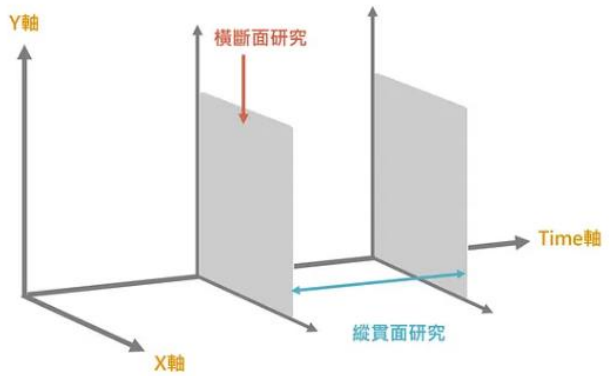
相關樣本/配對資料的統計推論

醫學研究部生統小組
陳俊朋
日期: 2025/5/20

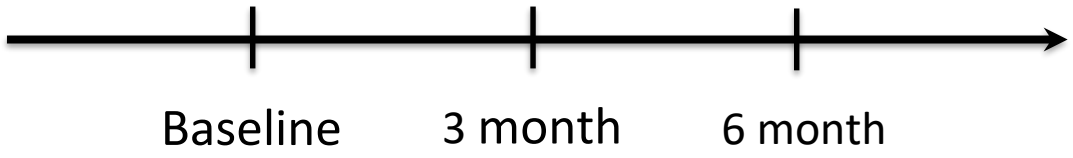
研究設計

Cross-sectional	Longitudinal
Single point in time	Period of time
Different samples	Same sample
Provides snapshot of society at a given point	Follows changes in participants over time
Compare many different variables at the same time	The difference between these studies is the timeline and variable
Cheaper	Expensive and require more resources

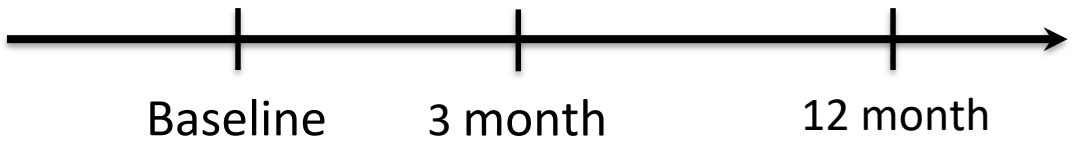


重複測量使用時機

- 相同受試者在不同時間點進行多次測量
  - 間隔時間相同



  - 間隔時間不同



重複測量優缺點

- 優點
  - 需求樣本數較少
  - 不同時間點變化
  - 不同組別，隨著時間的變化
- 缺點
  - 資料完整性不佳
  - 個案須定期追蹤
  - 某些因素可能影響資料

重複測量統計

- 單組重複測量
  - 同一組內的個案，在多個時間點測量
- 多組重複測量
  - 將個案分組後，依照各組分類在多個時間點測量

重複測量統計方法

重複2次

- 類別變項
  - McNemar test (2*2 table)
  - McNemar-Bowker test (3*3 table)
- 連續變項
  - Paired t test
  - Wilcoxon signed-rank test
  - ANCOVA

重複3次以上

- 類別變項
  - Cochran's Q test
- 連續變項
  - Friedman test
  - Repeated measures ANOVA
  - Linear Mixed Model (LMM)
  - Generalized Estimating Equation (GEE)

重複測量建檔

- 寬資料

no	Group	Sex	MMSE_1	MMSE_2	MMSE_3
N01	0	0	30	28	30
N02	0	1	11	15	14
N03	0	1	26	28	26
N04	0	0	22	21	22
N05	0	0	27	26	25

- 長資料

no	Group	Sex	visit	MMSE
N01	0	0	1	30
N01	0	0	2	28
N01	0	0	3	30
N02	0	1	1	11
N02	0	1	2	15
N02	0	1	3	14
N03	0	1	1	26
N03	0	1	2	28
N03	0	1	3	26
N04	0	0	1	22
N04	0	0	2	21
N04	0	0	3	22
N05	0	0	1	27
N05	0	0	2	26
N05	0	0	3	25

McNemar test

- 僅適用2*2 table
- 單組同一人前後測/兩種不同診斷工具

International Urogynecology Journal
https://doi.org/10.1007/s00192-021-04977-7

ORIGINAL ARTICLE

Transvaginal repair of anterior vaginal wall prolapse with polyvinylidene fluoride (PVDF) mesh: an alternative for previously restricted materials?

Mohammad-Javad Eslami[1] · Mahtab Zargham[1] · Farshad Gholipour[2] · Mohammadreza Hajian[3] · Katayoun Bakhtiari[4] · Sakineh Hajebrahimi[5] · Melina Eghbal[6] · Ziba Farajzadegan[7]

Table 3 Urinary and vaginal symptoms at baseline and 12-month follow-up

	Preoperative	Postoperative (12 months)	*P* value
Storage symptoms (*N*=108)			
SUI: *n* (%)	74 (68.5%)	7 (6.5%)	<0.0001 *
UUI: *n* (%)	33 (30.5%)	9 (8.3%)	<0.0001 *
MUI: *n* (%)	29 (26.9%)	3 (2.8%)	<0.0001 *
Other storage symptoms	30 (27.8%)	8 (7.4%)	<0.0001 *
Voiding symptoms: *n* (%) (*N*=108)	24 (22.2%)	13 (12%)	0.019 *
ICIQ-UI (mean±SD) (*N*=98)	8.79±6.05	0.77±1.87	<0.0001**
ICIQ-VS (mean±SD) (*N*=41)			
Vaginal symptoms	43.31±6.13	7.49±3.75	<0.0001**
Sexual symptoms	43.17±6.15	7.82±4.89	<0.0001**
Quality of life	8.27±0.98	1.6±1.73	<0.0001**

* McNemar's test

** Wilcoxon signed-rank test

International Urogynecology Journal (2022): 1-9.

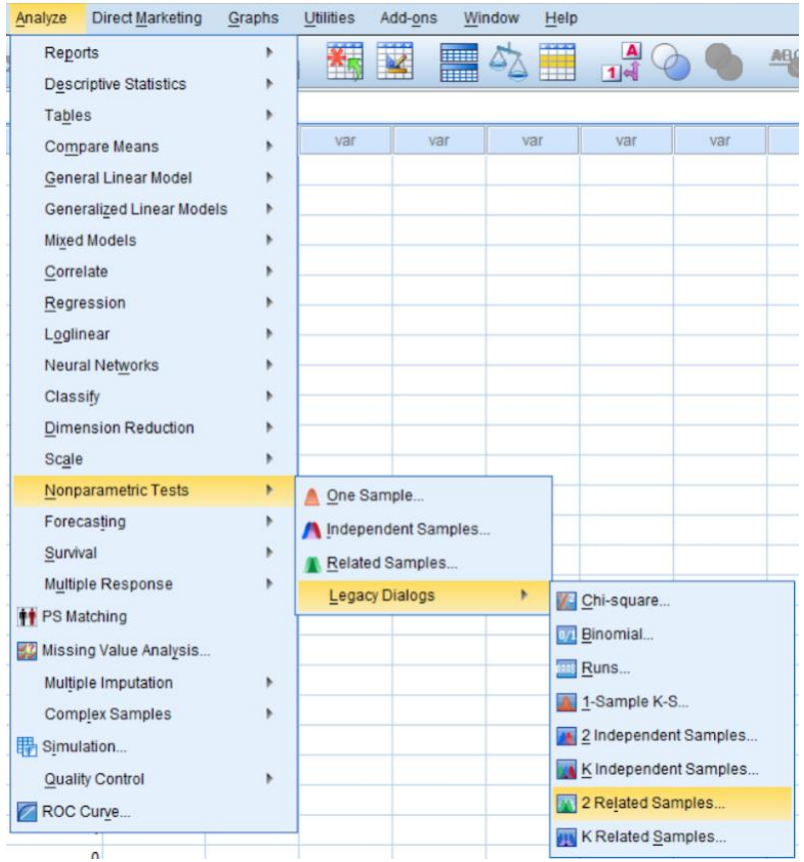
McNemar test dataset

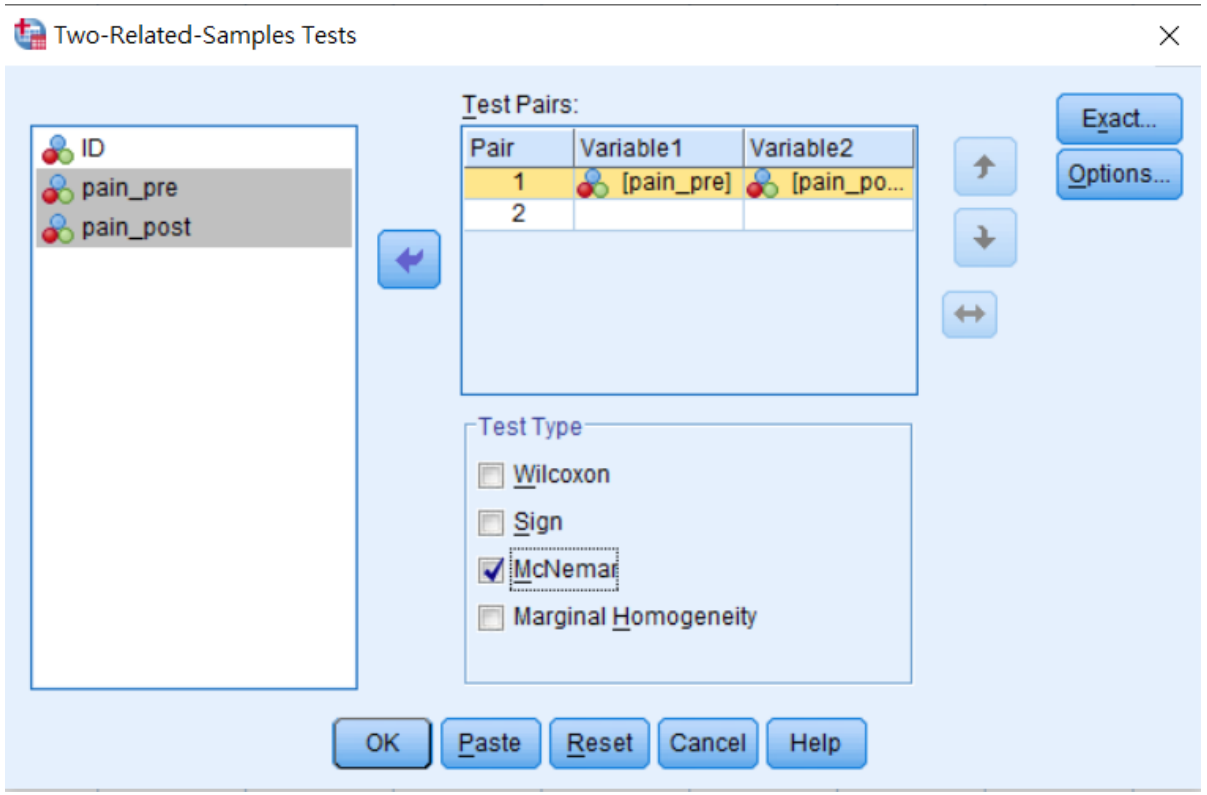
- 術前和術後有無疼痛比較

ID	pain_pre	pain_post
1	1	0
2	0	0
3	0	0
4	0	0
5	0	0
6	1	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	1	0
13	0	0
14	0	0
15	0	0

McNemar test analysis

分析>無母數檢定>歷史對話記錄>2個相關樣本





McNemar test output

McNemar Test

Crosstabs

pain_pre & pain_post

pain_pre	pain_post 0	pain_post 1
0	21	0
1	5	1

Test Statistics[a]

	pain_pre & pain_post
N	27
Exact Sig. (2-tailed)	.063[b]

a. McNemar Test

b. Binomial distribution used.

pain_post * pain_pre Crosstabulation

			pain_pre 0	pain_pre 1	Total
pain_post	0	Count	21	5	26
		% of Total	77.8%	18.5%	96.3%
	1	Count	0	1	1
		% of Total	0.0%	3.7%	3.7%
Total		Count	21	6	27
		% of Total	77.8%	22.2%	100.0%

Table.

	Pre-OP	Post-OP 1y	*p* value
Symptoms			
pain	6(22.2%)	1(3.7%)	0.063

McNemar test. *$p<0.05$, **$p<0.01$

Cochran's Q test

- 單組的相同個案，用同一工具測量三次/不同工具(類別型資料屬於二分類)

Open access Original research

BMJ Open

Implementation of a comprehensive surveillance system for recording suicides and attempted suicides in rural India

Lakshmi Vijayakumar,[1] Soumitra Pathare,[2] Nikhil Jain,[2] Renuka Nardodkar ,[2] Deepa Pandit,[2] Sadhvi Krishnamoorthy,[2] Jasmine Kalha,[2] Laura Shields-Zeeman[3]

Table 4 Comparison of the ability of community surveillance in obtaining additional data on suicide compared with the hospital and police records

	Non-case	Case	Test statistics
Community surveillance	15	67	Cochran's Q test 67.9 ($p<0.01$)
Hospital records	69	13	
Police records	65	17	

BMJ open 10.11 (2020): e038636.

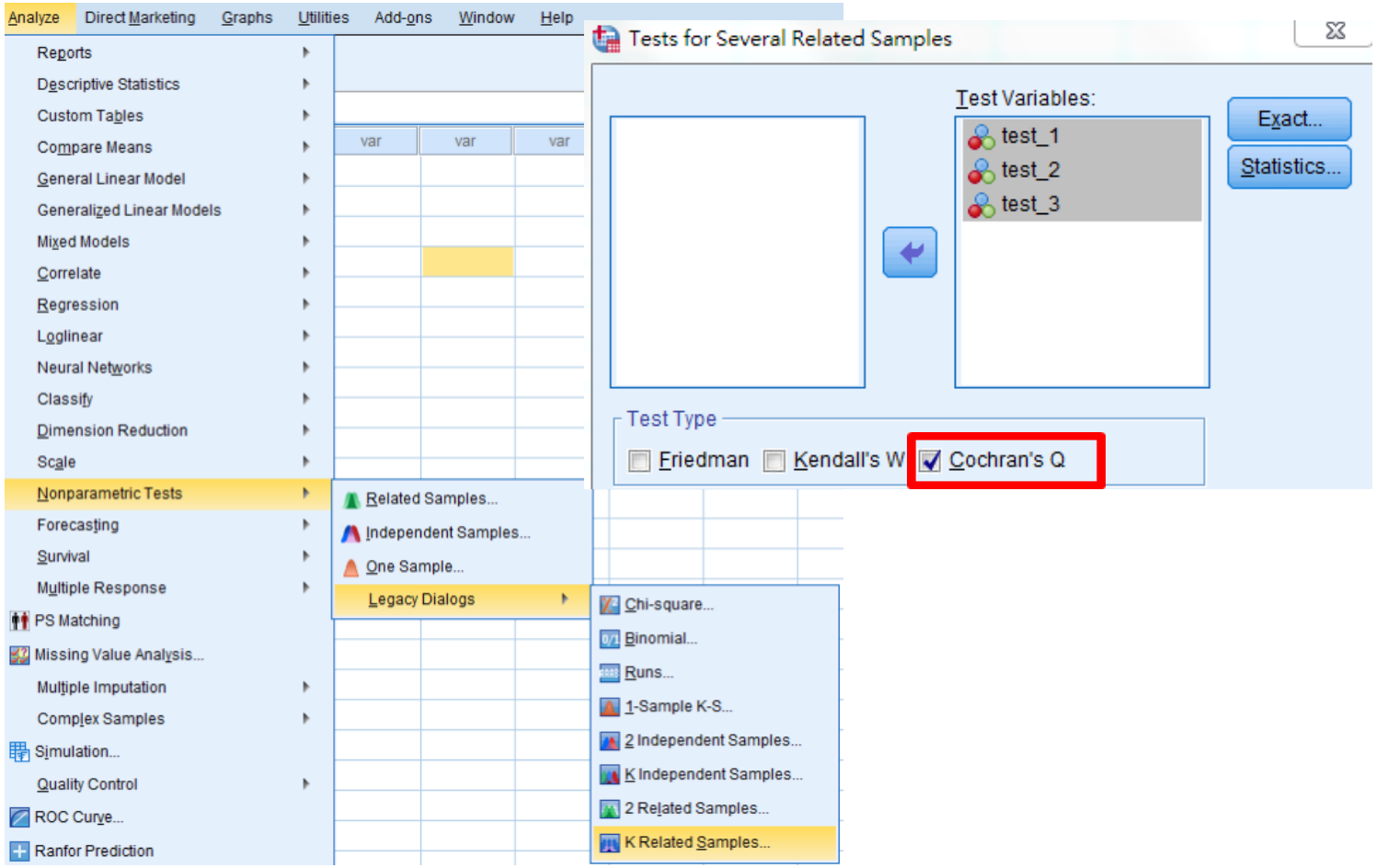
Cochran Q test dataset

- 同一組個案，測量三次時間點(類別型資料--二分類)
- 0: 無抽菸; 1: 有抽菸

no	test_1	test_2	test_3
1	0	1	1
2	0	1	1
3	1	1	1
4	1	0	1
5	0	0	0
6	1	1	1
7	1	1	1
8	1	0	1
9	1	1	1
10	0	0	1
11	1	1	1
12	1	1	1
13	1	0	1
14	1	0	0
15	0	0	1

Cochran Q test analysis

分析>無母數檢定>歷史對話記錄>K個相關樣本



Cochran Q test output

Cochran Test

Frequencies

	Value	
	0	1
test_1	5	10
test_2	7	8
test_3	2	13

Test Statistics

N	15
Cochran's Q	4.750[a]
df	2
Asymp. Sig.	.093

a. 0 is treated as a success.

Table.

	Test1 (n=15)	Test2 (n=15)	Test3 (n=15)	*p* value
Smoking				0.093
No	5 (33.3%)	7 (46.7%)	2 (13.3%)	
Yes	10 (66.7%)	8 (53.3%)	13 (86.7%)	

Cochran Q test.

