

CHAPTER 6

DISCUSSION

This chapter discusses the results presented in chapter 5. Initially, the discussion is made separately for the two studies viz., study one and study two. Later an attempt is made to discuss together by comparing study one and study two.

6.1 STUDY ONE

The change in the CD4 counts (post-pre) of the participants was negligible (-5.3% in YG and 2.4% in CG) and not statistically significant both in the yoga group and control group; nor was there any statistical difference between the two groups. Similarly, the change in the CD4/CD8 ratio (-6.1% in YG and 1.2% in CG) was also negligible. The group * time interaction effects for CD4 and CD4/CD8 ratio were also not significant. This means that in the current study the yoga intervention, on average, had no effect on the immune parameters. Overall the yoga group performed poorer than the control group, although the difference is very marginal, negligible and non-significant. It was expected that in the YG the immune parameters would improve since earlier studies have shown improvement in CD4 counts among adult groups (Naoroibam *et al.*, 2016).

The change in total HRQOL score (post-pre score) of the participants indicates that the HRQOL significantly reduced by 14.4% in the yoga group ($p=0.039$) and 1.2% in CG (non-significant, with $p=0.833$). Thus, here again, the YG has performed poorer than CG. Even the group * time interaction was not significant. Similarly, the total FRQOL score also reduced in both YG by 8.1% and increased in CG by 0.6%. Thus, here again, the YG performed poorer than the CG. Through yoga, it was hypothesized that the QOL would improve; while it did not. These differences in the QOL could be attributed to the disturbance in the sleep of the participants in YG since they woke up one hour earlier than

their daily routine, while the participants in the CG had ~1-hour extra sleep. This is also evident from the FRQOL's 'sleep fatigue' sub-scale, which shows a significant reduction in the sleep-related quality of life in YG by 12.4% ($p=0.012$) while the same increased in CG, although not significantly, by 2.1% ($p=0.742$). Some recent studies also have shown that sleep disturbance is a major issue, and proper sleep has a major role to play in QOL among HIV positives (Faraut *et al.*, 2018). A review of HIV positive individuals showed that physical activity increases QOL (dos Santos *et al.*, 2017), and yoga also involving physical activity QOL should have improved. However the children were made to wake up earlier, which resulted in deprivation of their sleep and thus reducing the sleep related QOL. Further HIV infection is also likely to induce subjective sleepiness (Besedovsky, Lange and Haack, 2019), impaired insomnia and sleep quality (Faraut *et al.*, 2018). Unfortunately in the current research this was not realized and is a shortcoming which could be a major factor that has led to a further decrease in quality of life.

The depression of the participants increased both in the yoga group and in the control group (Table 5.10). However, the increase was more in the control group than in the yoga group; although the difference between the groups was not significant. The group*time interaction too was not significant in any of the QOL sub-scales except for the physical functioning quality of life sub-scale, in which the control group performed better than the yoga group after intervention. This could be attributed to more physical activities that the participants of the CG involved in playing football and other outdoor games as part of their daily routine.

The current study showed improvement in the cognitive functions (CFs) of both the yoga and control group participants. The yoga group performed better in DSF, DSB, DSTot and SDMT. However, the control group performed better in SWS, SCS and SCWS.

Overall, in almost all cases, the results were not significant. The reason for this could be attributed to larger variability in the results. A sub-group analysis could help investigate the

results further. In this context, the first attempt that was made was to determine the effect of age and gender on the results since it is generally understood that the key HIV marker, the CD4 counts depend on age and gender(Uppal, Verma and Dhot, 2003). However, in this study, it was noted that at baseline there was no significant correlation between CD4 counts on either age or gender. The correlation coefficient, r , at baseline between CD4 and age is -0.002 considering both genders, -0.086 considering only males and 0.116 considering only females. Figure 6.1 shows the scatterplot of CD4 at baseline grouped by gender. Appendix IX shows the R codes to determine the correlation coefficients and to draw the scatterplot; and their corresponding outputs.

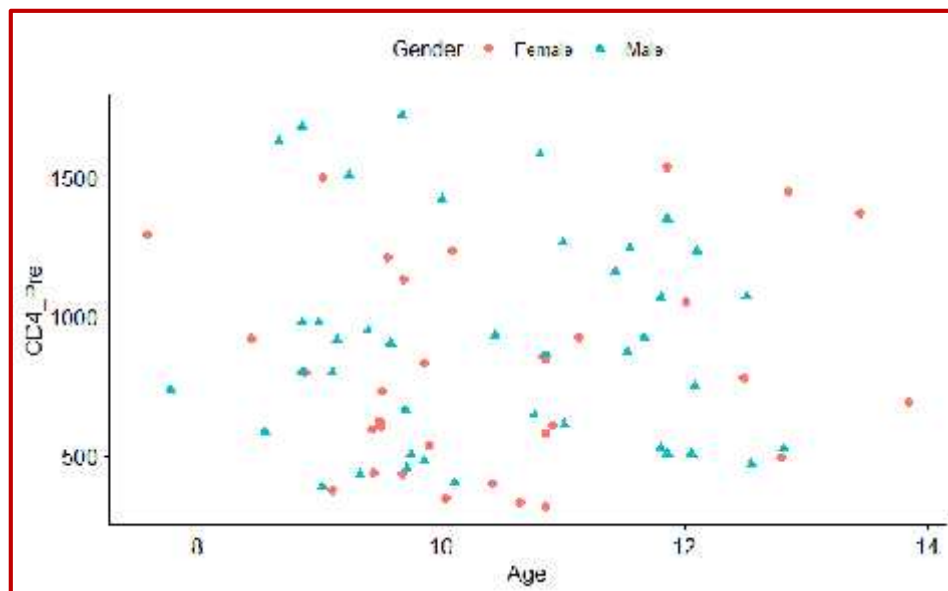


Figure 6.1: CD4 at baseline and age for both males and females

Another variable that was worth considering for sub-group analysis is the ART status. At the baseline, 60.8% of the participants were on ART and 39.2% were not. A comparison of CD4 counts between ART Vs No ART group showed a significant difference ($p=0.0002$) (Figure 6.2).

