CHAPTER 5

METHODOLOGY

5.0   METHODS

5.1   METHODS – DESIGN 1 (INJURY SURVEY)

5.1.1   SAMPLE SIZE

This study comprised of 319 domestic cricket players, who represent their State either as a domestic first-class player or as an U23 player.

5.1.2   SOURCE OF SAMPLE

Five State Cricket Associations were chosen based on their willingness to be part of the study and their periodical logging of the injury occurrences. They were – Karnataka State Cricket Association, Baroda State Cricket Association, Himachal Pradesh State Cricket Association, Vidarbha State Cricket Association and Kerala State Cricket Association.

5.1.3 SAMPLING TECHNIQUE

Purposive/selective sampling

5.1.4   SELECTION AND SOURCE OF PARTICIPANTS

Current study considers players at domestic cricket who represent their respective State Association either as a domestic first-class player or as an U23 player. There were two squads from each Association and annual injury prevalence was calculated for a total of 10 squads for a period of 365 days.

5.1.5 SURVELLIANCE PERIOD

Surveillance period was from January 2017 to January 2018.

5.1.6 DESIGN OF THE STUDY

Cross-sectional retrospective study. Cricket injury survey data were obtained from the respective team physiotherapists through a Google survey form.

5.1.7   INCLUSION CRITERIA

- Cricket players with a contract with the State Cricket Association who were considered as being part of the squad.
- Male cricket players with an age range of 18-35 years.

- Players who have been injured during the period of January 2017 - January 2018.
- Players who go through an injury while playing a match/during a training session (fitness session, warm up games and net sessions); who due to his injury is unavailable for selection during a major match;
- Players who due to an injury is unable to bat, bowl, or keep wicket when required by either the rules or the team's captain.

5.1.8   EXCLUSION CRITERIA
- Incomplete data on the injury.
- Cricket players unwilling to be part of the study.

5.1.9   FUNCTIONAL DEFINITIONS

For the purpose of this research, the most recent consensus definitions published in 2016 in the British Journal of Sports Medicine was adopted. (Orchard et al., 2016).

- Match time-loss injury is defined as any injury/illness that prevents a player from being fully available for selection for a major match or during a major match, causes a player to be unable to bat, bowl or keep wicket when required by either the rules or the team's captain (Orchard et al., 2016).

- Recurrent injury was defined as an injury to the same side and body part, and of the same injury type, as an injury that previously qualified as an injury earlier in the same season, but which had recovered and also an injury was considered recovered once a player has returned to unrestricted participation in at least one match of any type or grade (Orchard et al., 2016).

- Annual Injury prevalence is the average number of squad members not available for selection through injury or illness for a given time period, divided by the total number of squad members. Injury prevalence is expressed as a percentage, representing the percentage of players missing through injury on average for that team for the season in question (Orchard et al., 2016).

5.1.10   CLASSIFICATION OF THE INJURED PLAYERS

Adhering to the 2016 international consensus statement on injury surveillance, each player was classified according to his primary skill (the skill he was selected to perform during the season) as a bowler, if he has bowled more than 10% of the overs bowled by his team in matches that he played

in, for either of the two previous seasons. Applying the same 10% rule to wicketkeepers, a wicketkeeper is a player who has kept wicket for more than 10% of overs while on the field. A bowler was classified as either fast/pace and slow/spin. It was further sub-categorised among, pace as fast, fast-medium and medium and off/finger spin and leg/wrist spin among spin.

5.1.11   ASSESSMENT TOOLS

- Anthropometric data (age, height and body weight).
- Years of experience in playing cricket at domestic professional level.
- Details for each injury recorded: Skill code (B - batsmen, FB - fast bowler, FMP- fast medium pace bowler, MP - medium pace bowler, RAS - right arm off spinner, RLS - right arm leg spinner, LAS - left arm spinner and WK - wicket keeper)
- Hand dominance (HR- hand right, HL – hand left)
- Leg dominance (LR – Leg right, LL - Leg left)
- Injury diagnosis (according to Orchard Sports Injury Classification System (OSICS) 10.1). Level 1 - body region; level 2 - body part; level 3 - common diagnoses; level 4 - specific diagnoses (Rae, & Orchard, 2007).
- Injury side - left/right/bilateral/not applicable.
- Time of onset - match/training/gradual/other.
- Activity of onset - batting/bowling/fielding/gradual.
- Date of onset of the injury.
- Mechanism of the injury – overuse (gradual/sudden), recurrent, contact/impact, sprinting (while fielding or batting), insidious (gradual and no identifiable mode of onset) or medical illness.
- Loss of play days due to an injury.
- Management of the injury – physiotherapy, medication, both or other methods.
- Details of any surgery required or any other major treatment.

