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The Relationship of Training Parameters with Incidence of Injury, Sleep and Well Being of Young University Swimmers

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ABSTRACT

The purpose of present study was to examine correlation between Training Load (TL), Monotony (MT), Strain (ST), Acute Chronic Work Load Ratio (ACWR), Sleep, Well-being and Incidence of Injuries over a pre competitive season. The present study further compares Training load, Monotony, Strain and ACWR over seven weeks of training in a swimming team. Twelve males from the university swimming team took part in the study with the mean age of 20.41 years, mean weight 71.16 kg and mean BMI 22.19. All participants who enrolled in the study were followed and monitored for a period of seven weeks which included both training and competition. The training load was measured by Rating of Perceived Exertion (RPE) × time. ACWR, strain and monotony were calculated using standard formulas. Sleep quality was measured using Pittsburg Sleep Quality Index and well-being was assessed using WHO -5 well-being Index. Pearson correlation coefficients was used to examine the relationships. There were some interesting findings as very few injuries (n=3) occur during the training and no injury taking place during the competition. Interestingly, no relationship was seen between various training parameters and sleep. While strong positive relationship was seen between TL and ST (r = 0.89), TL and ACWR (r = 0.80) and ST and ACWR (r = 0.78). The relationship was also found between ACWR and Well-being (r = 0.71). The findings suggest that the training load was well within the acceptable range as enough recovery days were provided during the training weeks. One of the major limitations of the present study was that it was set up in a very demanding academic environment and therefore it may not be appropriate to generalize the findings to rest of the population or different geographical and educational settings.

Key words: *Injury, Sleep, Well Being, Training Load.*

INTRODUCTION

Sports injuries are major obstacles in performance in any sports at all levels of skill and age. An injury not only affects the physical functioning of a sports person but also affects his psychological characteristics. Sports injuries and their rehabilitation is always a challenge for coaches and team physicians. Training sessions build up teams and players for competitions. Training sessions design thus, becomes significant for any team with respect to both injuries as well as performance. Erratic training intensities and training volumes can not only cause injuries in players but also reduce the performance of player and team.

Exercise is one of the most important treatment methods for some patients [1, 2]. Some of the methods of training employed by few coaches might be stressful and along with other aspect of today's modern life, increase incidence of sports injuries [3]. The designing of training programs should ultimately lead to optimize the performance of athletes [4]. Throughout the competitive season, athletes may suffer from different categories of injuries and illnesses, which may have impact on performance, and success of any team and coach. The load of training as reported also affects athletes' performance and success [5]. Sports injuries might be a likely result from association between overtraining, different training patterns and possible daily stress [6].

Evaluating a training session using rate of perceived exertion (RPE) was found very important instrument in correlating overtraining of athletes with physical demands on the body [7]. RPE scale is quite useful in sports science and exercise mainly to monitor intensity of exercise and often employed to quantify exercise intensities [8 -11]. It was found that more number of playing injuries occur at the end of competitive season whereas greater training injuries took place in the beginning of season [12]. The consequences of sports injuries for a young athlete could be enormous, from re-injury to ending of career [13]. There is potential economic burden on the health related cost due to the injuries to sports persons. In United States itself, the estimated charges of hospital for sports injuries in 5-18-year-old people was $485 million over 4-year period and this increased steadily each year [14].

Gabbett et al. [15, 16] introduced the concept of acute chronic load ratio (ACWR) based on previous work done by Banister and Clavert [17]. ACWR is the ratio of acute training load (weekly mean training load) to the chronic load (4-week workload divided by 4). According to them, if chronic training load is increased systematically keeping acute load low, then an athlete is considered prepared well. While if acute load is more than chronic load, it result in fatigue and it will pose increased injury risk to the athlete. ACWR within the range of 0.8–1.3 is considered as good while when ACWR is more than 1.5, then there will be more chances of injury [18]. ACWR is a simple and reasonably good way to monitor training load, especially when controlling intensities over a longer period of time [15, 18 -20].

Sleep is another important factor which is associated with injuries. It is evident from a study by Meliwski where sleep deprivation was found related to injuries in adolescent athletic population. Allowing and motivating athlete to sleep over optimum time might be helpful in prevention of injuries [21]. Reduced sleep might be a factor which can affect mood, motor and other cognitive functions in young athletes that can increase the risk of injuries [22, 23]. It is important for manager and coaches to understand that they should allow adequate rest and recovery in their scheduling which may lead to better performance and reduced chances of injury [24].

In competitive swimmers, the relationship between greater training volume and performance was reported by Stewart and Hopkins in their studies [25]. They also reported the relationship between greater training intensity and performance. On the other hand it should be noted that greater incidence of injuries and illness takes place when the load is the highest [7, 26]. One of the pre season’s objectives should be to minimize the risk of injury and allow the athlete to adapt physiologically and maximize the player’s availability for training sessions [27].It is evident that the injuries in sports can greatly reduce the performance of team and its future. Nowadays, sport is developing in form of an industry where not only the prestige of nation is at stake but also the money. It is very crucial to take steps to prevent injuries not only during competitions but also in training sessions since it has a long-term impact on health of sportspeople. It is understandable that many injuries do not require hospitalization but they can have an impact on economy increasing the medical bill of the nation in the way of treatment and rehabilitation and it takes precious time of parents to take time off to care for their injured wards. Even a minor to moderate reduction in sports injuries is significant and can have a positive impact on athletes' health and economy of nation.

Due to increased demands and popularity of sports, a high number of players is participating in competitive sports nowadays. This has led to the increase in difficulty levels in training sessions. In the past years, interest in sports in Saudi Arabia has increased greatly. Now, in many sports there is considerable amount of financial rewards for successful players at elite level. This has increased the competition, the intensity of training sessions and also the number of injuries to elite players.