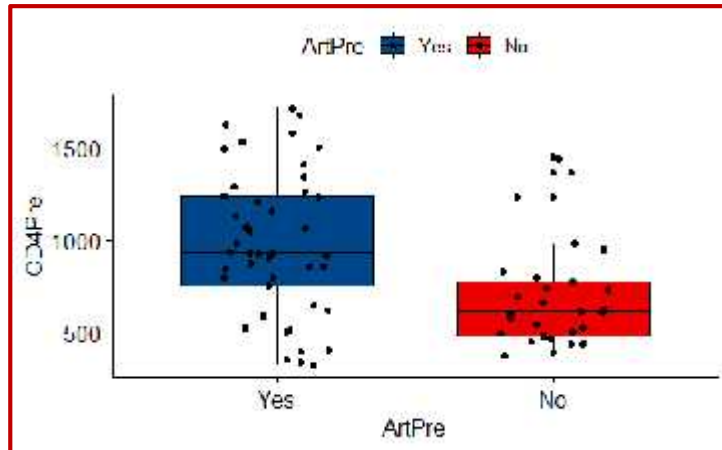


Figure 6.2: CD4 counts at baseline for ART and non-ART groups

Thus it would be worth an exercise to explore the effect of ART status on the results. For this, an analysis was performed by subdividing the data into four sub-groups.

-) “Yoga–ART No sub-group” (YG-AN sub-group)
-) “Yoga–ART Yes sub-group” (YG-AY sub-group)
-) “Control–ART No sub-group” (CG-AN sub-group)
-) “Control–ART Yes sub-group” (CG-AY sub-group)

Table 6.1 shows the results of immune parameters sub-divided based on the ART status of the participants. The performances in the four groups after intervention duration are ranked as 1, 2, 3 and 4, with rank 1 having relatively more favorable change.

After the intervention, while the CD4 counts increased in the CG-AY sub-group (by 6.46%), in all the other three sub-groups it decreased. Thus, with respect to CD4 counts, the CG-AY sub-group performed better than the other three sub-groups. Similarly, with respect to the CD4/CD8 ratio, the CG-AY group performed the best. Thus with reference to the immune parameters, the CG-AY sub-group performed better than the other three groups. Earlier studies have reported that chronic depression, stressful events and trauma may affect HIV disease progression in terms of decreases in CD4 T lymphocytes and greater risk for clinical decline (Leserman, 2008). CD4 and CD8 counts (and thus CD4/CD8 ratio) are also associated with psychosocial stress (Scanlan *et al.*, 1998).

Table 6.1: Change in immune parameters between ART and non-ART groups

Parameter			Mean				Diff. (Post- Pre)	p (within group)	P (Between AN & AY)	
			Pre	Diff. (AY-AN)	Post	Diff. (AY-AN)			Pre	Post
CD4 count (counts/~L)	YG	AN	654.8	331.8	607.5	355.6	-47.3↓4 (-7.2%)	0.613	0.0017**	0.0001***
		AY	986.6		963.1		-23.5↓3 (-2.4%)			
	CG	AN	701.7	269.6	700.2	331.9	-7.5↓2 (-1.06%)	0.904	0.049*	0.032*
		AY	971.3		1032.1		60.8↑1 (6.46%)			
CD4/CD8 ratio	YG	AN	0.501	0.333	0.515	0.255	0.014↑2 (2.8%)	1	0.012*	0.008**
		AY	0.834		0.770		-0.064↓4 (-7.7%)			
	CG	AN	0.574	0.236	0.531	0.31	-0.043↓3 (-7.5%)	0.779	0.026*	0.008**
		AY	0.810		0.841		0.031↑1 (3.8%)			

Legend:

AN = ART No = non-ART group
AY = ART Yes = ART group
↑=Increased compared to pre (favorable)
↓=Decreased compared to pre (not favorable)

***=Significant with p<0.001
**=Significant with p<0.01
*=Significant with p<0.05
1/2/3/4 = Rank of change

On similar lines, an analysis was carried out on all the parameters considered in the current study. The detailed tables are given in Appendix X. Unlike the immune parameters, there are no significant differences in any of the parameters between the AN and AY sub-groups neither at the baseline nor after intervention, both in YG and CG. The difference (post – pre) in the parameters are relatively ranked based on relative performance among the four groups, viz., YG-AN, YG-AY, CG-AN and CG-AY groups (Table 6.3). From the table, it can be noted that with reference to immune parameters the CG-AY sub-group performed better (as already discussed).

Previous studies have shown that ART treatment (and the duration of ART) improves QOL (Carrieri *et al.*, 2003; Lee, 2006). In the current study, Both AN and AY sub-groups of the

CG fared well on total HRQOL score and all subscale scores; i.e., these sub-groups ranked either 1 or 2. In particular, the CG-AN sub-group was relatively better, except with social and school function scores wherein the ART sub-group (of CG) was relatively better, although the quality of life reduced in all the cases.

Further, since there was a significant decrease in the school functioning score, the same was analyzed in more detail. The school function score has altogether five questions, of which three questions pertain to the cognitive aspects and two questions were on health-related aspects. Investigation into the two aspects revealed that overall the issue was more in the health aspects than in the cognitive aspects, although both reduced. Incidentally, it can also be noted that while the cognitive functions improved, overall the health-related QOL aspects have reduced among the participants immaterial of the groups/sub-groups. Table 6.2 shows the break-up of the school functioning score of QOL based on the cognitive functioning and health-related aspects in spite of improvements in the immune parameters.

With reference to the HRQOL, the control group performed better. Both AN and AY sub-groups of the CG fared well on total HRQOL score and all subscale scores; i.e., these sub-groups ranked either 1 or 2. In particular, the CG-AN sub-group was relatively better, except with social and school function scores wherein the ART sub-group was relatively better, although the quality of life reduced. Further, since there were significant decreases in the school functioning score in order to analyze this further, the school functioning score was investigated. The school function score has altogether five questions, of which three questions are pertaining to the cognitive aspects and two questions were on health-related aspects. Investigation into the two aspects revealed that overall the issue was more in the health aspects than in the cognitive aspects, although both reduced. Incidentally, it can also be noted that while the cognitive functions improved, overall the health-related QOL aspects have reduced among the participants immaterial of the groups/sub-groups. Table 6.2 shows

the break-up of the school functioning score of QOL based on the cognitive functioning and health-related aspects in spite of improvements in the immune parameters.

