
	stageIV	.0722	.0561	1.000	-.093	.237

*. The mean difference is significant at the 0.05 level.

在Alb的事後檢定， $p < 0.05$
Stage I vs Stage IIIA;
Stage I vs Stage IIIB;
Stage I vs Stage IV;
Stage I vs Stage V;
Stage II vs Stage IIIA;
Stage II vs Stage IIIB;
Stage II vs Stage IV;
Stage II vs Stage V;

.....

Kruskal-Wallis test example

- Independent variable : Typical, LP, HS and MA (Four groups)
- Dependent variable : Age, Education years and MMSE...(Continuous)

Chen et al. *Alzheimer's Research & Therapy* (2022) 14:141
<https://doi.org/10.1186/s13195-022-01083-8>

Alzheimer's
Research & Therapy

RESEARCH

Open Access



Imaging markers of cerebral amyloid angiopathy and hypertensive arteriopathy differentiate Alzheimer disease subtypes synergistically

Ting-Bin Chen^{1,2,3}, Wei-Ju Lee^{1,2,3,4}, Jun-Peng Chen⁵, Shiang-Yu Chang^{1*}, Chun-Fu Lin^{6*} and Hung-Chieh Chen^{4,6*}

Table 1 Clinical and imaging characteristics of the cohort, $N = 137$

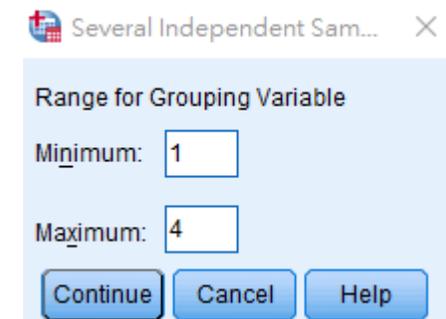
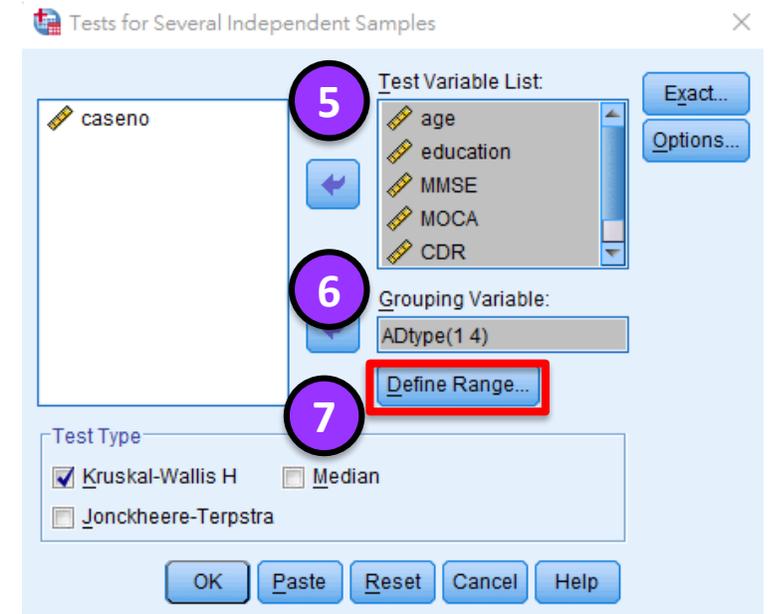
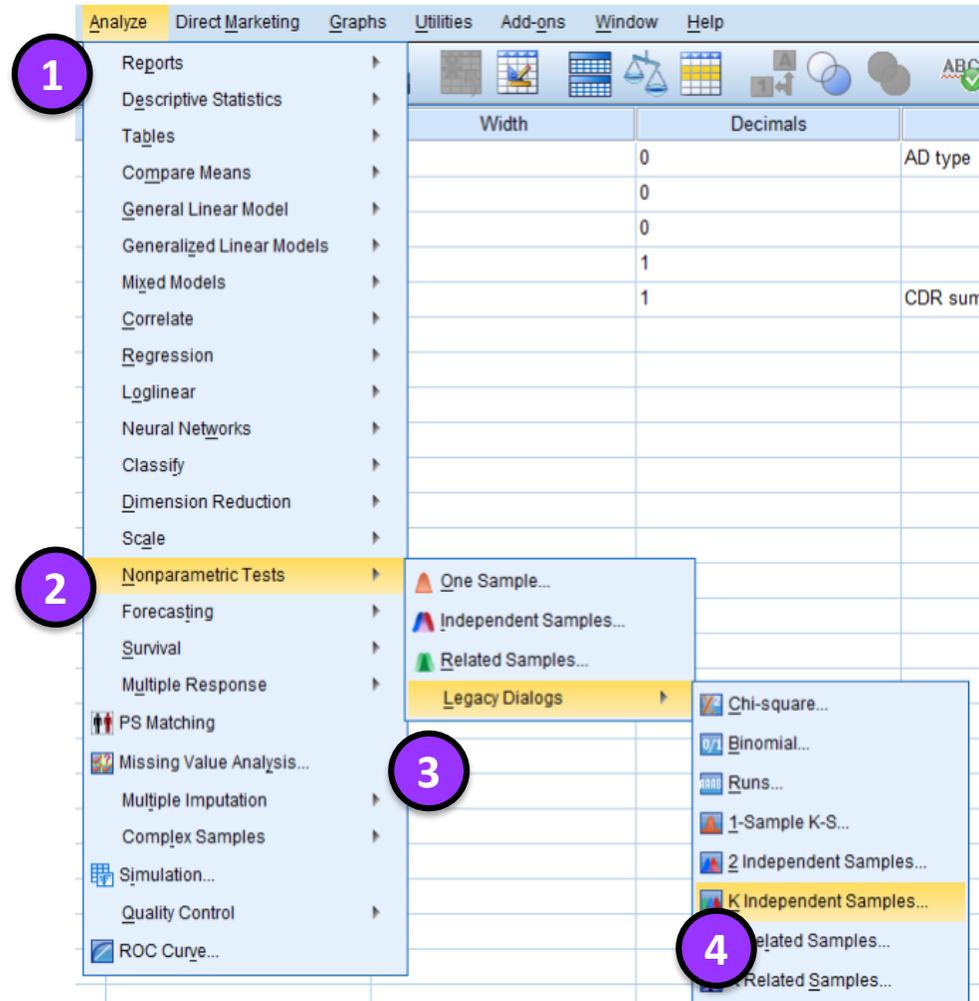
Characteristic	Typical ($N = 33$)		LP ($N = 26$)		HS ($N = 40$)		MA ($N = 38$)		P value
Sex, female, N (%)	20	(60.6%)	12	(46.2%)	25	(62.5%)	31	(81.6%)	0.030*
Age, years	81.0	(74.5–83.5)	76.5	(65.8–84.3)	79.5	(76.0–84.0)	77.0	(70.8–79.0)	0.010*
Education, years	6.0	(6–10.5)	6.0	(6.0–12.0)	6.0	(6.0–9.0)	6.0	(0.0–12.0)	0.659
