Chapter II

REVIEW OF RELATED LITERATURE

An essential aspect of a research is the review of the related literature. In the word of Good, “The key to the vast store house of published literature may open the doors to sources of significant problems and explanatory hypothesis, and provide helpful orientation for definition of the problem, background for selection of procedure, and comparative data for interpretation of results. In order to be truly creative and original, one must read extensively and critically as stimulus thinking”.

For any specific research project to occupy a place in the development of a discipline, the researcher must be thoroughly familiar with both previous theory and research. The literature related to any problem helps the scholar to discover what is already known, which would enable the investigator to have a deep insight, clear perspective and a better understanding of the chosen problem and various factors connected with the study. So a number of books, journals, and websites were referred. In the following pages, an attempt has been made to present briefly a few of the important researches and studies conducted abroad and in India, as they have significant bearing on the present study.

The literature in any field forms the foundation upon which all future work will be built. If a researcher fails to build upon the
foundation of knowledge provided by the review of literature, he/she will miss some works already done on the same topic. The reviews of the literature have been classified as reviews on gender difference, reviews on circadian rhythms and summary of the literature in chronological and alphabetical order.

**Reviews on Gender Difference**

**British Medical Association** (2009) have found out that the resting heart rate can predict heart attacks in women. Researchers in the USA assessed resting heart rate in 129,135 postmenopausal women with no history of heart problems. Risk factors that might be expected to affect heart rate, such as high blood pressure, high cholesterol levels, smoking and alcohol intake were taken into account at the start of the study. The women were monitored for an average of 7.8 years, during which time all hospital stays and coronary events were recorded. During the study period, 2,281 coronary events (heart attacks and coronary deaths) and 1,877 strokes occurred. Women with the highest resting heart rate (more than 76 beats per minute) were significantly more likely to suffer a coronary event than men with the lowest resting heart rate (62 beats per minute or less).

**Chou, Lin and Tsai** (2009) investigated the gender differences in the relationships of serum uric acid with fasting serum insulin and plasma glucose in patients without diabetes. A total of 7,483 non diabetic subjects (4,265 women, 3,218 men, and aged 30
to 89 years) were involved in a community based epidemiologic study. Overnight fasting blood samples were drawn for serum uric acid, glucose, insulin, lipid, and other biochemical measurements. Stratified analyses revealed that (1) serum uric acid levels were positively associated with hyper insulinemia and HOMA-insulin resistance in both men and women after adjusting for hyper triglyceridemia, hypertension, obesity, and plasma glucose levels; and (2) serum uric acid levels were more strongly associated with hyper insulinemia and plasma glucose levels in women than in men. The serum uric acid level was associated with insulin resistance and plasma glucose levels more strongly in females than in males in the study population.

**Esbjornsson, et al.,** (2009) studied and found that there was greater growth hormone and insulin response in women than in men during repeated bouts of sprint exercise. Metabolic and hormonal response to three 30-s sprints with 20-min rest between the sprints was studied in 18 physically active men and women. Accumulation of blood lactate and plasma ammonia after sprint exercise was greater in men. Serum insulin increased after sprint exercise more so in women than in men while plasma glucose increased in men, but not in women. Serum growth hormone increased in both women and men reaching similar peak levels, but with different time courses.
Jindrich Spinar and Lenka Spinarova (2009) investigated the gender differences in acute heart failure. Although the ADHERE registry had more female patients, more men than women (60:40, respectively) are hospitalized with AHF. Women were on average 5 – 6 years older than men when admitted with HF; the mean age of women was 75 years whilst the mean age of men was 70 years. Women have higher systolic blood pressure; the mean systolic pressure was approximately 140 mmHg for women and 130 mmHg for men, while diastolic pressure was approximately 80 mmHg for both sexes.

Shu-Hua Lu and Yu-Tzu Dai (2009) made a prospective, comparative study on normal body temperature and the effects of age, sex, ambient temperature and body mass index on normal oral temperature. The purpose of the study was to determine normal body temperature and the effects of age, sex, ambient temperature (AT), and body mass index (BMI) on normal oral temperatures (OTs). A prospective four group comparative descriptive design was used to compare four cohorts: young adults in summer, older adults in summer, young adults in winter, and older adults in winter. The OT of 519 community dwelling older adults aged 65–95 and 540 younger adults aged 20–64 was compared. The OT was taken with an electronic thermometer between 8 a.m. and 10 a.m. during summer and winter in 2007 in Taipei, Taiwan. Moreover this study found that the mean OT of older females was higher than that of older males in
both winter and summer cohorts. Finally, multiple regression analysis results indicated AT and sex were predictors of OT while age and BMI were not a significant predictor of OT.

**Hughes, Watkins and Owen** (2008) examined the gender differences in lower limb frontal plane kinematics during landing. The aim of this study was to investigate gender differences in knee valgus angle and inter-knee and inter-ankle distances in university volleyball players when performing opposed block jump landings. Six female and six male university volleyball players performed three dynamic trials each for which they were instructed to jump up and block volleyball suspended above a net set at the height of a standard volleyball net as it was spiked against them by an opposing player. Knee valgus/varus, inter-knee distance, and inter-ankle distance were determined during landing using three-dimensional motion analysis. Females displayed significantly greater maximum valgus angle and range of motion than males.

**Lan, Lian, Liu and Liu** (2008) conducted the investigation on gender difference in thermal comfort for Chinese people. Gender difference in thermal comfort for Chinese people was investigated through two laboratory experiments. Both subjective assessment and objective measurement were taken during the experiment. Skin temperature (17 points) and heart rate variability (HRV) were measured in one of the experiment. The results show that there are gender differences in thermal comfort for Chinese people. Subjective
assessment, skin temperature and HRV analysis suggest that females prefer neutral or slightly warmer condition, due to their constantly lower skin temperature and the fact that mean skin temperature is a good predictor of sensation and discomfort below neutrality. Female comfortable operative temperature is higher than male comfortable operative temperature; although males and females have almost the same neutral temperature and that there is no gender difference in thermal sensation near neutral conditions.