5.2   METHODS – *YOGA* MODULE VALIDATION
5.2.1   PHASE 1 – DESIGNING OF A *YOGA* BIOMECHANICS MODULE

The *yoga* module was designed based on the annual injury survey report on the prevalence, nature and mechanism of the musculoskeletal injuries among male cricket players. This module was

designed adhering to the references of the appropriate advantages of the *yoga* practices, as mentioned in the classical and contemporary works on *yoga* (Iyengar, 2011; Stiles, 2000; Muktibodhananda, 2011; Iyengar, 2015; Coulter, 2001; Germain, & Lamotte, 1996; Long, 2010; Kaminoff, & Matthews, 2012). The module constituted a total of 32 practices that aimed at targeting a substantial and a steady effect on the anatomical regions that are prone to injuries among male cricket players as determined by a one-year retrospective study on prevalence, nature and mechanism of musculoskeletal injuries among male cricket players in India that was undertaken by the authors, based on which the module was further presented for validation.

5.2.2   PHASE 2 – VALIDATION OF THE *YOGA* BIOMECHANICS MODULE

Subject matter experts (SMEs) from the field of *yoga, āyurveda*, sports medicine and physiotherapy with a minimum experience of 5 years were contacted. 19 SMEs with an average experience of 12 years provided their responses for the validation of the *yoga* biomechanics module through a Google survey form. A total of 32 practices (Breathing practices - 2; *śuryanamaskāra* - 12 steps; *āsanās* - 26; *prāṇāyāma* - 2; Deep relaxation) were suggested and discussed for the process of validation. Each practice was further rated on a five-point scale that was classified as: 1. Not at all 2. A little bit 3. Moderate 4. Very much 5. Extremely. The validation data was further analysed using Lawshe's content validity ratio (CVR).

5.2.3   PHASE 3 – CALCULATION OF CONTENT VALIDITY RATIO USING LAWSHE'S FORMULA

The content validity ratio (CVR) was calculated in order to reject or to retain the specific practices. Based on the responses by the 19 SMEs for all the 32 practices, the responses marked by SMEs as - very much and extremely, was accounted for the calculation of CVR. CVR value was computed for each item using the CVR formula = $(Ne – N/2)/N/2$. Where CVR = Content validity ratio, Ne = total number of essentials for each pertinent Yoga practice, N = Total number of experts in the validation panel (Gilbert, & Prion, 2016).
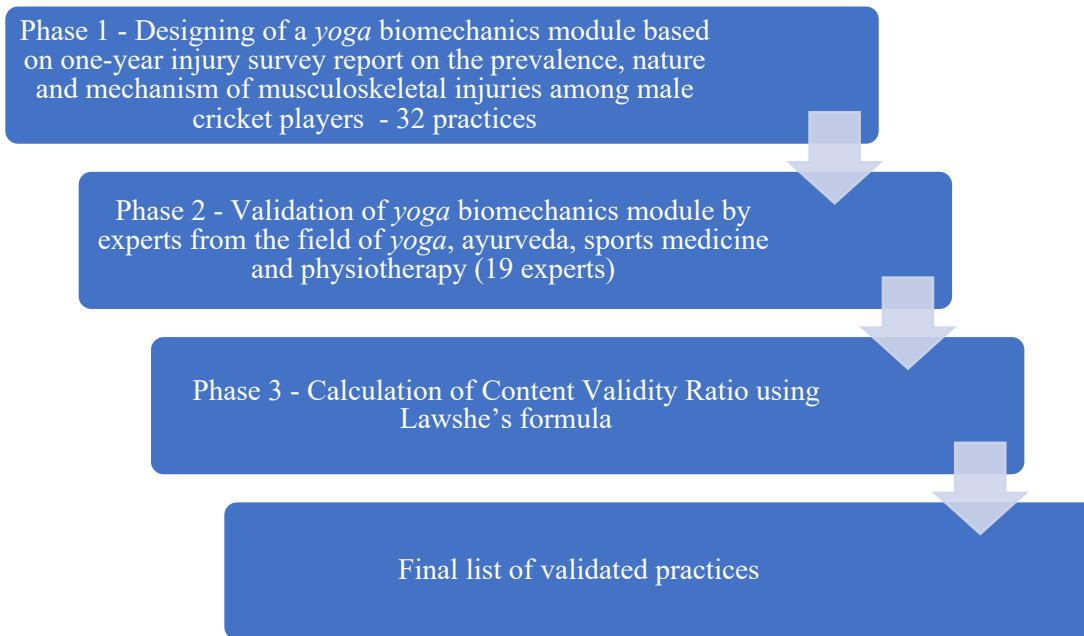
Figure 2: Flow chart explaining the process of *yoga* module validation

