Monitoring the formal implementation of a cognitive assessment protocol, and analysis of cognitive outcomes of Electro-Convulsive Therapy (ECT) in a regional psychiatric hospital setting

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Abbreviations (listed alphabetically)

ACE-R	Addenbrooke's Cognitive Examination-Revised
cSEs	cognitive Side Effects
DGX	pulse width of 1 mSec
ECT	Electroconvulsive therapy
HREC	Human Research Ethics Committee
LHDs	Local Health Districts
MMSE	Mini Mental State Examination
UB	Ultra Brief

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Abstract

Aims

Electroconvulsive therapy (ECT) is one of the oldest psychiatric treatments still in use. Cognitive side effects are well recognised and have been a major source of concern. This study monitors the formal implementation of a cognitive assessment protocol for patients undergoing ECT in a regional psychiatric hospital.

Methods

Clinical audit of adult in-patients undergoing ECT between November 2017 and December 2018 at the Bloomfield Hospital, Orange abstracted patient demographics, diagnosis and ECT parameters. Cognition (pre and post ECT course) was measured using the Addenbrooke's Cognitive Evaluation–R (ACE-R), and orientation (pre and post ECT sessions) using a standardised 10-item scale.

Results

Thirty-one patients completed a median of 10 ECT sessions (range 5-22; total 324). Implementation of the cognitive assessment protocol was poor, with orientation assessments both pre and post the first ECT session completed for 52% (n=16/31), and ACE-R completed both pre and post-ECT course for 61% (19/31). Of these 19 patients, 12 demonstrated an average 21% increase in ACE-R score (improved cognition), six an average 5% decrease, and one no change.

Conclusions and Implications

Given the potential cognitive side-effects of ECT, there is a need for proper monitoring. Implementation of the NSW Minimum Standards for cognitive assessment in Bloomfield Hospital indicated scope for improvement, particularly for pre- and post-session orientation assessments. This may reflect possible workforce shortages in a rural setting. A substantial proportion of patients experienced improved cognition which may reflect illness improvement post-treatment. The study results may provide reassurance to patients undergoing ECT in a rural setting.

***Keywords*: electroconvulsive therapy, side effects, cognitive impairment, orientation**

Executive Summary

Background

Electroconvulsive therapy (ECT) is one of the oldest psychiatric treatments for patients with psychiatric illnesses still in use. Electroconvulsive therapy is a safe and effective treatment for people with severe major depressive disorder and some other mental illness. Advances in the delivery of ECT, including anaesthesia and muscle relaxation during the brief treatment procedure and carefully adjusted dosing schedules, ensure that treatment is well tolerated. Cognitive side effects with ECT are well recognised and have been a major source of concern for patients undergoing ECT treatment (1). It is however, important to note that the conditions most commonly treated with ECT (major depression, mania and schizophrenia) are also associated with significant cognitive impairment (2). Many patients report an improvement in memory and cognition as their depression improves after treatment with ECT.

The NSW Health Guidelines for ECT Minimum Standards of Practice provide a comprehensive overview of ECT as part of the modern armamentarium of therapies for mental illness (1). They describe each element of the treatment pathway, from the indications for ECT, risks, consent and legal issues, to the treatment itself, including the facilities that are required, patient preparation, anaesthesia and administration of ECT. This study monitors the formal implementation of the cognitive assessment protocol for patients undergoing ECT in a regional psychiatric hospital setting as recommended in NSW Health Guidelines for ECT Minimum Standards of Practice.

Methods

Clinical audit of all adult patients undergoing ECT between November 2017 and December 2018 at the Bloomfield Hospital in Orange who had not received ECT during the previous 6 months. Data items abstracted included patient demographics, diagnosis, and ECT parameters. Cognition prior to and following the entire course of ECT was measured using the Addenbrooke's Cognitive Evaluation–R (ACE-R). Before and after each individual ECT session (i.e. during the course of ECT), patient orientation was assessed using a standardised 10-item scale.

Results

Thirty-one patients completed a median of 10 sessions (range 5 to 22) of ECT during the study period. While 24 patients had an ACE-R completed prior to and following their ECT course, only 61% had both measures. Patient orientation prior to treatment was assessed for approximately three-quarters (n=234, 72%) of the 324 ECT treatments. Post-treatment orientation assessments were only completed for 55% (n=177). Both pre- and post-treatment orientation assessments for the first ECT session were only completed for 16 of the 31 patients, i.e. 52%. Of these patients, 12 demonstrated an average 21% increase in ACE-R score, i.e.

improved cognition, six an average 5% decrease, and one no change. The magnitude of change in cognition between those who improved and those who deteriorated was not statistically significant (p=0.08).

Conclusions

Given the potential cognitive side-effects of ECT, there is a need for proper cognitive monitoring pre, during and post-ECT. Monitoring of the implementation of the NSW Minimum Standards for cognitive assessment in Bloomfield Hospital patients undergoing ECT indicated scope for improvement. This was particularly evident for the pre- and post-session orientation assessments. This may reflect possible workforce shortages in a rural, psychiatric setting. A substantial proportion of patients experienced improved cognition. This may be associated with improved illness severity following treatment. The study results may provide reassurance to patients undergoing ECT in a rural setting.

Implications

While this study showed that cognitive assessments were being performed, it also showed that this had not become a routine practice. As such implementation of the NSW Minimum Standards for cognitive assessment in Bloomfield Hospital patients undergoing ECT had commenced, but assessment rates were not meeting the standard. The other major study finding was improved cognition for a substantial proportion of patients. Further research is required to investigate the relationship between improved cognition and reduced illness severity and characterising patients at risk of cognitive side effects.

Recommendations

The researchers recommend staff education; including topics such as the cognitive side effects of ECT, on NSW Minimum Standards for cognitive assessment, the need for systematic monitoring, on the current hospital protocol etc. mainly targeting the medical and nursing staff who are involved in ECT (albeit medical/nursing staff in acute wards). It also would be important to educate staff around the implications of earlier identification of cSEs for more vulnerable patients i.e. those prone to long term cognitive side effects.

In addition, staff could start patient education/ patient reassurance regarding cSEs based on the findings of the study. It would be important to give objective feedback to patients regarding their cognition over a course of ECT using the cognitive monitoring data. Of note, further studies are warranted to investigate the relationship between improved cognition and reduced illness severity in future.

It would be recommended to health administration to address possible workforce shortages in rural, psychiatric settings as the workforce shortages appear to play a major role in maintaining health records including assessments by health professionals. The shortages were mainly noted in nursing (albeit which were well reflected in the collection of orientation data).

Context

The occurrence of cognitive side effects with ECT is well recognised and has been a major source of concern for patients undergoing ECT treatment (1). It is however important to note that the conditions most commonly treated with ECT (major depression, mania and schizophrenia) are also associated with significant cognitive impairment as an inherent component of the condition (2). Many patients with major depression report an improvement in their memory and cognition once their depression improves following treatment with ECT.

The vast majority of research in this area has been conducted in patients receiving ECT for major depression, and has aimed to exemplify the incidence and severity of cognitive deficits associated with ECT (3). More recent studies have explored optimising ECT technique (method and dose), aiming at maintaining treatment efficacy whilst minimising cognitive side effects (4).

Acute effects

General disorientation immediately after ECT is common (5). Orientation to person, place and time generally recovers at different rates, with orientation to time generally the slowest to recover (6). The duration of disorientation is greater with sine-wave stimuli, bitemporal electrode placement, and higher dose above seizure threshold (7). Some evidence suggests that longer duration of post-ictal disorientation predicts the severity of retrograde amnesia after ECT (8). As such routine measurement of this parameter may be useful in identifying those patients at higher risk of developing retrograde amnesia earlier in the ECT course, enabling alterations in treatment technique in an attempt to minimise this adverse effect (2).

Anterograde memory effects

Impairment in acquisition and retention of verbal and non-verbal material is frequently observed during and immediately after a course of ECT (Ingram et al., 2008). Deficits in retention are generally more marked and are often slower to recover than those in acquisition. Anterograde memory function generally returns at least to pre-ECT, baseline levels within two months (9). Longer-term follow-up studies have also demonstrated maintained improvement in performance relative to baseline scores (10).

Retrograde memory effects

ECT can cause deficits in retrograde memory for information learnt during, and prior to the treatment course (11). Deficits in both autobiographical and impersonal memory can occur, and tend to be most severe immediately after the index (initial) course. Recent memories may be more vulnerable than more remote memories, although some patients have reported loss of memories dating back several years (11). Although retrograde amnesia generally improves over several weeks following an index course, persistent deficits have been demonstrated in patients receiving bitemporal ECT when compared to right unilateral ECT, both at one to two months after the course, and at longer-term follow-up (12).

Non-memory cognitive effects

Studies of the effects of ECT on cognitive domains such as executive function, attention, information processing speed, and general intellect are relatively few and have yielded mixed results, presumably as a result of variations in study populations and methodology (3). A number of factors have been reliably demonstrated to be associated with more severe cognitive side-effects of ECT. These factors include: bitemporal electrode placement, higher dose above seizure threshold, increased frequency of treatments, and use of sine-wave ECT. Other factors such as patient age, cognitive reserve, and comorbid neurological disorders may also be relevant, but the importance or effect of these factors is yet to be fully elucidated (13). Recent evidence suggests that the use of ultra-brief pulse width ECT (pulse width of 0.3 milliseconds) significantly reduces the cognitive side effects of right unilateral ECT, and may have an important role in reducing the cognitive side effects of ECT overall (13).

Assessment of cognitive function at baseline and at completion of a course of ECT, using a standard screening instrument for cognitive impairment such as the Modified Mini-Mental State Examination (MMSE), Rowland Universal Dementia Assessment Scale (RUDAS) or Addenbrooke's Cognitive Evaluation – Revised (ACE-R), is considered essential (14,15). Further assessments during the treatment course are recommended in order to assist in early detection of cognitive deficits and facilitate alterations in treatment technique to minimise adverse cognitive effects. Such alterations may include changing electrode placement, reducing stimulus dose or re-titrating seizure threshold to confirm dosing protocol, reducing frequency of treatment or consideration of a switch to right unilateral ultra-brief pulse width ECT.

Patients with cognitive impairment at completion of an ECT course should have at least one repeat cognitive assessment a month later as part of routine clinical follow-up, in order to ensure resolution of, or improvement in, cognitive impairment. Further cognitive assessment should be considered if significant impairments persist.

In addition to the above recommendations, the ECT Minimum Standards of Practice in NSW notes the following risks of ECT and the minimum requirements that must be met in the delivery of ECT in New South Wales:

> "2.1 There are no absolute contraindications to ECT. The clinician must conduct a case-by-case risk benefit analysis, and take appropriate action to manage the risks of ECT.
>
> 2.2 All patients receiving ECT must undergo assessment of cognitive function prior to ECT, during the ECT course, and at the completion of the course.
>
> 2.3 Unusual levels of confusion or memory problems detected during the course must prompt a review of ECT prescription and technique." (15, 16)

Background / Introduction

Electroconvulsive therapy (ECT) has been used as a treatment for mental disorder since the 1930s. Decades of research have found that ECT is one of the most efficacious treatments for neuropsychiatric diseases, especially major depressive disorder (1, 17). The absolute number of patients, who receive ECT is large, annually estimated at 1 million worldwide (18). Treatment with ECT produces rapid response and remission rates and is safe for patients across the adult lifespan (20,21).

ECT is a safe and effective treatment for people with severe major depressive disorder and some other mental illness. Advances in the delivery of ECT, including anaesthesia and muscle relaxation during the brief treatment procedure and carefully adjusted dosing schedules, ensure that treatment is well tolerated. Views on ECT vary, from researchers who consider that it is probably ineffective but certainly causes brain damage, through to those who think it is the most effective treatment available in psychiatry and is completely safe.

Cognitive side effects with ECT are well recognised and have been a major source of concern for patients undergoing ECT treatment (1). The ECT neuro-cognitive profile is primarily comprised of decreased orientation immediately after the ECT session, anterograde amnesia for recent information, and retrograde amnesia for long-term autobiographical and impersonal information. Other neuropsychological domains that become inefficient or impaired include processing speed, attention, verbal fluency, and executive function

(e.g., cognitive flexibility). Unlike the neurocognitive profile of Alzheimer's disease that progressively worsens, this profile is transient in many cases. Nonetheless, the adverse neurocognitive changes produced by ECT can persist for up to 6-months or longer and result in functional impairment, poor adherence, reduced clinical outcome, and increased relapse rates (2). Unfortunately, as noted by the United States Food and Drug Administration (US FDA),underlying mechanisms of ECT neurocognitive effects remain poorly understood. Indeed, Fraser et al. in a systematic review of the past 20 years of ECT research reported that there exists no conceptual model that describes how ECT results in adverse neurocognitive effects. Though neuro imaging research suggests that most cortical and sub-cortical regions are involved in ECT associated memory impairment, no conceptual model exists of how the cognitive effects of ECT develop in patients. Thus, the field is at the initial stage of model construction.

According to a recent systematic review (2), differences in ECT modalities may explain variations in cognitive impairment, with bilateral ECT producing greater deficits than unilateral, treatment thrice weekly more than twice weekly and high-dose more than low-dose ECT. Nonetheless, these data have not been systematically analysed to provide clearer evidence about patterns of cognitive dysfunction and progression following ECT. Indeed, consensus regarding memory following ECT lacks specificity. Distinctions between encoding, learning, retention, and retrieval are rarely addressed, while results from verbal and nonverbal tasks are often amalgamated. Results derived from objective and subjective assessments have also been jointly reviewed despite consistent demonstration of a poor relationship between self-reported and objectively measured neurocognitive performance in depression. Discrepancies in reviewing methodology, as well as descriptive rather than quantifying approaches, could account for heterogeneous conclusions regarding cognitive outcomes of ECT. There are multiple moderating and mediating factors that are thought to underlie the neurocognitive effects of ECT. These factors include demographic and neuropsychological characteristics, neuropsychiatric symptoms, ECT technical parameters, and neuro-physiological effects (21). In addition; there is a substantial geographical variation in rates of use of ECT which suggests uncertainty about its efficacy and safety. It is however, important to note that the conditions most commonly treated with ECT (major depression, mania and schizophrenia) are also associated with significant cognitive impairment (4). Many patients report an improvement in memory and cognition as their depression improves after treatment with ECT.

The current study helps to further understand the cognitive outcomes of ECT and will ideally assist clinicians to minimise the cognitive side effects of ECT in a regional psychiatric hospital setup (Bloomfield Hospital). Bloomfield Hospital is a large tertiary Psychiatric hospital in Orange, NSW. It is the primary hub for Western and Far Western NSW psychiatric patients needing tertiary care. Of note, Bloomfield Hospital is the only public hospital currently providing ECT treatment for patients of the Western and Far Western LHDs. Patients who attend Bloomfield Hospital for ECT primarily reside within the Western New South Wales Local Health District, a large and diverse region, encompassing cities, inner regional, outer regional and remote communities. Eleven percent of the total population identify as being of Aboriginal or Torres Islander descent. Though some of the patients receive ECT as a voluntary patient, the majority are treated on an involuntary basis.

The NSW Health Guidelines for ECT Minimum Standards of Practice provide a comprehensive overview of ECT as part of the modern armamentarium of therapies for mental illness. They describe each element of the treatment pathway, from the indications for ECT, risks, consent and legal issues, to the treatment itself, including the facilities that are required, patient preparation, anaesthesia and administration of ECT. Prior to November 2017, these minimum standards had not been implemented at Bloomfield Hospital. The primary

goal of this study is to monitor the formal implementation of the cognitive assessment protocol for patients undergoing ECT in a regional psychiatric hospital setting as recommended in NSW Health Guidelines for ECT Minimum Standards of Practice and to describe the patterns of cognitive outcomes of ECT, in a regional psychiatric hospital setting.

