6 RESULTS

6.1 PRELIMINARY ANALYSIS

The visual analysis of all baseline data across participants establishes the existence of the problem in one or more parameters in respective cognitive, behavioural, and emotional domains. Quantifying the same, the minimum baseline mean (or median) >10 is considered as problem for parameters where expected outcome is to decrease. The maximum baseline mean (or median) <80 is considered as problem for parameters where expected outcome is to increase. Except "self-injurious behaviour" for Participant#1 and Participant#2, "temper tantrums" for Participant#2 and Participant#3, Participant#3 for "hyperactivity and inattention" and "repetitive behaviour" were not the observable problems during baseline analysis and thus excluded from further analysis. Based on the visual baseline analysis 66 out of 72 (12 parameters x 6 participants) qualified for the further analysis and interpretation. Supplementing data points to visual analysis within phase of level (mean), trend (slope) and stability for cognitive, behavioural, and emotional domains respectively are calculated and represented in **Table 7**, **Table 8** and **Table 9** respectively. Overall, all the subjects recorded more than 90% of the attendance during the intervention phase (institute settings). Participant#6 dropped during the last phase of intervention in home settings resulted in only three recorded observations, the between phase comparison for baseline (BL) vs intervention home (IH) results are not conclusive for this participant.

6.2 PRIMARY OUTCOME

The visual analysis done between the phases from baseline to intervention phase (institute setting) and baseline to intervention phase (home setting), establishes the functional dependency between *yoga* intervention and psychological skills. This is visible in at least one or more of the parameters under cognitive, behavioural, and emotional domains respectively

across all the six participants. Three or more number of instances of qualifying measures is observed for each of the participants across all the observable parameters to conclude the existence of functional dependency between baseline and intervention phases marked as positive, inconclusive, or opposite. The detailed domain wise, participant wise outcomes are covered in the following segment.

6.3 COGNITIVE OUTCOME

In cognitive domain, there are 24 qualifying sets for visual analysis and 44 out of 48 (4 intervention home setting data dropped for Participant#6) between-phase sets for quantitative effect analysis. Data reference available in **Table 7**, **Table 11**, and **Table 12** respectively. The participant-wise interpretation for the result is detailed as follows.

Participant#1 shows improvement in all the cognitive parameters except the 'number-time' parameter where the results are inconclusive. 'Language' and 'reading-writing' shows significant improvement. Visual analysis indicates the functional dependency of *yoga* intervention on cognitive domain for this participant. The magnitude of effect calculated using NAP and *Cohen's d* also supplements the outcome and suggest overall positive effect. The internal validity for the Participant#1 for cognitive component is established.

Participant#2 shows improvement in all the cognitive parameters, with significant improvement in 'cognitive component' and 'language' in visual analysis. The functional effectiveness of *yoga* intervention is from moderate to significant as calculated through NAP and *Cohen's d* except for 'number-time' parameter. This establishes the internal validity for Participant#2.

Participant#3 has shown significant improvement in all the cognitive parameters except 'cognitive component'. This visual analysis outcome is supplemented by NAP and *Cohen's d* with significant impact respectively establishing the internal validity of *yoga* intervention to have positive outcome in cognitive areas for Participant#3.

Participant#4 visual analysis resulted in inconclusive outcome of impact in all the parameters except 'number-time' showing positive improvement. However, small the non-overlapping and statistical effect size calculations shows moderate or significant improvement except for 'cognitive component' parameter. The internal validity for Participant#4 for cognitive component and its relationship with *yoga* intervention is inconclusive.

Participant#5 shows inconclusive results for the intervention on all cognitive parameters, with 'language' showing little improvement. Further calculation of effect shows the impact is ineffective and opposite effect across most of the parameters except 'language'. The internal validity of impact of yoga for Participant#5 for cognitive domain could not be established expect for 'language' area.

Participant#6 visual analysis shows improvement in 'language' parameter and rest all shows inconclusive to opposite effect. The magnitude of effect from NAP and *Cohen's d* also resonates with this result. Thus except for 'language', internal validity could not be established for cognitive domain impact from the intervention.

Overall, there is an established impact of *yoga* intervention on the cognitive domain across three replications and improvement seen in at least one parameter for other three replications establishing the external validity of intervention impact. The consolidated distribution view of all the measuring units and its interpretation is represented in the **Figure 13**.