**Patricia Landazuri, Claudia Granobles and Nelsy Loango** (2008) observed the gender differences in serum angiotensin-converting enzyme activity and blood pressure in children. This study was conducted with a total of 501 subjects between 8 and 18 years of age: 249 (49.7%) boys and 252 (50.3%) girls. There was no difference in mean systolic blood pressure (SBP) between the 2 groups. Although boys had a diastolic blood pressure (DBP) 1.3 mm Hg lower than girls, this difference was not significant; BMI was also measured, and mean BMI was 4.7% lower in boys than in girls, despite BP in both boys and girls being similar.

**Pavithran, Madanmohan and Nandeesh** (2008) studied on sex differences in short-term heart rate variability in patients with newly diagnosed essential hypertension. The results of the analysis of heart rate variability (HRV) indices during 5 minutes of supine rest and 5 minutes of standing and conventional indices of autonomic function in 69 men and 51 women with untreated newly diagnosed
hypertension matched for body mass index and resting blood pressure. Mean RR interval, standard deviation of normal-to-normal RR intervals, low-frequency RR spectral power, HRV during deep breathing at 6 breaths per minute, and the 30:15 ratio were significantly lower in women compared with men. HRV was significantly lower in women with untreated newly diagnosed hypertension compared with men.

**Sicree, et al.,** (2008) found out that the differences in height explain gender differences in the response to the oral glucose tolerance test. The purpose of the study was to determine the extent of gender-related differences in the prevalence of glucose intolerance for the Australian population and whether body size may explain such differences. Cross-sectional data were collected from a national cohort of 11,247 Australians aged ≥ 25 years. Glucose tolerance status was assessed according to both fasting plasma glucose (FPG) and 2-h plasma glucose (2hPG) levels following a 75-g oral glucose tolerance test (OGTT). Anthropometric and glycated haemoglobin measurements were also made. Women had a mean FPG 0.3 mmol/l lower than men but 2hPG 0.3 mmol/l higher and FPG-2hPG increment 0.5 mmol/l greater. Men and women had different glycaemic profiles; women had higher mean 2hPG levels, despite lower fasting levels.

**Uche Dimkpa, Andrew Ugwu and Daniel Oshi** (2008) investigated the assessment of sex differences in systolic blood
pressure responses to exercise in healthy, non-athletic young adults. Gender differences were assessed in SBP during and after exercise in non-athletic young adults. Three hundred and twenty five young adults 18-35 years (males n=160 and females n=165) performed ergometer exercise at > 90% maximum heart rate. SBP and heart rate (HR) were measured during exercise at two minutes intervals and post-exercise at two minutes interval until SBP recovered to baseline. SBP responses during and after maximal exercise were assessed using percentage SBP rise (%SBPRISE) and SBP ratio in three minutes of recovery relative to one minute (SBPR2). Males experienced a significantly higher %SBPRISE and lower SBPR2 in comparison to females. The data showed gender differences in SBP responses while males indicated higher SBP response during and after exercise than females.

Welsh and Griffin (2008) observed the normal values for finger systolic blood pressure in males and females. Eighty healthy subjects participated in the study: 20 males and 20 female aged 20–30 years, and 20 males and 20 females aged 55–65 years. Finger systolic blood pressures (FSBPs) were measured using strain-gauge plethysmography following local cooling at 30 and 10°C. The FSBPs were measured simultaneously in the thumb and the four fingers of the dominant hand and the percentage changes in finger systolic blood pressures (%FSBPs) due to the cold provocation were calculated. The median finger systolic blood pressures increased with
increasing age in both females and males, with the increase highly significant at 30°C but not at 10°C. The %FSBPs were not significantly affected by the age of males, but were significantly lower in older females than younger females. The FSBPs were lower in females than in males at 30°C but there was no significant difference between genders at 10°C. The %FSBPs were higher in younger females than younger males, but only significantly higher in the middle finger and there were no significant differences between the genders in the older age group. The %FSBPs across the four fingers were similar in the younger subjects and in the older females, but varied with finger in the older males.

**Laurin, et al.,** (2007) studied on sex differences in the prevalence of psychiatric disorders and psychological distress in patients with COPD. The present cross-sectional study evaluated the prevalence of mood and anxiety disorders, levels of psychological distress, and quality of life in 62 women and 54 men with documented, stable COPD. All patients (n = 116) underwent a sociodemographic and medical history interview, followed by a structured psychiatric interview and standard spirometry. Patients also completed a battery of questionnaires measuring psychological distress and quality of life. Significantly more women than men met the diagnostic criteria for anxiety disorders and a trend for greater levels of major depression in women was found. Women had significantly higher anxiety sensitivity and depressive symptoms
compared to men. Results indicate that psychiatric disorders are nearly two times higher in women than in men. Women also have greater psychological distress, worse perceived control of symptoms, and greater functional impairment.

**Tahir Hazir and Nazan Sukran Kosar** (2007) observed the assessment of gender differences in maximal anaerobic power by ratio scaling and allometric scaling. The purpose of this study was to determine gender differences in maximal anaerobic power by using both ratio scaling and allometric scaling. 27 males and 26 females voluntarily participated in this study. Wingate test was used to determine both peak power and mean power. Body weight, lean body mass and thigh muscle cross sectional area were determined anthropometrically. Males had significantly greater peak power and mean power in absolute terms, ratio-scaled and allometrically scaled to body weight, lean body mass and thigh muscle cross sectional area compared to females.

**Wyon, et al.,** (2007) investigated the cardiorespiratory, anthropometric and performance characteristics of an international/national touring ballet company. This study examined the cardiorespiratory and anthropometric indices of professional classical ballet dancers in relation to company seniority, gender, and supplemental training. Forty-nine participants from an international touring company carried out a peak VO$_2$ test and vertical jump test. Statistical analyses showed significant differences between gender
and dancer seniority levels. Gender differences were seen for jump height and peak VO$_2$ (M = 49.32 +/- 3.72 ml.kg$^{-1}$.min$^{-1}$; F = 43.3 +/- 5.16 ml.kg$^{-1}$.min$^{-1}$).

