# EFFECT OF CIRCADIAN RHYTHM ON SELECTED MOTOR FITNESS AND PHYSIOLOGICAL PARAMETERS IN TRACK AND FIELD ATHLETES

**A THESIS SUBMITTED TO THE JADAVPUR UNIVERSITY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ARTS**

*By*

**SUMANTA DAS**

**DEPARTMENT OF PHYSICAL EDUCATION**

**JADAVPUR UNIVERSITY**

**KOLKATA-700032**

**WEST BENGAL**

**INDIA**

**MARCH, 2022**

*Dedicated to*

*My Parents*

***LATE LAKSHMI KANTA DAS***

*&*

***PURNIMA DAS***

# CERTIFICATE

Certified that the Thesis entitled **"EFFECT OF CIRCADIAN RHYTHM ON SELECTED MOTOR FITNESS AND PHYSIOLOGICAL PARAMETERS IN TRACK AND FIELD ATHLETES"** submitted by me for the award of the Degree of Doctor of Phylosophy in Arts at Jadavpur University is based upon my work carried out under the supervision of **Dr. Atanu Ghosh,** Department of Physical Education, JadavpurUnivarsity, Kolkata and that neither this thesis nor any part of it has been submitted before for any degree or diploma anywhere/ elsewhere.

_____ _____

Countersigned by the supervisor Signature of the candidate

Dated: Dtaed:

# Acknowledgement

*I express my heartiest thanks and deepest gratitude to* ***Dr. Atanu Ghosh, Assistant Professor, Department of Physical Education, Jadavpur University,*** *for his valuable guidance, inspiration, suggestion and supervision. His remarks right from the commencement of the investigation and above all his magnanimous and unstinted support without which the research in its tangible form would not have been possible. He has painstakingly pursued the entire manuscript time to time and gave valuable suggestions and advice to bring about meaningful conclusion. I run shot of word to render my gratitude to him.*

*I offer my deep sense of gratitude to* ***Prof.SudipSundar Das, Head of the Department of Physical Education, Jadavpur University****, for providing all facilities and sincere cooperation in various ways in conducting the study, without which could not be impossible for me to reach up to this state of fulfillment of degree.*

*I also express sense of gratitude to* ***all the other teachers of the Department of Physical Education, Jadavpur University,*** *for their cooperation and counseling during entire the research work.*

*The researcher also expresses his special thanks to* ***all research scholars, Department of Physical Education, Jadavpur University****, for their help and cooperation.*

*I amgrateful to the* ***Central and Departmental librarians of Jadavpur University,*** *for their kind cooperation in Library Work.*

*My thanks are due to* ***Research Scholars of Department of Physical Education, University of Kalyani,*** *those who have helped me for collecting data.*

*Last but not the least I express my thanks to all well-wishers for their constant inspiration during research work.*

***Place:*** ***SUMANTA DAS***

***Date:*** ***ResearchScholar***

# CONTENTS

# CONTENTS (CONT.)

# CONTENTS (CONT.)

# CONTENTS (CONT.)

# CONTENTS (CONT.)

# LIST OF TABLES

# LIST OF TABLES (CONT.)

# LIST OF TABLES (CONT.)

# LIST OF TABLES (CONT.)

# LIST OF TABLES (CONT.)

# LIST OF TABLES (CONT.)

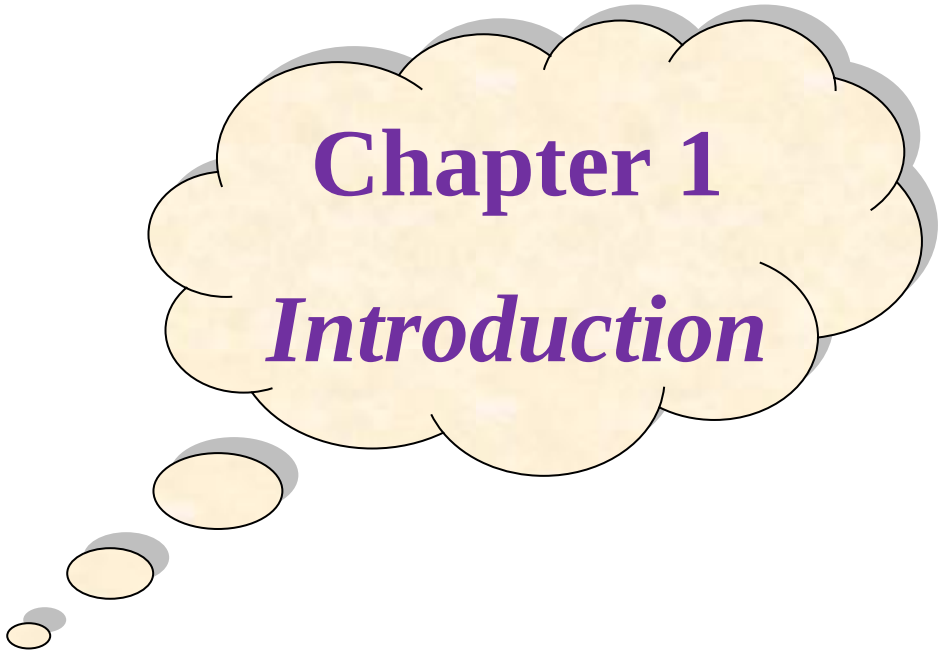
# LIST OF TABLES (CONT.)

# LIST OF TABLES (CONT.)

# LIST OF FIGURES

| Figure No. | Description | Page No. |
|---|---|---|

# LIST OF PHOTOGRAPH



# Chapter 1

# *Introduction*

1.1 General introduction

1.2 Statement of the problem

1.3 Purpose of the study

1.4 Delimitation of the study

1.5 Limitation of the study

1.6 Hypothesis

1.7 Significance of the study

1.8Definition of terms

# CHAPTER-I

# INTRODUCTION

## 1.1 GENERAL INTRODUCTION

Circadian rhythm may be defined as a natural, biological process to regulate the sleep-wake cycle and normally repeats in 24 hours **(Reilly, 1990).** According to the etymology of the term "circadian", it comes from the Latin word ‘circa’, meaning "around" and ‘diem’, meaning "day"**(Hower et al. 2018).** The physical, mental and behavioral structures are affected by the circadian rhythm which is primarily regulated by the diurnal effect (day-night) of the earth **(Winter et al. 2007).** However circadian rhythms are endogenous ("built-in", self-sustained) by nature and adjusted (entrained) to the environment by external signals called Zeitgebers (sunlight). Although many other internal and external factors such as chronic physical exercise, fatigue, sleep quality, anxiety, attitude, lifestyle, etc. broadly alter the dimension of circadian rhythm **(Touitou and Haus, 1992).** The circadian rhythm or sleep-wake cycle is largely controlled by the Suprachiasmatic nucleus (SCN) situated at the hypothalamus gland of the brain. In a simplified way, the hypothalamus collects signal via the optic nerve from the eyes and respond to signals accordingly through SCN. The light stimuli trigger SCN (releases cortisol and melatonin) and darkness innervates SCN as well as other parts of the central nervous system (CNS) to regulate neural and hormonal activity, heart rate, blood pressure, core body temperatures, and other internal mechanisms of the human body. From this point of view, circadian rhythm acted differently on physical, physiological as well as psychological variables throughout the day **(Mizuno, 2014).** So it is important to understand the best matched time plot to execute effective physical, physiological, and psychological variables throughout the day. Numerous scientific studies have been conducted to explore the effect of circadian rhythm throughout the time of day on different motor fitness components, physiological variables, and psychological variables **(Morgan et al. 2015).**

Circadian rhythm in some time is termed as a biological clock because of the inherent self-sustained mechanism which controls cyclic patterns of interval timing of a living being. This mechanism deals with the basic local temporal information of

external environments, such as the time of day, season, etc, and alters the internal biological phenomenon accordingly. These internal physiological or behavioral changes will be acclimatizing over time, may vary in intensity. If someone changes his/her local time zone (traveling from India to America) that largely affects on daily life schedule. Although he/she will familiarize him/herself with a new time zone and create a new biological rhythm to sustain. From this point of view, performance in sports or any other field may be affected by circadian rhythm. Sports-specific movements, training, and competition-oriented practice, behavior in terms of performance may decline drastically if there is a large difference in time zone between training and competition venue. Due to change in biological rhythm by default physical, physiological as well as psychological difference has been observed which taxes sports performance.

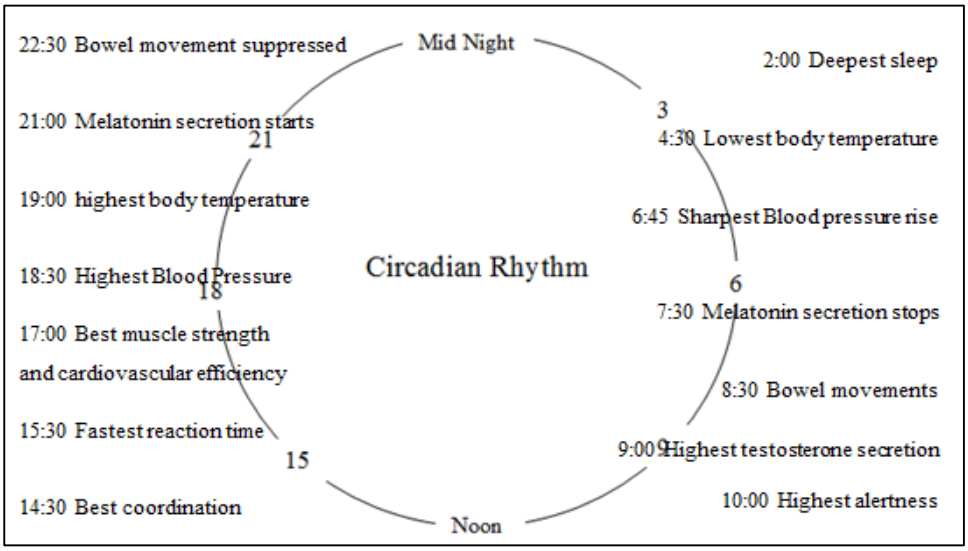



**Figure 1: Effects of the circadian cycle on humans according to the specific time of the day.**

**Importance of Study of Human Circadian Rhythm**

The circadian rhythm of human beings is an important parameter to understand current biological, physiological and psychological status which broadly affects physical fitness. The physiology of the circadian rhythm is yet to explore because little is known about the importance of circadian rhythm in terms of the physical and mental health of an individual. Recent studies in human circadian rhythm exposed **(Beachey et. al., 2012)** disorder in the human biological clock or circadian rhythm may be the cause of mental illness. However, according to the discovery of circadian rhythm a few physiological systems are influenced by circadian neural signals. The

neurobiology of mammal's circadian rhythm was extensively studied and analyzed to provide extremely important dimensions in treatment, diagnosis as well as exploring numerous mental and physical disorders in humans.

In the field of physical education, knowledge about circadian rhythm is also very limited. It is well known that the motor performance of human beings is mostly depending on the functioning efficiency of neuro-physiological coordination and psychological readiness. Numerous studies explore the relationship between circadian rhythm and several physiological parameters and established most of the physiological parameters (heart rate, blood pressure, body temperature, etc.) affected by specific time intervals of circadian rhythms. From this point of view, motor performance may also be pretentious by circadian rhythm. Health and skill-related fitness play a major role to execute motor performance, but which components play a leading role are yet to discover. So, extensive studies on circadian rhythm will help to know the effect of circadian rhythm on physical fitness remains at peak only at a particular time or hour of the day. It is also important to reveal how seasonal changes acted on circadian rhythm in relation to physical fitness. Is it remains unchanged throughout the year or there is some variation. The purpose of the study was to enrich the field of physical education with the knowledge of circadian rhythm that might be helpful in planning and programming training and competition for a higher level of motor performance.

The most common disturbance of circadian rhythm was encountered by athletes in world championships or Olympics due to sudden shifts of time zone. According to world literature and observation of**(Berge et al. 2001)** minimum three-hour time zone difference is required to get a substantial change in circadian rhythm. Alterations of circadian rhythm due to change in time zone was taxes on psycho-physiological parameters adversely which affects athletic performance in inter-continental championships. The findings of **Winget et al. (1992)** also supported this observation. **Winge et al. (1992)** works on 28 international shooters and reported sudden (12-hour) phase shifts (England to New Zealand) significantly lower the shooting performances. Although due to long journeys (jet lag) athletes become fatigued and tired which may also be the cause of significant changes in performance. Although some study explores new circadian rhythm may be adapted within a few days and was most rapid for an individual who normally worked in shifts.

The association between circadian rhythmicity and sports performance has been widely studied **(Reilly, 1990; Atkinson and Reilly, 1996; Atkinson and Speirs, 1998; Atkinson et al, 2005; Waterhouse et al. 2005)** and several contributing factors identified. These factors can be endogenous or exogenous, which includes physiological changes such as core body temperature; heart rate, blood pressure, etc. and sleep deprivation, daily training time, local weather, etc. **(Atkinson and Reilly, 1996; Waterhouse et al., 2005; Atkinson et al., 2005).** Sports performance may also fluctuate due to many other factors which may mislead to identifying exogenous and endogenous factors occurring at the same time of day.

Many physiological parameters contribute to circadian rhythmicity in physical performance **(Atkinson et al., 2005).** These can be internal (physiological) or external (environmental) changes that occur throughout the day. **Reilly and Waterhouse (2009)** identified three major determinants of circadian rhythms such as external influence, physiological variables, and lifestyle. External influences such as ambient temperature, physical and psychological arousal have been affected by the local environment which is usually uncontrollable. The second determining factor is physiological variables such as heart rate, blood pressure, sleep awake cycle, core body temperature, etc. last but not least, the lifestyle of an individual largely influences circadian rhythm which affects on timing preference of activity.

Some studies found a correlation between circadian variation and some variables of sports performance. The study suggested that morning time generally lows and evening time peaks the sports performance which also established in many laboratory and field tests **(Atkinson et al., 2005; Reilly and Waterhouse, 2009: Waterhouse, 2010: Atkinson et al. 2014).** Core body temperature has been used as a primary indicator of circadian rhythmicity in physiological variables which affect sports performance. Exercise physiologist **Starkie et al. (2005)** stated that core body temperature may increase due to carbohydrate utilization over fat as a fuel source to maintain energy supply to the muscle, possibly facilitating actin-myosin cross-bridge mechanics within the musculoskeletal unit **(Teo et al. 2011).** Early evening is considered as peck performance time of the day because of the natural cohesion of circadian rhythm. Peak core body temperature has been observed in the human body just before evening **(Reilly and Garrett, 1998; Atkinson et al. 2005).** A strong correlation has been established between core body temperature and sports

performance. It has been proposed that a higher core body temperature represents physiological arousal that enhances human performance. Although this observation did not truly represent the dimension of every sporting event. Another sports physiologist **Atkinson (2002)** defines performance in the context of sporting action. It is well-known success in the field of sports in terms of performance mostly depends on several internal and external factors such as physical fitness, mental state, neuro-muscular coordination, motor skills, gross motor performance, cognitive function, etc.

The noninvasive existence evidence of circadian rhythm in sports performance may be examined by observed athletes' quantitative performance at different times of the day. The observation can give a clear pictorial view of athletes' performance at different times of the day (morning, noon, afternoon, night, etc.) and according to specific results suitable time frame for certain sports can be sketched (Drust et al. 2005). The effect of circadian rhythmicity on sports performance was investigated directly in a laboratory setting and found strong evidence of association with performance. However, scheduling sporting events in the evening were not right for every sport that may create a false circadian record. According to the specific orientation of certain games or events suitable scheduled should be prepared. The knowledge about circadian rhythm is important for coaches, physical trainers as well as athletes that may help them to understand how the times of day affect various and inter-related components of sports performance **(Atkinson et al. 2005: Waterhouse et al., 2005).** An extensive detailed review by **Drust et al. (2005)** concludes that most world records in athletics have been set in the evening which suggests a connection between the times of the day, core body temperature, and sports performance. Heart rate has also been shown to fluctuate during the day with a range of 5 to 15% and a peak around 15:00 hours **(Reilly, 1990). Atkinson et al. (2005),** demonstrated better afternoon performance than the morning. **Pereira et al. (2011)** works on maximum isometric voluntary knee extensions during different sessions of the day and found evening session is better than the morning session. In addition, findings of **Kline et al. (2007)** suggest better performance has been observed in 100 m and 400 m swimming in the afternoon session than morning.

**Heart Rate:**

It is well established that resting heart rate is a noninvasive biomarker to understand the overall physical status of an athlete. According to the findings of **Kleitman and**

**Kleitman (1953),** resting heart rate shows a substantial circadian variation. The findings are also supported by **Lewis and Lobban (1957).** They stated the resting pulse rate of an individual is also determined by circadian rhythm. The study explores circadian rhythmicity acted on resting pulse rate and showed its lowest level between 4:00 a.m. to 6:00 a.m. then rising rapidly until noon, increasing slightly until 5:00 p.m. to 6:00 p.m., and finally decreasing gradually until again reaching its lowest level. Some studies explore the effect of circadian rhythm during exercise and found substantial circadian variation in heart rate both at rest and during submaximal exercise **(Voigt et al, 1967; Klein et al, 1968 and Crockford and Davies, 1969)**. The circadian cycles are also affecting the oral temperature and the magnitude of oral temperature and resting heart rate were parallel to each other (Sen and Kar, 1979). Another exercise physiologist **Reilly et al, (1984)** observed peak resting heart rate in the afternoon. The study also explores the effect of exercise on the biological clock and found that the normal rhythm became weakened at maximum heart rate.

**Blood Pressure:**

Blood pressure is an indirect biological indicator that may be affected by circadian rhythm. Many research works were done to find the relationship between circadian rhythm and blood pressure and reported that blood pressure also exhibits circadian rhythm. Due to circadian rhythmicity blood pressure was also varied throughout the day. Blood flow and oxygen consumption also showed circadian variation **(Cohen, 1980; Reilly et al, 1984).** Although, according to the findings of **Cabri et al, (1988)** no significant effect of circadian rhythm has been observed in pre-exercise blood pressure. They also stated that there was no change in systolic blood pressure after exercise but observed the effect of circadian rhythm only in post-exercise diastolic blood pressure.

**Kobrick and Johnson (1991)** suggested environmental changes largely influence psychological functioning before affecting physiological factors. Sometimes, athletes have to perform under extreme environmental conditions at a specific time of day **(Lane et al., 2005).** From this point of view, environmental changes adversely affect the psychological stress of an athlete that can lead to poor performance. A few pieces of literature investigate the effect of circadian rhythmicity and environment (hot and cold) on athletic performance. High-level training at specified times of the day and within specific environmental conditions is required to

improve sports performances. A combination of extreme environments situation with scheduled specific exercise protocol may alter the functions of white blood cells compared to either stressor **(McFarlin and Mitchell, 2003).**

**ATHLETIC PERFORMANCE AND CIRCADIAN RHYTHM:**

There is general agreement that athletic performance improves over the course of the day. One major factor in this variation is the level of arousal of the competitions. The soccer players during the match found that movement on the field reached a minimum at about 05.00 hours, with a peak at 17.00 hours **(Reilly and Walsh, 1981).** According to **Reilly and Brooks, (1982)** the metabolic responses to exercise under steady-state conditions varied with the time of day. The maximal efficiency has been noted in the late afternoon **(Ferrario et al, 1982)**. According to **Hill and Zauner, (1984)** the adaptation to exercise training might be specific to the time of the day of training. They found after regular weight training at a particular time of day, human subjects were stronger at that time of day than at another. Athletic competitions start in the morning and continue during the evening. Circadian rhythm affects many physical and physiological features during the day; and therefore, may affect the physical and physiological characteristics of sprinter and jumper athletes both in competition and in training sessions. Although there are studies carried out on circadian rhythm in different branches of sport in the literature **( Kline et al., 2007; Özdamar, 2009; Reilly et al.,2007),** no study has been found examining the effect of circadian rhythm particularly in sprinter and jumper athletes.

In international sports, the athlete encounters disturbance of biorhythm because of the shift of time zone during translatitudinal air travel. Problems become substantial if a time change of more than three hours is attempted. Disturbance of biorhythm can produce a lack of coordination and muscle weakness. The athlete needs a recovery period. This aspect also requires a clear understanding of circadian rhythm in physiological parameters and motor fitness performance to be tackled in a better way.

The present study has been designed to investigate the changes in motor fitness and physiological parameter that have been closely linked to the circadian rhythm. The supple change of motor fitness and physiological parameters maybe not be evident in the university student-athlete and sometimes evoked these changes of

physiological and motor fitness parameters indicate the alteration of the circadian variation. From the above discussion, it appears that there are several investigations have been made regarding the circadian variation of physiological and motor fitness performance on humans. But less importance has been given to the changes of motor fitness and physiological parameter of the university student-athlete in different time intervals of the day as well as seasonal variation.

## 1.2 STATEMENT OF THE PROBLEM

The purpose of the study was to investigate the effect of circadian rhythm on selected motor fitness and physiological parameters of the sprinter and jumper. Accordingly, the problem was stated as, **"EFFECT OF CIRCADIAN RHYTHM ON SELECTED MOTOR FITNESS AND PHYSIOLOGICAL PARAMETERS IN TRACK AND FIELD ATHLETES."**

## 1.3 PURPOSE OF THE STUDY

The purpose of the study were as follows

(i) To observe the effect of circadian rhythm on selected physiological and motor fitness parameters.
(ii) To find out the relationship between both physiological and motor fitness parameters at different times of the day.
(iii) To find out the zone peak performance i.e. peak value of circadian rhythm of both physiological and motor fitness parameters.
(iv) To observe seasonal influence such as summer and winter season on different physiological and motor fitness performance.
(v) To find out the appropriate time of competition for better performance of athletes.

## 1.4 DELIMITATIONS OF THE STUDY

To conduct the present study successfully the researcher had delimited the study in the following aspects

i) The age of the subject was delimited to 22-25year
ii) The study was confined to AAHPER Youth Physical fitness tests such as 50-yard speed, sit up, pull up, standing broad jump, shuttle run, 6oo yard run.

iii) The study was confined to resting pulse rate, body temperature, blood pressure (BP) only at physiological parameters.
iv) The study was delimited to only three-time of a day such as 8.00 am, 12.00 pm, and 4.00 pm.
v) The study was confined to environmental temperature and humidity.
vi) The study was confined to the summer and winter seasons only

## 1.5 LIMITATIONOF THE STUDY

The present study was carried out with limiting conditions such as:

i) The study would be better in its way if the scholar could also assess certain factors like lifestyle and socio-economic status among the population. But unfortunately, it was not done.
ii) It should be better if the motivational level would be measured. However, the participants were motivated verbally.
iii) The researcher was unable to control other variables such as the willingness of the participants which might serve as the limitation of the study.

## 1.6 HYPOTHESIS

The hypothesis for the present study were

i) $H_1$: There may be a positive relationship between both physiological and motor fitness parameters at different times of the day.
ii) $H_1$: There may be a significant difference among the different time periods of the day on the selected motor fitness and physiological parameters of the athletes.
iii) $H_0$: There may be no effect of seasonal circadian variation in selected motor fitness and physiological parameters among the athletes

## 1.7 SIGNIFICANCE OF THE STUDY

Every research must have some beneficial effects for expansion of knowledge and for the service of mankind, it was believed that the result of the present investigation would help physical education in its academic expansion and professional development in the following ways

i) The effect of circadian rhythm in motor fitness would be known and accordingly the games would be planned.

ii) The findings of the study might be beneficial to schedule the training and competition as per different climates, timing, and seasons of the year. To achieve the greater performance of the athletes
iii) The finding of the study will add to the quantum of knowledge in the area of sports literature.
iv) The study may suggest the effects of different times of the day on the levels of selected physiological parameters in resting condition.