Paired t test

- 針對常態分布的連續數值或是大樣本的資料做平均值的比較
- 用於前後測比較。

frontiers in Medicine

ORIGINAL RESEARCH
published: 11 February 2022
doi: 10.3389/fmed.2021.698728

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 Lin[2], Hui-Ping Lin[7], 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

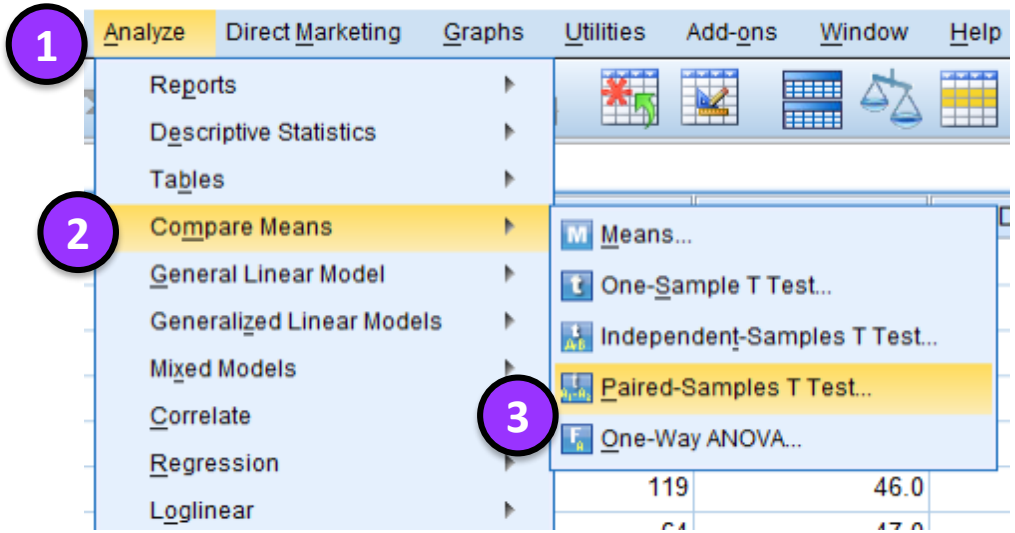
Frontiers in Medicine (2021), 8

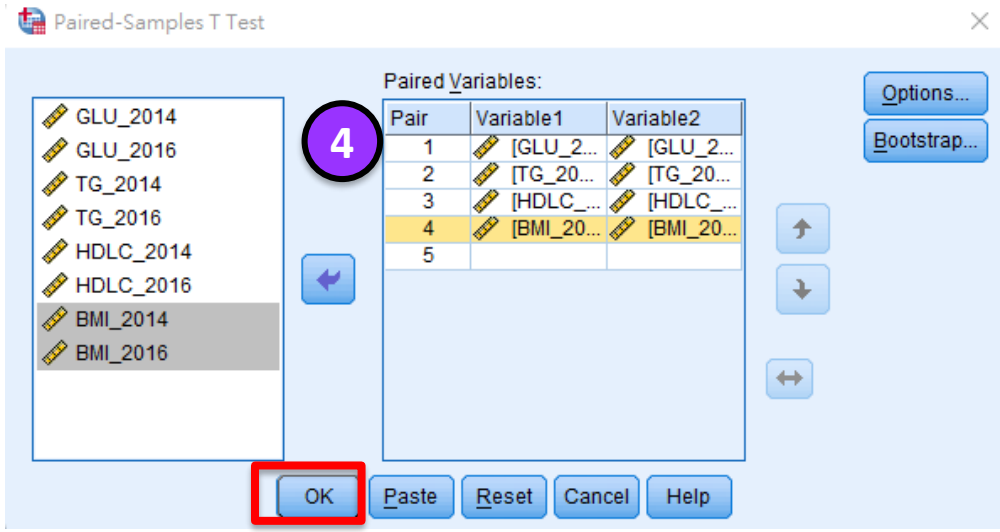
Paired t test dataset

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 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

- 針對非常態分布的連續數值或小樣本，檢定兩組資料的中位數
- 用於前後測比較

Tu *et al. BMC Musculoskeletal Disorders* (2021) 22:559
https://doi.org/10.1186/s12891-021-04439-7

BMC Musculoskeletal Disorders

RESEARCH Open Access

Direct reduction of high-grade lumbosacral spondylolisthesis with anterior cantilever technique - surgical technique note and preliminary results

Kao-Chang Tu[1†], Cheng-Min Shih[1,2,3†], Kun-Hui Chen[1,4,5], Chien-Chou Pan[1,6], Fuu-Cheng Jiang[7], Cheng-En Hsu[1,8†], Yun-Ming Wang[9] and Cheng-Hung Lee[1,10*]

Table 3 Changes in pre- and postoperative radiographic parameters

	Pre-operative ($n = 11$)		Postoperative ($n = 11$)		p value
EQ5D					
	12.0	(10.3, 12.0)	7.0	(5.0, 9.75)	0.018*
VAS					
	9.5	(8.0, 10.0)	2.5	(0.0, 6.0)	0.018*
ODI					
	59.4	(54.4, 65.6)	22.22	(7.2, 49.2)	0.017*

Wilcoxon signed rank, median (IQR). *$P < 0.05$, **$P < 0.01$

EQ-5D European Quality of Life questionnaire *ODI* Oswestry Disability Index,*VAS* visual analogue scale.

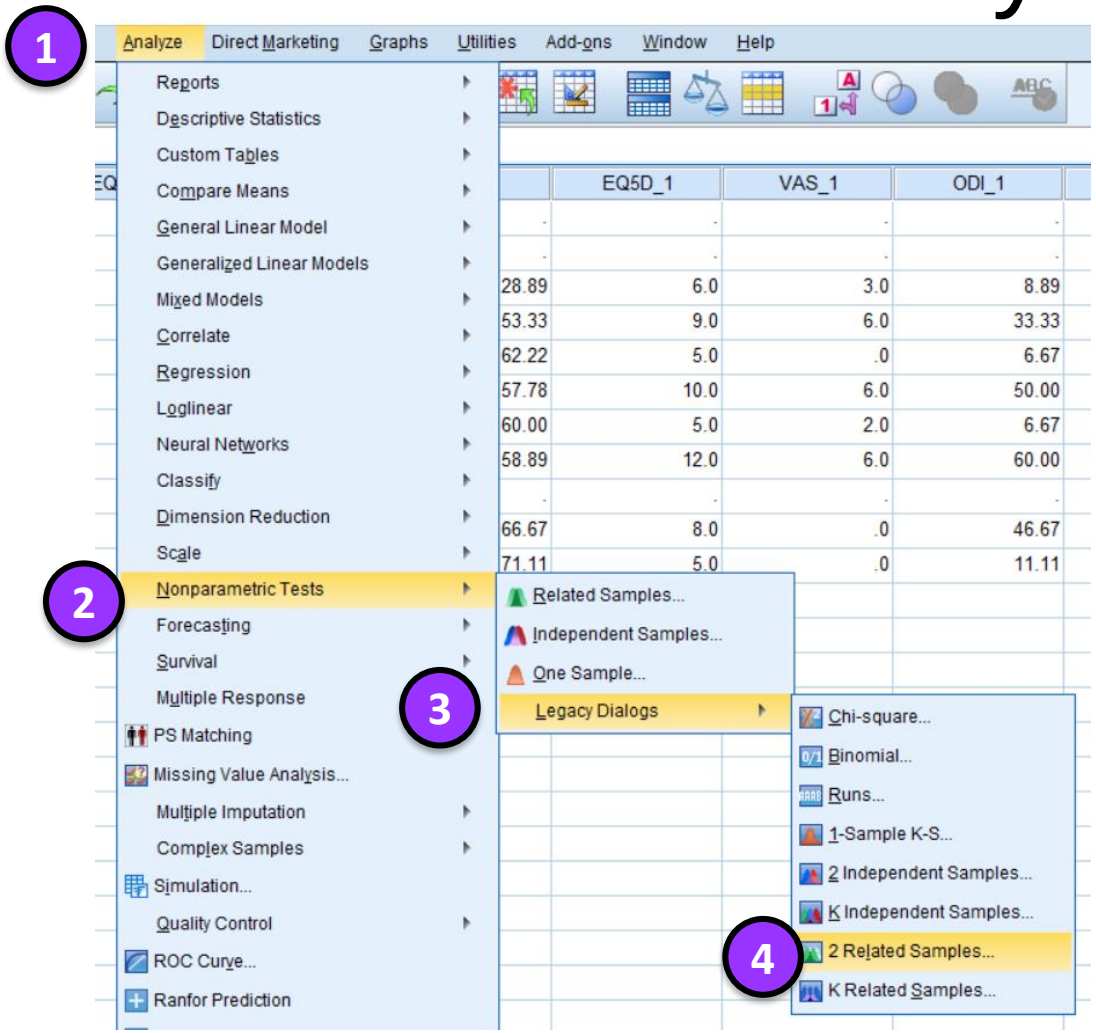
BMC Musculoskeletal Disorders 22.1 (2021): 559..

Wilcoxon signed-rank test dataset

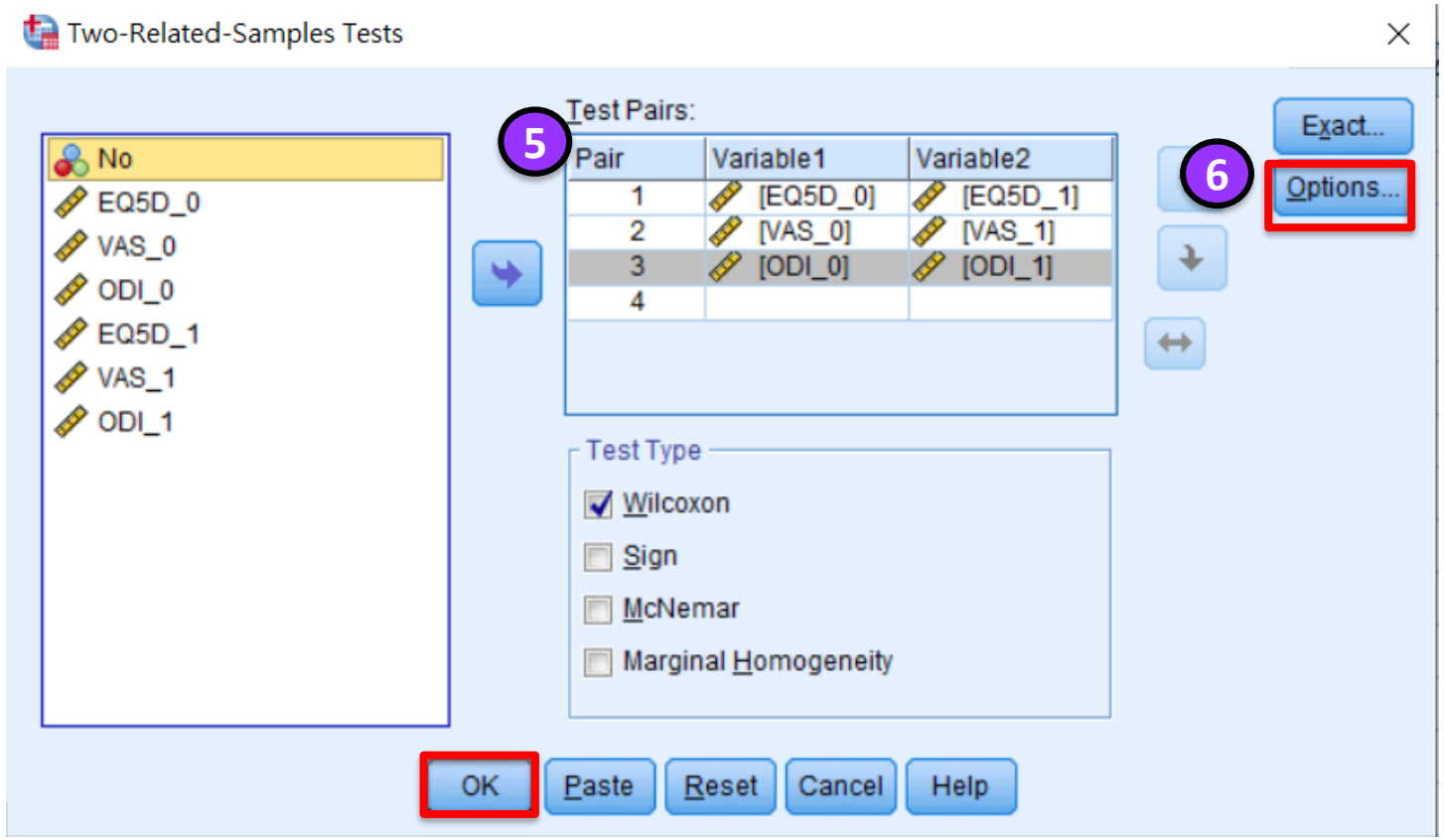
No	EQ5D_0	VAS_0	ODI_0	EQ5D_1	VAS_1	ODI_1
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	8.0	3.0	28.89	6.0	3.0	8.89
4	12.0	10.0	53.33	9.0	6.0	33.33
5	12.0	10.0	62.22	5.0	.0	6.67
6	11.0	8.0	57.78	10.0	6.0	50.00
7	10.0	9.0	60.00	5.0	2.0	6.67
8	12.0	10.0	58.89	12.0	6.0	60.00
9	.	.	.	.	.	.
10	12.0	8.0	66.67	8.0	.0	46.67
11	13.0	10.0	71.11	5.0	.0	11.11

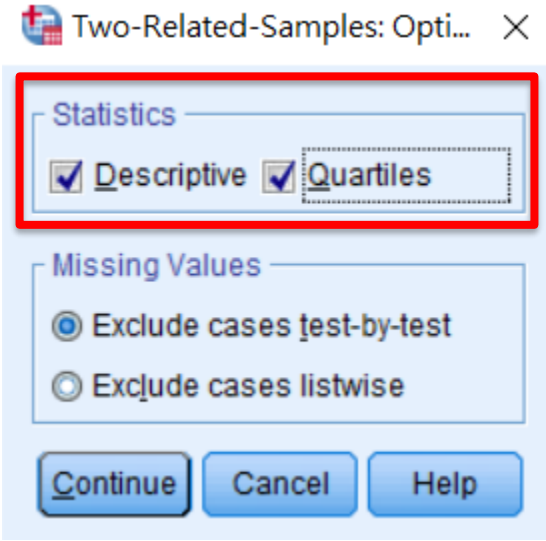
Wilcoxon signed-rank SPSS analysis-1

分析>無母數檢定>歷史對話記錄>2個相關樣本



Wilcoxon signed-rank SPSS analysis-2





Wilcoxon signed-rank SPSS output

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
EQ5D_0	8	11.250	1.5811	8.0	13.0	10.250	12.000	12.000
VAS_0	8	8.500	2.3905	3.0	10.0	8.000	9.500	10.000
ODI_0	8	57.3613	12.73705	28.89	71.11	54.4425	59.4450	65.5575
EQ5D_1	8	7.500	2.6726	5.0	12.0	5.000	7.000	9.750
VAS_1	8	2.875	2.7999	.0	6.0	.000	2.500	6.000
ODI_1	8	27.9175	22.18534	6.67	60.00	7.2250	22.2200	49.1675

Test Statistics[a]

	EQ5D_1 - EQ5D_0	VAS_1 - VAS_0	ODI_1 - ODI_0
Z	-2.366[b]	-2.375[b]	-2.392[b]
Asymp. Sig. (2-tailed)	.018	.018	.017

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

在EQ5D、VAS及ODI的部分，術前和術後皆有統計差異
術後的中位數皆低於術前

Friedman test

- 相同個案，測量三次時間點(數值型資料)
- 整體顯著可再做事後檢定(Dunn-Bonferroni)

BURNS 46 (2020) 1942 –1951

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/burns

The effect of foot reflexology massage on burn-specific pain anxiety and sleep quality and quantity of patients hospitalized in the burn intensive care unit (ICU)

Reza Alinia-najjar [a], *Masoumeh Bagheri-Nesami* [b,c,*], *Seyed Afshin Shorofi* [b,d], *Seyed Nouraddin Mousavinasab* [e], *Kiarash Saatchi* [f]

Table 3 – Comparison of median of duration of last night's sleep on the third, fourth, fifth and sixth days of hospitalization in two groups.

Duration of last night's sleep		Third day (before the intervention)	Fourth day (before the intervention)	Fifth day (before the intervention)	Sixth day (before the intervention)	Friedman statistic and *p*-value
Intervention	Median	4.5 (3–7.5)[a]	6 (3–7.3)	6 (3–7.5)	8 (5.5–9.75)	X^2=60.184
						$p<0.001$
Control	Median	4.5 (3–7.5)	4.30 (3–7.3)	4.5 (3–7.5)	4.5 (3–7)	X^2=12.183
						p=0.007
Mann–Whitney U test and *p*-values		Z=0.000	Z=2.28	Z=3.24	Z=6.12	
		p=1.000	p=0.023	$p<0.001$	$p<0.001$	

[a] (Min–Max).