Smoking, N (%)	4	(12.1%)	1	(3.8%)	2	(5.0%)	3	(7.9%)	0.588
Vascular risk factors									
Hypertension, N (%)	18	(54.5%)	12	(46.2%)	26	(65.0%)	23	(60.5%)	0.466
Diabetes mellitus, N (%)	12	(36.4%)	7	(26.9%)	21	(52.5%)	10	(26.3%)	0.067
Hyperlipidemia, N (%)	7	(21.2%)	9	(34.6%)	21	(52.5%)	14	(36.8%)	0.053
Peripheral or cardiac vasculopathy ^a	0	(0.0%)	6	(23.1%)	7	(17.5%)	6	(15.8%)	0.052
Atrial fibrillation, N (%)	4	(12.1%)	1	(3.8%)	2	(5.0%)	3	(7.9%)	0.588
Number of vascular risk factors	1.0	(0.0–2.0)	0.5	(0.0–3.0)	2.0	(1.0–3.0)	1.0	(0.0–3.0)	0.091
Use of antiplatelet, N (%)	5	(15.2%)	5	(19.2%)	13	(32.5%)	13	(34.2%)	0.186
Use of anticoagulant, N (%)	3	(9.1%)	1	(3.8%)	2	(5.0%)	2	(5.3%)	0.826
MMSE	18.0	(12.5–21.5)	16.0	(12.5–21.0)	20.0	(16.0–22.8)	20.0	(14.0–22.5)	0.117
MoCA	12.0	(9.5–14.0)	9.0	(6.5–13.5)	14.0	(10.0–18.0)	14.5	(8.3–18.8)	0.045*
CDR	1.0	(0.5–1.0)	1.0	(0.8–1.0)	1.0	(0.5–1.0)	0.5	(0.5–1.0)	0.021*
CDR—sum of boxes	6.0	(3.6–8.0)	6.0	(4.3–7.5)	4.0	(3.0–5.5)	4.5	(3.0–5.4)	0.006**

Kruskal-Wallis test SPSS dataset

caseno	age	education	ADtype	MMSE	MOCA	CDR	CDRsumbox
1	90	0	2	.	.	2.0	10.0
2	89	6	2	16	11	.	.
3	76	0	4	15	8	.	.
4	77	0	4	15	.	2.0	10.0
5	72	16	4	26	26	.5	2.0
6	77	6	2	11	.	2.0	10.0
7	70	6	4	20	14	.5	4.5
8	80	6	4	22	17	.5	3.5
9	78	0	4	10	5	1.0	5.0
10	83	6	3	11	9	.5	4.0
11	79	6	1	17	5	.5	2.5
12	79	0	4	20	9	1.0	4.5