## 1.8 DEFINITION OF TERM

**Rhythm:**

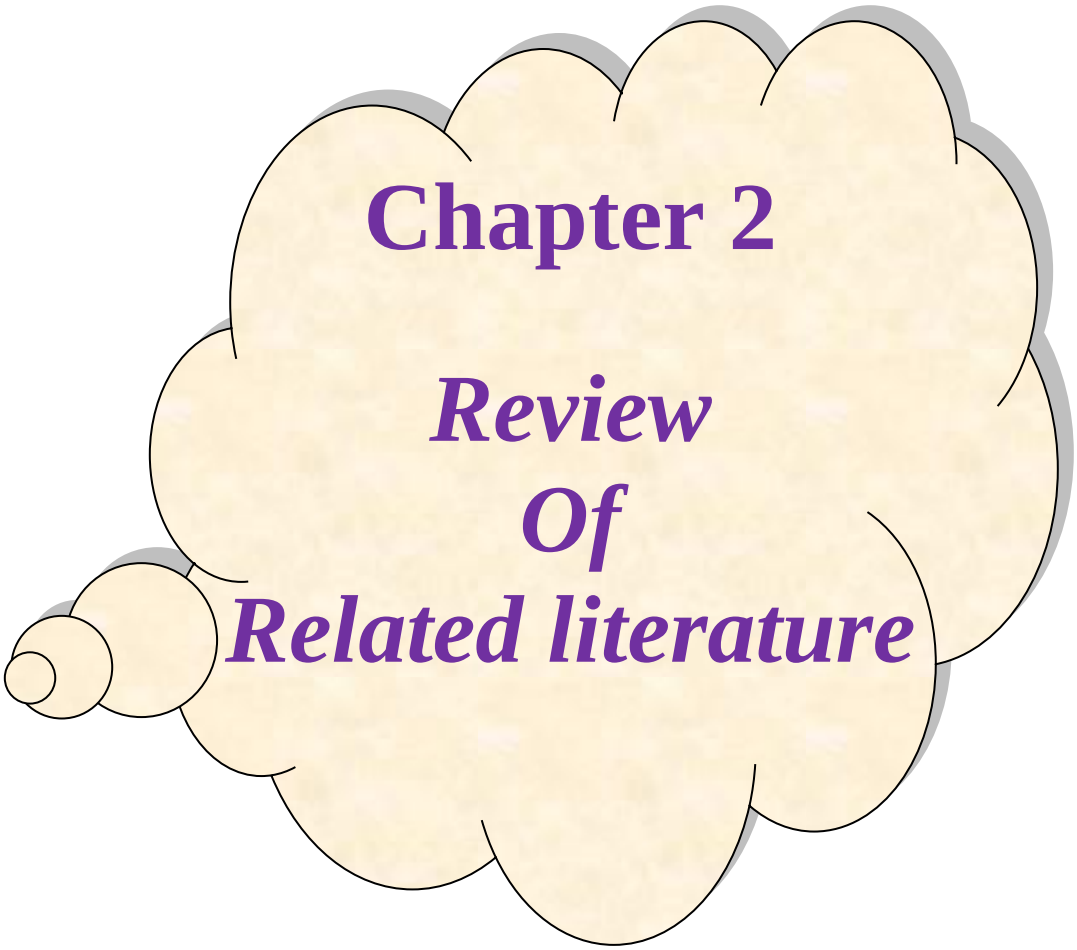
Rhythms are regular changes that satisfy two basic conditions. First, they should be extrinsic in origin usually associated with terrestrial periodicity, and secondly, they should persist for some time when fully established. In the present study, Rhythms were considered to be the regular changes within 24-hours of a day.

**Circadian Rhythm:**

Etymologically the word 'circadian' has been derived from Latin root-circa' and 'diem' meaning 'about a day. So, circadian rhythms are considered to be rhythmic changes of the biological functioning rate within 24 hours a day. Expressing the same opinion Astrand and Rodahl have mentioned that in human beings, a variety of physiological functions, such as heart rate, oxygen uptake, rectal temperature, and urinary excretion of potassium, show distinct rhythmic changes in 24 hours, with the values falling to their lowest during the night and rising during the day, reaching their peak in the afternoon. The circadian rhythms are thought to be regulated by several separately-operated biological clocks. It occurs in most individuals, although there are a few exceptions.

**Motor fitness:**

Motor fitness is the ability to perform some motor tasks whereas physical working capacity indicates the physiological efficiency based on organic fitness. Motor fitness has again several components such as strength, speed, endurance, flexibility, balance, coordination is measured by a test battery composed of several tests. There are standardized test batteries for the measurement of motor fitness. Some of them are AAHPER Youth Fitness Test Battery, Indiana Motor Fitness Index.


Chapter 2
Review
Of
Related literature

# CHAPTER-II

# REVIEW OF RELATED LITERATURE

The concept of circadian rhythm and its effects on sports training and performance was studied by several researchers, sports physiologists as well as sports scientists. The diurnal variation of circadian rhythm taxes on sports performance in terms of motor fitness as well as the physiological and psychological orientation of an athlete. Sincere efforts have also been made by the researcher to explore various dimensions of circadian rhythm in the sports arena. Nowadays, technological advancement and scientific orientation directly involve exploring sports performance and a tremendous comparative atmosphere has been observed in the field of sports. Now sports are not only limited to amateur settings, it is a profession as well as bread and butter. A large number of sports physiologists, sports scientists, and sports performance analyzers try to identify the specific internal and external orientation of optimum performance. However, it is well known that different types of sports demand different types of physical, physiological as well as psychological characteristics. Generally, physical training or activity indirectly alters physiological and psychological dimensions of human beings, and family culture, food habits, lifestyle, local climate, and genetic factors play a leading role to build the physical structure. From this point of view, it is clear that specific physical orientation is required to execute any task effectively, that may be fieldwork or daily life activity. Now researchers, coaches, physical trainers as well as sports physiologists try to explore specific times of the day for specific physical training or activity according to their psycho-physiological condition. However, the motor performance of an individual depends on the functioning efficiency of neuro-physiological coordination and psychological readiness and diurnal effects of circadian rhythm taxes on neuro-physiological coordination and psychological readiness. Several studies discover the relationship between circadian rhythm and various physiological factors and conclude most of the physiological parameters (heart rate, blood pressure, body temperature, etc.) are affected by specific time intervals of the day.

According to related review literature, **Cohen and Muchl (1977)** were the first to investigate circadian variation in human physiology. They conducted a study

to analyze the human circadian rhythms in resting and exercise pulse rates and founds lowest resting pulse rates for all subjects occurred between early morning to morning session (04:00 am - 08:00 am) and the highest resting pulse rates occurred between evening and night session (6:00 pm to 12:00 am). Furthermore, they concluded that exercise pulse rates also followed this same general pattern, and tended to amplify the circadian rhythmicity. The experiment of Cohen and Muchl was modified and carried forward by **Reilly, Robinson & Minors (1984).** They try to analyze and explore the effects of circulatory responses to exercise at different times of the day. To fulfill their outcomes heart rate was examined at rest, before, during, and post-exercise, and a significant circadian rhythm has been observed in pre-exercise laying and sitting heart rate. In the afternoon session, they observed peak heart rate values and that finding was similar to the findings of Cohen and Muchl. They also concluded that the rhythm of heart rate persisted during submaximal exercise but at the maximal state, the amplitude of the rhythm was decreased, and in this consequence the rate of perceived exertion increases. Post-exercise heart rate recovery pattern also followed a specific pattern which also denotes a significant association between submaximal and maximal exercise. Therefore, the circadian rhythm in heart rate responses to exercise should be considered when a heart rate variable is used as a criterion in fitness testing or as an index of physiological strain. After two years Reilly and Brooks conducted a study to explore the effects of exercise at different times on body temperature measures. The study exhibits significant time of day differences in mean skin and body temperatures at all exercise intensities as well as in the recovery period. All the measures peaked in the afternoon session and rose in agreement with exercise intensity. However, not only the effects of submaximal exercise on circadian rhythm was explored but also in the year 1997 pioneer physiologist Deschenes et al. studied biorhythmic influences on the functional capacity of human muscle and physiological responses to resistance exercise. The study revealed significant fluctuation in core body temperature during pre and post-exercise throughout different times of the day. However, post-exercise blood pressure and plasma levels of testosterone also displayed significant variation in bio rhythmicity. Although plasma concentrations were found higher at morning trials, testosterone to cortisol ratios was highest at night sessions. From this observation, it is clearly understood that maximal muscle performance may vary within the segment of the day but that variation is typically specific to the speed of movement.

In an observational clinical trial study, **Millar-Craig (1978)** and his team monitored continuous intra-arterial blood pressure for 24 hours from the 25 patients with hypertension to realize the diurnal effect on blood pressure and found the lowest blood pressure at early morning and slowly increased till mid-morning. The peak means arterial blood pressure has been observed at mid-morning and then fell progressively throughout the remainder of the day. A similar study was conducted by **Kanabrocki et al. (2008)** on long-term circadian influence on blood pressure, serum, and urine creatinine and recognized significant circadian variations in systolic and diastolic blood pressure serum and urine creatinine. The finding of **Vaidya et al. (2012)** also supported their experiment and concluded that circadian rhythm longitudinally acted on blood pressure. However, the finding of Brain and Doyals F. (1987) explores the effect of exercise intensity on the recovery heart rate and blood pressure for cross country athletes. No significant difference has been found in systolic and diastolic blood pressure measurements in different sessions of the day but in the case of resting heart rate, it was found that the afternoon and evening measurements were greater than morning measurement.

The first decade of the twenty-first century was a revolutionary period of sports and exercise sciences. Commercial and professional organizations came forward to explore the hidden quality of an individual. They investigate and try to explore key factors behind success scientifically. Although this was not limited only to the sports arena, lifestyle or daily life activity-related deformities were also investigated and successfully cured through scientific physical exercise. **Professor Jones and his fellows (2008)** conducted a study to explore the effects of circadian variation on blood pressure response to a controlled bout of exercise. Mean arterial blood pressure, heart rate, and total peripheral resistance were measured before and after exercise at different sessions of the day. They observed the highest blood pressure in the morning session which was merely the same as the findings of **Millar-Craig (1978)** and the afternoon session displayed significantly greater responses in heart rate and total peripheral resistance compared to the morning session. Another physiologist **Souissi et al. (2012)** examined the time-of-day effects on electromyography (EMG) parameters changes during a 30 sec Wingate test on 22 boys and founds specific muscle (vastuslateralis, rectus femoris, and vastusmedialis) power, strength, and neuromuscular efficiency of the volunteers significantly fluctuate

with time-of-day. The study concludes muscle power and fatigue during the 30 sec Wingate test increased significantly from morning to evening. However, different time frames of the day (morning, noon, afternoon, night) also alter the productivity of skill-oriented fitness components. In an observational study **Mahaboobjan (2010)** examine the effects of diurnal variations on selected physical and physiological parameters such as speed, explosive power, resting heart rate, and breath-holding time among college students and concludes explosive power, resting heart rate were significantly deferred with reference to change of temperature in a day.

Diurnal effects of the circadian rhythm also tax on sports performance. **Rajagopal (2010)** conducted a study to explore the effect of circadian rhythm on volleyball performance. Selected performance-related parameters such as flexibility, anaerobic power, aerobic power along with some physiological and psychological determine (body temperature, resting heart rate, blood sugar, blood urea, diastolic blood pressure, systolic blood pressure, and mood disturbance were measured from thirty 19-22 years volleyball players. The research reveals significant differences in flexibility, anaerobic power, aerobic power, body temperature, systolic blood pressure, and mood disturbance at different times of the day.Numerous studies were conducted to discover invasive effects of circadian rhythm on sports performance and they observed many performance-related indicators directly related to diurnal variation **(Atkinson et al., 2005; Reilly and Waterhouse, 2009; Waterhouse, 2010; Teo et al., 2011; Atkinson et al. 2014).** According to scientific literature survey, early evening (3:00 pm – 6:00 pm) is considered as prime performance time of the day, in consequence, core body temperature has also been observed optimum in the human body at that time **(Reilly and Garrett, 1998; Starkie et al., 2005; Atkinson et al., 2005).** Ideal core body temperature signifies physiological arousal which generally improves human performance. In the year 2005, Racinaiset. al. introduced a study design to evaluate fluctuation of maximal sprint power and repeated sprint ability with a different training time of the day. The study concludes that blood lactate concentration and heart rate were higher in the evening than morning in repeated sprint ability which indicates afternoon session training useful for improving blood lactate tolerance. The peak power developed during the first sprint was higher in the evening than morning, but this difference was not apparent in subsequent sprints. The study suggests that the beneficial effect of time of day may be limited to a single

expression of muscular power and fails to advantage performance during repeated sprints. A similar study was also investigated by**Giacommicet. al., (2006)** investigated the diurnal effect on repeated all-out cycle performance and short-term recovery. Short-term recovery patterns were investigated after ten 6-seconds maximal sprints inter-spaced by 30 seconds rest in the different times (morning, afternoon) of separate days. During the experiment, peak power output, total mechanical work, peak pedaling rate, and peak efficient torque were recorded. To evaluate neuromuscular fatigue and short-term recovery patterns from all-out intermittent effort maximal voluntary contraction of knee extensors muscles were also measured before and immediately after the cycle bouts. The activity of the vastuslateralis muscle was also tracked by electromyography. The study revealed different time of day was not significant for any biomechanical indices of neuromuscular performance. However, the results suggested that short-term recovery patterns of neuromuscular function are faster in the morning session compared to the afternoon sessions. **Reilly et. al. (2007)** conducted a study to analyze the diurnal variation in mental and physical performance and simulated football-specific skills. Strength, reaction times, flexibility, juggling and dribbling, and wall-volley tests were directed on different days at morning, noon, afternoon, and night in a counterbalanced manner.Significant diurnal variations were found for reaction time, flexibility. Juggling performance showed significant diurnal variation and was highest in the afternoon session, whereas performance on the wall-volley test tended to peak at night session and dribbling showed no time-of-day effect. The study concluded that football playing performance may be affected by circadian rhythm and afternoon to night session is most appropriate for optimum performance.Body temperature also peaked at a similar time, but positive mood states seemed to peak slightly earlier.Another group of sports physiologists Martin et al (2001) studied physiological responses to incremental running at different times of the day. Several noninvasive physiological variables such as core body temperature, heart rate, minute ventilation, oxygen uptake, respiratory exchange ratio, and capillary blood lactate were measured at rest, after a warm-up, and at 10, 20, and 30 minutes during the run. A significant diurnal variation was observed in core body temperature and respiratory exchange ratio. Diurnal variation continued for body temperature throughout the warm-up and during exercise. However, morning trials significantly elevated the rate of perceived exertion compared to afternoon running trials. These findings suggested core body temperature

is broadly affected by diurnal variation. Whereas other physiological responses during running at lactate threshold levels were rarely affected by circadian variation.

According to the review, it is clear that circadian rhythm is directly related to sports performance. Physiological responses in terms of sports performance to exercise are associated with variation time of day. In general, sports performance was found to be better in the afternoon session or early evening. Numerous researches were conducted to explore the physiological association of circadian rhythm with different times of the day effect and observed a significant connection with resting heart rate, core body temperature, blood pressure, oxygen uptake, and ventilation, as well as cortisol, adrenaline, and noradrenaline selection. The effects of aerobic training at different times of the day on the adaptive response have been studied by **Torii et al. (1992).** They designed a four-week moderate-intensity training protocol using a cycle ergometer to examine training effects at different times of the day and found statistically significant incensement in $\dot{V}0_2$max and blood lactate concentration in the afternoon session. Reilly & Brooks observed and concluded the afternoon session submaximal exercise touches the highest point of core body temperature. Another group of sports physiologists **Hill et al. (1989)** planned a six-week interval training program on a cycle ergometer and as a result, the mixed adaptive response has been observed. It is well known that cardiovascular endurance is an important marker that understands overall fitness status and maximal aerobic power ($\dot{V}0_2$max), the kinetics of aerobic response are also affected by variation of time within a day. According to experimental evidence of **Borden et al. (1992),** maximal aerobic power has been observed higher in the afternoon than in the morning session. In the year of 1992, physiologist Tori and his associates designed four weeks of experimental aerobic training scheduled to examine the time of day variation effect on aerobically trained sedentary male volunteers. Resting heart rate, $\dot{V}O_2$ max, and blood lactate concentrations were measured before and after a 4-week training program and no significant differences have been observed in resting heart rate. Although, a statistically significant difference has been observed in recovery heart rate, blood lactate concentration, and predicted $\dot{V}O_2$ max for the afternoon exercise group compared to the morning or the evening training groups. In the year 1987, a maximal graded arm ergometer test was directed by Cable and Reilly to investigate the time-day effect on maximal arm exercise. Resting measures of heart rate, core body

temperature, and minute ventilation were found significantly higher in the afternoon session compared to other sessions. However, no significant time of day effect was noted for the rate of perceived exertion at the light and moderate-intensity exercise. The authors concluded that the muscular efficiency of arm exercise is independent of time of day relative to a constant respiratory exchange ratio and a strong association has been observed between peak body temperature and time of exhaustion could be an important factor in optimal performance of maximal arm ergometry. Aerobic exercise, as well as anaerobic exercise, are also affected by diurnal variation of the circadian rhythm. The effect of maximal anaerobic exercise at different times of the day was investigated by **Bernard et al. (1997)** using a force-velocity platform and multi-jump test. The study denotes rectal body temperature increased significantly from morning to evening session but ground contact time did not vary throughout the day. However, no significant variations were observed between afternoon and evening sessions for cycling, jumping, and running tests. The study proposed a time-of-day effect in the maximal anaerobic power of cycle and multi-jump tests.

**Hill and Smith (1991)** and also compared anaerobic capacity at different times of the day using the Wingate test and found that better response in the afternoon than morning. The finding was also supported by **Melhirn (1993)** but **Redly and Down (1992)** did not observe a significant difference in time of day variation effect on anaerobic capacity. In review research, **Vitale et al. (2019)** expressed that chronic physical activity at different times of the day levies differently on heart rate variability. Based on scientific experimental literature, the study concluded that evening session physical activity has a higher perturbation with the autonomic nervous system (ANS), which slows parasympathetic activation, and higher heart rate values have been observed than the morning session. From this point of view, it is clear that we have to be aware of the time-of-day effect when trying to construct an effective training schedule because de-synchronization of specific activity, interruption in normal routine, sleep patterns may be obstructed sports performances, and diurnal variation of circadian rhythms of various biological variables allied to exercise.

Not only physiological associations of circadian rhythm were studied but also psychological effects of physical activity at different times of the day were studied. In the year of 1982 two psychologists, Faria and Drummond reported the rate of

perceived exertion (REP) during treadmill exercise at different times of the day. They observed perceived exertion was higher in the morning than evening. Another psychologist **Reilly and Baxter (1983)** investigates, "Influence of time of day on reactions to cycling at a fixed intensity" and no diurnal variation of circadian rhythm has been accounted for the perceived exertion. A similar type of study was directed by **Hill et al. (1998)** to explore diurnal variations of circadian rhythm in responses to exercise at different time frames of the day using the REP scale but no significant difference has been observed in their perception effort. From this point of view, it can be concluded that diurnal rhythm displayed mixed effects towards REP and that may be observed due to variations in research protocols, exercise mode, gender, workloads.

Mood states have also been studied at rest and during exercise. It is known that moderate physical activity improves mood states. Pioneer sports psychologist, **Hill, and HiII (1991)** works to understand, the influence of time of day on responses to the profile of mood states (POMS) on office workers and publicized that overall mood was improved in the afternoon session compared with the morning session. They also observed a significantly lower value in depression and tension in the afternoon session compared to the morning session. Another research paper entitled, "Effects of aerobic exercise on the mood of adult women" was studied byMaroulakis and Zervas and concluded a very interesting fact. They observed a merely similar score of pre-exercise mood state in the morning compared to the afternoon. The study also reported significant improvement in post-exercise mood state at a different time of the day and no significant diurnal variation has been observed. Some research articles also deal with the effect of diurnal rhythm on state anxiety. However, is well documented that acute physical activity reduces anxiety. **O'Connor and Davis (1992)** conducted a study to explore, "Psychobiological responses to exercise at different times of day" using State-Trait Anxiety Inventory (STAI) protocol and revealed a significant reduction in state anxiety after exercise has been observed each session of the day. However, the study concluded state anxiety is an independent predictor and not affected by diurnal variation of the circadian rhythm.

**Emek Can et al (2016)**investigated the effect of circadian rhythms on several physical and physiological parameters of male taekwondo athletes.The athlete's resting heart rates, intra-aural resting body temperatures were measured and counter

movement jump test, paldeung technique effect level test and Wingate anaerobic power and capacity test were applied. The normality assumption of the data was examined by Shapiro-Wilks test. Significant differences were observed in resting heart rates, intra-aural resting body temperatures, counter movement jump heights, paldeung technique effect levels and, mean power in Wingate test with respect to circadian cahnges. There was a negative correlation coefficient between resting body temperature and resting heart rate. As a result; athlete efficiency is affected by many factors. To improve the performance of individual athletes, the effects of chronotype characteristics and circadian rhythms should be considered when designing training and competitions.

**GuozhongZheng et al (2019)** reported that the effects of indoor high temperature on the circadian rhythms of human work efficiency.Ten healthy subjects were randomly selected for the experiments. The results showed that reaction time, grip strength, and willingness to work follow a circadian rhythm. However, the percentage of correct answers for the StroopColor Word Test (SCWT) and Numerical Test Task (NIT) did not reveal a clear circadian rhythm. The effect of high temperature on grip strength and circadian rhythm of work preparation was mainly reflected in the decrease in median and amplitude. The effect on reaction time was mainly reflected in the decrease in median. In addition, forehead temperature has a significant negative correlation with reaction time and can be considered as a predictor for assessing work efficiency. This study provides an alternative to direct measurement of workplace skill indicators and provides 24-hour continuous baseline data to show changes in human work efficiency. It may be helpful to anticipate performance degradation in advance to reduce occupational accidents

**Rajagopal I (2010)** conducted a study on the effects of circadian rhythms on selected factors related to volleyball performance. The purpose of this present study was to find out the effect of circadian rhythms on selected factors related to volleyball performance. A total of 30 volleyball players of age between 19 years and 22 years were selected as subjects. The two independent variables were gender and circadian variations and dependent variables of flexibility, anaerobic power, aerobic power, body temperature, resting heart rate, blood sugar, blood urea, diastolic blood pressure, systolic blood pressure and total mood disturbance (TMD) were selected for this study. The study reveals that there was significant difference for men and women

volleyball players on different times of the day in flexibility, anaerobic power, aerobic power, body temperature, systolic blood pressure and total mood disturbance (TMD) and not in other variables.

**Rahnama et al (2009)** studied the diurnal variation on the performance of soccer-specific skills. The purpose of this study was to investigate diurnal variation in some specific skills performance and some physical fitness and physiological factors in soccer players. Twelve male soccer players participated in the study. Subjects performed certain soccer skills and several fitness factors in one day. One test ran between 7am and 9am and another test ran between 7pm and 9pm.A significant main effect of time of day was observed for oral temperature, the temperature in the evening was higher than morning. No significant effect was found for heart rate, systolic pressure and diastolic pressure different time periods. A significant effect of diurnal variation was found for sergeant jump, sit and reach, flexibility of right hip and 20-m running, the values of these factors were better in the evening. **Edwards et al (2007)**reported that the diurnal variation in temperature, mental and physical performance, and tasks specifically related to football (soccer). The purpose of the present study, which consisted of two separate studies, was to determine whether game-related skills varied with time of day in phase with global markers of both performance and the body clock. Time-of-day changes in intra-aural temperature, grip strength, reaction times, flexibility, juggling and dribbling tasks, and wall-volley test were compared. Significant (repeated measures analysis of variance, ANOVA) diurnal variations were found for body temperature, choice reaction time, self-rated alertness, fatigue, forward (sit-and-reach) flexibility, and right-hand grip strength, but not left-hand grip strength nor whole-body (stand-and-reach) flexibility. In a second study, eight diurnally active subjects (23.0±0.7 years of age) completed five test sessions at the same times as in the first study but with a second session at 08:00 hours. Intra-aural temperature showed a significant time-of-day effect with mean temperature at 16:00 hours higher than at 08:00 hours. Diurnal variation was found for performance tests, including sit-and-reach flexibility and spinal hyper-extension. Peaks occurred between 16:00 and 20:00 hours and the daytime changes paralleled the temperature rhythm. The results of the present study showed that the soccer players perform best performence between 16:00 and 20:00 hours when they not only exhibit football specific skills but also perform measures of physical performance at

their peak hours. Body temperature peaked at a similar time, but positive mood states seemed to peak slightly earlier.