**Neumayr, et al.,** (2006) examined the physical and physiological factors associated with success in professional alpine skiing. The purpose of the study was to describe the physical and physiological characteristics of World Cup (WC) skiers. 20 female and 28 male members of the Austrian WC Ski Team were examined pre- and post-seasonally from 1997 to 2000. The physiological variables investigated consisted in the aerobic power and in the muscle strength of the lower limbs. The athlete's aerobic performance capacity was assessed by maximal exercise testing on a bicycle ergometer. The maximum power output was 4.3 +/- 0.4 (female) and 4.7 +/- 0.4 W/kg (male), the corresponding values for VO$_2$ max were 55 +/- 3.5 (female) and 60 +/- 4.7 ml/kg/min (male). In both sexes there was neither significant laterality nor dysbalance. Among all physical and physiological variables, only the aerobic power in males was found to be strongly correlated to racing performance.

**Sartorio, Agosti, De Col and Lafortuna** (2006) observed the age and gender-related variations of leg power output and body composition in severely obese children and adolescents. The purpose of the study was to depict the general trends of muscle anaerobic performance in a cohort of obese Italian children. Three-hundred-six obese children (141 males, 165 females), aged 10-17 years were
cross-sectionally studied. Lower limb maximal anaerobic power output (W) was assessed with the Margaria stair climbing test. In both genders, W increased significantly for effect of age and degree of obesity [three-factor multivariate analysis of variance (MANOVA)], but, while no difference was found between boys and girls in the age groups of 10-11 and 12-13 years (post-hoc Tukey test), boys in the age groups 14-15 and 16-17 years were more powerful than girls of the same age. In conclusion, no difference in absolute W can be detected between obese boys and girls up to the age of 13, but W differences observed in older age groups appear to be consistent with a concomitant gender-related variation in body composition.

Emika Kato, et al., (2005) studied the musculotendinous factors influencing difference in ankle joint flexibility between women and men. The purpose of this study was to investigate the factors influencing the difference in ankle joint ROM between men and women with respect to the extensibility of muscle-tendon complex. Eighteen men and twelve women participated in this study. During the passive loading, real-time ultrasonogram was taken to track the movement of MTJ as the elongation of muscle belly (dMus). The change of MTC (muscle-tendon complex) length (dMTC) during the passive dorsiflexion was estimated from changes in ankle joint angle. Tendon elongation (dTen) was calculated by subtracting dMus from dMTC. There was no significant difference in normalized passive torque during passive dorsiflexion between men and women. Women
were more flexible, i.e., they demonstrated greater dMTC, which was accompanied by greater dTen at lower torque levels. However, dMus was not different between men and women. It was concluded that gender difference in the joint ROM at the ankle reflects more compliant Achilles tendon in women than in men.

Mubasshir Sheikh, Samreena Jamal, Rukhshan Khurshid and Lubna Amer (2005) investigated the role of dyslipidemia in old age of both sexes. The purpose of the study was to observe the risk of dyslipidemia and variation in other biochemical parameters in old age subjects of both sexes and to observe the relationship of biochemical parameters with the dietary pattern. Seventy males and thirty females, with age ranging from 40-60 years were included in the study. Levels of serum triglyceride, cholesterol, uric acid, blood sugar, blood urea and serum creatinine were estimated. Levels of serum triglyceride, level of serum uric acid and level of serum creatinine were increased in both sexes and it shows a highly significant difference when compared with their normal level. Other biochemical parameters like serum cholesterol, blood sugar and blood urea did not show any significant difference in both sexes when compared with the normal values.

Roberta Oka, Andrzej Szuba, John Giacomini and John Cooke (2003) observed the gender differences in perception of patients with peripheral arterial disease (PAD). The purpose of the present investigation was to evaluate the effect of claudication on
quality of life in 71 men and 26 women (mean age 72 and 73 years respectively) with PAD. Disease severity as assessed by ankle brachial index (ABI) and community-based walking was similar for men and women, although men reported greater comorbid conditions than women. Despite the similarity in disease severity, women reported decreased physical functioning, more bodily pain and greater mood disturbance than men. Claudication and PAD had a greater impact on women than on men and may result from the higher prevalence of mood disturbance and bodily pain reported by women.

**Reviews on Circadian Rhythms**

Goel, et al., (2009) investigated the circadian rhythm profiles in women with night eating syndrome. Fifteen women with NES (mean age +/- SD, 40.8 +/- 8.7 years) and 14 control subjects (38.6 +/- 9.5 years) were studied in the laboratory for 3 nights, with food intake measured daily. Blood also was collected for 25 hours (every 2 hours from 0800 to 2000 hours, and then hourly from 2100 to 0900 hours) and assayed for glucose and 7 hormones (insulin, ghrelin, leptin, melatonin, cortisol, thyroid-stimulating hormone [TSH] and prolactin). Statistical analyses utilized linear mixed-effects cosinor analysis. Control subjects displayed normal phases and amplitudes for all circadian rhythms. In contrast, patients with NES showed an inverted circadian pattern in the glucose rhythm.
Jiang, et al., (2009) studied on circadian blood pressure and heart rate characteristics in haemorrhagic versus ischaemic stroke in Chinese people. To compare the circadian variation of blood pressure (BP) between patients with intra-cerebral haemorrhage (ICH) and with cerebral infarction (CI), around-the-clock BP measurements were obtained from 89 hypertensive patients with ICH, from 63 patients with CI and from 16 normotensive volunteers. The single and population-mean cosinor yielded individual and group estimates of the MESOR, circadian double amplitude and acrophase. Comparison shows that without any difference in BP MESOR, the circadian amplitude of systolic (S) BP was larger in ICH than in CI patients and both groups differed from the healthy volunteers in BP MESOR and pulse pressure and in the circadian amplitude of SBP. The smaller population circadian amplitude of diastolic (D) BP of the ICH group is likely related to a larger scatter of individual circadian acrophases in this group as compared with that in the other two groups, an inference supported by a smaller day-night ratio of DBP for ICH vs CI patients. Thus, patients with ICH had a higher incidence of abnormal circadian characteristics of BP than patients with CI, the major differences relating to larger circadian amplitude of SBP, a smaller HR-SD, and a larger incidence of odd circadian acrophases of DBP.