5.3   METHODS – DESIGN 2 (*YOGA* INTERVENTION)

5.3.1   PARTICIPANTS

First-class domestic male cricket players from the Karnataka State Cricket Association.

5.3.2   SAMPLE SIZE

The sample size used in the previous study on male athletes was N = 26 (Polsgrove et al., 2016). Based on the previous study, for the current study the sample size was calculated using the GPower Software. The derived sample size is 72 (36 + 36). With assumptions:

- Two group design with a two-tail hypothesis.
- α: 0.05, Power: 0.8, ES: 0.677

With an attrition of 25% the sample size came to 90 (45+45).

During the study a total of 42 cricket players were randomized into two groups. However, two cricket players from the wait-list control group were lost to both post and the follow-up assessments due to their unavailability. Hence, the *yoga* group consisted of *n*=42 and wait-list control group *n*=40.

5.3.3   SELECTION AND SOURCE OF PARTICIPANTS

Players from Karnataka State Cricket Association were randomly selected for the study.

5.3.4 DESIGN OF THE STUDY

Yoga biomechanics module intervention study was a longitudinal randomized controlled study.

5.3.5 INCLUSION CRITERIA

- Cricket players who play at first class domestic level.
- Cricket players with a contract with the Karnataka State Cricket Association and who are considered as being part of the squad.
- Cricket players with no physical signs of an injury in the past three months or longer.
- Players between the age range of 18 years to 35 years.
- Male cricket players only.
- Consenting and willing to participate for the entire duration of the intervention.

5.3.6 EXCLUSION CRITERIA

- Cricket players who have practiced any *yogic* practices including meditation or biofeedback relaxation technique in the past one year.
- Cricket players undergoing physiotherapy treatment.
- Cricket players who are not registered under Karnataka State Cricket Association.
- Cricket players with any recent history of surgical intervention.

5.3.7 VARIABLES STUDIED

- Core stability: Double leg-lowering test (DLL) - In this test, the stability of abdominal muscles were measured by the player's ability to keep the pelvis in a posterior tilt and to hold the lumbar spine flat while in the supine position with forearms folded across the chest with fingers touching the opposite shoulders (Zannotti et al., 2002). The digital inclinometer that was fastened parallelly along the lateral aspect of the thigh of the player recorded the angle of the legs in degrees from the floor (Krause et al., 2005).
- Core Stability: Side bridge test (SBT) - This test measures the control and endurance of the lateral core stabilizing muscles. The player was made to lie on the right side on an exercise mat with both the legs extended and stacked on top of each other such that the bottom elbow on the mat is in-line with the shoulder while the torso and thighs are off the mat, so that the body weight is on the forearm and the outer edge of the feet (McGill et al., 1999).

- Flexibility: Back saver sit and reach (BSSR) - This test used the sit and reach box to measure the functional hip region flexibility, including the lower back and hamstring muscles. As the player slowly reached forward, sliding the hands along the box scale as far as possible, the player held the full reach position for at least two seconds and the score was recorded to the nearest centimetre as the distance reached (Baltaci et al., 2003).

- Range of motion (ROM): Bilateral active shoulder rotation range of motion test (BASR) - A digital goniometer was used to measure the player's glenohumeral joint abduction in supine position with internal and external rotation (IR, ER) with shoulder complex at 90° of abduction and elbow flexed to 90° in the coronal plane. The digital goniometer was positioned over the olecranon and the moving arm was aligned along the lateral aspect of the ulna, with the styloid process (Stuelcken et al., 2008).

- Static Balance: Stork Balance Stand Test (SB) - In this test, the ability of the player to balance on the ball of the foot was assessed. The total time in seconds was recorded using a stopwatch (Hammami et al., 2015).