The purpose of the present study was to examine the correlation between Training Load (TL), Monotony (MT), Strain (ST), Acute Chronic Work Load Ratio (ACWR), Sleep, Well-being and Incidence of Injuries in a university swimming team. The present study further compares Training load, Monotony, Strain and ACWR over seven weeks of training in a swimming team. A comparison is also done with regard to the incidence of injuries between training and competition period.

MATERIALS AND METHODS

Participants

We selected 12 participants from the swimming team of King Fahd University of Petroleum and Minerals. A written informed consent was taken from the participants individually before enrolling in the study. All participants who enrolled in the study were followed and monitored for a period of seven weeks which included both training and competition. The injuries were recorded during this period. Both investigators with the help of coach associated with team monitored injuries. The injuries and training data were recorded and tabulated in the specially designed format. Two research assistants visited the participating team on daily basis. All information colected by the research assistants was recorded in a weekly format on daily basis.

Project Design

Training sessions are very important and crucial for any player or team. We aim to establish a relationship between various training parameters of a training session with incidence of injuries in swimming team. Training load and training monotony are important constituents in designing a training session. The Borg rating of perceived exertion (RPE) scale was used to calculate the training sessions' intensity and load. Borg rating of perceived exertion was found to be simple, reliable and valid estimations of exercise intensity [28, 29]. Training load was calculated by multiplying RPE of session and duration. Data pertaining to training sessions was recorded on standard training report form. Training session intensity, training session duration, training load and exercise characteristics were recorded. The following calculations were used to measure different training parameters:

The Formulas for Calculation of the Training Parameters

Variables	Calculation Formula/Method/Description
Training Load (TL)	Session RPE x Duration of Training
Training Monotony (MT)	Mean Weekly TL / Standard Deviation of TL
Training Strain (ST)	MT x Mean Weekly Training Load
Acute Chronic Work Load Ratio (ACWR)	Acute Work Load/ Chronic Work Load
Acute Work Load	TL performed by athlete in 0ne week (7 days) [30]
Chronic Work Load	The 4 week (28 days) mean acute work load [30]

Pittsburgh Sleep Quality Index (PSQI) was used to measure the quality of sleep [30]. The PSQI is a 19-item self-rated questionnaire to measure sleep quality in previous one month. There are seven components and scores from these components added to obtain a global score which has a range from 0-21, higher scores indicate worse sleep quality. The PSQI has been evaluated by several research groups [31 - 34]. The cut of global score of 5 was used to indicate the sleep quality. WHO well-being questionnaire was used to measure well-being of the participants. The World Health Organization-5 five well-being index (WHO-5) is a short self-reported questionnaire. There are five statements in WHO-5. The maximum raw score can be 25 which haas a range from 0 to 25, and multiplying this raw score with 4 gives the final score. Score of 0 represents the worst well-being whereas score of 100 is indicative of the best well-being [26]. Injury was defined as pain or disability suffered by the player during training or game that restricted full participation in general training program [35].

Statistical Analysis

Training monotony was calculated by dividing mean weekly TL by the standard deviation of the TL over a week period [36]. Pearson Product Moment Correlation was employed to find the relationship between TL, MT, ST, ACWR and incidence of injuries. We also examined the relationship of all these other training parameters with sleep and well-being. Differences between training and competition injuries was examined by t-tests. Repeated measure ANOVA was use to compare the training load, monotony, strain and ACWR over seven-week period. The significance level was set at .05 for statistical analysis.

RESULTS AND DISCUSSION

The incidence of injury was recorded during 7-week period of swimming team training, just preceding the swimming competition. We have observed and recorded three injuries among the participants during this period, which was presented in Table 1 below. Descriptive statistics of various training parameters sleep and well-being are presented in Table 2.

Table 1: Incidence of Injury

Week	Incidence of Injury
Week 1	1
Week 2	0
Week 3	1
Week 4	0
Week 5	1

Week 6	0
Week 7	0

Table 2 : Descriptive Statistics

	Mean ± Standard Deviation
Training Load (AU)	260.97 ± 56.33
Training Monotony (AU)	1.14 ± .12
Training Strain (AU)	307.83 ± 53.47
Acute Chronic Work Load Ratio (AU)	0.94 ± .53
Incidence of Injury (AU)	0.42 ± .53
Sleep	10.58 ± 2.02
Well Being	12.50 ± 4.60

Table 3: Training Parameters over 7 Weeks (Repeated Measure Anova)

	Training Load (AU)	Monotony (AU)	Strain (AU)	ACWR (AU)
Week 1	207.13 ± 63.44	1.24 ± .25	266.29 ± 114.36	0.93 ± .29
Week 2	190.61 ± 74.15	1.13 ± .22	226.23 ± 122.11	0.84 ± .29
Week 3	207.47 ± 78.38	1.34 ± .16	282.77 ± 123.85	0.92 ± .30
Week 4	292.78 ± 91.98	1.14 ± .31	360.99 ± 189.91	0.92 ± .30
Week 5	304.76 ± 95.88	1.09 ±.25$	353.60 ± 189.91	0.99 ± .31
Week 6	321.63 ± 80.45*#	1.10 ± .18	364.17 ± 153.20	1.03 ± .19
Week 7	302.44 ± 82.43*#	0.96 ± .14*$	300.79 ± 113.47	0.96 ± .21
P Value	.000*	.044*	.236	.662

Data shown as Mean ± SD, *significant difference from week 1
#significant difference from week 2, $significant difference from week 3

Table 4: Correlations between Training Parameters, Incidence of Injury, Sleep & Well Being

	TL	MT	ST	ACWR	Injury	Sleep	Well Being
Training Load		-0.67	0.89**	0.80*	-0.35	0.32	-0.12
Training Monotony			-0.32	-0.31	0.62	0.43	-0.17
Training Strain				0.78*	-0.12	0.44	-0.18
ACWR					0.08	-0.43	0.71*
Incidence of Injury						0.12	0.02
Sleep							-0.39

*Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

Correlations between Training Parameters, Incidence of Injury, Sleep and Well Being

Training Load (TL)

Data from the present study did not reveal any significant relationships between training load and injury (r = -0.35) during 7 weeks of the observation period of the swimming team (Fig. 1, Table 4). The mean reported weekly training load for the swimming team was 260.97 ± 56.33 Arbitrary Units (AU). The highest training load was in week number six (321.63 AU) and week five (304.76 AU). The lowest training load was reported in week number two (190.61 AU) and in week number one (207.13 AU). When we compared training load over seven-week period, it was found that one-way repeated measures ANOVA (Table 3) revealed a significant difference in TL over seven-week period ($F_{6,66}$= 5.39) ($p < .05$). There was a general uptrend in TL up until the 6th week. Further data reveled no significant relationship (Fig. 2-4, Table 4) between TL and sleep (r = 0.32), TL and general well-being of person (r = -0.02), TL and MT (r = 0.44).