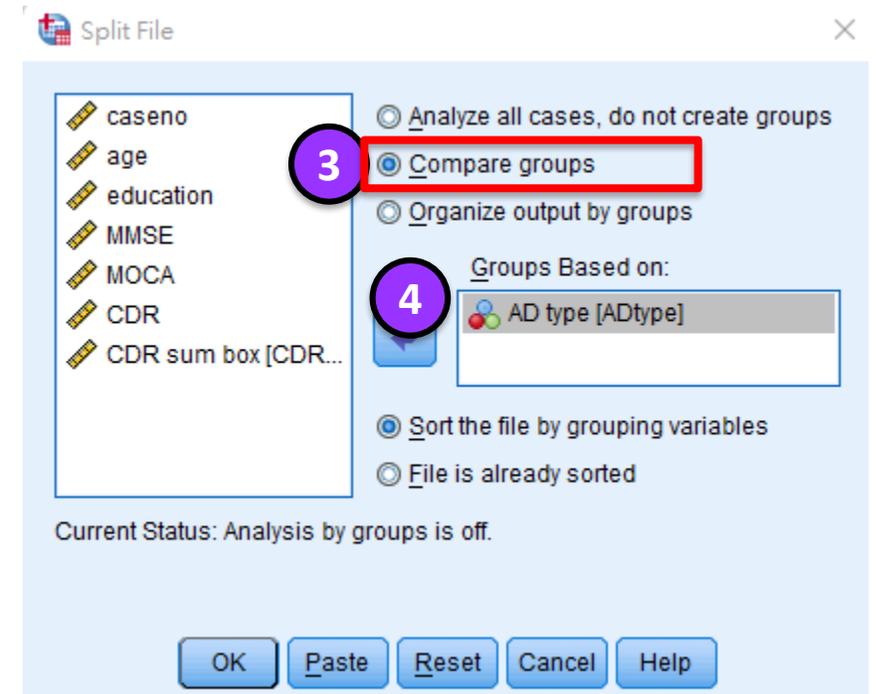
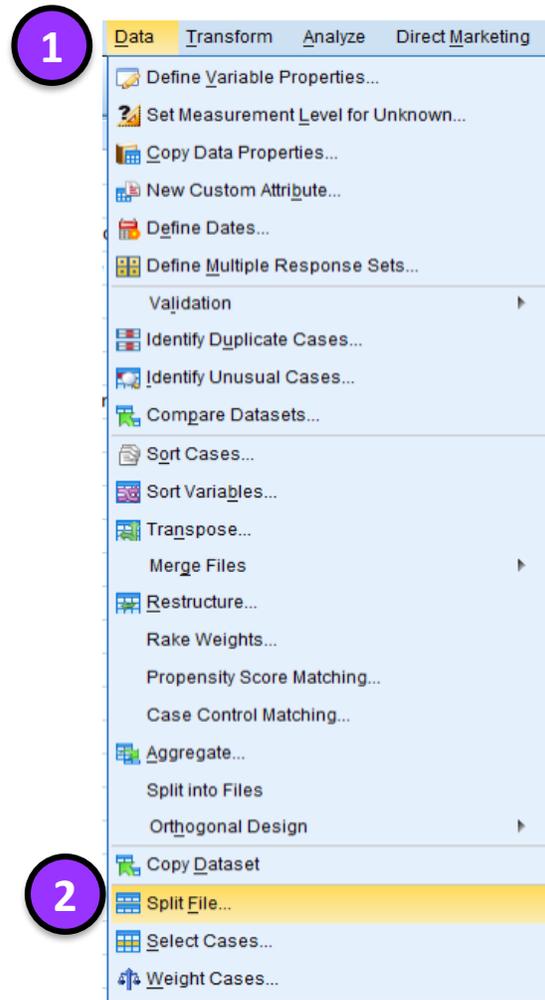
Kruskal-Wallis test SPSS analysis-1