Table 6.2: Break-up of school functioning score of QOL

Sub-group	Pre		Post		Difference (Post-Pre) (% Diff.)	
	cognitive aspect	health aspect	cognitive aspect	health aspect	cognitive aspect	health aspect
YG-AN	73.5	62.5	59.1	50.0	-14.4↓ (19.5%)	-12.5↓ (-20%)
YG-AY	84.0	71.3	67.6	51.9	-16.4↓ (19.5%)	-19.4↓ (-27.2%)
CG-AN	75.0	63.4	73.7	42.3	-1.3↓ (-1.7%)	-21.1↓ (-33.2%)
CG-AY	81.1	73.3	72.9	54.7	-8.2↓ (-10.1%)	-18.6↓ (-25.4%)

Even with FRQOL, the subgroups of CG ranked 1 and 2. In particular, the CG-AN sub-group ranked higher except for general fatigue score wherein the YG-AY subgroup performed relatively better although there was a marginal improvement of 2.7% in the general fatigue score.

With respect to depression, the overall score was relatively better in the YG-AN sub-group, although the score increased by 12.9%. The main factor contributing to better improvement in the YG-AN is the interpersonal issue which improved. However, this cannot be attributed to yoga intervention since the control group also improved, even better than the yoga group. The YG-AN sub-group was also relatively scored better in emotional and ineffectiveness sub-scales of the CDI. On other CDI sub-scales, the control group was relatively better.

With respect to cognitive functions, the YG-AN sub-group performed the best. Although DSB and DSTot score was better in the control group, in both cases they were not on ART.

With the above observations, overall it can be noted that C/As who were on ART performed better with reference to the immune parameters. With reference to cognitive functions and quality of life assessed in the current study, the non-ART sub-group was relatively better.

Especially, the cognitive functions improved in the yoga group which could be attributed to the yoga intervention which included, apart from *san s* and *pr n y m s*, the yogic games. The improvement in the cognitive parameters could be due to the introduction of yogic games as part of the intervention. Earlier studies too have proved that yogic games improve the cognitive parameters in children/adolescents(Purohit and Pradhan, 2017).

Overall, it can be noted that with respect to immune parameters and CDI, while in the yoga group, the non-ART sub-group performed better, in the control group on-ART sub-group performed better. Similarly with respect to quality of life, in the yoga group, the on-ART sub-group performed better and in the control group, the non-ART sub-group performed better. With respect to cognitive functions, overall non-ART sub-groups performed better both in yoga and control groups.

Table 6.3: Performance (Post – Pre) of the YG and CG divided by ART status

Parameter	YG-AN	YG-AY	CG-AN	CG-AY	Favored best in...
CD4 count (counts/~L)	-47.3↓4 (-7.22%)	-23.5 ↓3 (-2.38%)	-7.5↓2 (-1.06%)	62.6↑1 (6.46%)	CG-AY
CD4/CD8 ratio	0.014↑2 (2.79%)	-0.064↓4 (-7.67%)	-0.043↓3 (-7.49%)	0.025↑1 (3.06%)	CG-AY
Physicalfunctioningscore (PQ_PF)	-126.8↓4 (-19.9%)	-59.1↓3 (-8.7%)	102.8↑1 (17.3%)	30.1↑2 (4.8%)	CG-AN
Emotionalfunctioningscore (PQ_EF)	-43.2↓4 (-12.8%)	-28.6↓3 (-7.7%)	68.4 ↑1 (24%)	-5.3↓2 (-1.6%)	CG-AN
Socialfunctioningscore (PQ_SocF)	-65.9 ↓4 (-16.9%)	-60.7 ↓3 (-14.5%)	-54.9 ↓2 (-13.2%)	-17.6 ↓1 (-4.4%)	CG-AY
Schoolfunctioningscore (PQ_SchF)	-68.2 ↓3 (-19.7%)	-96.6 ↓4** (-24%)	-63 ↓2 (-17.1%)	-65.5 ↓1* (-16.7%)	CG-AY
Total psychosocial score (PQ_PSF_Tot)	-177.3↓4 (-16.5%)	-188.1↓3 (-15.8%)	-49.5↓1 (-4.6%)	-81.4 ↓2 (-7.3%)	CG-AN
Total HRQOL score (PQ_Tot)	-304↓4 (-17.8%)	-247.1↓3 (-13.2%)	53.3↑1 (3.2%)	-51.2 ↓2 (-2.9%)	CG-AN
General fatigue score (PF_GF)	-5.5 ↓4 (-1.2%)	13.6 ↑1 (2.7%)	5.8↑2 (1.2%)	6.3↑3 (1.4%)	YG-AY
Sleep fatigue score (PF_SF)	-56.8 ↓4 (-12.2%)	-53.3↓3* (-10.4%)	27↑1 (6.2%)	-14.5↓2 (-3.2%)	CG-AN
Cognitive fatigue score (PQ_CF)	-86.8 ↓4 (-19.6%)	-23 ↓3 (-4.9%)	20.1↑1 (4.7%)	2.8 ↑2 (0.7%)	CG-AN