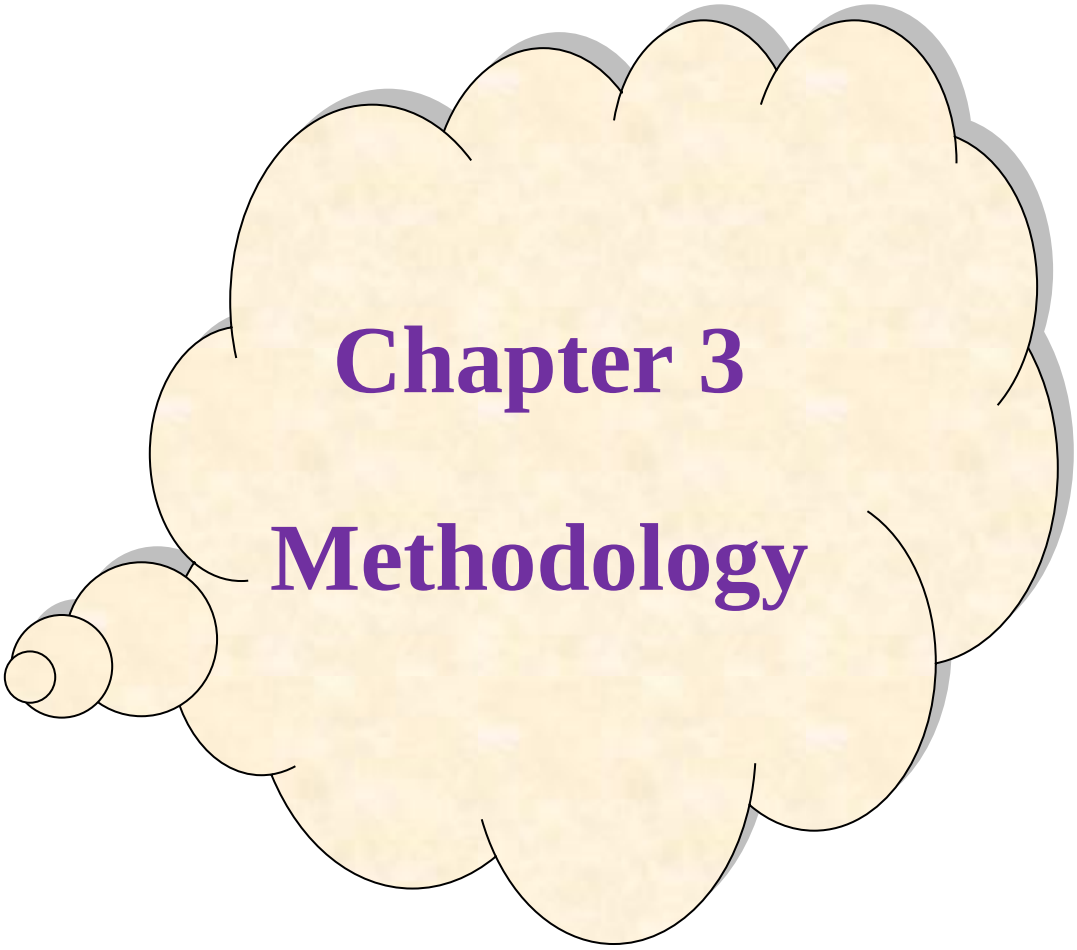
**Mahaboobjan A (2010)** conduct a study to analysis the diurnal variations on selected physical and physiological parameters .The purpose of the study was to analyze the diurnal variations on selected physical and physiological parameters such as speed, explosive power, resting heart rate and breath holding time among college students. To achieve the purpose of this study, a total of 20 players (n=20) from Government Arts College, Salem were selected as subjects To study the diurnal variation of the players on selected physiological and performance variables, the data were collected 4 times a day with every four hours in between the times it from 6.00 to 18.00 hours were selected as another categorical variable. It has concluded that both physical and physiological parameters were significantly deferred with reference to change of temperature in a day. Drust et al (2012) conduct a study on circadian variation and soccer performance: Implications for training and match-play during Ramadan Ramadan results in a number of behavioural alterations in individuals when compared to their normal habits outside of this holy month. These changes in behaviour could impact upon the effectiveness of the activity of an elite athlete who has high daily activity levels and energy expenditures. Understanding the true impact of Ramadan on human physiology will also require an awareness of the key aspects of circadian rhythms. This article will present theoretical background content on circadian rhythms along with data on the potential influence of circadian variation on soccer performance. It will also attempt to provide an insight into the problems of partial sleep deprivation and travel for the elite player. The contents will suggest that there is a basis for the within-day variation in physiological and psychological function to impact soccer performance if games are played early in the day or very late at night. As competitive fixtures are uncommon at these times these influences may be more relevant to the timing and organisation of training sessions. It is also likely that a lack of sleep and excessive travel will provide conditions that are not conducive to optimal performance. This would indicate that teams should think carefully about their preparation strategies for important tournaments and games.

**Rahnama et al (2009)** conduct a study on Diurnal Variation on the Performance of Soccer-Specific Skills. The purpose of this study was to investigate diurnal variation in some specific skills performance and some physical fitness and

physiological factors in soccer players. Twelve male soccer players participated in the study. Subjects performed some specific soccer skills and some physical fitness factors in one day. One test was carried out in the morning, between 7.00 am and 9.00 am and another one in the evening, between 7.00 pm and 9.00 pm. The oral temperature in the evening was higher than morning. No significant time of day effect was found for heart rate, systolic pressure and diastolic pressure. A significant major effects of diurnal variation was found for sergeant jump, sit and reach, flexibility of right hip and 20-m running, the values of these factors were better in the evening. A significant diurnal variation was found for dribbling, wall volley, soccer chipping and Yeagley soccer test, no significant difference was found in penalty kick. It can be concluded that there was a circadian rhythm in performance of soccer players. **Chtourou et al (2013)** reported the effect of static and dynamic stretching on the diurnal variations of jump performance in soccer players. Purpose The present study addressed the lack of data on the effect of different types of stretching on diurnal variations in vertical jump height - i.e., squat-jump (SJ) and countermovement-jump (CMJ). We hypothesized that dynamic stretching could affect the diurnal variations of jump height by producing a greater increase in short-term maximal performance in the morning than the evening through increasing core temperature at this time-of-day. Methods Twenty male soccer players (age, 18.6±1.3 yrs; height, 174.6±3.8 cm;) completed the SJ and CMJ tests either after static stretching, dynamic stretching or no-stretching protocols at two times of day, 07:00 h and 17:00 h, with a minimum of 48 hours between testing sessions. One minute after warming-up for 5 minutes by light jogging and performing one of the three stretching protocols (i.e., static stretching, dynamic stretching or no-stretching) for 8 minutes, each subject completed the SJ and CMJ tests. Jumping heights were recorded and analyzed using a two-way analysis of variance with repeated measures (3 [stretching]×2 [time-of-day]).Results The SJ and CMJ heights were significantly higher at 17:00 than 07:00 h ($p<0.01$) after the nostretching protocol. These daily variations disappeared (i.e., the diurnal gain decreased from 4.2±2.81% ($p<0.01$) to 1.81±4.39% (not-significant) for SJ and from 3.99±3.43% ($p<0.01$) to 1.51±3.83% (notsignificant) for CMJ) after dynamic stretching due to greater increases in SJ and CMJ heights in the morning than the evening. However, no significant effect of static stretching on the diurnal variations of SJ and CMJ heights was observed.Conclusion Dynamic stretching affects the typical

diurnal variations of SJ and CMJ and helps to counteract the lower morning values in vertical jump height.

From the above discussion, it appears that there are several investigations have been made regarding the circadian variation of physiological and motor fitness performance on humans. But less importance has been given to the changes of motor fitness and physiological parameter of the university student-athlete in different time intervals of the day as well as seasonal variation.The investigator in her attempt to review related literature has made extensive coverage of studies.


Chapter 3
Methodology

# CHAPTER-III

# RESEARCH METHODOLOGY

In this chapter, the researcher has described the procedure which was adopted for the selection of subjects, criterion measures, and design of the study, inclusion and exclusion criteria, procedure for collecting data, reliability of data, instrument reliability and analytical procedures

## 3.1 THE SUBJECT

In the present study, 30 male athletes were selected from each group of sprinters and jumpers having the age range 22-25 years from different training institutions of west Bengal. The subjects were studying in college and universities and have represented in Athletic Championship. The minimum training age of the participant was five years. Data were collected in two seasons (winter and summer) of the year at three time periods of a day (8.00 am, 12.00 pm, and 4.00 pm).

The participants were informed about the pros and cons of experiments during the course of research to be conducted in detail. Participants were asked to retain from exhaustive exercise for 48 hours and avoid food and fluids except for water for 2 hours before all laboratory and field visits.

All the participants were residing on campus of training institution hostel, pursuing similar courses(B.P.Ed&M.P.Ed). They were having similar daily routines and boarding facilities.

## 3.2 CRITERION MEASURE

The criterion measure adopted for the studies measuring the Motor fitness parameters and physiological parameters are given below.

**Tests and criterion measure for the selected parameters**

**Table A: Physiological Parameters.**

| Sl No | Parameters | Tests and instruments | Unit of measurement |
|---|---|---|---|
| 1 | Resting pulse Rate | pulse oximeter | Beats/minute |
| 2 | Resting systolic blood pressure (SBP) | Digital sphygmomanometer | mm of Hg |
| 3 | Resting diastolic blood pressure (DBP) | Digital sphygmomanometer | mm of Hg |
| 4 | Body temperature | Digital thermometer | Fahrenheit |

**Table B: Motor fitness parameters**

| Sl. No | Component | Test items | Unit of measurement |
|---|---|---|---|
| 1 | Speed | 50 - yard dash | In seconds |
| 2 | Agility | Shuttle run | In seconds |
| 3 | Explosive leg power | Standing broad jump | In meter |
| 4 | Basic endurance | 600-yard run | In seconds |
| 5 | Muscular strength endurance of arm and shoulder | Pull up | In number |
| 6 | Muscular strength endurance of abdominal muscle | Sit up | In number |

## 3.3 DESIGN OF THE STUDY:

The experiments of the study were divided into the following phases:

**Phase-I:** Comparison and correlation of motor fitness and physiological parameters among the sprinter in summer and winter season at the different time periods of the day – In this phase the evaluation of different selected motor fitness and selected physiological parameters of the sprinter at the different time periods of a day in summer and winter season on a comparative basis and also determine the correlation between motor fitness and physiological parameters in the different time periods of the day in both season.

**Phase- II:** Comparison and correlation of motor fitness and physiological parameter among the jumper in summer and winter season at the different time periods of the day – In this phase the evaluation of different selected motor fitness and selected physiological parameters of the jumper at the different time periods of the day in summer and winter season on a comparative basis and also determine the co-rrelation between motor fitness and physiological parameter in the different time periods of the day in both season.The schematic diagrams are shown below.

**Phase-1:**

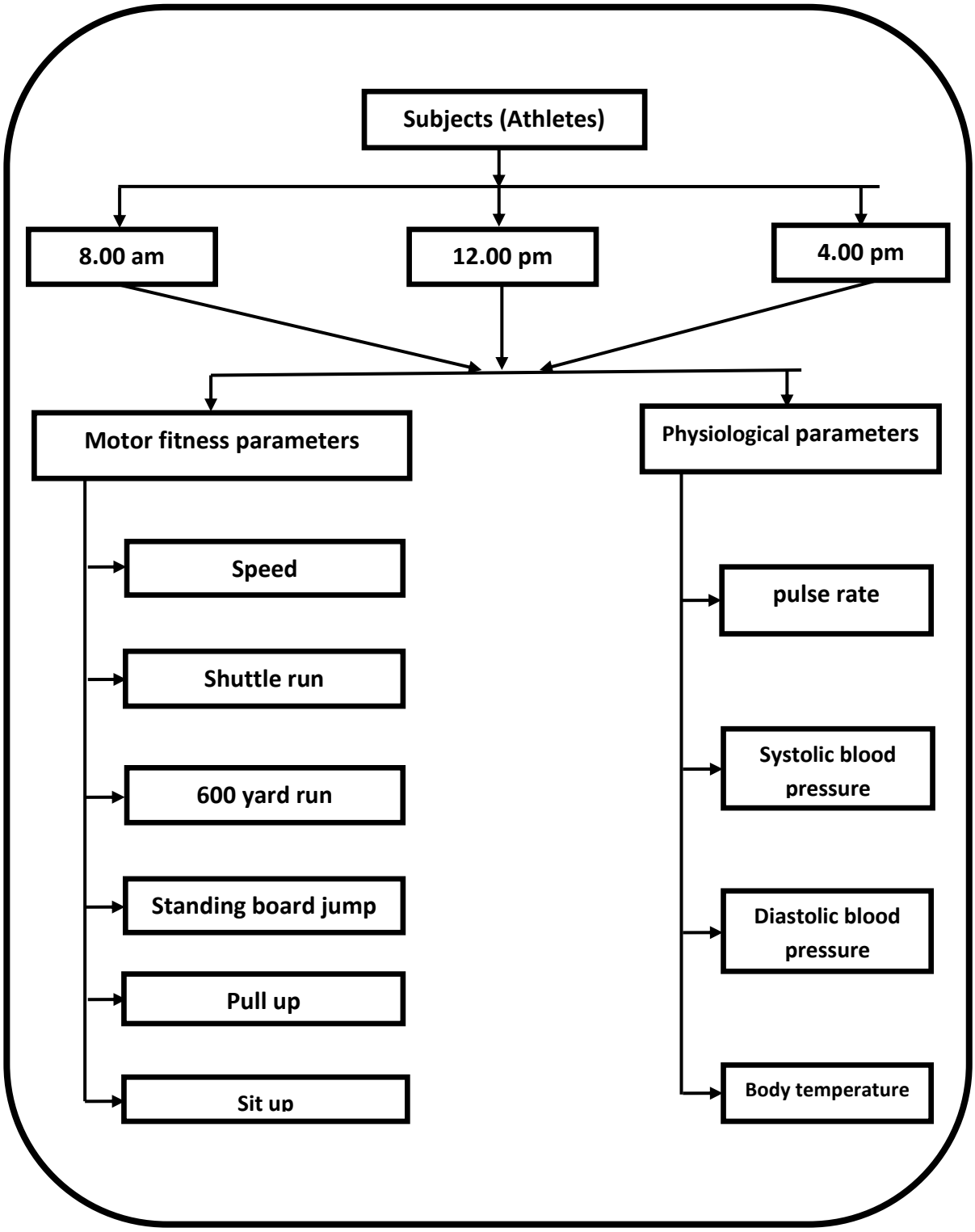



**Figure 2: Schematic diagram showed the experimental design to differentiate the motor and physiological parameters at different times of the day.**

**Phase-2:**

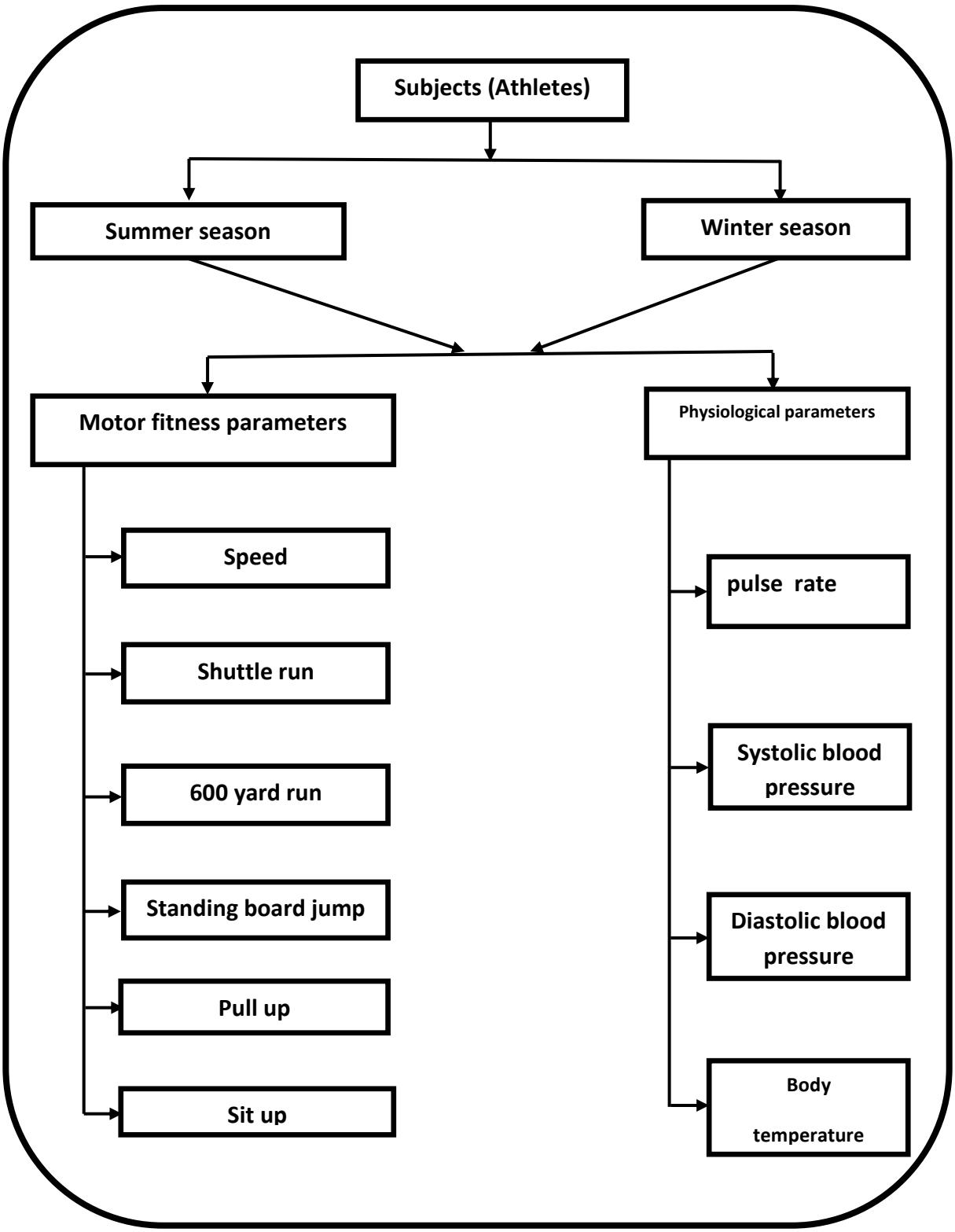



**Figure 3: Schematic diagram showed the experimental design to differentiate the motor and physiological parameters between two seasons.**

## 3.4 INCLUSION AND EXCLUSION CRITERIA

The athletes who were taking training regularly without break and did not have any long-term or short-term problems while doing exercise were included in the study.The athletes who were smoking regularly, taking medication, and had cardiovascular or metabolic diseases or other diseases that would affect their training, were excluded from the study.

## 3.5 PROCEDURE FOR COLLECTING DATA:

In order to acquaint the participants with the specific purpose of the research being conducted, all the participants were assembled in their Fitness Centre. All the necessary information pertaining to the requirement of the testing procedure was imparted to them. To make the research findings more authentic, a positive attitude towards investigation was emphasized.

During the test measurements, the subjects were informed that they should maintain their normal eating habits and avoid excessive fatty food intake. Before 24 hours of each test session. Athletes were warned that they should sleep for at least 8 hours, not use any caffeine or stimulants, and not perform high-intensity activity. They were also informed that they should receive light food before each test session. To see the circadian variation of the selected motor fitness and physiological variables (pulse Rate, Blood Pressure, body temperature) the data on the same day were collected from the selected participants in resting conditions at selected times of the day i.e. 08.00 hours, 12.00 hours, 16.00 hours. During the day athletes came to the sports hall thirty minutes before each test session. Firstly,a digital sphygmomanometer was attached to athletes in order to determine resting blood pressure, then body temperature and resting pulse rate were measured. The athletes were warmed with the trainer for 15 minutes. After warming up,the motor fitness of the subjects was measured by the six-item AAHPER Youth Fitness Test Battery. The administration of different items was as per instruction of AAPHER Youth Fitness Test Battery Manual, Washington DC, revised in 1976.

The procedural method of administration of different tests was as follows.

### 3.5.1 PERSONAL DATA

Age, height, the weight of the subject were measured as personal data of the subject.

### 3.5.1. a. AGE

The age of the subject was calculated from data of birth certificate or madhyamik admit card and recorded in the nearest year.

### 3.5.1. b. HEIGHT

**Required facilities and equipment:** Stadiometer and plane surface.

**Procedure:** The height of the subjects was measured by the stadiometer. Each subject was asked to stand erect with bare feet on a horizontal surface and to stretch as much as possible taking care that heels were touching each other on the horizontal surface. The stadiometer was held vertically and the horizontal arm was brought down so that it touched the highest point on the head in the midsagittal plane. The measurement was taken by the researcher

**Scoring:** The height of the subjects was measured in cm.

**Photograph 1: Measurement of height**

### 3.5.1.c. Measurement of Weight

**Required facilities and equipment:** Weighing machine, plane surface.

**Procedure**: A standard weighing machine was used for measuring the weight of the subject. The subjects were asked to stand on the weighing machine maintaining an erect position and look forward.

**The Scoring** Weight of the subjects was recorded in kg

**Photograph 2: Weight measurement**

### 3.5.2. Motor fitness parameter

The test administrations of all the Motor fitness parameters were as follows:

### 3.5.2.a. 50-yard Dash:

**Purpose:** The purpose of this test was to measure speed ability.

**Instruments/Arrangements**:

An area on track with a starting line, a 50-yard course, and a finish line, two stop-watches

**Procedure:**

After a short warm-up period, the boys took a position behind the starting line. Two subjects ran at a time for the time trial. The starter used the command, "Are you ready?" and blow the whistle. The latter was accompanied with a downward sweep of the arm with a handkerchief as a signal to the timer. The subjects ran across the finish

line. One trial was permitted. The subjects were allowed to take any position behind the starting line on the blow of the whistle they were instructed to run as fast as possible across the finish line. They were told not to slow down until they crossed the finish line.One starter, two timers, and one recorder were there as the testing personnel.The total arrangement has been shown in one photograph.

**Scoring:** The score was the elapsed time to the nearest tenth of a second

**Photograph 3: Performing 50-yard Dash.**

**3.5.2.b. Sit-up:**

**Purpose:**

The purpose was to measure abdominal strength and strength endurance

**Instruments /Arrangements**:

The required equipment were mats, a stopwatch, and a whistle.

**Procedure:**

The subjects lay flat on the back with knees bent and feet on the floor with the heels not more than one fool from the buttocks. The knee-angle was not less than 90 degrees. The fingers were interlocked and placed behind the neck with the elbows touching the floor. I was held securely by a partner. The subjects finally became curled to a sitting position and touched the elbows to the knees. This exercise was repeated as many times as possible in one minute.

The subjects were instructed to keep the fingers interlocked and in contact with the back of the neck at all times during curl-up from the starting position, push

off the floor with an elbow was not allowed. During the return to the starting position, elbows were flat on the mat.

**Scoring:**

One point was scored for each correct sit-up. The score was the maximum number of sit-ups completed in 60 seconds. One trained tester administered this test and for counting and recording the score, the one-time keeper was used the total arrangement has been shown in photograph.

**Photograph 4: Performing sit up.**

**3.5.2.c. Pull-Up:**

**Purpose**;

The purpose was to measure arm and shoulder strength and strength endurance.

**Instruments / Arrangements**:

A gymnastic horizontal bar placed at a convenient height.

**Procedure:**

The bar was adjusted to such a height that the subject could hang free of the floor. The subject grasped the bar with his palms facing away from his body then raised his body until his chin was over the bar and then lowered it again to the starting position with his arms fully extended.

He was instructed not to lit knees or assist his pull-ups by kicking He was to return to the hanging position with the arms fully straight but he was not permitted to swing or snap.

**Scoring:**

One point was scored each time the subject completed a pull-up. Part scores were not counted. Only one trial was permitted.One tester administered this test. Another person was employed for counting and recording. The total arrangement has been shown in photograph.

**Photograp 5: Performing pull up**

**3.5.2.d. Standing Broad Jump**:

**Purpose**: The purpose was to measure log explosive power.

**Procedure:**

The subjects stood behind a take-off line with the feet several inches apart Before jumping, the subjects dipped at the knees and swing their arms backward. They then jumped forward by simultaneously extending the knees and swinging the arms forward. Three trails were permitted. Measurement was from the closest heel mark to the take-off line.

The subjects were instructed to take off from both feet simultaneously, jump as far forward as possible, and land on both feet.

**Scoring**:

The score was the distance between the take offline and the nearest point where any part of the subject's body touched the floor. It was measured in Cm. Only the best jumping distance was considered as the performance. One trained tester administered this test Two judges and a recorder were employed Total arrangement has been shown in photograph.

**Photograp 6: Performing standing broad jump**

**3.5.2.e. Shuttle Run**

**Purpose**: The purpose was to measure agility.

**Instruments/Arrangements**:

Two lines parallel to each other were drawn on the floor 10 yard apart since the subjects were to overrun both of these lines, it was necessary to have several feet more of floor space at either end. Two blocks of wood 5cm x 5cm and two stop-watches were used

**Procedure:**

The subjects stood at one of the lines with the 2 blocks at the other line. On the signal to start, the subject ran to the blocks, took one, and returned to the starting line, and I

placed the block behind that line. He then returned to the second block, which was carried across the starting line on the way back. Two subjects ran at the same time on the signal to 'Go ' they were instructed to run as fast as possible to the next line and pick up a block. They were told not to throw the blocks.

**Scoring:** The score was the elapsed time recorded in seconds and one-tenth of a second. One trained tester operated the stopwatch for each subject and called out the times, and one assistant recorded the scores. The arrangement has been shown in photograph.

**Photograph 7: Performing shuttle run**

**3.5.2.f. 600-yard Run:**

**Purpose:** The purpose was to measure endurance.

**Instruments / Arrangements**: A track and a stopwatch were used for this test.

**Procedure**:

Subjects ran in groups. They were instructed to run not too last in the beginning but to keep going at a speed that could be maintained throughout the course.

**Scoring:**

The score was the elapsed time in minutes and seconds.One trained tester operated the stop-watch and called out the times, and one assistant was there to record the scores.

**Photograph 8: Performing 600-yard run.**

### 3.5.3 PHYSIOLOGICAL PARAMETER

**The test administrations of all the physiological parameters were as follows:**

**3.5.3.a pulse Rate (beats/min):**

The resting pulse rate of the subjects was measured with a digital pulse oximeter (Dr.Morepen).To measure the pulse rate make your body relaxed before putting on the pulse oximeter. Place the pulse oximeter on your index or middle finger. Keep the pulse oximeter on your finger for at least a minute, till the reading stabilizes. Record the highest reading that flashes on the oximeter after it has established after 5 seconds.