分析>無母數檢定>歷史對話記錄>K個獨立樣本



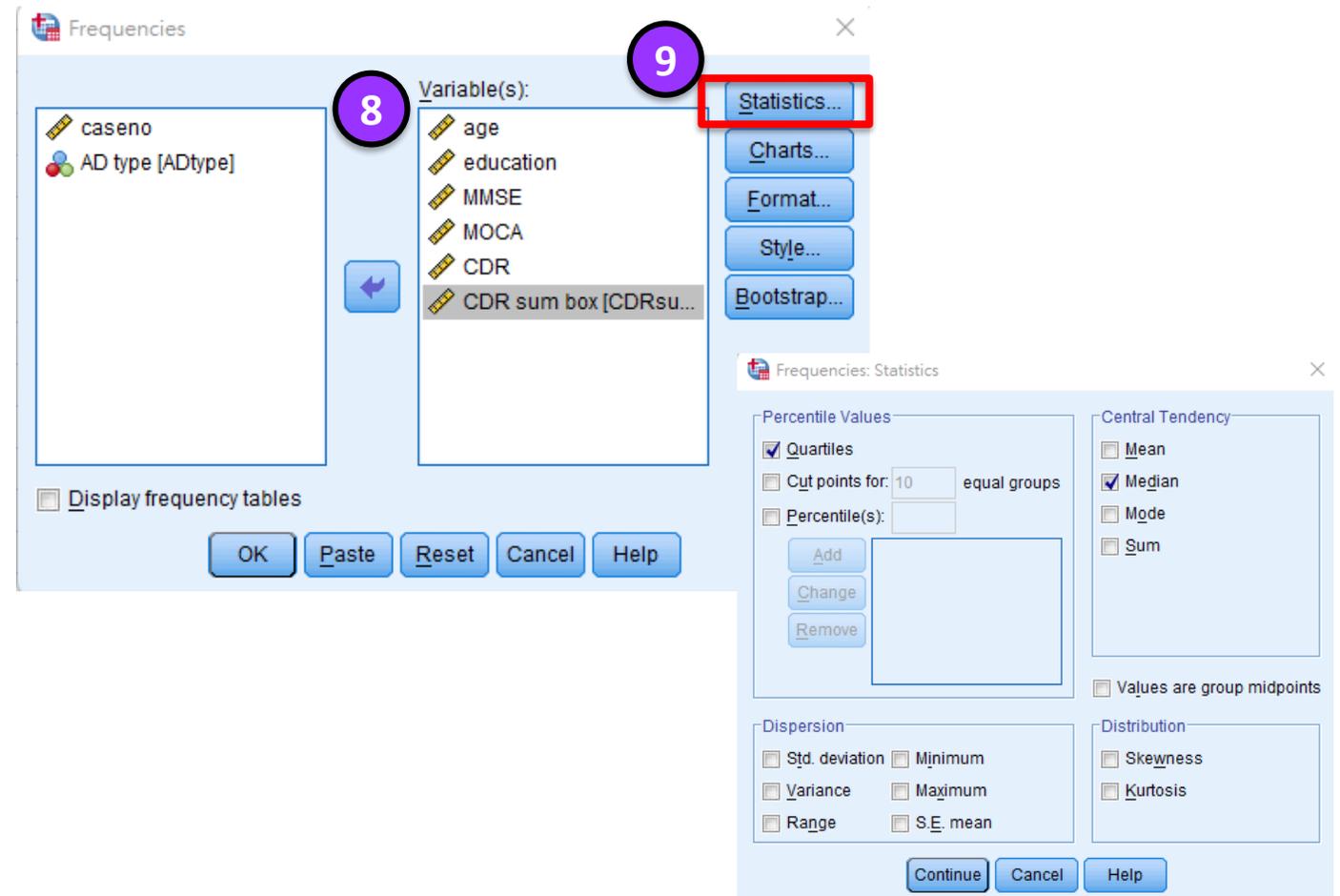
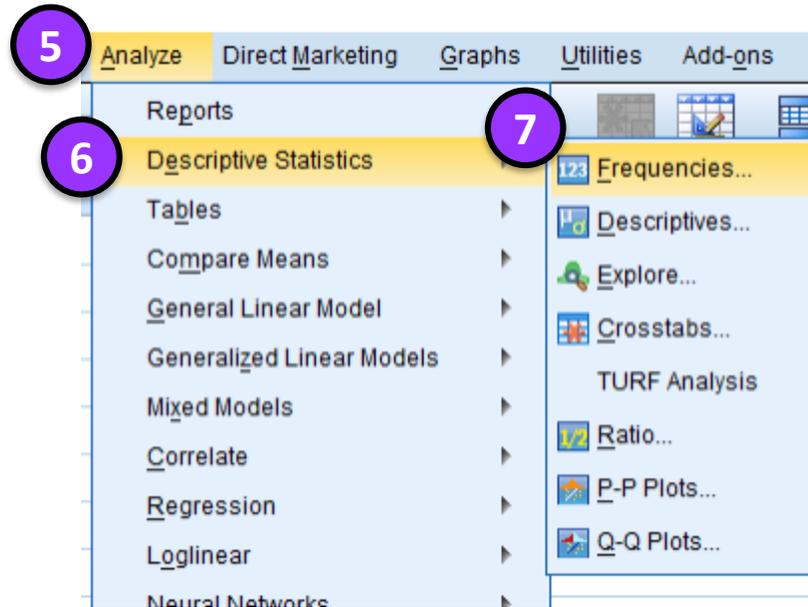
Kruskal-Wallis test SPSS analysis-2