Burns 46.8 (2020): 1942-1951

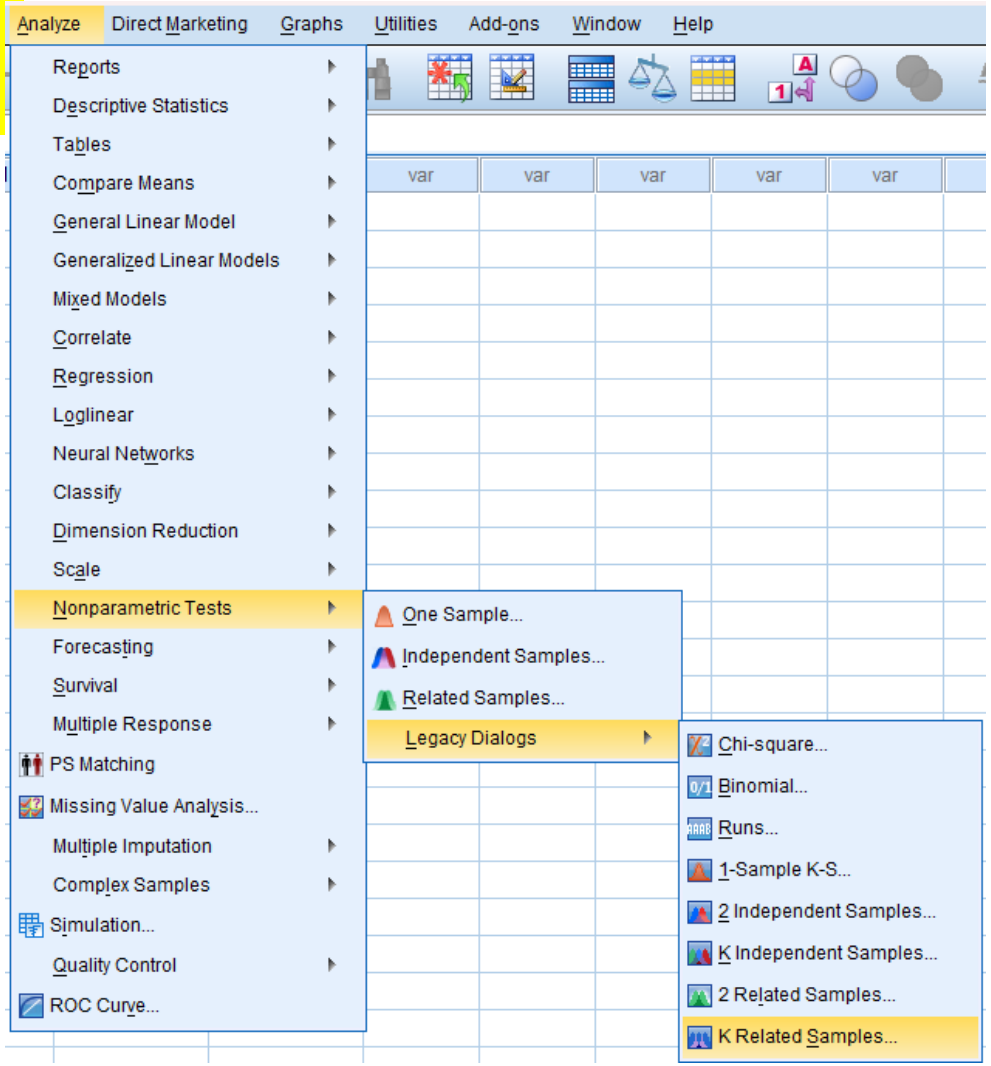
Friedman test dataset

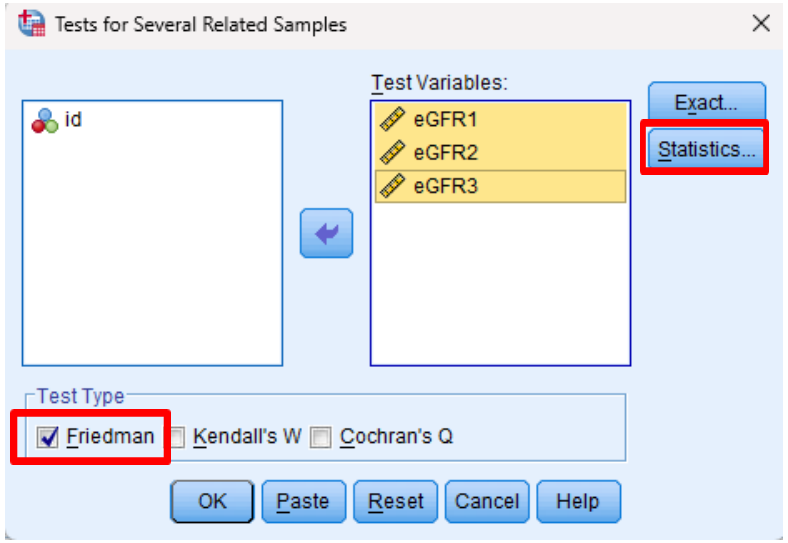
- 同一組個案，測量三次時間點(數值型資料)
- 整體顯著可再做事後檢定(Dunn-Bonferroni)

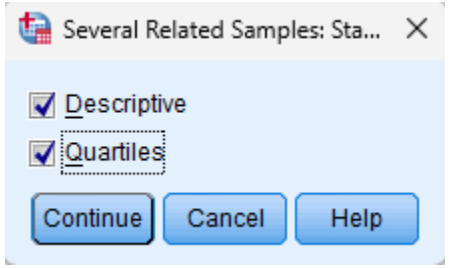
id	eGFR1	eGFR2	eGFR3
1	60.6	80.2	13.6
2	85.9	14.4	48.1
3	56.7	60.6	78.9
4	47.3	32.7	89.1
5	42.7	59.7	97.9
6	100.4	71.1	60.7
7	42.8	80.7	38.9
8	80.2	75.2	32.1
9	14.4	73.4	48.1
10	60.6	21.2	80.3
11	38.9	50.6	30.7
12	32.1	62.6	59.1
13	48.1	56.8	15.1
14	80.3	58.2	36.5
15	30.7	55.4	74.5

Friedman test analysis

分析>無母數檢定>歷史對話記錄>K個相關樣本







Friedman test output

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
eGFR1	57	50.565	20.7201	14.4	100.4	32.590	48.090	67.365
eGFR2	57	59.949	17.1628	14.4	99.8	52.150	60.570	71.830
eGFR3	57	49.082	21.6933	13.6	97.9	32.070	42.910	69.035

Friedman Test

Ranks

	Mean Rank
eGFR1	1.84
eGFR2	2.33
eGFR3	1.82

Test Statistics[a]

N	57
Chi-Square	9.509
df	2
Asymp. Sig.	.009

a. Friedman Test

Table. (N=57)

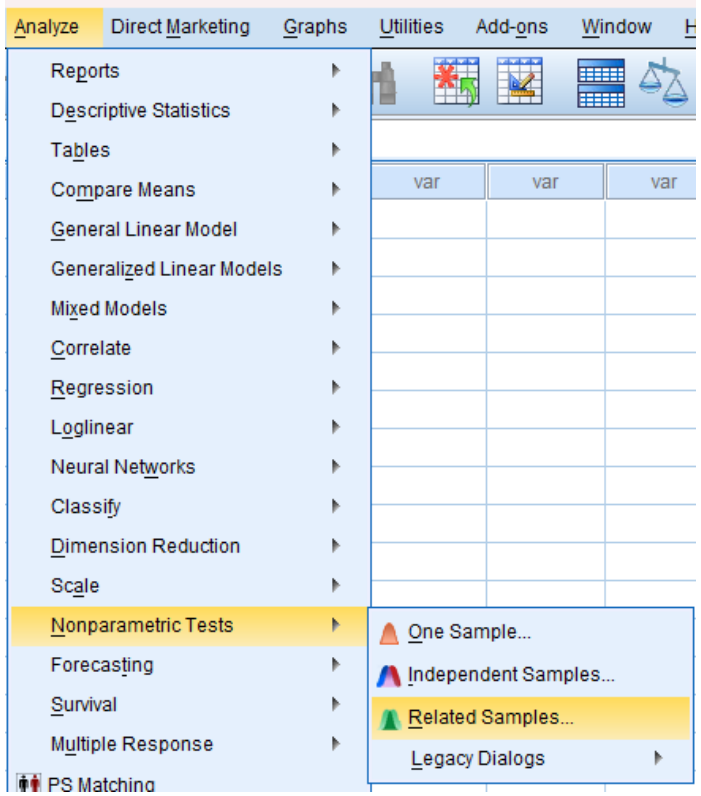
	Baseline	3 month	6 month	*P value*
eGFR	48.1 (32.6-67.4)	60.6 (52.2-71.8)	42.9 (32.1-69.0)	0.009

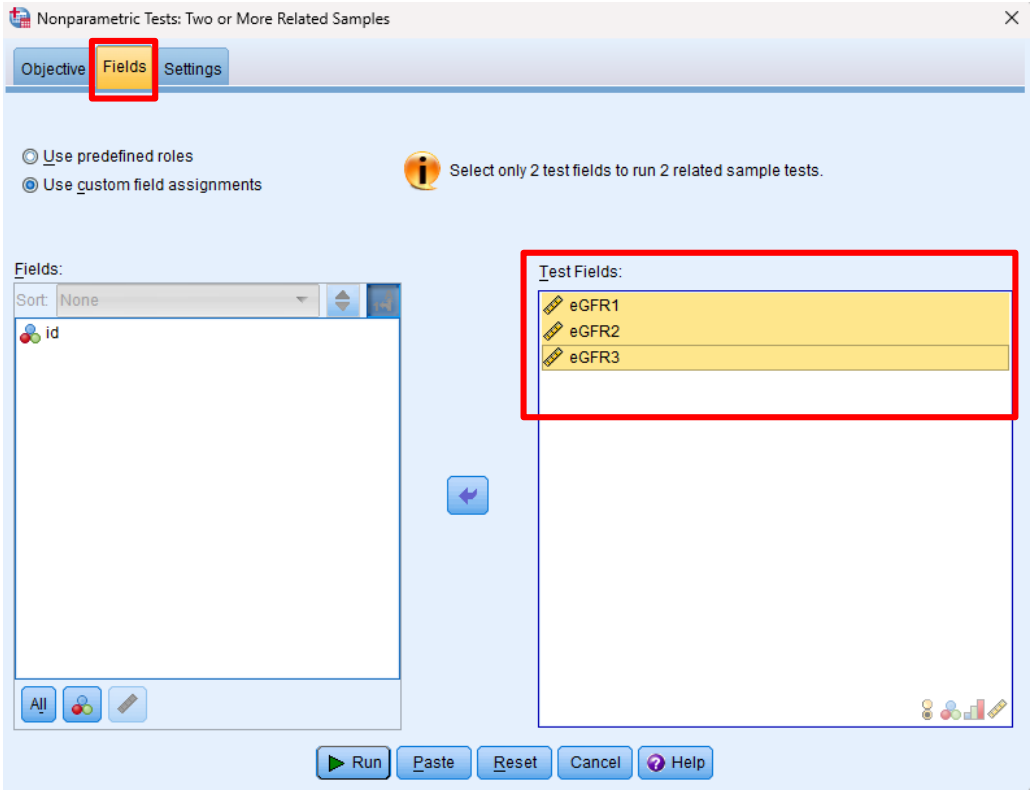
Friedman test. Median (IQR)

Friedman test (Post-hoc)

Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure
id	Numeric	2	0		None	None	10	Right	Nominal
eGFR1	Numeric	2	1		None	None	10	Right	Scale
eGFR2	Numeric	2	1		None	None	10	Right	Scale
eGFR3	Numeric	2	1		None	None	10	Right	Scale

分析>無母數檢定>相關樣本





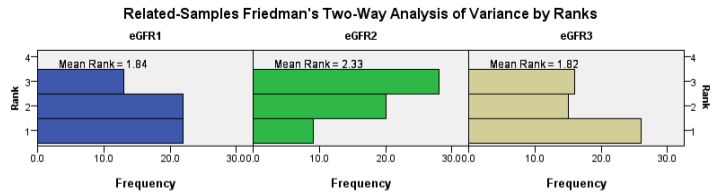
Friedman test (Post-hoc output)

1

Hypothesis Test Summary

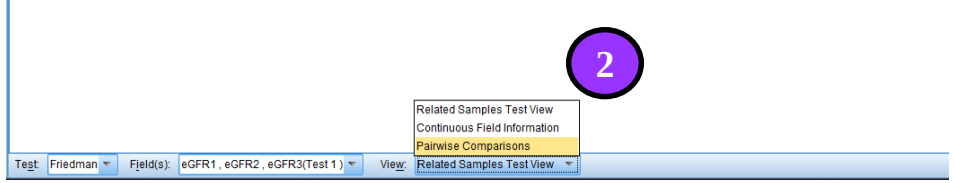
	Null Hypothesis	Test	Sig.	Decision
1	The distributions of eGFR1, eGFR2 and eGFR3 are the same.	Related-Samples Friedman's Two-Way Analysis of Variance by Ranks	.009	Reject the null hypothesis.

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



Total N	57
Test Statistic	9.509
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.009

2



Each node shows the sample average rank.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
eGFR3-eGFR1	.018	.187	.094	.925	1.000
eGFR3-eGFR2	.509	.187	2.716	.007	.020
eGFR1-eGFR2	-.491	.187	-2.622	.009	.026

3

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.

Repeated measures ANOVA

- Outcome為數值型資料且需符合常態分佈
- 寬資料，有一次資料missing則排除此個案

Neurodegeneration

ORIGINAL RESEARCH

Effects of vitamin D supplementation on cognitive function and blood Aβ-related biomarkers in older adults with Alzheimer's disease: a randomised, double-blind, placebo-controlled trial

Jingya Jia,[1] Jing Hu,[1] Xiaoxu Huo,[1] Rujuan Miao,[1] Yanping Zhang,[2] Fei Ma [1]

Table 2 The level of biochemical parameters at baseline, 6 months and 12 months between the two groups

			Treatment time*			Repeated measures†		
Items	groups	Cases (n)	Baseline	6 months	12 months	Interaction effect, P	Time effect, P	Group effect, P
Aβ40 (pg/mL)	Intervention	105	27.78±20.80	26.88±20.81	28.62±20.79	0.468	0.027	0.480
	Control	105	33.46±24.06	32.43±24.00	33.22±23.20			
Aβ42 (pg/mL)	Intervention	105	34.39±21.71	32.33±21.70	30.50±21.69	<0.001	<0.001	0.987
	Control	105	33.28±21.26	33.76±21.24	33.19±20.51			
PS1 (pg/mL)	Intervention	105	48.78±44.39	48.89±44.39	48.89±44.39	0.951	0.727	0.272
	Control	105	44.51±37.92	44.63±37.92	44.74±37.65			
PS2 (pg/mL)	Intervention	105	10.43±19.02	10.57±19.02	10.69±19.03	0.142	<0.001	0.133
	Control	105	11.01±17.44	11.17±17.44	11.55±17.53			
PS1mRNA	Intervention	105	28.85±2.59	30.19±2.61	29.77±2.59	0.040	<0.001	0.070
	Control	105	28.89±2.58	30.41±2.58	29.86±2.60			
PS2mRNA	Intervention	105	4.00±0.43	4.34±0.53	4.17±0.53	0.121	<0.001	0.409
	Control	105	4.18±0.39	4.60±0.61	4.34±0.38			
APP	Intervention	105	44.75±39.77	41.69±39.73	39.96±39.59	<0.001	<0.001	<0.001
	Control	105	44.71±33.20	42.56±33.20	45.56±33.24			
APPmRNA	Intervention	105	32.59±1.53	30.28±1.50	27.96±1.54	<0.001	<0.001	<0.001
	Control	105	32.41±1.41	31.44±1.47	31.55±1.38			
BACE1 (μg/mL)	Intervention	105	300.83±11.96	298.14±11.97	296.23±12.01	<0.001	<0.001	<0.001
	Control	105	299.94±12.05	297.76±12.06	300.62±11.84			
BACE1mRNA	Intervention	105	27.59±1.29	25.29±1.55	23.48±1.91	<0.001	<0.001	<0.001
	Control	105	27.24±1.32	26.09±1.31	27.82±1.27			
25-D (ng/mL)	Intervention	105	18.82±2.91	20.90±3.12	22.77±3.41	<0.001	<0.001	<0.001
	Control	105	19.44±2.81	19.18±2.81	19.08±2.84			
1,25-D (ng/mL)	Intervention	105	30.37±2.60	31.79±2.57	33.61±2.77	<0.001	<0.001	<0.001
	Control	105	30.22±2.67	29.01±2.67	30.71±2.64			

*Presented as mean±SD.
†P value for group (intervention vs control) derived from analysis of covariance adjusted for respective baseline value and for age, gender and education.
Aβ, amyloid beta; APP, Aβ protein precursor; BACE1, β-secretase 1; 25-D, 25-hydroxy vitamin D; 1,25-D, 1,25-dihydroxy vitamin; PS, presenilin.