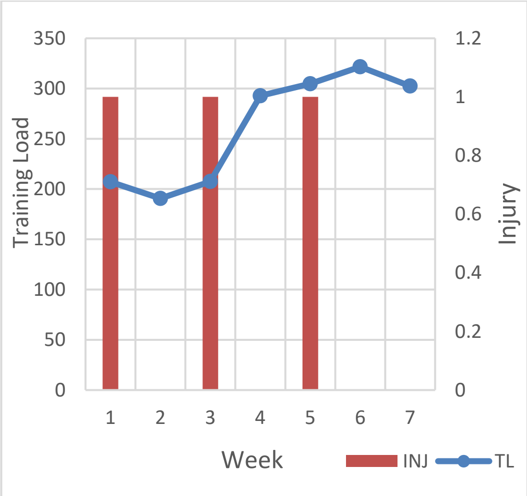

Figure 1: Reported MeanTraining Load & Incidence of Injury Over 7 Weeks Period

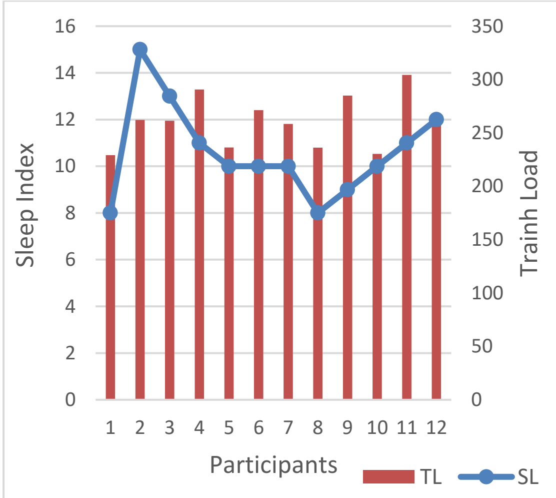

Figure 2: Reported Mean Training Load and Sleep Index Over 7 Weeks Period

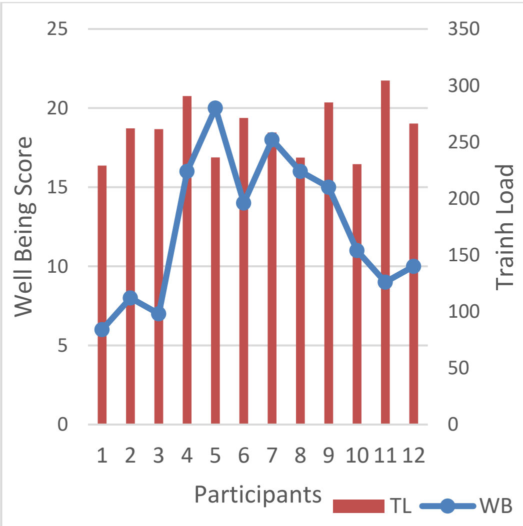

Figure 3: Reported Mean Training Load and Well Being Score Over 7 Weeks Period

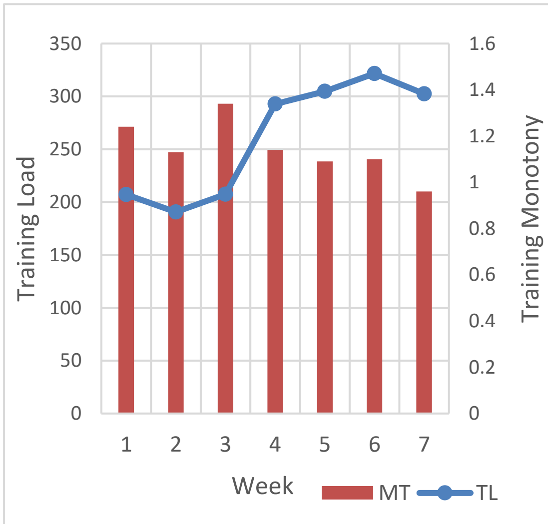

Figure 4: Reported MeanTraining Load & MeanTraining Monotony Over 7 Weeks Period

Training Monotony (MT)

No significant relationship was found between MT and injury (r = 0.62) during 7 weeks of observation period of the swimming team (Fig 5, Table 4). The mean reported weekly training monotony for the swimming team was (1.14 ± .12). The highest training monotony was in week number 3 (1.34 AU) followed by week 1 (1.24 AU). The lowest training monotony was reported in week 7 (0.96 AU) followed by week 5 (1.09 AU). When we compared MT over seven-week period, it was found that one-way repeated measures ANOVA (Table 3) revealed a significant difference in MT over seven-week period ($F_{6,66}$= 2.98) ($p < .05$). There was a general fluctuation in MT during reported period. Further data revealed no significant relationship (fig. 6-8, table 4) between MT and sleep (r = 0.43), MT and well-being of person (r= -0.17) MT and training strain (r = 0.32).