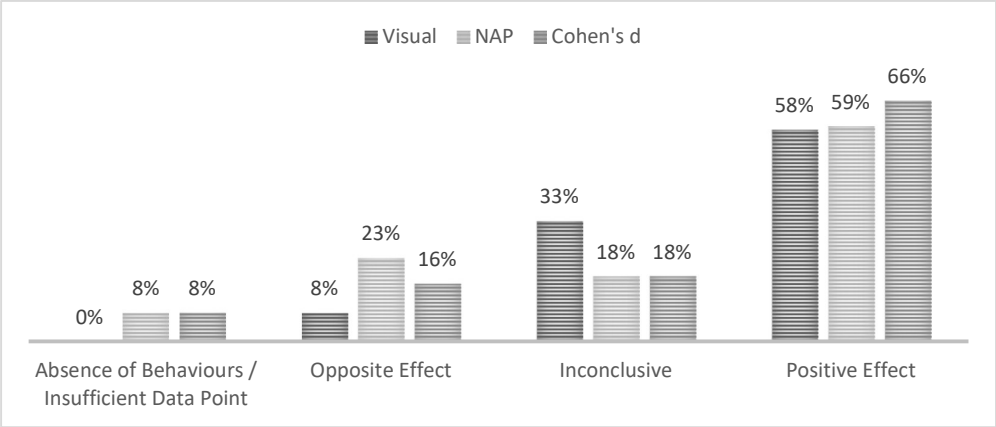

Figure 13: Cognitive - Overall consolidation of analysis outcome of effect across visual, NAP and *Cohen's d*.

6.4 BEHAVIOURAL OUTCOME

In behavioural domain, there are 16 out 18 (2 parameters dropped during baseline analysis) qualifying sets for further visual analysis and corresponding 29 out of 32 (3 intervention home setting data dropped for Participant#6) between phase sets for quantitative effect analysis under behavioural domain. The data reference is available in **Table 8**, **Table 11**, and **Table 12** respectively. The participant-wise interpretation for the result is detailed as follows.

Participant#1 shows significant effect of *yoga* intervention on behavioural domain across all the parameters and indicative of functional dependency. The magnitude of effect also resonates with the visual outcome in NAP values. The *Cohen's d* values however show small effect. The overall internal validity is be established for Partcipant#1 for behavioural domain.

Participant#2 shows significant effect of the intervention on all parameters for behavioural domain and indicates functional relationship. The effect size through NAP also aligns with the visual outcome. The *Cohen's d* values show no to small effect. The overall internal validity is established for Partcipatn#2 for behavioural domain.

Participant#3 demonstrated exisistence of problem only in 'behaviour patterns' among three parameters in this domain. The intervention of *yoga* shows significant impact in improvement of this one parameter across visual, non-overlapping effect and *Cohen's d* effect establishing the internal validity of the impact.

Participant#4 shows significant effect of the intervention on all parameters for behavioural domain and indicates functional relationship. The effect size through NAP also aligns with the visual outcome. The *Cohen's d* values show no to small effect. The overall internal validity is established for Partcipatn#4 for behavioural domain..

Participant#5 behavioural domain shows positive improvement but not significant but establishes the impact of *yoga* intervention. The effect size using NAP shows moderate effect and *Cohen's d* sets it to be overall non-effective. The internal validity however established for

Participant#5 for behavioural domain but it is not effective.

Participant#6 overall visual analysis tells the exisistence of relationship between intervention and behaviour domain except for 'behaviour pattern' parameter. The result is same as reflected in the magnitude of effect in the non-overlapping calculation. The statistical effect size shows no to small effect across and opposite for 'behaviour pattern'. The internal validity can still be established for two parameters in behavioural domain for Particpant#6.

Overall, the impact of *yoga* is significant and well observed for behavioural domain that can be seen across replication for all the six participants in one or more parameters. The external validity is established for behavioural domain. The consolidate distribution of outcome is represented in the **Figure 14**.

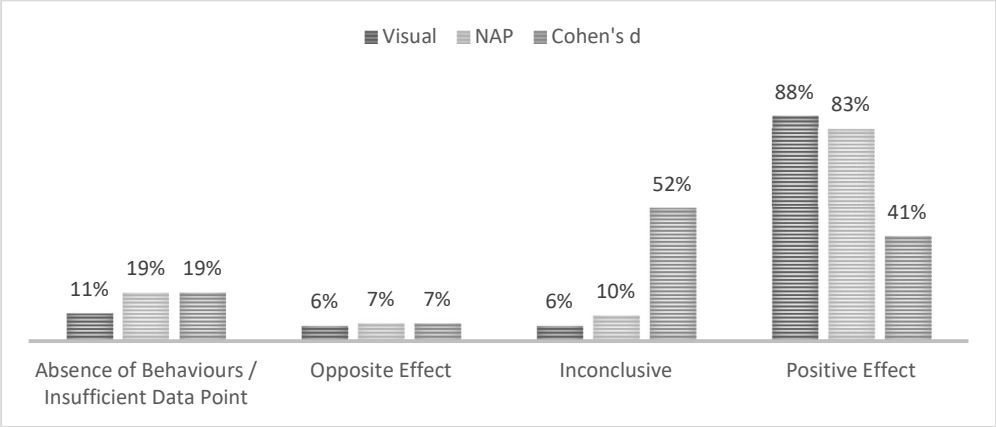

Figure 14: Behavioural - Overall consolidation of analysis outcome of effect across visual, NAP and *Cohen's d*.