Journal of Neurology, Neurosurgery & Psychiatry 90.12 (2019): 1347-1352

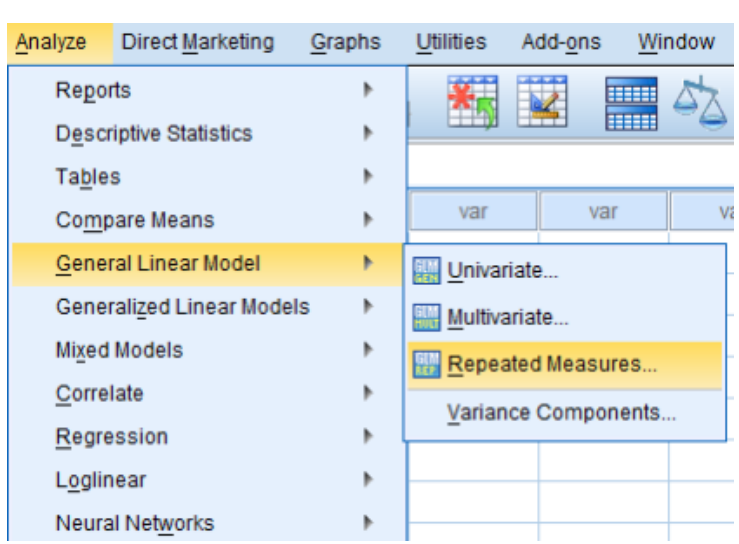
Repeated measures ANOVA dataset

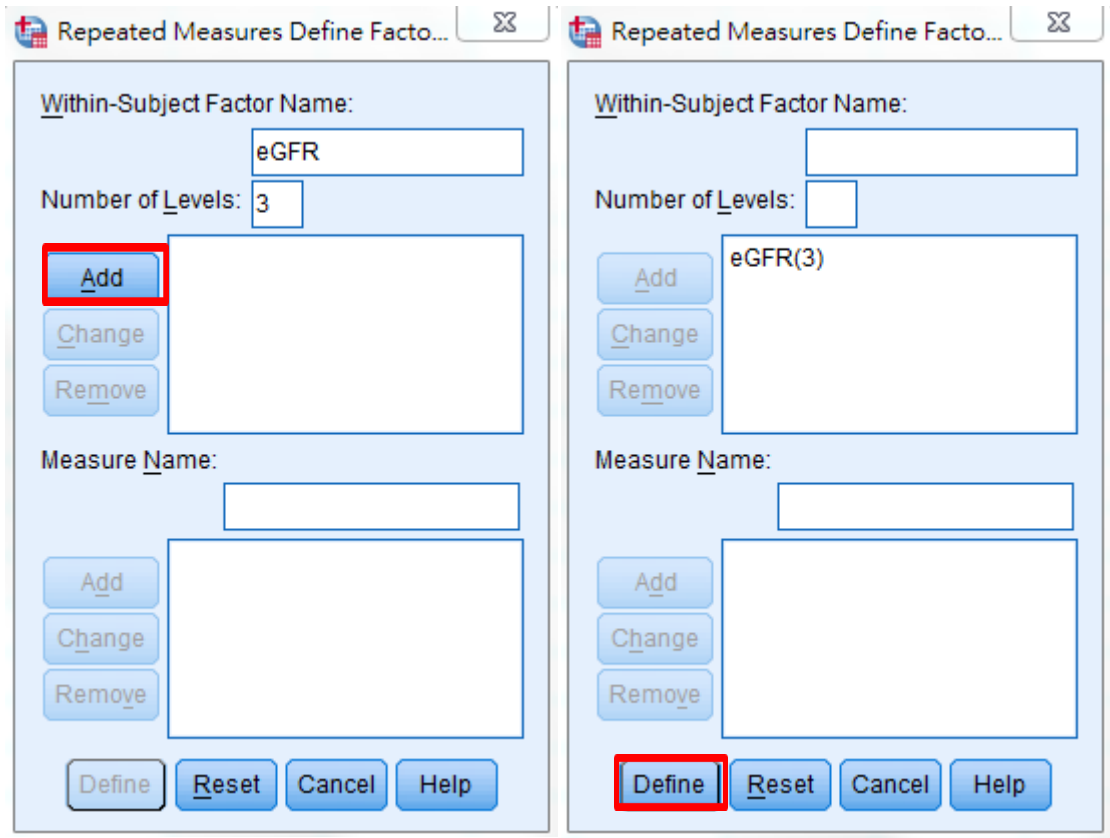
- 兩組測量三個時間點(數值型資料)
- 整體顯著可再做事後檢定

id	Group	eGFR_1	eGFR_2	eGFR_3
1	1	51.58	53.66	53.36
2	1	3.25	3.59	3.29
3	1	4.63	3.46	3.16
4	1	6.35	9.14	8.84
5	1	6.94	15.11	14.81
6	1	11.74	35.74	35.44
7	1	13.61	14.83	14.53
8	1	14.03	51.58	51.28
9	1	14.38	22.64	22.34
10	1	14.70	12.23	11.93
11	1	16.97	25.45	25.15
12	1	19.99	38.94	38.64
13	1	21.23	31.18	30.88
14	1	21.99	32.92	32.62
15	0	26.60	30.72	30.42

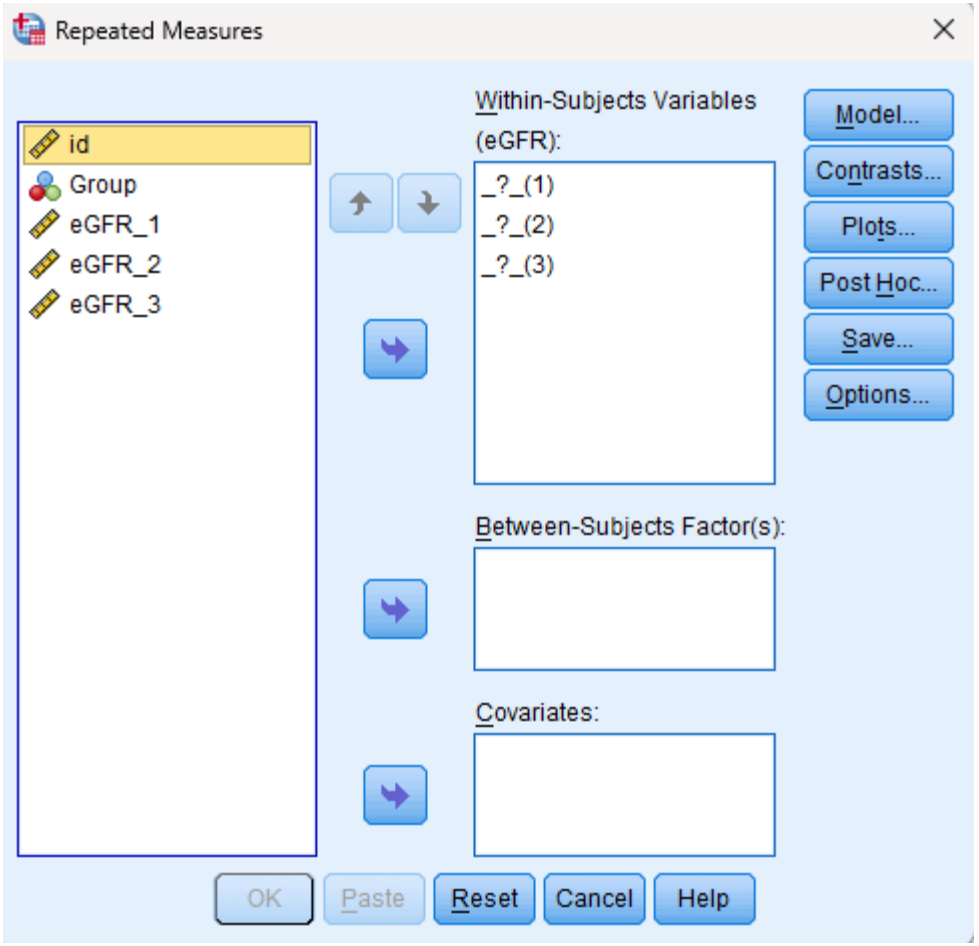
Repeated measures ANOVA analysis-1

分析>一般線性模式>重複測量

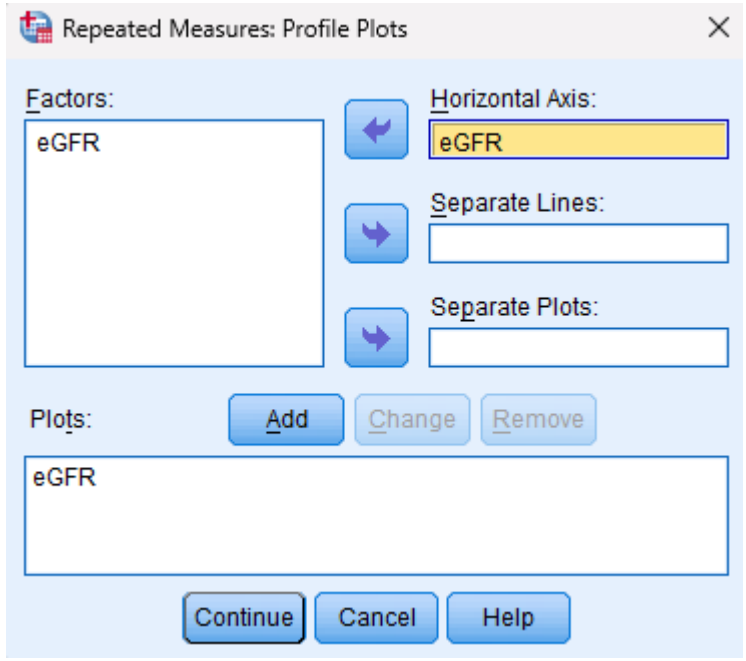


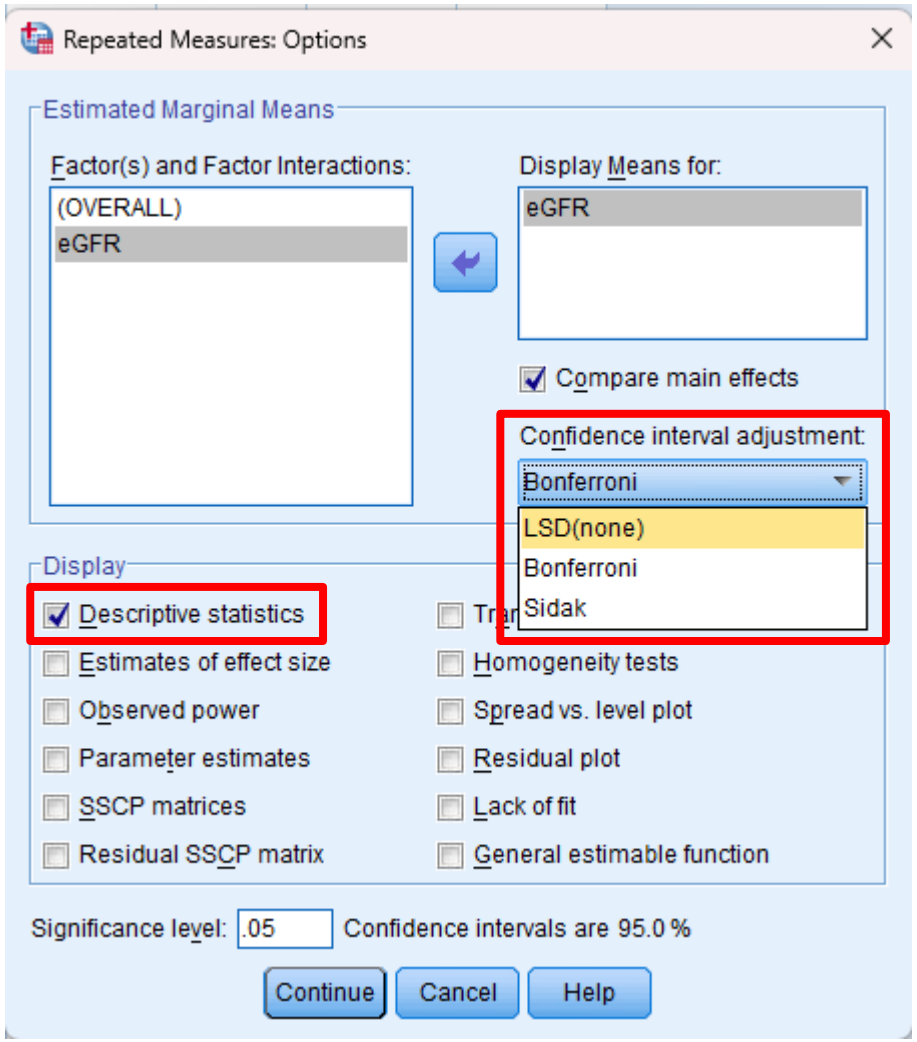


Repeated measures ANOVA analysis-2



Repeated measures ANOVA analysis-3





Repeated measures ANOVA output

Descriptive Statistics

	Mean	Std. Deviation	N
eGFR_1	59.3108	23.02112	1127
eGFR_2	57.5311	23.78461	1127
eGFR_3	57.2311	23.78461	1127

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
eGFR	.000	36007.760	2	.000	.500	.500	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: eGFR

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

***P*<0.05 代表資料未符合球形假設**

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
eGFR	Sphericity Assumed	2848.636	2	1424.318	20.420	.000
	Greenhouse-Geisser	2848.636	1.000	2848.636	20.420	.000
	Huynh-Feldt	2848.636	1.000	2848.636	20.420	.000
	Lower-bound	2848.636	1.000	2848.636	20.420	.000
Error(eGFR)	Sphericity Assumed	157081.715	2252	69.752		
	Greenhouse-Geisser	157081.715	1126.000	139.504		
	Huynh-Feldt	157081.715	1126.000	139.504		
	Lower-bound	157081.715	1126.000	139.504		

符合球形假設

不符合球形假設

Pairwise Comparisons

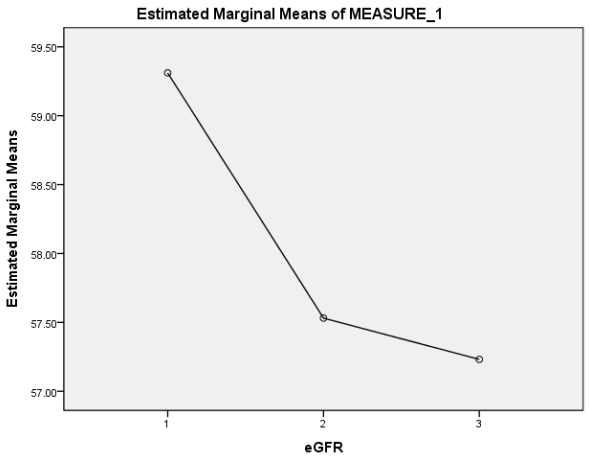
Measure: MEASURE_1

(I) eGFR	(J) eGFR	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	1.780*	.431	.000	.747	2.813
	3	2.080*	.431	.000	1.047	3.113
2	1	-1.780*	.431	.000	-2.813	-.747
	3	.300*	.000	.000	.300	.300
3	1	-2.080*	.431	.000	-3.113	-1.047
	2	-.300*	.000	.000	-.300	-.300

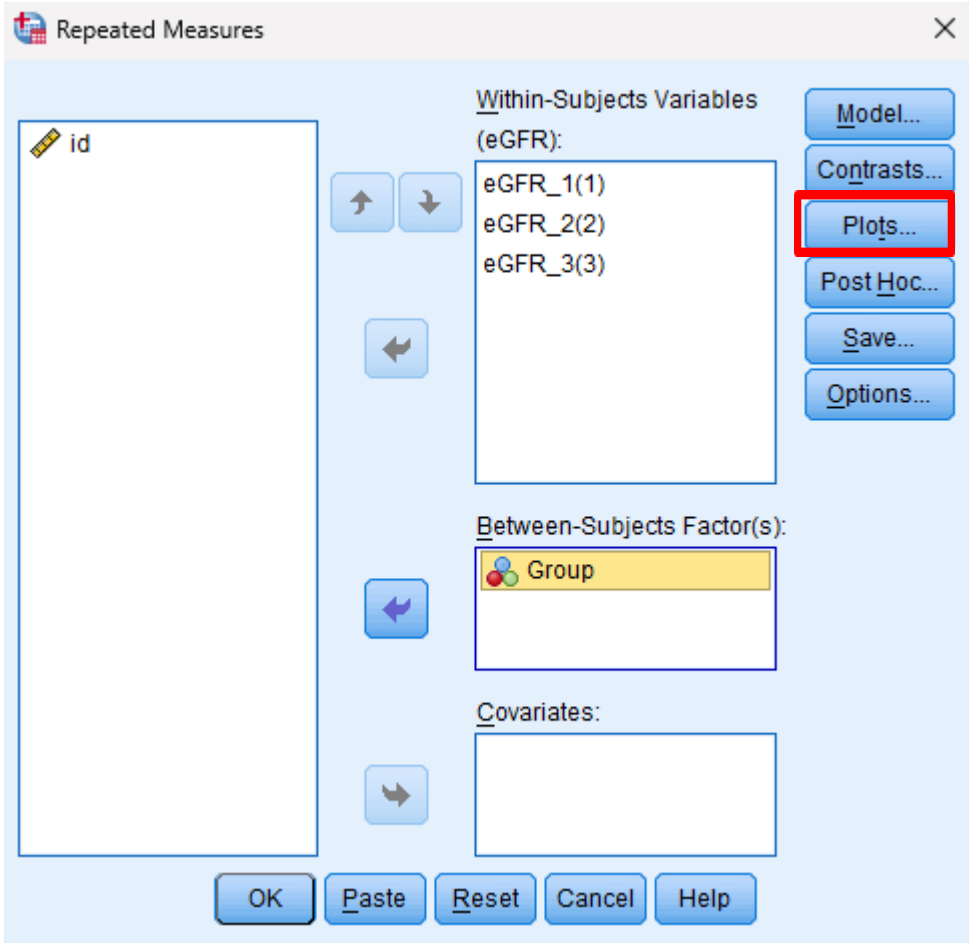
Based on estimated marginal means

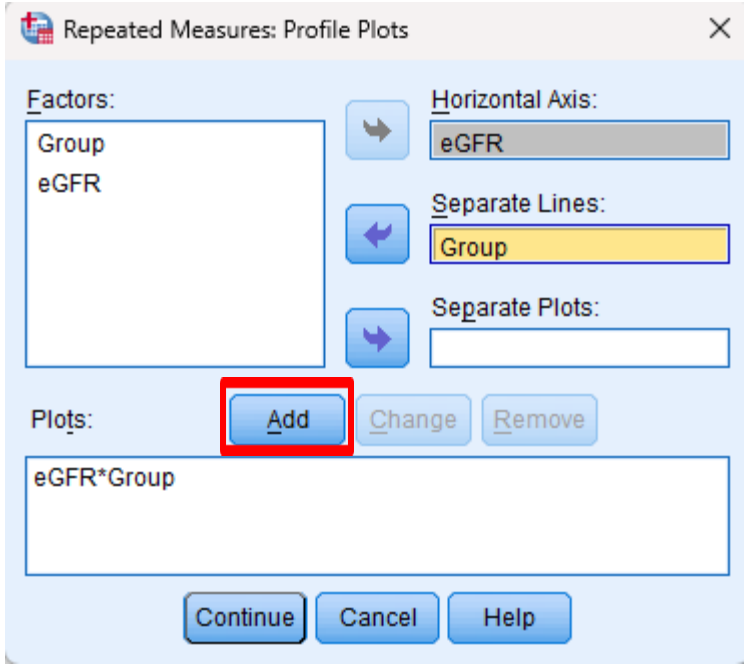
*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.