Research Aim and Objective

OBJECTIVE

The primary objective of this study is to monitor the formal implementation of a cognitive assessment protocol. As such, the researcher monitored/checked for the cognitive assessments done prior to ECT, during the ECT course, and at the completion of the course.

Secondary objectives were:

1. To identify individual 'new' patients (those who have not had ECT during the previous 6 months), whose cognition has not recovered (to their baseline) after a completed course of ECT (research aim 3).
2. To identify individual patients whose Orientation assessments indicate a decline during a course of ECT (research aim 4)

AIMS

1. to monitor the formal **implementation** of a cognitive assessment protocol in a regional psychiatric hospital setting

2. to describe **cognitive outcomes** of ECT [in order to improve the quality, and potentially minimise the cSEs of ECT]

3. to identify individual patients, whose **cognition has not recovered** (to their baseline) after a completed course of ECT and individual patients whose **orientation assessments indicate a decline** during a course of ECT (and the relationship of those two parameters, if any)

Method

Study Design:

Setting:

This research project was conducted at Bloomfield Hospital, Orange Health Service, 1502 Forest Road, Orange 2800 from November 2017 and December 2018.

Research population:

The research population was all patients undergoing ECT during the study period who met inclusion criteria and as such the study group in this research were the patients who went through ECT during that period. The data were collected from their files.

Eligibility criteria:

Inclusion criteria to collect data:

- all patients, underwent ECT, including maintenance ECT
- 18 years old and above

Exclusion criteria:

- As the project was to evaluate the policy directive as standard practice and no direct contact with patients occurred, the project requested permission to extract data from patient records with a waiver of consent from HREC. As such the researcher did not have any form of direct contact with the patients underwent ECT. As a result the only patients that were excluded from the study were the patient who had a completed course of ECT during 6 months prior to the study period.

Identification of patients

Information on patients undergoing ECT from November 2017 to December was accessed from the ECT Coordinator at Bloomfield Hospital, Orange Health Service. Thereafter all patients' files were screened so as to ascertain whether or not they were eligible for the study.

Allocation procedure:

The lead researcher allocated all eligible patients' files undergoing ECT for inclusion in the study under the primary and secondary research objectives.

Recruitment and Consent:

As per current NSW health guidelines, all patients receiving ECT must undergo assessment of cognitive function prior to ECT, during the ECT course, and at the completion of the course. As such, and as noted above, a formal cognitive assessment protocol was established, and formally implemented at Bloomfield Hospital. This was monitored and continued and the outcomes of those cognitive assessments were collected to carry out the research. As the project was evaluating the policy directive as standard practice using data from patient records (albeit no direct recruitment of patients requiring consent) and requested a waiver for consent from the HREC and same was granted under HREC/17/GWAHS/86 (GWAHS 2017-062).

Data Collection:

Data collection was done as described in Figures 1 and 2. All patients' files who underwent cognitive monitoring as a part of routine ECT procedure of the hospital was included in the study, albeit as per stated inclusion criteria of the research. All of the other procedures were occurred as per current standard practice.

Instrument used:
The monitoring of the formal implementation of the ECT protocol of the hospital was done simply by monitoring the number of patients who have had completed cognitive monitoring prior, during and at the completion of ECT (i.e. completed ACE R and orientation assessments) and who have not had the cognitive monitoring (as above), as per current hospital protocol. Assessment of cognitive function at baseline and on completion of a course of ECT was done using the Addenbrooke's Cognitive Evaluation – R (ACE-R) as the cognitive assessment tool in their routine assessments. However of note, as there are no established cut-off for this population and the researcher defined (albeit 'operationalised') that 5% improved or deteriorated cognition (i.e. from baseline) as a considerable difference. In addition, pre and post (each ECT treatment) orientation was assessed using a 10-Item Orientation Questionnaire developed by Donel M. Martin (22; see Appendix 1).

Demographics:
The baseline characteristics that were included: age, gender, ethnicity, indication for ECT, type of ECT and number of treatments. This information was collected from the patients' records. Of note, the ethnicity of the sample population was to identify only for demographic reasons; to describe the sample characteristics – to ascertain whether the sample represents the population of the area.

Data Management and Statistical Analysis:

Sample Size
Analysis question 1: The number of patients undergoing ECT per year in Bloomfield is roughly estimated to be between 40 and 50. As this would be a process of monitoring the current procedure and the collection of data from the files, all the patients' files fulfilling the inclusion criteria for research question were included in this research question.

Analysis question 2: The sample size calculations were based on effect sizes for subacute changes (i.e. within 0 to 3 days) of completing a course of ECT in cognition as measured by the MMSE reported in a meta-analysis conducted by Semkovska and McLoughlin (2011) (23). In order to detect changes in cognition post-completion of a course of ECT with an effect size of 0.28 in a sample with both bilateral and unilateral ECT, and with alpha set at 0.05, 81 subjects would be sufficient to detect such a change with 80% power using a matched samples t test. In order to detect changes in cognition post-completion of a course of ECT with an effect size of 0.33 in a sample with both bilateral and unilateral ECT, and with alpha set at 0.05, 59 subjects would be sufficient to detect such a change with 80% power using a matched samples t test. As such, was aimed to achieve 60 to 85 file reviews for aim 2.

Analysis question 3: The sample size calculations were based on effect sizes for changes in cognition post-seizure as measured by the word list learning reported in a meta-analysis conducted by Semkovska and McLoughlin (2011) (23).In order to detect changes in orientation post-seizure with an effect size of 0.66 in a sample with both bilateral and unilateral ECT, and with alpha set at 0.05, 16 subjects would be sufficient to detect such a change with 80% power using a matched samples t test. As such, was aimed to have at least 16 to 85 file reviews for aims 3.

Data analyses:

The data analyses were done using several methods including; descriptive statistics – calculations of means and standard deviations or medians and interquartile ranges, comparative statistics between groups i.e. independent samples t tests or the Mann-Whitney U [W-W U] test compared cognitive decliners and improvers. In addition Spearman's correlation used to explore the association between ECT dose and change in ACE-R and MMSE scores.

All analyses were conducted using SPSS vn 25 and p values < 0.05 considered statistically significant.

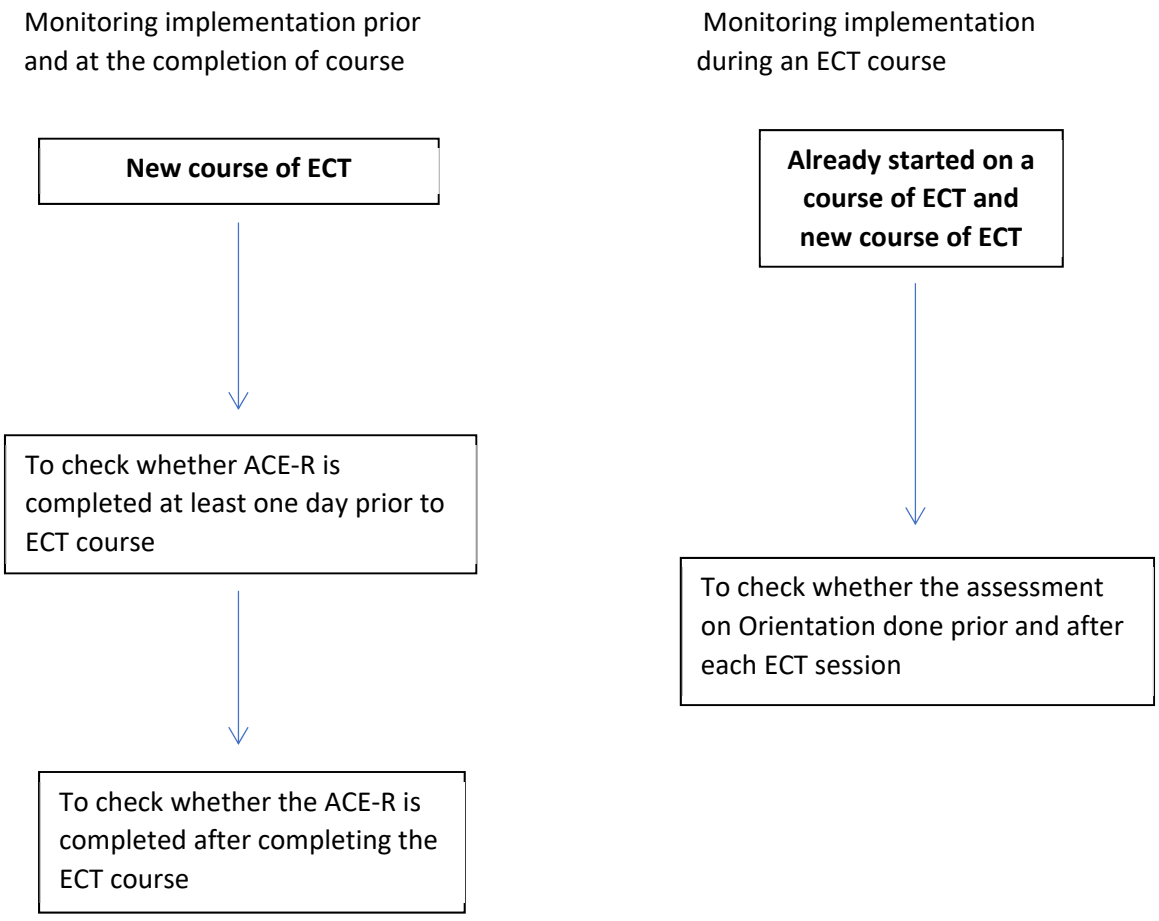
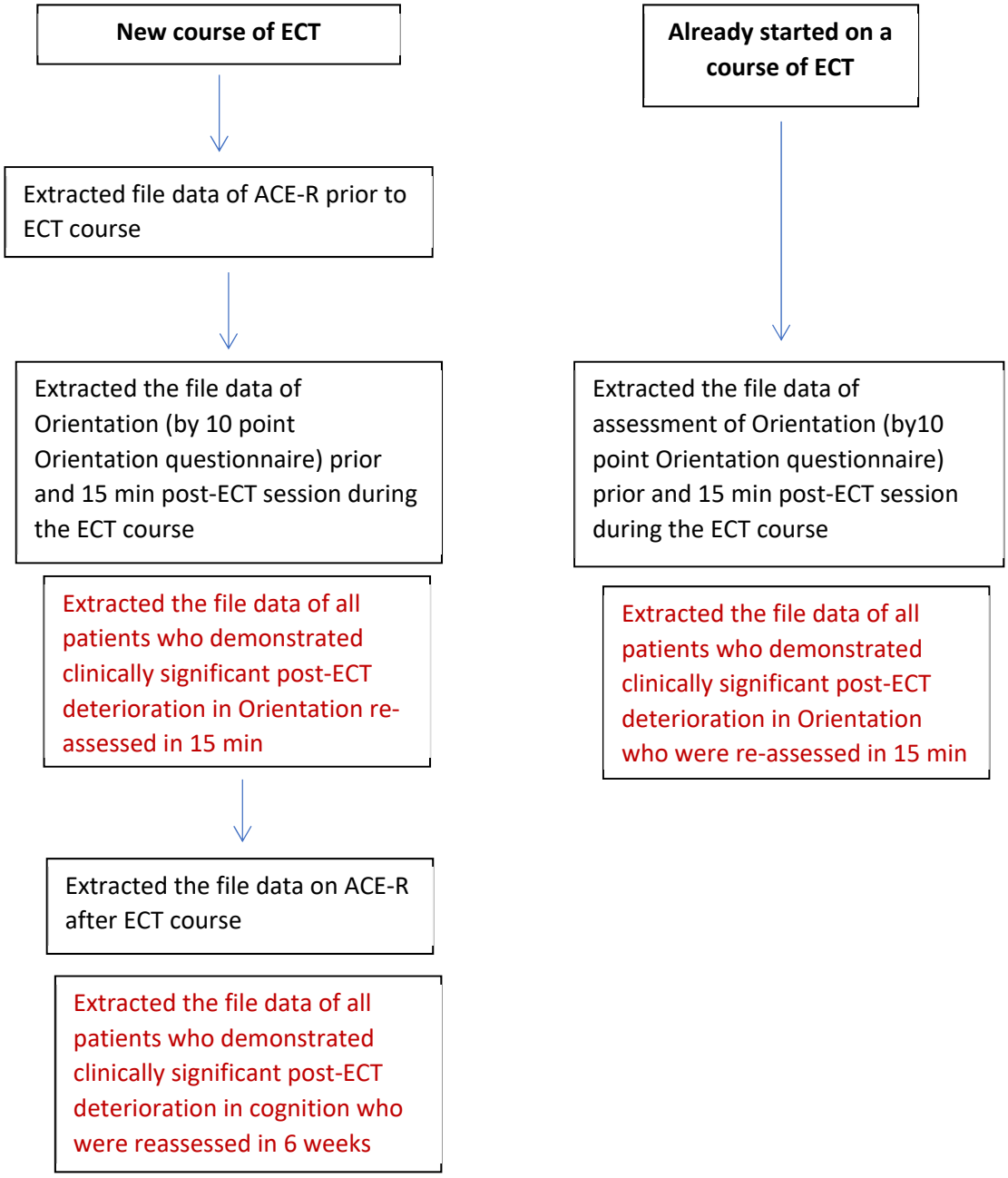


Figure 1: Procedure 1 -Monitoring the formal implementation of the Electroconvulsive Therapy (ECT) Minimum Standards of Practice in NSW policy



Unusual levels of confusion or memory problems detected during the course was informed to treating team to review ECT prescription (none noted during the said period).

All the patients who continued to have clinically significant deterioration in cognition/orientation was to be notified to the Treating Team(none noted during the said period).

Figure 2: Procedure 2 -Monitoring of cognitive side-effects as per ECT Minimum Standards of Practice in NSW

Results

Demographics and ECT parameters

There were 33 adults commenced treatment between Dec 2017 and Nov 2018 and 31 met inclusion criteria for the study (n=2 excluded - received ECT during the previous 6/12). Their average age was 61.1 years (SD 16.0; range 31 to 92). Most were female (77.4%, n=24/31) and over half were diagnosed with recurrent depressive disorder (51.6%) or recurrent depressive disorder with psychotic symptoms (16.1%).Unilateral electrode placement was the most common (n=21, 67.7%), as was DGX mode (n=18, 58.1%). Only two patients had a position change – one from bilateral to unilateral after five treatments, and the other from unilateral to bilateral after two treatments. The median total dose was 405 mC (interquartile range 460) and the median maximum treatment dose was 50 mC (interquartile range 55).

Research aim 1: to monitor the formal **implementation** of a cognitive assessment protocol in a regional psychiatric hospital setting

A total of 324 ECT treatments were given during the study period with a median of 10 (IQR 5) treatments per patient. Assessments using the MMSE/ACE-R were completed for approximately three-quarters of patients before and after their course of ECT (see Table 1). Of note, only 2/31 patients did not have an MMSE/ACE-R at either pre or post, during this time.

Table 1: monitoring the formal implementation of a cognitive assessment protocol

	Pre	**Post**	**Both (pre and post)**
MMSE/ACE-R (N=31)	**n (%)**	**n (%)**	**n (%)**
Valid	24 (77)	24 (77)	19 (61)
Missing	5 (16)	7 (23)	2 (7)
not attempted	2 (7)	0	n/a
Orientation (N=324)			
total number	234	177	174
% of treatments	72.2	54.6	53.7

N.B. there were 324 ECT treatments for the 31 patients.

Research aim 2: to describe **cognitive outcomes** of ECT [in order to improve the quality, and potentially minimise the cSEs of ECT]

Out of 31 patients only the 19 patients who had ACE-R both before and after ECT course were included in the cognitive outcome assessments. Out of the 19 patients; one had no change from baseline and six had a decrease in ACE-R score and 12 had increased scores (i.e. improved cognition; see Figure 3). Out of these, ACE-R differed between those who declined and those who improved significantly in **pre-ECT assessments (p=0.001);** but not with **post-ECT assessments (NS)**(see Table 2).