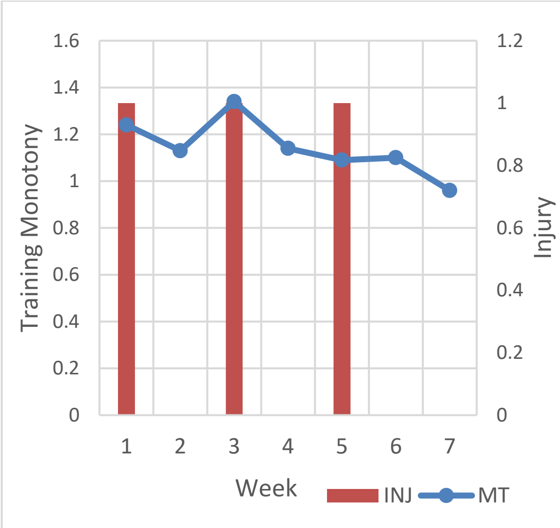

Figure 5: Mean Training Monotony and Incidence of Injury Over 7 Weeks Period

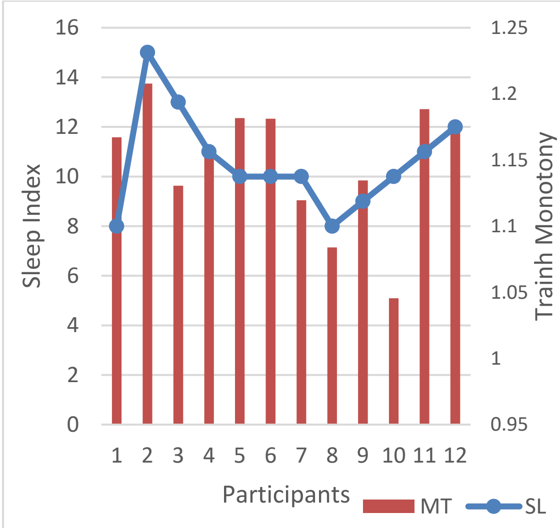

Figure 6: Mean Training Monotony and Sleep Index Over 7 Weeks Period

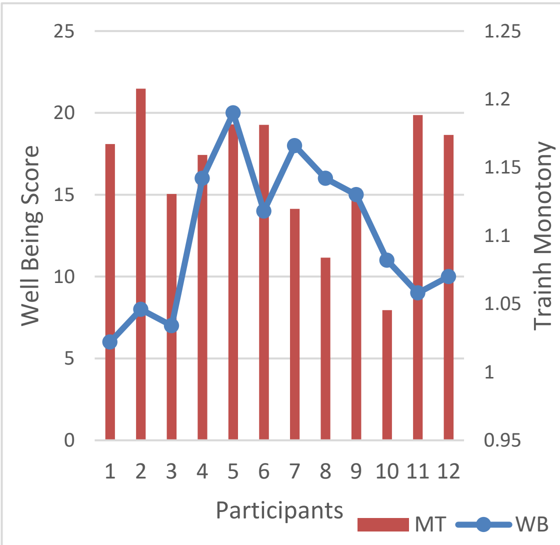

Figure 7: Mean Training Monotony and Well Being Over 7 Weeks Period

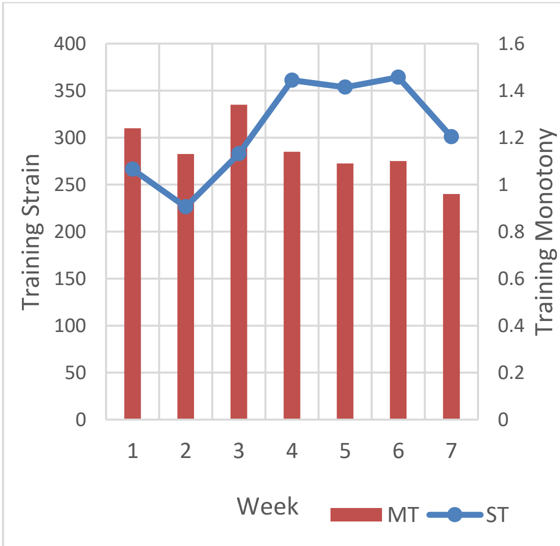

Figure 8: Mean Training Monotony and Training Strain Over 7 Weeks Period

Training Strain (ST)

There was no significant relationship between ST and injury (r = -0.12) during 7 weeks of observation period (Fig. 9, Table 4). The mean reported weekly training strain for the swimming team was (307.83 ± 53.47). The highest training strain was in week number 6 (364.17 AU) followed by week 4 (360.99 AU). The lowest training strain was reported in week number 2 (226.23 AU) followed by week 1 (266.29 AU). When we compared training strain over the seven-week period, it was found that one-way repeated measures ANOVA (Table 3) did not reveal a significant difference in training strain over the 7-week period ($F_{6,66}$= 1.49) ($p \geq .05$). There was a general uptrend in training strain during the reported period. Further data reveled no significant relationship (Fig 10-12, Table 4) between ST and sleep (r = 0.44) and between ST and well-being of person (r= -0.18). We have observed highly significant relationship between ST and TL (r = 0.96, $p < .01$).