Repeated measures ANOVA analysis





Repeated measures ANOVA output

Descriptive Statistics

	Group	Mean	Std. Deviation	N
eGFR_1	0	66.1851	19.40228	138
	1	58.3516	23.32970	989
	Total	59.3108	23.02112	1127
eGFR_2	0	63.7180	19.50203	138
	1	56.6678	24.20522	989
	Total	57.5311	23.78461	1127
eGFR_3	0	63.4180	19.50203	138
	1	56.3678	24.20522	989
	Total	57.2311	23.78461	1127

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
eGFR	.000	36298.754	2	.000	.500	.500	.500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + Group
Within Subjects Design: eGFR

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

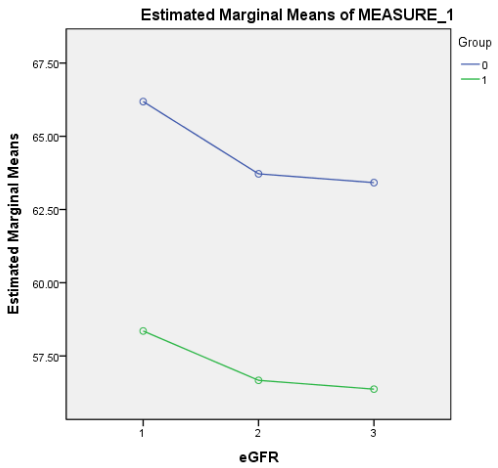
Source		Type III Sum of Squares	df	Mean Square	F	Sig.
eGFR	Sphericity Assumed	1621.180	2	810.590	11.614	.000
	Greenhouse-Geisser	1621.180	1.000	1621.180	11.614	.001
	Huynh-Feldt	1621.180	1.001	1619.739	11.614	.001
	Lower-bound	1621.180	1.000	1621.180	11.614	.001
eGFR * Group	Sphericity Assumed	49.520	2	24.760	.355	.701
	Greenhouse-Geisser	49.520	1.000	49.520	.355	.552
	Huynh-Feldt	49.520	1.001	49.476	.355	.552
	Lower-bound	49.520	1.000	49.520	.355	.552
Error(eGFR)	Sphericity Assumed	157032.196	2250	69.792		
	Greenhouse-Geisser	157032.196	1125.000	139.584		
	Huynh-Feldt	157032.196	1126.001	139.460		
	Lower-bound	157032.196	1125.000	139.584		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	5369346.712	1	5369346.712	3565.368	.000
Group	19420.818	1	19420.818	12.896	.000
Error	1694219.138	1125	1505.973		



Linear Mixed Model / Generalized Estimating Equation

- Linear Mixed Model
  - Outcome為數值型資料且需符合常態分佈
  - 資料型態為長資料，可容許遺漏值的存在
- GEE
  - 不需符合常態分佈假設，為半母數方法(semi-parametric)
  - Outcome可為連續、類別、順序或計數類型
  - 資料型態為長資料，可容許遺漏值的存在

GEE矩陣

- 獨立矩陣（Independent）
- AR(1) 矩陣（Auto-regressive first order）
- 可交換矩陣（Exchangeable）
- 未結構化矩陣（Unstructured）

獨立矩陣

	t_1	t_2	t_3	t_4	t_5
t_1	—				
t_2	0	—			
t_3	0	0	—		
t_4	0	0	0	—	
t_5	0	0	0	0	—

AR(1) 矩陣

	t_1	t_2	t_3	t_4	t_5
t_1	—				
t_2	ρ	—			
t_3	ρ^2	ρ	—		
t_4	ρ^3	ρ^2	ρ	—	
t_5	ρ^4	ρ^3	ρ^2	ρ	—

可交換矩陣

	t_1	t_2	t_3	t_4	t_5
t_1	—				
t_2	ρ	—			
t_3	ρ	ρ	—		
t_4	ρ	ρ	ρ	—	
t_5	ρ	ρ	ρ	ρ	—

未結構化矩陣

	t_1	t_2	t_3	t_4	t_5
t_1	—				
t_2	ρ_1	—			
t_3	ρ_2	ρ_5	—		
t_4	ρ_3	ρ_6	ρ_8	—	
t_5	ρ_4	ρ_7	ρ_9	ρ_{10}	—

GEE

Midlife overweight and obesity increase late-life dementia risk

A population-based twin study

W.L. Xu, MD, PhD
A.R. Atti, MD, PhD
M. Gatz, PhD
N.L. Pedersen, PhD
B. Johansson, PhD
L. Fratiglioni, MD, PhD

ABSTRACT

Objective: The relation of overweight to dementia is controversial. We aimed to examine the association of midlife overweight and obesity with dementia, Alzheimer disease (AD), and vascular dementia (VaD) in late life, and to verify the hypothesis that genetic and early-life environmental factors contribute to the observed association.

Methods: From the Swedish Twin Registry, 8,534 twin individuals aged ≥65 (mean age 74.4) were assessed to detect dementia cases (*DSM-IV* criteria). Height and weight at midlife (mean age 43.4) were available in the Registry. Data were analyzed as follows: 1) unmatched case-

Table 2 Adjusted odds ratio (OR) and 95% confidence interval (CI) of dementia, Alzheimer disease, and vascular dementia related to midlife BMI (results from generalized estimating equation models)

		All dementia			Alzheimer disease			Vascular dementia		
Midlife BMI	No. of twins	No.	OR (95% CI)[a]	OR (95% CI)[b]	No.	OR (95% CI)[a]	OR (95% CI)[b]	No.	OR (95% CI)[a]	OR (95% CI)[b]
Continuous	8,534	464	1.09 (1.06-1.12)	1.06 (1.03-1.10)	232	1.09 (1.04-1.13)	1.06 (1.01-1.10)	74	1.14 (1.08-1.21)	1.11 (1.04-1.19)
Categorical										
<20	627	17	0.74 (0.44-1.25)	0.79 (0.45-1.38)	8	0.89 (0.64-1.23)	0.66 (0.31-1.41)	0	—	—
20-25	5,366	240	1 (Reference)	1 (Reference)	120	1 (Reference)	1 (Reference)	36	1 (Reference)	1 (Reference)
>25	2,541	207	1.50 (1.22-1.84)	1.80 (1.37-2.35)	104	1.52 (1.15-2.02)	1.98 (1.36-2.88)	38	1.62 (1.01-2.59)	1.35 (0.81-2.24)
25-30	2,297	177	1.37 (1.11-1.70)	1.71 (1.30-2.25)	90	1.41 (1.05-1.89)	1.91 (1.30-2.80)	31	1.39 (0.85-2.29)	1.17 (0.69-2.00)
>30	244	30	3.01 (1.95-4.64)	3.88 (2.12-7.11)	14	2.87 (1.57-5.26)	3.43 (1.49-7.90)	7	4.38 (1.89-10.14)	3.50 (1.36-8.99)

Abbreviations: BMI = body mass index; CI = confidence interval; OR = odds ratio.
[a] Adjusted for age, sex, and education.
[b] Adjusted for age, sex, education, diabetes, hypertension, stroke, and heart disease.

GEE

Summative Effects of Vascular Risk Factors on the Progression of Alzheimer Disease

Wei-Ju Lee, MD, PhD,[*†‡§¶] *Yi-Chu Liao, MD, PhD,*[†‖] *Yen-Feng Wang, MD, PhD,*[†¶**] *Yung-Shuan Lin, MD,*[†**] *Shuu-Jiun Wang, MD,*[†¶**] *and Jong-Ling Fuh, MD*[†¶**]

OBJECTIVES: To investigate the summative effects of vascular risk factors (VRFs) on the progression of Alzheimer disease (AD).

DESIGN: Longitudinal follow-up cohort study.

SETTING: AD patients from two teaching hospitals in Taiwan with 3-year follow-ups.

three or fewer VRFs (MMSE, P = .009; CDRSB, P = .02). Subsequent analyses of APOE ε4 carriers with more than three VRFs also showed their more rapid cognitive decline compared with patients without VRFs (MMSE, P = .02; CDRSB, P = .001) and patients with three or fewer VRFs (MMSE, P = .009; CDRSB, P = .02), but no significant difference was found in APOE ε4 noncarriers.

Vascular risk factors, No. (%)	
Coronary heart disease	63 (19.1)
Cardiac arrhythmia	30 (9.1)
Cerebrovascular disease	12 (3.6)
Hypertension	217 (65.8)
Diabetes mellitus	154 (46.7)
Obesity	18 (5.5)
Smoking	44 (13.3)
Physical inactivity	121 (36.7)

Table 2. Results of the generalized estimating equation analyzing the effect of 3-year MMSE changes in AD patients with and without APOE ε4 and different VRF indexes

	All AD patients (n = 330)		AD patients with APOE ε4 (n = 129)		AD patients without APOE ε4 (n = 201)	
Variable	β (95% CI)	*P* value[a]	β (95% CI)	*P* value[a]	β (95% CI)	*P* value[a]
VRF groups						
>3 VRFs	−1.16 (−2.1 to −0.21)	.02	−1.99 (−3.62 to −0.36)	.02	−0.59 (−1.7 to 0.52)	.3
3 VRFs	−0.36 (−1.24 to 0.51)	.42	−1.2 (−2.8 to 0.4)	.14	0.11 (−0.9 to 1.1)	.83
2 VRFs	−0.15 (−0.92 to 0.61)	.69	−0.51 (−1.8 to 0.78)	.44	0.27 (−0.64 to 1.18)	.56
1 VRF	−0.04 (−0.83 to 0.73)	.89	−0.48 (−1.76 to 0.81)	.47	0.3 (−0.68 to 1.28)	.55
0 VRFs	Reference		Reference		Reference	
APOE ε4						
Carrier	−0.63 (−1.18 to −0.08)	.03				
Noncarrier	Reference					
Sex						
Female	0.35 (−0.15 to 0.85)	.17	0.64 (−0.21 to 1.5)	.14	0.19 (−0.42 to 0.79)	.55
Male	Reference		Reference		Reference	
Age	−0.001 (−0.05 to 0.05)	.96	0.02 (−0.06 to 0.1)	.65	−0.01 (−0.07 to 0.05)	.7
Education	−0.01 (−0.07 to 0.04)	.66	−0.06 (−0.15 to 0.03)	.2	<0.001 (−0.07 to 0.07)	.99
Disease duration	0.001 (−0.004 to 0.01)	.76	0.005 (−0.003 to 0.01)	.2	−0.001 (−0.008 to 0.005)	.72
Baseline MMSE	0.95 (0.9 to 0.99)	<.001	0.97 (0.9 to 1)	<.001	0.93 (0.87 to 1)	<.001
Time	−1.17 (−1.4 to −1)	<.001	−1.34 (−1.65 to −1.03)	<.001	−1.08 (−1.3 to −0.86)	<.001
Medication	−0.46 (−0.95 to 0.03)	.07	−0.85 (−1.77 to 0.07)	.07	−0.18 (−0.77 to 0.4)	.57
Hospitalization rates	−0.24 (−0.66 to 0.17)	.25	−0.6 (−1.2 to 0.004)	.05	−0.18 (−0.71 to 0.34)	.49

Abbreviations: AD, Alzheimer disease; APOE, apolipoprotein E; CI, confidence interval; MMSE, Mini-Mental State Examination; NMDA, N-methyl-D-aspartate; VRF, vascular risk factor.

[a]*P* values were adjusted for APOE ε4 carrier status (in all AD patients), sex, age, years of education, disease duration, baseline MMSE score, time, use of medication (acetylcholinesterase inhibitors or NMDA receptor antagonists), and hospitalization rates.

Journal of the American Geriatrics Society 68.1 (2020): 129-136.

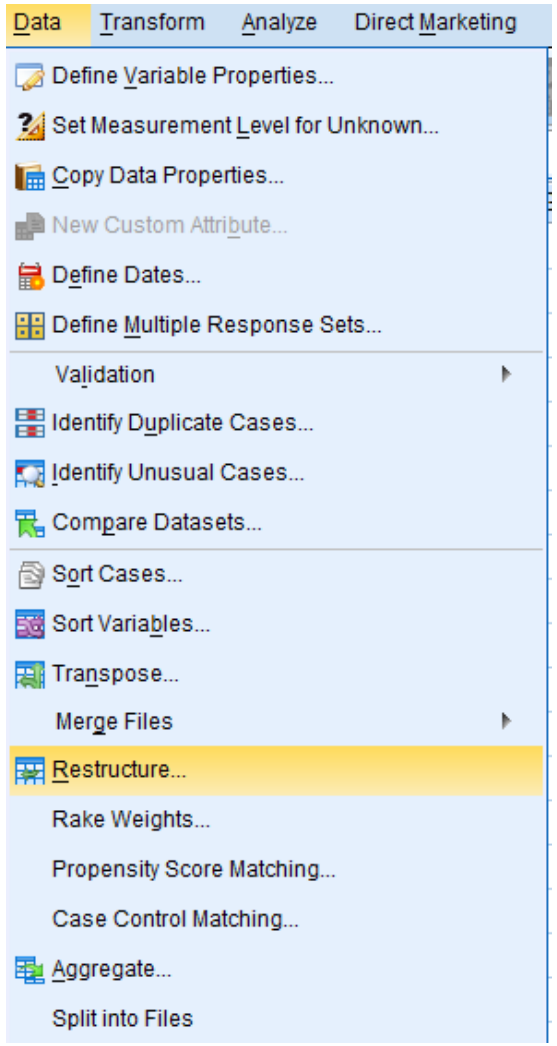
GEE/LMM-資料轉置處理

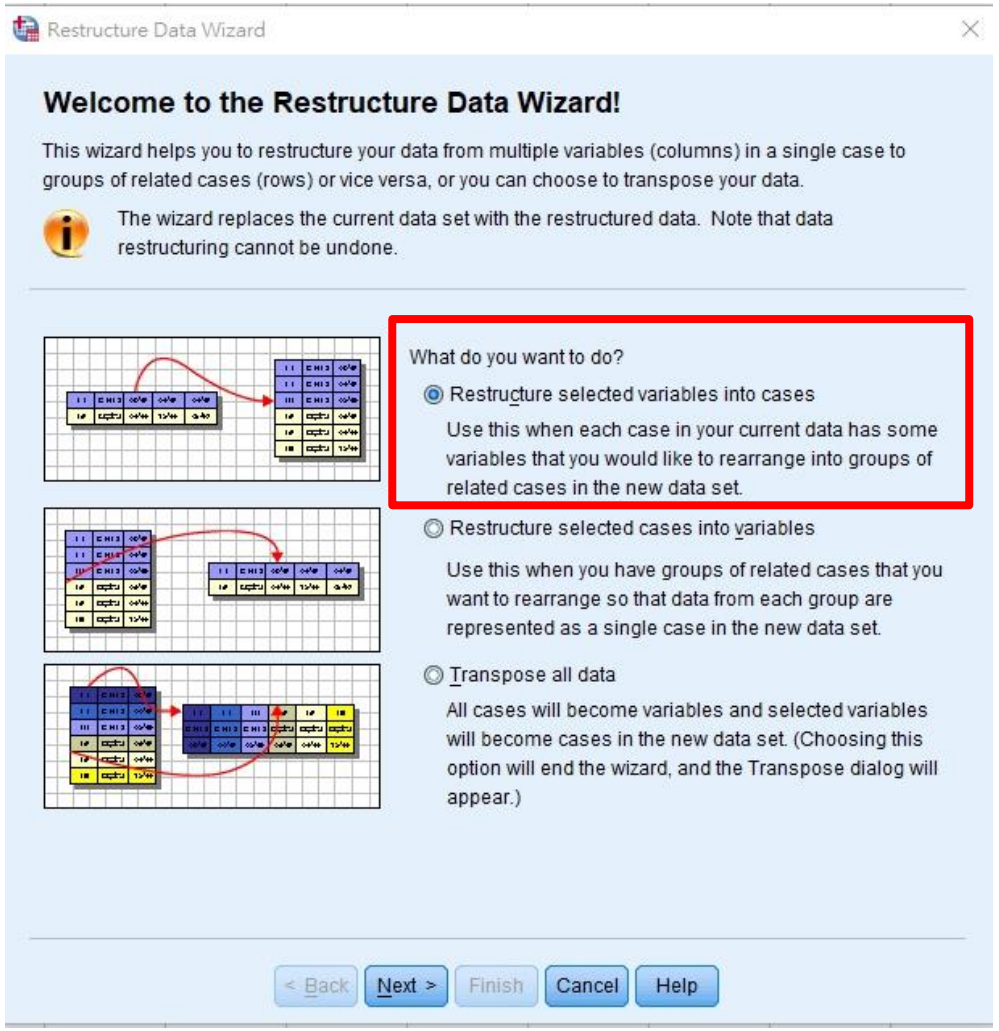
id	Gender	Treatment	Age	DepressionScale_1	DepressionScale_2	DepressionScale_3
1	2	1	29	4.0	32.0	13.0
2	2	1	32	29.0	14.0	8.0
3	1	1	32	19.0	27.0	9.0
4	2	2	35	19.0	29.0	33.0
5	1	2	31	20.0	27.0	9.0
6	2	1	33	8.0	12.0	12.0
7	1	2	34	20.0	2.0	19.0
8	1	1	34	23.0	6.0	23.0
9	2	1	29	9.0	.0	.0
10	1	1	34	4.0	33.0	10.0
11	2	1	25	24.0	15.0	10.0
12	2	2	34	10.0	31.0	31.0
13	1	2	26	26.0	27.0	8.0

id	Gender	Treatment	Age	Visit	DepressionScale
1	2	1	29	1	4.0
1	2	1	29	2	32.0
1	2	1	29	3	13.0
1	2	1	29	4	19.0
1	2	1	29	5	11.0
2	2	1	32	1	29.0
2	2	1	32	2	14.0
2	2	1	32	3	8.0
2	2	1	32	4	5.0
2	2	1	32	5	4.0
3	1	1	32	1	19.0
3	1	1	32	2	27.0
3	1	1	32	3	9.0
3	1	1	32	4	15.0