When considering the whole sample; there was a 6 point increase in ACE-R (or 11% increase). However when we consider the population who declined; they dropped 5 ACE-R points (or 5%) whist those who improved increased 12 ACE-R points (or 21%). Of note these differences were **statistically significant** (see Table 2). When considering the six patients declined in ACE-R score; they ranged from a drop of 10.3% to a drop of 1.2%. Specifically, one patient dropped 10.3%, one patient 8.4%, one 7.4%, one 4.1% and two 1.2% in ACE-R score from baseline. Of note, in terms of absolute change (considering only the size of the change, not the direction); those who declined and those who improved did not differ significantly in change on ACE-R pre to post ECT (t=-1.59, df=16, p =0.13). In other words, the average decline of 5.2 points and the average

improvement of 12.0 points did not differ significantly. Similarly, the 5.4% decrease in the decliners and the 20.7% increase in the improvers was not a statistically significant difference when compared as absolute (directionless) values (Mann-Whitney U z = -1.78, p=0.08).On the other hand, with regard to the absolute point change for MMSE; i.e. 2.0 for the six 'decliners' vs 5.1 for the 12 'improvers', was **statistically significan**t (t=-2.20, df=12, p =0.048) and the absolute precent change for MMSE, i.e. 6.8% vs 25.1%, was also statistically significant (Mann-Whitney U z = -2.48, p = 0.013).

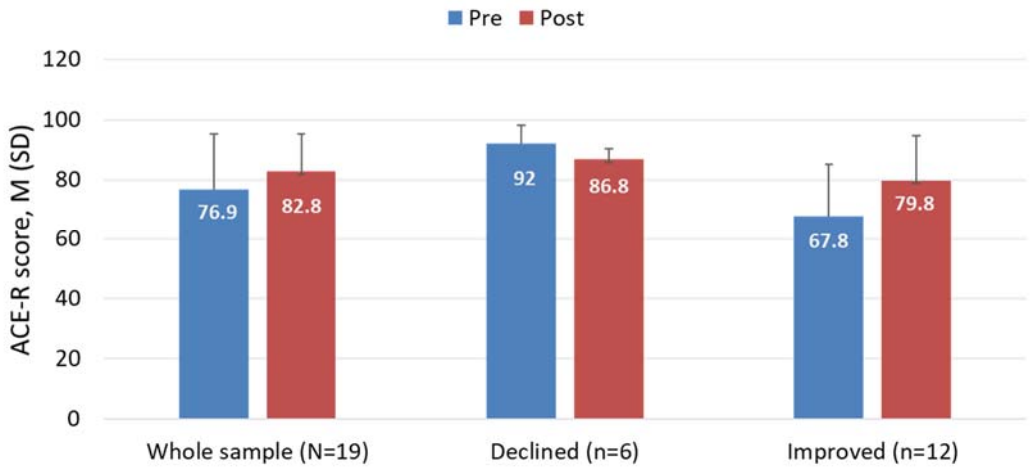


Figure 3: ACE-R Assessments pre and post ECT course

Table 2: ACE-R and MMSE assessments pre and post ECT course

	All	Decliners	Improvers	Statistics
ACE-R	**N=19**	**n=6**	**n=12**	
ACE-R pre, M (SD)	76.9 (18.5)	92.0 (6.3)	67.8 (17.3)	t=4.31, df=15, p=0.001
range	43 to 97	84 to 97	43 to 91	
ACE-R post, M (SD)	82.8 (12.6)	86.8 (3.7)	79.8 (14.9)	t=1.53, df=13, p=0.15
range	55 to 96	83 to 93	55 to 96	
Δ ACE-R				
points, M (SD)	6.0 (11.6)	-5.2 (3.8)	12.0 (10.1)	t=-3.98, df=16, p=0.001
range	-10 to 30	-10 to -1	2 to 30	
percent, M (SD)	11.3 (20.3)	-5.4 (3.9)	20.7 (20.1)	M-W U=-3.37, p=0.001
range	-10.3 to 58.1	-10.3 to -1.2	2.2 to 58.1	
MMSE	**N=19**	**n=5**	**n=9**	
MMSE pre, M (SD)	26.3 (4.5)	29.6 (0.9)	22.6 (3.9)	t=5.17, df=9, p=0.001
range	17 to 30	28 to 30	17 to 29	
MMSE post, M (SD)	28.3 (1.8)	27.6 (1.9)	27.7 (1.7)	t=-0.07, df=12, p=0.95
range	25 to 30	25 to 29	25 to 30	
Δ MMSE				
points, M (SD)	1.9 (3.8)	-2.0 (1.7)	5.1 (2.8)	t=-5.04, df=12, p<0.001
range	-5 to 10	-5 to -1	1 to 10	
percent, M (SD)	10.1 (19.1)	-6.8 (5.8)	25.1 (17.5)	M-W U=-3.01, p=0.003
range	-16.7 to 58.8	-16.7 to -3.3	3.4 to 58.8	

N.B. one patient had no change in ACE-R score, five patients had no change in MMSE score

There was no correlation between the maximum ECT treatment dose and either change in MMSE score (r_s=0.22, p=0.37, n=19) or change in ACE-R score (r_s=0.31, p=0.19, n=19); nor between total ECT does and change in MMSE score (r_s=0.27, p=0.26, n=19) or change in ACE-R score (r_s=0.23, p=0.35, n=19).

Research aim 3: to identify individuals whose **cognition** has not recovered (to their baseline) after a completed course of ECT and individual patients whose **orientation** assessments indicate a decline during a course of ECT (and the relationship of those two parameters)

When considering returning cognitions to baseline, there were number of patients whose cognitions did not recover to baseline. There were six patients whose ACE-R scores declined whilst 12 patients had improved scores (out of 19 patients with both pre and post ACE-R completed). On the other hand, there were five patients whose MMSE scores declined from their baseline whilst nine patients showed an improvement in their MMSE scores (see Table 2).

Regarding individual patients whose **orientation** assessments indicate a decline during a course of ECT; there were eight patients who were identified with a decline in post-session orientation scores, however only three patients of these eight patients showed a decline across pre-session orientation scores (see Table 3).

When considering the association/pattern of change in orientation scores across the course of ECT and change in cognition score (ACE-R or MMSE) from pre to post-ECT; there was no clear picture as there were a number of inconsistencies between cognitive assessments (i.e. ACE-R and MMSE) and orientation (see Table 3). For an example patient #28; the ACE-R dropped from 97 to 87 however the orientation across eight sessions of ECT were not consistent with same - pre-session stable from 10 to 9, post-session changed from 9 to 7.The individual graphs for all patients with orientation assessment scores are included in appendix 2. In addition, overall three patients had declines in post-orientation assessment scores, two declined over the course of ECT in both pre and post orientation, and 11 did not show any decline in orientation over the course of ECT. The change in ACE-R and MMSE scores for these three groups is shown in Table 4.

Table 4: Pattern of change in orientation scores across the course of ECT and change in cognition score (ACE-R or MMSE) from pre to post-ECT

	Decline in post-orientation assessments only	**Decline in both pre and post-orientation assessments**	**Neither**
	n=3	**n=2**	**n=11**
ACE-R change, mean (SD)	4.7 (18.2)	3.0 (4.2)	5.2 (10.5)
MMSE change, mean (SD)	2.3 (6.7)	-0.5 (0.7)	1.5 (3.6)

In addition, there was no consistent pattern noted in terms of demographics, diagnosis, type of ECT and change in cognition (ACE-R, MMSE) across ECT course. Considering the same cohort of eight patients whose post-ECT orientation scores declined; there were six patients who received unilateral ECT whist only two received bilateral. Further, there were five patients who received DGX ECT whist only three received UB ECT in the same cohort (see Table 3).

Table 3: The descriptive illustration of demographic, illness and ECT parameters to cognitions and orientation in the eight patients with a possible decline in orientation scores

ID	Demographics	Diagnosis	Type of ECT	Number of sessions of ECT	Orientation pre ECT, score (session #)		Summary, pre-session orientation	Orientation post ECT score (session #)		Summary post-session orientation	ACE-R or MMSE score change	Summary cognitive score
					First	*Last*		*First*	*Last*			
4	Female, 62 yrs	Affective illness	Unilateral, UB	22	7 (S3)	9 (S22)	improve	9 (S3)	6 (S22)	decline	missing	-
5	Female, 46 yrs	Affective illness	Bilateral, DGX; changed to Right Unilateral @ T#6	10	8 (S2)	10 (S10)	improve	8 (S2)	6 (S10)	decline?	ACE-R pre: 84, post: 83 MMSE pre: 30, post 29	Stable stable
6	Female 74 yrs	Combination	Unilateral, DGX	5	9 (S1)	6 (S5)	decline	7 (S2)	6 (S5)	decline?	ACE-R pre: 87, post: 93 MMSE pre: 30, post 29	Improved stable
10	Female 31 yrs	Affective illness	Unilateral, UB	7	10 (S2)	6 (S7)	decline	10 (S2)	8 (S6)	decline	ACE-R pre: 95, post: 95 MMSE pre: 29, post 29	Stable stable
11	male 82 yrs	Psychotic illness	Bilateral, DGX	17	6 (S2)	4 (S15)	?decline	5 (S2)	0 (S11)	decline	ACE-R pre: 43, post: 68 MMSE pre: 17, post 27	Improved improved

ID	Demographics	Diagnosis	Type of ECT	Number of sessions of ECT	Orientation pre ECT, score (session #)		Summary, pre-session orientation	Orientation post ECT score (session #)		Summary post-session orientation	ACE-R or MMSE score change	Summary cognitive score
					First	*Last*		*First*	*Last*			
20	male 76 yrs	Affective illness	Unilateral, DGX	11	7 (S1)	9 (S11)	improved	9 (S2)	8 (S10)	?decline	ACE-R pre: 58, post: 88 MMSE pre: 22, post 28	Improved improved
28	male 51 yrs	Affective illness	Unilateral, DGX	8	10 (S1)	9 (S8)	stable	9 (S1)	7 (S8)	?decline	ACE-R pre: 97, post: 87 MMSE pre: 28, post 26	Decline ?decline
29	Female 83 yrs	Affective illness	Unilateral, UB	12	5 (S1)	9 (S11)	Improved (declined and improved)	6 (S1)	6 (S11)	Stable (declined and improved)	ACE-R pre: 65, post: 68 MMSE pre: 24, post 26	?decline ?improved

N.B. higher orientation scores indicate better orientation

Discussion

1. **Implementation** of cognitive assessment protocol:

Given the potential cognitive side-effects of ECT, there is a need for proper cognitive monitoring pre, during and post-ECT. It is important to monitor outcomes to minimize the cognitive side effects. While this study showed that cognitive assessments were being performed, it also showed that this had not become a routine practice. As such implementation of the NSW Minimum Standards for cognitive assessment in Bloomfield Hospital patients undergoing ECT had commenced, but assessment rates were not meeting the standard.

Monitoring of the implementation of the NSW Minimum Standards for cognitive assessment in Bloomfield Hospital patients undergoing ECT indicated scope for improvement. This was particularly evident for the pre- and post-session orientation assessments. This may reflect possible workforce shortages in a rural, psychiatric setting.

The researchers recommend staff education; involving cognitive side effects of ECT, on NSW Minimum Standards for cognitive assessment, the need for systematic monitoring, on the current hospital protocol etc. mainly targeting the medical and nursing staff who involve in ECT (albeit medical/nursing staff in acute wards. It also would be important to educate staff around the implications of earlier identification of cSEs for more vulnerable patients i.e. those prone to long term cognitive side effects.

2. **Cognitive outcomes:**

A substantial proportion of patients experienced improved cognition. This may be associated with improved illness severity following treatment. The study results may provide reassurance to patients undergoing ECT in a rural setting. Similar findings have been noted in previous research. For an example, Mohn and Rund (2016) noted "*antidepressant effects of ECT do not occur at the expense of cognitive function*" (24) - improved cognitive function (memory) related to improved depression level. As such it is important to note that the conditions most commonly treated with ECT (major depression, mania and schizophrenia) are also associated with significant cognitive impairment (4, 5) as many patients report an improvement in memory and cognition as their depression improves after treatment with ECT.

A number of factors have been reliably demonstrated to be associated with more severe cognitive side-effects of ECT. These factors include: bitemporal electrode placement, higher dose above seizure threshold, increased frequency of treatments, and use of sine-wave ECT. Other factors such as patient age, cognitive reserve, and co morbid neurological disorders may also be relevant, but the importance or effect of these factors is yet to be fully elucidated (13). Recent evidence suggests that the use of ultra-brief pulse width ECT (pulse width of 0.3 milliseconds) significantly reduces the cognitive side effects of right unilateral ECT, and may have an important role in reducing the cognitive side effects of ECT overall (13). In the sample that was used in the study was patients with mostly unilateral electrode placement and the median energy used was 50% (albeit relatively low dose) and this may explain the for these patients to have an improvement in cognitions rather than a decline. However the researcher could not find any of the associations in the study due to the limited (small) number of patients and a substantial amount of data that were missing.

The other major study finding was improved cognition for a substantial proportion of patients. Further research is required to investigate the relationship between improved cognition and reduced illness severity and characterising patients at risk of cognitive side effects.

It would also be important to give objective feedback to patients regarding their cognition over a course of ECT using the cognitive monitoring data.

Of note, one of the other aims of the study was to assist clinicians to minimise the cognitive side effects of ECT by early identification and prompt communication of same to the treating team. However this wasn't needed as the researcher could not find patients with clinically significant deterioration in orientation (albeit confused) during the course of ECT.

3. **Orientation:**

We expected a relationship between brief orientation test and cognitive assessment; however the researcher could not find such a relationship in the results. The assessment tool was a 10-Item Orientation Questionnaire developed by Donel M. Martin (22) which is validated for Australian setup. There may be number of reasons for not been able to find a workable relationship; including (however not limited to) missing data and relatively small sample size. Re sample size; the researcher's aimed to achieve 60 to 85 subjects, however ended up having 31 in total. Further study is required to assess usefulness of brief orientation measure to reflect overall cognitive change that would be caused by ECT. This would be especially important in earlier identification of cSEs for more vulnerable patients i.e. those prone to long term cognitive side effects.

Strengths and limitations

Considering the strengths of study; the researcher did not miss any patient from the study (albeit any patient fulfilling the inclusion criteria) as the ECT co-ordinator was in research team. However, there may be number of limitations; including significant amount of missing data (especially orientation data) and relatively small sample size (smaller than the expected and desired number to achieve the power that was originally assumed in the protocol). The conclusions and the recommendation from this study should be considered in the context of this limited sample size.

Also the researcher only looked at immediately post course cognitive outcome and ideally needed to monitor the patients longer as the cSEs of ECT can persist up to 6 months or longer (2). However this had been difficult as the patients were discharged by that stage.

Conclusion and recommendations

Cognitive assessment is important in ECT to catch cognitive changes **early** so that treatment modality can be adjusted/terminated accordingly.

Monitoring of the implementation of the NSW Minimum Standards for cognitive assessment in Bloomfield Hospital patients undergoing ECT indicated scope for improvement.

A substantial proportion of patients experienced improved cognition which may reflect illness improvement post-treatment. The study results may provide reassurance to patients undergoing ECT in a rural setting.

The researchers recommend staff education; involving cognitive side effects of ECT, on NSW Minimum Standards for cognitive assessment, the need for systematic monitoring, on the current hospital protocol etc. mainly targeting the medical and nursing staff who involve in ECT (albeit medical/nursing staff in acute wards. It also would be important to educate staff around the implications of earlier identification of cSEs for more vulnerable patients i.e. those prone to long term cog side effects. The researchers also recommend addressing possible workforce shortages in a rural, psychiatric setting.

In addition to start patient education/ patient reassurance re the findings of the study. It would be important to give objective feedback to patients regarding their cognition over a course of ECT using the cognitive monitoring data.

Further study is required to assess usefulness of brief orientation measure to reflect overall cognitive change that would be caused by ECT.