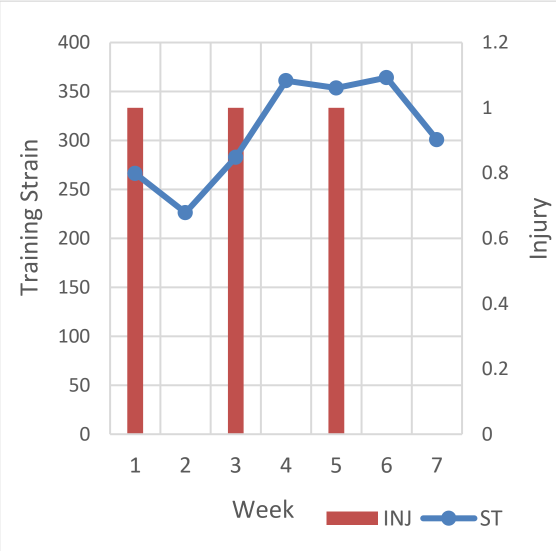

Figure 9: Mean Training Strain and Incidence Over 7 Weeks Period

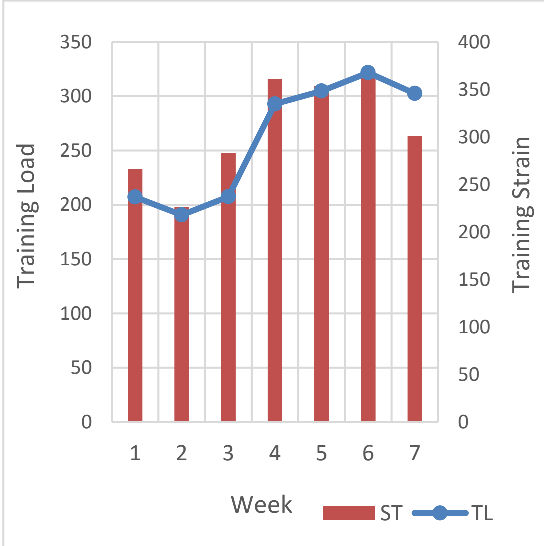

Figure 10: Mean Training Load and Training Strain Over 7 Weeks Period

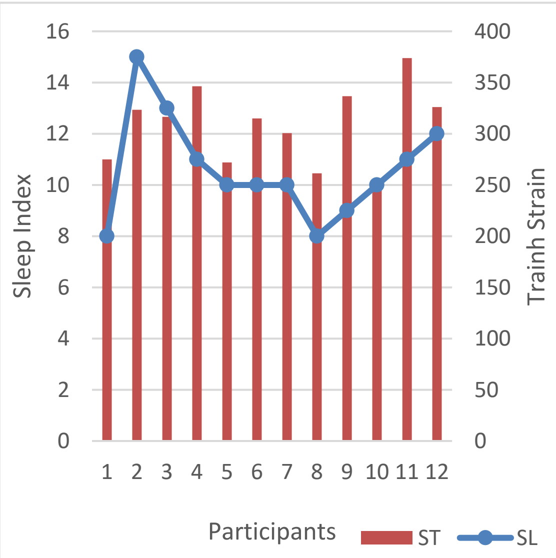

Figure 11: Mean Training Strain and Sleep Index Over 7 Weeks Period

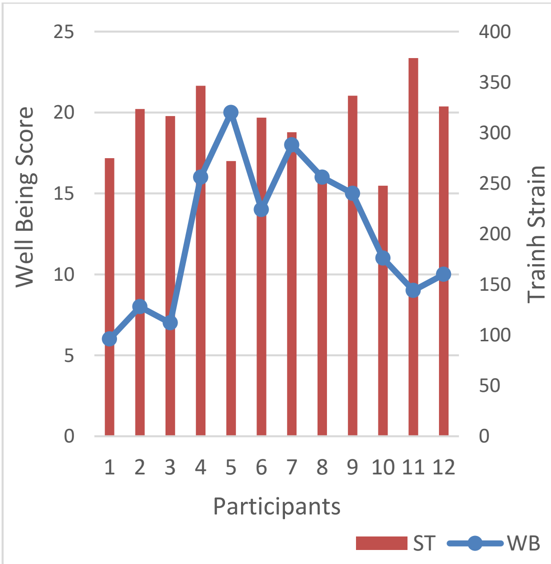

Figure 12: Mean Training Strain and Well Being Over 7 Weeks Period

Acute Chronic Work Load Ratio (ACWR)

No relationship was observed between ACWR and injury (r = 0.08) (Fig 13, Table 4). The mean weekly ACWR for the swimming team was (0.94 ± .53). The highest ACWR was in week number 6 (1.03 AU) followed by week 5 (0.99 AU). The lowest ACWR was reported in week number 2 (0.84 AU) followed by week 3 and 4 (0.92 AU). When we compared ACWR over seven week-period, it was found that one-way repeated measures ANOVA (Table 3) did not reveal a significant difference in ACWR over the 7-week period ($F_{6,66}$= 0.49) ($p \geq .05$). There was a general uptrend in ACWR during reported period. Further data reveled no significant relationship (Fig 14-18, Table 4) between ACWR and sleep (r = -0.43), and ACWR and MT (r = -0.31). There was a significant relationship found between ACWR and general well-being of the participants (r= 0.71, $p < .05$). We also observed a significant relationship between ACWR and TL (r = 0.80), ACWR and ST (r = 0.78).