Parameter	YG-AN	YG-AY	CG-AN	CG-AY	Favored best in...
Total FRQOL (PF_Tot)	-149.1↓4 (-10.8%)	-62.8↓3 (-4.2%)	53↑1 (3.9%)	-5.5↓2 (-0.4%)	CG-AN
CDI_EP	0.9↑1 (12.2%)	1.42↑3 (21.8%)	2.82↑4 (64.7%)	1.28↑2 (19.7%)	YG-AN
CDI_FP	0.9↑3 (13.6%)	0.93↑2 (13%)	0.45↑1 (7.3%)	1.57↑4 (26.2%)	CG-AN
CDI_IP	-0.1↓4 (-4.3%)	-1↓2 (-36.9%)	-1.09↓1 (-40.1%)	-0.43↓3 (-15.5%)	CG-AN
CDI_NMPS	0(4) (0%)	-0.71↓3 (-16.3%)	-2.27↓1* (-48.1%)	-2↓2 (-39.4%)	CG-AN
CDI_NSE	0.9↑4 (31%)	0.72↑3 (25.3%)	0.55↑2 (28.9%)	-0.71↓1 (-20.8%)	CG-AY
CDI_INE	1↑1 (23.3%)	1.93↑2 (43.7%)	1.55↑3 (44.9%)	2↑4* (62.3%)	YG-AN
CDI_Total	1.8↑1 (12.9%)	1.97↑2 (17.6%)	3.26↑4 (30.9%)	2.8↑3 (22.4%)	YG-AN
DSF	0.71↑1 (11.6%)	0(4) (0%)	0.65↑2* (9.8%)	0.08↑3 (1.2%)	YG-AN
DSB	0.71↑2 (22.9%)	0.55↑3 (22.9%)	1.14↑1* (39%)	0.35↑4 (12.3%)	CG-AN
DSTot	1.4↑2 (15.2%)	0.54↑3 (5.8%)	1.77↑1** (18.6%)	0.39↑4 (4%)	CG-AN
SWS	7.2↑1 (15.1%)	4.6↑2* (11.4%)	3↑4 (5.6%)	3.9↑3 (8.2%)	YG-AN
SCS	2.3↑2 (5.2%)	3↑1* (7.9%)	1.1↑3 (2.4%)	0.7↑4 (1.6%)	YG-AN
SCWS	2.5↑3 (10.1%)	5.0↑1** (21.1%)	1.2↑4 (4.3%)	3↑2 (12.1%)	YG-AY
SDMT	4.4↑1 (13.8%)	1.2↑4 (4.1%)	3↑2* (9.1%)	2.7↑3 (8.7%)	YG-AN
<p>Legend:</p> <p>YG-AN= Yoga group, ART no YG-AY= Yoga group, ART yes CG-AN= Control group, ART no CG-AY= Control group, ART yes PQ= PedsQL QOL questionnaire PQ_PF= PQ Physical Functioning score PQ_EF= PQ Emotional Functioning Score PQ_SocF= PQ Social Functioning score PQ_SchF= PQ School Functioning Score PQ_PSF_Tot= PQ Psychosocial Functioning PQ_Tot= PQ HRQOL total score PF= PedsQL multidimensional fatigue PF_GF= PF General Fatigue score PF_SF= PF Sleep/rest Fatigue score PF_CF= PF Cognitive Fatigue score PF_Tot= PF FRQOL total score CDI= Children's Depression Inventory EP= Emotional Problems NMPS= Negative Mood Physical Symptoms</p> <p>NSE= Negative Self Esteem FP= Functional Problems INE= Ineffectiveness IP= Interpersonal Problems DSF= Digit Span Forward DSB= Digit Span Backward DSTot= Digit Span Total SWS= Stroop Word score SCS= Stroop Colour Score SCWS= Stroop Colour-Word Score SDMT= Symbol Digit Modulation Test score</p> <p>↑= Increased compared to pre (favorable) ↓= Decreased compared to pre (favorable) ↑= Increased compared to pre (not favorable) ↓= Decreased compared to pre (not favorable) 1/2/3/4 = Rank of change **= Significant with p<0.01 *= Significant with p<0.05</p> <p>█= Favoured/changed the most among the 4 groups █= Favoured/changed the least among the 4 groups</p>					

Thus, with reference to the above discussions, it could be suggested that the yoga program should be planned in such a way that the normal sleep routines of the participants are not disturbed. Sufficient time should be given to the participants by insisting early sleeps at night for compensation. This would help realize the real potential of yoga program among HIV positives.

6.2 STUDY TWO

There was a significant improvement in the general health condition of the participants as reported by the physicians during their routine checkup. Skin infection in the participants was either reduced or nullified in all the participants. For the want of control group in the study, the improvement cannot be attributed purely to yoga intervention. However, *s ryanamask ra,kap lab ti (kriya)*, *bh strika&n i odhanapr n y ma* in the yoga intervention are known to be excellent practices for subjects having skin diseases(Mayer, 2014). Hence yoga could have played a role in improving the status.

The major point that was demonstrated through this study was the improvement in the immune parameters. The CD4 cells, the major marker for HIV/AIDS, increased by statistically significant 36.63%. The CD4/CD8 ratio improved by 42.05%, shifting from a lower value (0.814) to normal (1.016) by post-intervention; the normal CD4/CD8 ratio being 0.91 to 3.17 (Bosire *et al.*, 2013; Hussain *et al.*, 2015); all these indicating improvement in the immune system. This is further supported by a decrease in the viral load by an average of 178.5%. Figure 6.3 and Figure 6.4 shows the relationship between changes in viral load against changes in CD4 and that of CD4/CD8 ratio, it can be observed that in most the cases where there is a massive drop in the viral load they are characterized by a large increase in the CD4 cell counts or CD4/CD8 ratio.