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Appendices

Appendix 1: Orientation Scale

- **Read out each of the 10 questions to the patient before ECT treatment in the morning of ECT treatment**
- **Again read out each of the 10 questions to the patient at 30 minutes after the time of ECT treatment i.e. 30 min after pressing the ECT button E.g. if ECT was at 8am, repeat test at 8.30am.**
- **Tick the box if response is correct; if not 100% correct, write the actual response in the response box. For question 3 and 10, please record the exact response whether correct or not.**
- **For Question 10, correct responses are exact days (<14 days) or total weeks (>2 weeks)**

WESTERN NSW HEALTH SERVICE
MENTAL HEALTH ECT RECORD
10-ITEM ORIENTATION SCALE TEST
Bloomfield Hospital

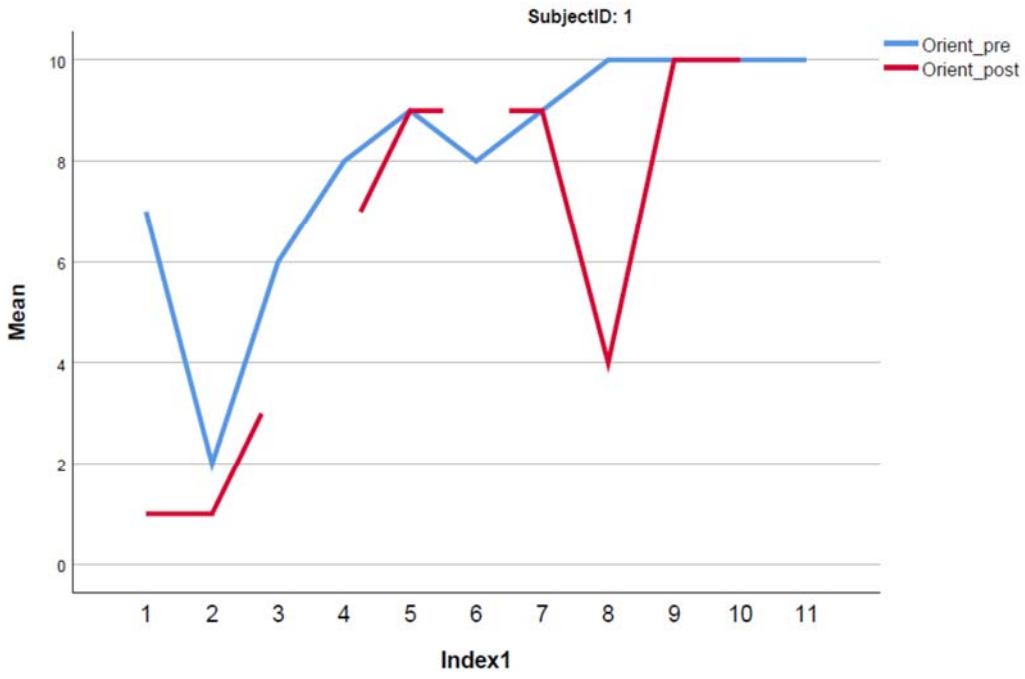
TREATMENT NO:	**TITRATION / 1**		**2**		**3**		**4**		**5**		**6**		**7**	
Date														
Time of ECT treatment														
	Pre	**Post**	Pre	**Post**	Pre	**Post**	Pre	**Post**	Pre	**Post**	Pre	**Post**	Pre	**Post**
Actual time Orientation tested														
1. *What is your name?*														
2. What is your date of birth?														
3. Who was the former prime minister of Australia?	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response	Record response
4. Who is the current prime minister of														
5. How old are you?														
6. What year is it?														
7. What month is it?														
8. What is the name of the place (i.e., institution/ hospital) you are in?														
9. What day of the week is it today?														

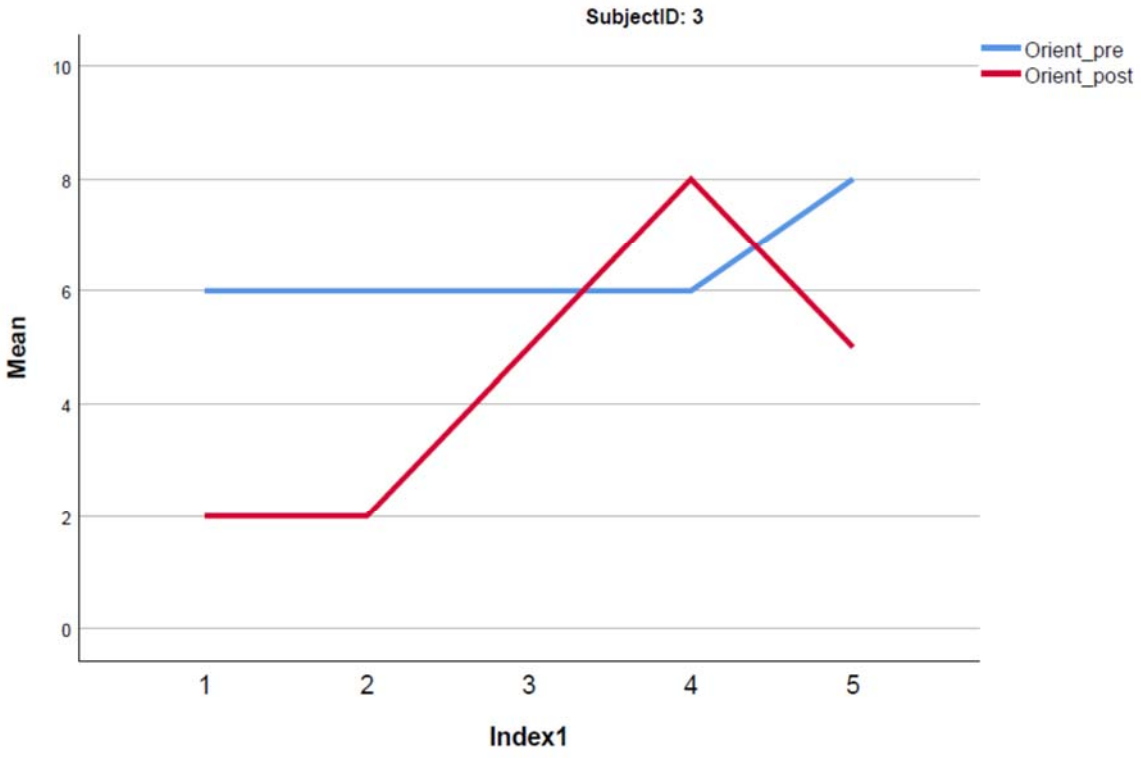
Ward/VMO	**DOB/Sex**	**Other Names**	**Surname**	**AUID/MRN**

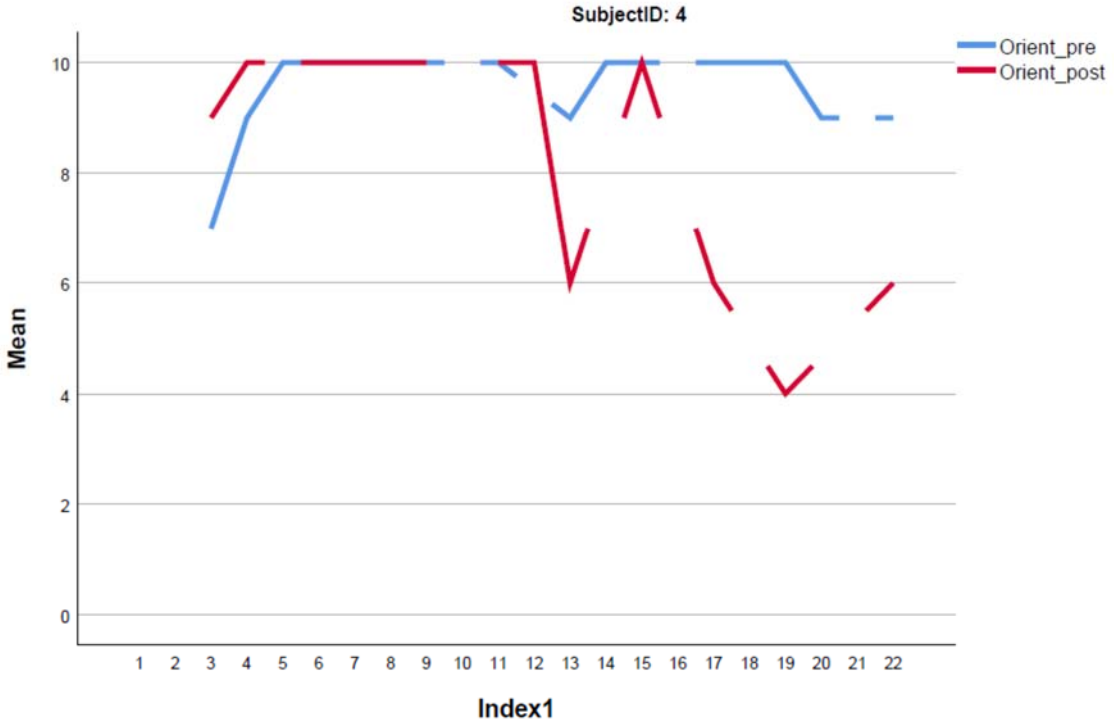
10. How many days/weeks* have you been at this hospital? * if the admission date is less than 14 days before today's date ask for days, otherwise ask for weeks	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)	Record response --------- Days/weeks (please circle*)
TOTAL CORRECT (out of 10)														
Name of Assessor														
Position of Assessor														