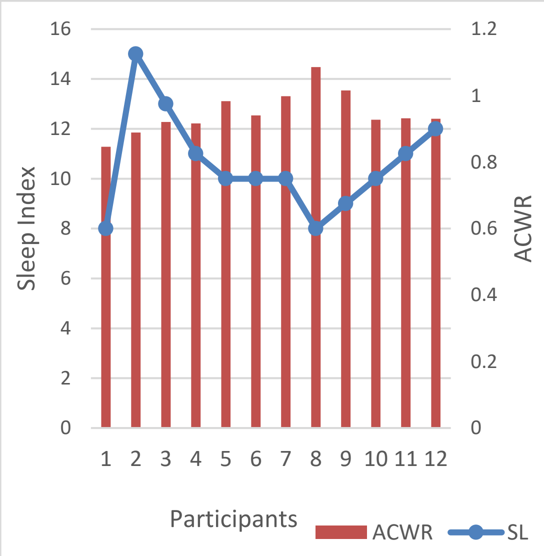

Figure 13: Mean ACWR Score and Sleep Index Over 7 Weeks Period

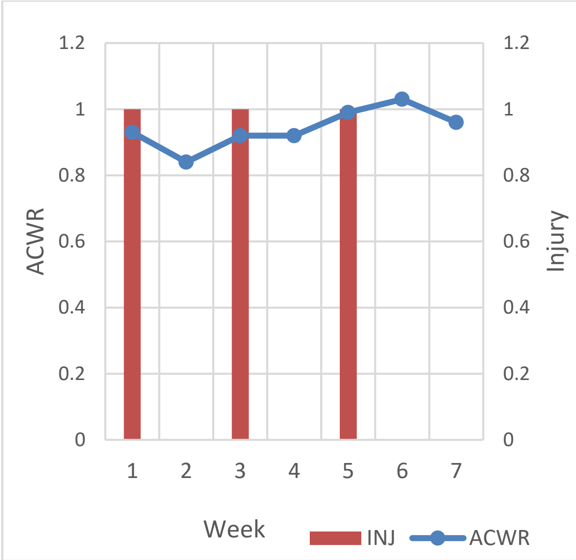

Figure 14: Mean ACWR Score and Incidence of Over 7 Weeks Period

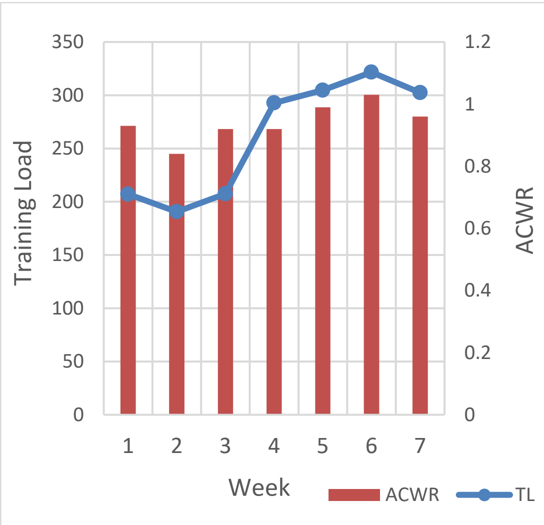

Figure 15: Mean ACWR and Training Load Over 7 Weeks Period

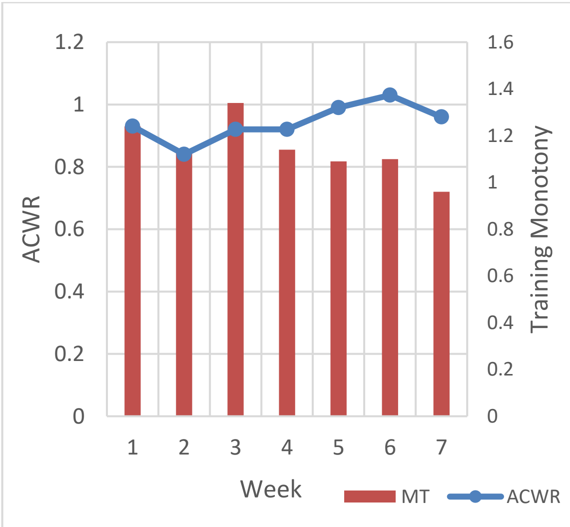

Figure 16: Mean ACWR and Training Monotony Over 7 Weeks Period

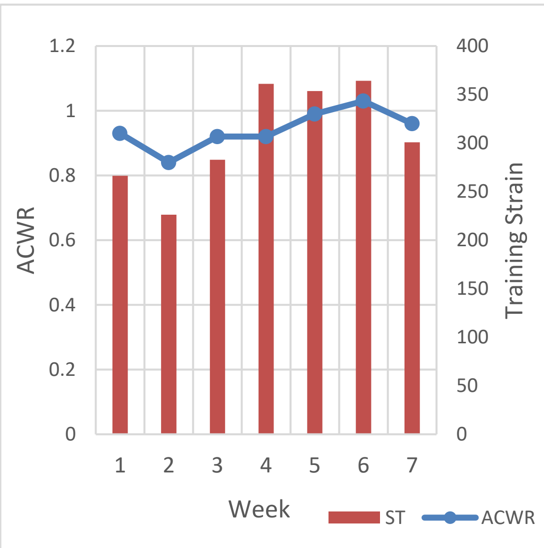

Figure 17: Mean ACWR and Training Strain Over 7 Weeks Period

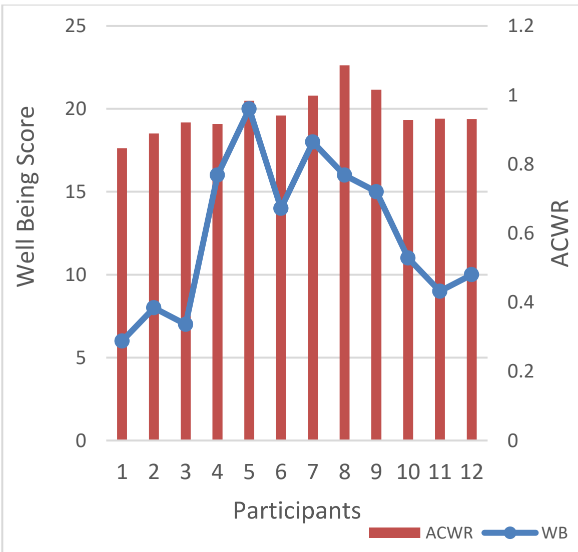

Figure 18: Mean ACWR and Well Being Over 7 Weeks Period

Sleep and Well Being

Data from the present study did not reveal any significant relationships between sleep and well-being (r = -0.39) among various participants of the swimming team (Fig 19, Table 4). The mean sleep index of participants was (10.58 ± 2.02). Mean well-being score of the participants was (12.50 ± 4.60). Further data reveled no significant relationship (fig 20-21, table 4) between incidence of injury and sleep (r = 0.12), incidence of injury and general well-being of person (r= 0.02).