- Dynamic Balance: Y Balance test (YBT) - anterior (A), posteromedial (PM), and posterolateral (PL) - This test measured the dynamic balance that is required for strength, flexibility, and proprioception. The player stood on one lower extremity, and was then asked to reach in the anterior, posteromedial, and posterolateral direction while maintaining their single-limb stance. The process was repeated while standing on the other lower extremity. The cricket player's limb length measurements, from the most distal end of the anterior superior iliac spine to the most distal end of the lateral malleolus on each limb, were also recorded. The composite score was calculated by dividing the sum of the maximum reach distance in the anterior (A), posteromedial (PM), and posterolateral (PL) directions by three times the limb length (LL) of the individual, then multiplied by 100 {[(A + PM + PL)/(LL X 3)] X100} for each side (Filipa et al., 2010).

- Proprioception of the ankle: Active reproduction test - 10° dorsiflexion, 11° plantar flexion and 25° plantar flexion - Eyes Open (EO) and Eyes Closed (EC). In this test, the player was made to sit with their legs extended and was told to move the ankles to target angles of 10° dorsiflexion, 11° plantar flexion and 25° plantar flexion with both eyes open and eyes closed (EO, EC). Measurements were done using a digital goniometer (Cay et al., 2018; Senol et al., 2019).

- Five-facet mindfulness questionnaire (FFMQ). Five-facet mindfulness questionnaire is based on a factor analytic study of five independently developed mindfulness questionnaires. The analysis yielded five factors that appear to represent elements of mindfulness as conceptualized in the psychological literature. The five facets are observing, describing, acting with awareness, non-judging of inner experience and non-reactivity to inner experience. The internal consistency of the five subscales is of adequate to good consistency - Cronbach alpha values: Observing = .83, Describing = .91, Acting with Awareness = .87, Non-Reactivity to Inner Experiences = .75 and Non-Judging of Inner Experiences = .87 (Baer et al., 2006) (Appendix VI).

5.3.8   INTERVENTION

Player recruitment started on 5 November 2018 and closed on 23 November 2018. Those players who signed the informed consent form were randomized into a *yoga* group and wait-list control group (Appendix IV). Baseline pre-intervention measures for both the groups were completed on 29 November 2018 (Appendix V). The six week intervention commenced on 3 December 2018 and was completed on 11 January 2019. The duration of the follow-up was for a period of six months. The assessment for both the groups were done at the end of the follow-up period (July 2019) wherein, the *yoga* group was expected to continue the practice of the *yoga* module on their own during the follow-up period (Figure 3). The wait-list control group received the *yoga* module in August-September 2019.
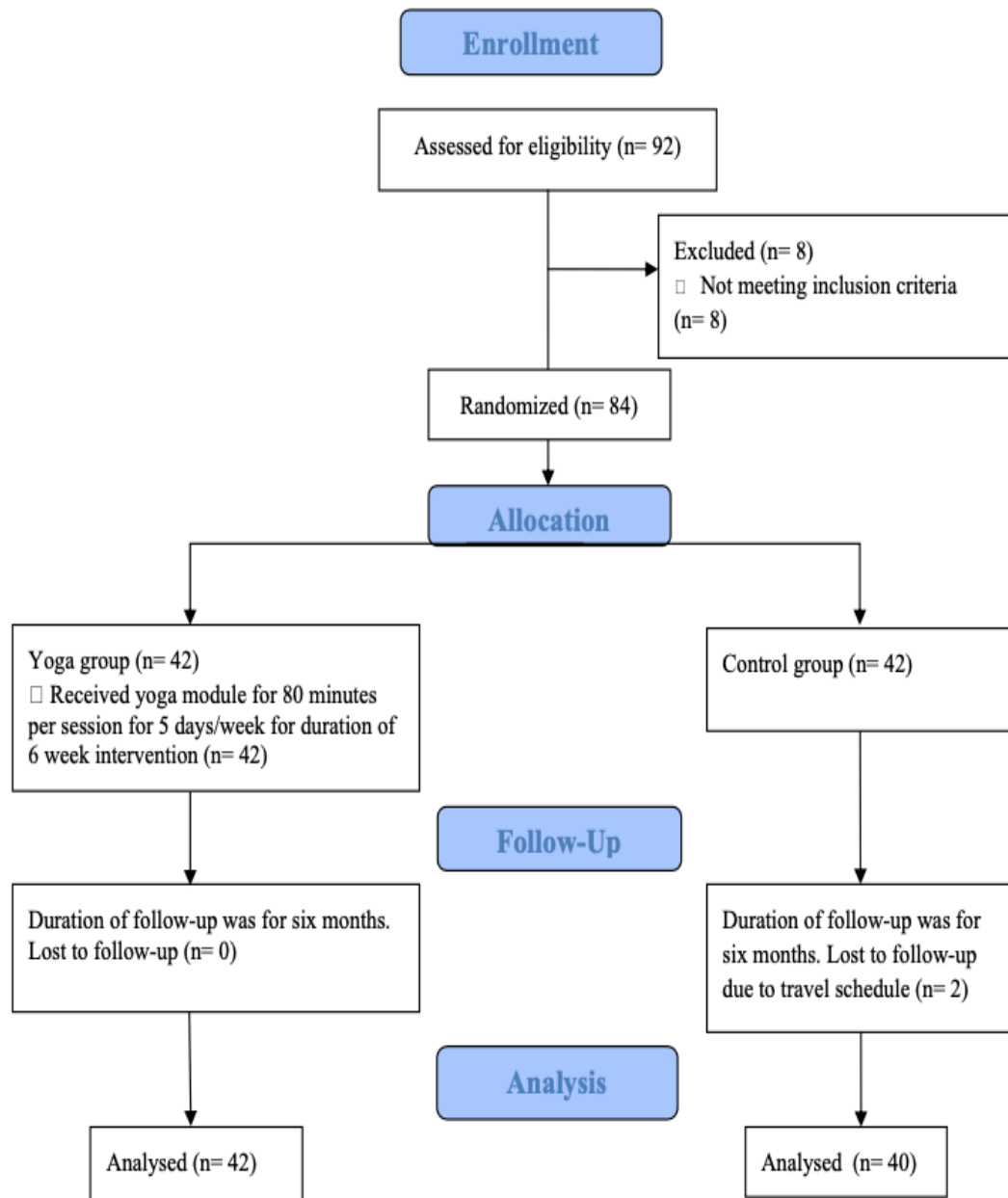
Figure 3: Flowchart depicting the enrollment, allocation, follow-up and analysis