6.5 EMOTIONAL OUTCOME

In emotional domain, there are 26 out 30 (4 parameters dropped during baseline analysis) qualifying sets for further visual analysis and corresponding 47 out of 52 (5 intervention home setting data dropped for Participant#6) between phase sets for quantitative effect analysis under emotional domain. The data reference is available in **Table 9**, **Table 11**, and **Table 12** respectively. The participant-wise interpretation for the result is detailed as follows.

Participant#1 establishes the internal validity with positive improvement across all the qualifying parameters. The visual analysis, effect analysis using NAP and *Cohen's d* all

resonate and indicate a functional impact of *yoga* on emotional domain for Participant#1.

Participant#2 visual analysis shows positive improvement in 'emotional responsiveness' and 'violent and destructive behaviour' parameter and inconclusive for 'odd behaviours'. The quantitative effect shows significant impact in NAP and small to moderate in *Cohen's d* calculations. Overall, for Participant#2 the internal validity is established with minor improvement.

Participant#3, except for 'emotional responsiveness' all other qualifying parameters shows improvement during visual analysis indicating intervention effectiveness. The non-overlapping and statistical effect size resonates with moderate to significant effect. The overall results indicate the internal validity of *yoga* intervention for Participant#3 in emotional domain.

Participant#4 visual analysis shows inconclusive to minor improvement across all parameters and only significant change in 'violent and destructive behavior' indicating an impact of intervention. The significance of impact is debatable to moderate for most of the parameters as per NAP and *Cohen's d*. For 'emotional responsiveness' the outcome is opposite as per the effect size. The internal validity is existing however; the effect is debatable in case of Participant#4 for emotional domain.

Participant#5 shows opposite effect for 'emotional responsiveness' and 'temper tantrums'; other parameters show either inconclusive or minor improvement. The overall visual analysis is inconclusive of the positive impact. The magnitude of effect is also either debatable and no impact as per NAP and *Cohen's d*. The indicative internal validity of impact of *yoga* could not be established for Participant#5 for emotional domain.

Participant#6 establishes the internal validity with significant improvement shown from baseline to intervention phases across all parameters in emotional domain through visual and quantitative analysis of effect size.

Overall, impact of *yoga* intervention on emotional domain is established across 4 replications

significantly with one showing minor improvement and one inconclusive. The external validity can still be proven based internal validities on multiple number of replications. The consolidated view of outcome is represented in the **Figure 15**.

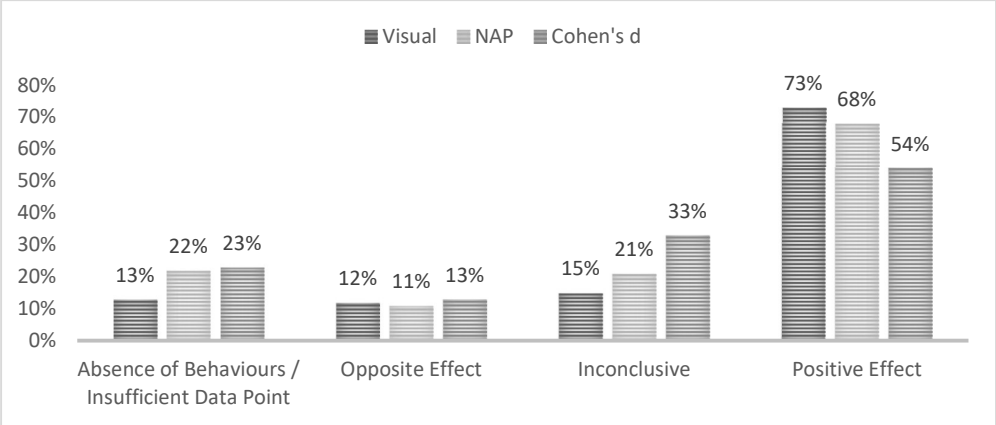

Figure 15: Emotional - Overall consolidation of analysis outcome of effect across visual, NAP and *Cohen's d*.

6.6 OVERALL OUTCOME

The internal validity and external validity of impact of *yoga* intervention is established across the replication for all three psychological domains cognitive, behavioural, and emotional and six participants. The replication of impact across institute setting and home setting could not be established due to insufficient data points and lack of evidence of continuity of practice. The maximum effect is observed in the order of behavioural domain, followed by emotional domain and then cognitive domain. The consolidated interpretation summary for visual, NAP and *Cohen's d* analysis are represented in **Table 13**, **Table 14**, and **Table 15** respectively. The overall consolidation of effect across visual analysis, quantitative analysis using non-overlapping measures and statistical significance using *Cohen's d* is represented graphically in **Figure 16** to see the overall outcome.