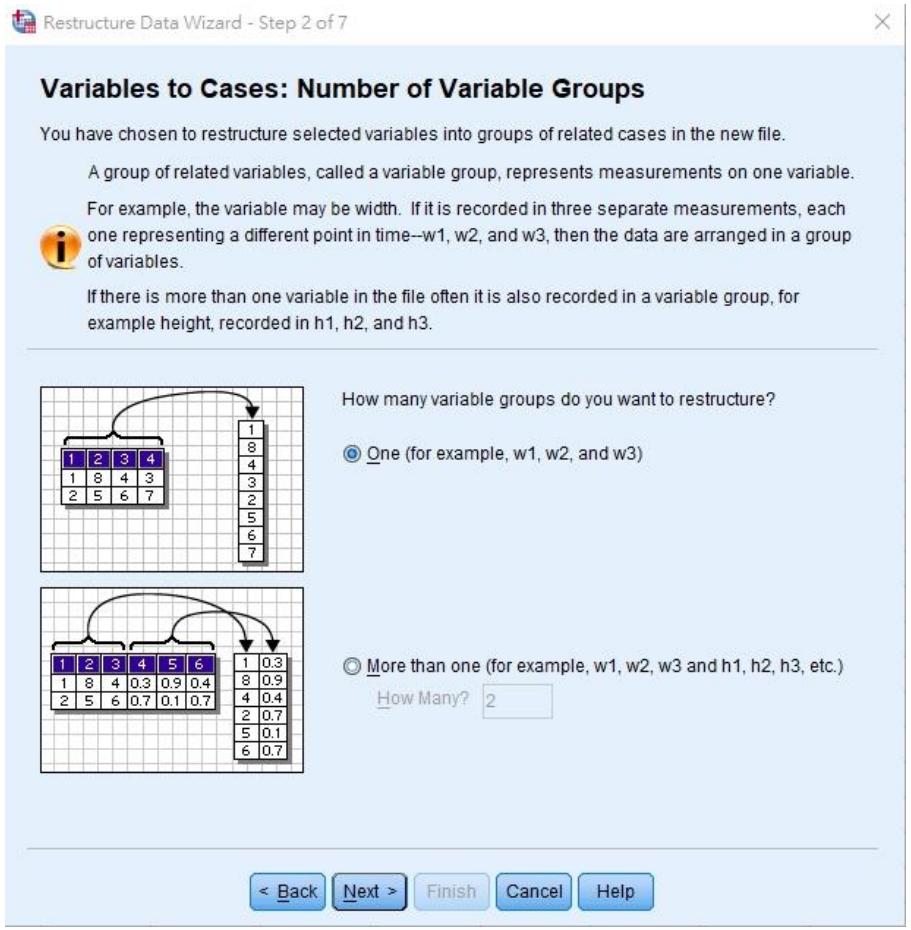
GEE/LMM-資料轉置處理

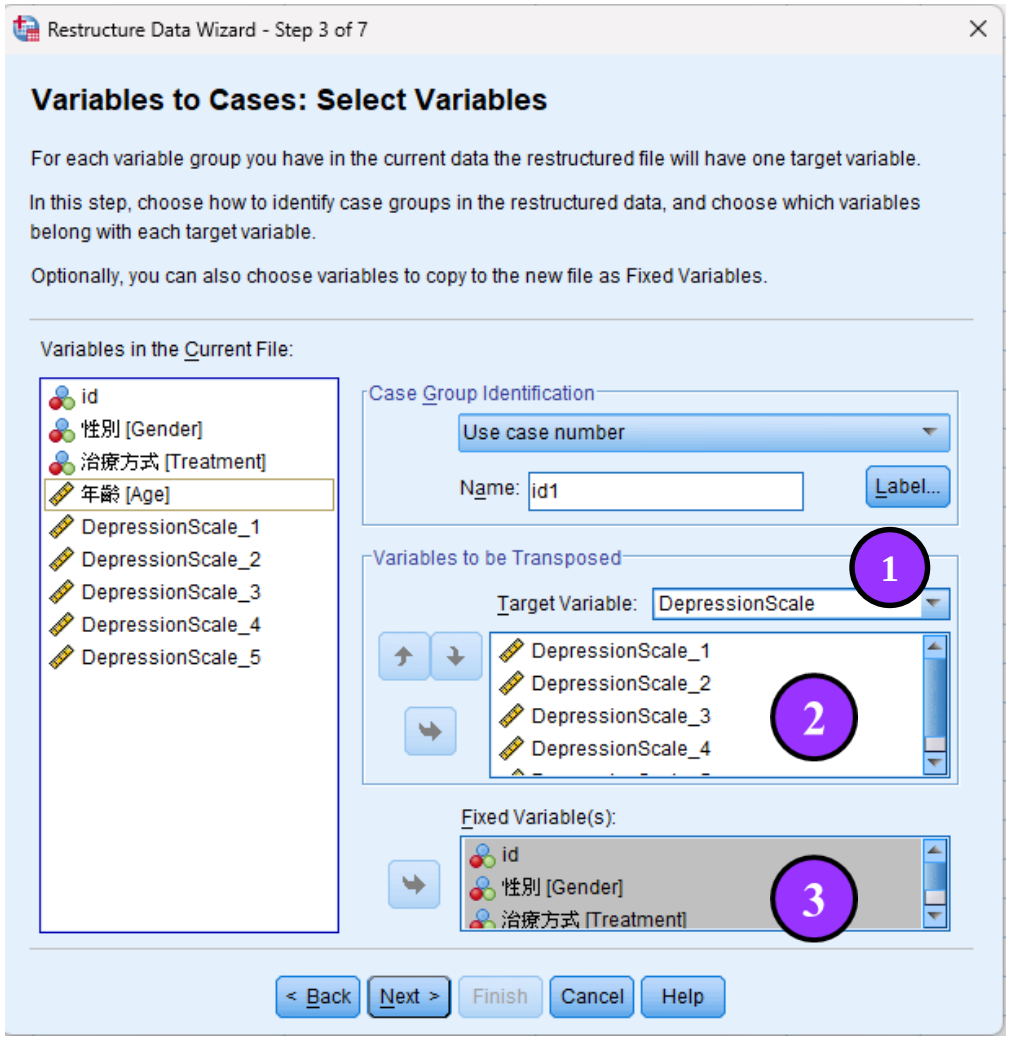
資料>重新架構



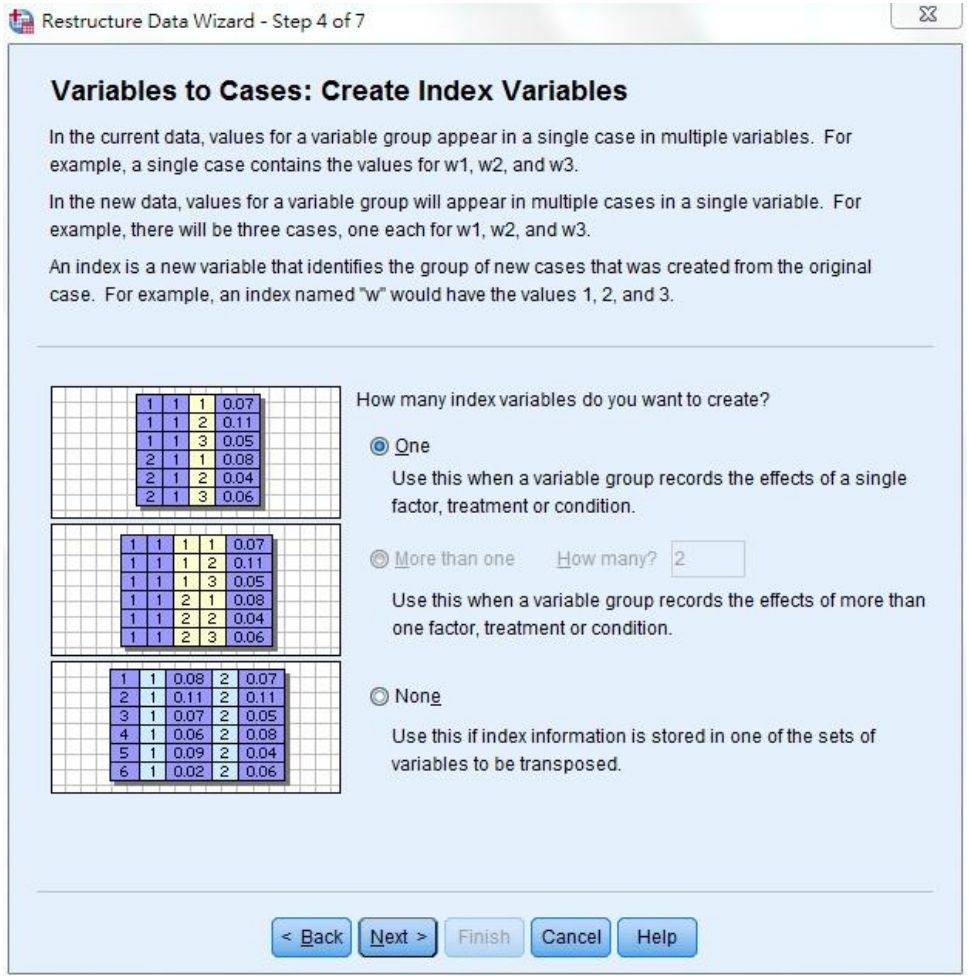


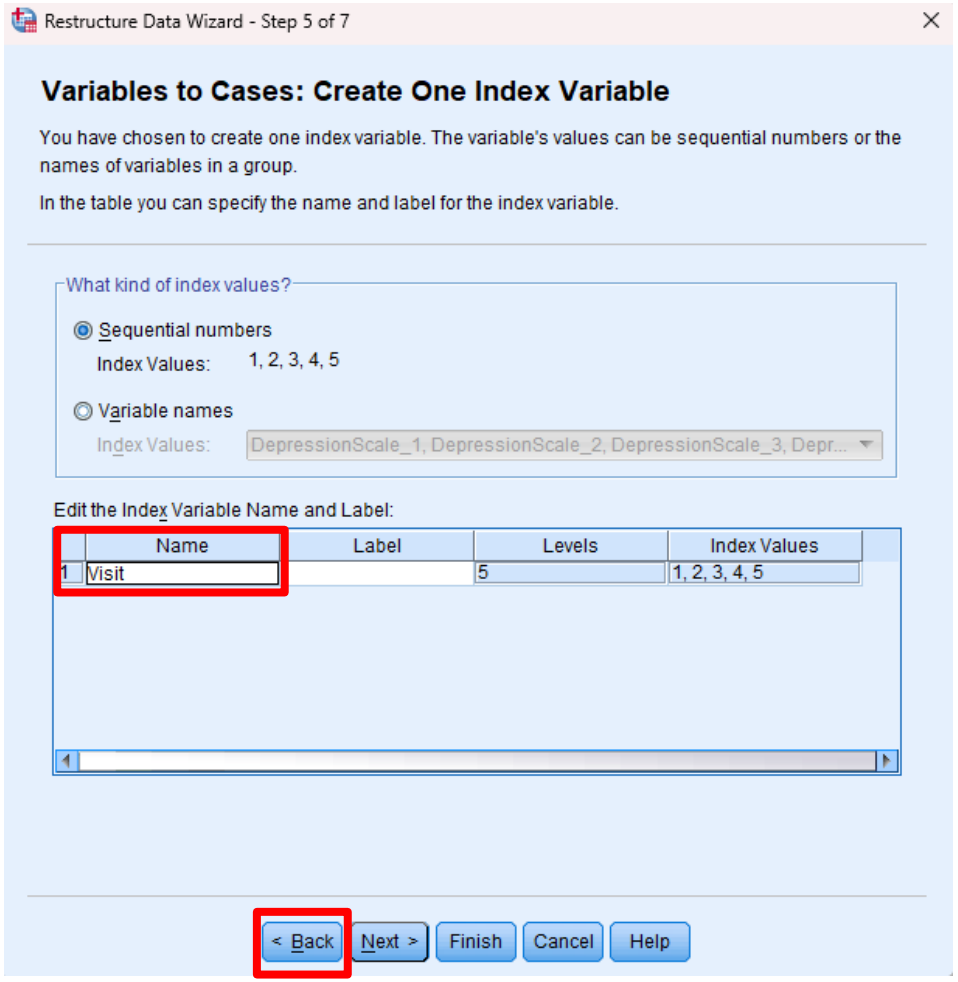
GEE/LMM-資料轉置處理





GEE/LMM-資料轉置處理



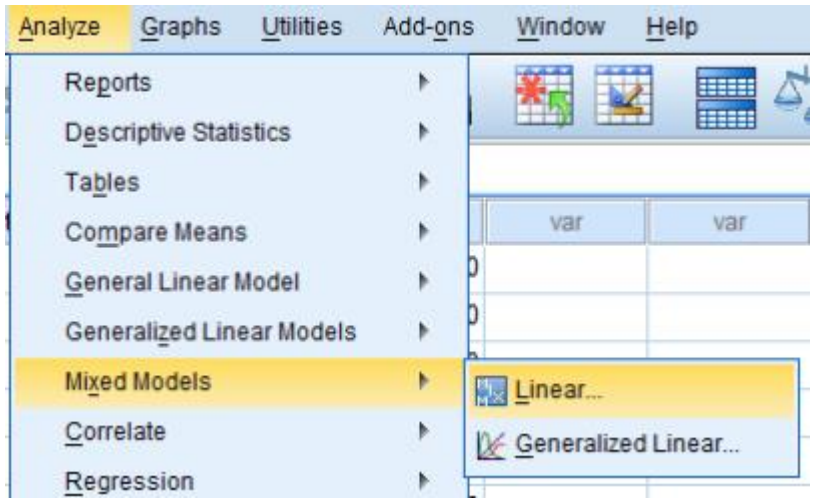


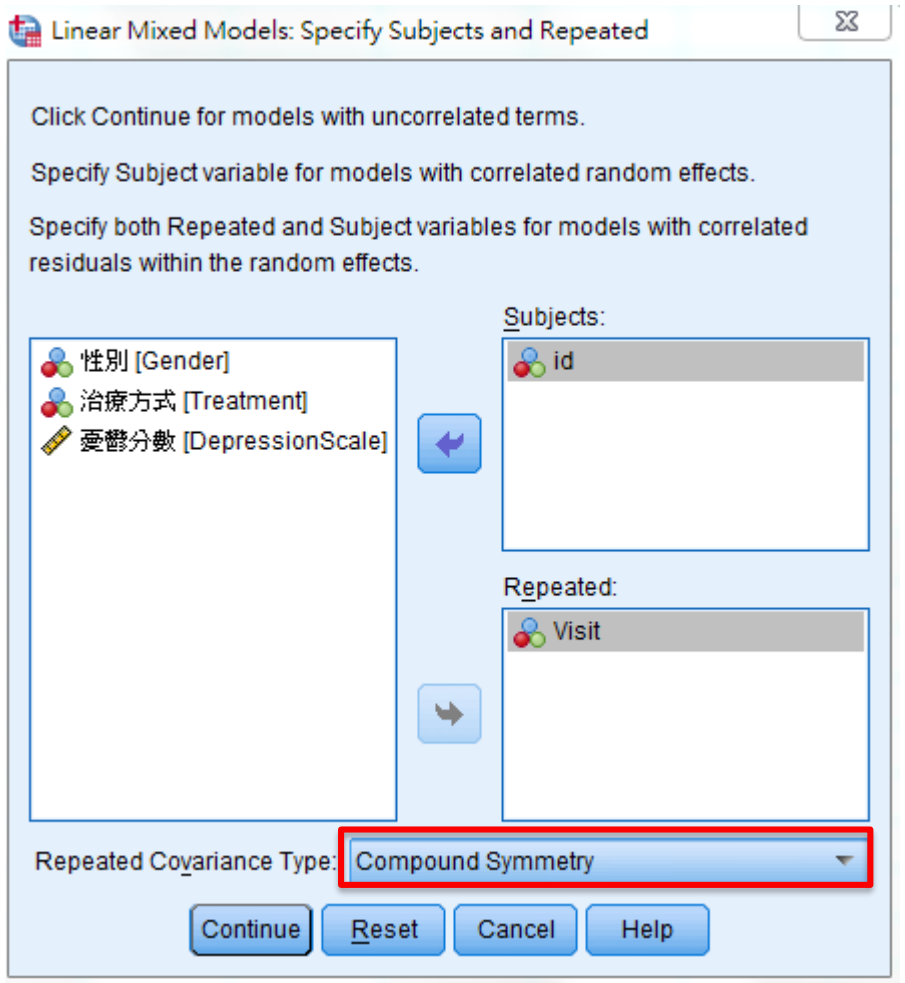
Mixed model

id	Gender	Treatment	Visit	DepressionScale
1	2	1	1	4.0
1	2	1	2	32.0
1	2	1	3	13.0
1	2	1	4	19.0
1	2	1	5	11.0
2	2	1	1	29.0
2	2	1	2	14.0
2	2	1	3	8.0
2	2	1	4	5.0
2	2	1	5	4.0
3	1	1	1	19.0
3	1	1	2	27.0
3	1	1	3	9.0
3	1	1	4	15.0
3	1	1	5	9.0