Cricket players received the *yoga* module for 80 minutes per session for five days/week for a duration of six weeks. The validated practices are mentioned in Table 3. The diagrams depicting the practices are in Appendix VII. The sessions were conducted in the morning (7:30am – 8:50am) before the routine fitness session at the cricket association by a qualified *yoga* therapist (MSc *Yoga*, PhD scholar) who took utmost care in monitoring the alignment of each and every *āsana*, breathing patterns and

optimum relaxation at the end of the session. The players were repeatedly reminded to maintain a non-competitive and non-comparative approach with their peers while on the mat and perform the practices to the best of their ability with complete awareness of their breath and body. While the players in the *yoga* group received the module along with their routine fitness sessions, the wait-list control group followed their regular daily routine during the study period. However, the wait-list control group received the *yoga* module post the follow-up period by the same *yoga* therapist. During the follow-up period, the continuation of *yoga* practice of the *yoga* group was monitored using a group formed on a multiplatform messaging application by the *yoga* therapist. In this phase, the therapist noted a drop of 10% every month in the rate of continuation of practice. All the outcomes of this study aimed at analysing the effect of this validated *yoga* module on specific anatomical areas that are prone to injury such as shoulder, lumbar spine and knee among male cricket players in particular. The assessments were done by the *yoga* therapist at baseline, immediate post-intervention, and a follow-up after six months of intervention.

Table 3. Validated list of *yoga* practices

Type of yoga practice	Name of the practice	Duration (min)
Breathing practice	Pavanamuktāsana kriya	3
Sūryanamaskāra	Sūryanamaskāra - 12 steps	10
Āsanās in standing position	Utthitatrikoṇāsana	2
	Parivṛttatrikoṇāsana	2
	Pārśvakoṇāsana	2
	Vīrabhadrāsana I	2
	Vīrabhadrāsana II	2
	Utthitahastapādāṅguṣṭhāsana	2
	Prasāritapādottānāsana	2
	Vṛkṣāsana	2
Āsanās in sitting position	Baddhakoṇāsana	1