Matthew Fortes and Martin Whitham (2009) have found out that no endogenous circadian rhythm in resting plasma Hsp72
concentration in humans. The purpose of the study was to measure resting concentrations of plasma eHsp72 throughout a 24-hours period. Blood samples were taken every hour from 1200–2100 hours and from 0700–1200 hours the following day from seven healthy recreationally active males. Ethylenediaminetetraacetic acid blood samples were analysed for eHsp72 concentration using a commercially available high-sensitivity enzyme-linked immunosorbent assay. One-way repeated measures analysis of variance revealed that measures of physiological stress such as heart rate, systolic and diastolic blood pressure remained stable throughout the trial.

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 some specific soccer skills and some physical fitness factors in one day. One test was carried out in the morning, between 7.00 and 9.00 and another one in the evening, between 19.00 and 21.00. A significant main effect of time of day was observed for oral temperature: the temperature in the evening was higher than morning. No significant time of day effect was found for hear rate, systolic pressure and diastolic pressure. A significant main 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.

**Analava Mitra and Bhattacharya** (2008) studied on effects of melatonin in mild diabetics with dyslipidaemia. This study was intended to observe the effects of melatonin at a higher dosage per day. The effects in rural Indian diabetic population at that melatonin dosage in different blood parameters were observed and also change in endocrine secretions was noted. Melatonin caused reduction in Serum Insulin, Serum Cortisol, Serum ACTH and Serum TSH levels while increase in Serum Gastrin level. Of the biochemical parameters, melatonin caused reductions in TLC, LDLC and FBS while increase in HDLC. It also caused reduction in neutrophil and increase in lymphocyte count in a diabetic with increase in faecal fat excretion. Other biochemical parameters like LFT, Serum Uric Acid, Blood Urea and Serum Creatinine, Serum Lipase and Urinary 24 hours VMA showed statistically no significant changes.

**Boudreau, et al.,** (2008) proved that cerebral temperature which varies across circadian phases in humans. The 24-hour rhythm of core body temperature (CBT) is commonly used in humans as a tool to assess the oscillation of the central endogenous circadian pacemaker. The invasive nature of the rectal sensor used to collect CBT makes it difficult to use in ambulatory conditions. Here they validate the use of a newly developed brain temperature (BT) sensor against that of a standard rectal temperature sensor using a 72-hour
ultra-rapid sleep-wake (URSW) cycle procedure. A significant circadian variation of both body temperature recordings was observed from which a phase and amplitude was reliably determined. These results indicate that BT can be refined as a non-invasive alternative to CBT measurements in the evaluation of circadian phase in field conditions.

Driziene, Jakutiene, Stakisaitis, Pundziene and Sveikata (2008) studied the characteristics of gender related circadian arterial blood pressure in healthy adolescents. The purpose of the study was to define 24 hours characteristics of arterial blood pressure in healthy adolescent girls and boys and to determine gender-related differences of blood pressure and its circadian pattern. The 24 hours blood pressure was monitored hourly in healthy girls (n=22) and boys (n=22). Additionally, blood pressure of adolescent girls (n=15) was examined during different phases of their menstrual cycle. Blood pressure was monitored with an auto-cuff automatic outpatient blood pressure monitor. Investigation showed gender-related differences in 24 hours blood pressure. Study results revealed the circadian blood pressure rhythm characterized by a period of low values during night time and an early morning increase in both adolescent groups. Nocturnal systolic blood pressure was higher in boys than in girls in all phases of their menstrual cycle. Diurnal systolic blood pressure in boys was higher than in girls in their follicular phase. The day and night blood pressure differed
between boys and girls. The study proved gender-related arterial blood pressure differences in healthy adolescents. The results demonstrate the gender-specific circadian blood pressure rhythm pattern in both gender groups.

Kanabrocki, et al., (2008) observed the creatinine clearance and blood pressure under a 34 year circadian study. Thirteen US Army male volunteers (23-27 years of age) served as subjects in the 1969 study. A majority of these men, two additional army men and two non-military subjects, participated in subsequent studies: 1979 (7,2,1), 1988 (8,2,1), 1993 (5,4,1), 1998 (7,2,2), 2003 (7,2,1). In each study, subjects were admitted to a hospital ward, were given medical examination including a 12-lead electrocardiogram and followed the same protocol. Lights went "OUT" at 22:30 hours and "ON" at 06:30 hours. Vital signs were measured immediately after each 3 hours urine collections, around the clock, and bloods were collected every 3 hours. Over the 34 years study span, 16 men provided sixty-one 24-hours profiles for CrCl-related variables (urine volume, creatinine, and serum creatinine) and fifty-eight profiles for BP. Using all normalized data, a significant circadian rhythm was found for each of these variables. Significant circadian variations in SBP, DBP, serum and urine creatinine, and urine volume, were evident with peak levels, on average, occurring in the evening hours.
Kigawa, et al., (2008) investigated the daily blood glucose profiles of glibenclamide and gliclazide taken once or twice daily in elderly type 2 diabetic patients. Daily blood glucose profile data were evaluated in 18 elderly type 2 diabetic patients treated with 80 mg/day gliclazide or 5 mg/day glibenclamide as monotherapy. The first daily blood glucose profile of the twice-daily regimen was performed approximately 1 week before hospital discharge, and the second was performed after taking a once-daily regimen for 4-7 days. Plasma glucose and plasma immunoreactive insulin (IRI) concentrations were measured daily at 12 time points: 08.00 (before breakfast); 10.00; 12.00 (before lunch); 14.00; 18.00 (before dinner); 20.00; 0.00; 02.00; 03.00; 04.00; 06.00; and 08.00 hours the next morning. Daily blood glucose profiles and plasma IRI profiles did not differ between the once- and twice-daily regimen groups in either the gliclazide group or the glibenclamide group. Plasma glucose values between midnight and early morning tended to be lower than the 08.00 hours plasma glucose value in the glibenclamide group, but not in the gliclazide group.