Mixed model analysis

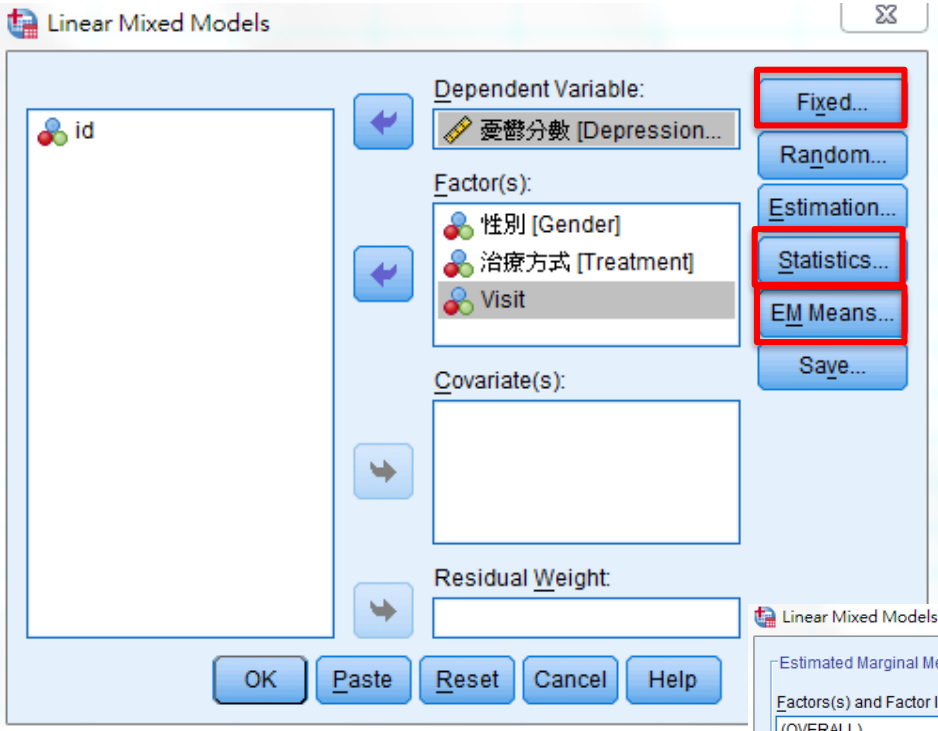
分析>混合模式>線性

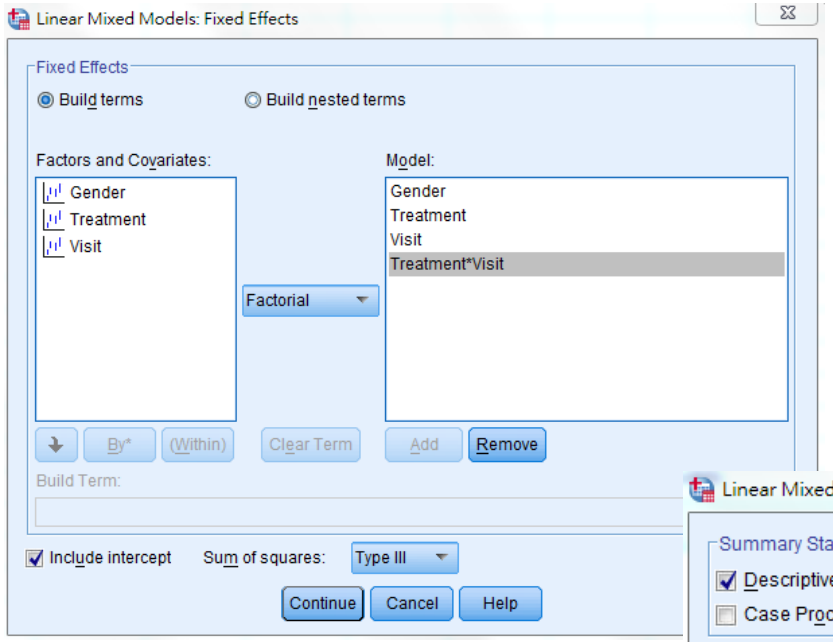


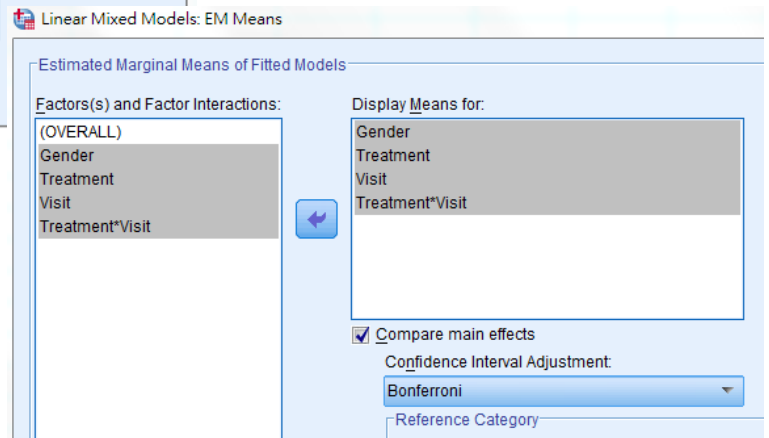


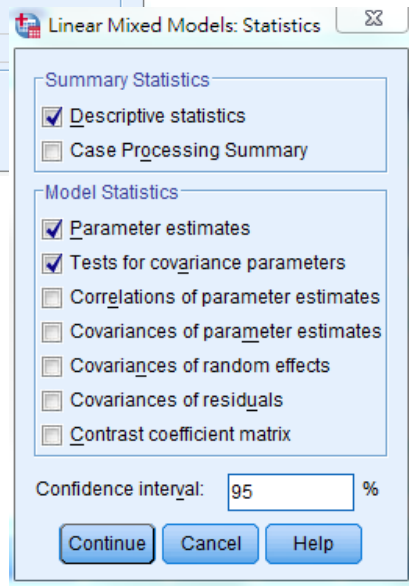
重複共變異數類型:
複合對稱
(選取AIC及BIC最小)

Mixed model analysis









Mixed model output

Information Criteria[a]

-2 Restricted Log Likelihood	650.289
Akaike's Information Criterion (AIC)	654.289
Hurvich and Tsai's Criterion (AICC)	654.433
Bozdogan's Criterion (CAIC)	661.198
Schwarz's Bayesian Criterion (BIC)	659.198

The information criteria are displayed in smaller-is-better form.

a. Dependent Variable: 憂鬱分數.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	10.457603	3.313212	74.672	3.156	.002	3.856871	17.058335
[Gender=1]	2.029279	2.351907	16.727	.863	.400	-2.938983	6.997541
[Gender=2]	0[b]	0	.	.	.	.	.
[Treatment=0]	3.590407	4.499750	81.501	.798	.427	-5.361851	12.542665
[Treatment=1]	0[b]	0	.	.	.	.	.
[Visit=1]	3.529088	3.898315	70.588	.905	.368	-4.244717	11.302894
[Visit=2]	3.619997	3.898315	70.588	.929	.356	-4.153808	11.393803
[Visit=3]	-2.107276	3.898315	70.588	-.541	.591	-9.881081	5.666530
[Visit=4]	.165452	3.898315	70.588	.042	.966	-7.608354	7.939257
[Visit=5]	0[b]	0	.	.	.	.	.
[Visit=1] * [Treatment=0]	.076556	5.731167	70.319	.013	.989	-11.352986	11.506098
[Visit=2] * [Treatment=0]	5.318980	5.731167	70.319	.928	.357	-6.110562	16.748522
[Visit=3] * [Treatment=0]	6.490697	5.731167	70.319	1.133	.261	-4.938845	17.920239
[Visit=4] * [Treatment=0]	-.782030	5.731167	70.319	-.136	.892	-12.211572	10.647512
[Visit=5] * [Treatment=0]	0[b]	0	.	.	.	.	.
[Visit=1] * [Treatment=1]	0[b]	0	.	.	.	.	.
[Visit=2] * [Treatment=1]	0[b]	0	.	.	.	.	.
[Visit=3] * [Treatment=1]	0[b]	0	.	.	.	.	.
[Visit=4] * [Treatment=1]	0[b]	0	.	.	.	.	.
[Visit=5] * [Treatment=1]	0[b]	0	.	.	.	.	.

a. Dependent Variable: 憂鬱分數.

b. This parameter is set to zero because it is redundant.

Pairwise Comparisons[a]

(I) Visit	(J) Visit	Mean Difference (I-J)	Std. Error	df	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
1	2	-2.712	2.741	68.882	1.000	-10.662	5.238
	3	2.429	2.741	68.882	1.000	-5.521	10.380
	4	3.793	2.741	68.882	1.000	-4.157	11.743
	5	3.567	2.868	70.166	1.000	-4.744	11.879
2	1	2.712	2.741	68.882	1.000	-5.238	10.662
	3	5.141	2.741	68.882	.649	-2.809	13.092
	4	6.505	2.741	68.882	.204	-1.445	14.455
	5	6.279	2.868	70.166	.319	-2.032	14.591
3	1	-2.429	2.741	68.882	1.000	-10.380	5.521
	2	-5.141	2.741	68.882	.649	-13.092	2.809
	4	1.364	2.741	68.882	1.000	-6.587	9.314
	5	1.138	2.868	70.166	1.000	-7.174	9.450
4	1	-3.793	2.741	68.882	1.000	-11.743	4.157
	2	-6.505	2.741	68.882	.204	-14.455	1.445
	3	-1.364	2.741	68.882	1.000	-9.314	6.587
	5	-.226	2.868	70.166	1.000	-8.537	8.086
5	1	-3.567	2.868	70.166	1.000	-11.879	4.744
	2	-6.279	2.868	70.166	.319	-14.591	2.032
	3	-1.138	2.868	70.166	1.000	-9.450	7.174
	4	.226	2.868	70.166	1.000	-8.086	8.537

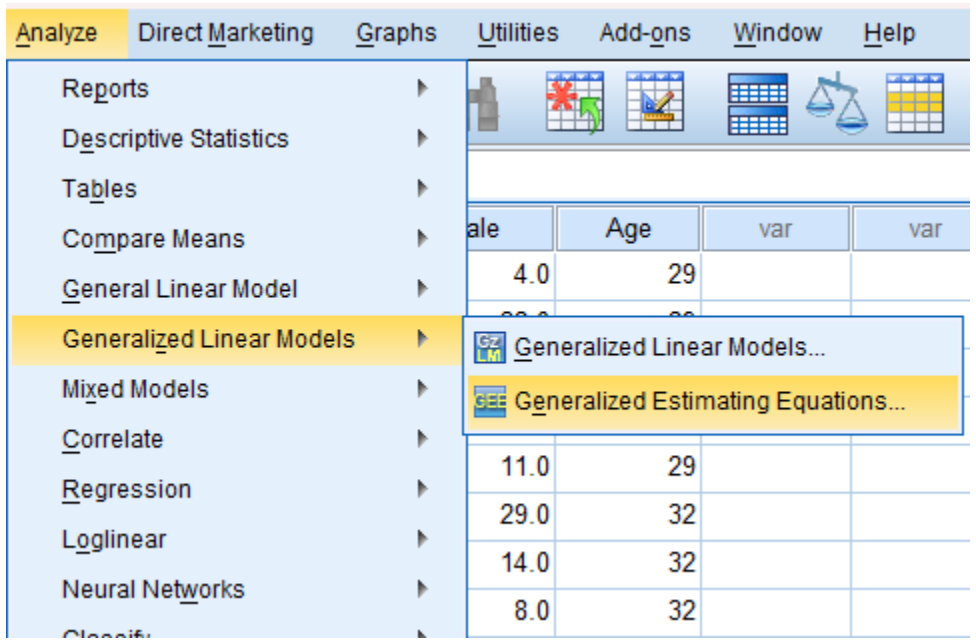
Based on estimated marginal means

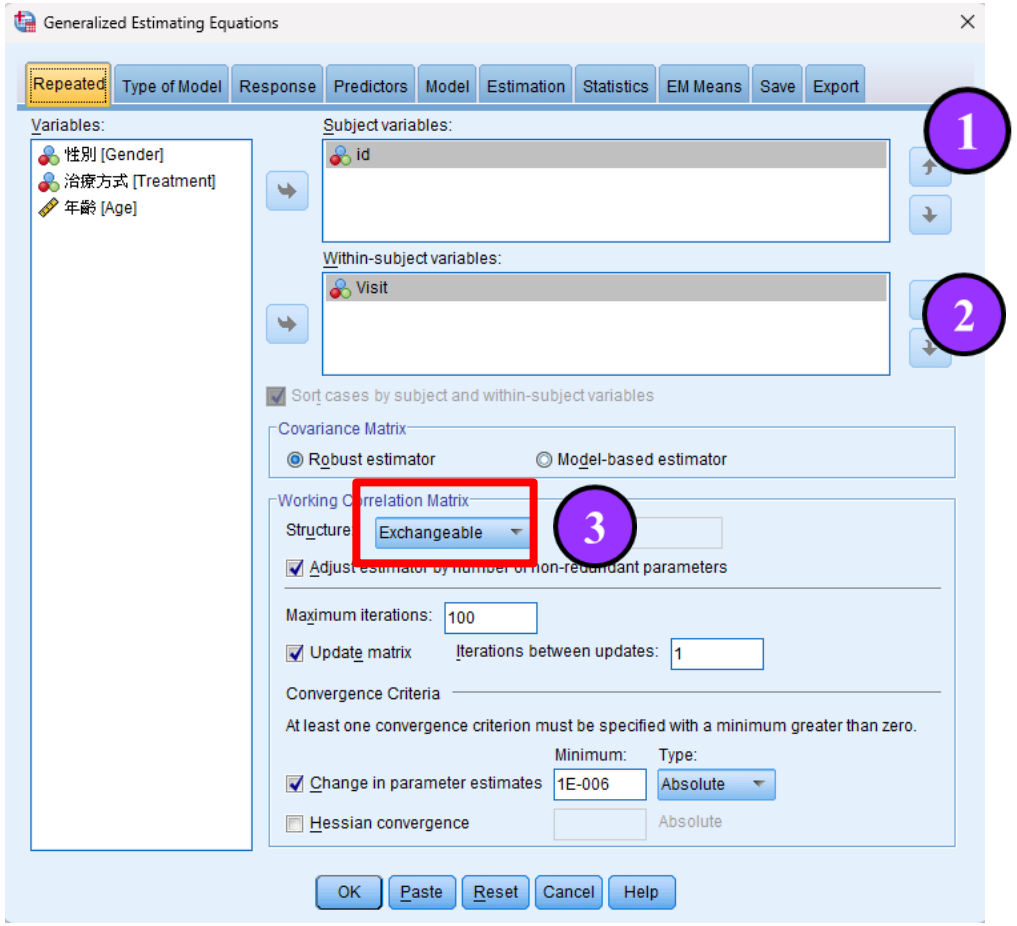
a. Dependent Variable: 憂鬱分數.

b. Adjustment for multiple comparisons: Bonferroni.

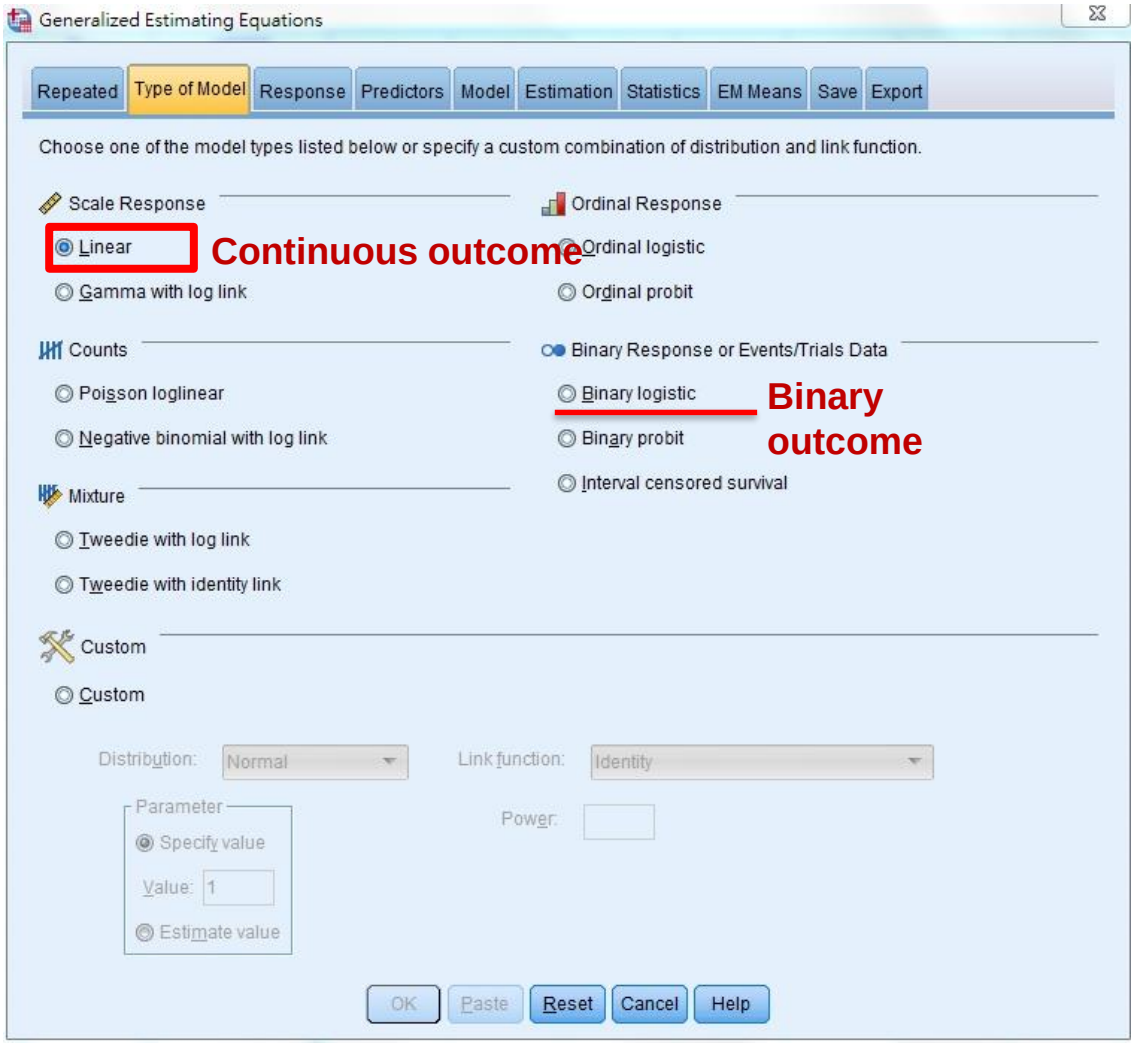
GEE analysis

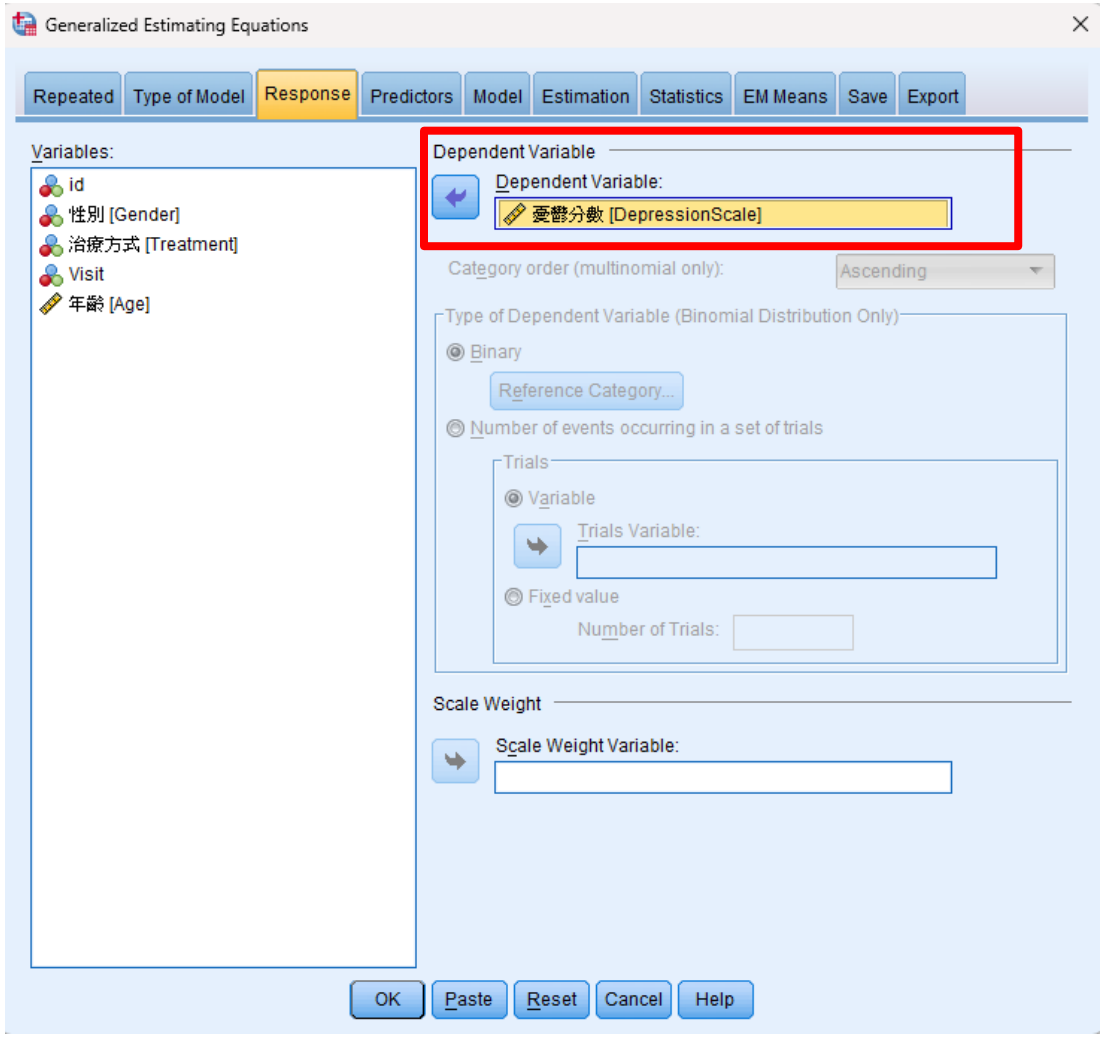
分析>廣義線性模型>廣義估計方程式(GEE)