**Photograph 9: Measuring pulse rate by Pulse oxymeter**

### 3.5.3.b. Blood Pressure (mm hg):

The resting systolic as well as resting diastolic blood pressure of the subjects were measured with a digital sphygmomanometer (Dr.Morepen B.P. Monitor). The cuff was wrapped around the upper arm with the cuff's lower edge one inch above the antecubital fossa. The start button was pressed which helped in measuring the blood pressure of the participant automatically. The value shown by the blood pressure monitor was noted down as the score of the individual.

**Photograph 10: Measuring blood pressure**

**3.5.3.c. Body temperature ($^0$F) -** The body temperature of the subjects was measured with the help of a Digital thermometer (Omsons Company).

**Photograph 11: Measuring body temperature**

## 3.6 RELIABILITY OF DATA

Reliability of data was assured by establishing the instrument reliability, tester competency, reliability of tests, and participant's reliability.

## 3.7 INSTRUMENT RELIABILITY

Fully automatic, standard, and digital watches **(Nivia)** were used for monitoring the duration of the workout about which data pertaining to different variables was to be collected.

The measurements of pulse rate were done by fully digital and automatic manufactured by(Dr.Morepen), which is an internationally recognized diagnostic clinical instrument manufacturer and was available Laboratory. The researcher was well acquainted with the standard procedure prescribed in the user's manual of the product and while in the test administration also the same procedure was adopted. The systolic blood pressure of the participants was monitored by Dr.Morepen's fully automatic digital Blood Pressure Monitor which was also calibrated.

The researcher was well equipped with the technique of conducting the tests and reliability of data was ensured. The researcher underwent several practice sessions for testing the variables and the techniques of conducting the tests were learned.

## 3.8 ANALYTICAL PROCEDURES

The obtained data in form of the digital score were treated statically to get the result and to draw a conclusion. Mean and SD were used as descriptive statistics. The degree of the relationship was measured with the help of the correlation coefficient. Significance of statistical difference at different time periods was measured with the help of F test and to find out the exact difference between the time periods of the day post hoc test was applied.

The 23th version of IBM SPSS Software which is widely used as statistical software for windows operating systems by social sciences faculties was used for the statistical analysis of data.In all the statistical significance was accepted at $P<0.05$ level.

# Chapter 4

## *Presentation of data, Results and discussion*

# CHAPTER IV

# RESULTS & DISCUSSION

The collected data on selected motor fitness and physiological parameters of sprinters and jumpers at different time of day were statistically processed and discussed in this chapter.

## 4.1 Meteorological condition of subjects of different time periods of a day in summer season:

The temperature and humidity had been measured in different time intervals of day before starting the experiment .In table 1 metrological condition of different time of day in summer season were presented. Table 1 showed the result.

**Table 1: Meteorological condition of different time of a day in summer season.**

| Variables | Time periods of the day | | |
|---|---|---|---|
| | **8.00 am** | **12.00 pm** | **04.00 pm** |
| Temperature | 24°C - 28°C | 32°C - 34°C | 31°C - 32°C |
| Humidity | 77% - 76% | 70% - 65% | 60% - 55% |

From table 1 it was seen that The temperature and humidity of a day in different time intervals were at 08.00 am- 24°C - 28°C (77% - 76%), at 12.00 pm- 32°C - 34°C (70% - 65%) and at 04.00 pm-31°C - 32°C (60% - 55%) respectively.

## 4.2 Personal data

The personal data had been measure before starting the experiment.In table 2 personal data of sprinters in summer were presented.

**Table 2: Personal data of subjects**

| Variable | MEAN ± SD |
|---|---|
| Age (years) | 22.88 ± 3.67 |
| Weight (kg) | 58.09 ± 1.61 |
| Height (cm) | 164.81 ± 4.28 |

From table - 2 it was clearly seen that the Mean and SD of age, weight, and height of the subject were 22.88 yrs. ± 3.67; 58.09 kg ± 1.61 and 164.81 cm ± 4.28 respectively.

## 4.3. Comparison of selected motor fitness parameters among the sprinter in different time periods of a day in summer season were presented.

### 4.3.1. Speed:

The difference in sprinting performance and significance of statistical difference in sprinting performance of differents time of day were presented in table 3

**Table 3: Comparison of speed (Sec) performance in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference at different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| 8.00 am | 6.87± 0.37 | 1.45 | 0.23 |
| 12.00 pm | 6.97± .45 | | |
| 4.00 pm | 6.79 ± 0.50 | | |

table value of $F_{0.05}(2,27) = 3.35$

From table - 3 it was reveals that Mean and SD with regard to speed in the different time of days were 6.87±0.37, 6.97 ±0.45, and 6.79±0.50 respectively. It was seen from the table that the mean score in speed was better during 4.00 pm (as lower mean value indicate higher performance) thus it was considered that performance was higher in 4.00 pm. In order to find out whether mean difference was significant or not ANOVA was calculated (Table 3). There was no significant difference were observed in sprinting ability at different time interval of a day (table 3) as P value is higher than 0.05.

### 4.3.2. Explosive leg power:

The difference in explosive leg power and significance of statistical difference in explosive leg power of different time of day were presented in table 4.

**Table 4: Comparison of explosive leg power (mtr) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference at different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| 8.00 am | 2.50 ± 0.18 | 3.53 | 0.03 |
| 12.00 pm | 2.45 ± 0.15 | | |
| 4.00 pm | 2.57 ± 0.19 | | |

**table Value of $F_{0.05}$ (2,27) = 3.35**

Table -4 reveals that mean and SD with regard to explosive leg power in the different time of day were 2.50±0.18, 2.45 ±0.15, and 2.57±0.19 respectively. From the table value it was clear that there was difference in performance at different time of the day. In order to find out significant difference F test were applied and by observing P value it was concluded that there was significant difference in explosive leg power at different time of day(Table 4**)**. In order to find out exact location of difference post hoc test was applied.

**Table 5: Post hoc test for difference between the paired means on explosive leg power.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm | .05433 | .04559 | .237 |
| | 4.00 pm | .06667 | .04559 | .147 |
| **12.00 pm** | 8.00 am | .05433 | .04559 | .237 |
| | 4.00 pm* | .12100* | .04559 | .009 |
| **4.00 pm** | 8.00 am | .06667 | .04559 | .147 |
| | 12.00 pm* | .12100* | .04559 | .009 |

**Significant at *p<0.05**

From post hoc table - 5, it was found that the explosive leg power in sprinters was significantly changed in different time interval of a day [$F_{(2,27)} - 3.53$, $p<0.05$]. The significant difference was observed between 12.00pm and 4.00 pm (Table 5).Thus, it was conclude that explosive leg power was significantly higher at 4.00 pm.

### 4.3.3 Agility:

The difference in agility and significance of statistical difference in agility of different time of day were presented in table 6

**Table 6: Comparison of agility (sec)in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| 8.00 am | 9.58 ± 0.59 | 4.85 | 0.01 |
| 12.00 pm | 9.98 ± 0.65 | | |
| 4.00 pm | 9.48 ± 0.79 | | |

**Table Value of $F_{0.05}$ (2,27) = 3.35**

Table - 6 represents that Mean and SD with regard to agility in the different time of day were 9.58±0.59, 9.98 ±0.65, 9.48±0.79 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing P value it was concluded that there was significant difference inagility at different time of day. (Table 6). In order to find out exact location of difference post hoc test was applied.

**Table 7: Post hoc test for difference between the paired means on agility.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -.39967* | .17185 | .022 |
| | 4.00 pm | .10867 | .17185 | .529 |
| **12.00 pm** | 8.00 am* | .39967* | .17185 | .022 |
| | 4.00 pm* | .50833* | .17185 | .004 |
| **4.00 pm** | 8.00 am | -.10867 | .17185 | .529 |
| | 12.00 pm* | -.50833* | .17185 | .004 |

**Significant at *p<0.05**

From post hoc table - 7, it was found that the agility in sprinter was significantly changed in different time interval of a day [$F_{(2,27)} - 4.85$, $p<0.05$]. The

significance difference was observed between 8 am and 12 pm as well as 12 pm and 4 pm. (Table 7). Thus, it was conclude that agility was significantly higher at 4.00 pm.

### 4.3.4: Muscular strength endurance of arm and shoulder

The difference in muscular strength endurance of arm and shoulder performance and significance of statistical difference in muscular strength endurance of arm and shoulder performance of different time of day were presented in table 8.

**Table 8: Comparison of muscular strength endurance of arm and shoulder (number) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference at different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| 8.00 am | 12.35 ± 4.48 | 2.08 | 0.13 |
| 12.00 pm | 14.27 ± 4.34 | | |
| 4.00 pm | 16.46 ± 3.18 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table - 8 shows that Mean and SD with regard to muscular strength endurance of arm and shoulder in the different time of day were 12.35±4.48, 14.27 ±4.34, 16.46±3.18 respectively. It was seen from the table that the mean score in muscular strength endurance of arm and shoulder was better during 4.00 pm.Thus, it was considered that performance was higher in 4.00 pm .In order to find out whether mean difference is significant or not ANOVA was calculated (Table 8).

There was no significant difference were observed inmuscular strength endurance of arm and shoulder at different time interval of a day (table 8) as p value is higher than 0.05.

### 4.3.5 Muscular strength endurance of abdominal muscle:

The difference in muscular strength endurance of abdominal muscle performance and significance of statistical difference in muscular strength endurance of abdominal muscle of different time periods of the day were presented in table 9

**Table 9: Comparison of muscular strength endurance of abdominal muscle (number) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference at different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| 8.00 am | 32.93 ± 7.60 | 0.36 | 0.69 |
| 12.00 pm | 34.40 ± 8.89 | | |
| 4.00 pm | 34.67 ± 8.98 | | |

**Table Value of $F_{0.05}$ (2,27) = 3.35**

Table - 9 reveals that Mean and SD with regard to muscular strength endurance of abdominal muscle in the different time of day32.93±7.60, 34.40 ±8.89, and 34.67±8.98 respectively. It was seen from the table that the mean score in muscular strength endurance of abdominal muscle was better during 4.00 Pm.Thus it was considered that performance was higher in 4.00 pm.In order to find out whether mean difference is significant or not ANOVA was calculated (Table 9).

There was no significant difference were observed in muscular strength endurance of abdominal muscleat different time interval of a day (table 9) as p value is higher than 0.05.

**4.3.6 Basic endurance:**

The difference in basic endurance performance and significance of statistical difference in basic endurance performance at different time of day were presented in table 10

**Table 10: Comparison of basic endurance (sec) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference at different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 105 .03± 18.94 | 3.78 | 0.02 |
| **12.00 pm** | 113.63± 9.99 | | |
| **4.00 pm** | 112.56± 8.01 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table - 10 reveals that Mean and SD with regard to basic endurance in the different time of day105.03±18.94, 113.63 ±9.99, and 112.56±8.01 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in basic endurance at different time of day (Table 10).In order to find out exact location of difference post hoc test was applied.

**Table 11: Post hoc test for difference between the paired means on basic endurance.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -8.60000* | 3.40895 | .013 |
| | 4.00 pm* | -7.53333* | 3.40895 | .030 |
| **12.00 pm** | 8.00 am* | 8.60000* | 3.40895 | .013 |
| | 4.00 pm | 1.06667 | 3.40895 | .755 |
| **4.00 pm** | 8.00 am* | 7.53333* | 3.40895 | .030 |
| | 12.00 pm | -1.06667 | 3.40895 | .755 |

**Significant at *p<0.05**

From post hoc table it was found the basic endurance in sprinters was significantly changed in different time interval of a day [$F_{(2,27)} - 3.78$, $p<0.05$]. The significancant difference was observed between 8.00 am and 12.00 pm, as well as 8.00 am and 4.00 pm. (Table 11).Thus, it was conclude that basic endurance was significantly higher at 8.00 am.

## 4.4. Comparison of selected physiological parameters among the selected sprinters in different time periods of a day in summer season were presented here.

### 4.4.1 Resting pulse rate:

The difference in resting pulse rate and significance of statistical difference in resting pulse rate of different time of day were presented in Table 12.

**Table 12: Comparison of resting pulse rate (Beats/minute) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| 8.00 am | 61.58± 2.15 | 2.75 | .06 |
| 12.00 pm | 62.95 ± 2.76 | | |
| 4.00 pm | 62.87 ± 2.64 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table - 12 reveals that Mean and SD with regard to resting pulse rate in the different time of day61.58±2.15, 62.95 ±2.76, 62.87±2.64 respectively. It was seen from the table that the mean score in resting pulse rate was lower during 8.00 am.In order to find out whether mean difference is significant or not ANOVA was calculated (Table 12).There was no significant difference were observed in resting pulse rate at different time interval of a day (table 12) as p value is higher than 0.05.

**4.4.2 Resting systolic blood pressure (SBP):**

The difference in resting systolic blood pressure and significance of statistical difference in resting systolic blood pressure of different time of day were presented in table 13.

**Table 13: Comparison of systolic blood pressure (mm of Hg) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 116.13 ± 2.66 | 27.06 | 0.00 |
| **12.00 pm** | 117.77 ± 2.19 | | |
| **4.00 pm** | 120.30 ± 1.66 | | |

**table Value of $F_{0.05}$ (2,27) = 3.35**

Table - 13 reveals that Mean and SD with regard to systolic blood pressure in the different time of day 116.13±2.66, 117.77 ±2.19, 120.30±1.66 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in systolic blood pressure at different time of day (Table 13).In order to find out exact location of difference post hoc test was applied.

**Table 14 Posthoc test for difference between the paired means on systolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -1.63333* | .57076 | .005 |
| | 4.00 pm* | -4.16667* | .57076 | .000 |
| **12.00 pm** | 8.00 am* | 1.63333* | .57076 | .005 |
| | 4.00 pm* | -2.53333* | .57076 | .000 |
| **4.00 pm** | 8.00 am* | 4.16667* | .57076 | .000 |
| | 12.00 pm* | 2.53333* | .57076 | .000 |

**Significant at *p<0.05**

From the post hoc table - 14 it was found that the systolic blood pressure in sprinters was significantly changed in different time interval of a day [$F_{(2,27)} - 27.06$, $p<0.05$] . The significance difference was observed between 8.00 am and 12.00 pm,12.00 pm and 4.00 pm, as well as 8.00 am and 4.00 pm (Table 14). Thus it was conclude that systolic blood pressure was significantly lower at 8.00 am.

### 4.4.3.: Resting diastolic blood pressure (DBP):

The difference in resting diastolic blood pressure and significance of statistical difference in resting diastolic blood pressure of different time of day were presented in table 15

**Table 15: Comparison of diastolic blood pressure (mm of Hg) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference at different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 76.67 ± 1.12 | 45.75 | 0.01 |
| **12.00 pm** | 78.50 ± 0.50 | | |
| **4.00 pm** | 80.60 ± 0.93 | | |

**table Value of $F_{0.05}$ (2,27) = 3.35**

Table - 15 reveals that Mean and SD with regard to diastolic blood pressure in the different time of day76.67 ± 1.12, 78.50 ± 0.50, 80.60 ± 0.93respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in diastolic blood pressure at different time of day (Table 15).In order to find out exact location of difference post hoc test was applied.

**Table 16: Post hoc test for difference between the paired means on diastolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -1.83333* | .23055 | .000 |
| | 4.00 pm* | -3.93333* | .23055 | .000 |
| **12.00 pm** | 8.00 am* | 1.83333* | .23055 | .000 |
| | 4.00 pm* | -2.10000* | .23055 | .000 |
| **4.00 pm** | 8.00 am* | 3.93333* | .23055 | .000 |
| | 12.00 pm* | 2.10000* | .23055 | .000 |

**Significant at *p<0.05**

From post hoc table - 16 it was found that diastolic blood pressure in sprinters was significantly changed in different time interval of a day [$F_{(2,27)} - 45.75$, $p<0.05$] . The significance difference was observed between 12 .00pm and 4.00 pm,8.00 am and 4.00 pm as well as 8.00 am and 12.00 pm (Table 16). Thus it was conclude that diastolic blood pressurewas higher at 4.00 pm.

### 4.4.4 Resting body temperature:

The difference in resting body temperature and significance of statistical difference in resting body temperature of different time of day were presented in table 17.

**Table 17: Comparison of resting body temperature (Fahrenheit) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 96.29 ± 0.95 | 36.41 | 0.00 |
| **12.00 pm** | 97.23 ± 0.82 | | |
| **4.00 pm** | 98.14 ± 0.72 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 17 reveals that Mean and SD with regard to resting body temperature in the different time of day96.29±0.95, 97.23 ±0.82, 98.14±0.72 respectively. From the table value it was clear that there was difference in body temparature at different time of the day. In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference inresting body temperature at different time of day (Table 17).In order to find out exact location of difference post hoc test was applied.

**Table 18: Post hoc test for difference between the paired means on resting body temperature.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -.94100* | .21718 | .000 |
| | 4.00 pm* | -1.85333* | .21718 | .000 |
| **12.00 pm** | 8.00 am* | .94100* | .21718 | .000 |
| | 4.00 pm* | -.91233* | .21718 | .000 |
| **4.00 pm** | 8.00 am* | 1.85333* | .21718 | .000 |
| | 12.00 pm* | .91233* | .21718 | .000 |

**Significant at *p<0.05**

From post hoc table - 18 it was found that resting body temperature in sprinters was significantly changed in different time interval of a day [$F_{(2,27)} - 36.41$, $p<0.05$]. The significance difference was observed between 12 .00pm and 4.00 pm and 8.00 am and 4.00 pm as well as 8.00 am and 12.00 pm (Table 18).Thus it was conclude that resting body temperature was significantly higher at 4.00 pm.

## 4.5. The relationship betwwen selected physiological parameters and selected motor fitness parameters at different time of tha day in summer were presented.

### 4.5.1 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinter (n=30) subjects in morning at 8.00 am

The relationship between selected physiological parameters and AAHPER Youth Physical Fitness parameters at different time of day of male sprinter (n=30) subjects in morning at 8.00 am were presented in table 19.

**Table 19: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinter (n=30) subjects in morning at 8.00 am**

| Physiological variables | Speed | Leg power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .87* | .40* | .17 NS | .47* | .67* | .07 NS | .92* |
| Systolic BP | .62* | .21 NS | .83* | .58* | .56* | .87* | .98* |
| Diastolic BP | .77* | .91* | .92* | .10NS | .78* | .65* | .48* |
| Pulse rate | .89* | .24 NS | .41* | .80* | .97* | .08 NS | .38* |

**table value of r at 0.05 level with 28 df =0.36**

Table - 19 revealed that in all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r(r= 0.36) with 28 df and 0 .05 level of significance.

It was observed that relationship between body temperature and arm strength as well as body temperature and abdominal strength displayed no significant relationship. It was also observed that relationship between systolic blood pressure and leg power showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood pressure and agility .It was also observed that pulse rate showed no significant relationship with abdominal strength and leg power.Though from the table value it was clearly

observed that selected physiological parameter showed significant positive correlation with total fitness.

### 4.5.2 Correlation between selected physiological parameters and AAHPER youth physical fitness parameter of male sprinters(n=30) in noon at 12.00 pm

The relationship between selected physiological parameters and AAHPER Youth Physical Fitness parameter at different time of day of male sprinter (n=30) subjects at 12.00 pm were presented in table 20

**Table 20: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinters (n=30) in noon at 12.00 pm.**

| Physiological variables | Speed | Agility | Leg power | Arm strength | Abdominal strength | Endurance | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | **.42*** | **.53*** | **.26NS** | **.93*** | **.91*** | **.96*** | **.88*** |
| Systolic BP | **.59*** | **.75*** | **.16NS** | **.93*** | **.95*** | **.20NS** | **.81*** |
| Diastolic BP | **.77*** | **.78*** | **.10 NS** | **.92*** | **.91*** | **.65*** | **.48*** |
| Pulse rate | **.79*** | **.37*** | **.79*** | **.53*** | **.80*** | **.15NS** | **.82*** |

**table value of r at 0.05 level with 28 df =0.36**

Table - 20 represents that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER Youth Physical Fitness parameters as the calculate value is higher than the table value of table value of r (r= 0.36) with 28 df and 0.05 level of significance. It was observed that relationship between body temperature and leg power displays no significant relationship. It was also observed that relationship between systolic blood pressure and leg poweras well as systolic blood pressureand endurance showed no significant relationship .From the table value it was also found that no significant relationship exist between diastolic blood pressure and leg power. It was also observed that pulse rate showed no significant relationship with endurance. Though from the table value it clearly observed that selected physiological parameter show significant positive correlation with total fitness.

### 4.5.3 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters at 4 PM.

The relationship between selected physiological parameters and AAHPER Youth Physical Fitness parameter at different time of day of male sprinters (n=30) in after noon at 4.00 pm were presented in table 21.

**Table 21: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinters (n=30) at 4.00 pm.**

| Physiological variables | Speed | Leg power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .63* | .52* | .91* | .38* | .61* | .37* | .54* |
| Systolic BP | .82* | .16NS | .38* | .40* | .95* | .37* | .77* |
| Diastolic BP | .77* | .91* | .92* | .10NS | .78* | .65* | .48* |
| Pulse rate | .62* | .77* | .65* | .18NS | .63* | .37* | .19NS |

**table value of r at 0.05 level with 28 df =0.36**

Table - 21 shows that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER Youth Physical Fitness parameters as the calculate value is higher than the table value of table value of r(r= 0.36) with 28 df and 0 .05 level of significance.

It was also observed that relationship between systolic blood pressure and leg power showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood pressure and agility. It was also observed that pulse rate showed no significant relationship with agility and total fitness.From the table value it clearly observed that selected physiological parameter show significant positive correlation with total fitness except pulse rate.

## 4.6 Meteorological condition of different time periods of a day in winter season:

The temperature and humidity had been measured in different time intervals of day before starting the experiment. In table - 22 metrological condition of different time of day in winter season were presented. Table 22 showed the result.

**Table 22: Meteorological condition of different time of a day in winter season.**

| Variables | Time periods of the day | | |
|---|---|---|---|
| | **8.00 am** | **12.00 pm** | **04.00 pm** |
| Temperature | 14°C - 16°C | 22°C - 25°C | 22°C - 23°C |
| Humidity | 74% - 77% | 60% - 63% | 40% - 43% |

From table 22 it was seen that The temperature and humidity of a day in different time intervals were at 08.00 am- 14°C - 16°C (74% - 77%), at 12.00 pm- 22°C - 25°C (60% - 63%) and at 04.00 pm-22°C - 23°C (40% - 43%) (Table 22) respectively.

## 4.7. Comparison of selected motor fitness parameters among the sprinters in different time periods of a day in winter season were presented here.

### 4.7.1 Speed:

The difference in sprinting performance and significance of statistical difference in sprinting performance of different time of day were presented in table 23

**Table 23: Comparison of speed (sec)in different time periods of the day among the selected sprinters (n=30).**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 7.16 ± 0.49 | 1.883 | 0.158 |
| **12.00 pm** | 6.99 ± 0.40 | | |
| **4.00 pm** | 6.94 ± 0.48 | | |

table value of $F_{0.05}(2,27) = 3.35$

Table-23 reveals that mean and SD with regard to speed in the different time of day7.16±0.49,6.99±0.40,6.94±0.48 respectively. It was seen from the table that the mean score in speed was better during 4.00 pm(as lower mean value indicate higher performance) thus it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 23).

There was no significant difference were observed in sprinting ability at different time interval of a day (table23) as p value is higher than 0.05.

**4.7.2. Explosive leg power:**

The difference in explosive leg power performance and significance of statistical difference in explosive leg power performance of different time of day were presented in table 24.

**Table 24: Comparison of explosive leg power(mtr) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 2.46 ± 0.18 | 3.98 | 0.02 |
| **12.00 pm** | 2.58 ± 0.15 | | |
| **4.00 pm** | 2.59± 0.24 | | |

table value of $F_{0.05}(2,27) = 3.35$

Table- 24 reveals that Mean and SD with regard to explosive leg power in the different time of day were 2.46±0.18,2.58 ±0.15,2.59±0.24 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in explosive leg power at different time of day (Table 24).

In order to find out exact location of difference post hoc test was applied.

**Table 25: Post hoc test for difference between the paired means on explosive leg power.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -.12200* | .05031 | .017 |
| | 4.00 pm* | -.12400* | .05031 | .016 |
| **12.00 pm** | 8.00 am* | .12200* | .05031 | .017 |
| | 4.00 pm | -.00200 | .05031 | .968 |
| **4.00 pm** | 8.00 am* | .12400* | .05031 | .016 |
| | 12.00 pm | .00200 | .05031 | .968 |

**Significant at *p<0.05**

From post hoc table - 25 it was found that the explosive leg power in sprinter was significantly changed in different time interval of a day [$F_{(2,27)} - 3.98$, $p<0.05$] . The significance difference was observed between 8.00 am and 12.00pm as well as 8.00 am and 4.00 pm (Table 25). Thus, it was conclude that explosive leg power was significantly higher at 4.00 pm.