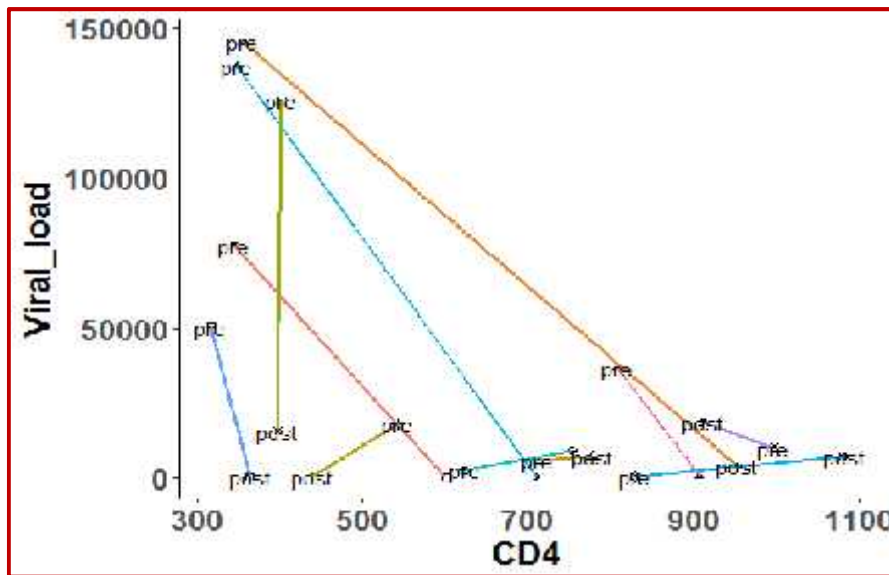


Figure 6.3: Case to case Relation between CD4 and viral load

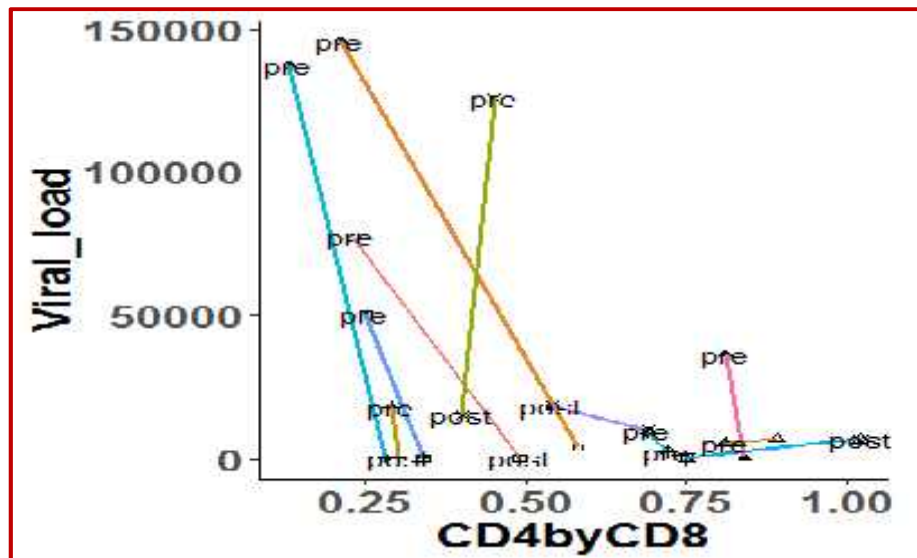


Figure 6.4: Case to case relation between CD4/CD8 ratio and viral load

Case to case observation indicated that yoga greatly helped those participants more whose viral loads were high. In order to explain this phenomenon further, the results were divided into two groups by arbitrarily considering a baseline viral load (BVL) of 18,000 cells/mm³. Thus the two sub-groups are high baseline viral load (HBVL) group with participants having viral load > 18,000 cells/mm³ at baseline, and low baseline viral load (LBVL) group with participants having viral load < 18,000 cells/mm³ at baseline. Through viral load based grouping, it can be noted that participants in HBVL group showed a significant decrease in

viral load from a mean viral load of 84,527 cells/mm³ to 3,029, cells/mm³ which is a decrease of 81,498 cells/mm³ (96.4%) (p=0.015) (Figure 6.5 & Table 6.4). On the other hand, the viral load in the LBVL group increased by 125.5% from mean 4,667 cells/mm³ to 10,525 cells/mm³. However, the increase was not significant (p=0.125).

Table 6.4: Change in viral loads between sub-groups divided on baseline viral loads

Group	Mean viral load (cells/mm ³)				p
	Pre	Post	Difference (Post-Pre)	% difference = ((Post-Pre)*100)/Pre	
HBVL	84527.86	3029.429	-81498.4	-96.4	0.015
LBVL	4667	10525.75	5858.75	125.5	0.125

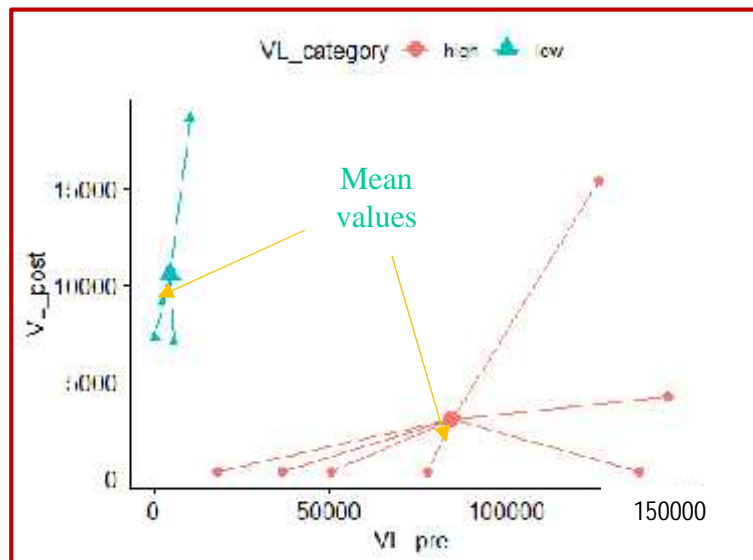


Figure 6.5: Viral loads, pre and post for two groups based on pre viral load

CD4 counts and CD4/CD8 ratio increased, although not significantly (p=0.128 and p=0.063) by a higher magnitude in the HBVL group compared to the LBVL group (Figure 6.6). The figure shows a star plot dividing the scatter plot into four categories (1) High*Post, (2) High*Pre, (3) Low*Post and (4) Low*Pre. The points pertaining to these four categories are shown as stars with the average in each category joined to the individual points in the category. The figure indicates that the increase in the CD4 counts and CD4/CD8 ratio was higher when the viral load was higher than when the viral load was lower. Further, there is a

strong relationship between the baseline viral load ($R^2=0.9878$) (Figure 6.7). However, the parameters considered for research in the current study could not explain the phenomenon.

The changes in immune parameters cannot be completely attributed to the yoga program as this study does not have a control group comparison. but finds validation through another one-month yoga intervention study report where a significant increase in CD4 cell counts among adults compared to the control group(Naoroibam *et al.*, 2016) was shown. Thus, this study shows that yoga can help HIV positive individuals in increasing the CD4 cells and reducing the viral load in children/adolescents, especially when the problem is severe. Overall it can be noted that yoga has helped candidates with high levels of viral loads. Perhaps yoga seems to have an attribute of addressing the crucial problems first, by prioritizing.

An unpublished work by the same research center also shows this phenomenon with respect to the heart rate variability (HRV). In this case,the yoga program significantly improved the HRV among candidates where the HRV was more an issue; while those who had moderate issues in HRV, the improvement was relatively less. However this phenomenon requires further studies for providing a logical explanation, and the current study only provides empirical evidence.