資料>分割檔案



Kruskal-Wallis test SPSS analysis-3

分析>描述性資料>次數分配表



Kruskal-Wallis test SPSS output

Statistics

AD type			age	education	MMSE	MOCA	CDR	CDR sum box	
Typical	N	Valid	33	33	33	22	32	32	
		Missing	0	0	0	11	1	1	
	Median		81.00	6.00	18.00	12.00	1.000	6.000	
	Percentiles	25		74.50	6.00	12.50	9.50	.500	3.625
		50		81.00	6.00	18.00	12.00	1.000	6.000
75			83.50	10.50	21.50	14.00	1.000	8.000	
LP	N	Valid	26	26	25	17	25	25	
		Missing	0	0	1	9	1	1	
	Median		76.50	6.00	16.00	9.00	1.000	6.000	
	Percentiles	25		65.75	6.00	12.50	6.50	.750	4.250
		50		76.50	6.00	16.00	9.00	1.000	6.000
75			84.25	12.00	21.00	13.50	1.000	7.500	
HS	N	Valid	40	40	40	31	39	39	
		Missing	0	0	0	9	1	1	
	Median		79.50	6.00	20.00	14.00	1.000	4.000	
	Percentiles	25		76.00	6.00	16.00	10.00	.500	3.000
		50		79.50	6.00	20.00	14.00	1.000	4.000
75			84.00	9.00	22.75	18.00	1.000	5.500	
MA	N	Valid	38	38	38	32	36	36	
		Missing	0	0	0	6	2	2	
	Median		77.00	6.00	20.00	14.50	.500	4.500	
	Percentiles	25		70.75	.00	14.00	8.25	.500	3.000
		50		77.00	6.00	20.00	14.50	.500	4.500
75			79.00	12.00	22.50	18.75	1.000	5.375	

在MoCA的部分，
不同AD type程度有統計差異
MA的中位數高於其他 (p=0.045)

Test Statistics^{a,b}

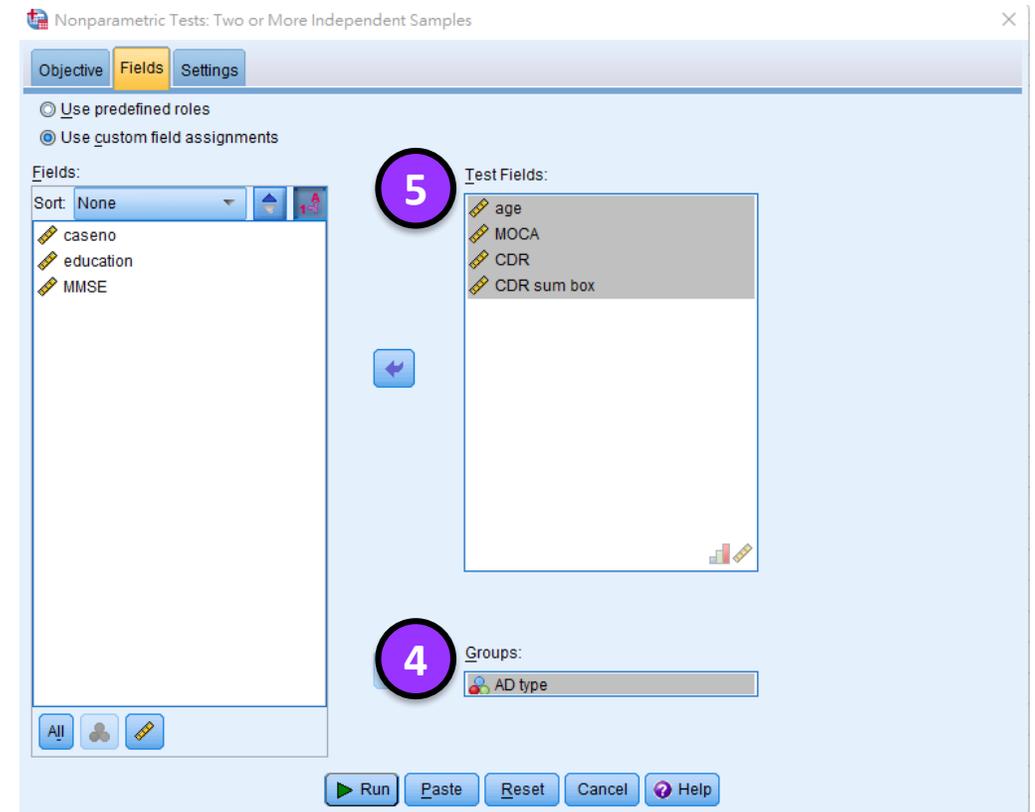
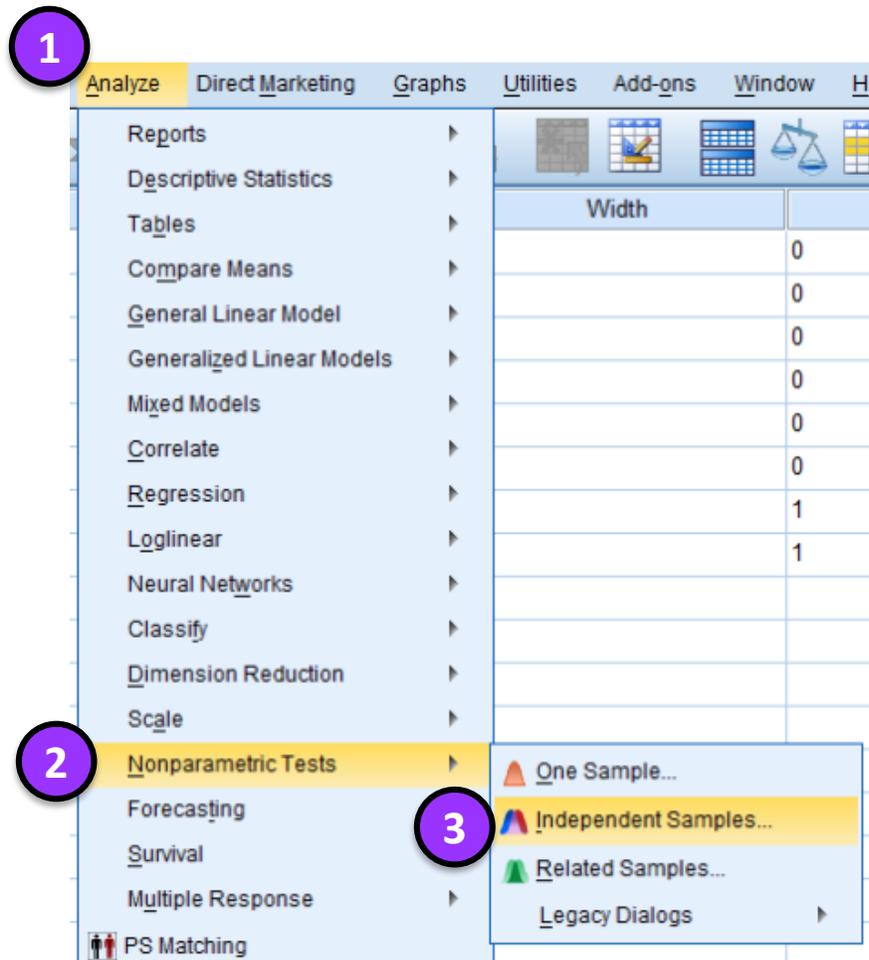
	age	education	MMSE	MOCA	CDR	CDR sum box
Chi-Square	11.329	1.600	5.891	8.059	9.774	12.575
df	3	3	3	3	3	3
Asymp. Sig.	.010	.659	.117	.045	.021	.006