### 4.7.3 Agility:

The difference in agility performance and significance of statistical difference in agility performance of different time of day were presented in table 26

**Table 26: Comparison of agility (sec) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 10.01± 0.65 | 5.60 | 0.005 |
| **12.00 pm** | 9.59± 0.49 | | |
| **4.00 pm** | 9.47± 0.59 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 26 reveals that Mean and SD with regard to agility in the different time of day were 10.01±0.65, 9.59 ±0.49,9.47±0.59 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in agility at different time of day (Table 26).

In order to find out exact location of difference post hoc test was applied.

**Table 27: Post hoc test for difference between the paired means on agility.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | .41833* | .17009 | .016 |
| | 4.00 pm* | .54400* | .17009 | .002 |
| **12.00 pm** | 8.00 am* | -.41833* | .17009 | .016 |
| | 4.00 pm | .12567 | .17009 | .462 |
| **4.00 pm** | 8.00 am* | -.54400* | .17009 | .002 |
| | 12.00 pm | -.12567 | .17009 | .462 |

**Significant at *p<0.05**

From post hoc table - 27it was found that the agility in sprinter was significantly changed in different time interval of a day [$F_{(2,27)} - 5.60$, $p<0.05$] . The significance difference was observed between 8.00 am and 12.00 pm as well as 8.00 am and 4.00 pm. (Table 27).Thus it was conclude that agility was significantly higher at 4.00 pm ( as lower mean value indicate high performance).

### 4.7.4: Muscular strength endurance of arm and shoulder

The difference in muscular strength endurance of arm and shoulder performance and significance of statistical difference in muscular strength endurance of arm and shoulder performance of different time of day were presented in table 28.

**Table 28: Comparison of muscular strength endurance of arm and shoulder (number) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 14.73 ± 4.30 | 2.37 | 0.09 |
| **12.00 pm** | 15.80 ± 4.08 | | |
| **4.00 pm** | 16.50 ± 3.56 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-28 reveals that Mean and SD with regard to muscular strength endurance of arm and shoulder in the different time of day were 14.73±4.30, 15.80 ±4.08, 16.50±3.56 respectively. It was seen from the table that the mean score in muscular strength endurance of arm and shoulder was higher during 4.00 pm, thus it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 28).

There was no significant difference were observed in muscular strength endurance of arm and shoulder at different time interval of a day (table 28) as p value is higher than 0.05.

### 4.7.5 Muscular strength endurance of abdominal muscle:

The difference in muscular strength endurance of abdominal muscle performance and significance of statistical difference in muscular strength endurance of abdominal muscle performance of different time of day were presented in table 29.

**Table 29: Comparison of muscular strength endurance of abdominal muscle (number) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 33.50 ± 8.06 | 0.26 | 0.76 |
| **12.00 pm** | 34.60 ± 8.79 | | |
| **4.00 pm** | 35.77 ± 8.74 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 29 reveals that Mean and SD with regard to muscular strength endurance of abdominal musclein the different time of day were 33.50±8.06,34.60 ±8.79,35.77±8.74 respectively. It was seen from the table that the mean score in muscular strength endurance of abdominal muscle was better during 4.00 pm. Thus it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated **(**Table 29).

There was no significant difference were observed in muscular strength endurance of abdominal muscle at different time interval of a day (table 29) as p value is higher than 0.05.

### 4.7.6 Basic endurance

The difference in basic endurance performance and significance of statistical difference in basic endurance performance of different time of day were presented in table 30.

**Table 30: Comparison of basic endurance (sec) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 113.63 ± 10.19 | 3.45 | 0.03 |
| **12.00 pm** | 112.56± 7.89 | | |
| **4.00 pm** | 108.26± 6.63 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 30 reveals that Mean and SD with regard to endurance in the different time of day were 113.63±10.19, 112.56 ±7.89.108.26±6.63 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in basic endurance at different time of day (Table 30).

In order to find out exact location of difference post hoc test was applied.

**Table 31: Post hoc test for difference between the paired means on basic endurance.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm | 1.06 | 2.16 | .623 |
| | 4.00 pm* | 5.36 | 2.16 | .015 |
| **12.00 pm** | 8.00 am | 1.066 | 2.16 | .623 |
| | 4.00 pm* | 4.300 | 2.16 | .050 |
| **4.00 pm** | 8.00 am* | 5.3666 | 2.16 | .015 |
| | 12.00 pm* | 4.3000 | 2.16 | .050 |

**Significant at *p<0.05**

From post hoc table it was found the basic endurance in sprinters was significantly changed in different time interval of a day [$F_{(2,27)} - 3.45$, $p<0.05$] . The significant difference was observed between 12.00 pm and 4.00 pm as well as 8.00 am and 4.00 pm. (Table 31). Thus it was conclude that basic endurancewas significantly higher at 8.00 am as lower mean value indicate high performance.

## 4.8. Comparison of selected physiological parameters among the selected sprinters in different time periods of a day in winter season.

### 4.8.1 Resting pulse rate:

The difference in resting pulse rate and significance of statistical difference in resting pulse rate of different time of day were presented in table 32.

**Table 32: Comparison of resting pulse rate (beats/min) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 60.76± 1.77 | 3.04 | .09 |
| **12.00 pm** | 64.10± 2.26 | | |
| **4.00 pm** | 65.03± 3.06 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-32 reveals that Mean and SD with regard to resting pulse rate in the different time of day60.76±1.77,64.10 ±2.26,65.03±3.06 respectively. It was seen from the table that the mean score in resting pulse ratewas lower during 8.00 am. In order to find out whether mean difference is significant or not ANOVA was calculated (Table 32).

There was no significant difference were observed in pulse rate at different time interval of a day (table 32) as p value is higher than 0.05.

**4.8.2 Resting systolic blood pressure (SBP):**

The difference in resting systolic blood pressure and significance of statistical difference in resting systolic blood pressure of different time of day were presented in table 33.

**Table 33: Comparison of systolic blood pressure (mm of Hg) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 117.13 ± 2.44 | 43.50 | 0.00 |
| **12.00 pm** | 120.27 ± 3.12 | | |
| **4.00 pm** | 124.20 ± 3.18 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-33 reveals that Mean and SD with regard to systolic blood pressure in the different time of day117.13±2.44,120.27 ±3.12,124.20±3.18 respectively. From the table value it was clear that there was difference in systolic blood pressure at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in systolic blood pressureat different time of day (Table 33).

In order to find out exact location of difference post hoc test was applied.

**Table 34: Post hoc test for difference between the paired means on systolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -3.13333* | .75918 | .000 |
| | 4.00 pm* | -7.06667* | .75918 | .000 |
| **12.00 pm** | 8.00 am* | 3.13333* | .75918 | .000 |
| | 4.00 pm* | -3.93333* | .75918 | .000 |
| **4.00 pm** | 8.00 am* | 7.06667* | .75918 | .000 |
| | 12.00 pm* | 3.93333* | .75918 | .000 |

**Significant at *p<0.05**

Systolic blood pressure in sprinter was significantly changed in different time interval of a day [$F_{(2,27)} - 43.50$, $p<0.05$] . The significance difference was observed between 8.00 am and 12.00 pm, 12.00pm and 4.00 pm, as well as 8.00 am and 4.00 pm (Table 34). Thus, it was conclude that systolic blood pressure was significantly higher at 4.00 pm.

### 4.8.3: Resting diastolic blood pressure (DBP):

The difference in resting diastolic blood pressure and significance of statistical difference in resting diastolic blood pressure of different time of day were presented in table 35.

**Table 35: Comparison of diastolic blood pressure (mm of Hg) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 78.30 ± 1.89 | 74.84 | 0.00 |
| **12.00 pm** | 81.73 ± 1.22 | | |
| **4.00 pm** | 82.70 ± 1.14 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-35 reveals that Mean and SD with regard to diastolic blood pressure in the different time of day78.30 ± 1.89, 81.73 ± 1.22, 82.70 ± 1.14respectively. From the table value it was clear that there was difference in diastolic blood pressure at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in diastolic blood pressure at different time of day (Table 35).

In order to find out exact location of difference post hoc test was applied.

**Table 36: Posthoc test for difference between the paired means on diastolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -3.43333* | .37800 | .000 |
| | 4.00 pm* | -4.40000* | .37800 | .000 |
| **12.00 pm** | 8.00 am* | 3.43333* | .37800 | .000 |
| | 4.00 pm* | -.96667* | .37800 | .012 |
| **4.00 pm** | 8.00 am* | 4.40000* | .37800 | .000 |
| | 12.00 pm* | .96667* | .37800 | .012 |

**Significant at *p<0.05**

Diastolic blood pressurein sprinters was significantly changed in different time interval of a day [$F_{(2,27)} – 74.84$, $p<0.05$] . The significance difference was observed

between 12 .00pm and 4 pm,8 am and 4 pm as well as 8 am and 12 pm. (Table 36).thus it was conclude that diastolic blood pressure was significantly higher value at 4.00 pm.

### 4.8.4: Resting body temperature (Fahrenheit):

The difference in resting body temperature and significance of statistical difference in resting body temperature of different time of day were presented in table 37.

**Table 37: Comparison of resting body temperature (Fahrenheit) in different time periods of the day among the selected sprinters (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 96.41 ± 0.97 | 34.27 | 0.00 |
| **12.00 pm** | 97.35 ± 0.83 | | |
| **4.00 pm** | 98.23 ± 0.72 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 37 reveals that Mean and SD with regard to resting body temperature in the different time of day96.41±0.97, 97.35 ±0.83,98.23±0.72 respectively. From the table value it was clear that there was difference in body temperature at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in resting body temperature at different time of day (Table 37).

In order to find out exact location of difference post hoc test was applied.

**Table 38: Post hoc test for difference between the paired means on resting body temperature.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -.94533* | .22064 | .000 |
| | 4.00 pm* | -1.82633* | .22064 | .000 |
| **12.00 pm** | 8.00 am* | .94533* | .22064 | .000 |
| | 4.00 pm* | -.88100* | .22064 | .000 |
| **4.00 pm** | 8.00 am* | 1.82633* | .22064 | .000 |
| | 12.00 pm* | .88100* | .22064 | .000 |

**Significant at *p<0.05**

Resting body temperature in sprinter was significantly changed in different time interval of a day [$F_{(2,27)} - 34.27$, $p<0.05$]. The significance difference was observed between 12.00pm and 4.00 pm and 8.00 am and 4.00 pm as well as 8.00 am and 12.00 pm (Table 38).Thus, it was conclude that resting body temperature was significantly higher value at 4.00 pm.

## 4.9. Correlation between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day

### 4.9.1 Correlation between selected physiological parameters and AAHPER youth physical fitness parameter of male sprinter (n=30) subjects in morning at 8.00 am.

The relationship between selected physiological parameters and AAHPER youth physical fitness parameter at different time of day of male sprinter (n=30) subjects in morning at 8.00 am were presented in table 39.

**Table 39: Correlation between selected physiological parameters and AAHPER youth physical fitness parameter of male sprinter (n=30) subjects in morning at 8.00 am.**

| Physiological variables | Speed | Agility | Power | Arm strength | Abdominal strength | Endurance | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .42* | .53* | .26NS | .93* | .91* | .96* | .88* |
| Systolic BP | .59* | .75* | .16NS | .93* | .95* | .20NS | .81* |
| Diastolic BP | .77* | .78* | .08 NS | .92* | .91* | .65* | .48* |
| Pulse rate | .79* | .38* | .79* | .53* | .80* | .15NS | .82* |

**table value of r at 0.05 level with 28 df =0.36**

From the table 39 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r= 0.36 with 28 df and 0.05 level of significance.

It was observed that relationship between body temperature and power displays no significant relationship. It was also observed that relationship between

systolic blood presser with leg power, endurance showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood presser and power. It was also observed that pulse rate showed no significant relationship with endurance.From the table value it was clearly observed that selected physiological parameter showed significant positive correlation with total fitness.

### 4.9.2 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinter (n=30) subjects in noon at 12.00 pm.

The relationship between selected physiological parameters and AAHPER Youth Physical Fitness parameters at different time of day of male sprinter (n=30) subjects in noon at 12.00 pm were presented in table 40.

**Table 40: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinter (n=30) subjects in noon at 12.00 pm.**

| Physiological variables | Speed | Power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .73* | .93* | .52* | .22NS | .38* | .95* | .73* |
| Systolic BP | .89* | .61* | .29NS | .40* | .22NS | .42* | .63* |
| Diastolic BP | .86* | .16NS | .07NS | .85* | .99* | .23NS | .28NS |
| Pulse rate | .64* | .08NS | .76* | .46* | .54* | .78* | .24NS |

**table value of r at 0.05 level with 28 df =0.36**

From the table 40 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER Youth Physical Fitness parameters as the calculate value is higher than the table value of r (0.36) with 28 df at 0.05 level of significance.

It was observed that relationship between body temperature and agility displays no significant relationship. It was also observed that relationship between systolic blood pressure and arm strength, endurance showed no significant relationship. From the table value it was also found that no significant relationship

exist between diastolic blood pressure with leg power, strength and total fitness. It was also observed that pulse rate showed no significant relationship with power and total fitness**.**

### 4.9.3 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinters (n=30) in afternoon at 4.00 pm.

The relationship between selected physiological parameters and AAHPER youth physical fitness parameter at different time of day of male sprinter (n=30) subjects in after noon at 4.00 pm were presented in table 41

**Table 41: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male sprinters (n=30)in afternoon at 4.00 pm.**

| Physiological variables | Speed | Power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .46* | .53* | .73* | .58* | .75* | .25NS | .98* |
| Systolic BP | .62* | .10NS | .17NS | .52* | . 61* | .51* | . 61* |
| Diastolic BP | .83* | .11NS | .07NS | .76* | .67* | .55* | . 02NS |
| Pulse rate | .52* | .06NS | .84* | .92* | .60* | .79* | .10NS |

**table value of r at 0.05 level with 28 df =0.36**

From the table 41 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r(0.361) with 28 df level of significance.

It was observed that relationship between body temperature and abdominal strength displays no significant relationship. It was also observed that relationship between systolic blood presser with leg power arm and strength showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood presser with power ,arm strength and total fitness. It was also observed that pulse rate showed no significant relationship with power and total fitness. From the table value it clearly observed that selected physiological parameter show significant positive correlation with total fitness except diastolic bp and pulse rate.

## 4.10. Meteorological condition and personal data of jumpers of different time periods of a day in summer season:

The temperature and humidity had been measured in different time intervals of day before starting the experiment.In table 42 metrological condition of different time of day in summer season were presented.

**Table 42: Meteorological condition of different time of a day in summer season.**

| Variables | Time periods of the day | | |
|---|---|---|---|
| | **8.00 am** | **12.00 pm** | **04.00 pm** |
| Temperature | 24°C - 28°C | 32°C - 34°C | 31°C - 32°C |
| Humidity | 77% - 76% | 70% - 65% | 60% - 55% |

From table - 42 it was seen that the temperature and humidity of a day in different time intervals were at 08.00 am 24°C - 28°C (77% - 76%), at 12.00 pm 32°C - 34°C (70% - 65%) and at 04.00 pm 31°C - 32°C (60% - 55%) respectable(Table 42).

## 4.11 Personal data

The personal data had been measure before starting the experiment.In table 43 personal data of jumpers were presented

**Table 43: Personal data of subjects**

| Variable | MEAN ± SD |
|---|---|
| Age (years) | 23.18 ± 1.45 |
| Weight (kg) | 62.00 ± 1.51 |
| Height (cm) | 162.01 ± 1.42 |

From table 43 it was clearly seen that the Mean and SD of age , weight and height of the subject were 23.18 yrs. ± 1.45,62.00 kg ± 1.51 and162.01 cm ± 1.42 respectively.

## 4.12. Comparison of selected motor fitness parameters among the jumpers in different time periods of a day in summer season were presented here.

### 4.12.1 Speed:

The difference in sprinting performance and significance of statistical difference in sprinting performance of different time of day were presented in table 44

**Table 44: Comparison of speed (Sec) performance in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 7.25 ± 0.55 | 0.10 | 0.90 |
| **12.00 pm** | 7.28 ± 1.04 | | |
| **4.00 pm** | 6.95± 0.50 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-44 reveals that Mean and SD with regard to speed in the different time of day7.25±0.55,7.28 ±1.04,6.95±0.50 respectively. It was seen from the table that the mean score in speed was better during 4.00 Pm.(as lower mean value indicate high performance) thus it was considered that performance was higher in 4pm .

In order to find out whether mean difference is significant or not ANOVA was calculated(Table 44).There was no significant difference were observed in sprinting ability at different time interval of a day (table 44) as p value is higher than 0.05.

**4.12.2 Explosive leg power:**

The difference inexplosive leg power performance and significance of statistical difference in explosive leg power performance of different time of day were presented in table 45.

**Table 45: Comparison of explosive leg power(mtr) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 2.50±0.19 | 11.01. | 0.01 |
| **12.00 pm** | 2.45±0.18 | | |
| **4.00 pm** | 2.66±0.16 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 45 reveals that Mean and SD with regard to explosive leg power in the different time of day2.50±0.19,2.45 ±0.18,2.66±0.16 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in explosive leg power at different time of day (Table 45).

In order to find t out exact location of difference post hoc test was applied.

**Table 46: Post hoc test for difference between the paired means on explosive leg power .**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm | .05433 | .04709 | .252 |
| | 4.00 pm* | -.15833* | .04709 | .001 |
| **12.00 pm** | 8.00 am | -.05433 | .04709 | .252 |
| | 4.00 pm* | -.21267* | .04709 | .000 |
| **4.00 pm** | 8.00 am* | .15833* | .04709 | .001 |
| | 12.00 pm* | .21267* | .04709 | .000 |

**Significant at *p<0.05**

From post hoc table it was found that the explosive leg power in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 11.01$, $p<0.05$] . The significance difference was observed between 12 .00pm and 4 pm as well as 4 pm and 8 am (Table 46).Thus it was conclude that explosive leg power was significantly higher at 4.00 pm.

**4.12.3 Agility :**

The difference in agility performance and significance of statistical difference inagility performance of different time of day were presented in table 47

**Table 47: Comparison of agility (sec)in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 9.59 ± 0.60 | 8.50 | 0.00 |
| **12.00 pm** | 10.19 ± 0.66 | | |
| **4.00 pm** | 9.55 ± 0.52 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 47 reveals that Mean and SD with regard to agility in the different time of day9.59±0.60,10.19 ±0.66,9.55±0.52 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in agility at different time of day(Table 47).

In order to find out exact location of difference post hoc test was applied.

**Table 48: Post hoc test for difference between the paired means on agility.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -.59367* | .15502 | **.000** |
| | 4.00 pm | -.09100 | .15502 | **.559** |
| **12.00 pm** | 8.00 am* | .59367* | .15502 | **.000** |
| | 4.00 pm* | .50267* | .15502 | **.002** |
| **4.00 pm** | 8.00 am | .09100 | .15502 | **.559** |
| | 12.00 pm* | -.52200 | .15169 | .001 |

**Significant at *p<0.05**

From post hoc table 48 it was found that the agility in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 8.50$, $p<0.05$]. The significance difference was observed between 8.00 am and 12.00 pm as well as 12.00 pm and 4.00 pm. (Table 48). Thus, it was conclude that agility was significantly higher at 4.00 pm (as lower mean value indicate high performance).

### 4.12.4: Muscular strength endurance of arm and shoulder

The difference in muscular strength endurance of arm and shoulder performance and significance of statistical differencein muscular strength endurance of arm and shoulder performance of different time of day were presented in table 49.

**Table 49: Comparison of muscular strength endurance of arm and shoulder (number) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 11.73 ± 4.04 | 1.98 | 0.14 |
| **12.00 pm** | 12.40 ± 3.82 | | |
| **4.00 pm** | 13.63 ± 3.30 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 49 reveals that Mean and SD with regard to muscular strength endurance of arm and shoulder in the different time of day11.73±4.04,12.40 ±3.82,13.63±3.30 respectively. It was seen from the table that the mean score in muscular strength endurance of arm and shoulder was better during 4.00 Pm, thus it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 49).

There was no significant difference were observed in muscular strength endurance of arm and shoulder ability at differents time interval of a day (table 49) as p value is higher than 0.05.

### 4.12.5 Muscular strength endurance of abdominal muscle:

The difference in muscular strength endurance of abdominal muscle performance and significance of statistical difference in muscular strength endurance of abdominal muscle performance of different time of day were presented in table -50

**Table 50: Comparison of muscular strength endurance of abdominal muscle number) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 28.20 ± 7.02 | 0.15 | 0.85 |
| **12.00 pm** | 23.26 ± 7.77 | | |
| **4.00 pm** | 30.03 ± 8.33 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 50 reveals that Mean and SD with regard to muscular strength endurance of abdominal musclein the different time of day 28.20±7.02,23.26 ±7.77,30.03±8.33 respectively. It was seen from the table that the mean score inmuscular strength endurance of abdominal muscle was better during 4.00 pm. Thus, it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 50).

There was no significant difference were observed in muscular strength endurance of abdominal muscle ability at different time interval of a day (table 50) as p value is higher than 0.05.

### 4.12.6 Basic endurance:

The difference in basic endurance performance and significance of statistical difference in basic endurance performance of different time of day were presented in table 51.

**Table 51: Comparison of basic endurance (Second) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 108.03 ± 6.23 | 4.13 | 0.01 |
| **12.00 pm** | 113.76± 10.26 | | |
| **4.00 pm** | 108.73 ± 8.61 | | |

Table Value of $F_{0.05}(2,27) = 3.35$

Table-51 reveals that Mean and SD with regard to basic endurance in the different time of day108.03±6.23, 113.76 ±10.26,108.73±8.61 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in basic endurance at different time of day (Table 51).

In order to find out exact location of difference post hoc test was applied.

**Table 52: Post hoctest for difference between the paired means on basic endurance.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm * | -5.73333* | 2.17619 | .010 |
| | 4.00 pm | -.70000 | 2.17619 | .748 |
| **12.00 pm** | 8.00 am * | 5.73333* | 2.17619 | .010 |
| | 4.00 pm* | 5.03333* | 2.17619 | .023 |
| **4.00 pm** | 8.00 am | .70000 | 2.17619 | .748 |
| | 12.00 pm* | -5.03333* | 2.17619 | .023 |

**Significant at *p<0.05**

From post hoc table 52 it was found the basic endurance in jumperwas significantly changed in different time interval of a day [$F_{(2,27)} - 4.13$, $p<0.05$] . The significance difference was observed between 8.00am and 12.00 pm as well as12pm and 4 pm (Table 52).Thus, it was conclude that basic endurance was significantly higher at 8.00 am. (As lower mean value indicate high performance).

## 4.13 Comparison of selected physiological parameters among the selected jumpers in different time periods of a day in summer season.

### 4.13.1 Resting pulse rate:

The difference in resting pulse rate and significance of statistical difference in resting pulse rateof different time of day were presented in table 53.

**Table 53: Comparison of resting pulse rate (Beats/minute) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 63.86 ± 2.39 | .14 | .86 |
| **12.00 pm** | 64.10 ± 1.40 | | |
| **4.00 pm** | 63.43 ± 2.61 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-53 reveals that Mean and SD with regard to resting pulse ratein the different time of day63.86±2.39, 64.10 ±1.40,63.43±2.61 respectively. It was seen from the table that the mean score in resting pulse rate was lower during 4.00 pm.In order to find out whether mean difference is significant or not ANOVA was calculated (Table 53).

There was no significant difference were observed inresting pulse rate at different time interval of a day (table 53) as p value is higher than 0.05.

### 4.13.2 Resting systolic blood pressure (SBP):

The difference in resting systolic blood pressure and significance of statistical difference in resting systolic blood pressure of different time of day were presented in table 54.

**Table 54: Comparison of systolic blood pressure (mm of Hg) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 115.30 ± 2.74 | 55.07 | 0.00 |
| **12.00 pm** | 116.73 ± 2.31 | | |
| **4.00 pm** | 121.33 ± 1.82 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-54 reveals that Mean and SD with regard to systolic blood pressure in the different time of day 115.30±2.74,116.73 ±2.31,121.33±1.82 respectively. From the table value it was clear that there was difference in systolic blood pressure at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in systolic blood presser at different time of day (Table 54).

In order to find out exact location of difference post hoc test was applied.

**Table 55: Post hoctest for difference between the paired means on systolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -1.43333* | .60066 | .019 |
| | 4.00 pm* | -6.03333* | .60066 | .000 |
| **12.00 pm** | 8.00 am* | 1.43333* | .60066 | .019 |
| | 4.00 pm* | -4.60000* | .60066 | .000 |
| **4.00 pm** | 8.00 am* | 6.03333* | .60066 | .000 |
| | 12.00 pm* | 4.60000* | .60066 | .000 |

**Significant at *p<0.05**

The systolic blood pressure in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 55.07$, $p<0.05$]. The significance difference was observed between 8.00 am and 12.00 pm, 12.00 pm and 4.00 pm, as well as 8.00 am

and 4.00 pm (Table 55). Thus it was conclude that systolic blood pressure was significantly lower at 8.00 am.