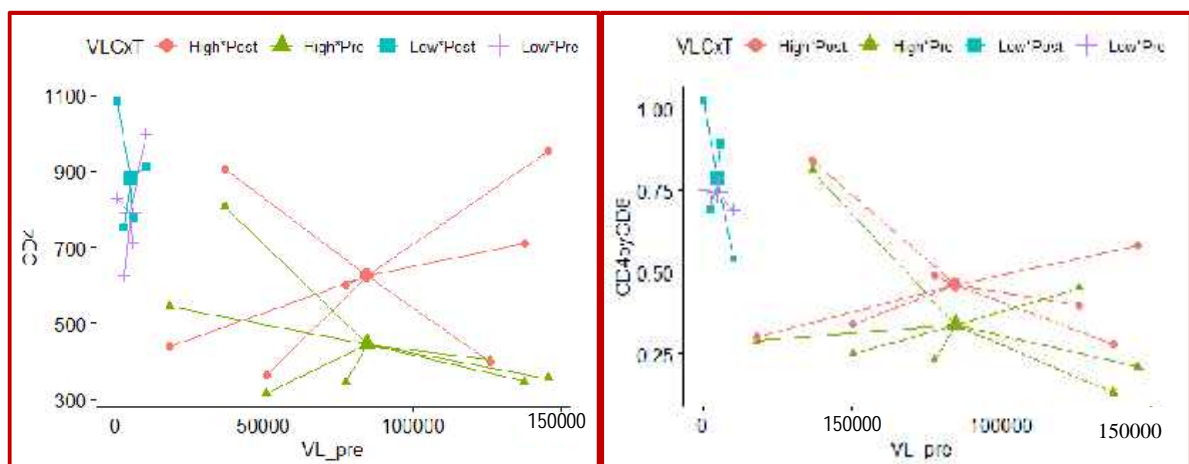


Figure 6.6: Post-intervention immune parameters sub-divided based on BVL

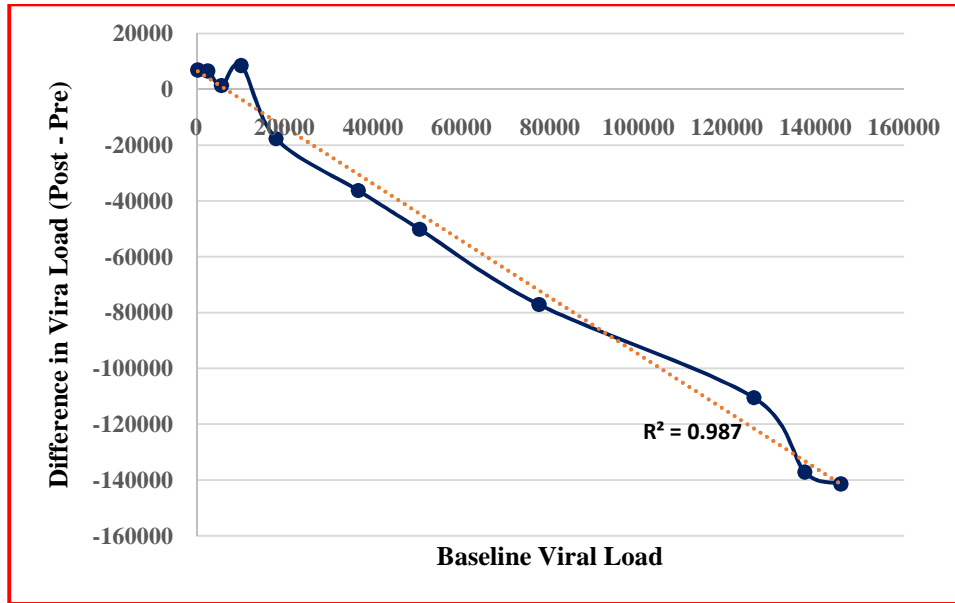


Figure 6.7 Change in viral load against baseline viral load

Table 6.5: Values of all variables included in RC2

Parameter	Diff. (Post- Pre)	p	Parameter	Diff. (Post- Pre)	p
CD4 count (counts/~L)	146.3↑ (25.57%)	0.039*	CDI-IP	0.3↑ (16.7%)	0.571
CD4/CD8 ratio	0.202↑ (24.82%)	0.091	CDI-Total	4.1↑ (38.3%)	0.015*
Viral load (copies/mL)	-49732↓ (-89.63%)	0.041*	CDI-EP_T	5.3↑ (9.4%)	0.041*
PQ_PF	112.9↑ (23.4%)	0.004**	CDI-NMPS_T	3.9↑ (6.8%)	0.203
PQ_EF	42.4↑ (14.4%)	0.068	CDI-NSE_T	11.4↑ (24.3%)	<0.001***
PQ_SocF	43.1↑ (11.9%)	0.123	CDI-FP_T	2.0↑ (3.6%)	0.631
PQ_SchF	39.1↑ (13.1%)	0.212	CDI-INE_T	6.0↑ (11.6%)	0.041*
PQ_PSF_Tot	124.5↑ (13%)	0.04*	CDI-IP_T	2.3↑ (4.0%)	0.632
PQ_Tot	237.4↑ (16.5%)	0.013*	CDI-Total_T	5.4↑ (9.7%)	0.029*
PF_GF	40.9↑ (9.8%)	0.203	DSF	-1.2↓ (-16.7%)	0.059
PF_SF	90.8↑ (30.1%)	0.022*	DSB	2.3↑ (127.8%)	0.009*
PQ_CF	52.7↑ (17.2%)	0.136	DSTot	1.1↑ (12.2%)	0.266
PF_Tot	184.6↑ (18%)	0.033*	SWS	14.4↑ (35.2%)	0.051