	Upaviṣṭakoṇāsana	1
	Gomukhāsana	2
	Parivṛttajānuśīrṣāsana	2
	Uṣṭrāsana	2
	Vīrāsana	2
Āsanās in prone position	Bhujaṅgāsana	3
	Śalabhāsana	2
	Dhanurāsana	2
Āsanās in supine position	Sālambasarvāṅgāsana	2
	Matsyāsana	2
	Uttānapādāsana	1
	Jaṭharaparivartanāsana	2
Prāṇāyāma	Nādiśuddhi	10
	Bhrāmari	2
Relaxation in supine position	Deep Relaxation (Śavāsana)	15

5.4   ETHICAL CONSIDERATION

All the five State Cricket Associations (Karnataka State Cricket Association, Baroda State Cricket Association, Himachal Pradesh State Cricket Association, Vidarbha State Cricket Association and Kerala State Cricket Association) had extended their consent for conducting the injury surveillance (Appendix III). Injury surveillance was non-interventional and preserved the confidentiality of the players. The Karnataka State Cricket Association had extended their consent for conducting the *yoga* intervention study (Appendix III). Written informed consent from the participants was obtained before the intervention (Appendix IV). The players were explained in detail about the nature of the study and the voluntary nature of participation. Confidentiality was assured as a part of the research process. This study was approved by the Institutional Ethics Committee (IEC), Swami Vivekananda Yoga Anusandhana Samsthana, Bengaluru (Appendix II).

5.5 DATA EXTRACTION AND ANALYSIS

5.5.1 DESIGN 1 (INJURY SURVEY)

The data were obtained from the respective team physiotherapists through a Google survey form. The data were then tabulated in the Microsoft Excel. Data were then statistical analysed using R Development Core Team, 2019 and Microsoft excel.

5.5.2 *YOGA* MODULE VALIDATION

The responses obtained from the experts through the google form were tabulated using Microsoft Excel. CVR was calculated for all the 32 practices using Microsoft Office Excel 2019.

5.5.3 DESIGN 2 (*YOGA* INTERVENTION AND FOLLOW-UP)

A total of 42 cricket players were taken in each group. However, there were two dropouts from the wait-list control group as they were lost to both the post and follow-up assessments due to their unavailability. Hence, in the *yoga* group $n=42$ and in the wait-list control group $n=40$. Prior to performing any statistical analysis for comparison, data were compiled to obtain the descriptive statistics. There were no missing data at T1 (baseline), T2 (immediate post-intervention) and at T3 (follow-up after six months of intervention).

Data were coded and recorded in the MS Excel spreadsheet program. R Statistical Software, RStudio Team (2019) was used for data analysis. Descriptive statistics were presented as appropriate. Independent *t*-test was conducted to check the statistical significance between the groups at each time point. Data were explored for normal distribution using the criteria of absolute skewness <2, absolute kurtosis <3, and a non-significant Shapiro-Wilk Test. In case the data were found to be non-normally distributed, appropriate transformations (Log10, square-root, reflection) were used to achieve a normal distribution, and analysis was performed for both the transformed and the non-transformed data to ensure that the deviation from normality did not affect the significance or the direction of associations. Results are presented for the outlier removed datasets. Group differences in the change in parameters over time was modelled using linear mixed-effects regression method as two groups were compared over three unevenly spaced assessment time points. Linear mixed-effects approach was employed as it has important advantages over traditional methods of repeated measures analysis while seamlessly dealing with unequally spaced observations over time (Gueorguieva, &

Krystal, 2004). Linear mixed-effect regression method was conducted using the lme4 package in R, with each outcome parameter respectively as the dependent variable, main effect of Group and Timepoint and their interaction as fixed effects, and allowing for a random intercept for each subject and a random slope for Time.

Full models were compared against baseline models with no fixed effects for deriving the significance of model fit. Statistical significance was assumed at $p<0.05$. Validity of the FFMQ was examined using Bartlett's test of sphericity to evaluate whether or not the variables intercorrelate and Cronbach's alpha for internal consistency. Intercorrelations between FFMQ facets were conducted to examine if facets represent related but distinct constructs. Regression analyses were conducted to predict each FFMQ facet from the other four facets combined. The adjusted R^2 indicates the variance accounted for by the dependents relationship with the other facets, hence revealing the extent to which facets are non-overlapping (Baer et al., 2008).

With these designs, the studies were hence conducted. Results and discussions are revealed in the coming chapters.