Souissi, et al., (2008) studied the effect of time of day and partial sleep deprivation on short-term, high-power output. The purpose of this study was to determine whether delaying bedtime or advancing rising time by 4 hours affects anaerobic performance of individuals the following day in the morning and afternoon. Eleven subjects participated in the study, during which the maximal, peak,
and mean powers were measured. Measurements were performed twice daily, at 07:00 and 18:00 hours, following a reference normal sleep night (RN), a partial sleep deprivation timed at the beginning of the night (SDB), and a partial sleep deprivation timed at the end of the night (SDE), and oral temperature was measured every 4 hours. Each of the three experimental conditions was separated by a one-week period. The results showed a circadian rhythm in oral temperature, and analysis of variance revealed a significant sleep x test-time effect on peak power (P(peak)), mean power (P(mean)), and maximal power (P(max)). These variables improved significantly from the morning to the afternoon for all three experimental conditions. Whereas the morning-afternoon improvement in the measures was similar after the RN and SDB conditions, it was smaller following the SDE condition. There was no significant difference in the effect of the two sleep-deprivation conditions on anaerobic performances at 07:00 and at 18:00 hours under the SDB condition in comparison with the post-reference night. However, the performance variables were significantly lower at 18:00 hours after the SDE condition.

Taylor, et al., (2008) observed the trait anxiety and salivary cortisol during free living and military stress. The relation of trait anxiety was examined with total and diurnal salivary cortisol during free-living conditions and during a stressful military exercise in 26 military men ages 19-30 years. Salivary cortisol was assessed at five time points over two consecutive days of free living
measurement, and three time points during a stressful military experience. Trait anxiety was measured with the trait portion of the Spielberger State Trait Anxiety Inventory 1-3 weeks prior to the military exercise. Total cortisol concentrations were similar between men reporting high or low anxiety during free living conditions and military stress. The diurnal cortisol profile differed significantly between these men during the free living condition, but not the stressful military experience. Specifically, during free living, men with low anxiety exhibited a diurnal cortisol pattern that peaked in the early morning, decreased precipitously during the midmorning, and continued to decrease throughout the day, reaching a nadir in the evening. By contrast, the cortisol pattern of high anxiety men remained elevated and significantly higher than their low anxiety counterparts during the midmorning, decreased more slowly throughout the day, and reached its lowest level in the evening.

Van den Bergh, Van Calster, Pinna Puissant and Van Huffel (2008) investigated the self-reported symptoms of depressed mood, trait anxiety and aggressive behaviour in post-pubertal adolescents and found that they had associations with diurnal cortisol profiles. The association between self reported symptoms and diurnal cortisol profiles was studied in post puberty adolescents (29 boys and 29 girls, M (age) = 15.06 years). The adolescents completed the Children's Depression Inventory, State Trait Anxiety Inventory, and an Aggressive Behavior Scale. The diurnal cortisol profile was
derived from three saliva samples, collected at awakening, noon and evening on a weekend day. Univariate repeated measurement regressions revealed that depressed mood and trait anxiety were strongly related to the diurnal cortisol profile where as aggressive behaviour was weakly related to the diurnal cortisol profile and greater emotional distress was associated with flatter diurnal cortisol profiles. Multivariate analysis, however, revealed that only trait anxiety made an independent contribution.

Martin, Nevill and Thompson (2007) investigated the diurnal variation in swim performance remains, irrespective of training once or twice daily. The aim of this study was to compare intra daily variation in race-pace performance of swimmers routinely undertaking morning and evening training (MEG) with those routinely undertaking evening training only (EOG). Each group consisted of 8 swimmers who completed morning and evening trials in a randomized order with 48 h in between two separate occasions. Oral temperature, heart rate, and blood lactate were assessed at rest, after a warm-up, after a 150-m race-pace swim, and after a 100-m time trial. No differences were found in blood-lactate, heart-rate, and stroke-count responses.

Souissi, et al., (2007) studied the effect of time of day on aerobic contribution to the 30-s Wingate Test Performance. The purpose of this study was to evaluate the effects of time of day on aerobic contribution during high-intensity exercise. A group of 11
male physical education students performed a Wingate test against a resistance. Two different times of day were chosen, corresponding to the minimum (06:00 hours) and the maximum (18:00 hours) levels of power. Oxygen uptake (\( \text{VO}_2 \)) was recorded breath by breath during the test (30 sec). Oral temperature was measured before each test and on six separate occasions at 02:00, 06:00, 10:00, 14:00, 18:00, and 22:00 hours. A significant circadian rhythm was found in body temperature with a circadian acrophase at 18:16±00:25 hours as determined by cosinor analysis. Peak power (\( P_{\text{peak}} \)), mean power (\( P_{\text{mean}} \)), total work done, and \( \text{VO}_2 \) increased significantly from morning to afternoon during the Wingate Test. As a consequence, aerobic contribution recorded during the test increased from morning to afternoon. Furthermore, power decrease was greater in the morning than afternoon.

**Thomas Reilly, et al.,** (2007) examined the diurnal variation in temperature, mental and physical performance, and tasks specifically related to football (soccer). The purpose of the present research, consisting 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. In the first study, eight diurnally active male association football players (19.1±1.9 years of age) with 10.8±2.1 years playing experience participated. Measurements were made on different days at 08:00, 12:00, 16:00, and 20:00 hours in a counterbalanced
manner. 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. Results indicate football players perform at an optimum 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. Body temperature peaked at a similar time, but positive mood states seemed to peak slightly earlier.