MENTAL HEALTH ECT RECORD 10-ITEM ORIENTATION SCALE TEST

Appendix 2: Graphs of change in orientation assessments over course of ECT



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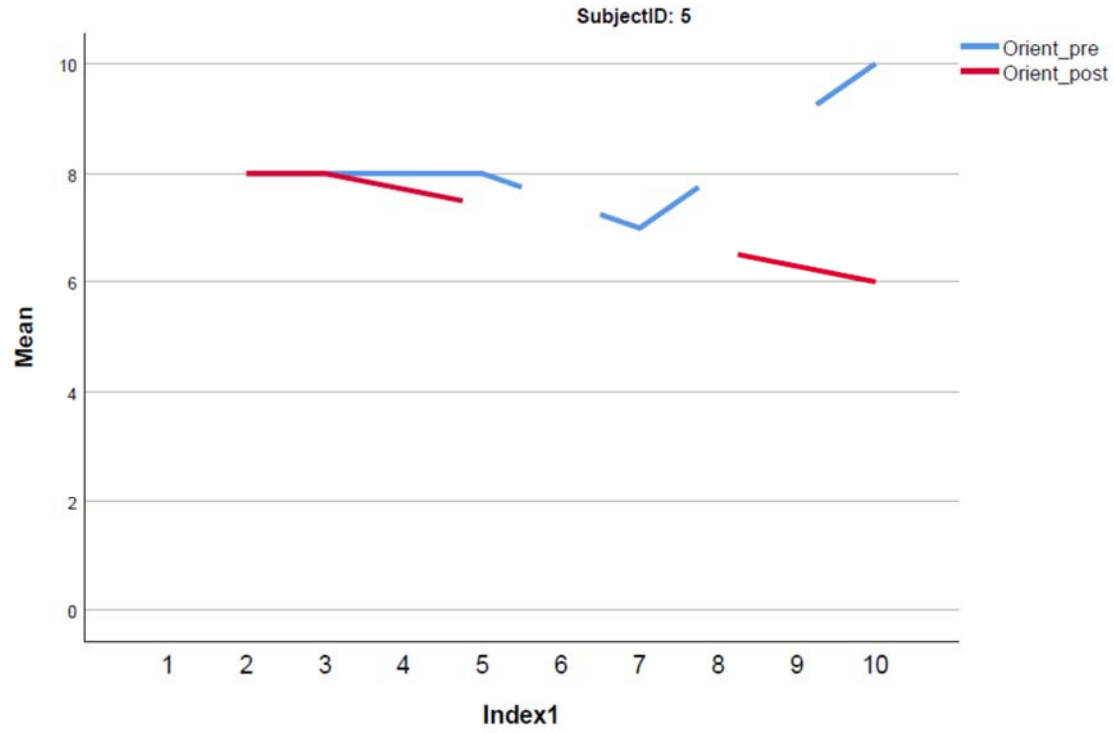
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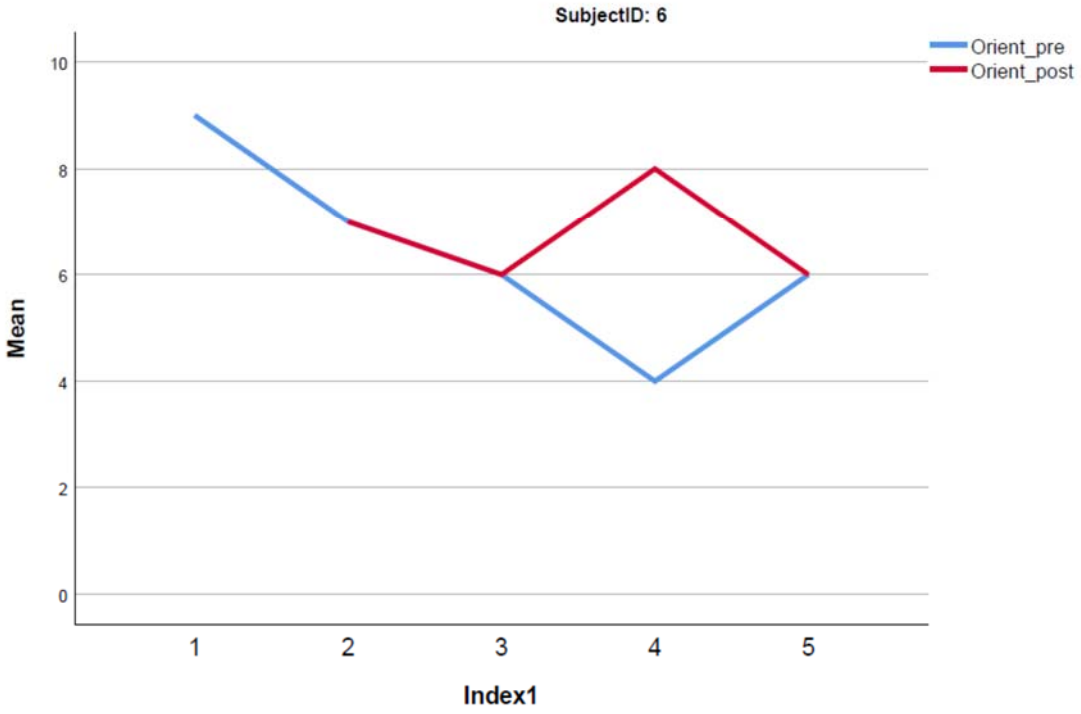
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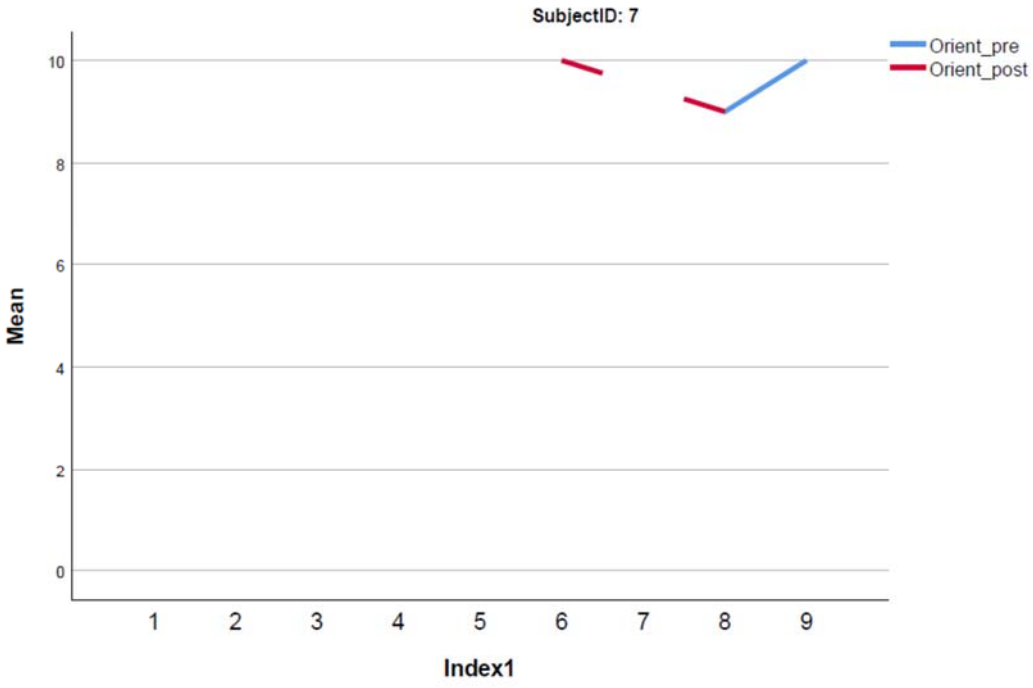
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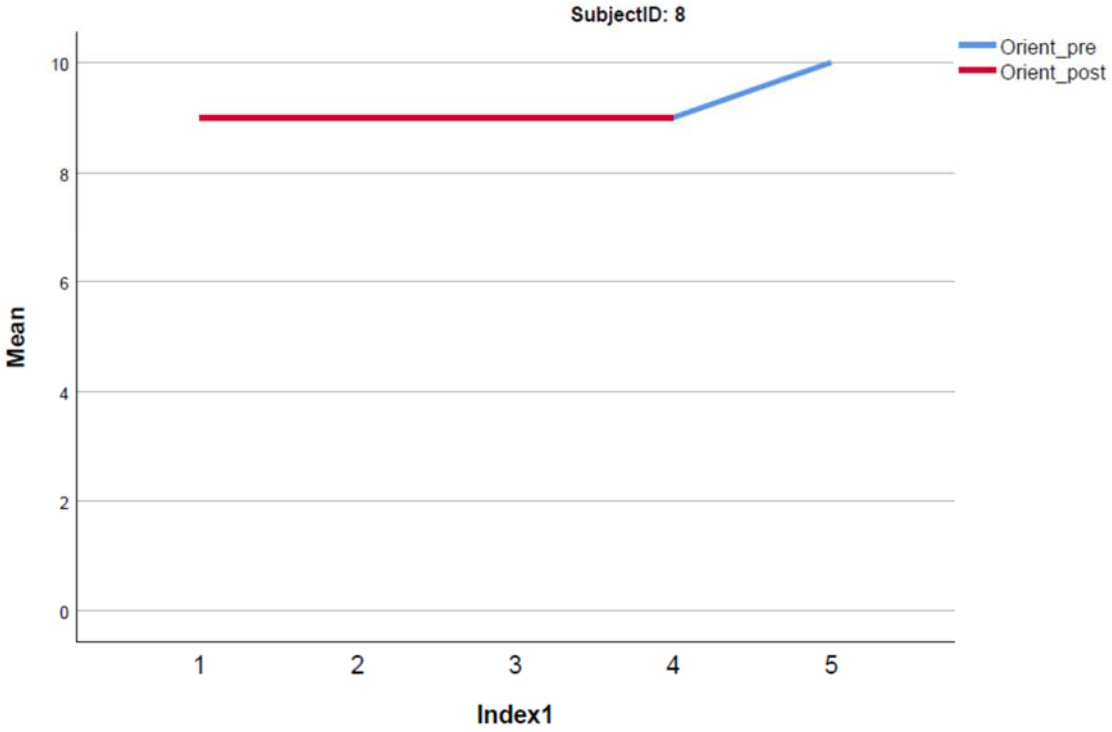
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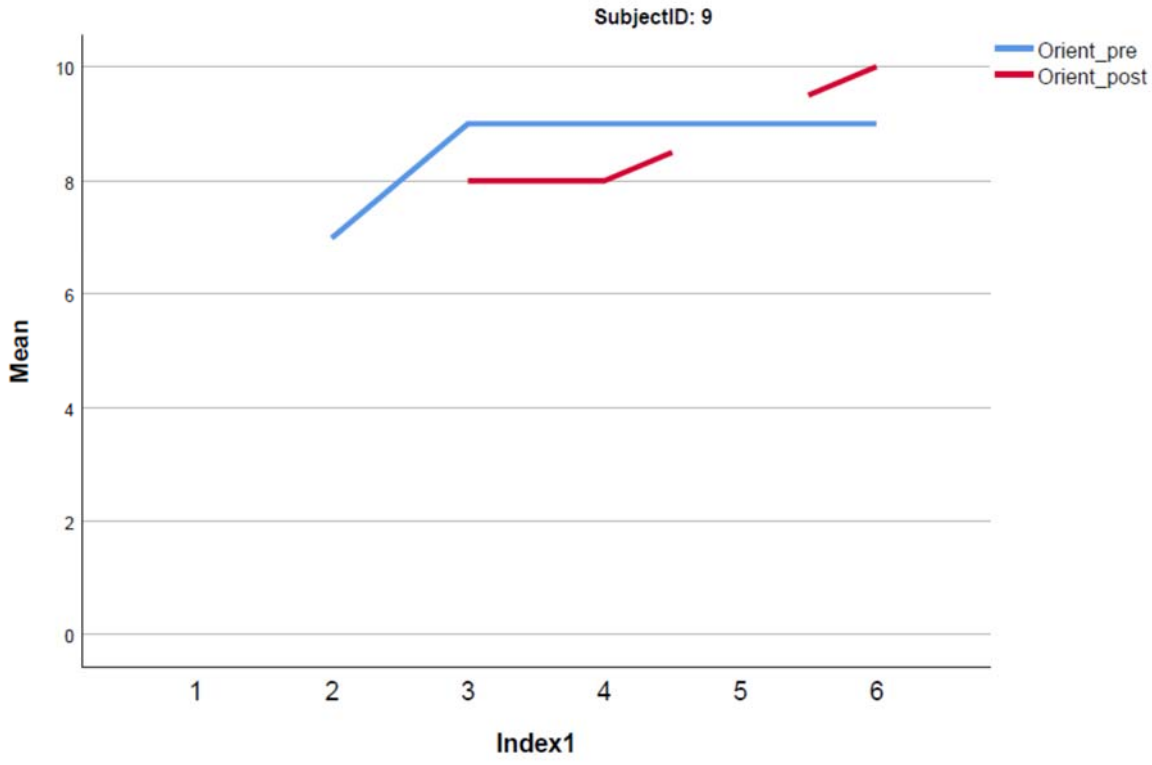
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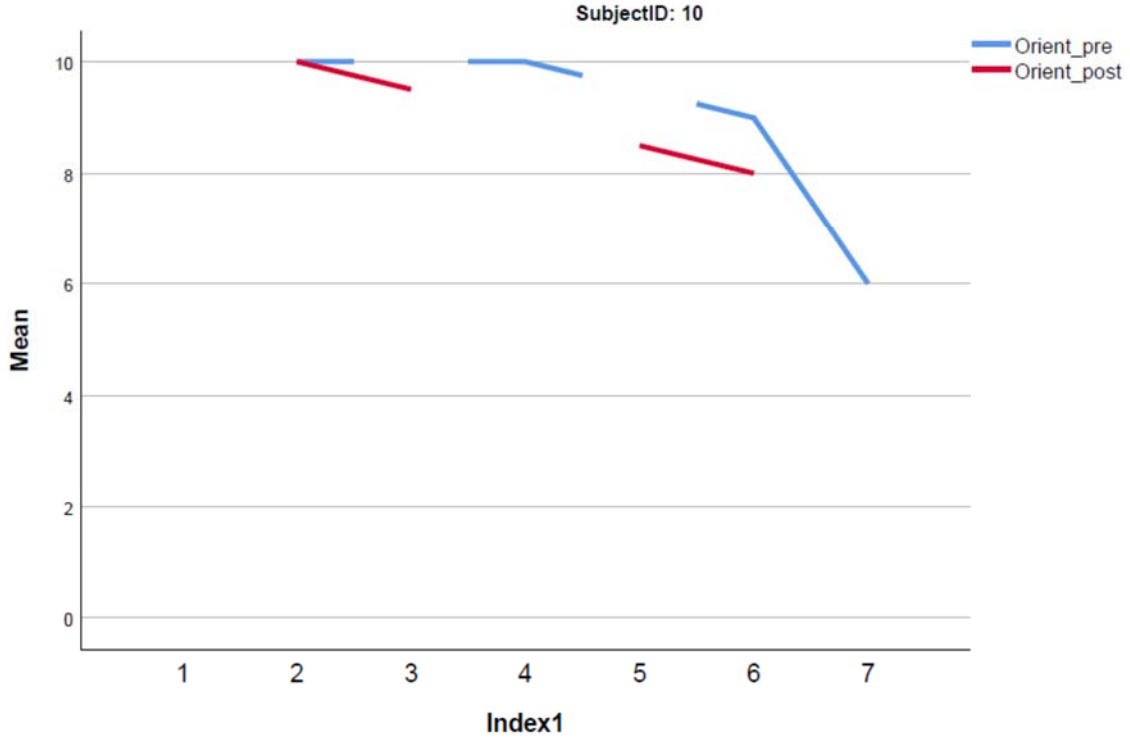