Parameter	Diff. (Post– Pre)	p	Parameter	Diff. (Post– Pre)	p
CDI-EP	2.0↑ (35.1%)	0.039*	SCS	4↑ (12.1%)	0.574
CDI-NMPS	0.1↑ (2.0%)	0.887	SCWS	-4.4↓ (-17.3%)	0.458
CDI-NSE	2.0↑ (333.3%)	<0.001***	SDMT	23.2↑ (115.4%)	<0.001***
CDI-FP	2.0↑ (39.2%)	0.082	SLCT	4.2↑ (17.9%)	0.01**
CDI-INE	1.7↑ (53.1%)	0.032*			
Legend:					
↑=Increased compared to pre (favorable) ↓=Decreased compared to pre (favorable) ↑=Increased compared to pre (not favorable) ↓=Decreased compared to pre (not favorable) ***=Significant with p<0.001 **=Significant with p<0.01 *=Significant with p<0.05 PQ_PF= Physical functioning score PQ_EF= Emotional functioning score PQ_SocF= Social functioning score PQ_SchF= School functioning score PQ_PSF_Tot= Total psychosocial score PQ_Tot= Total HRQOL score PF_GF= General fatigue score PF_SF= Sleep fatigue score			PQ_CF= Cognitive fatigue score PF_Tot= Total FRQOL Score CDI=Children’s Depression Inventory T=T-score EP=Emotional Problems NMPS=Negative Mood Physical Symptoms NSE=Negative Self Esteem FP=Functional Problems INE=Ineffectiveness IP=Interpersonal Problems DSF= Digit Span Forward score DSB=Digit Span Backward score DSTot= Digit Span Total score SWS= Stroop Word score SCS = Stroop Colour Score SCWS = Stroop Colour-Word Score SDMT = Symbol Digit Modulation Test score		

In the current study, there was a mixed response to CFs. One of the tests of CF, SLCT, was seen improving with yoga. Normative data for SLCT on healthy school children indicates a mean score of 24.04, for age group 9 to 16 years(Pradhan and Ramarao, 2008). In the current study, the mean scores before and after intervention were 23.4 and 27.6 respectively. Thus, at the baseline, the scores were lesser than that of normal and improved to normal after yoga. Similarly, SDMT also showed significant improvement (p~0). DSFB test which is a test for executive functions (EF) aspect of CF, showed a non-significant improvement. Stroop tasks that also require good working memory and is a test of EF(Giofrè *et al.*, 2016) also showed a non-significant improvement. Thus, in the current study, CFs pertaining to psychomotor performance (PP) showed significant improvement, while that of EF did not. With reference

to DSTot results, while the participants showed improvement in DSB, there was a difficulty with the DSF test. Supporting this phenomenon, another study on a large group of children with specific learning disabilities also showed similar results which are attributed to more requirement of working memory in DSF than in DSB(Giofrè *et al.*, 2016). It is also known that depression has a negative impact on working memory,(Christopher and MacDonald, 2005) thus resulting in poor executive function. Incidentally in the current study, the participants' depression level also showed an increase, which could be the reason why there was an improvement in the PP aspect of CF and not the EF aspect.

There was an overall significant improvement in the total QOL, although not statistically significant in any of the subscales. Physical functioning score had good significance since yoga is known to improve the flexibility of the body. The Fatigue Related Quality Of Life(FRQOL) assessed through the PedsQL fatigue questionnaire, also showed improvement. Of the three sub-scales sleep/rest fatigue QOL showed significant improvement. However, there was improvement in general fatigue and cognitive fatigue subscales, though not statistically significant. Improvement in sleep/rest fatigue state is an important aspect since HIV positive individuals are known to have issues in sleep(Chaponda *et al.*, 2018). The yoga program could help the participants in this regard. Hence there is overall improvement in the quality of life of the participants.

CDI total score increased significantly ($p < 0.05$). The total score comprises of emotional problem (EP) and functional problem (FP). Of these, the increase in EP is significant ($p = 0.039$) and FP is not significant ($p = 0.082$). EP has two components, negative mood physical symptoms (NMPS) and negative self-esteem (NSE). Of these NMPS does not show a significant change ($p = 0.887 >> 0.05$), while NSE has a significant change ($p \sim 0$). Exploring the components of NSE in the questionnaire, it can be understood that there is a need to address the issues like 'things not working out well with' (Q.2r (question 2; r indicating

reverse scoring)) (question-wise mean scores and reverse scores table given in Appendix VII for reference), 'blaming themselves for the faults that happen' (Q.7r), 'how I look' (Q.13), 'somebody else loving them' (Q.24r) and 'sometimes being disgusted' (Q.8). This means that in the current study yoga could not address these issues, and have to be looked into while considering future interventions. However, for the participants 'liking themselves' (Q.6r) was not an issue.

Similarly, FP has two sub-components ineffectiveness (INE) and interpersonal (IP). The IP has no statistical significance ($p=0.571$). However, with INE there is a significant increase ($p=0.032$). A detailed analysis of the ineffectiveness reveals that there are issues with 'making up mind to do things' (Q.12r), 'having fun at school' (Q.20r), 'feeling good relative to others' (Q.23). It can also be noted that the participants, overall, do have issues with 'having fun' (Q.4) in general (although not at school), 'to make time to do school-related things' (Q.14r, Q.22), 'remembering things' (Q.28). Although the EF tests indicated poor working memory, CDI is not sensitive to tap the difference between different types of memories. However, this also explains the improvement in other CFs that require memory. The component on issues related to going to school has been positive in spite of it being a component of ineffectiveness which had an overall negative effect. This is further supported by the improvement in the school functioning sub-scale of the PedsQL QOL questionnaire.

It can be further noted that although there was an improvement in quality of life scores, there is an increase in the depression scores. This is in contrary to the well-known phenomenon that the quality of life and depression are inversely correlated. A closer investigation reveals that despite other contributions, the major contributor to the increase in quality of life is the physical functioning score ($p=0.004$), and the major contributor for an increase in depression is the negative self-esteem ($p\sim 0$). While in the current research since yoga intervention largely addressed *annamaya*, *pranamaya* and *monomaya* ko a aspects and not

vijn namayako a aspect, this mismatch between QOL and depression could be quite evident, and yoga intervention could not help reduce depression although it helped physical aspects.

Thus, with reference to the discussions made pertaining to the study it can be understood that the yoga program needs to be improved to address psycho-social issues, which can perhaps be improved with addition of yogic games which help children as in case of study one, involve better with others and proper counseling to improve self-esteem of the participants.

6.3 COMPARATIVE DISCUSSION OF STUDIES ONE AND TWO

Although the two studies had the same aim, due to practical difficulties/considerations the studies were different in design and implementation. For easier comparison Table 6.6 presents the relative results of the two studies. More detailed comparative tables of the results are given in Appendix XI for reference.