Leandro dos Santos Afonso, et al., (2006) observed the maximal heart rate on treadmill at different times. The aim of this study was to compare the maximal heart rate (HR_{max}) in the Bruce test (TBruce) at different times of the day. Eleven male individuals,
with 22.0 ± 1.6 years, physically active and from the intermediate chronotype were studied. The resting HR (HR\textsubscript{res}), maximal HR (HR\textsubscript{max}), perceived exertion (PE) and time until exhaustion (T\textsubscript{Bruce}) were observed. The protocol by Bruce for treadmill was applied until exhaustion, at 6 different times: 9:00; 12:00; 15:00; 18:00; 21:00 and 24:00 hours. The results were submitted to the variance analysis for repeated measurements, followed by Tukey test and the Cosinor adjustment for identification of rhythmic patterns. There was significant difference between the HR\textsubscript{res} of the 15:00 and 24:00 hours and in the HR\textsubscript{max} of the 12:00 and 24:00 hours. Rhythmicity was found in one individual in the HR\textsubscript{res}, one in the HR\textsubscript{max} and two in the T\textsubscript{Bruce}.

Rob de Vries, Wil Witting, Dirk Van Veldhuisen, Pieter de Kam and Harry Crijns (2006) found out that the outcome of exercise tolerance testing is dependent on the time of the day. The present study was undertaken, analyzing the effects of the time of the day on exercise test parameters in a large population of cardiovascular patients. They compared the responses of bicycle exercise testing in 6674 patients, mean age 60 years, referred for evaluation of coronary artery disease. The daily variation was tested by grouping the exercise variables into four 2 hour periods. Further logistic regression analysis was used to assess predictors for the occurrence of ischemia. Significant times of the day differences were
found both at rest and in their changes to peak exercise for heart rate, systolic blood pressure, and diastolic blood pressure.

**Dalpino, Menna-Barreto, Castilho and De Faria** (2005) investigated the biological rhythms of biochemical serum parameters in a Brazilian population under a three year study. The objective of this work was to evaluate the occurrence of biological rhythms in several biochemical serum parameters in a Brazilian population. A retrospective study (1996 to 1998) was carried out to collect the test results within the reference intervals of adults, from 21 to 50 years of age (average age of 36 years) attending the outpatient clinics of the teaching hospital at the University of Campinas, Sao Paulo, Brazil. The reference sample was 52.9% male and 47.1% female and encompassed 15,036 calcium, 7,478 phosphorous, 53,641 urea, 58,315 creatinine and 6,433 uric acid determinations (140,903 in total). Significant annual rhythms were detected in serum calcium with maximum and minimum values in fall and spring and in serum creatinine with maximum and minimum values in summer and winter. The other parameters did not present significant annual rhythmicity.

**Giacomoni, et al.**, (2005) measured the gender differences in the circadian variations in muscle strength assessed with and without superimposed electrical twitches. The circadian rhythm in muscle strength was analyzed in twelve males and eight females. After two familiarization sessions, participants were tested at six
different times of the day (02:00, 06:00, 10:00, 14:00, 18:00 and 22:00 hours), the order of which was randomly assigned over 3-4 days. Peak isokinetic torques (PT) of knee extensors and flexors were then measured at 1.05 rad s\(^{-1}\) and 3.14 rad s\(^{-1}\) through a 90 degrees range of motion. A significant circadian rhythm was observed for T(rec) in both males and females (acrophase, Phi, 17:29 and 16:40 hours; mesor, Me, 37.0 and 36.8 degrees C; amplitude, A, 0.28 and 0.33 degrees C for males and females, respectively). The mesor of T(rec) was higher in males than in females. Significant circadian rhythms were observed for knee extensor PT at 3.14 rad s \(-1\) in males (Phi, 17:06 hours; Me, 178.2 N m; A, 4.7 N m) and for knee extensor PT at 1.05 rad s \(-1\) in females (Phi, 15:35 hours; Me, 128.7 N m; A, 3.7 N m). Group of female subjects tended to show lower circadian amplitudes than the males.

**Racinais, Blonc and Hue** (2005) studied the effects of active warm-up and diurnal increase in temperature on muscular power. To investigate the effects of both an active warm-up (AWU) and the diurnal increase in body temperature on muscular power, eight male subjects performed maximal cycling sprints in the morning (7:00-9:00 a.m.) and afternoon (5:00-7:00 p.m.) either after an AWU or in a control condition. The AWU consisted of 12 min of pedaling at 50% of O\(_2\) max inter-aspersed with three brief accelerations of 5 s. Rectal temperature, maximal force developed during the cycling sprint, and muscular power were higher in the
afternoon than in the morning. Rectal temperature, calculated muscular temperature, and muscular power were higher after AWU than in control condition. The beneficial effect of an AWU can be combined with that of the diurnal increase in central temperature to improve muscular power.

**Gauthier, Souissi, Sesboue, Larue and Davenne** (2004) investigated the circadian rhythms in two types of anaerobic cycle leg exercise: force-velocity and 30-s Wingate tests. The purpose of the present investigation was firstly, to determine the effect of the time of day on anaerobic performance during a force-velocity test on a cycle ergometer (F-V) and the Wingate test and secondly, to relate any change in anaerobic performance to the circadian rhythm in oral temperature. Nineteen subjects volunteered to take part in the study. In a balanced and randomized study design, subjects were measured for maximal power (P (max)) (force-velocity test), peak power (P (peak)) and mean power (P (mean)) (Wingate test) on six separate occasions. These were at 02: 00, 06: 00, 10: 00, 14: 00, 18: 00 and 22: 00 hours on separate days. There was an interval of 28 h between two successive tests. A significant circadian rhythm was found for P (max) with an acrophase at 17: 10 +/- 00: 52 hours and amplitude of 7 %. A time-of-day effect was significant for F (0) and V (0). Also a significant circadian rhythm was observed for P (peak) with an acrophase at 17: 24 +/- 00: 36 hours and amplitude of 7.6 % and for P (mean) with an acrophase at 18: 00 +/- 01: 01 hours and
amplitude of 11.3 %. The results indicated that oral temperature, P (peak), P (mean) and P (max) varied concomitantly during the day. These results suggest that there was a circadian rhythm in anaerobic performance during cycle tests.