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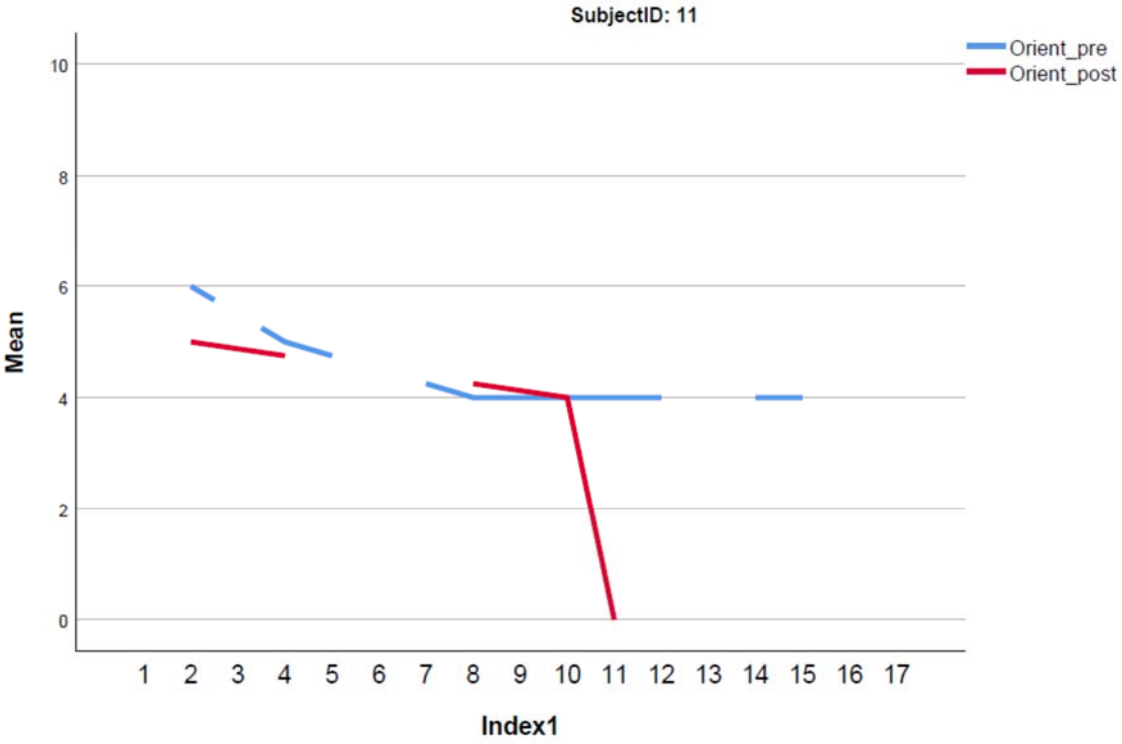
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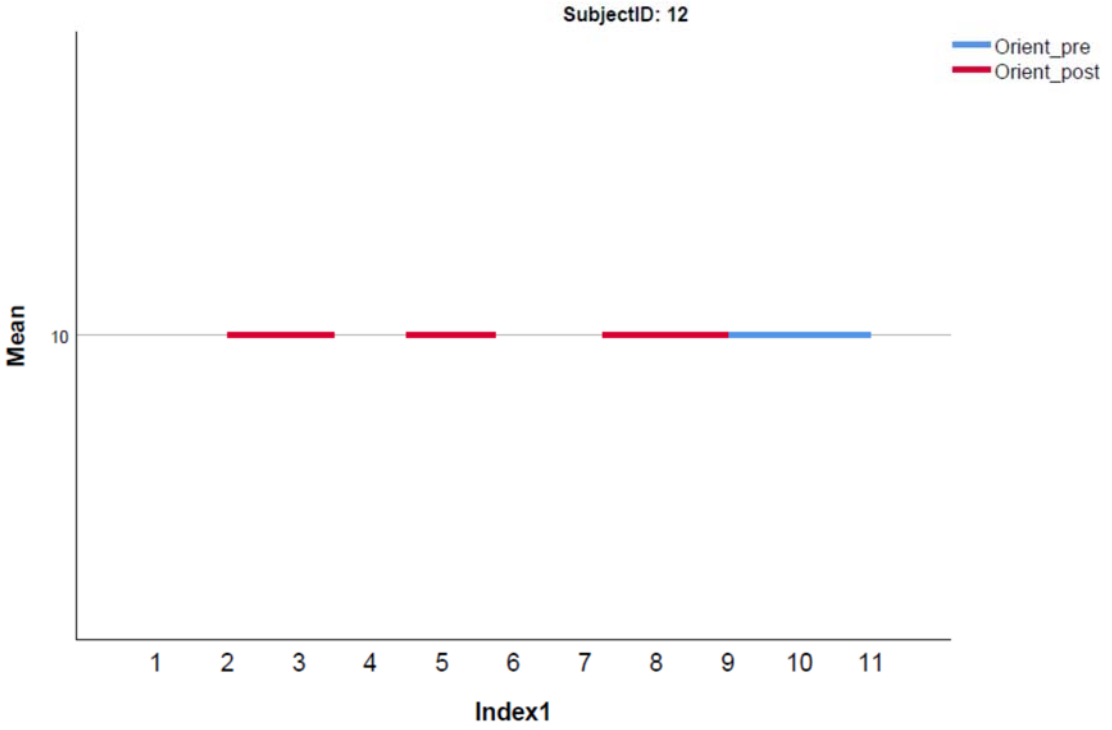
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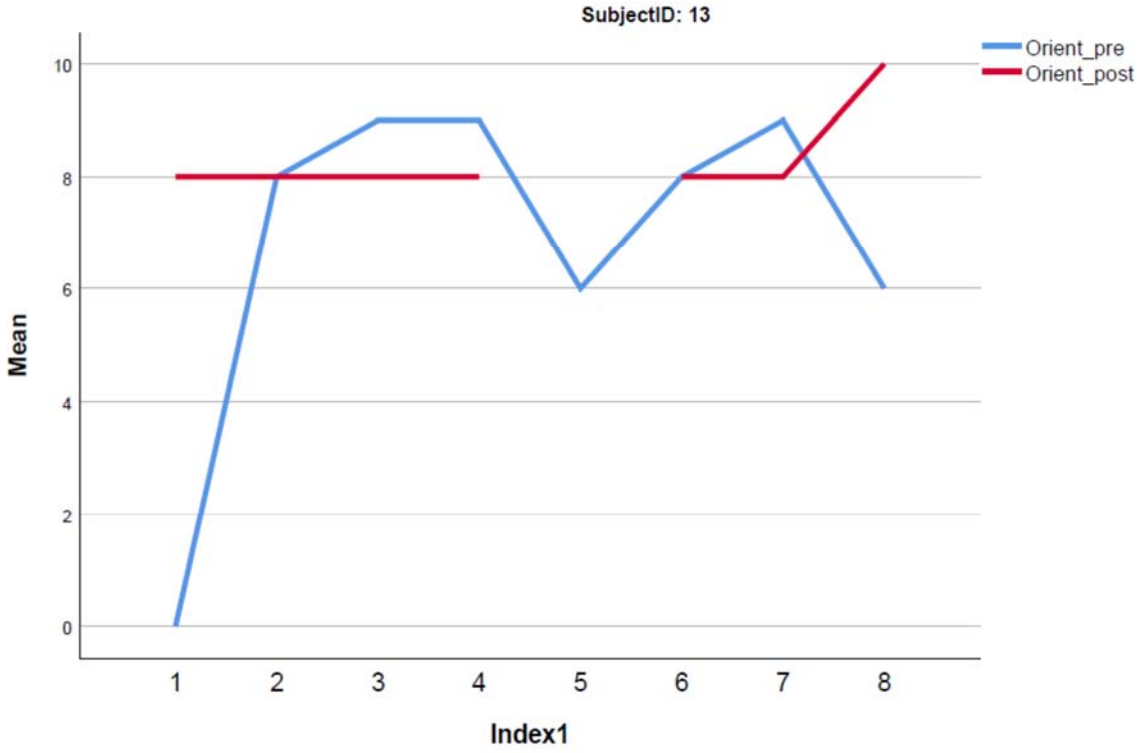
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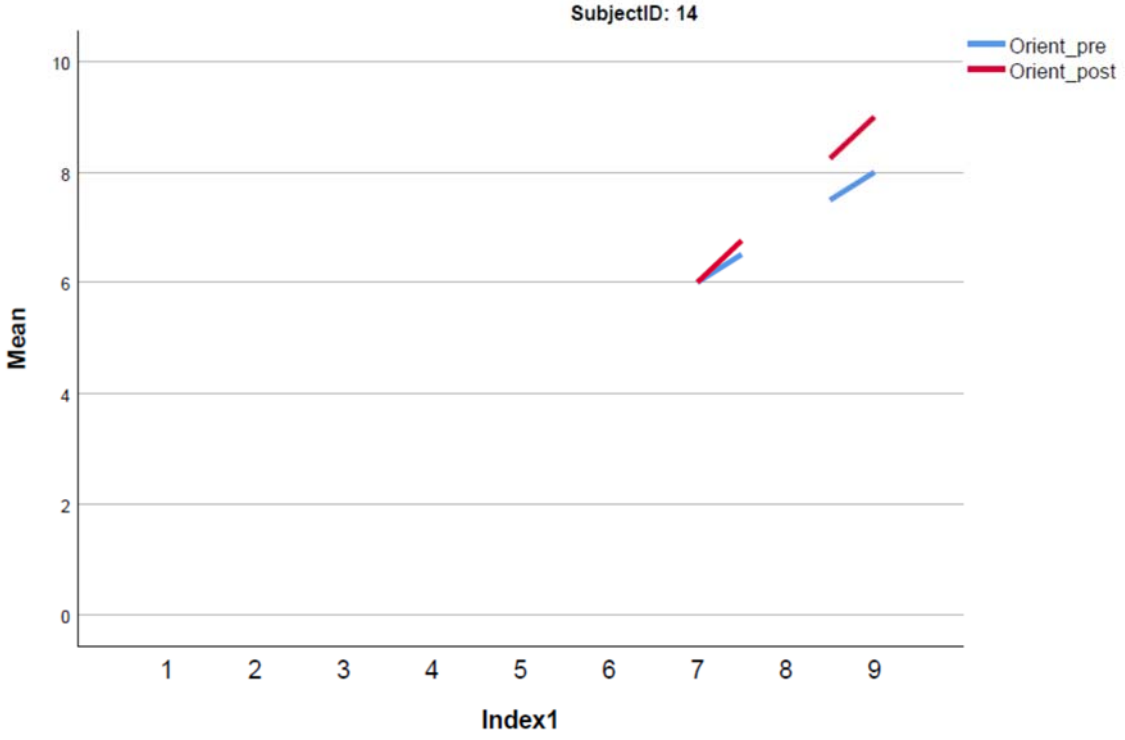
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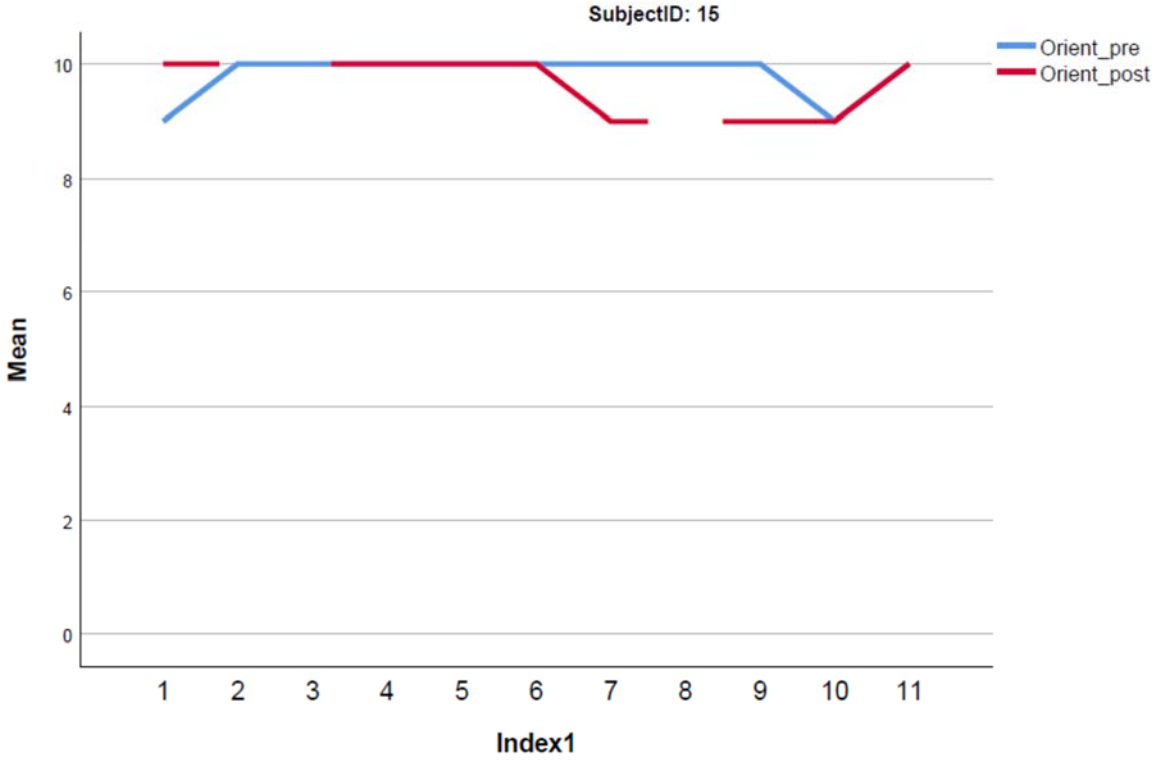
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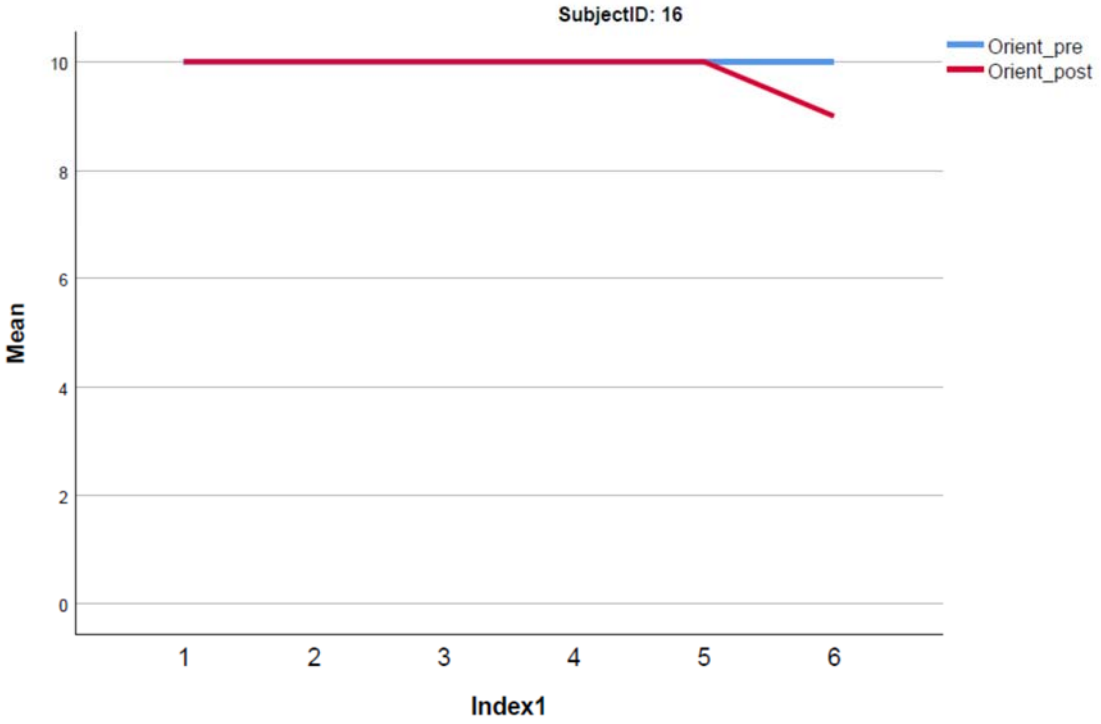
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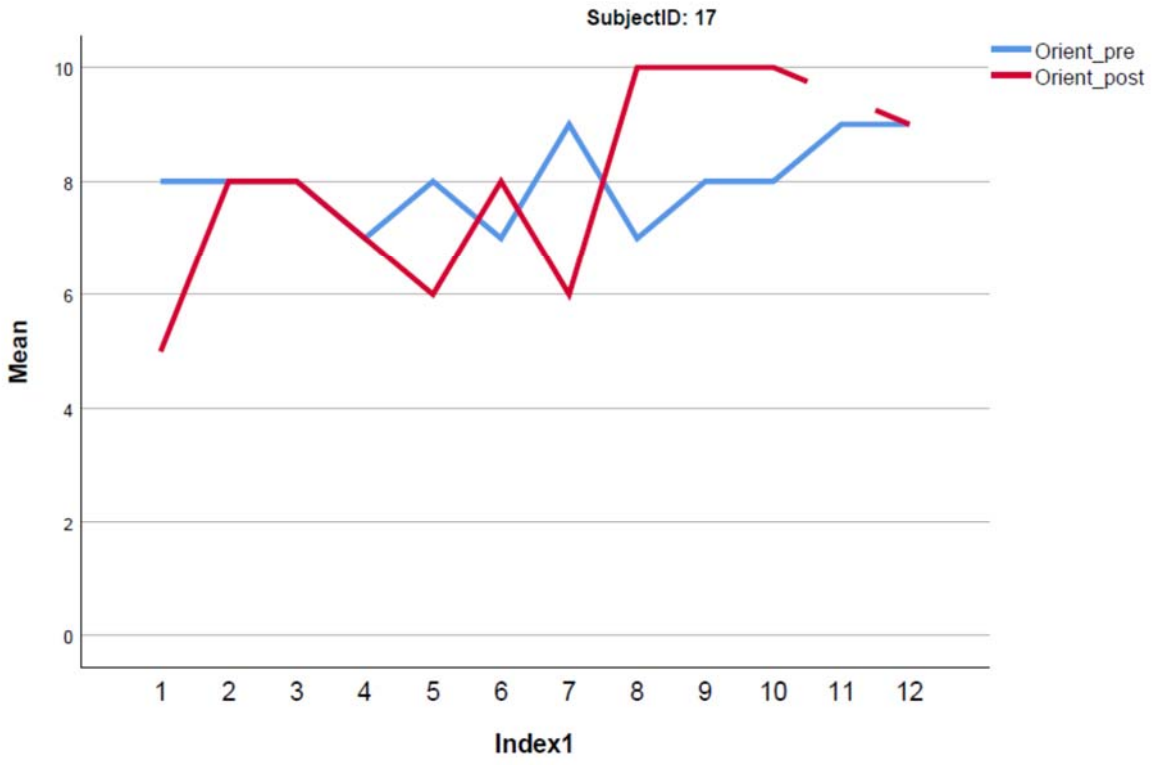