a. Kruskal Wallis Test

b. Grouping Variable: AD type

Kruskal-Wallis test SPSS post-hoc

分析>無母數檢定>獨立樣本



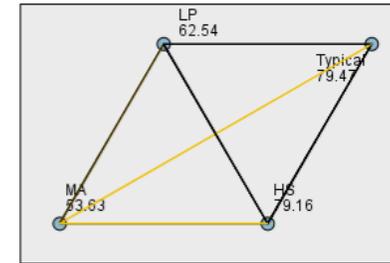
Kruskal-Wallis test SPSS post-hoc

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of age is the same across categories of AD type.	Independent-Samples Kruskal-Wallis Test	.010	Reject the null hypothesis.
2	The distribution of MOCA is the same across categories of AD type.	Independent-Samples Kruskal-Wallis Test	.045	Reject the null hypothesis.
3	The distribution of CDR is the same across categories of AD type.	Independent-Samples Kruskal-Wallis Test	.021	Reject the null hypothesis.
4	The distribution of CDR sum box is the same across categories of AD type.	Independent-Samples Kruskal-Wallis Test	.006	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Pairwise Comparisons of AD type



Each node shows the sample average rank of AD type

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
MA-LP	8.907	10.091	.883	.377	1.000
MA-HS	25.531	8.982	2.843	.004	.027
MA-Typical	25.838	9.434	2.739	.006	.037
LP-HS	-16.624	9.988	-1.664	.096	.576
LP-Typical	16.931	10.397	1.628	.103	.621
HS-Typical	.307	9.324	.033	.974	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

組數超過兩組-Post Hoc Tests

- Overall p -value < 0.05; 若拒絕虛無假設表示至少有一組平均值不相等，並非所有平均值均不相等
- 兩兩比較(pairwise comparison) :
 - 3 組(A,B,C)比較: (A v.s. B)(A v.s. C) (B v.s.C)
 - 4組比較 : 6種兩兩比較
- 至少一次檢定的 p 值小於0.05的機率
 - 4組比較 $1 - (1 - 0.05)^6 = 0.26$
- 常見post hoc比較法
 - Scheffe method
 - Bonferroni method
 - Least squares difference method (LSD)

$$H_0: \mu_0 = \mu_1 = \mu_2 = \mu_3$$

$$H_1: \mu_i \text{ 不全等}$$

# of popl.	n	Overall Type I error
3	3	0.1426
4	6	0.2649
5	10	0.4013
6	15	0.5367

Correlation

- Pearson correlation
 - Normal distribution
 - Continuous
- Spearman rank correlation
 - Skewed distribution
 - Ordinal/ Continuous

Table 4
Correlations of ANA, anti-dsDNA antibody, C3, C4 and subcomponents of PANSS and UKU in schizophrenia patients with SLE or autoimmune features.