Racinais, Hue and Blonc (2004) have studied the time of day effects on anaerobic muscular power in a moderately warm environment. Twelve male subjects [27.0 (+/-4) years] performed two different jump tests [a squat jump (SJ) and a counter-movement jump (CMJ)] and a brief maximal sprint on cycle ergometer (CS) in four different conditions (morning/neutral, morning/moderately warm and humid, afternoon/neutral, and afternoon/moderately warm and humid). The morning experiments were conducted between 07:00 and 09:00 hours, and the afternoon experiments were conducted between 17:00 and 19:00 hours. The mean laboratory temperatures and humidity were 20 (+/-1) degrees C, 70 (+/-5) % and 29 (+/-1) degrees C, 57 (+/-4) % for the neutral and moderately warm and humid conditions, respectively. In summary, (i) the same subjects were influenced by time-of-day differently, depending on the ambient temperature during testing; (ii) time-of-day affected muscular performance only in the neutral condition, (iii) the moderately warm and humid condition blunted the diurnal variation in muscular performance, and (iv) the effect of the ambient temperature was dependent on time-of-day.
Jim Reeves Silent Night (2003) studied the influence of circadian rhythms on selected physical, physiological and psychological variables. The purpose of the study was to find out the influence of circadian rhythms on selected physical, physiological and psychological variables. To achieve the purpose ten male untrained (MUT) and ten male trained (MT) were selected as subjects. The parameters of flexibility, anaerobic power, aerobic power, body temperature, resting heart rate and profile of mood state were measured. Measurements were made on different times of the day at 02:00, 06:00, 10:00, 14:00, 18:00 and 22:00 hours in a counterbalanced manner. Cosinor analysis was used to find out the circadian rhythm, the percentage rhythm with probability level, the mesor value, the amplitude and acrophase rhythm on variables. Circadian rhythm in flexibility for MUT and MT were statistically not significant (amplitude – 3.47 for MT and 2.72 for MUT, acrophase – 15:43 hours for MT & MUT and mesor – 36.67 cms for MT and 30.15 cms for MUT). Circadian rhythm in body temperature for MUT and MT were statistically significant (amplitude – 0.46˚ C for MT and 0.32˚ C for MUT, acrophase – 16:46 hours for MT and 17:20 hours for MUT and mesor – 37.29˚ C for MT and 36.94˚ C for MUT). Circadian rhythm in resting heart rate for MUT and MT were statistically significant (amplitude – 9.04 for MT and 7.30 for MUT, acrophase – 16:33 hours for MT and 17:20 hours for MUT and mesor – 69.87 cms for MT and 79.40 cms for MUT). Circadian rhythm in
anaerobic power for MUT and MT were statistically not significant (amplitude – 9.66 Kg/mt/sec for MT and 4.55 Kg/mt/sec for MUT, acrophase – 17:33 hours for MT and 16:53 hours for MUT and mesor – 143.95 Kg/mt/sec for MT and 79.48 Kg/mt/sec for MUT). Circadian rhythm in aerobic power for MUT was statistically significant and MT was statistically not significant (amplitude – 5.55 ml/Kg/min for MT and 4.57 ml/Kg/min for MUT, acrophase – 15:33 hours for MT and 15:53 hours for MUT and mesor – 57.68 ml/Kg/min for MT and 50.79 ml/Kg/min for MUT). Circadian rhythm in profile of mood state MUT was statistically significant and MT was statistically not significant (amplitude – 4.52 for MT and 6.01 for MUT, acrophase – 16:53 hours for MT and 15:48 hours for MUT and mesor – 107.18 for MT and 113.58 for MUT).

Ramon Hermida, Jose Fernandez, Diana Ayala and Artemio Mojon (2001) investigated the circadian rhythm of double (rate-pressure) product in healthy normotensive young subjects. The purpose of this study was to describe the normative circadian pattern of the double product in healthy normotensive young adults. They studied 125 men and 75 women, 23.0 ± 3.3 years of age, without medical history of hypertension and 24 hours ambulatory systolic/diastolic blood pressure mean consistently below 135/85 mmHg. Subjects underwent ambulatory blood pressure monitoring at 30 minute intervals for 48 consecutive hours once each season of the year, yielding 930 protocol-correct blood pressure and heart rate
time series. Subjects maintained their usual routine of diurnal activity and nocturnal sleep and avoided use of over the counter and other medication. Circadian rhythmicity in the double product was established by population multiple component analysis. The double product rose rapidly from the lowest value, attained 3 hours before awaking from sleep at night, to a markedly elevated level at the commencement of morning activity. The double product was highest in the afternoon, roughly 7 hours after the commencement of diurnal activity. The 24 hours mean in the double product in men was significantly lower than that in women. The circadian double amplitude of the rhythm was statistically significantly greater in men than women.

Joel Belmin, et al., (2000) observed the variability of blood pressure response to orthostatism and reproducibility of the diagnosis of orthostatic hypotension in elderly subjects. BP was measured in the supine position and after one and two minutes of orthostatism in 53 consecutive elderly patients (43 women and 10 men) of an intermediate care geriatric ward. BPRO was assessed four times on the same day (8–9 AM, 10–11 AM, 1–2 PM, and 5–6 PM) and twice more on another day of the same week (8–9 AM and 1–2 PM). There were significant within-day differences between the four orthostatic changes in systolic BP after one minute or two minutes. Day-to-day differences between the OCs measured at the same times were not significant. Resting supine systolic and diastolic BP,
measured on the six occasions. Repeated measures ANOVA, based on the values obtained on the same day, showed significant changes in both systolic and diastolic BP. Compared with 8–9 AM values, systolic BP at 10–11 AM and both systolic and diastolic BP at 1–2 PM were significantly lower. However, there were no significant differences in the systolic or diastolic BP values recorded at the same times on different days.