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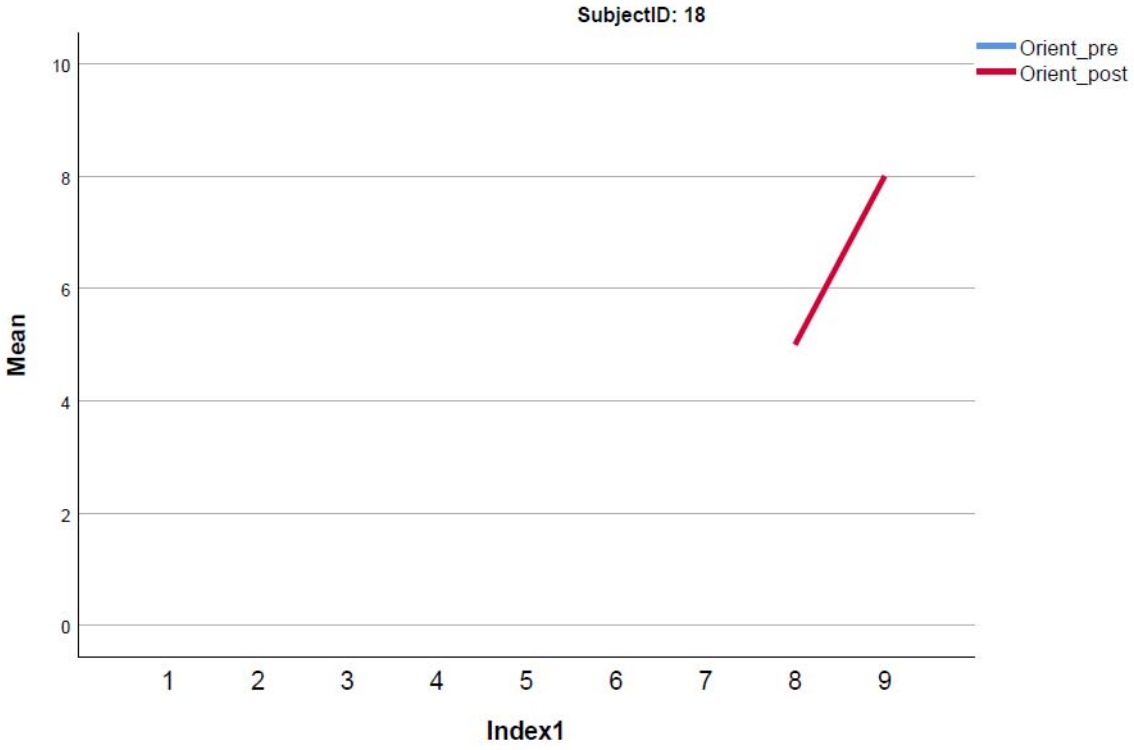
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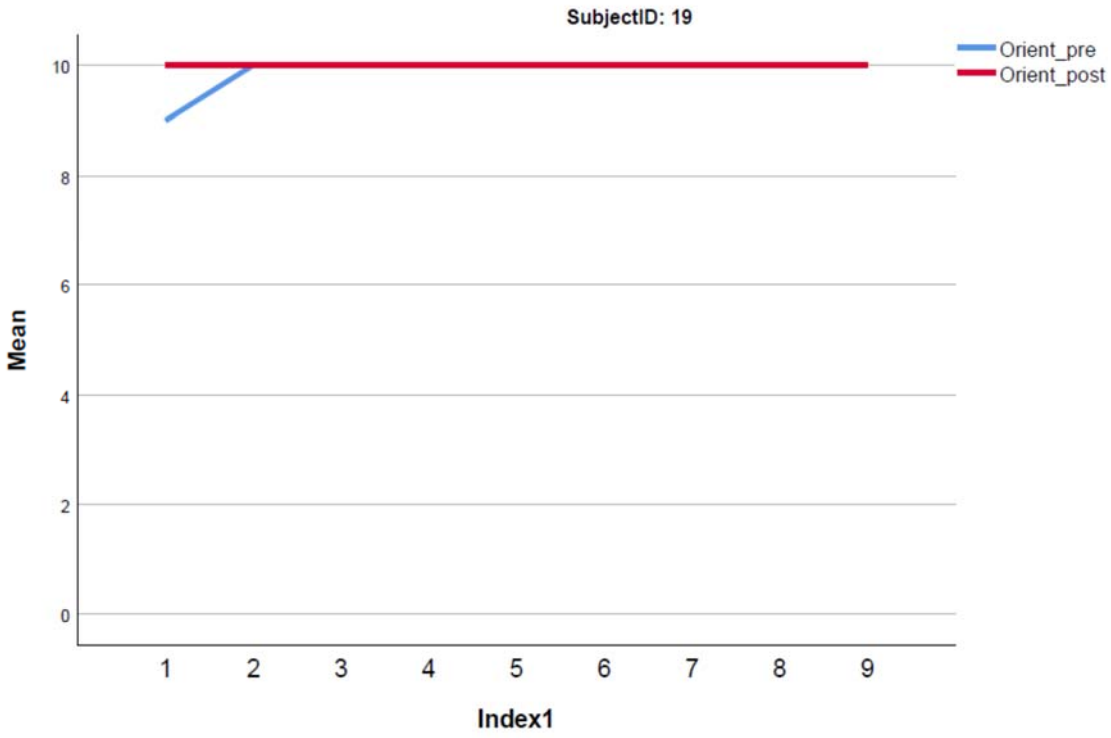
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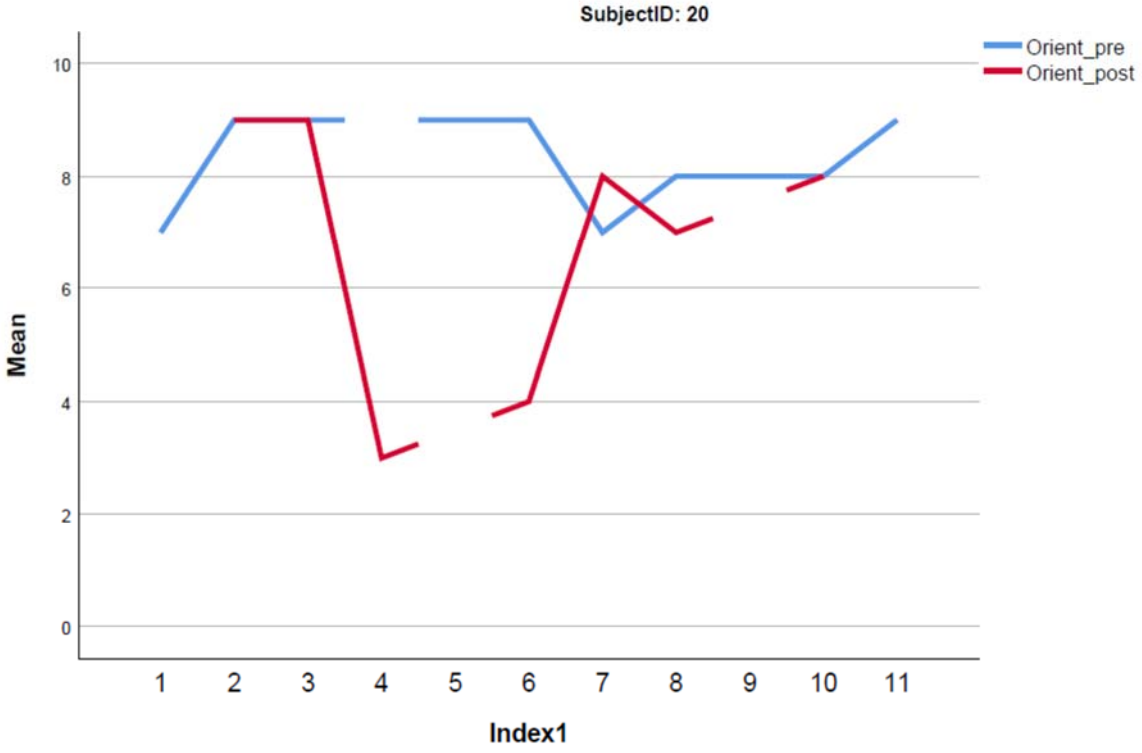
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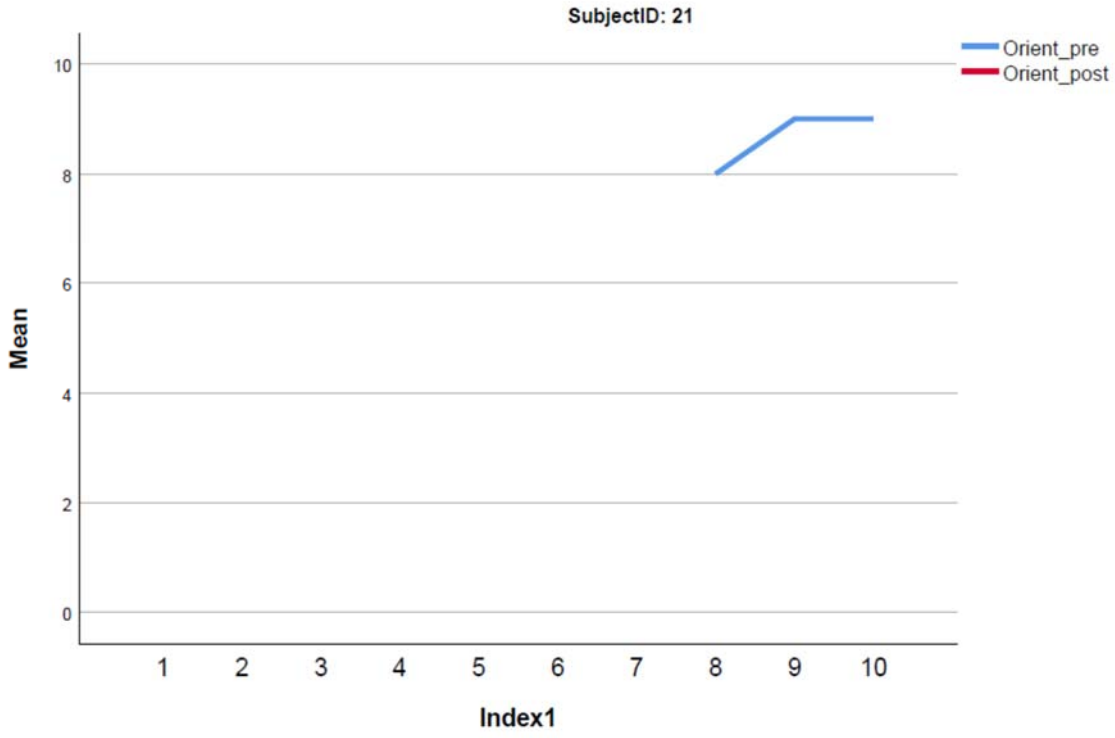
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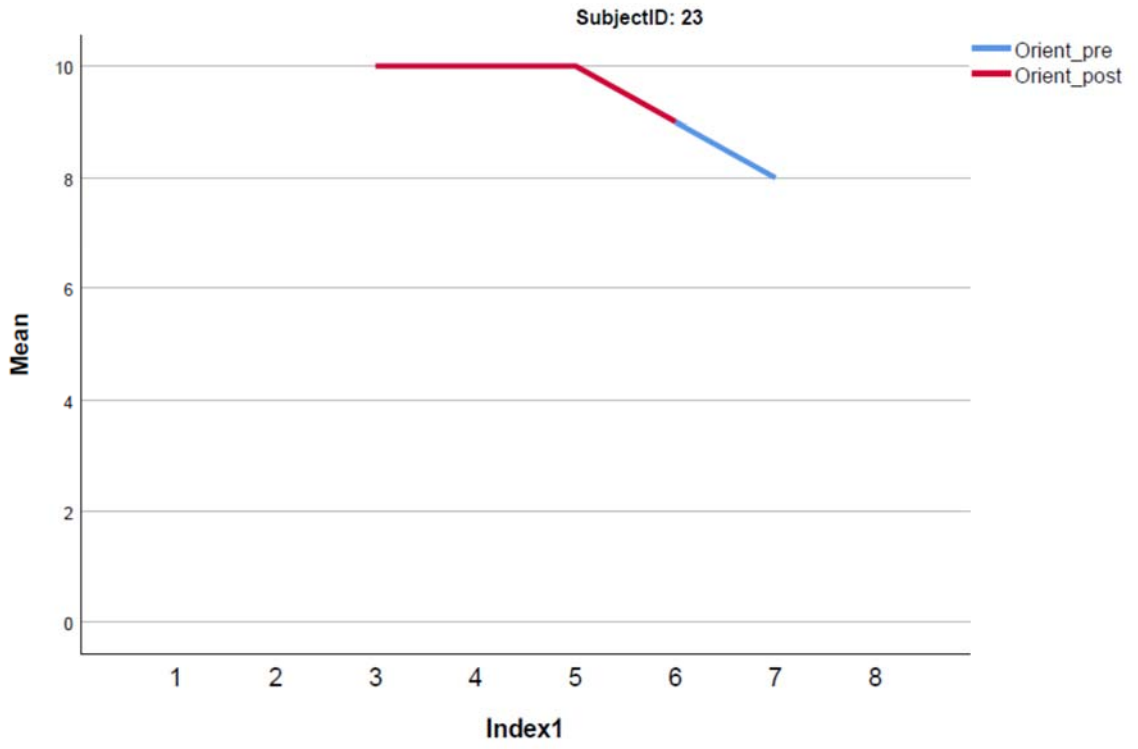
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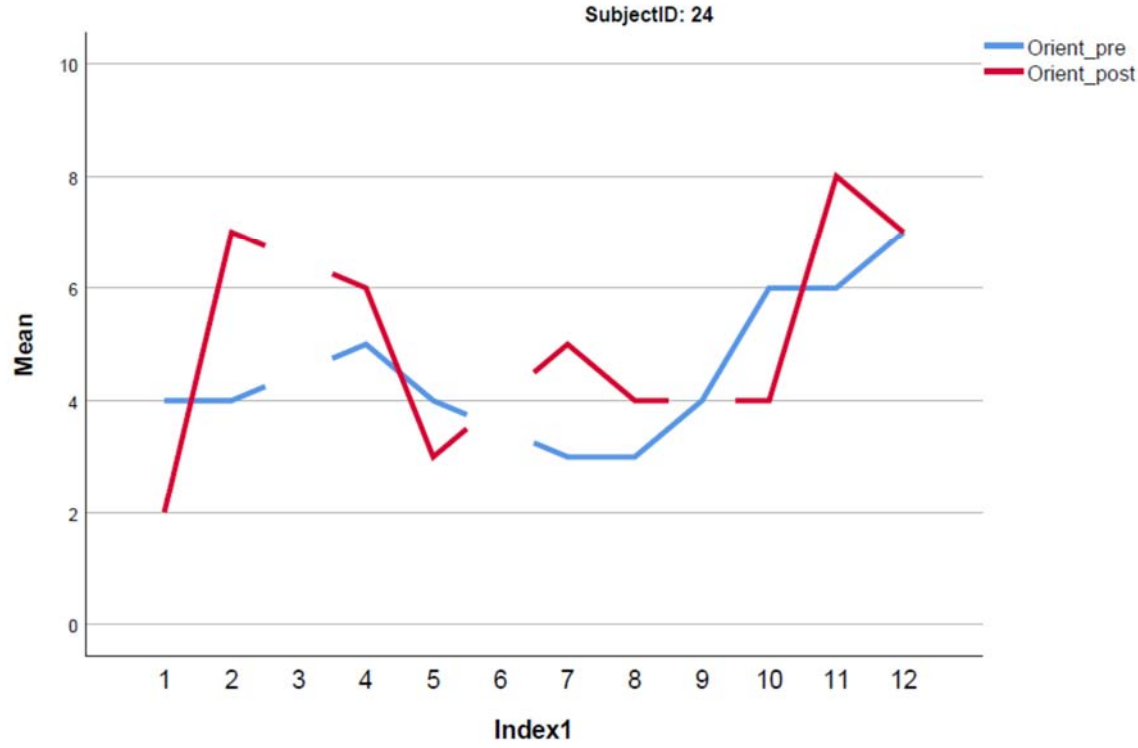
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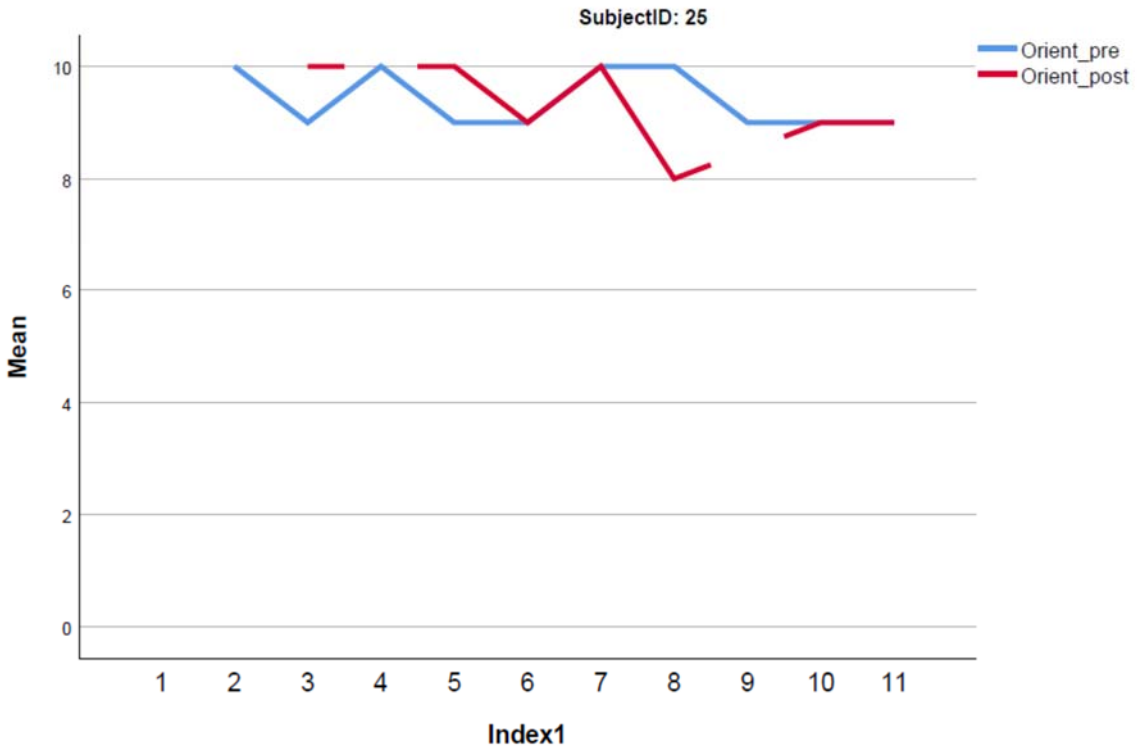