### 4.13.3: Resting diastolic blood pressure (DBP):

The difference in resting diastolic blood pressure and significance of statistical difference in resting diastolic blood pressure of different time of day were presented in table 56.

**Table 56: Comparison of diastolic blood pressure (mm of Hg) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 75.80 ± 1.24 | 59.37 | 0.00 |
| **12.00 pm** | 77.57 ± 0.56 | | |
| **4.00 pm** | 81.43 ± 1.00 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 56 reveals that Mean and SD with regard to diastolic blood pressure in the different time of day75.80 ± 1.24, 77.57± 0.56, 81.43 ± 1.00 respectively. From the table value it was clear that there was difference at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in diastolic blood pressure at different time of day (Table 56).

In order to find out exact location of difference post hoc test was applied.

**Table 57: Post hoc test for difference between the paired means on diastolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -1.76667* | .25300 | .000 |
| | 4.00 pm* | -5.63333* | .25300 | .000 |
| **12.00 pm** | 8.00 am* | 1.76667* | .25300 | .000 |
| | 4.00 pm* | -3.86667* | .25300 | .000 |
| **4.00 pm** | 8.00 am* | 5.63333* | .25300 | .000 |
| | 12.00 pm* | 3.86667* | .25300 | .000 |

**Significant at *p<0.05**

Diastolic blood pressurein jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 59.37$, $p<0.05$] . The significance difference was observed between 12.00pm and 4.00 pm, 8.00 am and 4.00 pm as well as 8.00 am and 12.00 pm. (Table 57).Thus it was concluded that diastolic blood pressurewas higher at 4.00 pm.

### 4.13.4 Resting body temperature:

The difference in resting body temperature and significance of statistical difference in resting body temperature of different time of day were presented in table 58.

**Table 58: Comparison of resting body temperature (Fahrenheit) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 96.41 ± 0.97 | 34.12 | 0.00 |
| **12.00 pm** | 97.31 ± 0.81 | | |
| **4.00 pm** | 98.21 ± 0.73 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-58 reveals that Mean and SD with regard to resting body temperature in the different time of day96.41±0.97, 97.31 ±0.81,98.21±0.73 respectively. From the table value it was clear that there was difference in body temperature at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant differencein resting body temperature at different time of day (Table 58).

In order to find out exact location of difference post hoc test was applied.

**Table 59: Post hoc test for difference between the paired means on resting body temperature.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm | .21841 | .000 | .157 |
| | 4.00 pm* | .21841 | .000 | .004 |
| **12.00 pm** | 8.00 am | .21841 | .000 | .157 |
| | 4.00 pm | .21841 | .000 | .139 |
| **4.00 pm** | 8.00 am* | .21841 | .000 | .004 |
| | 12.00 pm | .21841 | .000 | .139 |

**Significant at *p<0.05**

Resting body temperature in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 34.12$, $p<0.05$] . The significance difference was observed between 8.00 am and 4.00 pm (Table 59). Thus, it was conclude that resting body temperature was significantly higher at 4.00 pm.

## 4.14. The relatioship between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day

### 4.14.1 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in morning at 8.00 am.

The relationship between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day of male jumper(n=30) subjects in morning at 8.00 am were presented in table 60.

**Table 60: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in morning at 8.00 am**

| Physiological variables | Speed | Agility | Power | Arm strength | Abdominal strength | Endurance | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .81* | .47* | .19 NS | .42* | .69* | .47 * | .90* |
| Systolic BP | .65* | .27NS | .81* | .48* | .58* | .81* | .94* |
| Diastolic BP | .72* | .92* | .72* | .14NS | .68* | .65* | .46* |
| Pulse rate | .81* | .26 NS | .44* | .83* | .91* | .14NS | .29NS |

**table value of r at 0.05 level with 28 df =0.36**

From the table 60 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r(0.36) with 28 df and 0.05 level of significance. It was observed that relationship between body temperature and leg power displays no significant relationship. It was also observed that relationship between systolic blood presser and agility showed no significant relationship. From the table value it was also found that

no significant relationship exist between diastolic blood presser and arm strength. It was also observed that pulse rate showed no significant relationship with agility and endurance and total fitness

From the table value it clearly observed that selected physiological parameters showed significant positive correlation with total fitness except pulse rate.

### 4.14.2 Correlation between selected physiological parameters andAAHPER youth physical fitness parameters of male jumpers (n=30) in noon at 12.00 pm.

The relationship between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day of male jumpers (n=30) in noon at 12.00 pm were presented in table 61

**Table 61: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in noon at 12.00 pm.**

| Physiological variables | Speed | Agility | Power | Arm strength | Abdominal strength | Endurance | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .42* | .51* | .27NS | .91* | .91* | .93* | .84* |
| Systolic BP | .57* | .73* | .18NS | .83* | .85* | .20NS | .80* |
| Diastolic BP | .73* | .74* | .02 NS | .82* | .81* | .65* | .42* |
| Pulse rate | .79* | .38* | .71* | .63* | .50* | .25NS | .72* |

**table value of r at 0.05 level with 28 df =0.36**

From the table- 61 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r (0.36) with 28 df and 0.05 level of significance.

It was observed that relationship between body temperature and leg power displays no significant relationship. It was also observed that relationship between systolic blood presser and leg power as well as systolic blood presser and endurance showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood presser and leg power It was also

observed that pulse rate showed no significant relationship with endurance.From the table value it clearly observed that selected physiological parameter show significant positive correlation with total fitness.

### 4.14.3 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in after noon at 4.00 pm.

The relationship between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day of male jumpers (n=30) in after noon at 4.00 pm were presented in table 62.

**Table 62: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in after noon at 4.00 pm.**

| Physiological variables | Speed | Power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | **.61*** | **.52*** | **.90*** | **.39*** | **.61*** | **.39*** | **.64*** |
| Systolic BP | **.81*** | **.16NS** | **.38*** | **.40*** | **.91*** | **.47*** | **.71*** |
| Diastolic BP | **.67*** | **.81*** | **.91*** | **.20NS** | **.68*** | **.65*** | **.46*** |
| Pulse rate | **.52*** | **.67*** | **.61*** | **.18NS** | **.61*** | **.19NS** | **.21NS** |

**table value of r at 0.05 level with 28 df =0.36**

From the table 62 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r (0.36) with 28 df and 0.05 level of significance.

It was also observed that relationship between systolic blood presser and leg power showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood presser and agility. It was also observed that pulse rate showed no significant relationship with agility, strength

and total fitness.From the table value it clearly observed that selected physiological parameter showed significant positive correlation with total fitness except pulse rate.

## 4.15. Meteorological condition of different time periods of a day in winter season:

The temperature and humidity had been measured in different time intervals of daybefore starting the experiment .In table 63 metrological condition of different time of day in winter season were presented. Table 63 showed the result.

**Table 63: Meteorological condition of different time of a day in winter season.**

| Variables | Time periods of the day | | |
|---|---|---|---|
| | **8.00 am** | **12.00 pm** | **04.00 pm** |
| Temperature | 14°C - 16°C | 22°C - 25°C | 22°C - 23°C |
| Humidity | 74% - 77% | 60% - 63% | 40% - 43% |

From table 63 it was seen that the temperature and humidity of a day in different time intervals were at 08.00 am- 14°C - 16°C (74% - 77%), at 12.00 pm-22°C - 25°C (60% - 63%) and at 04.00 pm-22°C - 23°C (40% - 43%) respectable(Table 63).

## 4.16. Comparison of selected motor fitness parameters among the jumper in different time periods of a day in winter season were presented here.

### 4.16.1 Speed:

The difference in sprinting performance and significance of statistical difference in sprinting performance of different time of day were presented in table 64.

**Table 64: Comparison of speed (sec) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 7.17 ± 0.48 | 1.81 | 0.16 |
| **12.00 pm** | 7.01 ± 0.40 | | |
| **4.00 pm** | 6.95 ± 0.47 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-64 reveals that Mean and SD with regard to speed in the different time of day7.17±0.48, 7.01 ±0.40,6.95±0.47 respectively. It was seen from the table that the mean score speed was better during 4.00 pm(as lower mean value indicate high performance) thus it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 64).

There was no significant difference were observed in sprinting ability at different time interval of a day (table 64) as p value is higher than 0.05.

**4.16.2 Explosive leg power:**

The difference inexplosive leg power performance and significance of statistical difference in explosive leg power performance of different time of day were presented in table 65.

**Table 65: Comparison of explosive leg power (mtr) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 2.56 ± 0.28 | 18.39 | 0.00 |
| **12.00 pm** | 2.51 ± 0.25 | | |
| **4.00 pm** | 3.13 ± 0.68 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table - 65 reveals that Mean and SD with regard to explosive leg power in the different time of day2.56±0.28,2.51±0.25,3.13±0.68 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in explosive leg power at different time of day (Table 65).

In order to find out exact location of difference post hoc test was applied.

**Table 66: Post hoc test for difference between the paired means on explosive leg power.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm | .04367 | .11285 | .700 |
| | 4.00 pm* | -.56967* | .11285 | .000 |
| **12.00 pm** | 8.00 am | -.04367 | .11285 | .700 |
| | 4.00 pm* | -.61333* | .11285 | .000 |
| **4.00 pm** | 8.00 am* | .56967* | .11285 | .000 |
| | 12.00 pm* | .61333* | .11285 | .000 |

**Significant at *p<0.05**

From post hoc table 66 it was found that the explosive leg power in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 18.39$, $p<0.05$] . The significance difference was observed between 12.00pm and 4.00 am as well as 8 am and 4 pm (Table 66).

**4.16.3 Agility:**

The difference in agility performance and significance of statistical difference inagility performance of different time of day were presented in table 67

**Table 67: Comparison of agility (sec)in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 10.18 ± 0.65 | 9.04 | 0.00 |
| **12.00 pm** | 9.67 ± 0.49 | | |
| **4.00 pm** | 9.59 ± 0.59 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-67 reveals that Mean and SD with regard to agility in the different time of day10.18±0.65,9.67 ±0.49,9.59±0.59 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in agility at different time of day (Table 67).

In order to find out exact location of difference post hoc test was applied

**Table 68: Post hoc test for difference between the paired means on agility.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | .51567* | .15124 | .001 |
| | 4.00 pm* | .59067* | .15124 | .000 |
| **12.00 pm** | 8.00 am* | -.51567* | .15124 | .001 |
| | 4.00 pm | .07500 | .15124 | .621 |
| **4.00 pm** | 8.00 am* | -.59067* | .15124 | .000 |
| | 12.00 pm | -.07500 | .15124 | .621 |

**Significant at *p<0.05**

Table - 68 represent that the agility in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 9.04$, $p<0.05$]. The significance difference was observed between 8.00 am and 12.00 pm as well as 8.00 am and 4.00 pm (Table 68). Thus it was conclude that agility was significantly higher at 4.00 pm as lower mean value indicate high performance.

### 4.16.4: Muscular strength endurance of arm and shoulder

The difference in muscular strength endurance of arm and shoulder performance and significance of statistical difference in muscular strength endurance of arm and shoulder of different time of day were presented in table 69

**Table 69: Comparison of muscular strength endurance of arm and shoulder (number) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 09.30 ± 4.12 | 3.34 | 0.06 |
| **12.00 pm** | 12.30 ± 3.94 | | |
| **4.00 pm** | 13.86 ± 3.53 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-69 reveals that Mean and SD with regard to muscular strength endurance of arm and shoulder in the different time of day9.30±4.12,12.30 ±3.94,13.86±3.53 respectively. It was seen from the table that the mean score in muscular strength endurance of arm and shoulder was better during 4.00 pm(as higher

mean value indicate high performance) thus it was considered that performance was higher in 4.00pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 69).

There was no significant difference were observed in muscular strength endurance of arm and shoulderat different time interval of a day (table 69) as p value is higher than 0.05.

**4.16.5 Muscular strength endurance of abdominal muscle:**

The difference in muscular strength endurance of abdominal muscle performance and significance of statistical difference in muscular strength endurance of abdominal muscle performance of different time of day were presented in table 70.

**Table 70: Comparison of muscular strength endurance of abdominal muscle (number) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 32.23 ± 6.91 | 0.35 | 0.70 |
| **12.00 pm** | 28.76 ± 7.98 | | |
| **4.00 pm** | 33.80 ± 8.13 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 70 reveals that Mean and SD with regard to muscular strength endurance of abdominal musclein the different time of day32.23±6.91,28.76 ±7.98,33.80±8.13 respectively. It was seen from the table that the mean score in muscular strength endurance of abdominal muscle was better during 4.00 pm, thus it was considered that performance was higher in 4.00 pm.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 70).

There was no significant difference were observed in muscular strength endurance of abdominal muscle at different time interval of a day (table 70) as p value is higher than 0.05.

### 4.16.6 Basic endurance

The difference in basic endurance performance and significance of statistical difference in basic enduranceperformance of different time of day were presented in table 71

**Table 71: Comparison of basic endurance (sec) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 118.00 ± 10.28 | 6.01 | 0.00 |
| **12.00 pm** | 115.60± 10.24 | | |
| **4.00 pm** | 109.70± 6.14 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-71 shows that Mean and SD with regard to basic endurance in the different time of day118.00±10.28,115.60 ±10.24.109.70±6.14 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference inbasic endurance at different time of day (Table 71).

In order to find out exact location of difference post hoc test was applied.

**Table 72: Post hoc test for difference between the paired means on basic endurance.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm | 2.40000 | 2.46314 | .333 |
| | 4.00 pm* | 8.30000* | 2.46314 | .001 |
| **12.00 pm** | 8.00 am | -2.40000 | 2.46314 | .333 |
| | 4.00 pm* | 5.90000* | 2.46314 | .019 |
| **4.00 pm** | 8.00 am* | -8.30000* | 2.46314 | .001 |
| | 12.00 pm* | -5.90000* | 2.46314 | .019 |

**Significant at *p<0.05**

From post hoc table-72 it was found the basic endurance in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 6.01$, $p<0.05$] . The significance difference was observed between 12.00 pm and 4.00 pm as well as 8.00 am and 4.00 pm (Table 72). Thus it was conclude that basic endurance was significantly higher at 4 pm as lower mean value indicate high performance.

## 4.17. Comparison of selected physiological parameters among the selected jumpers in different time periods of a day in winter season.

### 4.17.1 Resting pulse rate:

The difference in resting pulse rate and significance of statistical difference in resting pulse rate of different time of day were presented in table 73

**Table73: Comparison of resting pulse rate (beats/minit) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 64.76± 1.82 | 0.92 | .40 |
| **12.00 pm** | 63.13 ± 2.19 | | |
| **4.00 pm** | 64.50 ± 1.71 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-73 reveals that Mean and SD with regard to resting pulse rate in the different time of day64.76±1.82,63.13 ±2.19,64.50±1.71 respectively. It was seen from the table that the mean score in resting pulse rate was higher during 8.00 am.

In order to find out whether mean difference is significant or not ANOVA was calculated (Table 73).

There was no significant difference were observed in resting pulse rate at different time interval of a day (table 73) as p value is higher than 0.05.

### 4.17.2 Resting systolic blood pressure (SBP):

The difference in resting systolic blood pressure and significance of statistical difference in resting systolic blood pressure of different time of day were presented in table 74.

**Table 74: Comparison of systolic blood pressure (mm of Hg) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 116.27 ± 2.74 | 61.87 | 0.00 |
| **12.00 pm** | 118.63 ± 2.31 | | |
| **4.00 pm** | 124.90 ± 1.82 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-74 reveals that Mean and SD with regard to systolic blood pressure in the different time of day116.27±2.74,118.63 ±2.31,124.90±1.82 respectively. From the table value it was clear that there was difference at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in systolic blood pressure at different time of day (Table 74).

In order to find out exact location of difference post hoc test was applied.

**Table 75: Post hoc test for difference between the paired means on systolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -2.36667* | .80207 | .004 |
| | 4.00 pm* | -8.63333* | .80207 | .000 |
| **12.00 pm** | 8.00 am* | 2.36667* | .80207 | .004 |
| | 4.00 pm* | -6.26667* | .80207 | .000 |
| **4.00 pm** | 8.00 am* | 8.63333* | .80207 | .000 |
| | 12.00 pm* | 6.26667* | .80207 | .000 |

**Significant at *p<0.05**

Table - 75 represent that systolic blood pressure in jumper was significantly changed in different time interval of a day [$F_{(2,27)}$ – 61.87, p<0.05]. The significance difference was observed between 8.00 am and 12.00 pm, 12.00 pm and 4.00 pm, as

well as 8.00 am and 4.00 pm(Table 75). Thus it was conclude that systolic blood pressure was significantly higher at 4.00 pm

### 4.17.3: Resting diastolic blood pressure (DBP):

The difference in resting diastolic blood pressure and significance of statistical difference in resting diastolic blood pressure of different time of day were presented in table 76.

**Table 76: Comparison of diastolic blood pressure (mm of Hg)in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 74.60 ± 13.81 | 9.06 | 0.00 |
| **12.00 pm** | 80.73 ± 1.22 | | |
| **4.00 pm** | 83.20 ± 1.49 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table-76 reveals that Mean and SD with regard to diastolic blood pressure in the different time of day74.60 ± 13.81, 80.73 ± 1.22, 83.20 ± 1.49 respectively. From the table value it was clear that there was difference in performance at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in diastolic blood pressure at different time of day (Table 76).

In order to find out exact location of difference post hoc test was applied.

**Table77: Post hoc test for difference between the paired means on diastolic blood pressure.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | -6.13333* | 2.07962 | .004 |
| | 4.00 pm* | -8.60000* | 2.07962 | .000 |
| **12.00 pm** | 8.00 am* | 6.13333* | 2.07962 | .004 |
| | 4.00 pm | -2.46667 | 2.07962 | .239 |
| **4.00 pm** | 8.00 am* | 8.60000* | 2.07962 | .000 |
| | 12.00 pm | 2.46667 | 2.07962 | .239 |

**Significant at *p<0.05**

Table - 77 shows that diastolic blood pressurein jumpers was significantly changed in different time interval of a day [$F_{(2,27)} - 9.06$, $p<0.05$]. The significance difference was observed between 8.00 am and 4.00 pm as well as 8.00 am and 12.00 pm (Table 77). Thus, it was conclude that diastolic blood pressure was significantly higher value at 4.00 pm.

**4.17.4: Resting body temperature (Fahrenheit):**

The difference inresting body temperature and significance of statistical difference in resting body temperature of different time of day were presented in table 78.

**Table 78: Comparison of resting body temperature (Fahrenheit) in different time periods of the day among the selected jumpers (n=30) and significance of statistical difference of different time of the day.**

| Different time periods of the day | Mean ± SD | F value | P value |
|---|---|---|---|
| **8.00 am** | 94.44 ± 0.97 | 29.89 | 0.00 |
| **12.00 pm** | 97.43 ± 0.84 | | |
| **4.00 pm** | 98.20 ± 0.81 | | |

**table value of $F_{0.05}$ (2,27) = 3.35**

Table- 78 reveals that Mean and SD with regard to resting body temperature in the different time of day94.44±0.97,97.43 ±0.84,98.20±0.81 respectively. From the table value it was clear that there was difference at different time of the day.

In order to find out significant difference F test were applied and by observing p value it was concluded that there was significant difference in resting body temperatureat different time of day (Table 78).

In order to find out exact location of difference post hoc test was applied.

**Table 79: Post hoc test for difference between the paired means on resting body temperature.**

| Post hoc test | | Mean difference | SE | P |
|---|---|---|---|---|
| **8.00 am** | 12.00 pm* | 2.98400* | .22822 | .000 |
| | 4.00 pm* | 3.76067* | .22822 | .000 |
| **12.00 pm** | 8.00 am* | 2.98400* | .22822 | .000 |
| | 4.00 pm* | .77667* | .22822 | .001 |
| **4.00 pm** | 8.00 am* | 3.76067* | .22822 | .000 |
| | 12.00 pm* | .77667* | .22822 | .001 |

**Significant at *p<0.05**

Table - 79 represent that resting body temperature in jumper was significantly changed in different time interval of a day [$F_{(2,27)} - 29.89$, $p<0.05$]. The significance difference was observed between 12.00pm and 4.00 pm and 8.00 am and 4.00 pm as well as 8.00 am and 12.00 pm (Table 79). Thus it was conclude that resting body temperature was significantly higher value at 4.00 pm.

## 4.18. The relationship between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day:

### 4.18.1 Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in morning at 8.00 am.

The relationship between selected physiological parameters and AAHPER youth physical fitness parameter at different time of day of male jumpers (n=30) in morning at 8.00 am were presented in table 80.

**Table 80: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers(n=30) in morning at 8.00 am**

| Physiological variables | Speed | Agility | Power | Arm strength | Abdominal strength | Endurance | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | **.47*** | **.51*** | **.29NS** | **.83*** | **.94*** | **.92*** | **.86*** |
| Systolic BP | **.50*** | **.75*** | **.19NS** | **.91*** | **.95*** | **.20NS** | **.76*** |
| Diastolic BP | **.71*** | **.73*** | **.04NS** | **.90*** | **.91*** | **.65*** | **.49*** |
| Pulse rate | **.71*** | **.33*** | **.71*** | **.53*** | **.80*** | **.15NS** | **.85*** |

**table value of r at 0.05 level with 28 df =0.36**

From the table 80 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r (0.36) with 28 df and 0.05 level of significance.

It was observed that relationship between body temperature and power displays no significant relationship. It was also observed that relationship between systolic blood pressure, leg power and endurance showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood presser and leg power.It was also observed that pulse rate showed no

significant relationship with endurance.From the table value it clearly observed that selected physiological parameters show significant positive correlation with total fitness.

### 4.18.2. Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers(n=30) in noon at 12.00 pm

The relationship between selected physiological parameters and AAHPER youth physical fitness parameters at different time of day of male jumpers (n=30) in noon at 12.00 pm were presented in table 81.

**Table 81: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) subjects in noon at 12.00 pm**

| Physiological variables | Speed | Power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .71* | .93* | .52* | .29NS | .38* | .95* | .71* |
| Systolic BP | .81* | .61* | .27NS | .40* | .26NS | .42* | .66* |
| Diastolic BP | .81* | .19NS | .11NS | .85* | .96* | .26NS | .26NS |
| Pulse rate | .61* | .03NS | .72* | .46* | .51* | .78* | .20NS |

**table value of r at 0.05 level with 28 df =0.36**

From the table 81 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r (0.36) with 28 df level of significance.

It was observed that relationship between body temperature and agility displays no significant relationship. It was also observed that relationship between systolic blood pressure and arm strength as well as systolic blood pressure and endurance showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood pressure with leg power ,arm strength as well as abdominal strength and total fitness. It was also observed that pulse rate showed no significant relationship with power and total fitness.From the

table value it clearly observed that selected physiological parameters show significant positive correlation with total fitness except diastolic blood pressure and pulse rate.

### 4.18.3: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30)in after noon at 4.00 pm.

The relationship betweenselected physiological parameters and AAHPER youth physical fitness parameters at different time of day of male jumpers (n=30) in after noon at 4.00 pm were presented in table 82.

**Table 82: Correlation between selected physiological parameters and AAHPER youth physical fitness parameters of male jumpers (n=30) in after noon at 4.00 pm.**

| Physiological variables | Speed | Power | Arm strength | Agility | Endurance | Abdominal strength | Correlation with total fitness |
|---|---|---|---|---|---|---|---|
| Body temperature | .56* | .53* | .63* | .58* | .75* | .29NS | .95* |
| Systolic BP | .62* | .10NS | .17NS | .52* | .11NS | .61* | .67* |
| Diastolic BP | .63* | .45* | .10NS | .76* | .57* | .55* | .19NS |
| Pulse rate | .52* | .10NS | .84* | .90* | .69* | .79* | .16NS |

**table value of r at 0.05 level with 28 df =0.36**

From the table-82 it was revealed that all the cases positive correlation were found. Almost all the physiological parameters showed significant positive correlation with AAHPER youth physical fitness parameters as the calculate value is higher than the table value of r (0.36) with 28 df level of significance.

It was observed that relationship between body temperature and abdominal strength display no significant relationship. It was also observed that relationship between systolic blood pressure and leg power, arm strength and endurance showed no significant relationship. From the table value it was also found that no significant relationship exist between diastolic blood pressure and arm strength and total fitness. It was also observed that pulse rate showed no significant relationship with power and total fitness.From the table value it clearly observed that selected physiological

parameters show significant positive correlation with total fitness except diastolic blood pressure and pulse rate.

## 4.19 DISCUSSION OF THE RESULTS

The influence of circadian rhythms in human physical performance has been reported in several studies (Atkinson and Reilly, 1996; Drust *et al*., 2005; Redlin and Mrosovsky, 1997; Reilly, 1990). There are some reports on clear relationship between circadian rhythms and Physical activities involving aerobic fitness, anaerobic fitness, fine and gross motor skills (Bessot *et al*., 2007; Kline *et al*., 2007; Reilly *et al*., 2007). Many of our habits, actions and the daily activities have been influenced by the rhythmic oscillation of biological process. According to the Winget *et al*., (1985) many physiological changes associated with the athletic performance have also been shown to follow the circadian rhythms. Cappaert (1999) also reported that many physiological functions like resting levels of sensory motor, perceptual, and cognitive performance and several neuromuscular, behavioural, cardiovascular, and metabolic variables have been found to occur in the early evening, in line with peak body temperature rhythm. The present study has showed that the selected motor performance and physiological functions have been altered in different time periods of the day among the both sprinter and jumper athletes.