Leonie van de Luit, Jan van der Meulen, Ton Cleophas and Aeilko Zwinderman (1998) investigated the amplified amplitudes of circadian rhythms and night time hypotension in patients with chronic fatigue syndrome. The objectives of the study were to study rhythms of heart rate and systolic and diastolic blood pressure in patients with chronic fatigue syndrome compared with age matched normotensive controls and to study the effects of melatonin and inopamil on such rhythms. Ambulatory blood pressure (ABP) measurements of 18 patients with CFS were made according to the 1987 U.S. Center for disease control criteria, and measurements of 12 age matched normotensive controls were used in a cosinor analysis of the two groups. The effects of melatonin and inopamil on ABP were studied subsequently in four patients in an 8 week open label evaluation. One patient was hypertensive (diastolic blood pressure > 90 mmHg at least once every 4 hours), and was, therefore, excluded. The data of the remaining 17 patients (15 women, 2 men) revealed a significant 12 hour rhythm in heart rate
and 24 hour rhythm in systolic and diastolic blood pressure with 95% confidence intervals not significantly different from sinusoidal patterns.

Hill (1996) studied on effect of time of day on aerobic power in exhaustive high-intensity exercise. The purpose of this study was to determine if there is an effect of time of day on aerobic power elicited during exhaustive high-intensity constant-power cycle ergometer exercise. Twenty-four college students (12 women and 12 men) were selected and each performed three exhaustive exercise tests (against 3.5 W.kg-1 for women and 4.0 K.kg-1 for men). The first test served as a learning trial. The second and third tests were scheduled at about 08:00 hours (AM) and 16:00 hrs (PM) with the order of testing randomly assigned. Results from these two tests were compared for evidence of a time of day effect using a two-way ANOVA with repeated measures over time of day and with subjects nested in sex. Peak VO₂ was 7% higher in the PM (3.34 +/- 1.00 1.min⁻¹) in the AM (3.11 +/- 0.98 1.min⁻¹). The aerobic system responded 6% faster in the PM than in the AM: the time constant describing VO₂ kinetics was 33.5 +/- 5.7 sec in the PM and 35.5 +/- 5.5 sec in the AM. However, there were no significant correlations between the AM-PM differences in time to exhaustion, time constant of the response, or peak VO₂. It was concluded that there is a higher peak VO₂ in the PM than in the AM. In addition, there is a time of day effect on VO₂
kinetics, with the aerobic system responding faster in the PM than in the AM.

**Pocock, Shaper, Cook and Phillips** (1989) studied on diurnal variations in serum biochemical and haematological measurements. Twenty five biochemical and haematological measurements were determined on nonfasting blood and serum samples collected between 9 am and 7 pm from a representative group of 7685 British middle-aged men. Most measurements showed significant diurnal variations, but only for bilirubin, phosphate, and triglyceride did time of day account for more than 5% of the between subject variance. Mean concentrations of potassium, haemoglobin, and haematocrit and red cell count were higher in the morning, while urea and creatinine concentrations and white cell count had higher means in the afternoon.

**Von Zerssen, et al.,** (1987) observed the diurnal variation of mood and the cortisol rhythm in depression and normal states of mind. A large scale chronobiological investigation was undertaken in twenty drug free psychiatric inpatients displaying RDC major depression (endogenous subtype) in comparison to ten healthy control subjects and ten of the patients after clinical recovery. A series of measurements was taken six times a day and, in eight of a total of fourteen variables, also once a night over a period of ten to fourteen days. The following variables were assessed: mood, performance, motor activity, salivary flow, urinary excretion of water,
sodium, potassium, and free cortisol, and rectal temperature. A phase chart of the acrophases of the eight variables with measurements was taken during day and night revealed two clusters in the depressives and three in the non-depressed subjects. In the depressives, the acrophases of the mood scales clustered around the time of awakening in the morning, together with the acrophase of UFC, whereas all other acrophases clustered in the afternoon. In the non-depressed subjects, however, the mood scales reached their circadian maxima in the middle of the night around the time when sleep was interrupted to take measurements. All other acrophases corresponded roughly with those found in the depressives.

**Jehan Francois Desjeux, et al.,** (1982) observed the circadian metabolic rhythms in obese children. In this study, circadian metabolic rhythm was examined in obese and non-obese children, by two different protocols. (1) Oral glucose tolerance tests (OGTT) were carried out at 9 a.m. and 3 p.m. on two consecutive days. (2) Circadian variations of plasma glucose and insulin were determined. After OGTT, in the control children there was a significant drop in the insulin/glucose ratio in the afternoon, whereas in the obese group this ratio remained high, with no significant change during the day. The control children showed a circadian rhythm for blood glucose levels which was not present in obesity.
**Summary of the Literature**

The review of literature helped the investigator to spot out relevant topics and variables. Further, the literature helped the investigator to frame the suitable hypothesis leading to the problems. The latest literature also helped the investigator to support his findings with regard to the problem.

The reviews were presented under the two sections such as gender difference \((N = 20)\) and circadian rhythms \((N = 30)\) with chronological and alphabetical order. Most of the research studies were presented in the section proves that the gender and circadian rhythm significantly differed with respect to the selected dependent variables. The research studies reviewed are from many journals available in the websites such as www.pubmed.gov, www.biomedcentral.com, ERIC websites etc. which employ physical, physiological and psychological variables related to gender difference and circadian rhythms.

The review of literature helped the researcher from the methodological point of view too. It was learnt that most of the research studies cited in this chapter on content analysis and experimental design are the appropriate methods for finding out the lapses and remediation.