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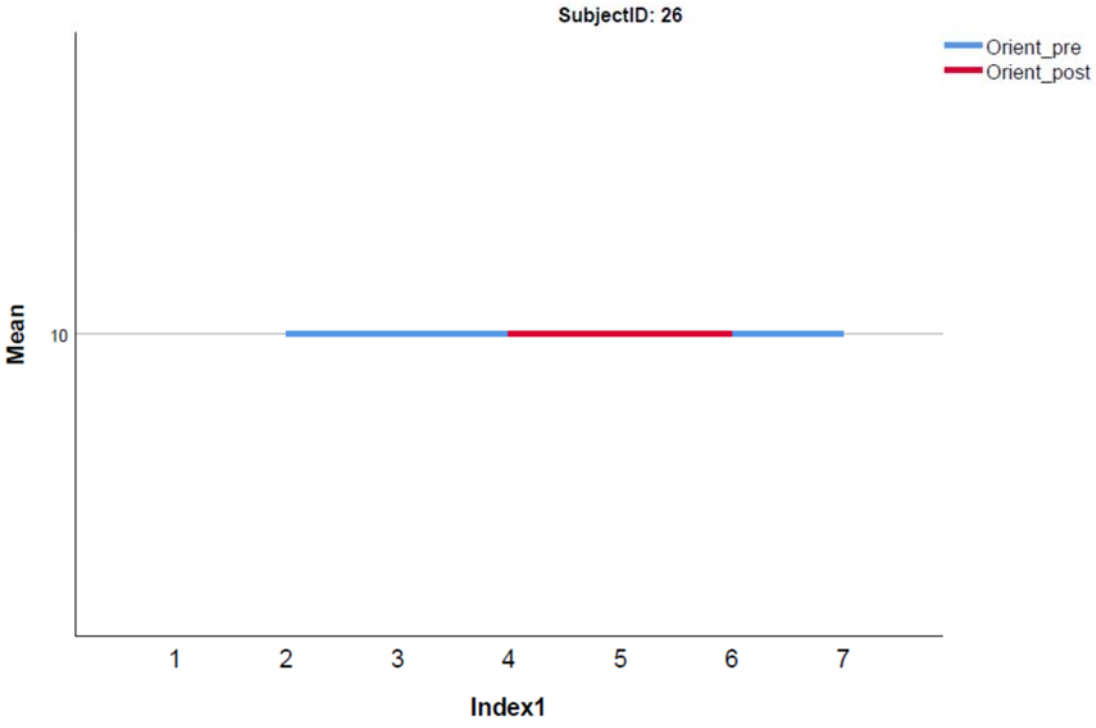
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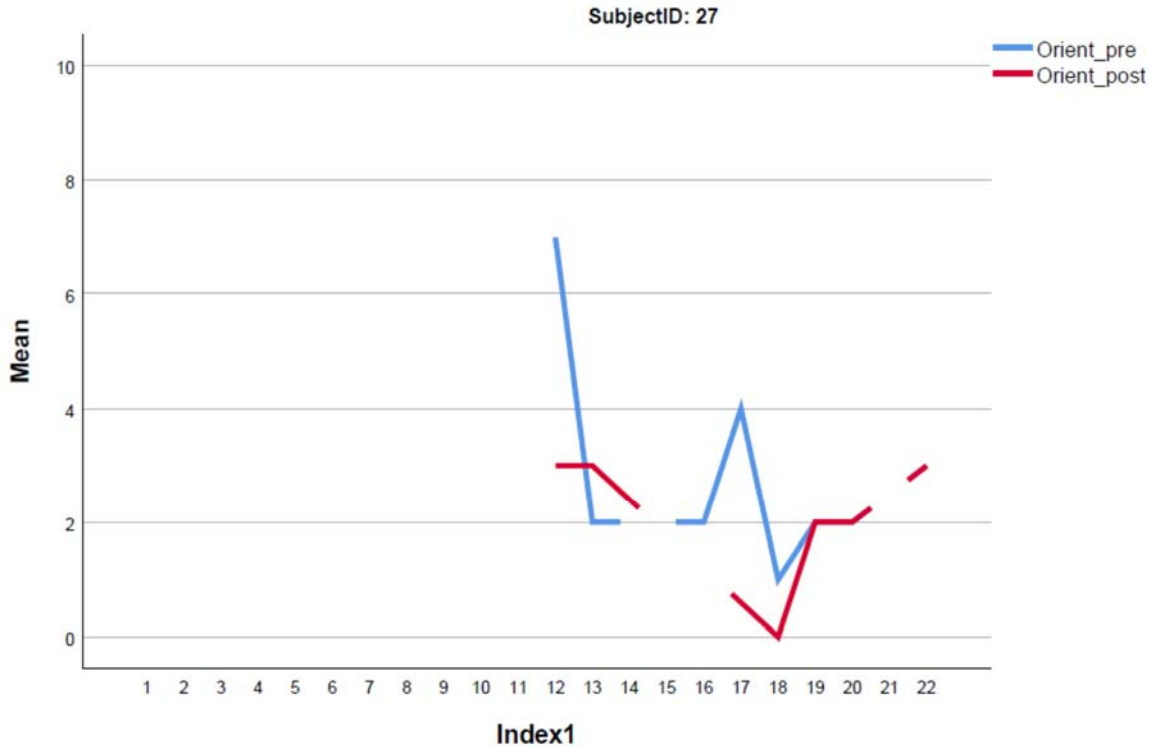
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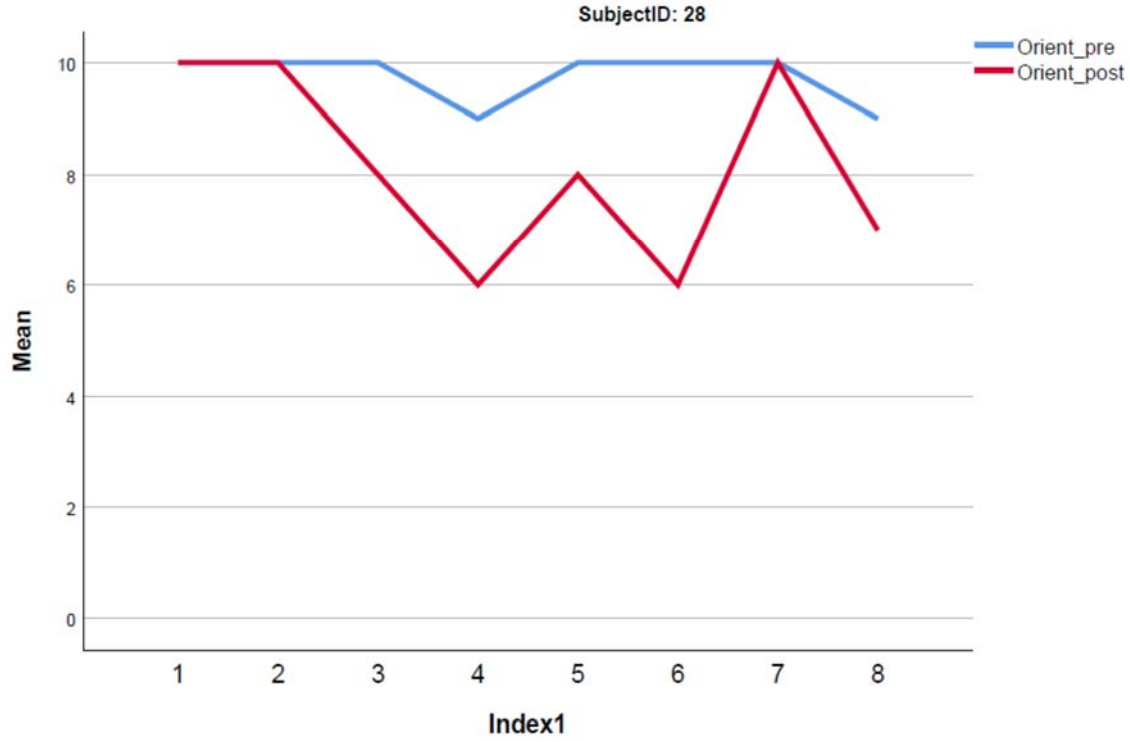
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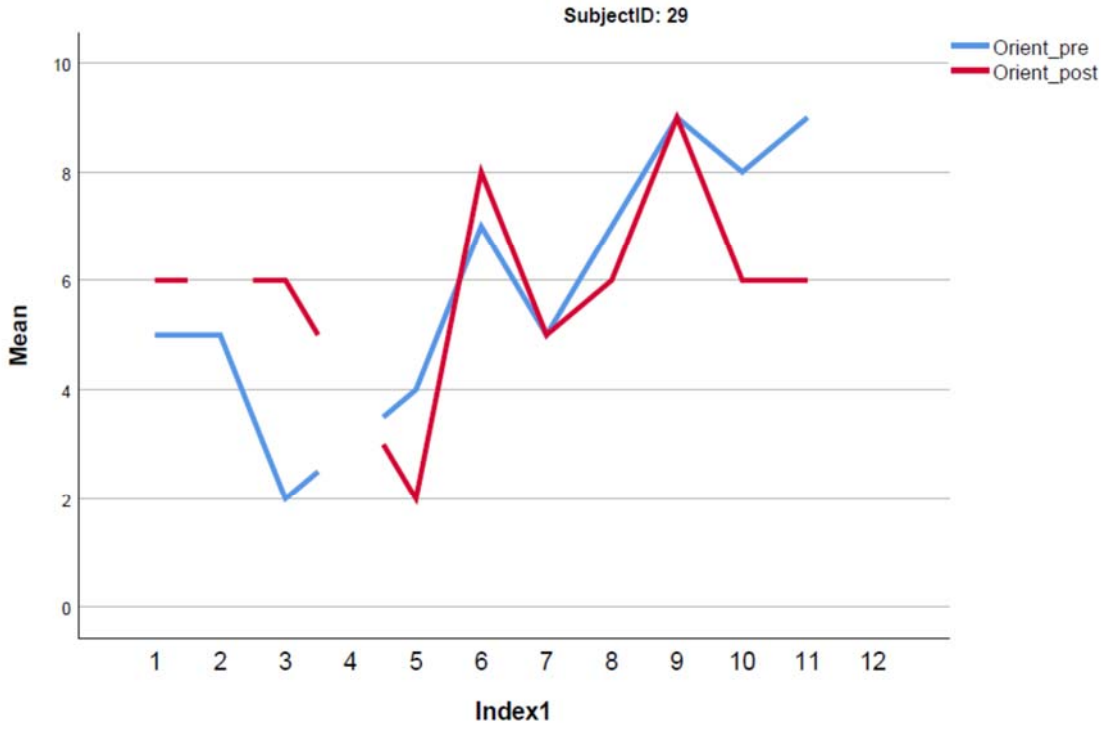
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Orient_post
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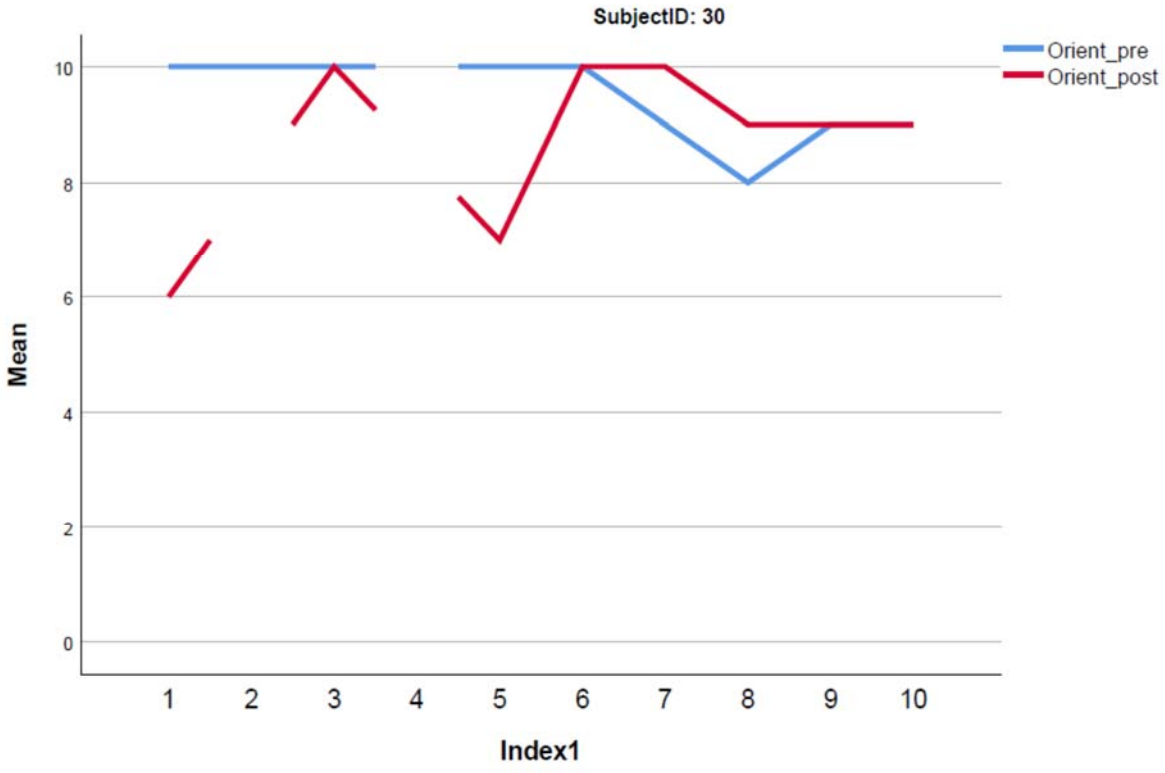
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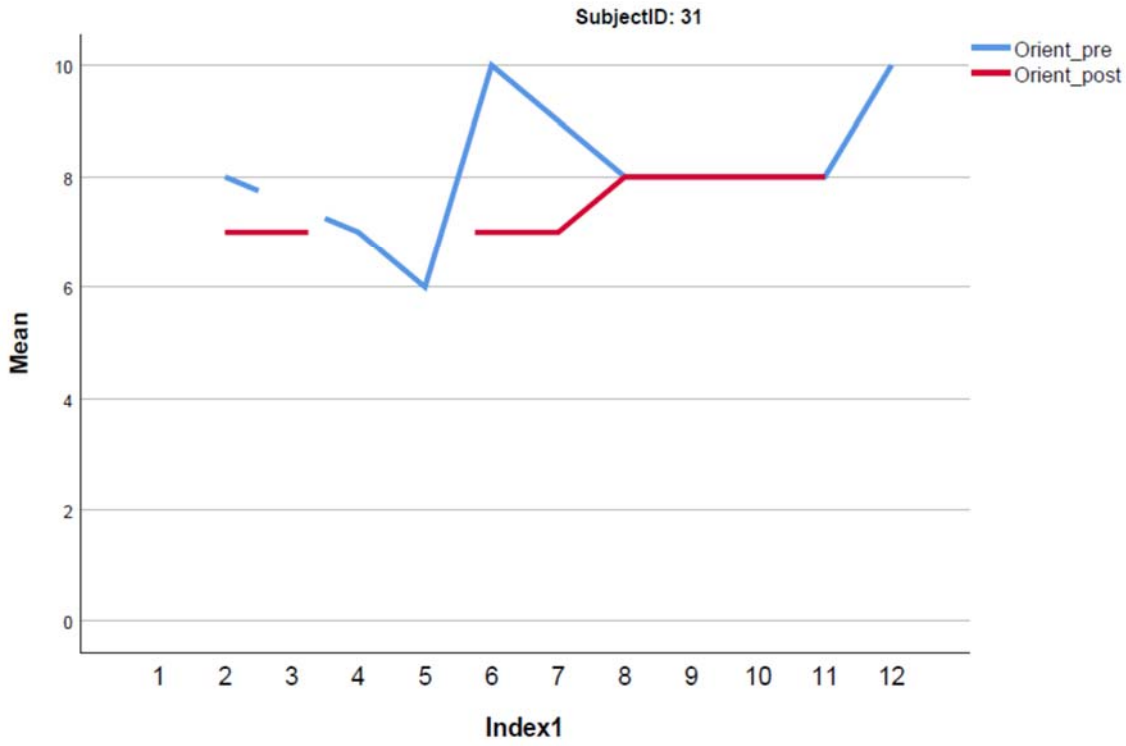
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Index1