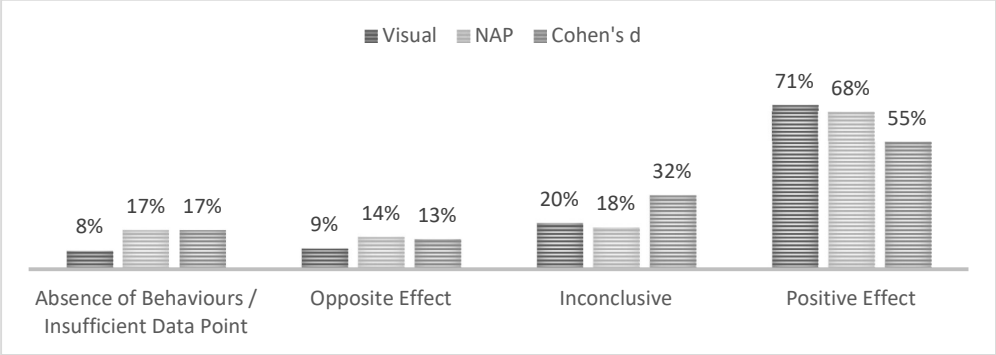

Figure 16: Overall consolidation of analysis outcome of effect across visual, NAP and *Cohen's d.*

Table 13: Visual analysis consolidated interpretation summary

Visual Analysis Interpretation	Overall		Cognitive		Behaviour		Emotional	
	Count	%	Count	%	Count	%	Count	%
Not Applicable	6	8%	0	0%	2	11%	4	13%
Significantly Opposite	3	5%	1	4%	0	0%	2	8%
Opposite	3	5%	1	4%	1	6%	1	4%
Inconclusive	13	20%	8	33%	1	6%	4	15%
Improvement	16	24%	6	25%	1	6%	9	35%
Significant Improvement	31	47%	8	33%	13	72%	10	38%

Table 14: Non-overlap analysis consolidated interpretation summary

Non-overlap Analysis Interpretation	Overall		Cognitive		Behaviour		Emotional	
	Count	%	Count	%	Count	%	Count	%
Absence of behaviour	12	8%	0	0%	4	11%	8	13%
Insufficient data point	12	8%	4	8%	3	8%	5	8%
Not effective	17	14%	10	23%	2	7%	5	11%
Debatably effective	21	18%	8	18%	3	10%	10	21%
Moderately Effective	29	24%	8	18%	11	38%	10	21%
Very Effective	53	44%	18	41%	13	45%	22	47%

Table 15: *Cohen's d* analysis consolidated interpretation summary

Cohen's d Analysis Interpretation	Overall		Cognitive		Behaviour		Emotional	
	Count	%	Count	%	Count	%	Count	%
Absence of behaviour	12	8%	0	0%	4	11%	8	13%
Insufficient data point	13	9%	4	8%	3	8%	6	10%
Opposite Effect	15	13%	7	16%	2	7%	6	13%
Not effective	38	32%	8	18%	15	52%	15	33%
Small Effect	15	13%	3	7%	6	21%	6	13%
Moderately Effective	10	8%	3	7%	1	3%	6	13%
Very Effective	41	34%	23	52%	5	17%	13	28%

6.7 OBSERVABLE CHANGES OF CLINICAL SIGNIFICANCE

There were changes observed by interventionist during the sessions and by caregivers beyond sessions. All the improvements were not consistent across all participants, and impact varied for participants from mild to moderate to significant and at an early, middle, or later stage of the intervention. Few indicators and observations with examples are as follows.

Cognitive All the participants' quality of participation and cooperation to follow the practice like, imitating the postures, following the instructions and reduced dependency on caregiver for patterning improved over time. Except Participant#2 and #5, all other participants towards end started to practice independently along with yoga interventionist in presence of caregiver as an observer. Participant#2 and Participant#4 were able to repeat the instructions at home for other family members as feedback shared by their respective caregivers.

Behavioural Repetitive behaviour for Participant#1 and Participant#6 were reduced. For example, Participant#1 used to pinch people around him that got reduced and Participant#6 used to be aggressive and hit people at times, got moderately reduced. Hyper-activity reduced gradually among all the participants. Fiddling during rest or practice reduced over time for all. Later stages they were more stable and calmer during the sessions. Participant#2 and Participant#4 could able to chant comfortably for even 5–10 min without distraction towards the end of the intervention. As shared by the caregiver, Participant#4 even continued chanting during his day-to-day activities while taking bath, and sometimes even during sleep.

Emotional Participant#6 used to demonstrate aggression which reduced over time during sessions. Also, the caregiver testified the participant had reduced temper tantrums at home.