	ANA titer		Anti-dsDNA antibody		C3		C4	
	r_s	p	r_s	p	r_s	p	r_s	p
N4 (social withdraw)	0.108	0.402	-0.010	0.940	-0.258	0.047*	-0.148	0.257
P3 (hallucinatory behavior)	-0.031	0.811	-0.041	0.754	-0.213	0.103	-0.285	0.027*
G9 (unusual thought content)	0.160	0.213	-0.172	0.181	-0.166	0.204	-0.296	0.022*
P1 (delusion)	0.097	0.452	-0.019	0.885	-0.271	0.036*	-0.158	0.229
N6 (lack of spontaneity)	-0.051	0.693	-0.007	0.958	-0.318	0.013*	-0.005	0.969
N1 (blunted affect)	0.046	0.721	-0.104	0.422	-0.327	0.011*	-0.036	0.783
G5 (mannerisms/posturing)	0.016	0.899	-0.093	0.472	-0.189	0.148	-0.063	0.635
P2 (conceptual disorganization)	0.387	0.002**	-0.011	0.933	-0.225	0.083	-0.200	0.125
UKU (increased salivation)	0.187	0.146	0.055	0.671	-0.325	0.011*	-0.162	0.217

說明：(相關係數數值範圍為-1~1)	
相關係數	相關程度
1	完全相關
0.7~0.99	高度相關
0.5~0.69	中度相關
0.25~0.49	低度相關
0~0.24	無相關

Spearman's rho coefficient.

PANSS: Positive and Negative Syndrome Scale.

UKU: Udvalg for Kliniske Undersøgelser rating scale.

* $p < 0.05$.

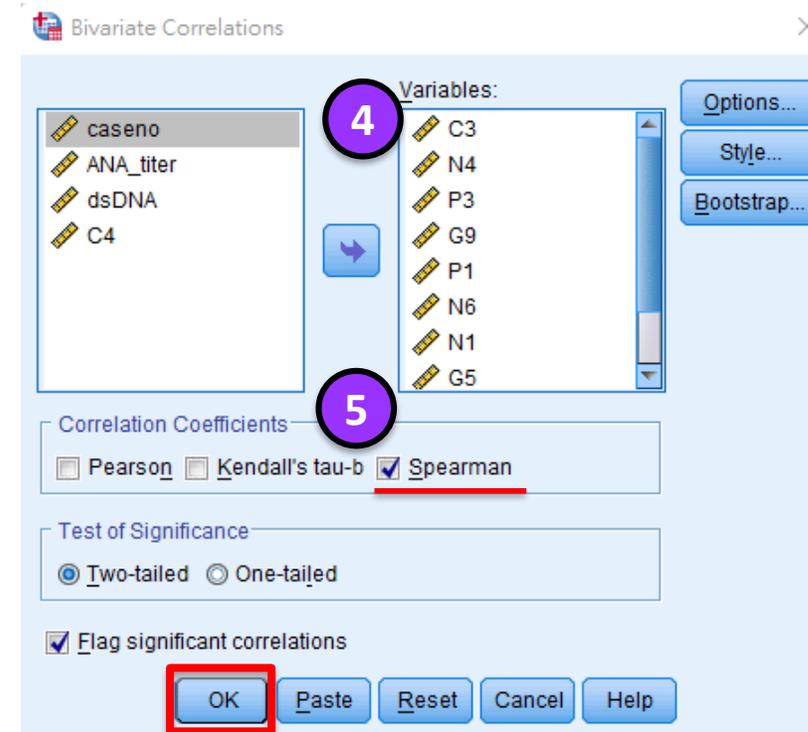
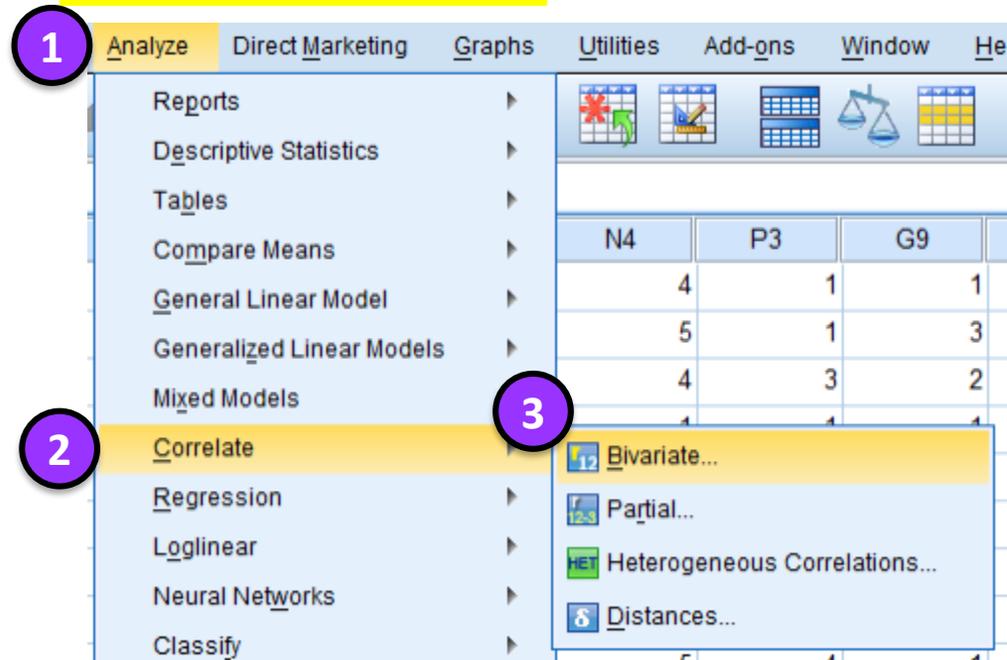
** $p < 0.01$.