It has been observed from the present study that the motor performance of the athletes changed at different time periods of the day. The motor fitness variables like speed, agility, strength/power and endurance of the athletes has been measured by 50 yard run, shuttle run, SBJ and 600 yard run respectively in both sprinter and jumpers in affected by different time periods of the day during summer and winter season. Therefore, the motor fitness performance in winter has increased with the increase in the day hours and reached to the peak level during afternoon at 4.00 pm. Thereafter, the motor fitness performance has showed increasing tendency. So, the results of the present study reveal that the motor fitness performance exhibits the circadian rhythm. The nature of the circadian rhythm in motor fitness performances is of moderate value in the morning, lower value at noon and the peak value reaches in the afternoon/evening in summer season. The reason behind this can be that in early morning hours of summer season, athletes feel easy to perform aerobic activities due to the moderate temperature prevailing in the atmosphere. On contrasting, in winter season athletes feel very easy to perform aerobic activities during the early evening

hours due to the temperature effect. This may be reason in which both resting heart rate and respiratory rate has been found to be better in the early morning hours (08.00 am) (Afonso *et al*., 2009).

The variation in performance which has been observed in the data of the present study is in consonance with many leading researchers (Atkinson and Reilly, 1996; Drust *et al*., 2005; Redlin and Mrosovsky, 1997; Reilly, 1990). Many of these researchers have indicated that from morning to afternoon there is a change in environment temperature with diurnal variation as a consequence, body temperature changes with minimum being in the morning and maximum during afternoon. Furthermore, they have indicated that these changes have a strong influence in body metabolism, calcium release in the muscle fibre, mental activity, sleep-wake cycle, which may be attributed in the final motor performance in selected test. From this observation, it is evident that due to these changes in body external environment as a consequence of circadian rhythm the significant improvement of performance is observed in selected activity. Perhaps for this reason many competition for example weightlifting, wrestling etc where power has a crucial role to play performance are being conducted in the afternoon. Considering the influence of circadian rhythm on performance if competition is being conducted in the afternoon accordingly, the athlete will be benefited maximum but it is also doubtful whether the organizer in various competitions are aware of the changes in performance due to circadian rhythm. In Olympics, it has been observed that marathon is being conducted when temperature is maximum to accommodate TV viewer worldwide. Competition should be conducted after considering the circadian rhythm influence on athletic performance. Training should be conducted by accepting this variation.

The effect of circadian rhythms on sporting performance and some other related variables have been dealt with such as maximal and resting heart rate, maximum isometric power, hormonal adaptations, flexibility, reaction time, body temperature, isokinetic leg power, anaerobic power and capacity has been revealed by many studies (Bougard *et al*., 2009; Afonso *et al*., 2006; Sedliak *et al*., 2007; Reilly and Waterhouse, 2009; Wyse *et al*., 1994; Hill and Smith, 1991). According to the Waterhouse *et al*., (2005), the Body temperature is one of the important basic variables of circadian rhythm and many sporting performance elements follow body temperature changes. The temperature is not constant geographically throughout the day. According to the change of the temperature in a day both physical and

physiological qualities are varied. According to Reilly (1992), the body temperature and motor performance both are closely related. In the present investigation, when the subject's body temperature at various times is measured, it has been revealed that body temperature has increased gradually from morning to afternoon in both summer and winter season. The body temperature measured at 4.00 pm is seen as statistically higher than the body temperature level obtained at 8.00 am and 12.00 pm; similar result has been reported by Venugopal *et al*., (2010). Both the physical and physiological variables differed significantly with the reference to change of temperature in a day (Navamani, 2004). He also found that the above physical variables during the evening hours (14.00 hrs) were significantly higher. Therefore, the results of the present study confirm a causal link between body temperature and exercise performances. Indeed, the increase in core temperature in the afternoon could enhance the conduction velocity of the action potentials and the metabolic reactions increasing. However, the present study's results also showed a significant correlation between body temperature and motor fitness Indeed, the increase in core temperature in the afternoon could enhance the conduction velocity of the action potentials and the metabolic reactions increasing, therefore, the muscle power also increase.

The results of the present study have been supported by the results of previous findings that the motor performance of the athletes shows circadian variations (Reilly, 1990; Atkinson and Reilly, 1996 ;). According to Reilly, (1994), many components of motor performances are closely related to body temperature which reaches to peak level in the evening. Reilly (1994) also suggested that the functions of the lungs, cardio vascular system, kidneys, muscular activity and cognitive abilities have been regulated by circadian rhythms. The maximum efficiency of the players was observed in the late afternoon (Ferrario *et al*., 1982). The grip strength of the athletes happens to be greatest during the day hours and least in night (Kleitman, 1963). Kleitman (1963) and Garai (1992) reported that the accuracy of the performances of the athletes reach to maximum level at 12.00 hours and minimum in the early morning. Reilly and Garrett, (1998) proved that the various sports performances are influenced by the different times throughout the day and it was also depend on the intensities and duration of the exercise. Many studies have documented the fluctuations and changes in athletic performance at various hours of the day. The isokinetic muscle strength of the knee-lowering muscles significantly change in different hours of the day and the muscle strength increases in the evening (Bambaichi *et al*., 2005 34). The fat oxidation was highest in both obese and normal

men observed in the evening (Mohebbi and Azizi, 2011). According to the Jourkesh *et al*., there is significant difference in the maximum anaerobic power at the different time periods of the day; however, there have been no significant changes in speed, strength at different hours of the day in present study. Winget *et al*., (1985) reported that circadian rhythm in motor fitness may also be due to the circadian rhythm in psychological parameters. Subjective alertness and variation in mental performance have been reported to exhibit circadian rhythm with peak value in afternoon Winget et al, (1985) , Brown (1949), Thayer (1970), Dermer (1972).Psychological parameters associated with arousal also exhibit pronounced circadian rhythm with high values during day and lower value during night Conroy and Mills (1970). Most of the world records and athletes peak performances are usually gained in the evening time, because during the evening hours the internal temperature of athletes body is maximum (Reilly and Garratt, 1998)

Results of the present study indicated that the physiological parameters were at peak level in the afternoon. Different physiological factors such as body temperature, pulse rate, blood pressure, cardiovascular functions, respiratory functions, blood compositions etc. involved in the alteration of motor fitness performances with circadian variations. Most of the physiological functions of the human have been influenced by the circadian rhythm along with the physical activity (Sollberger, 1965; Moore Ede et al, 1983). Circadian variations in cardio vascular functions make significant contributions to athletic performances, since these variations influence: the rate of delivery of oxygen, glucose and hormones to various systems, the removal of metabolites from these organs, the distribution of metabolic heat from core to periphery, and the relative impact of physical exercise upon cardiovascular function itself (Winget et al, 1985). According to Winget et al, (1985) the circadian rhythms in cardiac function (stroke volume, cardiac output, and heart rate) peak around 17:00 hrs. The blood pressure is also at the peak level during afternoon, associated with the minimal capillary resistance due to circadian rhythm (Doring and Riecke, 1976; Kanabrocki *et al*., 1973). *Reilly et al*., (2001) pointed out that the circadian rhythm in heart rate responses had significant variation after exercise. The cardiovascular system is most resistant to the impact of position or postural changes during the physical activity (Aschoff and Aschoff, 1969; Hossman *et al*., 1980).

As far as this current investigation is concerned, there are certain limitations. The cardiac output or stroke volume is not measured during the study period. The

hormonal status like the concentration of cortisol and testosterone of the subjects has not been measured during the study period. Only male subjects were selected for the experiment; females were not selected because the physiological conditions of females may change according to their menstrual cycle (Dunne *et al*., 1991; Freedman and Girgis, 2000; Kuwahara *et al*., 2005). So, effects of circadian rhythm may be affected by other physiological factors in females.

From the present study it can be concluded that the physical and physiological activity is higher in afternoon and/or evening in comparison to morning time. The cardiovascular system is influenced in the different time periods of the day in different seasons. Physical efficiency is higher in evening and/or afternoon compare to morning hours, is probably due to efficient regulation of cardiovascular system, and by the autonomic nervous system. However, reflex autonomic and cardiovascular activities are efficient in athlete subjects compared to normal subjects.

## 4.20 TESTING HYPOTHESIS

1) First hypothesis stated that there may be positive relationship between the both physiological and motor fitness parameter with different time of the day.The findings of the study showed that there was significant positive relationship between the some physiological and motor fitness parameter with different time of the day. However there was no significant relationship in few parameters.So as per the assessment of significance, null hypothesis was partially rejected.

2) The second hypothesis stated that there was significant difference among the different time periods of the day on the selected motor fitness and physiological parameter of the athletes.The findings of the study showed that there was significant difference in agility, explosive power, endurance, resting blood presser, and body temperature. Hence the second hypothesis on the above said parameters was accepted. However there was no significant difference in speed, strength, resting pulse rate, at different time of day hence null hypothesis was partially rejected

**3)** The third hypothesis stated that there was no effect of seasonal circadian variation in selected motor fitness and physiological parameter among the athletes. The finding of the study showed that there was significant deference observed thus null hypothesis was rejected.

# *Chapter 5*

***SUMMARY,***

***CONCLUSION &***

***RECOMENDATIONS***

# CHAPTER-V

# SUMMARY, CONCLUSION & RECOMENDATIONS

In this chapter, the summary of all previous chapters has been included. Summary of result and conclusion was drawn on the basis of the result obtained have also been presented in this section. Recommendations of the study for future research as well as for practical application have also been included here.

## 5.1 SUMMARY

The concept of circadian rhythm and its effects on sports training and performance was studied by several researchers, sports physiologists as well as sports scientists. The diurnal variation of circadian rhythm taxes on sports performance in terms of motor fitness as well as the physiological and psychological orientation of an athlete. Sincere efforts have also been made by the researcher to explore various dimensions of circadian rhythm in the sports arena. Nowadays, technological advancement and scientific orientation directly involve exploring sports performance and a tremendous comparative atmosphere has been observed in the field of sports. Now sports are not only limited to amateur settings, it is a profession as well as bread and butter. A large number of sports physiologists, sports scientists, and sports performance analyzers try to identify the specific internal and external orientation of optimum performance. However, it is well known that different types of sports demand different types of physical, physiological as well as psychological characteristics. Generally, physical training or activity indirectly alters the physiological and psychological dimensions of human beings, and family culture, food habits, lifestyle, local climate, and genetic factors play a leading role to build the physical structure. From this point of view, it is clear that specific physical orientation is required to execute any task effectively, that may be fieldwork or daily life activity. Now researchers, coaches, physical trainers as well as sports physiologists try to explore specific times of the day for specific physical training or activity according to their psycho-physiological condition. However, the motor performance of an individual depends on the functioning efficiency of neuro-physiological coordination and psychological readiness and diurnal effects of circadian rhythm taxes on neuro-physiological coordination and psychological readiness. Several studies discover the relationship between circadian

rhythm and various physiological factors and conclude most of the physiological parameters (heart rate, blood pressure, body temperature, etc.) are affected by specific time intervals of the day.

There are several kinds of research that have been carried out to study the effect of circadian rhythm of physiological parameters of human beings such as body temperature, heart rate, blood pressure. The physiological functions were closely related to the changes in body temperature. Body temperature depends on the balance between heat production and heat loss. **Kleitman et al, (1938**) reported that the cause of the rhythm of body temperature probably was in variation in functioning of the heat loss mechanism or temperature-regulating mechanism and also suggested that the accepted distinction between morning and evening types might be related to early and late peaking in body temperature.

According to **Conroy and Mills, (1970)** temperature thresholds for vasodilation and sweating are greater by day than at night, although this appears to be a secondary manifestation of altered hypothalamic activity rather than the primary cause of the variation in core temperatures. According to **Folkard et al, (1985)** that individuals could differ from one another in the phase of their circadian rhythms in various measures including body temperature and performance efficiency for various tasks. It was also concluded that the circadian rhythms in temperature, alertness, and some types of performance could vary from person to person.

According to **Kleitman and Kleitman (1953) and Lewis and Lobban (1957)**, the heart rate shows a substantial circadian variation at rest. They reported that the circadian rhythmicity in resting pulse rate showed its lowest level between 4 to 6 a.m., rising rapidly until noon, increasing slightly until 5 to 6 p.m., and finally decreasing gradually until again reaching its lowest level. There is a substantial circadian variation in heart rate both at rest and during submaximal exercise **(Voigt et al, 1967; Klein et al, 1968 and Crockford and Davies, 1969).**

The circadian rhythm in oral temperature and heart rate were parallel to each other in both phase and magnitude. They also observed individual variation in the circadian rhythms in these parameters **Sen and Kar, (1979). Reilly et al, (1984)** observed that the heart rate peaked in the afternoon. They also studied the effect of

exercise on circadian rhythm and found that the normal rhythm became weakened at maximum heart rate.

Many investigations have been reported that blood pressure also exhibits circadian rhythm.The blood pressure, blood flow, blood component, oxygen consumption show circadian variation **(Cohen, 1980).** Similar results were obtained by **Reilly et al, (1984).** But according to **Cabri et al, (1988)**, there is no significant effect of circadian rhythm in pre-exercise blood pressure. They also observed there was no change in systolic blood pressure after exercise. They could observe circadian rhythm only in post-exercise diastolic pressure.

There is general agreement that athletic performance improves over the course of the day. One major factor in this variation is plainly the level of arousal of the competitions. The soccer players during 45 minutes, and found that movement on the field reached a minimum at about 05.00 hours, with a peak at 17.00 hours **(Reilly and Walsh, 1981).**According to **Reilly and Brooks, (1982)** the metabolic responses to exercise under steady-state conditions varied with the time of day. The maximal efficiency has been noted in the late afternoon **(Ferrario et al, 1982).** According to **Hill and Zauner, (1984)** the adaptation to exercise training might be specific to the time of the day of training. They found after regular weight training at a particular time of day, human subjects were stronger at that time of day than at another. **Hill, Cureton, and Collins, (1989)** studied the effect of circadian rhythm on exercise performance. They found that the subjects who were trained in the morning had a higher value in the morning and subjects who were trained in the afternoon had higher values in the afternoon.

The present study has been designed to investigate the changes in motor fitness and physiological parameter that have been closely linked to the circadian rhythm. The supple change of motor fitness and physiological parameters maybe not be evident in the university student-athlete and sometimes evoked these changes of physiological and motor fitness parameters indicate the alteration of the circadian variation. From the above discussion, it appears that there are several investigations have been made regarding the circadian variation of physiological and motor fitness performance on humans. But less importance has been given to the changes of motor

fitness and physiological parameter of the university student-athlete in different time intervals of the day as well as seasonal variation. The purpose of the study was to enrich the field of physical education with the knowledge of circadian rhythm that might be helpful in planning and programming training and competition for a higher level of motor performance.So the problem was stated as **EFFECT OF CIRCADIAN RHYTHM ON SELECTED MOTOR FITNESS AND PHYSIOLOGICAL PARAMETERS IN TRACK AND FIELD ATHLETES.**

In the present study, 30 male athletes in each group of sprinters and jumpers were selected having the age range 22-25 years from different training institutions of west Bengal. The subjects were studying in college and universities and have represented in Athletic Championship. Data were collected at two seasons (winter and summer) of the year at three time periods of a day (8.00 am, 12.00 pm, and 4.00 pm). Keeping in mind the criteria and specific purposes of the present investigation the below-mentioned motor fitness and physiological parameter were measured at regular intervals during the selected time of day. The following motor fitness parameters were tested on the subjects**:** Speed, Explosive leg power, Muscular strength endurance of arm and shoulder, Muscular strength endurance of abdominal muscle, Basic endurance, Agility. The following physiological parameters were tested on the subjects:Resting pulse rate, Resting diastolic blood pressure (DBP), Body temperature, Resting systolic blood pressure (SBP).

The experiments of the study were described into the following phases. Comparison and correlation of motor fitness and physiological parameter among the sprinter and jumper in summer and winter season at the different time periods of the day. In this phase the evaluation of different motor fitness and physiological parameter of the sprinter and jumper at the different time periods of a day in summer and winter season on a comparative basis and also determine the correlation between motor fitness and physiological parameter in different time periods of the day in both seasons.

For the purpose of analysis of data, the following statistic was applied. The obtained data in form of digital scores were treated statically to get the result and to draw a conclusion. Mean and SD was used as descriptive statistic. The degree of

relationship was measured with the help of the correlation coefficient. The significance of statistical difference at different time periods was measured with thehelp of F test and to find out the exact difference between time periods of the day post hoc test was applied.

**SUMMARY OF RESULT**

The present study indicated that different time periods of the day had a effect on the different parameters of motor fitness (Speed, agility, explosive leg power, basic endurance, muscular strength endurance of arm and shoulder, and muscular strength endurance of abdominal muscles), the performance of the athletes as well as some physiological variables. It was seen that the nature of the circadian rhythm of motor fitness showed a lower/ moderate value in the morning at 08.00 am and noon at 12.00 pm, and peak value in the evening at 04.00 pm in winter season. Some components of motor fitness such as agility, explosive leg power, and basic endurance showed significant circadian variation. On the other hand, no significant circadian variation was noted in the speed, muscular strength endurance of the arm and shoulder, and muscular strength endurance of abdominal muscles values among the athletes. Regarding the effect of circadian rhythm in physiological parameter suggests that the physiological variables in resting condition increases from morning to afternoon and then starts declining slowly among the athletes. A significant circadian variation was seen in the blood pressure and body temperature having a peak value at 04.00 hours and lowest at 08.00 hours among the selected athletes. There was no significant circadian variation was noted in the pulse rate values at different time periods of the day in both seasons among the selected athletes. Almost all the physiological parameters showed a significant positive correlation with motor fitness components at different time periods of the day for both seasons. Regarding the effect of seasonal variation on circadian rhythm in motor fitness, it was noted that the nature of circadian rhythm became moderate value at 08.00 am and 12.00 pm and peak value during 04.00 pm in summer season and the winter season the rhythm of the motor fitness showed a lower value in the morning at 08.00 am, moderate value at noon 12.00 pm, and peak value in the evening at 04.00 pm.

## 5.2 CONCLUSION

Results of the present investigation lead to draw the following conclusion:

i. Total motor fitness shows circadian rhythm with changing values at different periods of the day. This circadian rhythm becomes different with seasonal variation.

ii. During winter the motor fitness reaches its peak value in afternoon and lowest in the morning. In summer also the motor fitness becomes highest in afternoon but it becomes lowest at noon.

iii. Specific motor fitness components of sprinters and jumpers – the agility, power and endurance exhibit circadian rhythm with their peak values in afternoon.

iv. Other motor fitness components of both the groups considered in this study – the speed, arm strength and abdominal strength endurance do not exhibit circadian rhythm either in winter or summer.

v. Physiological parameters in resting condition – the systolic, diastolic blood pressures and body temperature how circadian rhythm with the trend of increasing from morning to afternoon in both the seasons. But, the trend becomes a decreasing one from evening.

vi. The pulse rate at resting condition does not show any circadian variation.

vii. In both the season almost all the physiological parameters (except pulse rate) showed significant positive correlation with total physical fitness parameters in case of both the sprinters and jumpers at different time of the day.

## 5.3 RECOMMENDATION

On the basis of the results of the study and conclusions drawn, the following recommendation may be made for further investigation and for practical purpose.

### 5.3.1 RECOMMENDATION FOR FUTURE RESEARCH

The following recommendations were made for future investigation in the light of the results of the present study

i) It was recommended that similar research may be conducted collecting data for the entire duration of a day (24 hours) and also with the subjects both male and female of different age groups, subjects with different levels of participation in different games and sports.

ii) It was recommended that more study may be conducted to analyze the circadian rhythms in motor skills and also in the other components of fitness such as maximum strength, balance, adaptation ability, orientation ability, coupling, etc.

iii) It was recommended that the physical trainers and coaches should prepare the training and competition schedule on basis of the nature of circadian variation and plans for travel of the athletes in their respective games.

### 5.3.2 RECOMMENDATION FOR PRACTICAL APPLICATION

i) Training programmed for games and sports should be prepared on the basis of the nature of circadian rhythm in motor fitness and physiological parameter.

ii) For preparing the competition schedule nature of circadian rhythm should be considered.

iii) For the intercontinental championship, world championship and Olympic Games change of time of competition from the time of training is an essential feature. In these cases, long-term planning for adaptation with the change in time of training should be done.

# BIBLIOGRAPHY

# BIBLIOGRAPHY


1. Afonso, L. D. S., Santos, J. F. B. D., Lopes, J. R., Tambelli, R., Santos, E. H. R., Back, F. A., ... & Lima, J. R. P. D. (2006). Maximal heart rate on treadmill at different times. *RevistaBrasileira de Medicina do Esporte*, *12*, 318-322.
2. Atkinson, G., & Reilly, T. (1996). Circadian variation in sports performance. *Sports medicine*, *21*(4), 292-312.
3. Atkinson, G., & Reilly, T. (1996). Circadian variation in sports performance. *Sports medicine*, *21*(4), 292-312.
4. Atkinson, G., Edwards, B., Reilly, T., & Waterhouse, J. (2007). Exercise as a synchroniser of human circadian rhythms: an update and discussion of the methodological problems. *European journal of applied physiology*, *99*(4), 331-341.
5. Bessot N, Nicolas A, Moussay S, Gauthier A, Sesboue B, Davenne D (2006). The effect of pedal rate and time of day on the time to exhaustion from high-intensity exercise. Chronobiol International, 23(5): 1009–1024.
6. Bessot, N., Moussay, S., Clarys, J. P., Gauthier, A., Sesboüé, B., &Davenne, D. (2007). The influence of circadian rhythm on muscle activity and efficient force production during cycling at different pedal rates. *Journal of Electromyography and Kinesiology*, *17*(2), 176-183.
7. Bishop D, Edge J, Goodman C (2004). Muscle buffer capacity and aerobic fitness are associated with repeated-sprint ability in women. European Journal of Applied Physiology, 92(4-5): 540-547.
8. Bishop D, Girard O, Mendez-Villanueva A. (2011). Repeated-sprint ability – part II: Recommendations for training. Sports Med. 41: 741–56.
9. Bougard, C., Moussay, S., Gauthier, A., Espié, S., &Davenne, D. (2009). Effects of waking time and breakfast intake prior to evaluation of psychomotor performance in the early morning. *Chronobiology International*, *26*(2), 324-336.
10. Boussetta N, Abedelmalek S, Aloui K, Souissi N (2017). The effect of air pollution on diurnal variation of performance in anaerobic tests, cardiovascular and hematological parameters, and blood gases on soccer players following the Yo–Yo Intermittent Recovery Test Level-1. Chronobiology International, 34(7): 903-920.

11. Brown FM, Neft EE, LaJambe CM (2008). Collegiate rowing crew performance varies by morningness-eveningness. The Journal of Strength & Conditioning Research, 22(6): 1894- 1900.
12. Bruyn, L.; Lamoureux, T. Literature Review: Cognitive Effects of Thermal Strain; Defence Research and Development Canada: Toronto, ON, Canada, 2005
13. Cappaert TA (1999). Time of day effect on athletic performance: An update. The Journal of Strength & Conditioning Research, 13(4): 412-421.
14. Cappaert, T. A. (1999). Time of day effect on athletic performance: An update. *The Journal of Strength & Conditioning Research*, *13*(4), 412-421.
15. Carrier, J., & Monk, T. H. (2000). Circadian rhythms of performance: new trends. *Chronobiology international*, *17*(6), 719-732.
16. Chin CY, Chow GCC, Hung KC, Kam LH, Chan KC, MokYT, Cheng NM (2015). The diurnal variation on cardiovascular endurance performance of secondary school athlete student.Asian Journalof SportsMedicine, 6(2):e22697.
17. ChtourouH, AlouiA, HammoudaO, ChaouachiA, ChamariK, Souissi N (2013). Effect of static and dynamic stretching on the diurnal variations of jump performance in soccer players. PloS One, 8(8):doi:10.1371/journal.pone.0070534
18. ChtourouH, Engel FA, FakhfakhH, FakhfakhH, HammoudaO, SouissiN, SperlichB (2018). Diurnal variation of short-term repetitive maximal performance and psychological variables in elite judo athletes. Frontiers in Physiology, 9:1499.
19. Chtourou H, Souissi N (2012).The effect of training at a specific time of day: a review. J Strength Cond Res. 26(7):1984–2005.
20. Chtourou, H., &Souissi, N. (2012). The effect of training at a specific time of day: a review. *The Journal of Strength & Conditioning Research*, *26*(7), 1984-2005.
21. Chtourou, H., Aloui, A., Hammouda, O., Chaouachi, A., Chamari, K., &Souissi, N. (2013). Effect of static and dynamic stretching on the diurnal variations of jump performance in soccer players. *PloS one*, *8*(8), e70534.
22. Conroy, R. T. W. L., & Mills, J. N. (1970). *Human circadian rhythms*. Churchill.