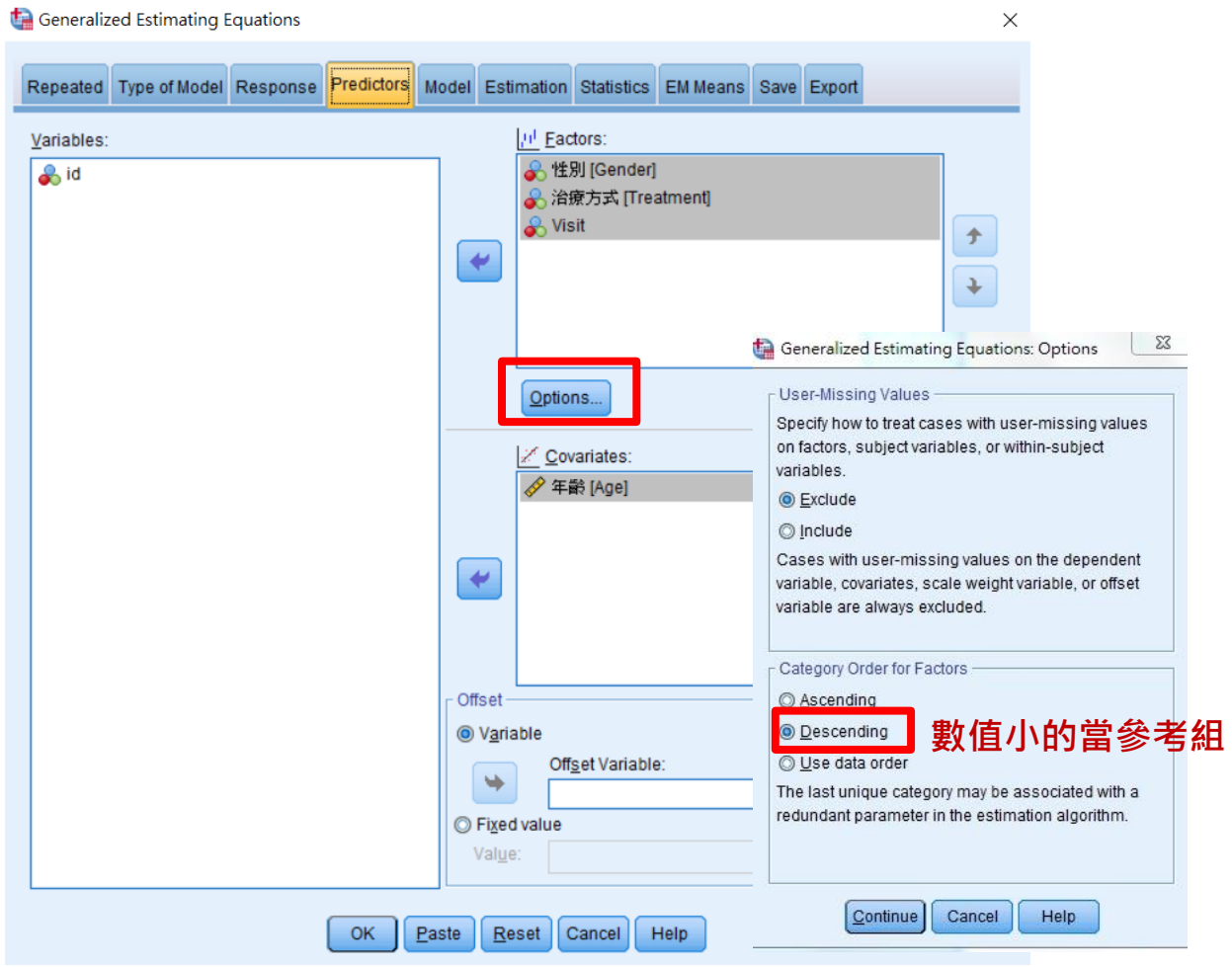


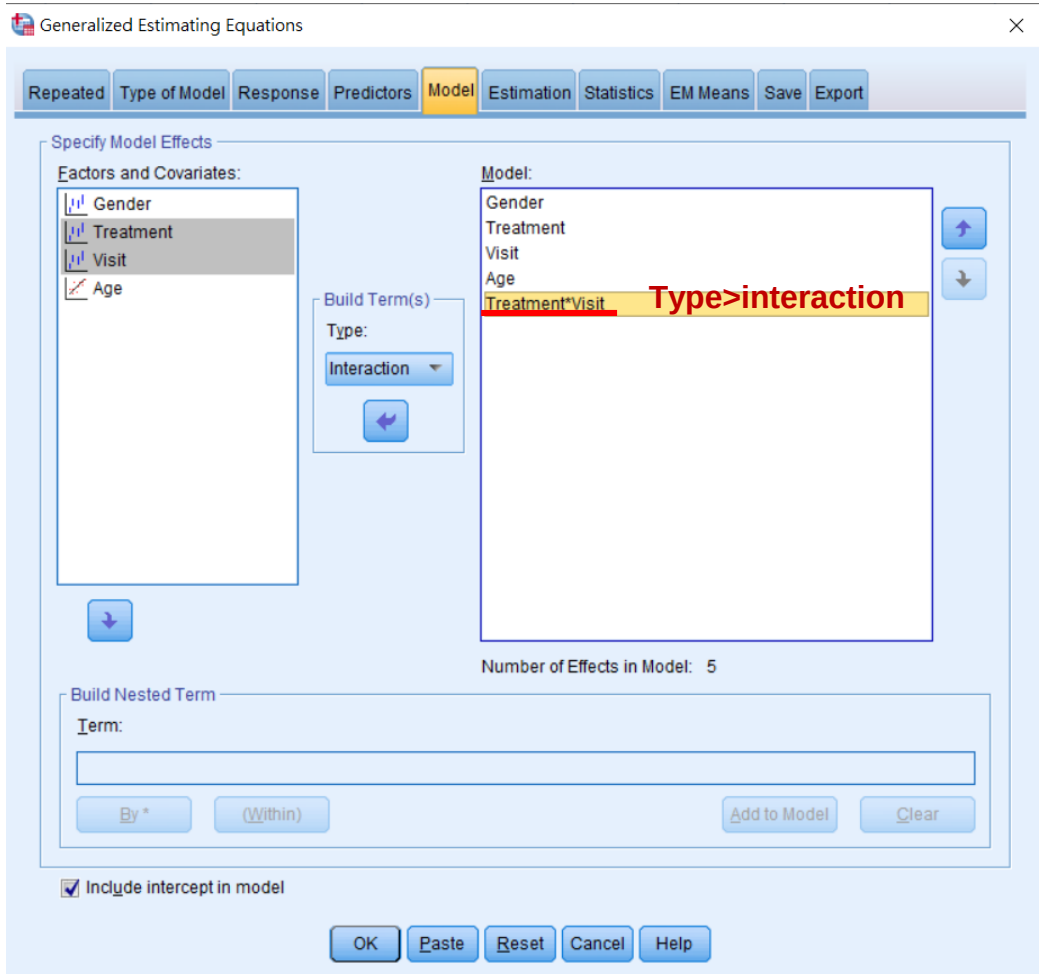
GEE analysis



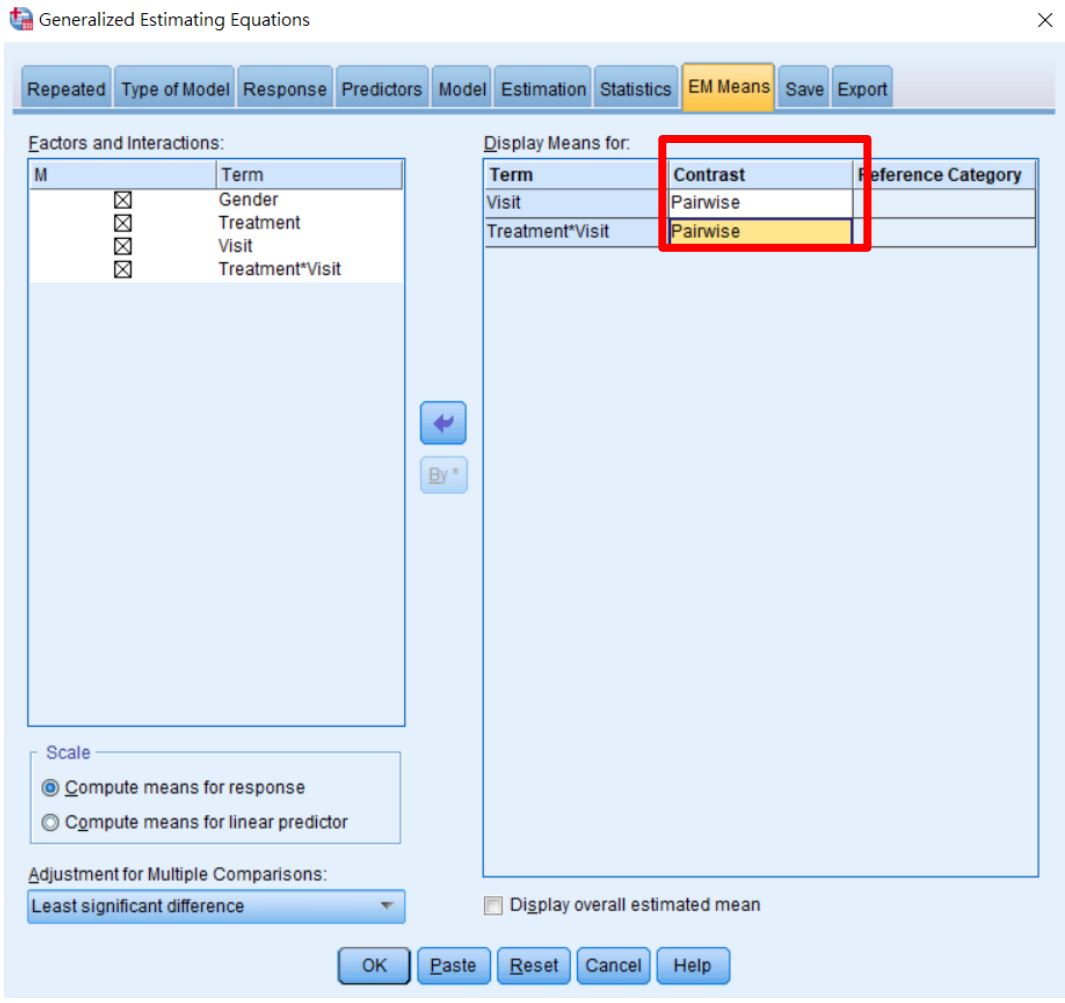


GEE analysis





GEE analysis



GEE-Output

Model Information

Dependent Variable		憂鬱分數
Probability Distribution		Normal
Link Function		Identity
Subject Effect	1	id
Within-Subject Effect	1	Visit
Working Correlation Matrix Structure		Exchangeable

Case Processing Summary

	N	Percent
Included	97	97.0%
Excluded	3	3.0%
Total	100	100.0%

Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	1.934	1	.164
Gender	1.047	1	.306
Treatment	6.465	1	.011
Visit	7.851	4	.097
Age	.122	1	.727
Treatment * Visit	3.053	4	.549

Dependent Variable: 憂鬱分數
Model: (Intercept), Gender, Treatment, Visit, Age, Treatment * Visit

QIC/QICC數值越小越好

Goodness of Fit[a]

	Value
Quasi Likelihood under Independence Model Criterion (QIC)[b]	7393.042
Corrected Quasi Likelihood under Independence Model Criterion (QICC)[b]	7389.820

Dependent Variable: 憂鬱分數
Model: (Intercept), Treatment, Visit, Gender, Age, Treatment * Visit

a. Information criteria are in smaller-is-better form.

b. Computed using the full log quasi-likelihood function.

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	21.404	16.1963	-10.340	53.148	1.746	1	.186
[Gender=2]	-2.306	2.2536	-6.723	2.111	1.047	1	.306
[Gender=1]	0[a]	.	.	.	.	.	.
[Treatment=2]	3.616	3.3682	-2.986	10.218	1.153	1	.283
[Treatment=1]	0[a]	.	.	.	.	.	.
[Visit=5]	-3.502	3.4075	-10.180	3.177	1.056	1	.304
[Visit=4]	-3.364	3.7090	-10.633	3.906	.822	1	.364
[Visit=3]	-5.636	2.7732	-11.072	-.201	4.131	1	.042
[Visit=2]	.091	4.6859	-9.093	9.275	.000	1	.985
[Visit=1]	0[a]	.	.	.	.	.	.
Age	-.166	.4758	-1.099	.767	.122	1	.727
[Treatment=2] * [Visit=5]	-.113	4.8978	-9.712	9.487	.001	1	.982
[Treatment=2] * [Visit=4]	-.859	5.5842	-11.803	10.086	.024	1	.878
[Treatment=2] * [Visit=3]	6.414	5.4913	-4.349	17.177	1.364	1	.243
[Treatment=2] * [Visit=2]	5.242	6.0191	-6.555	17.040	.759	1	.384
[Treatment=2] * [Visit=1]	0[a]	.	.	.	.	.	.
[Treatment=1] * [Visit=5]	0[a]	.	.	.	.	.	.
[Treatment=1] * [Visit=4]	0[a]	.	.	.	.	.	.
[Treatment=1] * [Visit=3]	0[a]	.	.	.	.	.	.
[Treatment=1] * [Visit=2]	0[a]	.	.	.	.	.	.
[Treatment=1] * [Visit=1]	0[a]	.	.	.	.	.	.
(Scale)	86.657						

Dependent Variable: 憂鬱分數
Model: (Intercept), Gender, Treatment, Visit, Age, Treatment * Visit

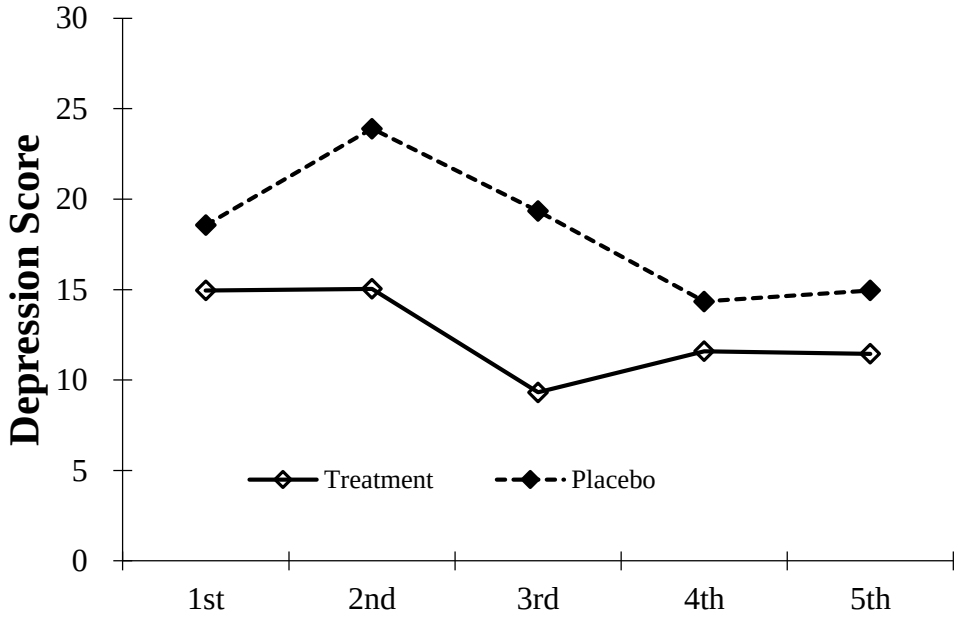
a. Set to zero because this parameter is redundant.

GEE-Output

Estimates

治療方式	Visit	Mean	Std. Error	95% Wald Confidence Interval	
				Lower	Upper
Placebo	5	15.036	44.2563	-71.705	101.777
	4	14.428	43.4721	-70.775	99.632
	3	19.428	43.6030	-66.032	104.889
	2	23.984	43.5271	-61.328	109.295
	1	18.650	43.3345	-66.284	103.584
Treatment	5	11.533	41.2402	-69.297	92.362
	4	11.671	42.2384	-71.115	94.456
	3	9.398	42.2932	-73.495	92.291
	2	15.125	42.2912	-67.764	98.014
	1	15.034	42.0632	-67.408	97.477

Covariates appearing in the model are fixed at the following values: Age=31.42



感謝您的聆聽！

Thank you !

5/20問卷