Correlation SPSS dataset

	caseno	ANA_titer	dsDNA	C3	C4	N4	P3	G9	P1
1	1	1280	77.946	97.6	23.3	4	1	1	1
2	2	160	21.197	140.7	28.2	5	1	3	2
3	3	160	68.895	122.4	37.6	4	3	2	1
4	4	160	40.632	114.3	24.1	1	1	1	1
5	5	160	6.306	113.7	18.8	5	2	2	2
6	6	320	166.537	63.7	9.5	4	2	3	3
7	7	640	207.814	84.4	10.9	6	2	2	2
8	8	80	141.294	95.3	20.6	5	6	1	3
9	9	640	19.552	107.0	19.1	5	4	1	1
10	10	160	15.728	113.9	21.4	2	4	2	2
11	11	320	161.745	107.3	19.4	2	1	1	1
12	12	80	220.212	138.6	27.9	4	1	1	1

Correlation SPSS analysis

分析>相關>雙變數



Correlation SPSS output

Correlations

			C3	N4	P3	G9	P1	N6	N1	G5	P2	UKU
Spearman's rho	C3	Correlation Coefficient	1.000	-.258*	-.213	-.166	-.271*	-.318*	-.327*	-.189	-.225	-.325*
		Sig. (2-tailed)	.	.047	.103	.204	.036	.013	.011	.148	.083	.011
		N	60	60	60	60	60	60	60	60	60	60
	N4	Correlation Coefficient	-.258*	1.000	.159	.200	.290*	.404**	.541**	.102	.382**	.016
		Sig. (2-tailed)	.047	.	.217	.119	.022	.001	.000	.429	.002	.899
		N	60	62	62	62	62	62	62	62	62	62
	P3	Correlation Coefficient	-.213	.159	1.000	.342**	.439**	.000	.010	.294*	.290*	.177
		Sig. (2-tailed)	.103	.217	.	.007	.000	1.000	.939	.020	.022	.170
		N	60	62	62	62	62	62	62	62	62	62
	G9	Correlation Coefficient	-.166	.200	.342**	1.000	.791**	-.047	.101	.315*	.309*	.085
		Sig. (2-tailed)	.204	.119	.007	.	.000	.716	.435	.013	.014	.512
		N	60	62	62	62	62	62	62	62	62	62
	P1	Correlation Coefficient	-.271*	.290*	.439**	.791**	1.000	.078	.217	.383**	.410**	.176
		Sig. (2-tailed)	.036	.022	.000	.000	.	.547	.091	.002	.001	.172
		N	60	62	62	62	62	62	62	62	62	62
	N6	Correlation Coefficient	-.318*	.404**	.000	-.047	.078	1.000	.616**	.273*	-.026	-.193
		Sig. (2-tailed)	.013	.001	1.000	.716	.547	.	.000	.032	.843	.133
		N	60	62	62	62	62	62	62	62	62	62
	N1	Correlation Coefficient	-.327*	.541**	.010	.101	.217	.616**	1.000	.067	.218	-.012
		Sig. (2-tailed)	.011	.000	.939	.435	.091	.000	.	.606	.088	.926
		N	60	62	62	62	62	62	62	62	62	62
	G5	Correlation Coefficient	-.189	.102	.294*	.315*	.383**	.273*	.067	1.000	.128	.033
		Sig. (2-tailed)	.148	.429	.020	.013	.002	.032	.606	.	.321	.801
		N	60	62	62	62	62	62	62	62	62	62
	P2	Correlation Coefficient	-.225	.382**	.290*	.309*	.410**	-.026	.218	.128	1.000	.257*
		Sig. (2-tailed)	.083	.002	.022	.014	.001	.843	.088	.321	.	.043
		N	60	62	62	62	62	62	62	62	62	62
	UKU	Correlation Coefficient	-.325*	.016	.177	.085	.176	-.193	-.012	.033	.257*	1.000
		Sig. (2-tailed)	.011	.899	.170	.512	.172	.133	.926	.801	.043	.
		N	60	62	62	62	62	62	62	62	62	62

*. Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Summary

有母數分析

- Independent T-test
- Paired T-test
- ANOVA
- Pearson correlation

無母數分析

- Mann-Whitney U test
- Wilcoxon signed-rank
- Kruskal-Wallis test
- Spearman rank correlation

感謝您的聆聽！

Thank you !