23. Copes, K., &Rosentswieg, J. (1972). The effects of sleep deprivation upon motor performance of ninth-grade students. *The Journal of sports medicine and physical fitness*, *12*(1), 47-53.
24. Crockford, G. W., & Davies, C. T. (1969). Circadian variations in responses to submaximal exercise on a bicycle ergometer. *The Journal of physiology*, *201*(2), 94P-95P.
25. Cruz R, de AssisManoel F, MeloBP, da Silva SF (2014). Circadian cycle and ıts ınfluence on parameters of aerobic training. American Journal of Sports Science and Medicine, 2(2): 65-69.
26. Da Silva JF, Guglielmo LG, Bishop D (2010). Relationship between different measures of aerobic fitness and repeated-sprint ability in elite soccer players. The Journal of Strength & Conditioning Research, 24(8): 2115-2121
27. Daan, S., &Aschoff, J. (1975). Circadian rhythms of locomotor activity in captive birds and mammals: their variations with season and latitude. *Oecologia*, *18*(4), 269-316.
28. Dalton B, McNaughton L, Davoren B (1997). Circadian rhythms have no effect on cycling performance. International Journal of Sports Medicine, 18(7): 538–542. doi:10.1055/s-2007- 972678
29. Draper N, Whyte G (1997). Here's a new running based test of anaerobic performance for which you need only a stopwatch and a calculator. Peak Performance, 96: 3-5
30. Drust, B., Ahmed, Q., &Roky, R. (2012). Circadian variation and soccer performance: Implications for training and match-play during Ramadan. *Journal of sports sciences*, *30*(sup1), S43-S52.
31. Drust, B., Waterhouse, J., Atkinson, G., Edwards, B., & Reilly, T. (2005). Circadian rhythms in sports performance—an update. *Chronobiology international*, *22*(1), 21-44.
32. Durnin J, Womersley J (1974). Body fat assessed from total body density and its estimation from skinfold thickness: Measurements on 481 men and women aged from 16 to 72 Years. British Journal of Nutrition, 32(1): 77-97.
33. Edwards, B, Reilly, T., Atkinson, G., Waterhouse, J., Farrelly, K., &Fairhurst, E. (2007). Diurnal variation in temperature, mental and physical performance, and tasks specifically related to football (soccer). *Chronobiology international*, *24*(3), 507-519.

34. Emek, C. A. N., Kutlay, E., Özkol, M., &Çetinkaya, C. (2016). The effect of circadian rhythm on some physical and physiological parameters in male taekwondo athletes. *Pamukkale Journal of Sport Sciences*, *7*(1), 12-24.
35. Faria IE, Drummond BJ. Circadian changes in resting heart rate and body temperature, maximal oxygen consumption and perceived exertion. Ergonomics 1982; 25: 381-6
36. Ferrario, S., Agius, I., & Morisot, A. (1992). Daily variations of xylemic exudation rate in tomato. *Journal of plant nutrition*, *15*(1), 69-83.
37. Ferrario, V. F., & VF, F. (1982). Ritmicircadiani in atletimilitari.
38. Fitzgerald, J. M., Adamis, D., Trzepacz, P. T., O'Regan, N., Timmons, S., Dunne, C., & Meagher, D. J. (2013). Delirium: a disturbance of circadian integrity?. *Medical hypotheses*, *81*(4), 568-576.
39. Hill CM, Hill DW. Influence of time of day on responses to the profile of mood states. Percept Mot Skills 1991 ; 72: 434
40. Hill DW, Cureton K1, Collins MA. Circadian specificity in exercise training. Ergonomics 1989; 32 (I): 79-92
41. Hill DW, Cureton KJ, Collins MA, et al. Diurnal variations in responses to exercise of "morning types" and " evening types". J Sports Med Phys Fitness 1988; 28: 213-9
42. Hill, D. W., & Smith, J. C. (1991). Circadian rhythm in anaerobic power and capacity. *Canadian journal of sport sciences= Journal canadien des sciences du sport*, *16*(1), 30-32.
43. Hill, D. W., Cureton, K. J., & Collins, M. A. (1989). Circadian specificity in exercise training. *Ergonomics*, *32*(1), 79-92.
44. Holland, G. J. (1968). Effects of limited sleep deprivation on performance of selected motor tasks. *Research Quarterly. American Association for Health, Physical Education and Recreation*, *39*(2), 285-294.
45. Hossmann, V., Fitzgerald, G. A., &Dollery, C. T. (1980). Circadian rhythm of baroreflex reactivity and adrenergic vascular response. *Cardiovascular research*, *14*(3), 125-129.
46. Hower, I. M., Harper, S. A., & Buford, T. W. (2018). Circadian rhythms, exercise, and cardiovascular health. *Journal of circadian rhythms*, *16*.
47. Hower, IM , Harper, S., Buford, TW (2018). Circadian rhythms, exercise, and cardiovascular health. Journal of Circadian Rhythms, 16(1): doi: http://doi.org/10.5334/jcr.164

48. Huang, X.D. Study on the Correlation between Heart Rate and Blood Lactate in Adolescent Middle and Long Distance Runners and Their Application in Training; Wuhan Institute of Physical Education: Wuhan, China, 2007. (In Chinese)
49. Iannone, L. P. (1988). *The effect of morning and evening aerobic class participation on adult mood states* (Doctoral dissertation, Southern Connecticut State University).
50. Innominato, P. F., Focan, C., Gorlia, T., Moreau, T., Garufi, C., Waterhouse, J., &Bjarnason, G. A. (2009). Circadian rhythm in rest and activity: a biological correlate of quality of life and a predictor of survival in patients with metastatic colorectal cancer. *Cancer research*, *69*(11), 4700-4707.
51. Jarraya S, Jarraya M, Chtourou H, Souissi N (2014). Diurnal variations on cognitive performances in handball goalkeepers. Biological Rhythm Research, 45(1): 93-101.
52. Jones, H., George, K., Edwards, B., & Atkinson, G. (2008). Effects of Time of Day on Post-Exercise Blood Pressure: Circadian or Sleep-Related Influences?. *Chronobiology international*, *25*(6), 987-998.
53. Kanabrocki, E. L., Sothern, R. B., Sackett-Lundeen, L., Ryan, M. D., Johnson, M., Foley, S., &Nemchausky, B. (2008). Creatinine clearance and blood pressure: a 34-year circadian study. *La ClinicaTerapeutica*, *159*(6), 409-417.
54. Kin-Isler A (2006). Time-of-day effects in maximal anaerobic performance and blood lactate concentration during and after a supramaximal exercise. Isokinetics andExercise Science, 14(4):335-340.
55. Klein, K. E., Wegmann, H. M., &Brüner, H. (1967). *Circadian rhythm in indices of human performance, physical fitness and stress resistance*. DEUTSCHE VERSUCHSANSTALT FUER LUFT-UND RAUMFAHRT EV BAD GODESBERG (WEST GERMANY) INSTITUT FUER FLUGMEDIZIN.
56. Kleitman, N., Titelbaum, S., &Feiveson, P. (1938). The effect of body temperature on reaction time. *American Journal of Physiology-Legacy Content*, *121*(2), 495-501.
57. Kline, C. E., Durstine, J. L., Davis, J. M., Moore, T. A., Devlin, T. M., &Youngstedt, S. D. (2010). Circadian rhythms of psychomotor vigilance, mood, and sleepiness in the ultra-short sleep/wake protocol. *Chronobiology international*, *27*(1), 161-180.

58. Lewis, P. R., &Lobban, M. C. (1957). Dissociation of diurnal rhythms in human subjects living on abnormal time routines. *Quarterly Journal of Experimental Physiology and Cognate Medical Sciences: Translation and Integration*, *42*(4), 371-386.
59. Mahaboobjan, A. (2010). Analysis the diurnal variations on selected physical and physiological parameters. *CitiusAltiusFortius*, *29*(4), 37.
60. Mahaboobjan, A. (2010). Analysis the diurnal variations on selected physical and physiological parameters. *CitiusAltiusFortius*, *29*(4), 37.
61. Mahaboobjan, A. (2010). Analysis the diurnal variations on selected physical and physiological parameters. *CitiusAltiusFortius*, *29*(4), 37.
62. Manfredini R, ManfrediniF, Fersini C, Conconi F (1998). Circadianrhythms, athletic performance, and jet lag. British Journal of Sports Medicine, 32(2): 101-106.
63. Maroulakis E, Zervas Y. Effects of aerobic exercise on mood of adult women. Percept Mot Skills 1993; 76: 795-801
64. Mizuno, K. (2014). Human circadian rhythms and exercise: significance and application in real-life situations. *The Journal of Physical Fitness and Sports Medicine*, *3*(3), 307-315.
65. Mohebbi, H., &Azizi, M. (2011). Maximal fat oxidation at the different exercise intensity in obese and normal weight men in the morning and evening. *Journal of Human Sport and Exercise*, *6*(1), 49-58.
66. Narishige, S., Kuwahara, M., Shinozaki, A., Okada, S., Ikeda, Y., Kamagata, M..& Shibata, S. (2014). Effects of caffeine on circadian phase, amplitude and period evaluated in cells in vitro and peripheral organs in vivo in PER 2:: LUCIFERASE mice. *British journal of pharmacology*, *171*(24), 5858-5869.
67. O'Connor PJ, Davis JC. Psychobiologic responses to exercise at different times of day. Med Sci Sports Exerc 1992; 24: 714-9
68. Rahnama, N., Sajjadi, N., Bambaeichi, E., Sadeghipour, H. R., Daneshjoo, H., &Nazary, B. (2009). Diurnal variation on the performance of soccer-specific skills. *World J Sport Sci*, *2*(1), 27-30.
69. Rahnama, N., Sajjadi, N., Bambaeichi, E., Sadeghipour, H. R., Daneshjoo, H., &Nazary, B. (2009). Diurnal variation on the performance of soccer-specific skills. *World J Sport Sci*, *2*(1), 27-30.

70. Rai V, Tiwari LM (2015). Diurnal variation on the performance of selected motor fitness components of volleyball Players. International Journal of Physical Education, Sports and Health, 2(2): 86-88
71. Rajagopal, I. (2010) Effect of circadian rhythm on selected factors related to volleyball performance.
72. Rajagopal, I. (2010). Effect of circadian rhythm on selected factors related to volleyball performance.
73. Redlin, U., &Mrosovsky, N. (1997). Exercise and human circadian rhythms: what we know and what we need to know. *Chronobiology international*, *14*(2), 221-229.
74. Reilly T. Baxter e. Influence of time of day on reactions to cycling at a fixed intensity. Br J Sports Med 1983; 17: 128-30
75. Reilly, T. (1990). Human circadian rhythms and exercise. *Critical reviews in biomedical engineering*, *18*(3), 165-180.
76. Reilly, T., Atkinson, G., Edwards, B., Waterhouse, J., Farrelly, K., &Fairhurst, E. (2007). Diurnal variation in temperature, mental and physical performance, and tasks specifically related to football (soccer). *Chronobiology international*, *24*(3), 507-519.
77. Sabzevari Rad, R., MahmoodzadehHosseini, H., &Shirvani, H. (2021). Circadian rhythm effect on military physical fitness and field training: a narrative review. *Sport Sciences for Health*, *17*(1), 43-56.
78. Sedliak, M., Finni, T., Cheng, S., Kraemer, W. J., &Häkkinen, K. (2007). Effect of time-of-day-specific strength training on serum hormone concentrations and isometric strength in men. *Chronobiology international*, *24*(6), 1159-1177.
79. Sen, R., &Kar, M. (1979). Circadian rhythms and adaptation in some indian shift workers and control subjects, Ptoceeding of the International Satellite Symposium on Work Physiology & Ergonomics. *Indian J. Physiol. Allied Sci*, *33*, 1-4.
80. Serín-Ferré, M., Ducsay, C. A., & Valenzuela, G. J. (1993). Circadian rhythms during pregnancy. *Endocrine Reviews*, *14*(5), 594-609.
81. Shephard RJ (1984). Sleep, biorhythms and human performance. Sports Medicine, 1(1): 11- 37.

82. SouissiN, BessotN, ChamariK, Gauthier A, SesboüéB, Davenne D (2007). Effect of time of day on aerobic contribution tothe 30-s Wingate test performance. Chronobiology International, 24(4): 739-748.
83. Souissi, N., Souissi, M., Souissi, H., Chamari, K., Tabka, Z., Dogui, M., &Davenne, D. (2008). Effect of time of day and partial sleep deprivation on short-term, high-power output. *Chronobiology international*, *25*(6), 1062-1076.
84. Torii J, Shinkai S, Hino S, et al. Effect of time of day on adaptive response to a 4-week aerobic exercise program. 1 Sports Med Phys Fitness 1992; 31: 348-52
85. Touitou, Y., &Haus, E. (Eds.). (2012). *Biologic rhythms in clinical and laboratory medicine*. Springer Science & Business Media.
86. Vaidya, N., Pati, A. K., &Parganiha, A. (2012). Circadian variability and nocturnal dipping pattern in blood pressure in young normotensive subjects. *Biological Rhythm Research*, *43*(5), 485-496.
87. Venugopal, R., Gupta, O., & Patel, H. (2010). Temporal pattern of circadian rhythm in sportsmen. *Journal of Exercise Science and Physiotherapy*, *6*(1), 1-6.
88. Vitosevic B (2017). The circadian clock and human athletic performance. The University Thought-Publication in Natural Sciences, 7(1): 1-7.
89. Waterhouse J, Drust B, Weinert D, Edwards B, Gregson W, Atkinson G, Kao S, Aizawa S, Reilly T (2005). The circadian rhythm of core temperature: origin and some implications for exercise performance. Chronobiology International, 22(2): 207-225.
90. Wessler, R., Rubin, M., &Sollberger, A. (1976). Circadian rhythm of activity and sleep-wakefulness in elderly institutionalized persons. *Biological Rhythm Research*, *7*(4), 333-348.
91. Winget, C. M., DeRoshia, C. W., & Holley, D. C. (1985). Circadian rhythms and athletic performance. *Medicine & Science in Sports & Exercise*.
92. Winget, C. M., Soliman, M. R. I., Holley, D. C., &Meylor, J. S. (1992). Chronobiology of physical performance and sports medicine. In *Biologic rhythms in clinical and laboratory medicine* (pp. 230-242). Springer, Berlin, Heidelberg.
93. Winter EM, Jones AM, Davison RR, Bromley PD, Mercer TH (2007). Sport and Exercise Physiology Testing Guidelines: Volume I–Sport Testing: The British Association of Sport and Exercise Sciences Guide. London and Newyork:Routledge.

94. Winter, E. M., Jones, A. M., Davison, R. R., Bromley, P. D., & Mercer, T. H. (Eds.). (2006). *Sport and exercise physiology testing guidelines: volume I–Sport testing: the British association of sport and exercise sciences guide*. Routledge.
95. Wyse, J. P., Mercer, T. H., & Gleeson, N. P. (1994). Time-of-day dependence of isokinetic leg strength and associated interday variability. *British journal of sports medicine*, *28*(3), 167-170.
96. YoungstedtSD, Kline CE, Elliott JA, Zielinski M, Devlin TM, Moore TA (2016). circadianphase-shifting effects of bright light, exercise, and bright light + exercise. Journal of Circadian Rhythms, 14(1): 2.doi:http://doi.org/10.5334/jcr.137
97. Youngstedt, S. D., Kline, C. E., Elliott, J. A., Zielinski, M. R., Devlin, T. M., & Moore, T. A. (2016). Circadian phase-shifting effects of bright light, exercise, and bright light+ exercise. *Journal of circadian rhythms*, *14*.
98. Zagatto AM, Beck WR, Gobatto CA (2009). Validity of the running anaerobic sprint test for assessing anaerobic power and predicting short-distance performances. J Strength Cond Res., 23(6): 1820-1827.
99. Zghibi M, MzidAbdelmalek S, Sahli H, Ben Khlifa W, Selmi O (2018). Effect of time of day on the offensive capability and aerobic performance in football game. Biological Rhythm Research, 1-9: https://doi.org/10.1080/09291016.2018.1445499
100. Zheng, G., Li, K., Bu, W., & Wang, Y. (2019). The effects of indoor high temperature on circadian rhythms of human work efficiency. *International journal of environmental research and public health*, *16*(5), 759.
101. Zum Berge, A. H., Loch, F., Schwarzenbrunner, K., Ferrauti, A., Meyer, T., Pfeiffer, M., &Kellmann, M. (2021). Assessment of sleep quality and daytime sleepiness in German national ice hockey players preparing for the world championship. *German Journal of Exercise and Sport Research*, *51*(1), 94-101.

# APPENDICES

# PARTICIPATION IN WORKSHOP

University of Kalyani

Department of Physical Education

SEVEN DAYS NATIONAL WORKSHOP ON RESEARCH METHODOLOGY AND STATISTICAL ANALYSIS FOR PHYSICAL EDUCATION

*Certificate of Participation*

*Awarded to*

**SUMANTA DAS**

RESEARCH SCHOLAR, JADAVPUR UNIVERSITY WEST BENGAL in recognition and appreciation for attending the Seven Days National Workshop on Research Methodology and Statistical Analysis for Physical Education, ***(19-25 June 2019)***

**Dr. Nita Bandyopadhyay**
*Workshop Director & HOD*
Physical Education

**Prof. Utpal Biswas**
*Dean, Faculty of Education*
University of Kalyani

**Col. Prof. Sankar Kumar Ghosh**
*Hon'ble Vice Chancellor*
University of Kalyani

## PARTICIPATION IN WORKSHOP

**Research Methodology Course in Social Sciences for PhD Students**

*Sponsored by*
**ICSSR-NERC, Shillong**
*Organised by*
**Department of Management, North-Eastern Hill University**
**Tura Campus, Tura-794002, Meghalaya**

**CERTIFICATE**

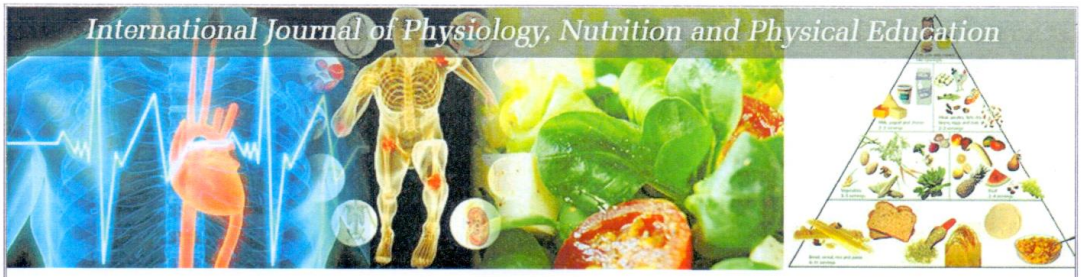
*This is to certify that Prof./Dr./Mr./Ms.* SUMANTA DAS *from* JADAVPUR UNIVERSITY *participated/acted as Resource Person in the Ten Days (24th May - June 2, 2016) Research Methodology Course in Social Sciences for PhD Students, Organised by the Department of Management, North-Eastern Hill University, Tura Campus, Tura-794002, Meghalaya (India) and sponsored by Indian Council of Social Science Research-North Eastern Regional Centre, Shillong, Meghalaya, India.*

*Given this on the Second day of June Two Thousand and Sixteen.*

(Prof. G. Singaiah)
HOD & Campus In-charge

(Dr. Abhigyan Bhattacharjee)
Director

# CERTIFICATE OF PUBLICATION




Peer Reviewed Journal, Refereed Journal, Indexed Journal

ISSN: 2456-0057, Impact factor (RJIF): 5.43

UGC Approved Journal. UGC Journal No.: 44404

## *Publication Certificate*

This certificate confirms that **"Sumanta Das"** has published manuscript titled **"Influence of circadian rhythm on selected motor fitness and heart rate of jumper"**.

Details of Published Article as follow:

| | | |
|---|---|---|
| Volume | : | **3** |
| Issue | : | **1** |
| Year | : | **2018** |
| Page Number | : | **2199-2201** |

Certificate No.: **5-2-67**
Date: **01-01-2018**

Yours Sincerely,

Akhil Gupta

AKINIK Director Publications

Akhil Gupta
Publisher
International Journal of Physiology, Nutrition and Physical Education
www.journalofsports.com
Tel: +91-9711224068

# CERTIFICATE OF DATA COLLECTION

**DEPARTMENT OF PHYSICAL EDUCATION**
FACULTY OF EDUCATION
UNIVERSITY OF KALYANI

From:
**Dr. Nita Bandyopadhyay**
Head & Director (Ex-officio)
Dept of Physical Education

Kalyani - 741235, West Bengal
Phone: (033) 2582 8282 (Extn232)
Mob. No.: +919474365375/08145418307
Email- nitabandyopadhyay@gmail.com

Ref. No.

Date: 28/02/2020

## TO WHOM IT MAY CONCERN

This is to certify that **Mr. Sumanta Das,** a Ph.D. scholar of the Department of Physical Education, Jadavpur University, conducted necessary tests and collected data for his research work on title "EFFECT OF CIRCADIAN RHYTHMS ON SELECTED MOTOR FITNESS, PSYCHOLOGY AND PHYSIOLOGICAL PARAMETERS" from BPED and MPED students of this university as subjects on February 11, 2020.

I wish him success in life.

Dr. Nita Bandyopadhyay
Head & Director (Ex-officio)
Department of Physical Education
University of Kalyani
28/2/2020

## CERTIFICATE OF DATA COLLECTION

Phone: Habra (032160237032,237104
Fax No.; 03216-2370320

*Government of west Bengal*

*OFFICE OF THE PRINCIPAL*

**POST GRADUATE GOVERNMENT INSTITUTE FOR PHYSICAL EDUCATION**

**P.O.:- Banipur, Dist:- North 24 Parganas, pin.:743263(W.B)**

Dated: **03/02/2020**

**TO WHOM IT MAY CONCERN**

This is to certify that **Sri.Sumanta Das**, a Ph.D. Scholar, Jadavpur University, had taken all necessary research data releted to his research work on **"EFFECT OF CIRCADIAN RHYTHMS, ON SELECTED MOTOR FITNESS, PSYCHOLOGY AND PHYSIOLOGICAL PARAMETERS"** on 3/02/2020.

I wish all the success for the work and wish him all the success in life.

**Officer –In -Charge**
Post Graduate Govt. Institute
For Physical Education, Banipur,
North 24 Parganas

Officer In-charge
Post Graduate Govt. Institute
for Physical Education, Banipur

# CERTIFICATE OF DATA COLLECTION

**The University Of Burdwan**
Department of Physical Education
Golapbag, Burdwan
Estd. 2015

**TO WHOM IT MAY CONCERN**

*This is to certify that Sri Sumanta Das, Ph.D scholar, Jadavpur University had taken all necessary research data related to his research work on " Effect of circadian rhythms, on selected motor fitness, Psychological and Physiological Parameters" on 02.10.2021 at 12.00 noon.*

*I wish his Success in future.*

*Your Sincerely*
*Dr. Gopa Saha Roy*
*TIC*
*Dept of Physical Education*
*The University of Burdwan*

Teacher-In-Charge
Dept. of Physical Education
The University of Burdwan

---

Phone: 03228-252222
**PANSKURA BANAMALI COLLEGE**
**(AUTONOMOUS)**
Largest Rural Based, NAAC Re-accredited 'A' Grade (2016-2021)
DST-FIST (Govt. of India), BOOST-DBT (Govt. of West Bengal) sponsored College
Website : www.panskurabanamalicollege.org E-mail : principal.pbc@gmail.com
P.O. - PANSKURA R.S. : PIN – 721152 : DIST. - PURBA MEDINIPUR : WEST BENGAL : INDIA

Date 09/11/2021

**TO WHOM IT MAY CONCERN**

This is to that Sri Sumanta Das, Senior Research fellow, Department of Physical Education, Jadavpur University, reached to our college on 26/08/2021 to collect data for his research study titled "Effect of Circadian Rhythms – On Selected Motor Fitness, Psychology and Physiological Parameters". After successfully collecting the data he left the college on the same. He collected the data on B.P.Ed. and M.P.Ed. students.

**Prof. (Dr) Nandan Bhattacharyya**
Principal
Panskura Banamali College
(AUTONOMOUS)

**Dr. Badshah Ghosh**
Head of the Deptt.
Physical Education
Panskura Banamali College

PANSKURA BANAMALI COLLEGE
Estd - 1960
PO - Panskura R S
Dist - Purba Medinipur
AUTONOMOUS

## CERTIFICATE OF PLAGIARISM

Curiginal

### Document Information

| | |
|---|---|
| **Analyzed document** | Sumanta Das_ Effect of circadian rhythm on selected motor fitness and physiological parameters in track and field athletes.docx (D129400024) |
| **Submitted** | 2022-03-04T10:41:00.0000000 |
| **Submitted by** | |
| **Submitter email** | asitabha.das@gmail.com |
| **Similarity** | 4% |
| **Analysis address** | asitabha.das.unikal@analysis.urkund.com |