The CD4 count significantly increased in RC2 while it decreased in RC1. This is in spite of the fact that the CD4 count in RC2 was poorer at baseline. The CD4/CD8 ratio also improved better in RC2, while it decreased in RC1.

On similar lines, the HRQOL and FRQOL improved in RC2, all of which were poorer at baseline in RC2. The depression parameters although further deteriorated after intervention both in RC1 and RC2 the depression status which was poorer in RC1 had a better status after the intervention.

With respect to cognitive functions, RC2 improved in most parameters compared to RC1. Interestingly, even with cognitive functions, parameters that were poorer at baseline they improved better relatively.

As normally argued, for want of control group the significant improvements in study-2 cannot be attributed purely to yoga intervention. However, although there was no control group in the study, it can be noted that the C/As were already on ART routine well before the

start of the yoga intervention. Hence ART effect could be considered to be nullified, and the effect of yoga was added on to the ART effect, overall leading to better improvement in the parameters. Further, from the study-1 it can be noted that neither similar intervention (of lesser duration) nor ART could show such significant improvement in the results. Thus it can be safely argued that yoga could have played an important role in improvement of the various parameters considered in the research.

Table 6.6: Comparison of relative performances of two centers wrt baseline status

Variables	Relatively poorer at baseline in...	Relatively more favorable after intervention in...	Variables	Relatively poorer at baseline in...	Relatively more favorable after intervention in...
CD4 cell count (Counts/~L)	RC2↓	RC2↑	CDI-NMPS_T	RC1↓	RC1↑
CD4/CD8 ratio	RC1↓	RC2↑	CDI-NSE_T	RC1↓	RC1↑
PQ_PF	RC2↓	RC2↑	CDI-FP_T	RC1↓	RC2↑
PQ_EF	RC2↓	RC2↑	CDI-INE_T	RC1↓	RC1↑
PQ_SocF	RC2↓	RC2↑	CDI-IP_T	RC1↓	RC1↑
PQ_SchF	RC2↓	RC2↑	CDI-Total_T	RC1↓	RC1↑
PQ_PSF_Tot	RC2↓	RC2↑	DSF	RC1↓	RC1↑
PQ_Tot	RC2↓	RC2↑	DSB	RC2↓	RC2↑
PF_GF	RC2↓	RC2↑	DSTot	RC2↓	RC2↑
PF_SF	RC2↓	RC2↑	SWS	RC2↓	RC2↑
PF_CF	RC2↓	RC2↑	SCS	RC2↓	RC2↑
PF_Tot	RC2↓	RC2↑	SCWS	RC1↓	RC1↑
CDI-EP_T	RC1↓	RC1↑	SDMT	RC2↓	RC2↑

With the above discussions two major points that can be noted are:

-) RC2 improved in almost all the parameters considered in the research, except CDI.
-) The center which was relatively poorer at baseline improved better in almost all parameters considered in the research.

Since the results of the two studies were opposite in most of the outcome variables, it is worth discussing the various attributes of the two studies (Table 6.7) which could have led to the differences in the outcomes, which in turn would help explain the results better.

The improvements in RC2 could be attributed to the higher duration of yoga intervention, food conducive to yoga and better ‘participant: teacher’ ratio. Thus it can be understood that yoga doesn’t work alone and a more integrated approach is required. Although the current research does not study the effect of food, through traditional literature, typically, Gheranda samhita 5-16, r mad Bhagavadg t 6-17, food conducive to yoga is inevitable for yoga practices to be effective. Thus food provided in RC2 could have added on to the effect of yoga to yield better results than that of RC1.

Although the comparisons made between the various outcome variables were meant to see how yoga worked in the two studies, it is interesting to note that after intervention, barring a couple of exceptional cases, between the two study centers the performance after yoga was better in the center where the baseline values were poorer before yoga.

This is similar to the observation made in the discussion on study two wherein the HBVL group showed more improvement. Thus, the argument that yoga gives priority to address the problem when it is more serious is further reiterated.

Table 6.7: Comparison of attributes of studies one and two

RC1	RC2
Intervention	
) Duration of intervention was four months, with five days of practice a week) The duration of the intervention was six months, with seven days of practice in a week.
) Yoga intervention included 50-55 minutes of basic yogic practices comprising of san s and pr y ma and 50-55 minutes of ‘yogic games a day.) Yoga intervention included 60 minutes of yogic practices comprising of san s and pr y ma
Strengths	
) Had Control group) More participants (73, including yoga and control groups).) Students: Teacher ratio was 22 : 1. A relatively lesser number of participants led to easy managing of the participants by one yoga teacher.) Yoga teacher was well-versed with Kannada, the local language and yoga was taught in the local language, wherein the participants were more comfortable.) The daily routine of the students perhaps was not disturbed.

RC1	RC2
Limitations	
<ul style="list-style-type: none">) Students: Teacher ratio was 40 : 1. Higher number of participants while practicing yoga group led to difficulty in managing the participants by one yoga teacher.) Both the yoga teachers; the one teaching sans and pr y ma and the other teaching yogic games, were not well-versed with Kannada, the local language and the yoga classes were taught in English, wherein the participants look to have felt less comfortable.) Participants' regular routine was disturbed, especially in the morning hour wherein they were to wake up one hour earlier than the normal; thus had disturbed/reduced rest and sleep.) No follow-up 	<ul style="list-style-type: none">) No control group) Lesser number of participants (22)) No follow-up
Other constraints	
<ul style="list-style-type: none">) As per the rules of RC1, the participants, whether they liked it or not had to consume non-vegetarian food daily on a compulsory basis which was not conducive. 	<ul style="list-style-type: none">) Food provided in RC2 was conducive to yoga.

With reference to the above comparative results and the discussions made on the individual studies, it can be summarized that:

-) While ART has a good effect on the immune parameters of HIV seropositives, they do not have an impact on the cognitive functions and quality of life. Perhaps the non-ART group has a better quality of life and depression scores.
-) Sleep is an important thing that should not be neglected. Any attempt to improve the status of HIV seropositive should not neglect sleep.
-) Yoga can improve the status of HIV seropositive individuals. However, a more integrated approach with compatible food and sufficient rest is important.