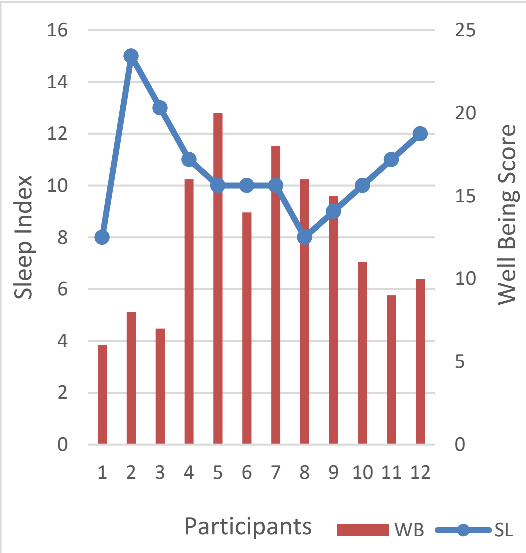

Figure 19: Well Being and Sleep Index Score Over 7 Weeks Period

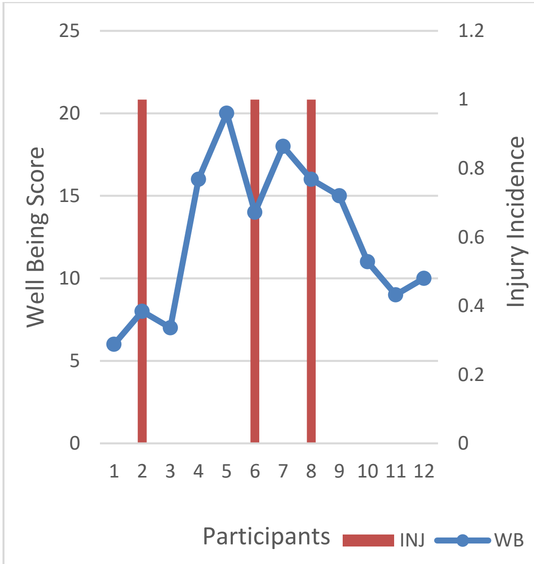

Figure 20: Well Being and Incidence of Injury Over 7 Weeks Period

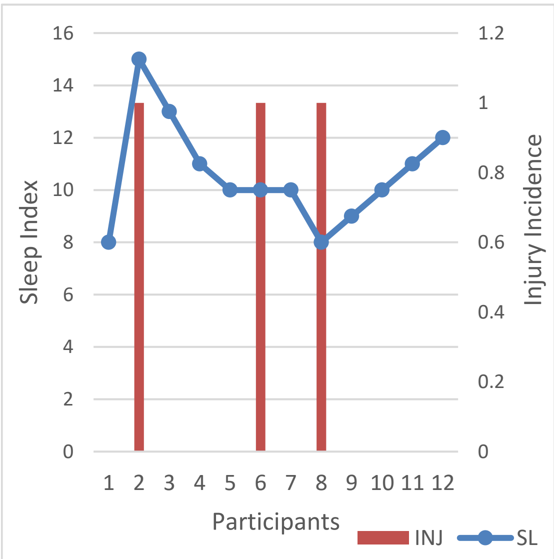

Figure 21: Sleep Index and Incidence of Injury Over 7 Weeks Period

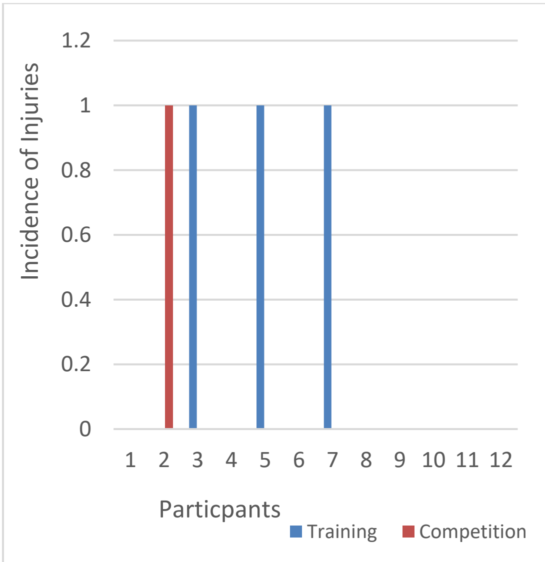

Figure 22: Incidences of Injury during Training and Competition Period

Comparison of the Incidence of Injuries between Training and Competition

Data from the present study did not reveal any significant difference (Fig 22, Table 5) in incidence of injuries between training and competition periods (t_{11} = 1.91, p > .05). Descriptive data revealed three incidences of injuries during the training period whereas no injury was occurred during the swimming competition.

Table 5: Comparison of Injuries between Training and Competition

	Training	Competition	P Value
Incidence of Injuries	0.25 ± 0.45	0.00 ± 0.0	0.08

Data shown as Means ± SD, *significant difference at .05

DISCUSSION

We investigated the relationship between various training parameters and injuries along with sleep and well-being of the university swimming teams. We tracked the training program for 7 weeks before the swimming competition. We also recorded injury occurred during swimming completion and compared incidence of injury between the training and competition period. The peak training load was observed in week seven. The data analysis from the present study indicated that there was no significant relationship of training load, training monotony, training strain and ACWR with incidence of injury. There were significant relationships that were exist between the training load and training strain (r = .96), training load and ACWR (r = .80) training strain and ACWR (r =.78) and ACWR and well-being (r = .71)

Training Load and Incidence of Injury

Other than the relationship as mentioned above, there was no significant relationship found between different training parameters and incidence of injury, which is not in line with earlier studies [36-38]. Actually, it was quite difficult to compare training load of our study with earlier studies [36, 38]. They were having different experimental designs and study protocol. The mean training load 260 ± 56.33 AU in our study is quite low in comparison to training load in other studies 1891-2113 [39] and 2945 ± 922 [40]. There are some studies, which did not report training load numbers; however, on analyzing the data presented, we interpret that training load in those studies was not high and is comparable to the present study to some extent [36]. It should be noted here that the participants in present study are although good swimmers, they are not fulltime swimmers, they are not trained throughout the year, and that could be one reason why training load in our study is not so high.

A very high positive correlation (r = 0.86) was found [37] between TL and incidence of injury in his study done on semiprofessional rugby players. A study suggests increased incidence of injuries with increase in training load in collision sports [38]. Otherwise, also injuries tend to be more in group sports than individual or non-contact sports. In the present study, emphasis was on the injuries caused by training load, since it there are very less chances of injuries other than that of fluctuation in training load and other training parameters. It was found that incidence of injuries are higher in lower limbs, muscle strain and sprains and were associated with large training loads [38]. It was found in another research that when the training loads were highest, there were more injuries with increase in the training loads [36].

In the present study, there were few incidences of injuries during the training period and no injury at all during competition period. There could be different reasons for fewer injuries. As observed through data analysis, the mean weekly training load was quite low in our study. The main reason for less workload is more number of off days in a week. Most of the swimmers have 2 to 4 training days, which was not even uniform throughout seven weeks. These off days not only lead to lower weekly mean training load, but also provided enough rest to recover and remain fresh for training. There was no specific strength and condition coach. A training coach supervised all the swimmers. There was no screening of risk factors, which could pre dispose athletes to injury. Injuries that occurred during the present study were more or less related to soft tissues. This was also reiterated [38] in a study where researchers indicated more occurrence of soft tissue injuries such as muscular strain and sprain during preseason.

It is difficult to exactly pinpoint the cause of injury due to training load, negligence or any other factors. Some studies that recorded higher incidence of injury and established correlation between injury and training load might not have identified the risk and screened athletes before the training and this could be due to the lack of available resources [36-38]. Gabbett [37] in his study mentioned that one head trainer worked with 79 players providing coaching, management, conditioning and other services. It should to be noted that availability of medical resource person to identify and screen the risk of injury in some of the studies cited could affect the occurrence of injuries. Again, in our study swimmers differ in their training program as the training is highly individualistic and swimmers are trained at different times according to their convenient time and days. Moreover, we did not do any screening to identify the risk as done in one of the study [40]. Furthermore, there are studies which have shown a relationship with training load and injury and that was well supported by literature. However direction of this relationship depends on type of the load and the time frame [41]. Owen et al. also indicated a difference in the relationship of training load to incidence of injury between pre-season and competitive season [42]. Systematic review by Drew and Finch has shown moderate emerging evidence of relationship between training load and occurrence of injury and illness [43]. The sole reason of fewer injuries in the present study can be attributed to lower training load and more number of off days, which aided recovery process. Our observation period was also 7 weeks.

Training Monotony and Strain

There are certain studies, which have comparable training monotony with our study. Our training monotony of 1.14 can be compared to training monotony of 1.44, speed skater [7], 0.74, 400m sprinter [39], semiprofessional rugby league players (1.72) [44]. Training monotony in the present study is 1.14 ± 0.12, which is on the lower side. Low monotony could be another reason for lower incidence of injuries. This indicates a very high variation in the training program for the swimmers. There are studies, which recorded low monotony 0.74 in their program with no occurrence of injuries [39]. Even in some studies where there was a strong relationship between TL and injuries, they were not able to detect any symptoms of overtraining [36]. Greater variation in TL therefore is important to reduce the incidence of injury. Mean strain in our study was 307 ± 53.47 units. Our strain values are quite low in comparison to other studies done [44] where mean strain was 4920 units. In another study [40], strain value was 3654 units. Foster [7] also recorded strain value of 5397 units. Possible explanations for these differences may be due to differences in experimental designs and training status of subjects. Lower strain value in the present study is attributed to lower training load and lower monotony.

Training Parameters, Well Being and Sleep

The results of the present study revealed no relationship with well-being. None of the training parameters including training load MT, ST, ACWR, have any significant relationship with well-being. This is quite surprising and our results are not in line with many other studies done on elite athletes of different sports where there is a clear relationship between training load and well-being [45-47]. Sleep could be an important factor in training effectiveness and performance of athlete. It is a well-established fact that sleep deprivation can alter mood [48], and there is a relationship between increased training loads with reduced level of sleep [24]. However, in the present study there is no relationship between training parameters and sleep index score. With regard to ACWR, if the ACWR ratio is < 0.80 (Under training and higher relative injury risk), 80 – 1.30 (Optimal workload and lowest relative injury risk – "The Sweet Spot") [15] and > 1.50 (The "danger zone" and highest relative injury risk). In the present study, ACWR is 0.93, which is considered being sweet spot. The ACWR is very important as it is not only used to monitor athletes on daily basis, but also used for periodization of training load. There is sufficient evidence to prove that accumulated physical hard training and hard training are helpful in protection against injuries [30].

CONCLUSION

No significant relationship was found between training load, strain and monotony and incidence of injuries. However, there was a significant relationship between training load, ACWR and strain. We can conclude that training load (RPE x Time) was an effective way to monitor the training of athletes. Strain and monotony of training is also an important tool for training monitoring. There are very few incidences of injuries in the present study, which supports the training design. In addition, there was greater variation in the training program, which might have attributed to lower incidence of injuries.

We also found a significant positive relationship between ACWR and well-being of athlete. There was no relationship between training load, strain and monotony and well-being. There was also no relationship at all of training load, strain, monotony and ACWR with sleep. We did not find any significant difference on incidence of injuries between training period and competition period. There was a significant difference found in TL while comparing it over seven-week period. There was a general uptrend in TL up to the 6^{th} week. In MT also we observed a significant difference over the seven-week period. There was a general fluctuation in MT during reported period. No significant difference was seen in ACWR and ST during the study period.

It's important to note here that a well-planned training design with controlled training can lead to fewer incidences of injuries. It is important to monitor each athlete individually and systematic screening of athletes is required to minimize any chances of injuries during training period. One of the major limitations of the present study was that it is set up in very demanding academic environment and therefore it may not be appropriate to generalize the findings to rest of the population or different geographical and educational settings.

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